# Exhibit 233

# Karen Kingston uncovers patents revealing "cognitive action" spike protein structures in vaccines Video

https://rumble.com/v1pg4gf-karen-kingston-uncovers-patents-revealingcognitive-action-spike-protein-st.html Karen Kingston uncovers patents revealing "cognitive action" spike protein structures in vaccines

Health Ranger Report\_Published October 23, 2022 https://rumble.com/v1pg4gf-karen-kingston-uncovers-patents-revealing-cognitiveaction-spike-protein-st.html

## Highlight notes from the video:

Karen: If you go to the Moderna website, they have about 8 major patents that are for the mRNA vaccines.

This is what I call the master patent for the lipid nanotechnology. US 10,703.789 B2

This actually has the sequences in it for the body to product the spike protein. It's biosynthetic.

The master patent in Section 219 it says "the polymer-based self-assembled nanoparticles suchas, but not limited to, micro-sponges, may be fully programmable nanoparticles."

US 2012/0228565 A1 Patent

In the Moderna patent, 80 or 90 other patents listed. This one was filed for waterdispersible nanoparticles.

Section 003 Semiconductor nanocrystals (also known as quantum dot particles).

Qdot Label Conjugates for Cell & Tissue Staining <u>https://www.thermofisher.com/us/en/home/life-science/cell-analysis/cellular-imaging/fluorescence-microscopy-and-immunofluorescence-if/qdot-nanocrystal-conjugates-for-cell-and-tissue-staining.html</u>

15 year deal with Moderna. Thermo Fisher had already partnered with Moderna last year to help scale up production of its COVID vaccine branded as Spikevax.

18:17 FOIA to get ingredients because they have FDA approval Medical device technology

WO2012148684 CELL-FRIENDLY INVERSE OPAL HYDROGELS FOR CELL ENCAPSULATION, DRUG AND PROTEIN DELIVERY, AND FUNCTIONAL NANOPARTICLE ENCAPSULATION https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2012148684 Fluorescent Inorganic-Organic Hybrid Nanoparticles https://onlinelibrary.wiley.com/doi/10.1002/cnma.201800310

Method for making semiconducting single wall carbon nanotubes <a href="https://patents.google.com/patent/US20130251618A1/en">https://patents.google.com/patent/US20130251618A1/en</a>

Graphene structure that encapsulates the quantum dot and delivered in the body. This patent owned by the Chinese military.

<u>Carbon Nanotubes & Quantum Dots: Army Thinks VERY Small</u> – January 2020 <u>https://breakingdefense.com/2020/01/carbon-nanotubes-quantum-dots-army-thinks-very-small/</u>

Three New Projects for DOD's Innovate Beyond 5G Program Aug. 2, 2022 | https://www.defense.gov/News/Releases/Release/Article/3114220/three-newprojects-for-dods-innovate-beyond-5g-program/

Activtion is contingent on 5G Quantum dots activated by LED LED, 5G and Fiber Optics

Acidic pH-responsive nanogels as smart cargo systems for the simultaneous loading and release of short oligonucleotides and magnetic nanoparticles <u>https://pubmed.ncbi.nlm.nih.gov/20355740/</u>

Multi-functional magnetic hydrogel: Design strategies and applications https://onlinelibrary.wiley.com/doi/full/10.1002/nano.202100139

Lipid Nanoparticles—From Liposomes to mRNA Vaccine Delivery, a Landscape of Research Diversity and Advancement https://pubs.acs.org/doi/10.1021/acsnano.1c04996 Further capable of autonomous and/or cognitive action

# Intelligent sensor platforms https://patents.google.com/patent/US20160178652A1/en

[0020] In one embodiment, the instant invention teaches one or more elements that in whole or in part execute one or more types of actions for creating, spawning, comprising, modifying, repairing, regenerating, reassembling, and or control and regulation of one or more cells, cellular elements, cell organelles, including like actions and behaviors involving cellular processes such as endocytosis, exocytosis, mitosis, trafficking and signaling, communication between cells, receptor upregulation and downregulation, other behaviors, and the like. Failures and defects in any of these cellular elements and processes can lead to diseases, for example, cancer. This type of efficacious behavior is not taught in prior art, including in protein cage art.

[0021] In one invention embodiment, one or more elements, with or without additional elements, and in some embodiments with minimal functionalization, enter the central nervous system, including passing the blood brain barrier (BBB) for efficacious effect. Although different protein cage



Methods and systems of prioritizing treatments, vaccination, testing and/or activities while protecting the privacy of individuals https://patents.google.com/patent/US20210082583A1/en

They plan to put it in everything.

ANNOYS 2020

[0523] One or more elements and or platforms of one or more types may be encapsulated, packaged, stored, incorporated, and or utilize one or more methods known in the art, including for example, but not limited to: catheters; injections, including intramuscular injections; syringes; droppers and bulbs; pills; intravenous means; oral means; anal means; capsules; nanocapsules; nanoparticles; nano-devices; prescriptions; hospital and medical supplies; dental supplies; non-prescriptions; medications; over the counter products and remedies; alternative medicine supplies, systems, products and devices; hair care products; splints, casts, walkers, crutches, canes, wheelchairs, and other ambulatory aids; natural foods; vitamin and mineral supplements; first aid products; emergency health care procedures, systems, devices, and products, including combat medicine; health care products; grafts; skin patches; bandages; adhesives; wraps; masks; markers; powders; granules; geriatric care products: pediatric care products; diagnostic devices, systems, and products; medical imaging devices, systems, and products; telemedicine devices, systems, and products; in vivo monitoring systems, products, systems, and devices; in vitro monitoring systems, products, systems, and devices; laundry products; chemical, nuclear and biological sensors; MiFIGHT.

610

ANALYSIS 2022/0



#### (12) United States Patent De Fougerolles et al.

#### (54) MODIFIED POLYNUCLEOTIDES FOR THE PRODUCTION OF SECRETED PROTEINS

- (71) Applicant: ModernaTX, Inc., Cambridge, MA (US)
- (72) Inventors: Antonin De Fougerolles, Waterloo (BE); Justin Guild, Framingham, MA (US)
- (73) Assignce: ModernaTX, Inc., Cambridge, MA (US)
- (\*) Notice: Subject to any dischaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days. This patent is subject to a terminal dis-
- (21) Appl. No.: 16/438,978
- (22) Filed: Jun. 12, 2019
- (65) Prior Publication Data

claimer.

US 2020/0017565 A1 Jan. 16, 2020

#### **Related U.S. Application Data**

- (63) Continuation of application No. 14/987,328, filed on Jan. 4, 2016, now Pat. No. 10,385,106, which is a (Continued)
- (51) Int. CL

IDL CL	
461K J8/09	(2006.01)
461K 38/17	(2006.01)
461K 47/54	(2017.01)
461K 9/127	(2006.01)
C07K 14/535	(2006.01)
CI2N 15/88	(2006.01)
461K 9/50	(2006.01)
C07K 14/47	(2006.01)
461K 31/7888	(2006.01)
C07K 19/00	(2006.01)
CI2N 15/85	(2006.01)
461K 38/18	(2006.01)
461K 38/19	(2006.01)
461K 38/48	(2006.01)
461K 9/14	(2006.01)
461K 47/10	(2017.01)
461K 38/21	(2006.01)
461K 38/36	(2006.01)
461K 38/44	(2006.01)
461K 39/395	(2006.01)

- (Continued)
- (52) U.S. CL

#### (10) Patent No.: US 10,703,789 B2 (45) Date of Patent: \*Jul. 7, 2020

(2013.01); A6IK 38/36 (2013.01); A6IK 38/363 (2013.01); A6IK 38/44 (2013.01); A61K 38/4833 (2013.01); A61K 38/4846 (2013.01); A6IK 39:3955 (2013.01); A6IK 47/10 (2013.01); A61K 47/54 (2017.08); A61K 47/542 (2017.08); A61K 48/0833 (2013.01); A61K 48/0066 (2013.01); A61K 48/0075 (2013.01); CØ7K 14/47 (2013.01); CØ7K 14475 (2013.01); C07K 14/505 (2013.01); C07K 14/525 (2013.01); C07K 14/56 (2013.01); C07K 14/565 (2013.01); C07K 14/745 (2013.01); CW7K 14/75 (2013.01); C07K 16/2887 (2013.01); C07K 16/32 (2013.01); C07K 19:00 (2013.01); C12N 9/0069 (2013.01); C12N 9/644 (2013.01); C12N 15/85 (2013.01); C12N 15/88 (2013.01); CI2Y II3/12007 (2013.01); CI2Y 304/21005 (2013.01); C12Y 304/21022 (2013.01); A61K 9/09/9 (2013.01); A61K 48/09 (2013.01); C12N 2849/90 (2013.01)

(58) Field of Classification Search CPC ...... C07H 21/02; C12N 15/67; C12N 15/11 See application file for complete search history.

#### (56) References Cited

U.S. PATENT DOCUMENTS

5,489,677	Λ.	2/1996	Sanghvi et al.
5,991,722	A	1/1997	Montgomery et al.
		(Con	(inned)

#### FOREIGN PATENT DOCUMENTS

CA	2028849 A1	9/1991
CA	2473135 A1	6/2003
	(Cou	(inned)

#### OTHER PUBLICATIONS

Anderson et al., "Incorporation of pseudoutidine into mRNA enhances translation by diminishing PKR activation," Nucleic Acids Res. 38(17):5884-92 (2019).

(Continued)

Primary Examiner - Autonio Galisteo Goazulez (74) Attorney, Agent, or Firm - Clark & Elbing LLP

#### (57) ABSTRACT

A pharmaceutical composition which has a plurality of lipid nanoparticles that has a mean particle size of between 80 am and 160 nm and contains a modified mRNA encoding a polypoptide. The lipid nanoparticles include a cationic lipid, a neutral lipid, a cholesterel, and a PEG lipid. The mRNA contains a S-cap, S-UTR, NI-methyl-pseudouridine, a S-UTR, and a poly-A region with at least 100 nucleotides.

#### 14 Claims, 14 Drawing Sheets

Specification includes a Sequence Listing.



USP01202 (55554)

# ... United States (5) Patent Application Publication (5): Pub. No.: US 2012/0228565 A1

#### Adums et al.

- 150 MICHLOD FOR PICKISCHING ACREACE-MODIFIED SEARCONDECTIVE ENHANCED DISPERSIBILITY IN AQUEOUS MIDIA
- 12) LINDA Lidnight William Arctan, Sair Filmelie 5, CA, 7781, Marcel Pierre, Benefica, 4TL, 26, syntyl, DA (US)
- 1.2) Aspini TANK PLANING FOR DATE CORPORATION, CALLS ... CA. :05)
- And Artiches 124023-065
- Mar. 14, 2012 ..... IL12

#### Referred Los, upplication flane

(C6) Comparison of Application Value (2012), field on Are 15, 1000 most fail No Kitshi he references control of a phone. No. 1200-151 does of Jan, H. 2003, etc. March rep. Alvel. to construction allewhether for DDVD/244, Ref n Nov 18 (200), new dan ibawa waxi, a a tiyowa diappinalar Ala-0.274, 220 fileson tes del 2011 el 6 del No.5.247 135.

Sep. 13, 2012 say Puly Date:

(90) The to call go digging, No. 55-2002, S. Akologi Oct. 

#### Publication Consideration

:-11	Inc.41.	
	11010 1139	224-525
	443.36.6	(2011.0) -

- (1) U.S. CLARK AND AND AND AND PROPERTY 73
- 12.54 GEAL RADIE.

Water-Topological contractions and the exclusion of chemic alle multiple cintonte las sugettes i de less dessail a neuroplasmos de oportes dios no todos el a controbablica e con menthe second of the soluptor sussisters dispersion takes to complete enumption regions and two control to how phile organism of a typically required. Thereine, help name digentical of principle system in the first of the name digentic structure compared of the name in photo these terms if the high philadian the compared of the high structure with hydroxic first makes, and in the high set better yet كالمأرك والمترك والمترك والمراجع وتستعار وكستك twong i iz intiget optable blanches. Microdiste ce popul brings of zoner dispersive to trips unlet ble dispersiver. nearly activities of the weisted scheme in the following all retriention according to a description of the From:

#### NETHOD FOR PREPARING NERFOR MODIFIER SEARCONIRGETME AND METALLICEN CORPORTION FOR TRAINING IN REACTED DIS MURSI DELLITED A QUICTES DELEDIA

#### ARASSAULI DODILI DODILI AL DI ACIVIDATIONIS

[000] This is finite distribution of of DN part in poltation So. For the solution of the type N, NT is due to be as printing of CP Processing of the NM POPPT/POP, that Out 17, NTD The distribution of the structure model applitations are interpreted by rate and united emulated.

#### APPENDED FOR A PROPERTY OF A P

[0002] This is send an element of analytic state encoded in a particular of a consistent of a long of the term of a consistent of a constant of the term of the constant of the term of term of the term of term of term of the term of term of term of term of term of terms of term of terms of term of terms of term of terms of terms

#### 64050-001.30

[LDV] in content of neuron networks and the network of quantum comparises of white recent of an effective internet white the decomparise of the second end of the recent of the second end of th

[LD4 - rementation cavery-labore comprehenced we wai keli da mangga nga wayole ang karawané, pang ang karel and race implemented to real played critical and real trace uplication perfect another financial approximation of a sector and the seccreative approximation density and the role there are substrained asybar, inty in a miny of lenter steep, us detained a labels. in telepiertory bertion, and or as following in the new s Colorence and the second second second berlyn, Sermont - Community in mark - man have an one solution is used to be solution to the bar Treated pervicing to methods the contrast of sites to manifely Branch, these corresponds to asther as many recoverance or powers and formations (MI). (ii) Concernent S. S. Managaran program and presiding of the set when the number exception days modified when all pripa many lookapations, and all allong with many searched or all (1994) A. Const. New York States in Constantiation staste and standard at all (1964), and developed while Oten, Scotterral grandiance yiely interarieses offic antically are proved a manian. Some you'd di-1995) J. See Class. Soc 115 8709, 300 (J. a. L. 1994) J Nyu Wein 32 (1985) The track of the standard state of the state where the force mass pulliplication of the pick the cost of the transmission of transmission of the transmission of transmission accessor meeting class in addition, whose you cloude on the texture to are physically relating the physical friends in an efficiency of the physical data and the systematic

[006] Each each the Strangen transfer is the form of the second strain wave back of the contrast to the formation of the second strain and stra

[0006] - 30 might in the kinet in the kinet of your definition is interval with sever dispersive have been easy field over a set if you feer the functions of the trade section intervations with suffer them for the and saturative section for the two complexities interval to state of the section for two complexities in the section of the section for two complexities in the section of the section of the section of the set is the section of the section of the section of the set is the set of the trade of the section plitting a contrast the set is the set of the trade of the section plitting a contrast the set is the set of the trade of the section plitting a contrast the set is the set of the trade of the section plitting a contrast the set of the set of the trade of the section plitting a set of the set of the set of the trade of the section index set of the set of the set of the trade of the trade of the set index set of the set of the set of the trade of the trade of the set index set of the set of the set of the trade of the trade of the set index set of the set of the set of the trade of the trade of the trade of the index set of the set of the set of the trade of the trade of the trade of the index set of the set of the

[0007] Differ gettips in versphere the tripulie power trig layer of the scalar in our memory statistic methods in the militation between the termination is shown in the transstatisty of the termination of the organization in the method is constructed with and the organization in the off termination with these many generation is when on the left if integrates the sector in the generation is when on the off termination of the termination of the organization is the matching of the sector in the generation is a state of the matching of the termination of the organization of the matching of the termination of the organization of the matching of the termination of the termination of the method of the termination of the termination of the termination are different termination of the termination of the termination are different termination of the termination of the termination and the Amay and termination of the termination of the area different termination of the termination of the and the Amay and termination of the termination of the area different termination of the termination of the termination and the Amay and termination of the termination of the area different termination of the termination of the termination and the Amay and termination of the termination of the termination and the Amay and termination of the termination of the termination and the Amay and termination of the termination of the termination and the Amay and termination of the termination of the termination and the Amay and termination of the termination of the termination and the termination of termination of the termination of the termination and the termination of termination of termination of the termination of the termination of termination

[0008] Jaka a verti scatga gazanzi yi olma stali, ia en berbaut bite grücklichen gewähnen in inwakanst fühler say tahang ng Capitaliya Mangada na ting farakiy ta Bating faran sharel harara baka na tari tiga dale b well' relacione freitallen ander sedar vermittens Encourses any cost we explicitly that the operation rendered frederick to be write in Netronom, politically consistence on a many other politic spring inductor tensions a my orabitational to trace out while Independent, revokal and making strategies in which such that or much course of marchen reacked the preservation water entrance for completingnerical local Profession No. 40 to contest assemblies as accented an instead that can share ention, contractopale reach dataside planar an ana piesentera atementeden fingenaage pedag wal dat Ly notaet ien pion of the pullation, itselfering process too بالمستعدية والمثلو المتعاطية فالمترسب سنائل iyl maquum firm 's Minariq' e a syr condition is synthetic in the addition with the N 200 Includes to Dawood let all devices a structure method.  $v_i$  excite accounter  $v_i$  and p into the of length  $1.2 \pm 10^{12}$  , 3

(derein nis preim Uy ≦ró nu "Xuy envirgible et sur harte contractionplace at her accurate an isotats.

[CON] Konner, J. (1977) J. Char. New MCS009005 View of State straining sciences and a Ministration of State (2018). Doued Contracts Selender (ChierShell Comparises for Los) to wait in warpoor of the decivities Charteren Scherely free in the state succe, lower at the instrument model relative use curriers, 1944), and dimensional division Presidence from W1001 1992miles textor and efficience support and departed appointer while contract attention research custanes policies cole y aver dispersionity of hydro on-kiecaresports in pound they remove in featurant. advingent being an Hyder Edde vertier at by charter ina, eyari xafa isheka yati kinaké talah wali, baf adyoin 1.98 or los 178 a titu pará dua ye de rífici برا كالأنفو محتاومتا الرابقة مهرما وأكرار Tipland as here I.C. signal for prime last inrefre surfacione averagina della contra ligande restansi a o where and decrease in grant to the diff of the easily grant epotencine risperved in when the pot declared locied policychi yn orthograf a teiniowidd arth fa dlante reach siry. services, particles, many and information homologies. united that particular took time to all receiving a viscovictaiende and desenden im the story interaction and (CO) that, does territy a need role at for a chalos. successful international conductions and a second sec or na periodo do peceleccie neucolo neccia el de preservo ing the proton address of the wegling burnings much zlaine valtikla stakile, on avtičine je prahodale, neg Surge in the Alexian Iso betice. It stills is the real of candilly a film of software containing a star make with the style of the openic establishy logic the

succession of section not very report of the body of the sector of the provide sector of the provide sector of the sector of the

#### SEARARY REPAIRS IN A DATA BASE

[111] I. J. Ansaroling was conserved parts. In mean an adable of the clument reader reading the only potential plane taken received in a seven reader to only of the cost cosparation y anappears reading strength framework calls a vice in procedure and near seven manipulity in plates on fact action bases layer. At a number by any layer the supervision.

[CO2] The self mestage of period for insertion to an old sochwart on multi-object of the insertion to an old sochwart of the constraint of the second of the set of the [CO2] The spectrum of the light of the second [CO2].

[0013] This year of a fight of the continuous of the such many such synthese in the part ply a oper part is a sige set of a polyment with providence is the typhone objects methods of the typhone back of groups.

[111] I. J. and Jonez, at particular transmission of the second secon

[FF15] This multiplicate the second tension of the Manuscripter processing of the matrix of the matrix of the second tension of the second tension of the second tension of the second tension of the matrix of t

(FF16) If its work of the two objective track to a many reliansuch a correct the symptotic second intermediate to a minymetric tracket values in the line metric tracket program in a powerkation metric second of the assess.

[FF17] This conduction and object in the overlap unity in Metal all notice disperse by gradient of worked size disks worked. Del troll even de constations finance discuir de la tribunit in transformations a first an altre de la constation politication anna de la destru 200 constitución de la constance de la transformación.

[Exid] — Additional objects instructions and note instruction to the instantion will be not into in part in the rescription should initiate an experiment of the array apparent to have so that exists an experiment which have are prior to the latence. In the test of the investment

[D019] In the demand of the international strategy parts inter an emergence provided all as a reprocessive enternanconstruction Exercit independent of prime, iter temperatur-intration or below of the second to see a second capital e separate the management appication weigen ihr eine aufliche fühlten eine eine eine eine entited), the contrast detection of sufficiency of the dy being a sub-couples dying dispose by laye a floor consultation contain council of the mon to vertica d'al su ben transée a tanta amb e cami name the suffice must need the interaction y hydrol photo: and the bodie of tNA, who is in the physical three head a might the constration of a contained metals, which he how many services and the provinces and show in them the incruire de la contra de contra de la secondada en la contra de to require the company. The object years the performance and there a plander of sear symposize equits and dramoutly ngalens, dias en alle ign-administera (chigos) fil e narecars, teta as sol as traduce acts allong body over an face. Proticuarily accorded supervariant hyperboarder or dear crite requires whill according to refer to the local datasets. er en el l'indigensants de la catility in reserve se trads-publisher and all'ait d'ait filly all her congesti les fina prete left en en unear tres comport des piel un revieru service and we reach work in the one of an exercise te-"their" over ensemble the tot excent the could show on provident and remove interesting desires. The califications have been contraction and you be able to recemail cont, and privile classified price straighter and contract to all official or a normality of the transfer-stationer. The design facility dedected in the methods berefated and provides contraction of the outer layer of the surface species fee no ceale proteine chargerine "secjarate feat s radioundee ing he is the engineering the operation ware the standing they conducted a office for high an Politika minalen gör ir ernyk apatör u lige a feith an eargaí aí díth a chuir af an faith a ch العناية المتراجة المتراجي أيتا التنابي أراده المتنا Marganiska

[Fukt] In a relate access to the interview of the score of cutor is the elastic operation of the score of the score of the interpret of the spectrum of the score of the score of the transition of the provident of the score of the score of the solution of the score of the score of the score of the cutor of the score of the score of the score of the score of the cutor of the score of the score of the score of the score of the cutor of the score of the score of the score of the cutor of the score of the score of the score of the score of the cutor of the score of the sco

[DG1] In an other details of the model and the model reason population of sub-decisively content provides to provide electronics in the energy of source inpersion tensors and the model is equal and the wave sub-provided of a consider the elecment for models hand, so incoming the model wave on the layer comparison of the provide is the formation of the formation of the constraints of the formation of the formation of the constraint solution if y the models wave and dependent the constraint solution if y the models would be present the constraint solution if y the models would be present the constraint of the model of any solution to the models can be the constraint of the model of any solution to the constraint of the constraint of the model of a significant of the models can be the constraint of the model of a significant of the models can be the constraint of the model of a significant of the models can be the constraint of the model of a significant of the models can be the constraint of the model of the constraint of the models of the constraint of the model of the constraint of the models can be the constraint of the model of the constraint of the models can be the constraint of the model of the constraint of the constraint of the constraint of the model of the constraint of the co inter core The matrix view listifultion of similar ispense point on more as the formation is styliften with the Merican solution Marganitic All the second states in the market and even problems we explore us a to not is non-given to a point is composition.

The provide entropy for [10032] The poly basis of the medical entropy of the poly of the medical entropy of the formation of the poly of t

#### DETAILED DESCRIPTONN (E THE INVENTON)

I Del Cas

[0033] In this values they be present institution of the frincing statement in a statement of the soles of how sole in the test free instant of the sole of the

(FF3) The one of a set of the particular and specification and the approximation of the direction frames (CF3) for (Cradination by the rest of the rate of set of the test of the set of the state of the set of the constraints of the test of the set of the set of the constraints of the test of the set of the set of the constraints of the test of the set of the set of the constraints of the test of the set of the set of the constraints of the test of the set of the set of the constraints of the test of the set of the set of the set of the test of the test of the set of the set of the test of the test of the test of the test of the set of the test of test of the test of test of

[1125] The control of the only hepping a mean on the following left in a special heat of the control of the following at the station of the second second second second second at the station of the second secon

(FF36) The term is operative in effecting to the dispersions any operative endistation in using contributing enveropmeticate interval above to experime the network measurement of the nechild of second ready to series to the network industry the regime effecting operation and the device measure industry the regime endises are more highly with the regime.

(FFS7) The element of the definition of the resonance is a function method of the support of the transport of the support of the base is the definition of the support o

[CC38] Altholment of the sets of multiply implays the Supervised set to set the set of an anti-Supervised set of sets and platters will grade fly the first set of set of sets of balances in an example of the sets of a constant set over the sets of an example of the sets of a constant set over the process and internation was an existent set over the sets of a measure was an existent set of the set of electrony measurement of here are the first set of the balances may be reached at the restriction from the balances may be reached at the restriction from the balances may be reached at the restriction from the Washer sets and the reaches of a constant sets of a proter set of the restriction of the set of the set of the sets of the restriction of the set of the set of the sets of the restriction of the set of the set of the set of the restriction of the set of the set of the set of the restriction of the set of the set of the set of set of the restriction of the set of the set of the set of set of the restriction of the set of the set of the set of set of the restriction of the set of the set of the set of the set of the restriction of the set of the set of the set of the set of the restriction of the set of the set of the set of the set of the restriction of the set of the restriction of the set of the restriction of the set of the restriction of the set of the set

(00 W) Charte of the point of the trade operating sectors by you service structure on nexuling particle. It as ingle discrete the element of the sector matrix of the trade power site burge. rough of the double state in 25 and an expression by a funcing problem to be a characterized when 25 and 25 are specificating to be a considered of the contract for the specificating of problem that require form the method rose for both approxmetric that require form the method rose for both approxmetric that require form the method rose for maturation is sub-integrate as the same form solvement at the method have been approximated in the resonant solutions. And there is the form that we we were the integration of the resonant to her the method second solvement of the resonant solves the later the method is a removable of the resonant solves the later the method is solver to be the second solves and the bound of the method is a removable of the removable of the bound of the method is a removable of the removable of the bound of the method of the removable of the removable of the bound of the method of the removable of the removable of the bound of the removable of the removable of the removable of the bound of the removable of the removable of the removable of the bound of the removable of the removable of the removable of the bound of the removable of the removable of the removable of the bound of the removable of the removable of the removable of the bound of the removable of the removable of the removable of the bound of the removable of the removable of the removable of the bound of the removable of the removable of the removable of the bound of the removable of the removable of the removable of the bound of the removable of the removable of the removable of the bound of the removable of the removable of the removable of the bound of the removable of the removable of the removable of the bound of the removable of the removable of the removable of the bound of the removable of the removable of the removable of the bound of the removable of the removable of the removable of the bound of the removable of the removable of the removable of the removable of the bound of the removable of the removable of the

[0000] The terms "connected you content the final "connected you're comparate frechen on comparately as to the table of the strong yield to minimpatie contendar Event fan humality of the minime of imaging the content for the matrix bar again service from the table of the image in a significant control battle content in the officie for a moment of membratic sector in layou

[FP41] Listerri form in another velocity for an another set of a streether is compared in a traditional optimation of an analysis of a streether is a streether in a streether is a streether of a streether is a streether in a streether is a streether in a streether is a streether in a streether in a streether in a streether is a streether in a str

[1102] Distant in Concerning on Inter-And Claim Rep. coal land. Cyllo/V cavery-la flord root in cruip goathy To the up to be to compare a subsection takes our properties. as increased on such as the first owner exception to get are easily of of a molear of evaluation and the cade likes of we overtailing and higher or intersection of one or these destroyant. (ckernalization) of prices provided within an is nearly out the Profession sectors of the feature of the no system and Athy causion an i ma' track with the device the tracket of the first of needs work the substanting shell save to great a lythe solid organization is an entire technologies eregi a lite and recent and new solution is here an apprecounty as which have a brack much series. an alconnection of a locate comparation shall a remain on an unit. Further of the other actual reaction of prevales to the above mentioplased which served and it of the Periods, thread The Chemican and a substitution according from the out for light ang anggan in COAR asa Oli a Hang Pala da Ig Kga, Maša, KgT 1, 146, O Se, O Te, Saš, Šaše, S.T., Baš, Fride Bills, and the also car teacher carrying of const Reput were red to an viscourd? If the Periodic Tells of the Reput to the tells of the set of the set of the tells of the residence 15 provided the set of Set of the tells of the tells of the file receive composed whet Group 11 elements Get Structure Lines more dévision PDS - tRealide e Stelanda Linea d record install does also which to characterize Binders Isthetic for an an genetic solution and the second s system for more the element is might as we found in the Londroop of Charners and Physics, St. 1910, 10700. Photo 200001

[D05] 10 them estimated with the set theory cost of each public decision agreed in this case to have an espective result when a vester to have view with a ten speaking of each of any single in the tended of an tender of the set of

incoding, an interfaciently checking in magnetics of a renegged in the physical contrast of the type of mangets and a specific many sign system of the main sector solution in the system of the sys

(112) The term from conservative first only a population of the device of search end system is then in the name of the substantial vielence is even to start of the negative of the vielence transford in the term of vielence of the term of the negative search in MSE is the vielence of the term of a constraint of the search in MSE is the vielence of the start search of the term of the constraints prove frequenties when the search of the constraints prove frequenties when the population of the constraint spectra relatives (0) of the dynamic trace mean spectry in the population of population of the population of the population of the dynamic trace mean spectry in the population of the dynamic trace mean spectry in the population of the dynamic trace.

[L175] The physical final strains closes of the economics of the closest contract using whether physics. "Success the particle street distributions of many particulation of the fordariary shift of the arsolffice fixed factors if the sizes of final predicts back we can incersit over removing this in the canaly of tanks has back the sizes fitter fixed as not predicted in the canaly of tanks has back the sizes fitter fixed as a second state of the sizes.

(1124) It is una charter to increase variable of the origination of the matrix state of the variable of the

[1177] The modulation of the rest of scalar of the form of the rest of the res

[1178] A necker information media frequencies consistential inof figure vertice, feel commutes and feel aviage spectra code bioloor in particular sectors matches has converted to out interfeel or matches to construct the tripped relative intervence.

(012) The residues in a conversion? Even to by more gradient or the end of a conversion of the end of a conversion of the end of a conversion of the end of the device of the end of the

angle hydrowith the minimum and set two the new systemption big sector remains of the stage set of some to sufficient and may actively remove active and work.

[041] A tryde plate tear your region of parts that for a structure (is on a more a new an increase increase of your series at increase of your series at the series of the

[0042] The Chart's disable function (a) given the Us when the divertised on some integrals rate on become three they are the dipertitive by a magnitude charges in thigh an entropy of pUt requires by.

[048] The term in Fighteen bedra term reference and the telement of second of Hydron and the telephone of the process matches 24 constrained at the process back of another term of the process is provided in the process to the process the process of the proces of the process o

[00-4] The term is depindent on which we taken to be in the set of the set of the term is the term is the set of the term is the ter

[11:5] The lots behavior of the each term when a method of the term behavior between the method process of the term of ter

[0440] The four full-any mainted flocar refersion a branced to the branches flocar-ban group is preatly of being not necessarily containing the observation scenario of the structuring of the door bit ember scenario of the structuring of the based on the schedule scenario of the structuring of the structure door by the set from the structure flocation group in the structure flocation of the file scenario flocation of the structure scenario flocation and the scenario flocation of the structure scenario. The temperature scenario flocation of the structure scenario scenario scenario scenario flocation of the scenario scenario scenario scenario flocation of the scenario.

[08.7] For the off constraints of the gradient prototion of the state of constraints and gradient state.

Wy fire not a construction only. If they are a which the other ways of an as is replaced with a construction of equilibrity equivalent with the properties of a [0048] . The sum "allows "as use, herein refers to sub-tribute (120,12) where  $(R_{\rm est}/R_{\rm est})$  is the definite free en el la completação de la contra y una estencia Reference ally is defined a knew equires have at any addition to a we'r fir stillae rywd, wedi'r laid orffers offersine specifier. the star specials much arrests of 102 specials res-Density our spectation in equipment of the line true runch, logal or lineal. And providently subshalazzon i kerzun alsernen, hat wisszen erter tena ver nigt simetike mentions myan dari babem, end merada, for counds only fullerate profession monochristical loste aletta divit perfective losterador e alerent perfeang lawa dikugita akgaya na finang lewe a Lyugita ideasy (accently as an intersy rithing around 1 reafice any lower filling orders ( ) and assaring open stand same optimized as the science of the filling of the standard freeded of a factorized. The other first free and the received a controlly of singly in a contract hit is not servere al la rééger, ségue en criter l'us e e log ere" effektiv villarationalary mility orbesa cessag to be left to be relative to an all the territories interests [COM] The term to dig Dimension of the proposal and والاستغاد أنشاب بالمانية فالعادية متعاصفا المتكاورة leasing approximation any substitution in the loss of a long Transmission to a cary is organized to should under their and the is in al referê bû re oznavere gerşevî hatal v storine -1

[0050] The term that fixed 2 days 2 a constant for remeating is exectly sector as a constant of the term of unconnected is the term if the term is shown as a set of the term should be according to the term of the term of the term is a strong test rection place sector in systems on

[0051] The contrapplitive densities "general queby constitutions," of selected discussion in a selection of the selection. a nitro vada biored (france) card nei mitros i statie nei acades. o nino sud dirte sion well as polypepties, peptiel fag. near serves arrive rationly contrast metals. in exercising there is the real sector of the sector of th while task the local function is balls while requires in observarum for two control and the previous lienter remains exclusion to the on provide been reported, and a provident characteristic onation caracteristic convention for meetingly age, in--a a cost concurrand), occurrando concorreito, contra o pos-Statistical scale set with the hand when the design The second se nonic trials? results on a resultant is not a conthree conducted any long in write to here a conducted and -monorphysical distribution of the symplectic symplectic system cine of the network of the photoenergy indicates where the second s and simples handed. They as well be unifed brub of the surgestimeters (CAC) to be includes and free less science en med var en neger ey vigter je end mar ed fied barra va he ofponado, Edel Kote bard charge he ( ha indo es (a) Layel and clubs - Latanias 2 frees Different pairs and address of the Schweigen (Configuration) استأشار بالشكاكة ولوائبة أتحاب متقام كالاطاب والز phantan and Constrained in generated tide monitors Primarpe, powerine Apripapide male a cardo Città Sur a miljer y fio gind le conformé d'al y

os filance from the ALL Marky file. Corrulity Corp., in New ی کار میں معاملہ میں معاملہ میں راس ہوتا ہے۔ مرکز میں میں میں ماری کا بھی میں راس میں میں میں میں میں میں میں م trates are in a configuration that discuss the more particle and exemption instants for duality and they is non-restationary and related above the arrivinglyrelated "Horizontal" menesuri ni herur and individe fractions, converted on your or primary employed the indicate. This disc letter the est, on complet, Society-2024 (NAtional-Recommence on and N2) 100 mergine and a low of grandautic fed to Acida, hisapproximate of the two should be determined of the second s and at RNA 2100 SNe hybrids and hybrids a rate PSNs and EOM is S2Sig and use incode knew physics of an iteransile maquia tel vaido relavoria acore rashy'n tina, Angos Asa's di ati ang kangena ang sa · . . . . التعدي المراجع والمتعادية فالمتعادية وأستعاده أرابه tradition options as the estimate time with them and Loopened, control programmer photon reners, this photon brows control consistences and the control regiments are per-I more an (a processing one of more as phone transfer in the state of a fuand values of which among the equilation of managements of plost measurements intiplost to inducts), does consider ing perabase involves which as the networks may enabled and in nation acts intrelies aged special silety bar steam down sits is teachard and a readance particular, cost of one commuting checkows (tips include multipacted اجتدى سينتها والمراز والانتقاب أحدثته والمحت In a state of a new field having a first optimized in the second se radar 7. nanig radar 7. n

[Os2] The contribution of is used before and secondband being the contribution of a point of the last second in a contribution of the band of the last second band of polymers the number of states of the last second band of the probability polymers the number of the second band of the polymers of the number of the second band of the polymers. The number of the second band of the second ban

[0953] The transform of question function has been in the site term in anti-fly margging, tailed question of questions with unred or the particles of approximate with much function of a single required with the statistic concern of approximate single required with the statistic concern of approximate.

[0664] The set, "Challey pic bosine to Disorce record (a) Issue of the possible of prime on such of the "Second formal ing" of the instance of each of the Possible grade the Constant of Second Second organization and the Second Found of the Con-tension of the Constant prime of the Second Found of the Con-tension of the Second organization of the Second Found of the Con-tension of the Second organization of the Second Found of the Second Second Found of the Second Found of the Second Found of the Second Second Found of the Second Found of the Second Found of the Second Found Second Found of the Second Found Second Found of the Second Found of the Second Found of the Second Found of the Second Found Second Found Found of the Second Found of the S Kindling on the Block neighbor to the section of each submit was where with present of the wood specificity in a method work of per enversite e report des territes de son des recentes de Inchronyment suspend understate of the same full may in filos, of a phytometric analysis' and the resultance fairs in foreign to Inclusional education of Network of making part respectively. Interview Multiplians (while an Tapanesis structure economic in crickical on with a conceptudate rate sety or Exclusive procession from the terror of page descent and and descended a non-transmission for any part metina ne innaezkostaj na unimum kajel kadag pli og hati na hati je na svesi in hermeljeg fign man a tradient for ensembled on a structure of માં ગુજરુ કુલા આ સામે કુલા આવેલું માં મંદ્રી મેં મિલ્લાઓ પ્રાય prest in losio in an depicterent i typigenesions, lecus 23 A 1977PH A 27 FIR HOTORY AT DODOC, A 177 DA AC25T14

imitet at and complementary pressurely. Edge inter-outleast

For ing on the order prove that he here (CCS) - Missions is the onjugation and the comparate Loved to an ghor anne lager afan ang allach a siger aon to า เพราะ หนึ่ง "Bridging" เป็นทางไม่เพิ่มสระจำไหว และ กระสงราย เป็นสระจะจำสาย และ กระจะสุดสระจะเป็น orable for incompletion had relevant and follow interpreted a compression with a stable or present of any notes to the rest poly over here, here, to be new weights and dief when some kapping are New Prevalued Vires (antwaged as a second concernent of a final spectra

[1156] All molecular solution shall be be under in relation nuon musicle sortis.

#### E The National Activity

(FEST) — manufact incentratification actions multiple in all into a specta mane to the solid state of the main opposition in data in reception rations to period an real memory in the parents of the state of the state of the state weighter with the sense of the 2 min sectors of the needs violetini via triena such den such a chemitto na Coma Coma Com evely the renerge fulles will be a reproceed a service days the estimation result will be monday to encountring enferred. More as will be expanded in accurate and better. ie wiewie is control least sin y to be a coning alang, nginesie antooning kopenasi, hing is in the sec The Section of the Transition Scheme and the section of the and the hydroxy binance on of the analyzability to a diving the particulation of the coupling trial spectrum. which will the incorplanate space with course spectrum. [COS8] Semicorday by multipritic stary by converse of comparing the construction of the comparison of the construction of the second s حستر تسرغت ويزاعب كالمناخ حسيرا فرآفتني زبالمطاواتك twinde innesingle characters preventeller, pilytwere even in the property even polytope in polynonume, postationteres, set-schuzephitare, passnary underes, in the tension of the prior of the with plant for any providence of plants of an input sources Association provider and speed of private some titlemest teleterenykow (1900 - 99 Corea, and 15 a North 189 DA w wide of any self fightered doctment to optimize Fighter (1997) And AMPA and American American and American Ameri American Am American Am American A American A Disa.2(Gio)(....N. 3007807186) (nd (...), 1 MM (far alga nin Anglas anglas taoni. Tin US NI Na 1981, Stefanga Katilan di Laga ina manlatin يجاربه فيوسد كتباد الالبرامة مشرات البارين office material and convert here even of the manufacture na manananaka neen Nembaarina mananaka e reported the information set operation of the respective operation of the first operation of determination of the set of transferrer metalements area subset. The second entrest preventeller in mexer performance. He explored were the according to the set of the second probated systems, prioritize of the near system of shifting thereconcernance. Many or locker new relation of the apportral en pertes effett constations per traditioner en pertes effette constationer ( adjecting trize of nenoerystable datases the precorder to aa, ayoo laroi biin axweed qabaan ahay weedargahaa the Weitzler Congress Willingen the on-other time sample, a minimum of the state of the (i) The age in this for a surface the OD CDS CIT. Zine Zinfe dia Lata Cana Newton Inter Inconcepta-s two each element in the gent of those installes on one wa

Laitel (TENLAS, LS), 205, and Név Filley, waiwamakes innergolasi dad entil entravolis die blue eorspie characterization interest much a throad Galacter والمتراجع والمنافقة والمتراجع والمتراجع والمتراجع والمتراجع the obtained on desired which real dependences particle size advectories. In widered enforcements, p-30 discrete errors and dive to making tills elock to provide the (a) All the calls ingo shall a number of the number of care, such a discover constitution are obtained for the periods Encounter contraction design and the second state of the second state ten beithe fielder (fin 1659 ein sold (sin 1656) ein either tweity invalues cool to estimate they in fight a network we only of the second address method and provide completions of hotor accounts with respect, well be a reasonable to enternation statical respective property feature or the housed as the within the set in the piece desset [DS94] The explored in size of non-disperved rate such a population of particles and the date were in a binarie principal meterization affer dentital scatterization. In the lanan umbahman kitah ying diamin un aang supering s three increases constructed a plants. Intel 26 mm m creaking used protonetly love them 2% may. Minisebenotic company contention of the Nethological makaning Flamay et al. (1992). Units Cheve 2011, 1997 (00) and an Manage White storad Characteria to crofit My consistent Downed there Assertedy and some Quantum 111 selection neo//d. and (dated a interface and interface) is all the particle (1975-1976) particular participation of the result for the contrast fractional constant in tends only the well congress on the dependence of a proof of rentric specify of the particles for the or the decirity for our echologies eriptives. Se classification in el responsable type on Hear exchange exection on the Hear Clark Charles and the Hear exchange execution of the Hear Clark Charles and the Hear Provide exchange execution of the Hear Provide execution of t Ion and new soly from the vice rando due to slokal

[Over] The second concerning in the high in second con-5. descriptions of a first transfer of a mining structive name name polydicyw ne ponesies. Dins two opplic consultando non equienti () and more reason the lacontractive conversion residentiation of the Decimi [Obd] Social in considering the coloring Ledan Constitution in the anti-Station of 15 (20) from 0.715 (10) 4 Sciences Account Application of 5550 (557) (2000) soline introduction in London Nr. Weith Children, part Long May 27, 1988. Digon and reverging non-taken is a critical conservation of a constal and energial associate potential statutes in the beautiful Further by these descention of which mail, using 3 which do not 2-14. By Clark, Approximate Health Science 203, 2 may Asto SeX, tubo Odio, NpX, ApX, Ap, 5 C&, 3 (b);

For Dev Steel and All provides the All Parallel Control, and Parallely, GENELEP TEAST ENCLUSION AND A SECTOR OF SERVICE AND تحديثا بمادلتك وعيدة البراطير والبيج أتبر [DW2] The measured or well acressing the end of the series

annanako mendaryang non-bahatan dimensio Indu Indunay al averagiana mento avirenza lifar per obcavirale to you equivaly essently at item waves dractages a ded a desead construction of the definition the flooring the sufficient methods in a cases, s (a) and collected access blind quarter details a fields for the advice for a distribution of proporties of the anti-ficate many station is after groups of the main off reserved at the internet of the internet youngs. province are not pre-optimize the best are informed

categy writes that can be write to point in the electronic and related they benchman against efficiency multiplication response on case

[0063] - 500 from the flow here of its half the ended للسوار محاصلا فيرهمه والورب المهومة ووصحت المعاورة فالمعا entry environmental and What having in an hard กระบบของการได้ ประกาศการการเกิด a single patient entry interpretation and solerve, old crow with respect to the state service efforts. minian solutions, the amazine in term is decisive to be references to reacher a secondly keys to the second for an a simple to on receiver. The simple to one the sail sets far un progen ne verde tage MBR d'actedite, American Calence and Report Physics and the second states of the second 1980, Person di materia, Ida, India, dari san seri seringgi di Troa labor ta terragona pray de ascar taxangar en realem a la includer wary Outleand major site research produce and the Mary Masse and NgTh Ecolar and action econys of the dial statistics Leava IR, and gias assure that paperings in Levalue. and an OR on 108 and years of a firm and 10 approximation of a install an initial on this system with the formation of s Define the Higher to Physics of the Selford Barrier of ana na sa kataona ang kataona kataon na k Const March 10, 5019 NOS and Know when the Star Physics : Net: 10, 545, 5.

(114) The non-net related for inversion may also be needed, and percent one model for even percent or even environment Kines is one only NDKGE of the relative service environment Kines is one only NDKGE of the relative service environment of a functional array of models of the relative site of presence of a functional array of models of the site Kashan a sectoric, the relative distribution of Actual interpretative any the exception of the relative matrix percent of a functional array relative model of the relative sectoric distribution of the SERS of SERS are for the first and relative for the function of the relative to the relative sector of the first first her relative to the former of Chinese for the first of the first first her relative second where the first sector of the percent method for the cell is a research of the SEC on the percent method form well in the second first on Kine provide model method for the cell is the second first on Kine provide model are the second of the second first on Kine provide model are second of the second first on the percent of the first of the second first of the second second second second of the second first on Kine provide model are second or the second first on the second second second second of the second second second second second second of the second second second second second second second of the second second second second second second second or the second second second second second second second second second of the second se

(EDr&) in the relation of the second active the manual hold renargo fieldo-ente la redición enversa de la presenciona dos near conceptions are served producing inplates are egen de services autores metal is subaria resultary de m source to randoms, of a cash to associate and produced characterization For complet some addedive intervalualistic in multiple and will priotly user with include example, and وسالم المعادية المتستعد فأعارا أتستاهم المستحدية بالتربية المراجع في المحمود المراجع المستحدين المراجع المستحدين المراجع المراجع المحمود المراجع المر المراجع المستحدين المراجع المحمد المحمد المراجع المراجع المراجع المحمد المحمد المحمد المحمد المحمد المحمد المحم ghine é lin vital gur spisoé varielle glin locadytivogitus ishe (1990) ningkitayane 1 din larihin (jara there is the communication provides and the nen de orte a rozbilla nena serrekentet er mitemetet iter creation metriks. Monace is recample, second net rikeles anical of strategy crimes and same apparent recent bis reac-Were non-memory will expose to how or simplem exposed cial labolitime for them station in to at other stating structure. a envirge foar oarfaetaet vermeen dat ween, die naare bezare stavalle a equities of Tarsman of Courses couplined at a by routes, is sufficient.

### III. T. Disposed.

(FFG) — we dependent of each phonon start a strike source of the sour

i en realize a la singue contracte, notat la subtración de la definicación contracte de la definicat formátic la confectar a la sub-bancher polynetica de la sy anyone of enter a la sub-bancher polynet, where notat a vocanter glatencial y contract polynet, where notat a vocanter glatencial y contract in observally sy designad. Since relies polynetic de sous de sea de la men entractiva de sectar a la companya de sea de sea de la men contracter a sub-sectar a contractar polynetical y more for the ment share relia o mente mai, contracter mente la de sectar a la contracter de sectar de sectar a de response de sectar de serve de unical polynet for contracter de response de sectar de serve de unical polynet for sectar de la polynet textilence.

[000] As we compression without the large skill of the assume viscoles, bringed promoving the Trend the Lind (pageness where a large viscole as the trend and the large density of the large viscole as the assume the set of the large states of the large state of the large density of the large viscole density.

Board ingoing the system integrating the future as a first of the first formal formation in the state determine for the problem in the system of the state determine ingits a such boards a polyty considerate of a first state of 10545, 17 Proceeding Constant 2012 (1913), and the as replace and takes problem formation in the barb system as replace and takes problem formation in the barb system of the system of the problem formation in the barb system of the system of the problem formation in the barb system of the system of the system. The formation is the barb system of the system. The formation is the system of the system of the system.

[UW8] The summer discuspensis in evolves the cremental physical and bein of a cososicher cristicous selence, i en al segurario senataro sensor man-ita el polypeo prema or practice are energized departed for use of planetic relcare relievely, any he and monomer parts budged of وسنابه فالمحرج وتاريك ومشيا يسيبني واللاب والماهر may life al-Walling for a string in Manufa in any fighteen of the first product the section of 1. . ' ana a a trible en produtera ville e chrecerzeean e mor hore-prostebor ches los la logo torste in ressolationes a Invisible powers that a network providing history builded a hosternon statilitation of one memory ranks. Mer-Inschumps are still actual many structure way some Inel printer to dynkmic region of kaulos, in the unit-of most on records there and we have a discount of characterization. langes may be practically descriptioned "topandy". transformed on the met of structures distantly opposed Tukyu utyi kasi-ti asafa

[0009] The markinghas displayed any loss have strength or other broadpointients, here many the more reachtime and type programs is described in U.S. Sharket, with the function type programs and the problem time and the force time (PAC 20) and the 20.

[000] Is that dy previously applying in Tippes to the ender agent has set from the right of the system in the end of contrast the gradient fraction, and the end of contrast the agent there is a set of the three real model in the system of the provides shall fract any reaction of the transformed by a set of the real track of the system of the provides the system of the set of the system of th

Los pretele sufface (se calling to helpele photos regions of the last of the facing helphotos and the the same seorter of the conduct shift by the most that the interested profile of typics of the epicers of segments).

[0071] Tablesh, plite equilation provide the 30 (0071). Tablesh, plite equivalence and provide the 30 (0078) is 75 (or 1001). Tablesh and be called a second state in the second state of the second state of

[0073] The term 1.6 level plane Type and even 1.5, Complete Plane Barrier Strategy and Strategy

(007) – Alster en del filmine distribute distribute del policies de policie del rack le rest

[0074] disk, Catalyanzin, Catalyanzin, Catalyan (up low) and actually from and thinking the model yield strain from the basis of global characterized of global control of global (34) yields stay and an yield of the from opposition from strains to global control of strains grant and period any associations from to expert a metric star.

1075, the fully occur. In the relation photo-

(Construction of the second second

1075, striggmitten

(CCS) - NACED INDERING

(ED9) there could could be contract, contractions and contract of the state of the second second could be second as a second second could be second as a second second

[11] Proceeding and solution a Neuropean description and

[008] Construction of the product of the left of the product of are annuales accently deplemented, sat Milare with attente oardig de splittie faare bearling te oler ware arbeidgta oo a tomology (terreral) a civile dynamics of instna De Malandi na antifika agén géata jagén génnén n hearing and the disk inclusion of an an columno coldet crimettino eccel. (NUR' efwherein Briann C<sup>a</sup> are also in the mean and the group is reasonal or na reported shared many even interests equation of the balance of the second start of the conduct parts a serie in the negative Net New School will , apply to the of the general keep the mystelko verific surger of sweeting, betweet the powerer besideed, and the treatof if columnized an approximate independence, called an Instead to the result of unit-united a type of her result of , dan debi din Eleay kenes tin debi di on a dan debi di betke aday.

Interflypically of generic catalogs are a more than on N° to be got a for all the solutions. If have offer replaced your type if y the y's more the generic more shown at the Pither is they in replace the tenany acalory are preferience and be too the integers trypically in that 2 to 21 more typically 2 to 13 outparts of solu[0082] Tayliyah philo mpicas may use recomposed of provide and by hyperboly in provide the hyperboly mapping provide an and the hyperboly of the providence.

• Sylpath polyty for barrier dealing that your set in the consecutive problem is the consecutive problem. The problem is the consecutive problem is a comparison of the transmission of

[D005] The principle of regions, by even any extra rely of the region of the property of the experimentation of the property of the experimentation of the transmission of transmission of the transmission of transmission of

[1060] Leary Statement is multiple back, matter multipletyla clearly interfaced by converting the resource methods are been stated at the state network interface method states are interfaced interfaced by the methods are been provided by back sets mysteeping the resource by backyback of the clarkyback sets of all.

[1965] Alwaray and available are reported.

[0:wi] - 1. Constitution for the phase of a

[0497] Tasky tany randos to becautile alfold potents tagget taug (over object participantly object) bandes of them the object group has been a more emboding and typically view of two by each manager participation yiew if the my heavy to mike and the Tasky.

[0080] A series and dysterplate and distributed systems. Size: A years and shift feel we have a compared by a spheric solution of the analysis of the last operation of the sphere.

power sighters.

[104] Anti-Index as his any maintenal

[OVI] - right-files for sight for

[0092] Table room tier picebary as becomercial of poly likes precise (e) can deal the lytike are poly diminishes the state of your bareful test of your state of the poly conduction of the poly dimension of the poly of the poly conduction. If a poly dimension of the poly dimension of th

 $\begin{bmatrix} f(\mathbf{x} \mathbf{x}) & \text{say is f} & \mathbf{x} \end{bmatrix} = \begin{bmatrix} \mathbf{x} & \mathbf{x} \\ \mathbf{y} & \mathbf{y} \end{bmatrix} = \begin{bmatrix} \mathbf{x} & \mathbf{x} \\ \mathbf{y} & \mathbf{y} \end{bmatrix} = \begin{bmatrix} \mathbf{x} & \mathbf{x} \\ \mathbf{y} \end{bmatrix} = \begin{bmatrix} \mathbf{x} & \mathbf{y} \\ \mathbf{y} \end{bmatrix} = \begin{bmatrix} \mathbf{x} & \mathbf{y}$ conversion and shall be from the first defined that Nañ renttan ôn instéle 🕫 letangle harire arattu to a sufficient terms (only sufficient all party sold algorith there have show and are related by real-from his position, sermiciated from the resmeno dividivo nel scande o vere a presi y pomenta i si-Counterplants and base with indictions be all configura-Department between a well high wholes heard as the OC a brought that my new this hydrographic is low dessing, and is substituted with othe hydrophila, and hydrocensies նով պետ Ջայն բենչու են ծրանն բարթել է եր եպ, հանդել nethod modely factors in the conference of the factor of the set o na al pell de sur fa alse constigue plané actionalization d'algère d'Anna se se d'anna de sur control technics curvities, sectors good is through which the hyperated in the and on the network externing other in the more

class: Alternatively, good to possible that the property by output biologic virtual to do on this matching on the visit years, such that will find to the polynomial field by year of years, property dispersively, polynomial field by (2) years, property dispersively, and the field by the field by the years with the second mean the field field by the field by the years of the sphere dispersively and the field by the field by the second second means with the field by the field by the property of the field by the field by the field by the new means the second second second by the field by the new means the second second by the field by the field by the analysis of the field by the second by the field by the field by the second second by the second second by the field by the second by and by second by the second by the field beautifier by the second by the second by the field beautifier by the second by the second by the second by the field beautifier by the second by the second by the field beautifier by the the second by the second by the field beautifier by the second by the second by the second by the field beautifier by the second by the second by the second by the field beautifier by the second by the second by the second by the field beautifier by the second by the second by the second by the field beautifier by the second by

in the site on area prophytical departments 1112 menduality index. Indicate the relianced only new work ideal standalate inconvertige regions, powedlies, provigrees as why relieves a second requirement of state which it takes in the renerands save as deplacy and estimate or effator allying care propagation account havy makes using segular i id eo ango aylandege polyfinatalogal i radwhere the standard standard standard and the basis research the pot of building recomposition a employed which he appreciated the interval of out only a difference. and the other provides the case of take at the structure on roles during your stars and set polynemics of sets and posternously characterized and the time provides the trajectory methods are provided as colors relations, and participation and the trademoliemedication de la physicie de ensure le formed es addisour point existing of other media unsultance in ordered. Soel - dynamic contoer i noter gener by the lyzed marg men beget apparty generic content that that also asso Zigdi, Nito ortigata Bround, spelo Olysta de Luid y shally be to substanting the mathematical fait by the first at by the second page of the first second as "Matter) of a und a received in white elevated in moorpheter prevales nodec an internative prevention of the entering end provides the prestrict poly certified internationale of the original of recel, recentred, or homespectrometers by where as a control to remain moving conductor molet access we are been as a comparison of a spectra of an and a packy reset. As all alot to another transport posteriors are be tracterol. congress reviewed by mendiougn rewaise a review the subjects included and propriorization to publy compartalitat anne frieden of inclusion or crito, taking it not call e activesing follow (10) syntaxison pulling of courses of ienaetio at u

(EPA) The vectorial uncounter, the any results cocover the every code further content to any results over section to every and the hydrodilic teaching product to the magnetic dataset as severe the classifier payter are vector product to the year of grants (e.g. we to the magnetic configure 3 in contrast sympletic payments which part in the data year of grants (e.g. we to the fit of the state of the fit of the set of the data in the fit of the state of the fit of the set of the added to the set of the state of the fit of the set of the added to the set of the state of the set of the set of the added to the set of the state of the set of the set of the added to the set of the state of the set of the se proves of polygony lists information to see the solution of the first set of the set of the solution of the set of the set of the solution of the set of the set of the set of the solution of the set of the se

[060] Willis do chemistional groups' starqueers care indicative tradechille previous and enumptionedly. any iter population of states as in photon by a which was tand späsphytides. The and also all the suspension of the set of t profession in the design of the leader of the statement for an exercise contraction of conductive generation (1.5, a.5). fore printelegicistly in the codification be extended in homogenets primps are renabled on brief through the second polygopiale dear or a work or managed, hum and behave, [UW7] Surrick, of storadisms have all (As I-Assarbly) rus v forsovreplatin black opportunited vnor over transle terre printe nel teste por un or desimentationes la local recontante. Minak, the Transford matching a spoke many security a segregarization in typhenel for add contrainer one after ration the control black the state common in again plate and or weathing completedy by itely of iter can be used ited via standard Language shallaf ay nghone adeda ing Tarenbag lag niga ngo too tif angan (Arageside he what ini geografiat adarati ni ina ada ng the mang salarate i piesto in providente in consectore a stissione i erés literier el coste any los contrepoire to officity nin leven wa

(D44) — Lus principations aporth operative present interval for new sole norther next in the root power new polynypern (Johliczky opyrymers) is lijor in host samelys rice if machillow in nortals (N-16.). I the action control a population por necessario environmente e, but may measured from the beneficient we be cleared at the bears from early av dat oraniza for die divideor adaity rezional affin programme are som visited i frid handele er ungedenkennigt hand um felt Ly round in giodyne cangalacter fri lowene Ly round. alian and the will complete the by the work only will in the rate hypothesis and no include, the commun-مسوعه الأنبي تشهط والمتناه فالمراجز والمساط المتحدث والمتعام فروه فتختف أمتني كالتكريك والالا In oder hydro yn i wyrdin wydr ynd rfedin, rwhrie hydro. photo side chains to the bydiophilic and the addition to the sponies in the measure years emirate historic, and a tene contra esta marina micinaria

[1100] The main only of set set years years by shoch that receivering us that the new weight in the same site process marks (SRC) in SP1000, the weight in the same site process marks (D00 ex 10000), there is believed as may weight had been senarely 1000 objects, the dates are may weight had been set active functional same sites (D00 for respective marks (D00 ex 10000), the dates are may would had be be rescaled for the dates are index on the set of the dates are index on the dates are index. The functionalization dates are index on the dates are index. The functionalization dates are index of the mark is grave may formed as an event of the marks of the could be indicated in the set of the index on the dates are index of the set of the indicates of the set of the set of the set of the set of the indicates are any of the set resolution of the set of the set of the mark has mark of the set resolution of the set of the one of the mark of the set of the set of the set of the set of the mark has mark of the set of the set of the set of the one of the mark of the set of the set of the set of the set Liq. 1. e.g., unless programitized, endocy be activitized and the kinetic of the Kinet Activity. Theory of the ease while the mean fractional state of the kinetic state of the state of th

#### Participant and incrementatively of America Island

[1000] A subset of the neuron manual control we remained while subpersive by surface module with which the module and enerors of the first for the expression expression of the data was an above the submittle hydroxic properties of the data was an above the submittle hydroxic block and control of the sum of the hydroxic block. We have made the single of the neuron of the first control of the the laws.

[C001] Interlay a activity of the coeplage constrained as in stand by admining the schedule and in the discession stiture out of kipstones and state posterilly reparation. nate un infide des condum d'actions fide l'un la isolén yang sara beling mesari dipuseni kan faransa na asi taki manihyatari da taki na ngangalar adar three south re-second run a stir gageon by the processing. primps, sum the bases are generally interprint bases, e.g. remaining training data in remaining to block month (age). value of clock model desires of the contract of the reshare we defend the lowlyce's her rearrange radius are been verses in the server equal correct take each in the readings. nervice nonzero cep, fornelly, forserer he careprotetoric added afericationics, recorder an optic one decare actained the proceed operand. Allocative ye factamonally leaves by forestellar headwards, he is toolad the day spatial costs have. As such as a here they two ag and addition of y for property of the only with one and in the content of heads, the transition of the only chain gill a na a gcath faoi sé Rháin fa an tíoc a s sReichte a su to him, the content as writing of scored, otherly equivalence (use the provide stope with solverned to show the structure is information multiconservation of a service model in the PRANE AND A DESIGNATION

[0103] That the estimate the process of the solution of the process dispersion of the solution of the process of the solution of the solution

[110] Notificating the relations of the set of the set

people costing sold that each pagents into a poleitic in the transport statement as seen to observe only net chains as the print is One of expressions which is the match for pagents that for an O is the solar of the observe of a nine sold to we be explained in the solar of the cost for pagents with O particular in Figure reasolities a through the given of a group consider that of Figure 5 and the parallel. For key that for an of the solar of the parallel of the solar for group consider that of Figure 5 and the parallel of the formula of the group constraints of the parallel of the sotion may the group constraints of the solar solar of the solar of the group constraints of the solar solar of the solar of the group constraints of the solar solar of the solar of the group constraints of the solar solar solar of the solar of the group constraints of the solar solar solar of the solar of the group constraints of the solar solar solar of the solar of the group constraints of the solar solar solar solar solar solar of the solar solar the solar the solar the solar solar solar solar solar of the solar to the solar the solar the solar solar solar solar solar solar solar solar to the solar the solar the solar the solar solar

[Cited] The subsection is a play finite for success part of the subsection of the spectra terms of the one position of the section of the sec

#### Somptime a Conjugation for Associated Communication

[L109] The non-orthographic contracts to the contract of the process success of the process success of the model of the process of the pro

[1394] Harris in the environment of service data manage particles in the mean new may be an present or what may index of he serves as dis first nearborist to white very country structures accurately it is the unitered in Lightration of a near preference in the defending of a second the Large to the affinity molecule the metod positionage ienia liego a populari Ablintura y logidie agi ano titu analisi E. Jiperanang perikk benera Indanggar for their real learning for instituting and see th مترزعة ليقاف لتحاوشك كماتات اديثت غالبه streaments and to see to us of the toleane. The for one will generally be a spielen and critch ellipsec ble disstrend upper on III, show that the network many rerenkan event more det reproduktion de vereiken er t resonant, or scoreporter Demonstry, Local sport per-HALF PLACE TO BOOM VIEW,

[FIG7] such the contractive to the tide Solutions' g Since of the officing the learly was beinged in determine presente presentação as al Nel 1995, and e tentent per se pende recolume a reduced second television preposte charable in polyakely spoke protection incluemployee Modulation received and the python large halfconduction in real indicious real on characterizing an instant with a test, give larger that so we can be served. menter d'une la gine paul la trade or dates presigned processo de la contra de la contr processes. Presently, the interaction of the affining medical n i ferfaning editing transferes perferbandes en i en igni ne ensilere per ensiert, i simplet in lyster filte ... hat it is so the Wis Wissen as not from a noticely ante the affinite no estile physicality are arrive that a line k skol teren

[COM] The efficity and size associate with the efficient regiver an opportie construction and y the array of effective as here in a specific construction of a lower restart phyrsolution of the Dirksgird populy. So here put the module of the efficient to excite the construction of a social dissolution of interaction of a specific particle of a social discipation of the interaction of a specific construction of the policity of the particle of the social dissolution of the theorem of the first section of the social factor of the specific of the first section of the bid operation of the specific construction of the social factor of the specific of the specific the rest parts of the module of the specific to a set the specific construction of the specific to a set the specific construction of the specific construction construction (specific construction of the specific construction construction) and the specific construction construction (specific construction) and the specific construction construction (specific construction) and the specific construction construction (specific construction) and the specific construction construction.

[Fire \_\_ind we exact near the actor with evolution in a comprised of the minimum environments of a hard mus-From any simple overallow functions were set for the mission seturi neverensien entre entres entrettes. I semicute ents den ist und interneture spelt (kowyntern, diard undg astock-mennicated and creative conversion and construction a network the true pie acceleration as he was substituted at frage length of a to according to the single-singled dearlest On in all tricks stranded to high provider children into your. Rodiday ja astronationista integral stranded DON, which has 1.0 G  $^{-1}$  An  $\pm$  of ECGs, ECGs to be specification in ECEO state for the part of the set of the ST  $^{-1.0}$  S  $^{-1.0}$  and  $\pm$  Compared to the set of the ST  $^{-1.0}$  S  $^{-1.0}$  and  $\pm$  Compared to the set of t I shall feature a structure of the threat to straight photomore tricks agains by blocks. So stin investados e a recerto i celetados antidas entrethis to remember and the second second and the partynontrary we colling up to seep of the power reside and the second descent miles for the new research as eventual with industrie interfactive decognization to, astock-real-process in taxy converses and pointner madecoulded as a fer DNAC was activated on a standard 1015 sequencing research association of KNA (10) 1445. and pulyaneas. And we constitute to the iso departables plate, final stars and righter bore and System de La relación de la marca de la deplicação de la complexitación de la complexitaci

a Veral 1.1.1 Encode each include of the annotable to a person eached mean consequence of the provement of the mean each of the mean each of the term of term of the term of term

[U100] The net sparse elevation could are unique a surger space (i.e., space iter the second with a number of second to the space iter the second structure of second to the second structure of second structure of second structure is the second structure iter to the second structure of the second structure of the second structure of the second structure is the second structure of the seco

(17) 767 7. The selective target species (e.g., species) of the needed plans, the field set generalized in the addition for an eggeneral instant of a ball plans. The style phile report of his of an symmetry.

[CIII] Trajna test of tenicoularity in many statistical tail affiny information of tenicoularity induced viewgent of the transition function of tenicourse, providing the reaction of the tenic of the ensemined reaction long or at the tradition of the ensemined reaction tails to reach (Molecular 1) the tengene (resplice to the Verbourse view contextion of the molecular operation to the Verbourse view contextion of the molecular operation which the tennet of Molecular 1 theory of the tension which the tennet context of the ensemination of the tension which the tennet context of the context of the tension which the tennet context of the context of the tension of the tension of the context of the context of the tension ten mergers the tension of the context of the tension of the context of the context of the context of the tension of the context of the context of the context of the tension of the context of the context of the context of the tension of the context of the context of the tension of the tension of the context of the tension of the tension of the tension of the context of the tension of tension of tension of tension of tension of tension of tension of

[0112] If it is to be an existent of the black the investment test been developed in commercial with the prefer of the Efimpediatence that if the the file pring develop in our well as the wamples for fille to we with the the state of the top of the fille top in the investment of the top with the top of the fille top in the investment of the top with the top of the fille top in the investment of the investment of the approximation of sections of the investment of the provide top in the children of the investment of the provide top.

[0119] The fifth any consider on intended the exist for an indianaly Arthout consettly complete dedexing of the first and the tracket of the formation partition of the first model. The move heat is a set on end as produced with repetition to the site of the structure of the produced with repetition to the site of the site of the produced with repetition to the site of the site of the produced with repetition to the site of the site

[1114] The youtke of the present interaction will any optimizes of an over other accounteraction of the response of structure in the interaction of the flat of the structure in the flat of the structure in the flat of the structure in the flat of the flat

#### DARAMP 1

Synthesis and galaxy devides Michiel Cycles (47). Refyreserve

[CL15] Source/Electroe/succeytion and was prepared by Electric probability of the source of the s

are the of heat of this matches there were benefit to the first of the  $20\,$  y  $< 20\,$  matches  $10\,$  y (for edge or in spin  $[\pm1]$  ) by the best index by and the  $10\,$  M at the  $20\,$  spin  $10\,$  M at the  $10\,$  M at the were acception to favor them the first was seried bits priced was by and the states to have \$10 mile in every \$2.5. remains former make "A one all severe recommendation per use revery interface models that our one has not set control while a new weight child of the (14 met) at rely control search planta communication provide the control to construct the scale scale and not great do to the composition and the Africa description of the states of the remarked for 12 loans, this bouild use concertaine of 106 Let of a leaving employies (30 relieve SYM), yound the dyana aro azvipio (1715) - daien a 200 m d. 35/0 ie tav reclede mentanely Elizable occupy any official test. the stations of the Comparison of the astwith moduli by the modules the performance this we the still of entry accesse is that, who gende write the other who included a Door 100 (AN N Nites à centrals a constrair traitise de péople soutras (b.174, con for Cherky hundred s storswisseries one polers that as comparing protocold comparing March 102 we can a second reaction of the article of the second (17). which which all of which the contains when the work beds adapted up (2x100 m, second of oth theories (adapted) actual production y and added by the product flags, and comconsists of many publication of the second subjects structure level in 300 cd to be block and profiled in two E. CONORT 28 39 Chierard Discussion (Council) on the second se of compare Acclusion to the state. Provide constant of all by Wilk segrency and hepping better as a queled which for regentions is the element of the second states of the second states and the second states of the second states and the second states are second states and the second states are second s call goal of the prior flootkins are goth the traction says is nearly the overlap of a configuration of every educed in the second s (25.4 t) for the intervalide stability has deviablished NVLF. VERSING DED SPACE NO ACCESS NO ACCESSION AND A (#1.80) White Logica Middle Constraint for the reaction of accelly Benn processing and where the Steam in the State 1.

#### WAMP 1.5

#### Inspire a consumer look feet No on a spire.

[U104 11] were unit in proci GC uMC with a constraint of 94 (GP) points a case of the memory-sale used. Marrow we can be twee Act of least store the 2018, were precisited to in 25 millings of metric and the flower law processes based at 950000 (the School 10), comes pellot of hermology sales. The supersystem was the information of and 35 millibres of the lamb was symmethed to be only by The particles where in the sole symmethed to be only by The particles where in the sole symmethed to be only by The particles where in the sole symmethed to be only by The particles where in the sole symmethed to be only by The particles where in the sole symmethed to be only by the act if the differter based in the sole of the sole of the sole of the sole forter based to the sole of the sole sole of the least sole of the so

[CH7] B. Smillighters of Lynometric II, and the body recycle reducers the body in Smill of encoder man. The dot pairs and the term in the solution of the filler respective solution term in the solution of 115 (p) has been all by specify an early liquid the body main solution to a may appear stops or gate of the main she solution to gate play which at lied cover. Thereafter use pays and substantian was added to 20 mL of the strain into 200 mL model to an indicate proposition  $\Gamma$  is in the obtain each And the Industry communities in is a set for polyme souther. With conferrence on type everthed in enreceiptions work indees, her a size system for discretisence inpolyne worker. The constructions there may be the remeasurements are placed as rescaled and comparisonal traduction to the second state work in second the heat to second that there we weldered your party do not he will of the lock downly on index is should a company action is the flage and a sided along the wirks of the liask of aid and activities the particles in the aqueous medium. The ciaentous envilouentes estructions augus (instant) un percurs at this year. Let a using to branchedy hippercedia the operation and any strategy product in a subject to addite of the is a refuncy here an isolated to a first manufactor of inconsulation instructions, internet for himselving estes i cerus. La velación de esta des des reconstruis resp time along cylic to get on the means the source mentity. rul and longer ye error yet by word, experiments Plinter to renter of high restriction pools that has

#### EXAMPLE ?

Population Nationals Company and وبالمحادثة والكاثر والكاثر والمعاد تتعاد الالالك rode sub-case also ritely scendine our activitizantine polyme into the dig on decimary payring a several defiway the devices of the chef, pointed a the chury and remain the weak with the statistic base of the transmission 10 straise next little methods of this are little dis- Fishkeler relate detail to mV in mixing compactlying. earlicellary (2.3) from the of preparation was preparately to 20 millionaria and a such they of discussion and datasets construction and subject to the formal technology linedynamics, pt., cardilines, 1 (doctrons, 3400) القابعة والتسبية والحظابية وعاطمها كالهوار كالأسبير الكاراتية minute of room supported. The since supported was found the method, in price 5.5 states in the second state and plangle to be implified. We should us at the improve and edge 15.5 surger all associated in the participant of 5.5 protein profilie and all 25 onto escluid, neglitar the evaluation right eithe location over the station permits who compression exemptions available concentration metricks rain versions de l'Armeteorie (mode la lipperent en reserve) el they could have a long to 100000 hit with a large threads of menory regional 2 mercils for energy Network, pH ч*с*.,

[0119] An of is sound does traiterate on the sound or any machenic visiological ballow and module framework biological in forces to do et a footing having modules of interact. Anthogical symptotic is not been as meaningly the timplicity and ground by the footing interface modules are a to the key part of white terming interface modules are an in provident through the terming interface and any layer with any combiner through the terming interface but not be outtoo experiment and go the earliest for example.

#### LICOMP 1

[F120] Cresting of Theory Stabilized Name you statistical statistics.

[CD1] The collification is assigned at 2.5. Multi Aritzation is a subscription of the subscription is high regarded free differences as a subscription of the large 2 age and 1. Second collections are subscription of the large 2 age and 1. Second collections are subscription of the large 2 age and 1. Second collections are subscription.

control (5.05) inflifted and the VE default of the devices of the set decreased to political with 20 million additional of 0.1 Million additional of 0.1 Million additional with the metric of 0.1 Million additional with the metric of 0.5 Million additional default of 0.5 Million

#### TO MP . A

[LEE] A. C. Sobriver, and "Physical Scholars, however, and spinol logarithm Physical 25.

[1124] The first there after the web and All March Steel. in termined in terminate 2, we expected by rough multi-first I three is contrary former layous Thomas In Ref. solatika tara 200 kata parata ni humatkanya ang sanparameters for the south to visit. Independent terms star et e skurtes da var y 1 Stylen haffet i e Martin skal of 1 M FUL working that for sunches to the work added to the of a grantee you, signs out the reaction was allowed on encoded for the minutes, where it mill four of 0.04% bords. ويتشاهده البابية لمانت الأكر وتشاييهم تتكافر والان a agentization to dimano care aglicule providence i e portae and in this case I've surface the meson of the in Maria conclusion products and face and the strend Section from between non-off yeighter of the edich site by the year way. the instruction 74 hours application to over or 10 here into over

#### DOM: N

(CD4) Chemistry of Chemistry Postellar, Nandery-rabition, Deppedding.

(E125) A until work of particle point read of Dispertice\_p-(Non-underschied-geneichgibte honnebolis), des inderschievioles creatively leader watching to informing to the cultures of a second cause, yet a position were wanted to coorded is thready a reacted association protected on and find Multiple of the Associated Nickasian. (Server) = Likeling with every discover in Suitling en in Statum damenden in eine farmeland beieffind Set, by patient to reasoning to brack digramme on heighter when high with (17 Mirlan Grawl) this the periode south in which the convertex Altra. If the Convertex non-include one entry store both the other rays a president de la contra de la contra complete e recente de la c solenal intervan duge ver inchen dein sole nursekkal an posed of the source programmed of them and the course the another of results of a functional databases. There are no set a polyary was provide in our provide the 144. successes to your offic threaf the prototocolysis. remeasure the south of the flue. It second class of distriked on the worker Longo doled to the Erick and synchrical includes to and independent der understatig ander in weben der finde work for one gates at thest in Pariple Sec. 1 by probabilities are may solve able to be dyperided away more care polypoptic by dispose arguint data. hand at a two working of the antimophy of constant are defied in teach

19 - on nodelli -

 A proparties of subscripting carbon matrix takes, conprinting.

- a virtuality of nyot pinets, range fullow of elementation intercondenses electron and over a configuration realizes by even and a uniperpendice therefore determine input perpendicular any specific difference and a country of all ylacey randomizes of each base and a clustery of all ylacey randomizes of each base and a clustery of all ylacey randomizes of each base and a clustery of all ylacey randomizes and a second base of hyline cover cuch action and the site of a second base for each to of each action of the site of years for permanents. As a for an equation is were all years for
- If a population of evaluation of evaluation in the alloy, group of such actyphysic public many cases in one carbon relation.
- 12. The paper enter of even 10, element relative group of each entry of mediantic currants (2000) and the relative.
- 14 The paper are many and 10 wherein the align group of a shares arrive solutions in the aphintment action states.
- le l'exerptic au d'étient θ, statue le pire Ry efaleytes y arrivés de la recomptise activité de l
- ÍS The sponsor of Kim Direlevic Lepidym Chr. Englishing Lydoniki Side mais.
- to the department's End 10, whereas the provides the free supplication (sub-specip)
- but reports to the closer (1), when an independent of the independence of proceeded in the on the content of when on the reports, and the empiric work.

16. The population of the TLU, where the relative company stational free a by a result on the state of the

We the population methods in 13, where using the residue prises of zero k and an performance in non-method zero.

Still (1) population and the Direct contribution of poly) a phase for complete phase in the poly may include the phase in the poly of the poly in the phase in the phase radius of poly control of a contribution of the school structure.

21.1 reverse account committy of around encounter account of a second committee of a second comparison of a sec

32. The population of all inclusion bunchmain was a more postial context or context soft for a factory of the probability of the population.

23.5 Repopulation de sur l'écolorier la somme due conserve la sono colorie.

 See Provide a confidence il parte de la contractiva de parte plate en comparti les conspisas a contractor de la contractiva en reprinte es

25. The templation of classifier of a first state particle of the anomalogy as to particle comparison server, a direct managemutation.

So the explorement in the state despiration of solution of the state o

27 A percebuic relation genues configurate comprising

(L. population of states a ispended to moon filles of an inthe selection of a number of the interaction of the off monstates and end of the states of the interaction of the off monstates.

36 The population in the other to construct to construct a second system of a silf monitor of the solutions defined as the population of the solution of th

Will population through the same get and bit 27, we can the other way on each is subscent for the synthesis stating of an engene in gravity of the gravity of the state

- George (1999) (1.5.1. Removed at matter banding provide surgers are provide fortune and plantage interaction region in communication.
- But systems dive of confirmation is so op in leg the politicity of system in persible octopationes into the left ref.
- (i) it octors findering wherein the limit vehicle, in the weathing are described in the aqueous declaring and value it is in management of a statistic result approximate energy of the.

. . . . .



USP010025-6-04

# (a) United States (5) Patent Application Publication (5) Publics US 2013/0251618 A1

# LI et al.

#### 20) MICHEOD FOR MARING SEMIRONIDGE (13)G MAGEL WALL CARION NANOTOBES

- (i) Applicate TRENGHERCONSTRATES, say 6 A NERONBALPHEADSION INFORMATION COLUMN, MENUTIPA 0.561
- tomens, 1911 11, Reprised vice MARLANCES, 1.4 WITH A STOCKIDAN DAM. vjiu v V
- (11) AND AND THE REAL AND AND A REAL AND A R 6.00 LEBERLS (apply) or g TELNGHUAUNIMIKEETI (ISAjugi 0...54
- (21) Appl No. 11245,264
- Mar. 13, 200,5 11:2 :--- ·

#### 1204 transfers heptilizer on this ring tradu-

WV 70,2005 CONC

NUCLOCOTISAIT

# Sep. 26, 2013 org Puls Date:

#### Publication Constitution

211	hi .44.	
	100033200	204-60
22) -	V.5. CI	
	с. <b>м</b> .	CAMB SPARSE COLUMN 1 COM STATES
		27, 27, 2000 (MI YOF)
	1 9 <del>2</del> 1	4085471-01145-072515

#### 17.1 OINTRACT.

a contra databas operas a atraccias fingle zo les sado a mentes (Wolfshild refers) collette entende la ong a solid order renormalized to a purely of mostly reactive and correct it wang reactive a sector on the submatrix Alimetry invites to mean the complexities on the smalle well exception in a run, he firm investors more single walkel sation matches first the manufactors contend layer, the sight- walled earlier manetates (for any feedback and the physical and reaching and filled with continuing actory side. The mechanicately material layer revening the planet year the result of SATIST deviated and start particular splacehopter, Byl Consulfa, SWON'S, Chernet Ci-VOYNE and here in an low increasing the service interior Steal States environment





FTG. 1





FIG. 2



FIG. 3



FIG. 4



FIG. 5

#### CONTRACTOR ON A

[000] The set of th

#### EMIXTED JUD

[COCT 1: IN LESS (Field)

[LDO] — Thermodentaper cartained association of the semialeequisition content is right with discussion and only as

[110] A Disalier of Color Vi-

[0095] Bugh an lieb a dama and the (SW27221) may be be? To see a meaning in the plass of sylication that and isother approximation of SW272. A coupled as much set (N1) when the contractory second all service state many structure the silic Second service state and coupled maty, whether the material service distance SW2721 sets 2007.51

(E16) A method for colong section interior SWEN As convestigation on the end in Association electric material (web) efficient of Sectors ANC 1972, 486 contracts as invariants in the subcontracting SWEN is over be comstill to implement on a variants of the next be contracting SWEN is ny systematic internex by an electric specific SWEN is expected on the fact scatter resultions interacting methods as a systematic fact scatter resultions interacting systematics. Sector is near resultions interacting weaking as integrated to be the processor by the specific SWEN integration screently on non-the information as a systematic screently on non-the information sector of the SWEN.

[LD97] Vina representation, form precision of contrast of the representation of the state of

#### PRIME SOR VERNIGHT IN SKAWINGS

[FIGH] Warv operation in the end of inerty operation is here proportional with the according to the operation operation in the proving similar barbon regions and the proving similar the provinging the transmission operation is being the matter provinging the matter provinging the provingited the provinging the provinging the provingited the provingi

[1119] G. The manageria property were an embedied menuficating behavior as generating and XXX-N (a)

[COO] 300 glob multiple rise of a gassing determination industry resides of Ref. International states.

(EFF1 — G. Antosen assuming electron of a hospital range in the chiple statistic status of a contract restriction of by inclusion systems. (I) 100–20.

[0012] The track of experiments were shaped or experiment of the signification of experiments is for methoding excited as [0013] TO 55 in solution of the other shaped of the track sectors allower of the side of the single station software intermediation of 2.

#### DETAILED DESCRIPTIKOS

[0014] The disclosure is iterative, by we performance and not by very of function on the Equator of the resonance approtion by the disclosure is a matter to the function of the bar 2 the most of the resonance of the function for the function of the state of the resonance of the function for the resonance of the state of the resonance of the function of the state of the state of the resonance of the state of the st

[1045] Kelemigan, R. Thankelt-Humakap canoninatogramma structure and an inclusion of seven states.

[096] Alj - Aligendent Infizinge Service 165

[D017] Szün visemis a single withstruction norms to the 12 per the first surged fills of all single shall be ensured to single waited career transition of first 2 decision appression of mention of Without 25 and in countrily on democraticating power 3 to 250;

[Fold] [134] applied performance entries care of layer 14, in thes operations of an intercontribution 12 in care such of the pirmit yield care in Section 13 and and a contribution of the sector of a contribution of a contribution of the sector of the sec

[0012] S4) exposing (L. phys.D) of mentle, SW(1778) 155 by metally, in decomposing (L. material, level), material layer left conversion and Physics for for any other sec-(0050]. (ASI: writes in the characterized are select SWC Network (00500).

[0021] Soft benus has the inversion of end instant by a 14-to domin the too fly schemizer. They SWCNT schemizer (1962) The network of the network of the schematic structure schematic structures and the top schematic structures and the schematic structures and the schematic structures and the schematic structure schematic structures and the schematic structure schematic structures and the schematic structure schematic structures and the schematic structures and the schematic structure schematic structure schematic structures and the schematic structure schematic structure schematic structure schematic structure schematic schem

(0.85) In the wey 635 the shape so test on the more Here 12 cm advess plend sy of Solid Sites advestig a part by monthe SWC Num 122 years more a way wards that they 1990 Colls 124. A post and inflatore fits of the manual 144 CVI v122 nr. In som considered SWC V1 v121 i en he hers, the parallely (LNW) Nationated to a series of the ergic solid contracted by her (Z and the had an erg DC of the automic fills to the sequencial control on targetized fine 12.160 in juga DAWAN, size inclusional size case. (Ling): provide the Line (ExiST) for a forming of adjustment of the star SWONDS A finitude University te so da lea, BWCHEs coll le gierte, tala ta ego (10, 10 a la cassa The Jacking a SWCHES, a character so a long hand separable to find an implementing a SW 1973. colored there is you and so a lement often in tre exhedurers, us privity in \$40305 or the sitie ken en menseren et kommen eller i de die vroe het woer moo ange and SWCN for a role in three well All the creation for engle wated an opprovide light 12 and the reasons, some e preside ne soneas reportoes. Hue revisientes, in mis envirosemental ethologistic desirale vetres enformance mentric 12 and a strate fraction how 0.5 major steps to also up states to 

[0024] K. D. Bayt, P.C. Simon field in the logical ingle switches in a neuromber film (2) of the embod method in order, steps of [0037] S20) providing a graving device 30 incoding a long squark 200 per control (1997).

(CO) Solid possibility a university all subset of the and the solution of D scheroling in entrays they derive its informed the anset of other growing subset to 115 Aug

[LEC7] — [NZNE viewing the privary substance for in the factory substance 200 and pervary the substance 10 and the substance for the factory for X12.

(LECK) production methods and encoded structure of products of the method SWA (N) is a closed on the construction of the second system in the second structure of the second system of the second s

(FF29 — 1925) stopy on particular paths to a new region inclusion of the OV is formed for the start set for 2 and new region of 10 in particular starts affecting and

(FF3) — "Si20 share og ure goræng sunstree 316 and ue ungle ten er satte unartheft in 12 is teorer andte het undere bi2 of residuartes (F

[000] If the supplied the contribution of the last system is the Automatic system the AllS for the History and DD hippenet in the neutring of the Turk of Sing supports. The hippenet is the contribution of the Main and Son Sing supports the state of the support of TD and the National Automatics the state of TD and the History of the Sing state of the the high state of the the state of the Sing state of the Sing the high state of the the state of the Sing state of the Sing the high state of the the state of the state of the Sing the high state of the Sing state of the state of the Sing the high state of the Sing state of the state of the Sing the high state of the Sing state of the state of the Sing state of the state of the high state of the state of the state of the Sing stat

[0073] L. Le sep (222). Usity (optimates J184). Index a kyrene for model of the output filment function in given builty (kyren filmekyren) for the material software of film (second second).

[LL23] — Vim only depicted to respect of the algebraic state of the structure of the provide state, the thread state of the structure of the s

[004] If the others hyperist & is made of much inperse. addient characterization of with the process of Remains the tan la 19 ya 20 Surata ya king afarawa 20 Gunda Surata. U Buwing afa tanan tan gupiyi ya na jinganasa da an a) the interval of a graving advection of the interval system work of the 2, any inglite the contraingnees. which we are an availabling the way offers a to replace by more the geodes and the SIA republic noncomparezolation, apportance de parti-se na criste o as terms gained by using the compary-top of screeks. It mining analysis avaitable in new new discussions. Ergen differences a plant for all near respondent style remarks for ear in 1976. cose program characteristic second from the second temensing at colden of FGN of Final space condense. (FG), and write scheme of Bolt, relevant, on the of Final states of the scheme of Bolt, relevant, on the of Feffélytane (etailet), dation a California etailet and whether in The Types had a sub-the same trigonous whether in net franketel teer flage ja engelaky a stational Fac Monal are an is from a Table 70 and are an so rike of the known destruction of the Molecular respectation of the lation of the second state of the lation

(a) available set too of Fact Konnet - Leno, set too Fact Constant action is the end of the konstant in the method of the fact of Alexandy Alexandri Fact in methy resetter to a 22 Fe(NE), and state

[0036] The theory (5.25) a shallow having the proving poly on the State on the Exchange product 510. It is the exceeded that the state of the Exchange ADD have the Her growing of State 216 and the scillation of the exchange High fielding of the H Her mething of the of the growing orthogone 316 and the state structure of the State of the growing orthogone 316 and the strucstructure of the State of the growing orthogone 316 and the strucstructure of the State of the Growing orthogone and the State structure of the State of the State of the State of the State results are 216 and the structure 110 is offer the structure of the structure of the State of the State of the State of the State 316 and the structure 110 is offer the struc-

[00%] They using obtained the other of any finance of the second mean mean respectively when any UA mark the second mean second mean second mean second mean second mean of the second mean of the second mean of the second mean second m

[F047] The step of a non-index rule millioning strategy of (F1047) The step of a trade is a section but no minimum 2 M so awarded by an index backing or the 200 March 200 of the restand, mean (244), prior but when a separation of the power 2.1 sound 1.54 million and a contract part of the 11 prior back 22.1 sound 1.54 million and a contract part of the 11 prior back 22.1 sound 1.54 million and a contract part of the 200 million has 52 with 1.5

[for Sa] The fact shap in the fact that are given in the fact in the fact for generative price of some of the gravity of the fact the fact the three exclude one in the protective gravity open (Arr) gas

[D00] In the same [52], the photon given parameters in the same "Mathematics even some also man 200 counters in 1000 matches to be obtained on the proving temperature varies with the careful record part in the proving temperature of the SWONT sources approximately from \$00.1 provide 920 to provide the same set of the SWONT sources approximately from \$00.1 provide 920 to provide the same set of the SWONT sources approximately from \$00.1 provide 920 to provide the same set of the SWONT sources approximately from \$00.1 provide 1000 to prov

[10,01] In the copy(20), but an expression of a product of proteen with endow procession we converge the convergence of a procenter densities in the average of provide the outer of the mediane, in the one endices the convergence of a densities for an expression process of the convergence of the first of the interface one provide the convergence of a colonal first of the median of the convergence of the first of the interface on the object of the convergence of a densities of the other median of the convergence of the first of the first of the median of the convergence of the first of the first median gravity of the convergence of the first of the first median gravity of the convergence of the first of the median gravity of the convergence of the [D41] I is the median gravity of the convergence of the median of the first of the convergence of the convergence of the first of the first of the convergence of the convergence of the [D41] I is the median of the convergence of the convergence of the first of the convergence of the convergence of the first of the median of the convergence of the convergence of the first of the convergence of the convergence of the first of the first of the convergence of the convergence of the first of the first of the convergence of the convergence of the convergence of the first of the convergence of the convergence of the convergence of the first of the convergence of the convergence of the convergence of the first of the convergence of

reacting them 500 as some in price dension to remove indep indep care. The tage of a One carbon domain of the other methods to the trade growing sets and the active them as the set of the other and a growing sets and the active the carbon removes the first and the carbon removes a set to the set of the density of the trade methods by independention and the density of the trade methods by independen-

to here the sub-yet Al&hedd (inglo charal), then the boost only algorith Thermitian manual formation when the gauge into SWC with The matching or pporter R (follog) and in formating on a 164 second folgorith of the follow W (PTA) here a reacting on the gravitation of the correct inter 2000 b) is with matching on the gravitation constrate. The last the safety of from the support supplies State

DAN HER ARE

phen.co.ce.

٦,

wrete wryte, no o 10 in orreste. Petrolinnen, fins leinn of

active follow pressent de tweed them it contration of 414.

(C042) The distribution (S26), in figure at this set of each of y soft free surfacences wight an is the terminary rotan 204, the SWONTES.

Approximate addend a alternation to 10. The SWCMIs all

2. So that there is not the proof that the sound by free of the gravity and result and tensor that decimate an excite side in a fit.

The SOM set  $r_{\rm c}$  that is the probability of a distribution of the term of te

teo or o Pel Contel dra tra or niè ne attre la tre

new state engrands for contact much state in 12 recently.

b) any day the anset of the event that buy methods we want to a transmission of the event to a life of the event of the

[field] The overthe borne of the outer to see

restance which of a new preference collaboration and on two ad-

the maps wolkshe control metrics that 12 millions are as replaced an entrol control matrix to be surveyed by surface

-citizates for resources the 12 show many resultance 10.

ean Neimin a seach an faoir agus seachdean a s-fhashailt as seachda Reny as an acts shacid a reac seachdead a na artial ac an 14 acts a

Lacht frie choat ly of SWeB to A discussed the macronation length and hy a dwa relate to the tisted of the car to such that SWCNI. The Liekneys of the national length

materia, hyper 14 er 11 e international de la Oland Barra. Reacht d'arth a fficial de l'arthreachtailte eitheoir an d

in the life Addition of the specie about sourcest

[D449] In the sky (S4), the neutral scene in a unal layer.

14 server of the order of each magnetic restriction and the factor canadig product and of the magnetic for a character of hyper 14.

is general dan da baarengener en undersa of too single welled - alexa many de Chard's "The sension of starge

SWONTS 124 Developments for the factor angle for any sign for from a file SWOOD 129, and so it from

In organization are seen as your special that it is a particular device of the particular sectors are seen as good for and fit.

See 1515 122 in these consists operation itsology states at

through a systeme prioritive removativity 2000 Mix.

121. They do not other mode of the second was shared

a contextuar of the receipt SWCN in 122 merciances.

This is provide the trade with the uniterpretation of the trade run titles the trade of hyper following must be trade the SWC Mills

100 multille meteoriekende notere i Liyer 14 militation internetical i fine cieration 3950, 3 a 222 cm opposed.

Балары Гар учал тарубану алактун жалару простал туру 14

complete offerWONDER interdent convexes

[D(Q)] Intrife solved be the heat page and by the near 32.

Control C 11 contractor can write concording a con-

na investigate desenvabilitats de serventa e dire-

or provided particle methods in 12 you have not feature to

crean ARPAC, and the sparse following resolution 12.

Let even him a PSTy of palys Leagues.

(0.64) To for our (S2b), exampling the proving subseries show the enrich of by an oblig once one of the proving solution 900 with the cool you by enduity once the proving the solution of the cool you by enduity of growing whe data of the cool you (2000) The original growing whe data of the cool you (2000) The original growing whe data of the cool you (2000) The original growing whe data of the cool you (2000) The original growing whe data of the cool you (2000) The original growing whe data of the cool you (2000) The original growing whe when the cool you (2000) The original growing when the coordinate of the solution of the coordinate manager (2000) The originate of the coordinate of the coordinate manager (2000) The originate of the originate of the coordinate manager (2000) The originate of the originate of the coordinate manager (2000) The originate of the originate of the coordinate manager (2000) The originate of the originate of the coordinate manager (2000) The originate of the originate of the coordinate manager (2000) The originate of the originate of the coordinate manager (2000) The originate of the originate of

(004) Exclusion of the Antic Single worked on we may use the Disbody unity of sort NTS particle to the other. The physical social SWONTS has the same begath of 100 incomplete the distance of events and mean SWONT. Its form the same the APACNET in the single self-standard methy of a the APACNET in the single self-standard methy of a the shere of the single self-standard methy with some character that he single some station in the single soft of the could be sensative.

(E146) The admit is the providing method being the formation of the state scale of each or negative the state of the scale of of the scale

(000) It is achieved the single valid care in microson that is only contained by contingeneous (interfaw (interfaw)). The transmission defect the substrate to Achieve and the transmission defect (interface) of Achieves and the transmission of the transmission of the substrate of the substrat

[EE47] The reacy (SS) are not to the transmission base bits and the second of the planchest method work to the factor frequencies and the straight of NESS the space consistent call two impacts (SN) with our the parallel of SWCNT, with the impacts (SN) with our the parallel of SWCNT, with the impacts of the second broad in the characteristic to the impact of the second broad is formed by the system of the impact of the second broad is formed by the system of the second second broad is formed by The straight the second second broad is the second broad by The straight the second second second broad is formed by The straight to we may the straight former in the second second the straights to we may the straight former in the second second the straight to the straight former in the second second second the straight to the straight former in the second seco without the server community 0.0415, 124 hereby also the first server community 0.0415, 124 hereby also the first server of the powies of the mercure level of the mercure of the server of the mercure of the server of the serve

[0952] The mass a back of the H1 for two shows that it is a series of the series of th

133 be not built of the hadro card, the onder the SWINTS -24 the observation of the third states of the non-incompany to accurate to the second states and goals in other a little states to the second states of the second states and the second states and a second states are states the second states and the second states based on the second states and states are states and states when the second states are states are states.

[1155] A present of the such integration when on here it monitoriphon WC walk patients. The result of process there exists on precisive sector comments are been and 1024 automotive restances for another the electronic processing Approximation to the loggeney and the set, and the trade of far a function of the context ment of the second president avec ам нак чело. Арохот, бі стакомахи лагосьта задо frage Ux (300 certs to Ux) 176 as 0.0 All equipped of the ى ياما يور 20 ( د با د بين 1 مونيد يا بيا در اير د مركز مختلف de 1500 giglier e l'estrug and i Aquina a 111.6. Physic have a say of an Earl as a constraint and a first hardness controlling on the flow of our or a first length of the t to check led with the to crosswes more shorn 3 ceso visito. a set 47 sectors. The may subtheat righted steppings standard of standarmin (strategy conditional) in a new notical fairs a new your lide to the prosent faith many converse. Inclusion represent district waves, inclusion la time cherchemischnichte in der beiter wern inder nehmer-beiter nichte envirolities qui relaine round d'Unice ricol

[0054] The angle (sAmaterice carried one on the actual of the control of one model de actived on of provide or ground and as therefore as we need prove to grow the order of the core readments in a range from the total set. Down to the observed for Prove to The single write control and no observed for the free engine on the band of Thegan control and controls are needed on the test of the total set. Just the sum of the controls are needed on the set of the total set of the set of the sum of the prove the test of the total set of the sum of the sum of the set of the test of the set of the set of the set of the set of the total set of the total set of the total set of the set of the

[CCS5] T. Berger, SSJ Science 26, 2007 (1975) and the encoded on a source of encode (kills, restord to certify of the Residue encode neor to reast separate.

(FFS6) CS61 in type: (a) the macroscopy of entropy in the fill that sign is solidal antition remains a fill in the solidal state of the solidal state of a solid solid state of the solid state of the solid so

[0057] = 352 ) of each single section growth the excition on the transformation c and

[COS8] 553), exchanges any the matrixing 500(NTo 122 by a perior toor percented by place distance of the matrix-gas. [LE99] 11: The start (1692) also researce gas can be observed by a mapping captor transformet or 3.1 gamma can be dimensioned continentials to object pair.

[1160] In the step (322 a contrary the electric provates the electronic server and avoid a transmitter SV CA to 125, we prove there is trayyler contrary to the Vige risk contrary to electronic server be reactive present for the electronic server between the determined of the reactive present for the electronic server between the beautiful terms of the electronic server. As the right constraints the electronic server to the electronic server of the terms of the electronic server beautiful terms of the reactive server of the terms of the electronic server beautiful terms of the reactive server of the terms of terms of the terms of terms

[COVID-16: the applicable for many relation of equilibrium in the probability of contrast in the relation of the formula of the second second

SemiconformageW1075124[constraints interaction 100] the solution differentiation of the Conference of the gravity of the state.

[E062] Kels Lights P.G. Light & a period P. Link esection mating 200 MPA diamates in characterization sectors.

[1145] Columpion and States Technological Activity 116;

[D94] Szir viterine a single set folice for increases in the foliosi function of a fill of the single random provides fill single via folioarcal standards for the technical approximation increase a weights fill and interacting to the technical SWCNT (2014).

[D985] Solar approximate for a module state of the model state of the strate scalled conversion and as built in 12 and electrically observed ages to the signal of state of the transmission for the [D986] Solar community representation and and the filter intersection of the state means that it is 12 as a solar and a filter planetic scheduling as (12.15, 12.25) and peels the summary and high SV of No. 12.44.

[1147] Office apparent to plantic value with SWC Network 122 by veniced by harmonic recently network by a bit of a refer mathema.

[Enid] Solution with the phase interval is 200 Million 155, and

[Cove] NJ meansing the number of a functional hyperbalance in the plane in your and in any NOTECL 24 [COVI] The skew path sector the ranking point solution of since 16 can be obtained.

[1071] The angle (S2), i.e., copered SV CN, foot the single welfed care in marking of the fillence with contrast via care in the state of the single settled care in the state of the single settled care in the state of the single settled care in the state of the sta

[D072] The function of the single calculation for the interlevated careful care of the single calcular boundary of the 12. In our carbodian of the source for the excisence. In these overheads the apposite to studies of the dagle states in a similar target hand 2. The all cart target for the doll of caracterized ground of the term of the two cars is the plan by a f8W (177).

[0035] The eleverse of each is made of evoluties with the sector matrix of pointers of indexity enhanced, and the center made best of indexing in the eleverse decay in the center with eleverse decay in the center with eleverse the sector matrix of the sector of the sector matrix of the sector matrix of the sector of the sector matrix of the sector of

[0055] In the trackSite of the devices of the state of the theorem remains the state of the state of the state field is supplied terms in the electric beam correction the reason of earlier correction by a first beam of the state of the state of the height-strategy size introduction is the state of the state of the height-strategy size introduction is the state of the state of the height-strategy size introduction is state of the state of the height-strategy size introduction is state of the state of the height-strategy size introduction is state of the state

[0056] During for both and they are not set. They for all years are set of a best set for the sector of the set of a best set of the sector of the sector

SWONT, 124 vill code in a gritter Linkenity and e the staffing for Cigare barrant. Exteriously, for the formation of the gritter of the protection of the SWONT (Cigare) and the state of the sector is barrante elevation barrante contracts and the sector is barrante elevation barrante is SWONT (Cigare) with the sector of the elevation barrante is SWONT (Cigare) with the sector of the protection barrante is SWONT (Cigare) with the sector of the sector of the sector of the sector and relative the protection barrante is SWONT (Cigare) and relations for the protection barrante is the swont (Cigare) and relations for the protection barrante is the state is the Cigare 122 is the death the sector of the elevation of Cigare 10 atoms and each direction of the trackation is wONT (Cigare) and the contract of the trackation is wONT (Cigare) and the contract of the trackation is wONT (Cigare) and the contract of the trackation is wONT (Cigare) at the contract of the trackation is wONT (Cigare) at the contract of the trackation is wONT (Cigare) at the contract of the trackation is wONT (Cigare) at the contract of the trackation is wONT (Cigare) at the contract of the trackation is wONT (Cigare) at the contract of the trackation is wONT (Cigare) at the contract of the contract of the cigare of the contract of the contract of the intercant device is when it is the the contract of the intercant device is when it is the contract of the cigare of the intercant device is when it is the contract of the cigare of the intercant device is when it is the contract of the cigare of the intercant device is when it is the the second of the intercant device is the cigare of the cigare of the intercant device is when it is the contract of the cigare of the intercant device is when it is the cigare of the cigare of the intercant device is when it is the cigare of the cigare of the intercant device is the cigare of the cigare of the cigare of the intercant device is the cigare of the cigare of the cigare of the intercant device is when it is the

[EF50] Deepy of the clynens yn electrón i wor tradius section word of the clynens yn electrón chair 20 elechon wolds word a chair 100 kilwe comor wars i word. Dee hon cwar for forten tij i no can bein wronn i tarren och e storn de koch nu blinn mes i froewen betri of the electry cline manyer statistic for become on two terretor com sy to actual 000 km, and the comor com two terretor com prima maps for indexe. We come occubied and the

[1176] The contrary of the process of molecular phase material means, new 2015, 124, by two sets of key much be in the byth means of W1N is 122 on the sense are view of a contrart to contextual young SWARS on 124 to set upon to right whether the model young SWARS on 124 to set upon to right whether the model do much group the single and while SWCMTs 124 to the model do much group of a college to right whether the model do much group produced into large group.

[LLN] It is a the instruction of the second-borned enveloped to manufaction difference rates from the disclosure variations are two rade of the most rate state of the complete are spinite from its low enveloping. The accessible free endodment on times of 0, its size the support free borne and no estimate the vector of the fields on

[008] The sub-two end extended for access to coincide and the objects do yet to a minimum years in the sum in the loss interpretation to contain the sufficient of the andre nonthe discount to be viewed for identifier tion prior to sum acmical aggregation of the minimum to the adopt.

Who is compliant

 I. A sector for any single soft for dominant data (S4) is the optimized comprising.

- phong a single value on box milities that the many some end on board is box in the single software box or or double to the single should be single SM SM S and provide the software box SMSD A care service on the op SMSD A.
- replying a macconcord composite layer on the single set of the demonstrates of the tensor of the ingle set leaf a three constraints for the tensor of the machine layer of the tensor demonstrates of each set to a first order of layer, the slope set leaf set to a machine film of the states of the layer of the states.
- (e) car, E. nastalie SWCNTs, yawitapour e car to fragmentaria frequencies? I for a to diagonalizaity he and fit SWC diagonalization and the fit original comparison brack strength of parts.
- reacting branchill SWEETS and
- renably the recommission entry of layer

3 To benize the ong 377CNT on kingmata a of a intest as in allow a SW PT with a plantic get VACNT a not in a state with wat other contracts and latter of

proventing of the second state of the second s

3. The sector in the optical SALON from Borg or end of the Salo Location and parallely of SWC billion is a sector construction of primitally state of the according.

1. It is considered in a second structure produce as a constition represented in a single control control and constitution of the second structure containing structure.

 Set for contracting sweet(1) on the another of varies 1, where no expanding we give his case of Contraction plaand one spaced from the state.

6 The behavior and SWCNT, and Engenders, of which Further in the electric diagonal for the behavior. This is the first and the first adult for any procession of growth there is SOYN to a the loss of Englishing system.

7. Les service entrates S-ECNE configurement d'unité Entres introphent exercisée. Nue le gazete tour configure des inglésestes entrates entre efficie de étacorrecte d' la supartie.

2. Distancial constrainty VMCNU on the post of the first of the second state for granded appendix property of the state state levels in an all by each optices that the post of of the state state kan be trained at two microscopy result, the state that or constant AC is demonstrated as a

9. If the sector of a significant of the sector is a significant of the sector of t

In the sector factory COTNER acting and that that has a single program on teacher teaching a material and sector generative teacher (\$200, \$12) and evaluative constraintly (\$20, \$12)

11. He wante fact is SOTNER and ing and that that takes any lying transmission back in territory tothe complete filling space between algorithms (FTX) integration (WCDSWEEN).

[12] The send connecting SWONTs in King motion of the function of the set of the rest of motion best by each one goal in a size of the maximum of the bard function of the set.

13. The sensition range SWCNTs in himp methods of four to when in the experimenter methods SWCHTs reacpriors on young for an approximation can be as

14. The demission of provide the making method of elements exercised a construction provider mero-area mericology light provider an element of the officer

Elementary for the SS reads to be 200 or the supervision of the second state of the

19 The send of roting SWONTS in kine motion of Kin JJ, conside the compound is exposed to the microserved ration 20 across

to the tenicectarity sweets to taking totally of Kart, waven the tenoting the near the SWCNT, can price stype a

- conversing the induction participation resource test and the manual straining.
- Interaction active gas into the reactive set of any system dynafter and
- erated by give consultantial of the second second pererated by give cluster play of the over we get

With a term of experimental end of the transfer of the transfer of the term of term o

(i) A second contrained compare the contract of t

- placept a single with the establishment of the time is a limit in the collocation with the time is which contains the time bettern constrained and with y of the William contains prime, and the SWENNA contract contains and WWENCH with the place to place day of XWENCH is in part of the coll contains.
- replying a maccanoocal elimeteri filoyation (La single will be enhanded one obsertant to enclude the metality SWONDAL the senioraal sing STONIA.
- (a) Sug for a chill SOTNER's acting a family of signs on a first strategy of a control by a secry the near 25027 Mission end arrive more strategy of generation.

extensions the dealer of merclassic Set Nicht and terre-track investmentiation merclassic

19. The component of the Wei Mills metal to the component Network of the Network of Network of Network of Network of the Network of the Network of Netw

Do the foreign and up to WWH can be a method of value 16, of even a coping the case method inside high first a compares filling scaces between admonth 5 WHV is at the chemity of \$WHVEs.

1 - 1 1 -



#### © 2010 American Chemical Society

# Acidic pH-Responsive Nanogels as Smart Cargo Systems for the Simultaneous Loading and Release of Short Oligonucleotides and **Magnetic Nanoparticles**

Smriti R. Deka,<sup>†</sup> Alessandra Quarta,<sup>†</sup> Riccardo Di Corato,<sup>‡</sup> Andrea Falqui,<sup>†</sup> Liberato Manna,<sup>†</sup> Roberto Cingolani,<sup>†</sup> and Teresa Pellegrino<sup>\*,†</sup>

<sup>†</sup>Istituto Italiano di Tecnologia, via Morego 30, 16163, Genova, Italy, and <sup>‡</sup>National Nanotechnology Laboratory of CNR-INFM and IIT Research Unit, via per Arnesano km 5, 73100, Lecce, Italy

Received February 1, 2010. Revised Manuscript Received March 1, 2010

Smart materials able to sense environmental stimuli can be exploited as intelligent carrier systems. Acidic pHresponsive polymers, for instance, exhibit a variation in the ionization state upon lowering the pH, which leads to their swelling. The different permeability of these polymers as a function of the pH could be exploited for the incorporation and subsequent release of previously trapped payload molecules/nanoparticles. We provide here a proof of concept of a novel use of pH-responsive polymer nanostructures based on 2-vinylpyridine and divinylbenzene, having an overall size below 200 nm, as cargo system for magnetic nanoparticles, for oligonucleotide sequences, as well as for their simultaneous loading and controlled release mediated by the pH.

#### 1. Introduction

Research on nanocomposites aims at developing and miniaturizing structures made of different functional entities, each of them able to carry out specific tasks. In order to design multifunctional nanostructures that might serve as new medical devices, it is crucial to identify "smart materials" that are capable of responding to defined stimuli. Hydrogels are an interesting class of functional materials that have been exploited as intelligent cargo systems for the encapsulation and the delivery of different active molecules, such as oligonucleotides or anticancer drugs,1-4 and that can be useful for the capture and for the controlled release of inorganic nanoparticles. These polymers, whose structure is composed of a three-dimensional network of cross-linked units, can undergo substantial modifications of some of their properties (such as their total charge or their hydrophobicity/ hydrophilicity balance) as a consequence of small variations in the local environment, like a change in pH or in the temperature.<sup>5,6</sup>

Hydrogels in their bulk form have been applied so far in implants, contact lenses, dental materials, and vascular grafts.<sup>1,7</sup> In past years, there has been increasing research activity focused on the miniaturization of hydrogel particles (henceforward referred to as "nanogels") and on the study of their potential as drug delivery agents.<sup>1</sup> Research in this area has shown that in order for nanogels to have reliable structure-properties relationships one needs to finely control both their size and their purity.<sup>6</sup> Size control is particularly critical because a nanogel designed for in vivo delivery of drugs, genes, or nanoparticles should be smaller

\*Corresponding author. teresa.pellegrino@unile.it; tel. +39 0832 298 214; fax +39 0832 298 230.

(5) Ganta, S.; Devalapally, H.; Shahiwala, A.; Amiji, M. J. Controlled Release 2008, 126, 187.

than 200 nm.<sup>8–13</sup> Once injected intravenously, a nanogel smaller than this size will remain colloidally stable, it will not be sequestered immediately by the reticulo-endothelial system,<sup>11</sup> and hence, it will stay in circulation for a sufficiently long time to reach the tumor regions and pass through the pore vessels at these regions.1,9,14

While nanogels based on temperature-responsive polymers are generally designed to be altered by external stimuli, those based on pH-responsive polymers can respond to variations in the intracellular or tissue environment.<sup>1</sup> It is known, for example, that certain cancer tissues, due to hypoxia environment, exhibit an extracellular pH around 6.5,<sup>15</sup> while the pH of some intracellular compartments, like lysosomes, is around 4.5.<sup>16</sup> The pH-dependent swelling behavior of a nanogel can be useful not only for the release of the cargo, but also for its loading. Indeed, when the nanogel swells, its permeability increases, allowing either for the incorporation of molecules/nanoparticles or alternatively for the release of previously trapped payloads. So far, several pH-responsive polymers have been widely used as a controlled drug delivery system.<sup>17-21</sup> In some studies, pH-responsive polymers have been exploited as templates for the in situ synthesis of nanoparticles, and the resulting hybrid systems were tested mainly in catalytic applications.<sup>22,23</sup> Only in a few works were pH-responsive

- (10) Decuzzi, P.; Pasqualini, R.; Arap, W.; Ferrari, M. Pharm. Res. 2009, 26, 235.
- (11) Cairns, R.; Papandreou, I.; Denko, N. Mol. Cancer Res. 2006, 4, 61.
- (12) Torchilin, V. P. Adv. Drug Delivery Rev. 2006, 58, 1532.
- (13) Torchilin, V. P. J. Controlled Release 2001, 73, 137.
- (14) Prokop, A.; Davidson, J. M. J. Pharm. Sci. 2008, 97, 3518.
- (15) Gerweck, L. E.; Seetharaman, K. Cancer Res. 1996, 56, 1194.
- (16) Grabe, M.; Oster, G. J. Gen. Physiol. 2001, 117, 329.

(19) Zhao, C.; Zhuang, X.; He, P.; Xiao, C.; He, C.; Sun, J.; Chen, X.; Jing, X. Polymer 2009, 50, 4308.

<sup>(1)</sup> Schmaljohann, D. Adv. Drug Delivery Rev. 2006, 58, 1655.

<sup>(2)</sup> Nayak, S.; Lyon, L. A. Angew. Chem.-Int. Ed. 2005, 44, 7686.

<sup>(3)</sup> Gupta, P.; Vermani, K.; Garg, S. Drug Discovery Today 2002, 7, 569.

<sup>(4)</sup> Vinogradov, S. V.; Bronich, T. K.; Kabanov, A. V. Adv. Drug Delivery Rev. 2002, 54, 135.

<sup>(6)</sup> Raemdonck, K.; Demeester, J.; De Smedt, S. Soft Matter 2009, 5, 707.

<sup>(7)</sup> Liu, S.; Maheshwari, R.; Kiick, K. L. Macromolecules 2009, 42, 3.

<sup>(8)</sup> Takakura, Y.; Mahato, R. I.; Hashida, M. Adv. Drug Delivery Rev. 1998, 34.93.

<sup>(9)</sup> Mitragotri, S.; Lahann, J. Nat. Mater. 2009, 8, 15.

 <sup>(17)</sup> Dai, S.; Ravi, P.; Tam, K. C. Soft Matter 2008, 4, 435.
(18) Wu, D. Q.; Sun, Y. X.; Xu, X. D.; Cheng, S. X.; Zhang, X. Z.; Zhuo, R. X. Biomacromolecules 2008, 9, 1155.

<sup>(20)</sup> Qu, T.; Wang, A.; Yuan, J.; Gao, Q. J. Colloid Interface Sci. 2009, 336, 865. (21) Peppas, N. A.; Hilt, J. Z.; Khademhosseini, A.; Langer, R. Adv. Mater. 2006, 18, 1345.

<sup>(22)</sup> Zhang, J. G.; Xu, S. Q.; Kumacheva, E. J. Am. Chem. Soc. 2004, 126, 7908. (23) Palioura, D.; Armes, S. P.; Anastasiadis, S. H.; Vamvakaki, M. Langmuir 2007, 23, 5761.

#### Article

polymers combined with magnetic nanoparticles,<sup>24,25</sup> and in such cases, the magnetic nanoparticles were always covalently linked to the nanogel networks. In most of those works, the magnetic nanoparticles were actually used as templates on which the polymer was grown around,<sup>25,26</sup> or vice versa, the polymer was used as template on which the magnetic nanoparticles were nucleated (and remained bound to it). To our knowledge, there has been no report so far on the use of nanogels as carrier systems for the controlled release of magnetic nanoparticles.

Among the vast class of nanoparticles, iron oxide nanoparticles (IONPs, both maghemite and magnetite) are superparamagnetic nanocrystals that have been widely investigated as drug delivery, diagnosis, and therapeutic agents.<sup>27</sup> Due to their intrinsic magnetic properties, IONPs are ideal candidates as delivery agents: when exposed to an external magnetic field of moderate intensity, they are able to accumulate to the site where the magnet is positioned, while upon removal of the magnet, they do not undergo aggregation, as they do not exhibit any residual magnetization. Furthermore, IONPs are valuable contrast agents in magnetic resonance imaging (MRI) because their magnetic moments can affect the relaxivity of the water molecule protons present in the tissues, resulting in a negative contrast in the area where the nanoparticles are localized.<sup>28</sup> IONPs can also serve as colloidal mediators for generating heat for hyperthermia treatment in cancer therapy, under the application of appropriate alternating magnetic fields.<sup>29</sup> The inclusion of IONPs in the nanogel confers to it all the additional advantages of IONPs as described above.

In the present work, we employ acidic pH-responsive nanogels as delivery systems for different types of payloads, namely, IONPs and short oligonucleotide sequences, and combinations of them. We have modified a previously reported synthetic procedure for preparing pH-responsive nanogels<sup>30</sup> in order to obtain nanogels with sizes tunable from 40 to 200 nm, and we have tested those materials as carrier systems. A full characterization based on transmission electron microscopy (TEM), photoluminescence spectroscopy, confocal microscopy, and dynamic light scattering (DLS) was carried out in order to elucidate the loading and the release processes of short DNA sequences, of IONPs, and the combined loading and release of both payloads at the same time. Our pH and of salt concentration results show that full control over the loading and the release of IONPs and DNA is clearly achieved.

#### 2. Experimental Section

**2.1.** Chemicals. All chemicals were of the highest purity available and were used as received. 2-Vinyl pyridine (2-VP, 97%), sodium tetraborate decahydrate, boric acid, as well as all the disposable materials were purchased from Sigma-Aldrich. Divinylbenzene (DVB), 2,2'-azobis(2-methylpropionamidine)-dihydrochloride (AIBA), and Diamine-PEG (MW 897) were purchased from Fluka. The HPLC purified oligonucleotide sequence modified at the 5' end with Cy3 (5'-CAC CAC ACG GTC GGC AGC CAC GGT A-3', henceforth referred to as Cy3-DNA) was purchased from Thermo Electron Corporation. Doubly distilled deionized water (pH ~6) was used for the polymerization

and for all experiments. Poly(maleic anhydride-*alt*-1-tetradecene) (PC 14) was purchased from Sigma-Aldrich, although at present, this polymer is no longer commercially available. The reader can refer to a new polymer coating procedure implemented by us which employs a similar polymer, which is still commercially available.<sup>31</sup>

2.2. Synthesis of Nanogels via Emulsion Polymerization. A series of polyvinyl pyridine nanogels were synthesized with a control over the size diameter of the nanogel below 200 nm, following a procedure published by Dupin et al.<sup>30</sup> and modified by us. As an example, we describe here the experimental conditions for the synthesis of nanogels of about 110 nm in diameter (as determined by transmission electron microscopy, TEM). A mixture of 2-vinyl pyridine (2-VP, 0.25 g) and divinylbenzene (DVB, 0.013 g) was dissolved in 60 mL of water in a round-bottom flask. The pH of the resulting solution was 8.3 immediately after mixing. The flask was sealed with a rubber septum, and the aqueous solution was degassed at ambient temperature by five vacuum/ nitrogen cycles. The degassed solution was constantly stirred with a magnetic stirrer and heated at  $60 \pm 1$  °C. After 20 min, the solution of the AIBA initiator (0.022 g in 1 mL water) was added to the flask, and after 15 min, the solution in the flask turned milky white, indicating the nucleation of the nanogels. This solution was left to polymerize for a further 2 h under stirring conditions at 60 °C, after which the flask was opened to air in order to expel the nitrogen atmosphere and to stop the reaction. In order to remove the residual monomers in solution, the 2-VP nanogel particles were washed at least 10 times with a Millipore Dialysis System (MWCO 100.000) on centricone tubes, and the reaction mixture was centrifuged at 4000 rpm for 30 min. Fresh water was added each time before any centrifugation. All dispersions were diluted using Milli-Q water (18.2 M $\Omega$ ) that had been ultrafiltered (0.20  $\mu$ m filter) prior to use. The solution pH was adjusted by using a solution of HCl (0.1 M) or NaOH (0.1M) and the pH was checked with a pH-meter equipped with a microelectrode (Crison pH-Meter Basic 20+). In order to tune the size of the nanogels below 200 nm in diameter, we have varied the molar ratio of 2-VP/DVB by changing the amount of 2-VP added, while keeping constant all the other reaction conditions, as described above (Table 1).

2.3. Preparation of Diamino-PEG Conjugated Iron Oxide Nanocrystals. Iron oxide nanocrystals (diameter of 7 nm) were synthesized according to the Sun method.<sup>32</sup> The "as synthesized" nanoparticles had a capping of oleic acid and oleylamine and were soluble in organic solvents. They were transferred into water by using a polymer coating procedure developed by us.<sup>33</sup> Briefly, the nanoparticles were wrapped in an amphiphilic polymer shell made of poly(maleic anhydride *alt*-1-tetradecene), and such shell was then cross-linked using a triamine. The nanocrystals were therefore soluble in water and were negatively charged, as determined by zeta potential measurements (Table 1, Supporting Information), due to the outstretched carboxylate moieties of the polymer molecules. In order to remove the excess free polymer, an ultracentrifugation step was performed at 150 000 rcf on a continuous sucrose gradient.<sup>31</sup> Then, diamino-PEG molecules (molecular weight 897 Da) were bound to the carboxy groups at the nanoparticle surface via EDC chemistry. The amino-PEG molecules were introduced in order to make the nanoparticles more stable at different conditions of pH and ionic strength.<sup>34</sup> In detail, to 500  $\mu$ L of a nanocrystal solution 6  $\mu$ M, 500  $\mu$ L of a solution containing a molar ratio of diamino-PEG/NP equal to 500 were added, and after mixing,  $500 \,\mu\text{L}$  of a solution containing an excess molar ratio of EDC/NP (equal to 75000) was also

<sup>(24)</sup> Bhattacharya, S.; Eckert, F.; Boyko, V.; Pich, A. *Small* **2007**, *3*, 650. (25) Zhou, L. L.; Yuan, J. Y.; Yuan, W. Z.; Sui, X. F.; Wu, S. Z.; Li, Z. L.; Shen,

<sup>(25)</sup> Zhou, L. L.; Yuan, J. Y.; Yuan, W. Z.; Sui, X. F.; Wu, S. Z.; Li, Z. L.; Shen, D. Z. J. Magn. Magn. Mater. 2009, 321, 2799.

<sup>(26)</sup> Zhou, L. L.; Yuan, J. Y.; Yuan, W. Z.; Zhou, M.; Wu, S. Z.; Li, Z. L.; Xing, X. H.; Shen, D. Z. *Mater. Lett.* **2009**, *63*, 1567.

<sup>(27)</sup> Laurent, S.; Forge, D.; Port, M.; Roch, A.; Robic, C.; Elst, L. V.; Muller, R. N. Chem. Rev. 2008, 108, 2064.

<sup>(28)</sup> Na, H. B.; Song, I. C.; Hyeon, T. Adv. Mater. 2009, 21, 2133.

<sup>(29)</sup> Gazeau, F.; Levy, M.; Wilhelm, C. Nanomedicine 2008, 3, 831.

<sup>(30)</sup> Dupin, D.; Fujii, S.; Armes, S. P.; Reeve, P.; Baxter, S. M. *Langmuir* **2006**, *22*, 3381.

<sup>(31)</sup> Di Corato, R.; Quarta, A.; Piacenza, P.; Ragusa, A.; Figuerola, A.; Buonsanti, R.; Cingolani, R.; Manna, L.; Pellegrino, T. J. Mater. Chem. 2008, 18, 1991.

<sup>(32)</sup> Sun, S. H.; Zeng, H. J. Am. Chem. Soc. 2002, 124, 8204.

<sup>(33)</sup> Pellegrino, T.; Manna, L.; Kudera, S.; Liedl, T.; Koktysh, D.; Rogach, A. L.; Keller, S.; Radler, J.; Natile, G.; Parak, W. J. *Nano Lett.* **2004**, *4*, 703.

 <sup>(34)</sup> Sperling, R. A.; Pellegrino, T.; Li, J. K.; Chang, W. H.; Parak, W. J. Adv. Funct. Mater. 2006, 16, 943.

Table 1. Experimental Conditions for the Synthesis of Nanogels of Different Diameters<sup>a</sup>

sample name	2-VP (g)	DVB (g)	[2-VP]/[DVB] Molar ratio	TEM diameter (nm)	DLS diameter (nm)	polydispersity index
NG197	0.754	0.013	71.6	$197 \pm 10$	$223 \pm 60$	0.073
NG142	0.505	0.013	48.3	$142 \pm 7$	$185 \pm 51$	0.035
NG110	0.250	0.013	23.7	$110 \pm 8$	$137 \pm 29$	0.028
NG75	0.101	0.013	9.5	$75\pm7$	$92\pm20$	0.022

<sup>*a*</sup> By varying the molar ratio between the 2-VP and the DVB (column 4), while keeping all the other reaction condition constant, it was possible to tune the sizes of the nanogels from 41 nm to 197, as determined by statistical TEM measurements (column 5) on an average of 100 nanogel particles. The hydrodynamic diameters of the same samples, as measured by dynamic light scattering, (column 6) were clearly bigger. The low polydispersity index indicates uniform size distribution (column 7) (all measurements were conducted at pH 7.5).

added. After a reaction time of 3 h at room temperature under vigorous stirring, the unbound diamino-PEG molecules were removed by performing several washing steps on centrifuge tubes having a MWCO of 30 000.

2.4. Loading and Release Experiments of Diamino-PEG Conjugated Iron Oxide Nanocrystals in the Nanogel. The loading of IONPs in the nanogels was performed as follows: 3 mL of a solution of nanogel in water (0.053 w/v (g/mL) %) were mixed with 9  $\mu$ L of a solution of PEG-coated  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub> (the concentration of nanoparticles in this solution was equal to 14.5  $\mu$ M) and the resulting mixture was stirred for 24 h at pH 3.5 at room temperature. Under these conditions, the swollen nanogels started incorporating the IONPs. The pH of the solution was then increased slowly to 7 by dropwise addition of a solution of NaOH 0.1 M (a slight turbidity appeared as soon as the pH reached 5.25, indicating shrinkage of the nanogels). Soon after, the nanogels loaded with IONPs were separated from free excess of IONPs using a magnet: the solution was placed close to the magnet, and within 1 h, the nanogels loaded with nanoparticles were attracted toward it. The nanogels were characterized by TEM and by DLS measurements. For the release experiments, the pH of the nanogel solution was decreased again to 3.5 by dropwise addition of a solution of HCl (0.1 M), in order for the nanogels to swell again. For the quantification of the average number of IONPs loaded within the nanogel, the determination of iron concentration was carried out via elemental analysis on the loaded IONPsnanogels (as explained more in detail in the paragraph of the 2.11).

2.5. Loading Experiment of Cy3-DNA in Nanogel and Subsequent Release. For the loading experiments of oligonucleotide sequences of 25 bases, 3 mL of nanogel solution (0.053 w/v (g/mL %) were mixed with 9  $\mu$ L (100 pmol/ $\mu$ L) of Cy3-DNA solution and the pH was adjusted to 3.5 by addition of HCl0.1 M. The sample was left to stir for 24 h at room temperature, and soon after, the pH was increased again to 7 by dropwise addition of a solution of NaOH 0.1 M, after which it was left to stir for additional 3 h. To remove the excess of free Cy3-DNA, the final solution was centrifuged on 100 000 MWCO amicon tubes at 3000 rpm. The process was repeated until all the free Cy3-DNA was washed away, as monitored by PL spectra on the filtered solution (5 to 7 washing steps on centricone tube of 4 mL were usually required). The free Cy3-DNA solution was collected on the lower part of the centricone tube, while the Cy3-DNA/nanogels were recovered on the upper side of the filter and were redispersed in 1 mL of water.

For the quantification of Cy3-DNA loaded within the nanogel, we have recorded the PL of loaded nanogel samples (both Cy3-DNA/nanogel and Cy3-DNA-IONP/nanogel). We have then extrapolated the Cy3-DNA concentration of those samples on calibration curves of photoluminescence vs Cy3-DNA concentration (PL/Cy3-DNA concentration). These were obtained by preparing standard solutions at known Cy3-DNA concentrations, in which we have simulated the matrix. In more detail, for building the calibration curve for the Cy3-DNA/nanogel sample, to each of the standards at different DNA concentrations we have added the same amount of nanogel that we had in our sample. Likewise, in order to build the calibration curve for the Cy3-DNA-IONP/nanogel sample, to each of the standards we have added an amount of nanogel and IONP at the same concentration that we had in our sample (Figure 8S, Supporting Information). For the release experiment of the Cy3-DNA, 50  $\mu$ L of a solution of NaCL (5 M) were added to 1 mL of the above nanogel solution loaded with Cy3-DNA, and the pH was adjusted to 3.5. The sample was left under stirring for 72 h, and soon after the solution was centrifuged on an amicon tube of MWCO 100000. PL spectra were recorded on fractions collected both on the upper part and on the lower part of the membrane.

2.6. Simultaneous Loading in Nanogel of Both Cy3-DNA and IONPs and Subsequent Release Experiments. To load IONPs and Cy3-DNA simultaneously within the nanogels, the same procedure as described above (to load IONPs and Cy3-DNA separately) was applied. The only difference in the present case was that 3 mL of nanogel in water (0.053 w/v (g/mL %) was mixed together with 9  $\mu$ L of the Cy3-DNA solution (100 picomol/ $\mu$ L) and with 9  $\mu$ L of the IONPs solution (14.5  $\mu$ M), after which the pH was adjusted to 3.5 using HCl 0.1 M. Also, in this case the loading and the release were monitored by TEM and by PL.

**2.7.** Dynamic Light Scattering. Zeta potential and dynamic light scattering measurements (DLS) were performed on a Zetasizer Nano ZS90 (Malvern, USA) equipped with a 4.0 mW He–Ne laser operating at 633 nm and with an avalanche photodiode detector. Measurements were made at 25 °C in water. All the samples were filtered before analysis.  $0.2 \,\mu$ m filters were used for the nanogel alone, while for nanogel samples loaded with nanoparticles and Cy3-DNA solution, 0.5  $\mu$ m filters were preferred.

**2.8.** UV-vis Absorption, Photoluminescence (PL) Spectroscopy. UV-visible absorption spectra were measured using a Varian Cary 300 UV-vis spectrophotometer. Photoluminescence (PL) spectra were recorded on a Cary Eclipse spectrophotometer. To record the PL spectra of Cy3-DNA alone and in nanogel, the samples were excited at 500 nm.

**2.9. Transmission Electron Microscopy.** TEM images were recorded on a JEOL jem 1011 microscope operated at an accelerating voltage of 100 kV. TEM samples were prepared by dropping a dilute solution of nanogel in water on carbon-coated copper grids and letting the solvent evaporate. The reported TEM diameters were measured on an average of 100 particles.

**2.10.** Confocal Microscopy Imaging. Confocal microscopy images were acquired with an Olympus FV-1000 microscope, equipped with an argon laser source (488 nm excitation line) and a DM488/405 type dichroic filter. The fluorescence reading channel was set at  $565 \pm 25$  nm.

**2.11. Elemental Analysis.** An inductively coupled plasma atomic emission spectrometer (ICP-AES) Varian Vista AX was used to measure the concentration of Fe and thus the concentration of IONPs. The samples were digested in the following way: they were dissolved in a concentrated acid solution (HCl/HNO3 (3/1 v/v) and were left for 24 h, before performing elemental analysis. The Fe concentration was converted into nanoparticle concentration using a procedure described by us in a previously published paper.<sup>35</sup> In detail, the average diameter of the nanoparticles was assessed via statistical analysis on TEM images. The average number of Fe atoms per nanoparticle was determined by

<sup>(35)</sup> Deka, S.; Quarta, A.; Lupo, M. G.; Falqui, A.; Boninelli, S.; Giannini, C.; Morello, G.; De Giorgi, M.; Lanzani, G.; Spinella, C.; Cingolani, R.; Pellegrino, T.; Manna, L. J. Am. Chem. Soc. **2009**, *131*, 2948.


**Figure 1.** Sketch of the structure of the vinyl pyridine (VP) and divinylbenzene (DVB) units, which were employed for the synthesis of pH-responsive nanogels. TEM images of four different nanogel samples, with average diameters corresponding to (a) 75, (b) 110, (c) 142, and (d) 197 nm (the TEM diameters reported were estimated on an average of 100 nanogel particles; see Table 1, column 5).

building a structural model of the nanoparticle, with the same geometrical parameters of the nanoparticles as determined by TEM. Then, by knowing the average number of Fe atoms per nanoparticle and the total concentration of this species in solution, it is possible to determine the concentration of nanoparticles. In order to elucidate  $Fe^{3+}$  leakage in the condition of the loading experiment, we kept the IONPs at pH 3.5 overnight and we collected the supernatant solution, i.e., the solution separated from the IONPs by filtration on centricone filter. Finally, we measured the Fe concentration in both fractions.

#### 3. Results and Discussion

**3.1. Preparation of pH-Responsive Nanogels and Characterization of Their Swelling Behavior.** The pH-responsive nanogels employed in this study are based on copolymers of divinylbenzene (DVB) and vinyl pyridine (VP) (sketch of Figure 1). They were synthesized following earlier reported procedures, with minor modifications.<sup>30,36</sup> This type of surfactant-free emulsion polymerization procedure was first described by Loxley and Vincent,<sup>36</sup> who synthesized monodisperse cationic nanogels of 2-vinylpyridine by varying the amount of styrene (the hydrophobic monomer) and that of DVB (the cross-linker agent). The authors demonstrated a tight control over the particle size in the

range between 160 and 200 nm. According to a modified version of the Loxley and Vincent procedure, Dupin et al.<sup>30</sup> have reported the synthesis of sterically stabilized PVP latexes at much higher solid density, and with control over the diameter from 300 to 1000 nm. They used suitable stabilizer molecules, namely, monomethoxy-capped poly(ethylene glycol) methacrylate (PEGMA), and surfactant molecules named "336".

Our interest in the present study was to control the size of the nanogels below 200 nm, which is a more suitable size range for the potential use of such nanogels as cargo system, as highlighted above. We were able to synthesize a series of nanogels in the size range between 40 and 200 nm, by reducing the monomer concentration of 2-VP, while keeping all the other parameters constant (Table 1 and Figure 1). Reducing the concentration of 2-VP corresponds to a decrease in the 2-VP/DVB molar ratio, or the same to an increase in the amount of DVB (the cross-linker monomer) per nanogel. The formation of smaller nanogels can be ascribed therefore to a higher degree of reticulation of the nanogel network. The smallest nanogels that we could prepare had a TEM diameter of about 40 nm (Figure 1S, Supporting Information).

For a given nanogel sample, the average diameter, as measured by DLS (Table 1, column 5), was slightly higher than that measured by TEM. This was expected, since the DLS measurements were carried out on hydrated nanogels. Moreover, the DLS

<sup>(36)</sup> Loxley, A.; Vincent, B. Colloid Polym. Sci. 1997, 275, 1108.



**Figure 2.** Swelling behavior of the nanogels. The DLS diameter is reported as a function of the pH (each measurement was carried out three times.) All nanogel samples exhibited a sharp swelling behavior below pH 4.3.

polydispersity indexes were low, confirming the uniformity in size distribution of the nanogels (Table 1, column 7).

It is also worth highlighting that in our preparation we ran the reaction for 2 h, while in previously reported methods the reaction time was 24 h.<sup>30</sup> We additionally observed that by increasing the reaction time from 2 to 24 h the size of the nanogel increased, but the final nanogel was mostly aggregated (Figure 2S, Supporting Information).

To investigate the swelling behavior of the various nanogel samples in water, the pH of each nanogel solution was lowered from an initial value of 7.5 by dropwise additions of an HCl solution. After an equilibration time of about 10 min, the nanogel diameters increased sharply at pH below 4.3, due to progressive protonation of the nitrogen of the 2-vinylpyridine residues<sup>37</sup> (Figure 2). Regardless of the starting size of the nanogels, the swelling occurred always at pH below 4.3. The various samples exhibited critical swelling transition at pH values between 4.3 and 3.9, depending on the ratio between 2-VP and DVB employed in the preparation of the nanogels (i.e., the degree of cross-linking of DVB).

The majority of the pyridine groups became protonated below pH 3.8, and the average diameters of the nanogels reached a maximum due to the electrostatic repulsions between the strongly cationic chains.

Above pH 4.5, the particles were in the swollen state, because of the absence of inner charges, and they behaved like conventional polymer latex particles.<sup>37</sup> The swelling of the nanogel particles was also confirmed by visual inspection, as the solution turned from turbid, milky-white to clear when the pH was decreased from 7 to 3.5 (Figure 3S, Supporting Information). Zeta potential measurements indicated a strong cationic character of the nanogels at pH 3.5, which is the pH at which the payload was usually loaded. However, even at pH 7 the nanogels retained a slightly positive charge (Table 2, Supporting Information).

**3.2.** Loading and Release Experiments of Iron Oxide Nanoparticles. For the loading and release experiments, a nanogel sample having average "TEM" diameter equal to 110 nm at pH 7 was employed (henceforward referred to as "NG110"), and the loading and release process of IONPs was monitored by TEM (Figure 3). After mixing the nanogels with IONPs (PEG-coated nanoparticles, 7 nm in diameter)<sup>32–34</sup> and upon switching the pH from 7 to 3.5, the nanogel was turned into a swollen state (under

TEM, the edge of the nanogel was not sharply defined anymore; see Figure 3B). A gentle overnight shaking at room temperature was then followed by restoration of the solution pH back to 7 (by addition of NaOH), which induced the shrinkage of the nanogels, inside which the IONPs remained entrapped (Figure 3C).

By application of a magnet, the nanogels loaded with IONPs could be recovered and they were separated by the excess of free IONPs (Figure 3D), as the former were attracted faster than the latter to the magnet (Figure 3D). In order to achieve a complete cleaning of the loaded nanogel from the free IONPs, a second purification step on Sephadex column was performed. The incorporation of the IONPs in the nanogel induced an appreciable increase of the average nanogel diameter, as determined by TEM (in one sample, for instance, it varied from  $110 \pm 8 \text{ nm to } 117 \pm 12 \text{ nm}$ ).

DLS was additionally exploited to examine the behavior of the nanogels at each step of the procedure. Immediately after mixing the IONPs with the nanogel, at pH 3.5 the DLS diameter of the nanogel was around 480  $\pm$  94 nm (Table 1, Supporting Information), which was lower than that of the nanogels when they were swollen at the same pH but in the absence of IONPs (713  $\pm$ 158 nm). This reduced swelling of the nanogels might be due to the ionic interactions in solution between the IONPs and the nanogels. After switching the pH of the same solution back to 7, the DLS diameters of the nanogels in the presence of the IONPs was  $191 \pm 8$  nm, as opposed to the DLS diameter equal to  $137 \pm 29$  nm for the empty nanogels (Table 1, Supporting Information). TEM characterization confirmed the presence of IONPs within the nanogel structure (Figure 3C). The nanogels loaded with IONPs could release their payload by switching the pH again from 7 to 3.5. Indeed, after 3 h at pH 3.5, most of the particles were released from nanogels, as confirmed by TEM (Figure 4).

In order to rationalize and understand the driving force for the loading, we have characterized the system in more detail by analyzing the surface charge of the individual units, namely, the nanogels and the IONPs, and that of the nanogels loaded with IONPs at various pH values. At pH 3.5, the surface charges of the swollen nanogels and those of the IONPs were both positive (zeta potentials were +56 mV and +8 mV, respectively), and at the same time, the nanogels were in the swollen state, which promoted the entrapment of the nanoparticles at their interior. We have also attempted to load the nanogels at pH 7 instead of pH 3.5. At this pH, the surface charge of the nanogels was still moderately positive, while that of the IONPs was negative. The negative charge is likely due to the charge balance at the surface of IONPs given by the sum of amino-PEG moieties and carboxyl-terminated groups of the polymer (zeta potentials are +28 and -42 mV, respectively; see Table 2, Supporting Information). Therefore, even if at this pH value the nanogels were swollen, one should expect a higher electrostatic interaction between the nanogels and the IONPs. We observed indeed that also after incubation under these conditions we could load IONPs within the nanogels (Figure 4S, Supporting Information). A loading experiment was attempted even at pH 10, at which the surface charge of the nanogel was only slightly positive (zeta potentials for the nanogels and for the IONPs were +15 and -42 mV); hence, the electrostatic interactions between the nanogels and the IONPs were weaker than at pH 7. In this case, we could still observe (by TEM) the adsorption of a few nanoparticles on the surface of the nanogels, but most nanogels had not been able to incorporate the IONPs (Figure 4S, Supporting Information).

For the quantification of IONPs loaded within the nanogel at the different pH values, the various samples were digested in HCl/HNO<sub>3</sub>, and their iron content was estimated by means of elemental analysis, which allowed us to estimate quantitatively

<sup>(37)</sup> Fernandez-Nieves, A.; Fernandez-Barbero, A.; Vincent, B.; de las Nieves, F. J. *Macromolecules* **2000**, *33*, 2114.



**Figure 3.** (A) Scheme of the loading of magnetic nanoparticles within the pH-responsive nanogels. Corresponding TEM characterization of the different steps: (B) at acidic pH the nanogels were mixed with the IONPs; (C) after 12 h, the pH was switched back to pH 7, such that the IONPs were entrapped within the nanogel network. (D) The application of a small magnet helped to remove most of the free IONPs in solution. A complete cleaning was achieved by performing an additional purification step on a Sephadex column.



**Figure 4.** Release experiment of the IONPs. Switching the pH of the IONP-loaded nanogel solution from 7 to 3.5 induced the swelling of the nanogels and consequently the release of the IONPs entrapped within the polymer network.

the number of IONPs entrapped within the nanogels.<sup>35</sup> The highest concentration of IONPs was found in the beads loaded at pH 3.5, followed by those loaded at pH 7 and then by those at pH 10 (see Table 2S, Supporting Information). Those results were reproducible and provided a clear indication of the average loading efficiency of the nanogels. These data nicely correlate with the trend in IONP-loaded nanogel diameter (as estimated by the DLS), which is bigger for the gels loaded at pH 3.5, followed again by those loaded at pH 7 and at pH 10, respectively. This correlation suggests that the swelling behavior is the main driver for the encapsulation of IONPs, although a contribution due to electrostatic interactions between the nanogels and the IONP surface cannot be excluded.

Once the nanogels were loaded with IONPs, their surface charge became negative at pH 7. However, the trend in absolute values of surface charges was reversed in this case: it was higher for the nanogels loaded at pH 10, followed by those loaded at pH 7 and pH 3.5, respectively. This might likely be attributed to a

much lower fraction of nanoparticles adsorbed at the nanogel surface with respect to those trapped deeper in the network structure of the nanogel at pH 3.5 (the nanoparticles contributed with negatively charges).<sup>31,33</sup>

3.3. TEM Characterization of the Entrapment of the IONPs within the Nanogels. In order to confirm the entrapment of the IONPs, we carried out additional TEM characterization. Several bright field electron microscopy (BF-EM) images of a nanogel sample loaded with IONPs were taken at different tilts on a large angular range (from  $-55^{\circ}$  to  $0^{\circ}$ , to  $60^{\circ}$ ). Two BF-EM images of the same IONP loaded nanogel are shown in Figure 5A, B. Figure 5A corresponds to the specimen tilted at 0° (i.e., the plane of the sample is basically normal to the electron beam direction) and Figure 5B corresponds to the same sample tilted by 60°. From the high-tilt image, two main considerations can be made: first, the projection of the light gray zone (observed circular at 0° tilt) is elliptical at high tilt, indicating that the polymer behaves as a sphere pressed on the plane of the carbon grid in a direction perpendicular to it. Second, at high tilt the spherical nanoparticles are located inside the contours of the light-gray zone that corresponds to the polymer. This suggests that the IONPs were embedded within the first few polymer layers. If, on the other hand, the IONPs were simply attached on the surface of the polymeric crushed sphere, they should have appeared also on the external side of the light-gray zone's contour.

In order to localize the radial distribution of IONPs within the nanogels, we have performed TEM on the cross sections of the IONP-loaded nanogels, which had been embedded within a paraffin resin. The sections analyzed had thickness of 70 nm (Figure 5C) and 50 nm (inset of Figure 5C), respectively. As observed in Figure 5C, most of the IONPs were densely packed at the edge of the beads, within the first layers of the polymer, and only few of them were found deep inside in the nanogels. It is interesting to compare these results with the cross-sectional images of the same type of nanogel used as template for the gold synthesis reported by Nakamura.<sup>38</sup> In that case, as the gold nucleation occurred only at the surface on the TEM cross sections, no nanoparticles were found within the nanogel.

<sup>(38)</sup> Kensuke Akamatsu, , Takaaki Tsuruoka, Hidemi Nawafune, Syuji Fujii Yoshinobu Nakamura *Langmuir* 2009, [Online early access].



Figure 5. (A,B) Inverted bright field electron microscopy images of a sample of nanogel loaded with IONPs. (A) corresponds to the specimen tilted by  $0^{\circ}$  and (B) corresponds to the same sample tilted by  $60^{\circ}$  under the electron beam. On the tilted sample, the light gray edge, corresponding to the polymer, covers the bright spots, which are the magnetic nanoparticles. (C) Cross-sectional TEM image of nanogel loaded with IONPs recorded on a section having a thickness of 70 nm (while for the inset the section thickness is of 50 nm).

It is also worth noting that our IONP-loaded nanogels can be kept for months at pH 7 and at room temperature without observing leakage of IONPs. This is likely an indication of the entrapment of the particles within the polymer networks. Taken all together, these results point to the entrapment and localization of the IONPs within the first layers of the polymer network in the nanogel. This configuration rationalizes the loading and thus the consequent release of the IONPs that we observe. Our results are in agreement with those reported by Jang et al. who used hydrogel spheres based on a thermoresponsive polymer PNIPAM and pH-responsive units 4-vinylpyridine to entrap CdTe nanoparticles. In that case, however, the authors provided other indirect proofs that pointed to the nanoparticle entrapment.<sup>39</sup>

Additionally, it is also worth noticing that, if the IONPs are left at pH 3.5 overnight, no change in the composition or shape of the nanoparticles was observed, and no leakage of  $Fe^{3+}$  was detected in the acidic medium.

On the basis of the above results, we decided in all the subsequent experiments to load the IONPs at pH 3.5, as in these conditions we achieved the highest efficiency of nanoparticle loading.

**3.4.** Loading and Release Experiments of Oligonucleotides. We have applied the procedure described above to load and release short oligonucleotide sequences of about 25 bases. In order to detect the loading and release process, we have employed a sequence bearing at the 5' end the fluorophore molecule Cy3, which allowed us to track the presence of the Cy3-DNA within the nanogel by photoluminescence (PL) spectroscopy (Figure 6) and UV-visible absorption spectroscopy (Figure 5S, Supporting Information). Figure 6 shows the PL spectra of free Cy3-DNA (red line) and of the nanogels loaded with Cy3-DNA (black line), after the solution was purified from the excess Cy3-DNA (see section 1.5 of the Supporting Information). When loaded in the gels, the Cy3-DNA exhibited a PL spectrum that was red-shifted by about 3 nm with respect to that of free Cy3-DNA.

The signal recorded was due only to the Cy3-DNA loaded into the nanogel and not to free Cy3-DNA. As proof, we have recorded the PL spectra after each washing step (the solution recovered from the lower part of the centricone filter used for the purification). The signal of free Cy3-DNA in this solution was progressively reduced, and after 6 washing steps there was no PL signal from free Cy3-DNA. These data clearly confirmed the loading of the Cy3-DNA within the nanogel. The Cy3-DNA loading was further corroborated by DLS measurements, since an increase in the



**Figure 6.** PL spectrum of Cy3-DNA loaded within the nanogel after the cleaning procedure had been applied (black curve); PL spectrum of the free Cy3-DNA (red curve) and starting nanogel solution (blue curve). The plot reports in addition the PL spectra of aliquots collected at the different washing steps, as well as those of the loaded nanogel solution, Cy3-DNA and nanogel only. After 6 washing steps, the free Cy3-DNA was removed completely from the solution containing the loaded nanogels. The inset shows a scheme of the loading of Cy3-DNA within the nanogel.



**Figure 7.** (A) TEM characterization of nanogels loaded simultaneously with IONPs and Cy3-DNA. (B) Confocal microscopy characterization of the sample shown in A. The fluorescent signal of the DNA bearing the Cy3 marker (left panel) is colocalized with the spots seen in the phase contrast image of the nanogel (right panel). The central panel is a merged image of both panels.

average nanogel hydrodynamic diameter was observed after loading (i.e., from  $137 \pm 29$  nm to  $165 \pm 63$  nm for a nanogel sample loaded at pH 3.5 and measured at pH 7 (the dye signal is quenched at pH 3.5); see Table 1S, Supporting Information).

**3.5.** Simultaneous Loading and Release of Oligonucleotides and IONPs. In a third series of experiments, we have loaded simultaneously IONPs and the oligonucleotide sequences in the nanogels, by mixing together solutions of IONPs, Cy3-DNA, and nanogels, according to the protocols described above. The simultaneous loading of IONPs and Cy3-DNA was confirmed by a combination of TEM measurements, by which we could locate the IONPs in the nanogels, and by confocal microscopy, by which we could identify the PL signal from the Cy3-DNA within the nanogel (Figure 7).

<sup>(39)</sup> Kuang, M.; Wang, D. Y.; Bao, H. B.; Gao, M. Y.; Mohwald, H.; Jiang, M. Adv. Mater. 2005, 17, 267.



**Figure 8.** (A) PL characterization of the release process. The inset is a sketch showing the separation on the centrifuge filter between the IONPs and nanogels from the small Cy3-DNA molecules. The green curve corresponds to the Cy3-DNA signal recorded on the lower side of the centrifugation filter after 72 h at pH 7, while the blue curve corresponds to the PL signal recorded on the upper side of the filter. The violet curve corresponds to the PL of Cy3-DNA recovered on the lower side of the centrifuge filter (at pH 3.5, the dye signal is quenched). (B) Corresponding TEM characterization of the sample recovered on the upper side of the membrane. The IONPs released by the nanogels are retained on the upper side of the filter. In addition, the nanogel structure appears damaged after the simultaneous release of both cargo elements. (C) Confocal characterization of the release process: the image shown in C1 is obtained by merging the fluorescent and the phase contrast images of the same area of the nanogels loaded with IONPs and Cy3-DNA, before the release. C2 and C3 correspond, respectively, to the fluorescent and phase contrast images of the same areas of the filter. At and C5 correspond, respectively, to the fluorescent and phase contrast images of the same areas of the

Despite the confocal images were taken by working at the resolution limit of the confocal setup (hence the nanogel particles could not be focalized), on dilute solutions these fluorescent spots were colocalized with spots in the corresponding phase contrast images, and which could be ascribed to the nanogels (Figure 7B).

Additionally, under the same experimental conditions the TEM and DLS diameters of the nanogels simultaneously loaded with IONPs and Cy3-DNA were bigger than those of the corresponding nanogels loaded either with Cy3-DNA or with IONPs alone (Supporting Information Table 1S). As an example, the diameter of the loaded nanogel increased to  $250 \pm 50$  nm (by DLS) and the zeta potential became negative ( $-10.5 \pm 1.5$  mV). Additional PL characterization of the nanogels loaded with Cy3-DNA and IONPs was performed and confirmed the presence of DNA (Supporting Information Figure 6S).

In order to release the multicargo, the nanogels were first equilibrated at pH 3.5 in a solution containing 140 mM NaCl. To achieve complete release of the DNA from the nanogel, it was necessary to keep the nanogel at pH 3.5 for 72 h. After this time, we first separated the Cy3-DNA from the nanogel and IONP portions by using centrifuge filters. By choosing an appropriate pore size for the membrane, we could retain the IONPs and the nanogel on the upper side of the membrane, while molecules like Cy3-DNA (see inset Figure 8A) were able to pass through the membrane. By recording the PL spectra on the fraction collected at the bottom side of the membrane, we could verify the release of the oligonucleotides (Figure 8A). It is worth noting that after 24 h we could still record the fluorescent signal, not only on the lower part of the centrifuge tube, but also on the upper part of the membrane (data not shown). Only after 72 h was a complete release of the DNA achieved, since at this time no further PL signal was detected on the upper side of the membrane.

These data were also supported by confocal microscopy observations on the various aliquots that had been recovered from each side of the filter (Figure 8C). When both Cy3-DNA and the IONPs were packed within the nanogels, in the confocal fluorescence image the spots appeared point-like. In addition, they were colocalized with spots in the phase contrast image (Figure 8C1). After the complete release, on the upper side of the filter it was still possible to capture the phase contrast image of the nanogel, while no fluorescence could be recorded in the corresponding channel (Figure 8C4 and C5). The portion recovered from the lower part of the membrane still showed a fluorescent signal. This signal, however, was not clumped any more in pointlike regions, but was rather distributed homogeneously in the whole field of view. This could be interpreted as arising from the Cy3-DNA that had been released from the nanogels (Figure 8C3). In the corresponding phase contrast image, the nanogels could not be seen. TEM analysis of the part retained on the upper side of the filter indicated the presence of both released IONPs and nanogels, but the nanogels appeared disrupted in this case (Figure 8B). These findings are somehow unique, since in all previous experiments involving either DNA or IONPs, unloading the nanogels had retained their original shape. Apparently, the simultaneous release of both DNA and IONPs was responsible for this effect.

Such irreversible swelling during unloading of both DNA and IONPs deserved a deeper analysis. We tested therefore the effect of the pH on the swelling of nanogels (both with and without the cargo) by switching the pH of the medium from 8 to 3 and back. Swelling of the empty nanogels was reversible, since the curve describing their size dependence on the pH, when this was cycled from 3.5 to 8 and back, did not show any hysteresis (Figure 7S A, Supporting Information). These results are in agreement with previously published data.<sup>36</sup> A similar behavior was also observed in the case of nanogels loaded with IONPs (Figure 7S C, Supporting Information), while an appreciable hysteresis was recorded on the nanogels loaded with Cy3-DNA (Figure 7S B, Supporting Information).

The situation was drastically different when the nanogels were filled with both IONPs and Cy3-DNA (Figure 7S D, Supporting Information). This time the curve describing the size dependence on the pH, when this was increased from 3.5 to 8 (the "forward curve"), did not overlap with the corresponding curve when the pH was decreased from 8 back to 3.5 (the "backward curve"). Starting from pH 6, the nanogel size from the backward curve was always higher than that from the forward curve, pointing to a modification in the structure of the nanogel after it was used as cargo. These data, together with the TEM characterization, are indicative of the structural degradation of the nanogel after the simultaneous release of Cy3-DNA and IONPs (Figure 8).

For the quantification of DNA loaded within the nanogel, calibration curves of PL/[DNA] (photoluminescence/DNA concentration) were used (Figure 8S, Supporting Information). Using those curves, we found that, when only DNA was loaded within the nanogel, the amount of DNA that could be actually loaded corresponded to about 16% of the initial DNA added (which corresponded to an amount of DNA equal to 0.048 pmol/ $\mu$ L for 0.053 g weight of nanogels). On the other hand, the amount of DNA loaded in the case of simultaneously loading of DNA and IONPs was slightly higher and corresponded to about 20% of the initial DNA added (0.0623 pmol/ $\mu$ L of DNA for 0.053 g weight of nanogels).

**3.6.** Salt Effect on the Swelling of the Loaded Nanogels. The swelling behavior of the nanogel was affected by the presence of salt in solution (Figure 9). We report here only the data related to nanogels loaded with IONPs. At pH 8, for instance, the size of the loaded nanogels was not altered significantly by the presence of salt. At pH 7.4, on the other hand, the loaded nanogels in 100 mM and 200 mM NaCl solutions were bigger than those loaded in plain water, by about 50 and 70 nm, respectively. At pH 6.5, the loaded nanogels in 100 mM and 200 mM NaCl solutions were of salt in solutions were affected significantly by the presence of salt in solution, since an increase in size of 130 and 150 nm, respectively, as compared to the sample of nanogel in water was recorded.

At pH 3.9, the differences in size were even more remarkable: the nanogels loaded with IONP in 200 mM NaCl were again the biggest (their diameter was around 850 nm, which corresponded



Figure 9. Salt effect on the swelling behavior of nanogels loaded with IONPs in plain water (red curve), 100 mM NaCl (blue curve), and 200 mM NaCl (violet curve).

almost to their swelling limit), followed by those loaded at 100 mM (529 nm), and was still 373 nm for the nanogel in water.

It has been reported by others<sup>40</sup> that on the vinyl pyridinedivinyl benzene-based nanogels, the addition of salts reduces the screening effect of the charges, resulting in a reduced swelling of the nanogels. The higher the amount of salt added, the stronger the screening effect is, and thus the lower the extent of swelling of the nanogel. Also, in our case, when the nanogels were loaded with IONPs, the swelling behavior in the presence of salt had a trend in the pH range from 7 to 4.2 that was similar to that of previous reports. Namely, the addition of 200 mM NaCl resulted in a reduced swelling with respect to 100 mM. The difference occurred for the swelling of the IONP-loaded nanogel below 4.2 in 200 mM, which is bigger than that in 100 mM. The IONPs have charged groups at their surface, and those groups can coordinate counterions in their surroundings. This results in a high local ionic strength that can break the nanogel structure and consequently increase the DLS diameter of the polymer. This behavior has been confirmed by TEM images of the nanogel under these conditions (data not shown).

The different diameters of the nanogels in a solution 100 mM NaCl indicate that the leaking of the IONPs occurred already at pH close to 6.5 (which is actually the pH of the extracellular tumor environment), while no appreciable leakage was observed at pH 7.4 (which is the pH of the blood) (Figure 9).

#### 4. Conclusions

In this work, we have reported the fabrication of a multivalent nanosystem based on a class of functional molecules known as stimuli responsive polymers, which can work as cargo system for gene (or drug) delivery, and which can entrap at the same time inorganic magnetic nanoparticles. Differently from previously reported studies, the magnetic nanoparticles in this work are not covalently linked to the gel networks, and thus they can be loaded and released by tuning the pH. The full characterization provided when only DNA or IONPs or a combination of them were employed has allowed us to understand both the mechanism by which the different payloads are retained within the gel and the release process as a function of the pH and of the salt concentration.

The system developed in this work, especially in the case when both DNA and IONPs have been loaded, has interesting features and might find application as a therapeutic agent. It can act as a heat mediator for performing hyperthermia, as gene delivery system (for instance in si-RNA treatment), and at the same time

<sup>(40)</sup> Fujii, S.; Dupin, D.; Araki, T.; Armes, S. P.; Ade, H. Langmuir 2009, 25, 2588.

as an imaging contrast agent in MRI. The magnetic nanocarriers developed appear to have the right geometry for performing those tasks. Preliminary studies by other groups  $4^{1-43}$  have shown indeed that clustering of IONPs (like in our case when they are loaded in the nanogels) improves the relaxivity signals recorded with respect to individual magnetic nanoparticles. On the other hand, hyperthermia seems more efficient when the magnetic nanoparticles are not encapsulated within a matrix, but they are freely delivered to a certain target site.<sup>29</sup> Our system appears to have the right features for such purposes. When circulating in a medium with pH below 7.4, like blood, the nanogels will be in a packed configuration, allowing for a better enhancement of the MRI signal form the IONPs. On the other hand, once the nanogels will be delivered to a compartment with a pH below 6.5, like the extracellular tumor environment, they would begin to swell, and thus they would release the IONPs. The hyperthermia treatment could be therefore performed on the IONPs, once they will be delivered into the extracellular tumor environment, where the pH is around 6.5. The further uptake by tumor cells would allow the system to experience the different pH of the intracellular compartments. For such a purpose, cellular studies are now under investigation in our laboratory.

Additionally, it is worth noting that the nanogels developed by us could also work as a targeting tool to deliver the payload with a spatial and temporal control. The presence of magnetic nanoparticles allows spatially controlled delivery, since the nanogels feel an externally applied magnetic field and thus might be attracted to specific locations of the body, where the magnetic field will be placed. Temporally controlled delivery will be ensured by the variations in pH that the nanogels will sequentially experience during their journey (hence by the response of the nanogels to these variations) in the various body/cellular compartments. The synergy between both effects might allow a more efficient delivery of the nanogel cargos.

Acknowledgment. This work was supported in part by the European project Magnifyco (Contract NMP4-SL-2009-228622). We thank Mario Malerba for TEM sample preparation and Sergio Marras for helpful discussion.

**Supporting Information Available:** Experimental details; two tables summarizing the DLS and TEM diameters and the zeta potential measurements; additional TEM characterization images of the nanogels, additional PL and absorption measurements of the nanocarriers and swelling behavior of different loaded nanogel solution in the decreasing and increasing pH profiles; PL/[Cy3-DNA] calibration curves. This material is available free of charge via the Internet at http://pubs.acs.org.

<sup>(41)</sup> Nasongkla, N.; Bey, E.; Ren, J. M.; Ai, H.; Khemtong, C.; Guthi, J. S.; Chin, S. F.; Sherry, A. D.; Boothman, D. A.; Gao, J. M. Nano Lett. 2006, 6, 2427. (42) Taboada, E.; Solanas, R.; Rodriguez, E.; Weissleder, R.; Roig, A. Adv. Funct. Mater. 2009, 19, 2319.

<sup>(43)</sup> Fresnais, J.; Berret, J. F.; Petesic, B. F.; Sandre, O.; Perzynski, R. Adv. Mater. 2008, 20, 1.

Nano Select / Volume 2, Issue 12 / p. 2291-2307

REVIEW 🛛 🔂 Open Access 🛛 😨 🚺

## Multi-functional magnetic hydrogel: Design strategies and applications

Fangli Gang 🔀, Le Jiang, Yi Xiao, Jiwen Zhang, Xiaodan Sun 🔀

First published: 06 May 2021 https://doi.org/10.1002/nano.202100139

## Abstract

Hydrogel is one of the hottest biomaterials in recent years. Especially, magnetic hydrogels (MHs) prepared by combining unique magnetic nanoparticles (MNPs) with hydrogels have attracted wide attention due to their excellent biocompatibility, mechanical properties, absorbability and rich magnetic properties (magnetocaloric, magnetic resonance imaging and intelligent response, etc.). However, the current literature mainly focuses on the application of MHs, without fully understanding the relationship between the design strategies and applications of each function in MHs. This review highlights six major functional properties of MHs, including mechanical properties, adsorption, magnetocaloric effect, magnetic resonance (MR) imaging, intelligent response and biocompatibility. Principles and design strategies of each performance are thoroughly analyzed. Furthermore, the latest applications of MHs in biomedicine, soft actuators, environmental protection, chemistry and engineering in recent 5 years are introduced from the perspective of each function. In the carefully selected representative cases, the design strategies and application principle of multi-functional MHs are detailed, respectively. The classical fabrication processing of MHs is summarized. At last, we discuss the unmet needs and potential future challenges in MHs development and highlight its emerging strategies.

# **1 INTRODUCTION**

Hydrogels are a highly swollen three-dimensional (3D) polymer networks synthesized by hydrophilic monomers, which can be considered as polymer-reinforced water. Hydrogels with unique physicochemical properties, such as excellent softness, water content, biocompatibility, bioactivity, etc., provide a strong candidate material for many fields including biomedical and environmental engineering.<sup>[1]</sup> Various biomimetic hydrogels have been developed to mimic natural hydration microenvironments and successfully applied in tissue engineering and cancer treatment.<sup>[2]</sup> Hydrogels with specific microstructures (anisotropic, tubular, etc.) have also been developed to deliver drugs/cells and provide three-dimensional biochemical

microenvironments for supporting cell growth.<sup>[3]</sup> Despite great progress has been made, conventional hydrogel systems still have some limitation. In particular, insufficient functionality severely limits its practical application potential in many fields. Therefore, it is a hot research topic to endow hydrogels with functionality.

With the rapid development of permanent magnet materials and electromagnetic technology, magnetic field as an important physical field is widely used in scientific research. The magnetic field can provide a feasible and flexible strategy for inducing the functionality of hydrogels. Thus, MHs composed of magnetic particles (γ-Fe<sub>2</sub>O<sub>3</sub>, Fe<sub>3</sub>O<sub>4</sub>, etc.) and hydrogel matrix have attracted more and more attention for their biocompatibility, controllable structure, high adsorption and rich magnetic properties (magnetocaloric, MR imaging and intelligent response, etc.).<sup>[4]</sup> For example, MNPs endow hydrogels with remotely controllable characteristics, which can be used in drug delivery,<sup>[5]</sup> local hyperthermia,<sup>[6]</sup> magnetic/thermal drive,<sup>[7]</sup> tissue image enhancement,<sup>[8]</sup> adsorption, separation and purification,<sup>[9]</sup> and so on. In addition, stimulus-responsive MHs have broad application prospects in soft robot.<sup>[10]</sup>

As everyone knows, the versatility of materials will enrich their potential in practical applications. In turn, different applications can also dictate the material desired properties. Therefore, in this paper, from the design concepts and application strategies of multi-functional MHs (Figure 1), we review the latest research progress on MHs. Six main functional properties of MHs are highlighted: mechanical properties, adsorption, magnetocaloric effects, MR imaging, intelligent response and biocompatibility. Focusing on its specific functions, the potential applications of MHs in biomedicine, environmental protection, soft actuators, chemical catalysis and engineering are further analyzed. Finally, the common preparation methods of multi-functional MHs are systematically reviewed.



**FIGURE 1** 

Open in figure viewer **PowerPoint** 

Schematic illustration of multifunctional MHs and their applications

# 2 DESIGN STRATEGIES AND APPLICATIONS FOR MULTIPLE FUNCTIONALITIES OF MAGNETIC HYDROGELS

MHs are generally formed by the interaction between magnetic components (γ-Fe<sub>2</sub>O<sub>3</sub>, Fe<sub>3</sub>O<sub>4</sub>, etc.) and hydrogel matrix through non-covalent or covalent bonds. This combination simultaneously absorbs the advantages of hydrogel (high water content, flexibility, etc.) and magnetic particles (smart response, etc.). There are differences in raw material selection, design strategies and application fields of MHs with specific performance. For example, in most literatures, the composite MNPs in MHs are generally spherical nanoparticles with a diameter of 1~20 nm, and some MNPs with significant magnetocaloric effect have a ring shape.<sup>[11]</sup> Biomedical MHs focuses on biocompatible hydrogel matrix, while engineering application MHs uses cheap and readily available materials. Therefore, it is of great significance to study MHs

from the six functions of mechanical properties, adsorption, magnetocaloric effect, magnetic resonance imaging, intelligent response and biocompatibility.

In general, the good dispersity of MNPs in the matrix is the fundamental factor in preparing high-performance composite gels. However, most MNPs have a high specific surface area and can easily agglomerate (Figure 2A). The MHs obtained by simply compounding MNPs and hydrogel matrix often exhibits uneven network structure and unstable properties. Notably, the introduction of functionalized MNPs or special hydrogels components can effectively solve these problems. Both of these aims to increase the dispersity and crosslinking degree of the MNPs in the hydrogels (Figure <u>2B,C</u>). The difference is that the former focuses on the modification of MNPs (Fe<sub>3</sub>O<sub>4</sub>, MnFe<sub>2</sub>O<sub>4</sub>, etc.), mainly including increasing functional groups (e.g., carboxylic groups),<sup>[12]</sup> chemical loading,<sup>[13]</sup> coating (e.g., tannic acid),<sup>[14]</sup> etc. While the latter usually selects specific hydrogel components with a large number of active functional groups (carboxyl, hydroxyl, etc.), which can coordinate with Fe ions and easily gelled. Polyacrylamide,<sup>[15]</sup> polyvinyl alcohol,<sup>[16]</sup> hyaluronic acid,<sup>[17]</sup> fibrin,<sup>[18]</sup> and nano-cellulose are commonly used MHs with high coordination activity. The MHs obtained by these two methods have uniform structure, stable performance and enhanced mechanical properties. Under the action of long-range magnetic field, functional MNPs exhibit remarkable intelligent response (mobility), magnetocaloric effect and MR imageability. The hydrogel matrix, as a structural and mechanical support, is also affected by MNPs to produce corresponding behaviors, including deformation, movement, thermogenesis and MR imaging. By regulating the types or proportions of MNPs and hydrogel matrix to control multiple functions of MHs, so as to promote its fascinating application prospects in different fields.



**FIGURE 2** 

#### Open in tigure viewer | **★**PowerPoint

Design strategies of MHs. Structure and properties of MHs prepared by A, MNPs + hydrogel, B, functionalized MNPs + hydrogel and C, MNPs + special hydrogel

## 2.1 Mechanical properties

Mechanical property is a set of commonly used indexes, which is the resistance to failure of materials under load (such as tension, compression, torsion, impact, cyclic load, etc.). Generally, the mechanical properties of hydrogels mainly include strength, stiffness, toughness and fatigue strength. For hydrogels, their mechanical properties determine their usage and service life.

At present, there are mainly four ways to improve the mechanical properties of hydrogels: (1) the "sacrifice bond" is introduced to dissipate energy effectively, thereby enhancing the mechanical properties of hydrogels. A variety of non-covalent interactions such as hydrogen bonding, complexation, supramolecular recognition and hydrophobic association have been applied to prepare high-strength hydrogel.<sup>[19]</sup> The most representative example is double network hydrogels. (2) The "pulley effect" is used to reduce the internal stress in the crosslinking network and greatly enhance the mechanical properties of the hydrogels. Topological hydrogel is a kind of material with high strength by using O-shaped crosslinking ring which can slide freely on the polymer chain as a controllable crosslinking point.<sup>[20]</sup> (3) the fracture and reconstruction of some reversible non-covalent bonds will also give hydrogels high-strength,<sup>[21]</sup> while providing certain recoverability and self-healing properties. (4) The introduction of nanoparticles has been shown to significantly alter hydrogel mechanical properties.<sup>[22]</sup> This paper focuses on MNPs composite hydrogel materials. On the one hand, the rigid MNPs can not only improve the compression modulus, storage modulus and thermal stability of the composite hydrogel, but also adjust the water absorption, retention, saturation magnetization and pore size of the MHs by changing its content. On the other hand, the reversible interaction between MNPs and hydrogel components can endow MHs with good self-healing, thermal stability, shear-thinning, and mechanical properties (rigidity and viscoelasticity). Therefore, the design and application of high-performance MHs with intrinsic magnetism have received much attention from scientists.

High-strength MHs, as an important branch of nanocomposite hydrogels, have important applications in biomedical and soft actuators.<sup>[23]</sup> Biomaterials are a promising strategy for repairing damaged or diseased tissue. In general, in order to ensure the clinical safety of biomaterials, rigorous in vitro biological evaluation must be carried out in advance. In vitro simulation, hydrogels can be used as mechanical support for cell growth and differentiation. Unlike most in vitro cell culture 2D substrates (petri dishes, porous plates), hydrogels provide a 3D microenvironmental cell experience,<sup>[24]</sup> better mimicking the in vivo biological environment.

Up to now, a variety of MHs have been used as multi-functional in vitro culture platform to explore the effects of different conditions (e.g., magnetic field and hyperthermia) on cell function and morphology.<sup>[25]</sup> Gu et al. reported a magnetic polyacrylamide hydrogel with cell adhesion microarray interface,<sup>[25]</sup> which can effectively promote the formation of multicellular spheroids. It is considered as a prevailing tool to study the microenvironmental regulation of therapeutic problems and tumor cell physiology. In addition, as a polymer material most similar to biological tissue, hydrogels can be used as scaffolds for tissue engineering to repair or replace damaged tissues. As one of the three key elements of tissue engineering, it is very important for scaffolds to have excellent mechanical properties. In particular, for osteochondral repair materials, excellent compressive and anti-fatigue properties ensure that they can withstand repeated mechanical stress without being damaged, so as to steadily continue to exercise their biological functions. However, it is still a great challenge to develop MHs that match the mechanical properties of normal tissues for repairing osteochondral defects in situ.

# 2.2 Adsorption

As a highly absorbent and high water-retaining material, 3D network hydrogels have been widely applied in many fields, such as food preservation, drought resistance in arid areas. Moreover, hydrogels have a broad application prospect in wastewater treatment by virtue of their high adsorption capacity.<sup>[26]</sup> Heavy metals (Pb, Cu, Cs, etc.), organic compounds (pesticides, etc.) and dyes are all water pollutants causing worldwide environmental problems. These pollutants are non-biodegradable, carcinogenic and highly toxic and should be removed from wastewater prior to disposal. Compared with traditional hydrogels, MHs, as an environment-friendly 3D nanomaterial with high physical strength, high adsorption rate and renewability, has attracted increasing attention in wastewater treatment.<sup>[27]</sup> As shown in Table <u>1</u>, the combination of magnetic additives (such as magnetite) and hydrogel matrix can simultaneously adsorb contaminants such as heavy metal ions and dyes. Some MHs have a removal rate of more than 99.5%. Moreover, the optimized MHs has high-sensitivity, high-selectivity, fast-adsorption and reusability.

**TABLE 1.** Typical examples of magnetic hydrogels successfully applied in the removal of heavy metals, organic compounds, inorganic salts and dyes

Magnetic additive	Hydrogel matrix	Contaminant	Remarks <sup>a</sup>	Ref.	

Magnetic additive	Hydrogel matrix	Contaminant	Remarks <sup><i>a</i></sup>	Ref.	
		and congo red)	g <sup>-1</sup> congo red		
lron oxide nanoparticles	Prussian blue/polyvinyl alcohol	<sup>137</sup> Cs	Excellent selectivity, high removal efficiency (>99.5%)	[29]	
γ-Fe <sub>2</sub> O <sub>3</sub>	(3- acrylamiddopropyl) trimethylammonium chloride/lanthanum nitrate	Fluoride	q <sub>max</sub> = 136.78 ± 2.19 mg g <sup>-1</sup> , the adsorption capacity reaches 93% in 10 minutes, better fluoride adsorption at low pH (2.8-4.0)	[30]	
Graphene oxide/magnetite	Ascorbic acid	Au(CN) <sup>2–</sup>	q <sub>max</sub> = 309 mg g <sup>-1</sup> , the spent hydrogel could be easily collected using a magnetic separator	[31]	
Fe <sub>3</sub> O <sub>4</sub>	Xylan/poly(acrylic	Methylene	q <sub>max</sub> = 438.60 mg g <sup>-1</sup> , porous structure,	[32]	

<sup>a</sup> (n cycle refers to the adsorption/desorption cycle n times, and qmax refers to the maximum adsorption capacity).

The adsorption principle of MHs is shown in Figure <u>3A</u>. Porous hydrogels containing active functional groups such as carboxyl, hydroxyl and amino groups can act as adsorbents to remove contaminants through electrostatic, ionic exchange or complexation with contaminants such as heavy metal ions. More importantly, the incorporation of MNPs can promote the separation, collection and reuse of hydrogel adsorbents,<sup>[42]</sup> and also have a positive effect on the adsorption of MHs (Figure <u>3B-D</u>).<sup>[43]</sup> The main results are as follows: (1) MNPs embedded in MHs can increase the cross-linking degree and porosity of the system, providing a channel for the entry, exit and adsorption of some substances. (2) When the amount of MNPs is in a certain range, the adsorption amount of MHs is positively correlated with the amount of MNPs. The reason is that with the increase of MNPs addition, the surface of the hydrogel becomes rougher, which can increase the surface area and adsorption capacity of MHs. However, once the amount of MNPs exceeds a certain value, the saturation absorptivity of MHs will decrease unexpectedly. This may be attributed to the excessive coordination of the active groups in the hydrogel system with MNPs, resulting in a decrease in the number of free active groups and insufficient binding to pollutants.<sup>[44]</sup>



## **FIGURE 3**

Open in figure viewer **PowerPoint** 

A, Schematic diagram of removing contaminants from wastewater using MHs. B, MHs with different Fe<sub>3</sub>O<sub>4</sub> contents. C, SEM images of different MHs. D, Adsorption kinetics of Cr<sup>VI</sup>on the MHs adsorbent. Reprinted with permission.<sup>[44]</sup> Copyright 2018, Elsevier

The complete adsorption process of MHs is described in Figure <u>4</u>. First, the prepared MHs were added to the treated wastewater, and the complete adsorption was guaranteed by shaken in an end-over-end manner. Then, under the assistance of magnets, magnetic separation is carried out on contaminants-loaded hydrogel. In this way, treated water and renewable hydrogels are obtained. The reutilization of MHs requires regeneration solution to desorb the contaminants on the hydrogel, and then magnetic separation to obtain reusable adsorption materials. The realization of this process is attributed to the large surface area, multiple adsorption (hydrogen bond, hydrophobic interaction, etc.), suitable pore size distribution and paramagnetism of MHs. Therefore, MHs can be considered as a low-cost, efficient and recyclable adsorbent, and have great attraction and broadly applicable in wastewater treatment.



## **FIGURE 4**

Open in figure viewer **PowerPoint** 

The process flow chart of removing contaminants from wastewater using MHs

Because magnetic separation methods can selectively recover the desired proteins from biological fluids, MHs materials have been extensively studied in protein separation.<sup>[45]</sup> For biomedical applications, especially tissue engineering, the tendency of hydrogel to adsorb protein in biological media should be considered as an important characteristic. It has been demonstrated that magnetic apatite nanoparticles introduced into poly(vinyl alcohol) (PVA)/sodium alginate hydrogel could generate magnetic response and enhance hydrogels.<sup>[46]</sup> When pH = 4.5, the maximum adsorption capacity of nano-beads for bovine serum albumin was the highest, reaching 127.3 mg·g<sup>-1</sup>. In addition to the above applications, the absorbability of MHs could also be used for enzyme immobilization,<sup>[47]</sup> dehydrators,<sup>[48]</sup> data storage,<sup>[49]</sup> moisture transport,<sup>[50]</sup> and so on.

# 2.3 Magnetocaloric effects

Magnetocaloric effect refers to the phenomenon that the magnetic energy is transferred to the particles in the form of heat when the ferromagnet or paramagnetism is placed in the alternating magnetic field (AMF) and the magnetic direction is randomly transformed between parallel and anti-parallel. This phenomenon can be used to destroy morbid cells in organisms and control drug release. As a common magnetocaloric agent, superparamagnetic iron oxide (SPIOs) nanoparticles have obtained considerable development in tumor ablation. However, SPIOs have shortcomings such as short residence time in vivo, limited timeliness, and many injections. Notably, the magnetic particles were incorporated into hydrogels will greatly prolong the residence time in vivo. Not only that, hydrogel matrix with a 3D internal network microstructure, high water content and biocompatibility, which are analogous with those of the natural tissue, plays a key role in the application of MHs. On the one hand, hydrogel matrix provides a microenvironment for magnetocaloric therapy,<sup>[51]</sup> effectively avoiding heat damage to normal tissues, and provides adjustable 3D scaffolds for cell adhesion, migration and differentiation.<sup>[52]</sup> On the other hand, injectable hydrogels with pores or microchannels are one

of the best candidates for local drug delivery.<sup>[53]</sup> The magnetocaloric effect of MHs can be designed to sustain and control the release of one or more combined therapeutic drugs. Studies demonstrated that the anisotropic magnetic coupling inside the gel is the main reason for the thermogenesis of MHs. Moreover, compared with the disordered MHs, the self-assembled oriented MHs has stronger thermogenesis.<sup>[54]</sup>

The practical application of MHs magnetocaloric effect is mainly reflected in biomedicine, including tumor treatment and tissue repair. Surgery is currently one of the most common methods for solid tumor treatment. However, wound infection and postoperative recurrence are major challenges facing the surgical treatment of solid tumors. Neoadjuvant and postoperative adjuvant therapies play an important role in improving the prognosis of patients. MHs have been applied to target tumors by remote heating with an external magnetic field and controlled release of anticancer drugs from hydrogels for cancer therapy.<sup>[55]</sup> Compared with photothermal therapy, magnetocaloric therapy has unlimited tissue penetration depth and is effective for deep-seated tumors such as liver cancer and glioma. Moreover, an AMF-triggered delivery system enables on-demand drug delivery with more effective anticancer chemotherapy effects. However, increasing the efficacy of 42°C therapeutic temperature without resistance to induced thermal stress has been a challenge. Therefore, Zhang et al. designed an injectable magnetic hydrogel nano-enzyme (MHZ) utilizing the inclusion interaction between α-cyclodextrin and PEGylated nanoparticles.<sup>[56]</sup> Employing this hydrogel could improve the tumor oxidative stress level by generating reactive oxygen species via nanozyme catalyzed reaction based on hyperthermia (Figure 5). Magnetic Fe<sub>3</sub>O<sub>4</sub> nanoparticles play a dual role of nanozymes and magnetic heating simultaneously in the hydrogel system. On the one hand, the magneto-heat generated after MHZ injection into tumor tissue promoted Fe<sub>3</sub>O<sub>4</sub> nanozymes to produce more ·OH. On the other hand, ·OH further damages the highly expressed protective heat shock protein 70 in hyperthermia, thereby improving the efficacy of hyperthermia. As such, this MHs exerts dual functions of catalytic therapy and hyperthermia to synergistically treat tumors and overcome the resistance of tumor cells to induced thermal stress. This developed system offers a universal platform for safer and precise synergistic therapy of solid tumors.



## **FIGURE 5**

Open in figure viewer PowerPoint

Schematic diagram of enhanced tumor synergistic therapy by injectable MHZ.<sup>[42]</sup> A, Synthetic procedure for MHZ. B, The synergistic mechanism of MHZ on the generation of hyperthermia and ROS for cancer therapy. Reprinted with permission. <sup>[42]</sup> Copyright 2019, American Chemical Society

In the past decade, the combination of hyperthermia-based physical therapy and biomaterials has exhibited significant potential in tissue repair. In vitro cell experiments have proved that mild thermal stimulation could effectively promote osteochondral repair.<sup>[57]</sup> Further in vivo experiments are yet to be studied. In addition, hyperthermia plays an important role in inhibiting local inflammatory response, relieving pain and protecting joint function.<sup>[58]</sup> Therefore, hydrogels with magnetothermal effect can be expected to have great application prospects in the treatment of rheumatoid arthritis and osteoarthritis.

It is worth mentioning that the superior magnetocaloric effect of MHs is conducive to develop discoloration hydrogel,<sup>[59]</sup> which may provide a new platform for color display. This remarkable magnetochromatic property is attributed to the superior magnetocaloric effect of 1D magnetic chain immobilized in a thermosensitive hydrogel. Under an AMF, the magnetocaloric effect of aggregated magnetic chains leads to hydrophilic–hydrophobic transition of the hydrogel, which reduces the inter-particle distance of the 1D magnetic chains and results in a blueshift of the diffraction wavelength. Thus, the MHs also shows the potential to monitor magnetic hyperthermia with significant changes in its color and appearance.

# 2.4 MR imaging

11/33

Non-invasive imaging is a powerful tool that can provide effective feedback for clinical diagnosis. MR imaging has become one of the most powerful detection methods in contemporary clinical diagnosis due to its characteristics such as safety, functional sequence diversity, good soft tissue contrast and penetration depth. However, in practical application, the relaxation time of different tissues or tumors overlaps with each other, which leads to the diagnosis difficult. Therefore, the contrast agent began to be studied in order to enhance the signal contrast and improve the image resolution. Due to its biocompatibility and superparamagnetism, Fe<sub>3</sub>O<sub>4</sub>-based superparamagnetic contrast agents are widely used in cancer detection, drug delivery monitoring and stent implantation labeling. Significantly, the incorporation of magnetic particles with MR imaging into the hydrogel system will endow the gels a good imaging capability.<sup>[60]</sup> This non-invasive imaging of materials could provide effective feedback for the real-time degradation of biomaterials and the remodeling of new tissues in vivo.<sup>[61]</sup> Moreover, non-invasive monitoring methods help to reduce the number of experimental subjects. The reason is that the experimental data can be obtained repeatedly to avoid unnecessary sacrifice in histological analysis at different time points. In addition, noninvasive continuous observation will provide more effective information, reduce individual differences, and contribute to the clinical transformation of tissue engineering.

For the first time, Chen developed a functional, visualizable superparamagnetic iron oxide (USPIO)-labeled natural hydrogel system for semi-quantitative monitoring the cartilage degradation process and elucidated the regeneration of hyaline cartilage by multiparametric MRI.<sup>[62]</sup> USPIO particles with diameter of  $\sim$ 15.7 ± 2.0 nm and a concentration less than 25 µg Fe/mL had no effect on chondrogenesis and cell proliferation of human bone marrow mesenchymal stem cells (hBMSCs).<sup>[63]</sup> In this experiment, cellulose nanocrystal (CNC)/silk fibroin (SF) blend hydrogel was selected as scaffold for tissue engineering to promote cartilage regeneration. It has a moderate degradation rate to coincide with cartilage regeneration, which is essential to maintain the structural integrity and mechanical properties of the joint. As shown in Figure 6A, the USPIO-labeled CNC/SF hydrogel has an interconnected network structure and uniform porosity. Prussian blue staining exhibited that USPIO was evenly distributed in the hydrogel matrix, and the material showed no obvious cytotoxicity. This biocompatible hydrogel with pore sizes ranging from 70 to 250 µm, are effective in promoting cartilage formation.<sup>[64]</sup> Next, MRI characterization of the composite hydrogel was performed with T2-weighted imaging (T2WI) sequence, indicating that the signal contrast of the prepared hydrogel increased with USPIO content. In vivo MR imaging further demonstrated that the USPIO-labeled hydrogel had sufficient MR contrast to monitor the degradation process (Figure 6D). Therefore, this system may provide meaningful insights for non-invasive monitoring and therapeutic efficacy of implanted hydrogels in tissue engineering.



#### **FIGURE 6**

#### Open in figure viewer

PowerPoint

Non-invasive monitoring of hydrogel degradation by multiparametric MR imaging.<sup>[62]</sup> A, In vitro SEM observation, MRI characterization and Prussian blue staining of CNC/SF hydrogels incorporated USPIO. B, R2 and R2\* relaxometry rates and (C) cytotoxicity of USPIO-labeled hydrogel. D, MRI analysis of the in vivo degradation of non-labeled and USPIO-labeled CNC/SF hydrogels in a rabbit cartilage defect model. Reproduced with permission.<sup>[62]</sup> Copyright 2018, lvyspring International Publisher

## 2.5 Intelligent response

Smart hydrogel is a kind of material that can perceive small physical/chemical stimuli (such as temperature, light, magnetism, pH) and make significant response behaviors.<sup>[65]</sup> Because of this intelligence, hydrogel has a fascinating application prospect in tissue engineering, drugcontrolled release and soft actuators. Especially, as an external stimulus of stimulus-responsive materials, magnetic field has the advantages of instant action, contactless control and easy

integration into electronic devices. Therefore, the research and development of smart MHs has been very active in recent years.<sup>[66]</sup>

Over the past few decades, tissue engineering has been successfully applied to the repair of various tissues (retinas, ligaments, fats, blood vessels, etc.). With the potential of hydrogel to construct microenvironment, the scaffolds based on multi-functional MHs have attracted much attention due to their intelligence. On the one hand, under the guidance of magnetic field, MHs can move directionally or be induced into specific tissue-like microstructure,<sup>[67]</sup> providing a suitable growth environment for tissue reconstruction. Schmidt proposed a novel magnetic templating technology which can induce highly aligned 3D tubular microstructures in naturally derived hydrogel scaffolds.<sup>[68]</sup> The scaffold was constructed by adding soluble magnetic alginate particles (MAM) containing nano-iron oxide to the hydrogel precursor solution. The diameter of MAM is 100 nm~20 µm, and a concentration of 5 mg mL<sup>-1</sup> of MAM is the upperlimit allowing for optimal chain length on the millimeter scale. Under an external magnetic field, the gel forms an aligned columnar structure (Figure 7A). The removal of MAM results in scaffolds with aligned tubular microarchitectures that can facilitate cell remodeling in various applications. Moreover, the hydrogels with electromagnetic effects can realize the above functions, while constructing electric microenvironment under external electrical stimulation to simulate directional tissue, guide cell proliferation and tissue regeneration.<sup>[69]</sup> On the other hand, magnetic scaffolds can control the biological behavior of cells through the magnetic response between MNPs and magnetic field<sup>[70]</sup>; thus, promoting revascularization, cartilage/bone regeneration,<sup>[71]</sup> neuroregulation,<sup>[72]</sup> and wound repair.<sup>[67]</sup> Carlo et al. described a 3D magnetic hyaluronic hydrogel that provides non-invasive neuromodulation by magnetomechanically stimulating primary dorsal root ganglion (DRG) neurons (Figure 7B).<sup>[73]</sup> Mechanosensitive PIEZO2 channel is activated by magnetic particles embedded in the system through membrane stretching. Mechanosensitive TRPV4 channel is activated by magnetically induced deformation of HA hydrogel. Under acute magneto-mechanical stimulation, calcium influx in DRG neurons is induced through TRPV4 and piezo2 channels, avoiding the step of exogenous ion channel transfection.<sup>[74]</sup> Under chronic magneto-mechanical stimulation, is able to reduce piezo2 channel expression, playing a role in chronic pain modulation. This general strategy offers a way to achieve remote magnetic modulation of different types of excitable cells through 3D magnetic biomaterials.



### **FIGURE 7**

### Open in figure viewer **PowerPoint**

A, Macroscopic view of crosslinked hydrogel, and porous microarchitecture after removal of MAM.<sup>[68]</sup> Copyright 2020, IOP Publishing Ltd. B, Mechanism of magneto-mechanical stimulation of dorsal root ganglion neurons by magnetic hyaluronic acid (HA) hydrogels.<sup>[73]</sup> Copyright 2018, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim.

Another important application of smart soft material is soft robot. The advent of soft robots has made great strides in robotics, wearable devices and other areas by using complete software systems that can safely interact with any random surface while provide excellent mechanical flexibility. The latest development in soft robotics have benefited from advances in soft actuators and sensors that enable robots to work mechanically unimpeded; thus, expanding the range of robotic applications.<sup>[75]</sup> Soft actuator generally refers to a soft body that can reliably adapt to any surface and cause various motions of the robot. Up to now, many attempts have been made to fabricate soft actuators sensitive to external stimuli.<sup>[76]</sup> Especially, MHs with flexibility and sensitivity to external magnetic fields are expected to form a new research focus in the coming era of soft robots.<sup>[77]</sup> What is more, taking advantage of the

minimal invasions and the drive ability to use magnetic fields of magnetic microrobots, therapeutic drugs can be delivered to target areas.<sup>[78]</sup> This controlled release method can significantly reduce the dosage and minimize the side effects on normal cells. Sukho park presented a novel hydrogel actuator (Figure **8**),<sup>[79]</sup> which can deliver anticancer drugs to cancer targets through a customized near-infrared (NIR) and electromagnetic actuation (EMA) integrated system, then retrieve problematic MNPs. First, the microrobot reaches the predetermined lesion target through the magnetic field of EMA. Next, after the NIR irradiation, the hydrogel matrix was decomposed, drug particles and MNPs were left in the target tissue. Finally, with the assistance of EMA magnetic field, the disassembled MNPs were recovered from the target region, and the remaining anticancer drugs are continuously released to generate therapeutic effects. This hydrogel actuator can compensate for the inherent disadvantages of MNPs (toxicity) by retrieval of MNPs, thereby maintaining the advantages of electromagnetic drive (target characteristics and drug delivery). In the future, developing a practical drug delivery hydrogel robot is an attractive topic.



## **FIGURE 8**

### Open in figure viewer **PowerPoint**

Schematic diagram of the treatment process using retrievable biodegradable hydrogel microrobot for drug delivery. Reproduced with permission.<sup>[79]</sup> Copyright 2019, Elsevier

# 2.6 Biocompatibility

Biocompatibility refers to the degree of compatibility of materials with human body after implantation, that is, whether they will cause toxic effects on human tissues. It mainly includes blood compatibility and histocompatibility. Blood compatibility refers to the ability of materials to interact with blood directly without causing coagulation, thrombosis, damaging blood composition and function. Hydrogel directly contacting blood requires good blood compatibility, such as hemostatic dressing.<sup>[80]</sup> Histocompatibility is the affinity between materials and tissues without being eroded by tissues when they come into contact with organs. Tissue engineering and regenerative medicine research put more emphasis on the histocompatibility and cytocompatibility of hydrogels.<sup>[81]</sup> Generally, strict biocompatibility evaluation is required first to ensure the clinical safety of biomaterials. At present, the biocompatibility evaluation of hydrogels is mainly from the following aspects: cytotoxicity, hemolysis test, acute systemic toxicity, subacute toxicity test, implant test evaluation and so on.

In recent years, MHs find widespread applications in biomedical fields due to their similar structure to native extracellular matrix, hydrated environment, tunable properties (mechanical, biocompatibility) and unique active response characteristics. Fibrin, chitosan, hyaluronic acid, collagen and other natural biomaterials are the preferred raw materials for preparing medical MHs hydrogel matrix.<sup>[82]</sup> The reason is that they have excellent biocompatibility, low toxicity, enzyme degradation and degradation products are not easy to trigger immune response. Some compounds are decomposed into small molecules (water, carbon dioxide, etc.) that can be metabolized by human body, such as polyglycolic acid. Therefore, these compounds can also be widely used in the synthesis of biocompatible MHs. In addition, the concentration of MNPs in most MHs is generally less than 1 wt.%, but it has a positive effect on cells. Huang has proposed that the existence of magnetic Fe<sub>3</sub>O<sub>4</sub> nanoparticles can promote the growth of stem cells and accelerate the cell cycle process.<sup>[83]</sup> When MNPs are incorporated into the scaffold, their magnetic field effect may affect ion channels on cell membrane and initiate changes in cytoskeleton structure.<sup>[84]</sup> However, the biosafety issues related to MNPs is the impact of MNPs released from the degradation of implanted MHs. In general, MNPs (1~20 nm in diameter) selected for preparing MHs can be absorbed by the interaction with proteins and cells. They can then distribute to different organs, where they may stay in the same nanostructure or be metabolized.<sup>[85]</sup>

Liu and his colleagues created a magnetic hydrogel (MagGel) containing type II collagen, hyaluronic acid and polyethylene glycol to provide a biomimetic, bioactive and biodegradable platform for cartilage tissue engineering.<sup>[86]</sup> In cell experiments, MagGel has the highest average cell adhesion density, indicating its excellent cytocompatibility. This is attributed to the synergistic effect of hydrogel matrix and magnetic nanoparticles to improve cytocompatibility, <sup>[87]</sup> including adhesion and growth. First, hydrogel mimics the extracellular matrix, providing a favorable environment for cells. Second, the interaction between magnetic nanoparticles and

BMSCs might promotes cell adhesion and growth. In addition, BMSCs were observed to phagocytize magnetic nanoparticles in cell culture without any effect on cell adhesion or morphology (Figure <u>9</u>).<sup>[88]</sup> The authors suggest that the ingested nanoparticles may eventually be decomposed by lysosomes and excreted by exocytosis.



## **FIGURE 9**

## Open in figure viewer **↓**PowerPoint

Cytocompatibility of magnetic nanocomposite hydrogels (MagGel).<sup>[86]</sup> Fluorescence images of BMSCs adhesion and morphology cultured on (a) MagGel and (b) gel. c-d, The endocytosis of magnetic nanoparticles by BMSCs. Black: magnetic nanoparticles; Blue: nucleus; Green: F-actin; Red circle: magnetic nanoparticles outside of the BMSCs. Reproduced with permission.<sup>[86]</sup> Copyright 2015, American Chemical Society

# **3 FABRICATION PROCESSING OF MHs**

MHs are generally composed of polymer matrix and magnetic components embedded in the matrix (such as  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub>, Fe<sub>3</sub>O<sub>4</sub>). Up to now, various methods have been developed to prepare MHs, including blending method, in-situ precipitation method and grafting-onto method.

The blending method refers to simply mixing the pre-prepared MNPs with hydrogel precursor solution, so that MNPs is covered in hydrogels (Figure <u>10A</u>).<sup>[89]</sup> This is the simplest and most commonly method for fabricating MHs. However, the hydrogel obtained by simple blending

method usually has the defects of uneven distribution of magnetic particles in colloids. This may result in unstable properties (mechanical, magnetocaloric, MR imaging) of the prepared MHs.



### **FIGURE 10**

#### Open in figure viewer +PowerPoint

Preparation technology of MHs. a, The blending method:<sup>[89]</sup> the prepared MNPs was mixed with a hydrogel precursor solution and crosslink hydrogels to embed the MNPs. b, In-situ precipitation method:<sup>[91]</sup> MNPs was prepared by in-situ precipitation reaction in polymer hydrogel network after cross-linking reaction. c, The grafting-onto method:<sup>[93]</sup> MNPs and hydrogel systems are connected by covalent or coordination bonds. Reprinted with permission.<sup>[94]</sup> Copyright 2012, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim

In the in-situ precipitation method,<sup>[90]</sup> the hydrogel network work as a chemical reactor, within which metal ions react with precipitating agents (NaOH, NH<sub>3</sub>·H<sub>2</sub>O, etc.) to generate MNPs (Figure <u>10B</u>). For example, Ye and Shen prepared a novel magnetic chitosan/polyvinyl alcohol hydrogel beads (MCPHBs) by freeze-thaw method combined with in-situ precipitation method. <sup>[91]</sup> First, the prepared PVA solution was mixed with CS solution, and then Fe<sup>3+</sup> and Fe<sup>2+</sup> solutions were added. Then, the mixed solution was added to the beaker containing ammonium hydroxide to form MNPs. Finally, MHs beads were obtained by repeated freezing and thawing. However, the preparation of MHs by in-situ precipitation is often limited by alkali-resistant hydrogel matrix.

Apparently, for both blending method and in-situ precipitation, there are no bonding interactions between MNPs and hydrogel networks. Therefore, the stability of MNPs dispersed in hydrogels cannot be guaranteed. The generalized grafting-onto method,<sup>[92]</sup> including modifying or changing the structure and properties of MNPs, can connect MNPs and hydrogel systems through covalent or coordination bonds (Figure 10C). This direct coupling allows MNPs to be stably and uniformly embedded in the hydrogel. Recently, our group fabricated a magnetic nano-Fe<sub>3</sub>O<sub>4</sub> composite polyolefin-chitosan (AAD-CS-Fe) double network hydrogel by grafting-onto method.<sup>[93]</sup> A large amount of Fe ions is exposed on the surface of nano-Fe<sub>3</sub>O<sub>4</sub> pre-etched by HCl, which can be cross-linked with the active groups (carboxyl and hydroxyl) in the hydrogel system. In this way, magnetic AAD-CS-Fe hydrogel with uniform structure and stable properties can be obtained.

# **4 CONCLUSION REMARKS**

MHs are composed of magnetic components (such as γ-Fe<sub>2</sub>O<sub>3</sub>) and hydrogel matrix. The incorporation of MNPs can enhance the initial performances (mechanical properties, adsorption, etc.) of the hydrogel, while providing further magnetic properties (magnetocaloric, MR imaging and intelligent response, etc.). In recent years, MHs have attracted worldwide attention as a potential multi-functional intelligent soft platform. This paper focuses on six major functions of MHs, including mechanical properties, adsorption, magnetocaloric effects, MR imaging, intelligent response and biocompatibility. The design strategies of various functions, as well as its application prospects in biomedicine, soft actuators, environmental protection, chemical catalysis and engineering in recent 5 years are reviewed. In addition, the classical fabrication processing of MHs was introduced.

To further promote the development and practical application of MHs, its future research focuses include the following aspects:

- 1. At present, the magnetic component in MHs is mainly confined to iron-containing nanoparticles. Further exploration of other MNPs to enhance thermotherapy, MRI contrast and intelligent response is of great significance for promoting the practical application of multi-functional MHs.
- 2. MHs have important application prospects in biomedical fields, mainly including tissue engineering, because of their unparalleled advantages such as in situ magnetocaloric therapy, magnetocaloric drive and MR imaging. However, a lot of work remains to be done on the long-term fate of implanting MHs to truly achieve clinical application, such as metabolism and biodegradability evaluation.<sup>[95]</sup>
- 3. The development of MHs in the future depends largely on the synthesis of novel multifunctional hydrogels. Combining magnetic stimulation with other stimuli, such as light,<sup>[96]</sup>

electricity,<sup>[97]</sup> temperature,<sup>[98]</sup> pH,<sup>[99]</sup> and redox,<sup>[100]</sup> MHs will become more intelligent and versatile.

# ACKNOWLEDGMENTS

This work was supported by the Natural Sciences Foundation of China (21977083); Natural Sciences Foundation of China (No. 52072210); Tsinghua University-Peking Union Medical College Hospital Initiative Scientific Research Program (grant number 20191080871); Tsinghua University Initiative Scientific Research Program [grant number 2017THZWYX07].

# **CONFLICT OF INTEREST**

The authors declare no conflict of interest.

# **Biographies**



**Fangli Gang** received her PhD degree in chemical biology from Northwest A&F University in 2020. Currently, she joined the Biology department of Xinzhou Teachers University. Her research interests are mainly focused on functional hydrogel materials and their biomedical applications.



**Xiaodan Sun** received her PhD degree in engineering from Tsinghua University under the supervision of Prof. Hengde Li. At present, she is an associate researcher in the School of Materials of Tsinghua University. Her current research is on the nano biomaterials, osteochondral tissue engineering, nerve tissue engineering, tumor diagnosis and treatment.

#### REFERENCES

a) Y. S. Zhang, A. Khademhosseini, *Science* 2017, **356**, eaaf3627;.
 Google Scholar
 b) T. Nonoyama, J. P. Gong, *Proc. Inst. Mech. Eng. H* 2015, **229**, 853;
 Google Scholar
 c) N. A. Jalili, M. Muscarello, A. K. Gaharwar, *Bioeng. Transl. Med.* 2016, **1**, 2975.
 Google Scholar

2 a) Z. Gu, K. Huang, Y. Luo, L. Zhang, T. Kuang, Z. Chen, G. Liao, *WIREs Nanomed Nanobiotechnol*.
2018, **10**, e1520;
Google Scholar
b) Y. Wu, H. Wang, F. Gao, Z. Xu, F. Dai, W. Liu, *Adv. Funct. Mater.* 2018, **28**, 1801000.
Google Scholar

3 a) N. Rodkate, M. Rutnakornpituk, *Carbohydr. Polym.* 2016, **151**, 251;
Google Scholar
b) M. Karzar Jeddi, M. Mahkam, *Int. J. Biol. Macromol.* 2019, **135**, 829.
Google Scholar

4 a) N. S. Satarkar, D. Biswal, J. Z. Hilt, *Soft Matter* 2010, 6, 2364;
Google Scholar
b) J. Zhang, Q. Huang, J. Du, *Polym. Int.* 2016, 65, 1365.
Google Scholar

5 a) X. Chen, M. Fan, H. Tan, B. Ren, G. Yuan, Y. Jia, J. Li, D. Xiong, X. Xing, X. Niu, X. Hu, *Mater. Sci. Eng. C Mater. Biol. Appl.* 2019, 101, 619;
Google Scholar
b) X. Hu, Y. Wang, L. Zhang, M. Xu, J. Zhang, W. Dong, *Int. J. Biol. Macromol.* 2018, 107, 1811.
Google Scholar

Y. P. Jia, K. Shi, F. Yang, J. F. Liao, R. X. Han, L. P. Yuan, Y. Hao, M. Pan, Y. Xiao, Z. Y. Qian, X. W. Wei, *Adv. Funct. Mater.* 2020, **30**, 2001059.
 Google Scholar

7 R. Patwa, N. Saha, P. Sáha, *AIP Conference Proceedings* 2020, **2205**, 020027. Google Scholar

8 a) T. Jin, F. J. Nicholls, W. R. Crum, H. Ghuman, S. F. Badylak, M. Modo, *Biomaterials* 2017, **113**, 176; Google Scholar

b) X. Yang, Y. Sun, S. Kootala, J. Hilborn, A. Heerschap, D. Ossipov, *Carbohydr. Polym.* 2014, 110, 95.

#### **Google Scholar**

9 Y. Guo, J. Bae, Z. Fang, P. Li, F. Zhao, G. Yu, *Chem. Rev.* 2020, **120**, 7642. Google Scholar

10 a) J. Yeom, A. Choe, S. Lim, Y. Lee, S. Na, H. Ko, *Sci. Adv.* 2020, 6, eaba5785;
Google Scholar
b) Y. Ye, Y. Zhang, Y. Chen, X. Han, F. Jiang, *Adv. Funct. Mater.* 2020, 30, 2003430;
Google Scholar
c) K. Liu, Y. Zhang, H. Cao, H. Liu, Y. Geng, W. Yuan, J. Zhou, Z. L. Wu, G. Shan, Y. Bao, Q. Zhao, T. Xie, P. Pan, *Adv. Mater.* 2020, 32, e2001693.
Google Scholar

F. Gao, W. Xie, Y. Miao, D. Wang, Z. Guo, A. Ghosal, Y. Li, Y. Wei, S. Feng, L. Zhao, H. Fan, *Adv. Healthcare Mater.* 2019, 8, e1900203.
Google Scholar

12 H. Liu, J. Yang, Y. Yin, H. Qi, *Chin. J. Chem.* 2020, **38**, 1263. Google Scholar

K. Liu, X. Pan, L. Chen, L. Huang, Y. Ni, J. Liu, S. Cao, H. Wang, ACS Sustain. Chem. Eng. 2018, 6, 6395.
Google Scholar

14 X. Hu, Y. Wang, M. Xu, L. Zhang, J. Zhang, W. Dong, *Polymer Testing* 2018, **71**, 344. Google Scholar

15 Y. Wang, J. Zhang, C. Qiu, J. Li, Z. Cao, C. Ma, J. Zheng, G. Huang, *Carbohydr. Polym.* 2018, **196**, 82. Google Scholar

16 M. Chen, G. Gong, L. Zhou, F. Zhang, *RSC Adv.* 2017, **7**, 21476. Google Scholar

17 L. Shi, Y. Zeng, Y. Zhao, B. Yang, D. Ossipov, C.W. Tai, J. Dai, C. Xu, ACS Appl. Mater. Interfaces
2019, 11, 46233.
Google Scholar

18 A. B. Bonhome-Espinosa, F. Campos, I. A. Rodriguez, V. Carriel, J. A. Marins, A. Zubarev, J. D. G. Duran, M. T. Lopez-Lopez, *Soft Matter* 2017, 13, 2928.
Google Scholar

19 a) S. Liu, A. K. Bastola, L. Li, ACS Appl. Mater. Interfaces 2017, 9, 41473;
Google Scholar
b) F. Chen, Q. Chen, L. Zhu, Z. Tang, Q. Li, G. Qin, J. Yang, Y. Zhang, B. Ren, J. Zheng, Chem. Mat. 2018, 30, 1743;
Google Scholar
c) S. Azevedo, A. M. S. Costa, A. Andersen, I. S. Choi, H. Birkedal, J. F. Mano, Adv. Mater. 2017, 29, 1700759.

**Google Scholar** 

20 A. Bin Imran, K. Esaki, H. Gotoh, T. Seki, K. Ito, Y. Sakai, Y. Takeoka, *Nat. Commun.* 2014, **5**, 5124. Google Scholar

21 a) X. H. Wang, F. Song, D. Qian, Y. D. He, W. C. Nie, X. L. Wang, Y. Z. Wang, *Chem. Eng. J.* 2018, **349**, 588;

**Google Scholar** 

b) H. Wang, H. Zhu, W. Fu, Y. Zhang, B. Xu, F. Gao, Z. Cao, W. Liu, *Macromol. Rapid Commun.* 2017, **38**, 1600695.

**Google Scholar** 

a) P. Zhu, M. Hu, Y. Deng, C. Wang, *Adv. Eng. Mater.* 2016, 18, 1799;
Google Scholar
b) Y. Zhai, H. Duan, X. Meng, K. Cai, Y. Liu, L. Lucia, *Macromol. Mater. Eng.* 2015, 300, 1290.
Google Scholar

a) Z. Liu, J. Liu, X. Cui, X. Wang, L. Zhang, P. Tang, *Pharmaceutics* 2018, 10, 145;
Google Scholar
b) S. Veloso, P. Ferreira, J. Martins, P. Coutinho, E. Castanheira, *Smart Mater. Struct.* 2016, 25, 027001;
Google Scholar
c) H. Li, G. Go, S.Y. Ko, J. O. Park, S. Park, *Smart Mater. Struct.* 2016, 25, 027001;
Google Scholar
d) D. I. Kim, S. Song, S. Jang, G. Kim, J. Lee, Y. Lee, S. Park, *Smart Mater. Struct.* 2020, 29, 085024.
Google Scholar

24 a) Q. Liu, H. Li, K.Y. Lam, *Bioelectrochemistry* 2019, 129, 90;

**Google Scholar** 

b) R. Singh, A. Wieser, S. Reakasame, R. Detsch, B. Dietel, C. Alexiou, A. R. Boccaccini, I. Cicha, *J. Biomed. Mater. Res. A* 2017, **105**, 2948;

Google Scholar

c) M. Santhosh, J. H. Choi, J. W. Choi, *Nanomaterials (Basel)* 2019, **9**, 1293. Google Scholar

25 a) J. Huang, P. Zhang, M. Li, P. Zhang, L. Ding, *Biochem. Eng. J.* 2016, **114**, 262;

#### Google Scholar

b) S. Tang, K. Hu, J. Sun, Y. Li, Z. Guo, M. Liu, Q. Liu, F. Zhang, N. Gu, ACS Appl. Mater. Interfaces 2017, 9, 10446;
CAS | PubMed | Web of Science® | Google Scholar

c) X. Shi, Z. Shi, D. Wang, M. W. Ullah, G. Yang, *Macromol. Biosci.* 2016, **16**, 1506.

**Google Scholar** 

a) J. Li, S. Dong, Y. Wang, X. Dou, H. Hao, *J. Environ. Sci. (China)* 2020, 91, 177;
Google Scholar
b) G.M. Ispas, S. Porav, D. Gligor, R. Turcu, I. Crăciunescu, *Water Environ. J.* 2020, 34, 916.
Google Scholar

a) N. Malatji, E. Makhado, K. E. Ramohlola, K. D. Modibane, T. C. Maponya, G. R. Monama, M. J. Hato, *Environ. Sci. Pollut. Res.* 2020, 27, 44089;
Google Scholar
b) N. Sarkar, G. Sahoo, S. K. Swain, *Journal of Molecular Liquids* 2020, 302, 112591.
Google Scholar

28 R. Sahraei, Z. Sekhavat Pour, M. Ghaemy, *J. Clean. Prod.* 2017, **142**, 2973. Google Scholar

H. M. Yang, J. R. Hwang, D. Y. Lee, K. B. Kim, C. W. Park, H. R. Kim, K. W. Lee, *Sci. Rep.* 2018, 8, 11476.
Crossref | PubMed | Web of Science® | Google Scholar

30 S. Dong, Y. Wang, *Water. Res.* 2016, **88**, 852. Google Scholar

31 K. Sun, W. Peng, H. Li, S. Song, *Hydrometallurgy* 2018, **176**, 208. Google Scholar

32 X. F. Sun, B. Liu, Z. Jing, H. Wang, *Carbohyd. Polym.* 2015, **118**, 16. Google Scholar

33 J. Li, Y. Wang, X. Dou, H. Hao, S. Dong, X. Shao, Y. Deng, *J. Environ. Sci. (China)* 2020, **89**, 264. Google Scholar

34 Y. Meng, C. Li, X. Liu, J. Lu, Y. Cheng, L. P. Xiao, H. Wang, *Sci. Total Environ.* 2019, **685**, 847. Google Scholar

35 S. C. Tan, H. K. Lee, *Microchim. Acta* 2019, **186**, 545. Google Scholar

36 S. Wang, X. Li, M. Li, X. Li, X. Li, S. Li, Q. Zhang, H. Li, *Appl. Sci.* 2020, **10**, 5665. Google Scholar

37 M. Khan, I. M. C. Lo, *J. Hazard. Mater.* 2017, **322**, 195. Google Scholar

38 S. Dong, Y. Wang, Y. Zhao, X. Zhou, H. Zheng, *Water Res.* 2017, **126**, 433. Google Scholar

39 A. A. Edathil, E. Alhseinat, F. Banat, *International Journal of Greenhouse Gas Control* 2019, 83, 117.
Google Scholar

40 S. Pirsa, F. Asadzadeh, I. Karimi Sani, *J. Inorg. Organomet. Polym. Mater.* 2020, **30**, 3188. Google Scholar

41 P. Pal, A. A. Edathil, L. Chaurasia, K. Rambabu, F. Banat, *J. Inorg. Organomet. Polym. Mater.* 2020, 30, 3188.
Google Scholar

42 D. P. Facch, A. L. Cazetta, E. A. Canesin, V. C. Almeida, E. G. Bonafé, M. J. Kipper, A. F. Martins, *Chem. Eng. J.* 2018, **337**, 595. Google Scholar

43 G. Yao, W. Bi, H. Liu, *Colloids and Surfaces A* 2020, **588**, 124393. Google Scholar

E. Yan, M. Cao, X. Ren, J. Jiang, Q. An, Z. Zhang, J. Gao, X. Yang, D. Zhang, *J.Phys. Chem. Solids* 2018, 121, 102.
Google Scholar

45 a) K. Rajar, E. Alveroglu, *Journal of Molecular Structure* 2017, 1146, 592;
Google Scholar
b) M. Soleymani, A. Akbari, G. R. Mahdavinia, *Polymer Bulletin* 2018, 76, 2321;
Google Scholar
c) G. R. Mahdavinia, M. Soleymani, H. Etemadi, M. Sabzi, Z. Atlasi, *Int. J. Biol. Macromol.* 2018, 107, 719.

#### **Google Scholar**

46 G. R. Mahdavinia, S. Mousanezhad, H. Hosseinzadeh, F. Darvishi, M. Sabzi, *Carbohydr. Polym.*2016, **147**, 379.
Google Scholar

47 J. Song, W. He, H. Shen, Z. Zhou, M. Li, P. Su, Y. Yang, *Chem. Commun. (Camb)* 2019, **55**, 2449. Google Scholar

48 S. Li, Z. Zhu, Z. Hu, H. Sun, P. Mu, C. Xiao, W. Liang, L. Chen, A. Li, *J. Appl. Polym. Sci.* 2018, 135, 46869.
Google Scholar

49 Q. Gui, Y. Zhou, S. Liao, Y. He, Y. Tang, Y. Wang, *Soft Matter* 2019, **15**, 393. Google Scholar

50 M. K. Lima-Tenório, E. T. Tenório-Neto, M. R. Guilherme, F. P. Garcia, C. V. Nakamura, E. A. G. Pineda, A. F. Rubira, *Chem. Eng. J.* 2015, **259**, 620. Google Scholar

X. Zhou, L. Wang, Y. Xu, W. Du, X. Cai, F. Wang, Y. Ling, H. Chen, Z. Wang, B. Hu, Y. Zheng, *RSC Adv.* 2018, 8, 9812.
 Google Scholar

52 Y. Zhang, Y. Cheng, C. Chen, Q. Liu, X. Bi, L. Duan, J. Liu, M. Wan, L. Huang, K. Hu, *J. Biomed. Nanotechnol.* 2018, **14**, 594. Google Scholar

53 B. Chen, J. Xing, M. Li, Y. Liu, M. Ji, *Colloids Surf. B Biointerfaces* 2020, **190**, 110896. Google Scholar

54 K. Hu, J. Sun, Z. Guo, P. Wang, Q. Chen, M. Ma, N. Gu, *Adv. Mater.* 2015, **27**, 2507. Google Scholar

55 a) H. Wu, L. Song, L. Chen, Y. Huang, Y. Wu, F. Zang, Y. An, H. Lyu, M. Ma, J. Chen, N. Gu, Y. Zhang, *Nanoscale* 2017, **9**, 16175;

**Google Scholar** 

b) H. Wu, L. Song, L. Chen, W. Zhang, Y. Chen, F. Zang, H. Chen, M. Ma, N. Gu, Y. Zhang, *Acta Biomater*. 2018, **74**, 302; Google Scholar c) R. Jahanban-Esfahlan, H. Derakhshankhah, B. Haghshenas, B. Massoumi, M. Abbasian, M. Jaymand, *Int. J. Biol. Macromol.* 2020, **156**, 438. Google Scholar

56 H. Wu, L. Liu, L. Song, M. Ma, N. Gu, Y. Zhang, *ACS Nano* 2019, **13**, 14013. Google Scholar

a) J. Huang, Z. Jia, Y. Liang, Z. Huang, Z. Rong, J. Xiong, D. Wang, *RSC Adv.* 2020, 10, 541;
Google Scholar
b) A. B. Bonhome-Espinosa, F. Campos, D. Durand-Herrera, J. D. Sanchez-Lopez, S. Schaub, J. D. G. Duran, M. T. Lopez-Lopez, V. Carriel, *J. Mech. Behav. Biomed. Mater.* 2020, 104, 103619.
Google Scholar

a) S. Zhang, L. Wu, J. Cao, K. Wang, Y. Ge, W. Ma, X. Qi, S. Shen, *Colloids Surf. B Biointerfaces* 2018, 170, 224;
Google Scholar
b) S. M. Lee, H. J. Kim, Y. J. Ha, Y. N. Park, S. K. Lee, Y. B. Park, K. H. Yoo, *ACS Nano* 2013, 7, 50;
Google Scholar
c) S. Wang, J. Lv, S. Meng, J. Tang, L. Nie, *Adv. Healthcare Mater.* 2020, 9, e1901541.
Google Scholar

59 W. Wang, X. Fan, F. Li, J. Qiu, M.M. Umair, W. Ren, B. Ju, S. Zhang, B. Tang, *Adv. Optical Mater.*2018, 6, 1701093.
Google Scholar

a) T. Cheng, M. Mishkovsky, M. J. Junk, K. Munnemann, A. Comment, *Macromol. Rapid Commun.* 2016, **37**, 1074;

**Google Scholar** 

b) R. Bakalova, B. Nikolova, S. Murayama, S. Atanasova, Z. Zhelev, I. Aoki, M. Kato, I. Tsoneva, T. Saga, *Anal. Bioanal. Chem.* 2016, **408**, 905.

**Google Scholar** 

61 a) Q. Li, Z. Feng, H. Song, J. Zhang, A. Dong, D. Kong, W. Wang, P. Huang, *Biomater. Sci.* 2020, **8**, 3301;

**Google Scholar** 

b) V. Nandwana, S.-R. Ryoo, T. Zheng, M. M. You, V. P. Dravid, *ACS Biomater. Sci. Eng.* 2019, **5**, 3049. Google Scholar

62 Z. Chen, C. Yan, S. Yan, Q. Liu, M. Hou, Y. Xu, R. Guo, *Theranostics* 2018, **8**, 1146. Google Scholar 63 E. Roeder, C. Henrionnet, J. C. Goebel, N. Gambier, O. Beuf, D. Grenier, B. Chen, P. Vuissoz, P. Gillet, A. Pinzano, *PLoS One* 2014, **9**, e98451. Google Scholar

64 Q. Zhang, H. Lu, N. Kawazoe, G. Chen, *Acta Biomater*. 2014, **10**, 2005. Google Scholar

65 Q. Liu, M. Liu, H. Li, K. Y. Lam, *International Journal of Solids and Structures* 2020, **190**, 76. Google Scholar

66 a) B. Rashidzadeh, E. Shokri, G. R. Mahdavinia, R. Moradi, S. Mohamadi-Aghdam, S. Abdi, *Int. J. Biol. Macromol.* 2020, **154**, 134;
Google Scholar
b) W. Shi, J. Huang, R. Fang, M. Liu, *ACS Appl. Mater. Interfaces* 2020, **12**, 5177;
Google Scholar
c) O. Goncharuk, Y. Samchenko, D. Sternik, L. Kernosenko, T. Poltorats'ka, N. Pasmurtseva, M. Abramov, E. Pakhlov, A. Derylo-Marczewska, *Applied Nanoscience* 2020, **10**, 4559;
Google Scholar
d) M. R. Nematollahi, M. Montazer, *J. Appl. Polym. Sci.* 2020, **137**, 48961.
Google Scholar

M. Noh, Y. H. Choi, Y.-H. An, D. Tahk, S. Cho, J. W. Yoon, N. L. Jeon, T. H. Park, J. Kim, N. S. Hwang, *ACS Biomater. Sci. Eng.* 2019, **5**, 3909.
Google Scholar

68 C. S. Lacko, I. Singh, M. A. Wall, A. R. Garcia, S. L. Porvasnik, C. Rinaldi, C. E. Schmidt, *J. Neural. Eng.* 2020, **17**, 016057.
Google Scholar

K. Liu, L. Han, P. Tang, K. Yang, D. Gang, X. Wang, K. Wang, F. Ren, L. Fang, Y. Xu, Z. Lu, X. Lu, *Nano Lett.* 2019, **19**, 8343.
Google Scholar

70 M. Namdari, A. Eatemadi, *Artif. Cells Nanomed. Biotechnol.* 2017, **45**, 731. Google Scholar

71 H. Y. Lin, H. Y. Huang, S. J. Shiue, J. K. Cheng, *J. Magn. Magn. Mater.* 2020, **504**, 166680. Google Scholar
J. J. Pavon, J. P. Allain, D. Verma, M. Echeverry-Rendon, C. L. Cooper, L. M. Reece, A. R. Shetty, V. Tomar, *Macromol. Biosci.* 2019, **19**, e1800225.
 Google Scholar

73 A. Tay, A. Sohrabi, K. Poole, S. Seidlits, D. Di Carlo, *Adv. Mater.* 2018, **30**, 1800927. Google Scholar

74 A. Tay, F. E. Schweizer, D. Di Carlo, *Lab. Chip.* 2016, **16**, 1962. Google Scholar

75 a) Y. Lin, Y. Sun, Y. Dai, W. Sun, X. Zhu, H. Liu, R. Han, D. Gao, C. Luo, X. Wang, *Talanta* 2020, **207**, 120300;

### **Google Scholar**

b) J. Y. Wang, Q. Y. Guo, Z. Y. Yao, N. Yin, S. Y. Ren, Y. Li, S. Li, Y. Peng, J. L. Bai, B. A. Ning, J. Liang, Z. X. Gao, *Mikrochim. Acta* 2020, **187**, 333. Google Scholar

76 L. Vikingsson, A. Vinals-Guitart, A. Valera-Martínez, J. Riera, A. Vidaurre, G. Gallego Ferrer, J. L. Gómez Ribelles, *J. Mater. Sci.* 2016, **51**, 9979.
Google Scholar

77 a) X. Ma, Z. Yang, Y. Wang, G. Zhang, Y. Shao, H. Jia, T. Cao, R. Wang, D. Liu, *ACS Appl. Mater. Interfaces* 2017, **9**, 1995;

## Google Scholar b) J. Li, F. Ji, D. H. L. Ng, J. Liu, X. Bing, P. Wang, *Chemical Engineering Journal* 2019, **369**, 611. Google Scholar

78 a) G. Babaladimath, V. Badalamoole, *Polymer International* 2018, 67, 983;
Google Scholar
b) J. Supramaniam, R. Adnan, N. H. Mohd Kaus, R. Bushra, *Int. J. Biol. Macromol.* 2018, 118, 640;
Google Scholar
c) M. P. Kesavan, S. Ayyanaar, N. Lenin, M. Sankarganesh, J. Dhaveethu Raja, J. Rajesh, *J. Biomed. Mater. Res. A* 2018, 106, 543.
Google Scholar

79 a) D. I. Kim, H. Lee, S. H. Kwon, Y. J. Sung, W. K. Song, S. Park, *Adv. Healthcare Mater.* 2020, 9, e2000118;
Google Scholar
b) D. I. Kim, H. Lee, S. H. Kwon, H. Choi, S. Park, *Sensors and Actuators B: Chemical* 2019, 289, 65.
Google Scholar

a) Y. Hong, F. Zhou, Y. Hua, X. Zhang, C. Ni, D. Pan, Y. Zhang, D. Jiang, L. Yang, Q. Lin, Y. Zou, D. Yu, D. N. Arnot, X. Zou, L. Zhu, S. Zhang, H. Ouyang, *Nat. Commun.* 2019, **10**, 2060;
Google Scholar
b) Y. Huang, X. Zhao, Z. Zhang, Y. Liang, Z. Yin, B. Chen, Y. Han, B. Guo, *Chem. Mat.* 2020, **32**, 6595.
Google Scholar

81 S. Khorshidi, A. Karkhaneh, *J. Tissue Eng. Regen. Med.* 2018, **12**, 1974. Google Scholar

a) M. S. Amini-Fazl, R. Mohammadi, K. Kheiri, *International Journal of Biological Macromolecules* 2019, 132, 506;
Google Scholar
b) W. Xie, Q. Gao, Z. Guo, D. Wang, F. Gao, X. Wang, Y. Wei, L. Zhao, *ACS Appl. Mater. Interfaces* 2017, 9, 33660.
Google Scholar

D. Huang, J. Hsiao, Y. Chen, L. Chien, M. Yao, Y. Chen, B. Ko, S. Hsu, L. Tai, H. Cheng, S. Wang, C. Yang, Y. Chen, *Biomaterials* 2009, **30**, 3645.
Google Scholar

84 S. Hughes, A. El Haj, J. Dobson, *Med. Eng. Phys.* 2005, **27**, 754. Google Scholar

85 G. Liu, J. Gao, H. Ai, X. Chen, *small* 2013, **9**, 1533. Google Scholar

86 N. Zhang, J. Lock, A. Sallee, H. Liu, *ACS Appl. Mater. Interfaces* 2015, **7**, 20987. Google Scholar

a) S. Hughes, A. J. El Haj, J. Dobson, *Med. Eng. Phys.* 2005, 27, 754;
Google Scholar
b) J. F. Shen, Y. L. Chao, L. Du, *Neurosci. Lett.* 2007, 415, 164.
Google Scholar

88 S. Park, H. S. Kim, W. J. Kim, H. S. Yoo, *Int. J. Pharm.* 2012, **424**, 107. Google Scholar

a) J. Liang, B. He, P. Li, J. Yu, X. Zhao, H. Wu, J. Li, Y. Sun, Q. Fan, *Chem. Eng. J.* 2019, **358**, 552;
Google Scholar
b) F. Fan, J. Sun, B. Chen, Y. Li, K. Hu, P. Wang, M. Ma, N. Gu, *Science China Materials* 2018, **61**, 1112.

### **Google Scholar**

90 A. A. Mohamed, G. A. Mahmoud, M. R. E. ElDin, E. A. Saad, *Polymer-Plastics Technology and Materials* 2019, **59**, 357.

Google Scholar

91 W. Wang, H. Zhang, J. Shen, M. Ye, *Colloids and Surfaces A: Physicochemical and Engineering Aspects* 2018, **553**, 672.

**Google Scholar** 

92 M. Hayati, G. R. Bardajee, M. Ramezani, S. S. Hosseini, F. Mizani, *Polym. Int.* 2020, **69**, 156. Google Scholar

93 F. Gang, H. Yan, C. Ma, L. Jiang, Y. Gu, Z. Liu, L. Zhao, X. Wang, J. Zhang, X. Sun, *Chem. Commun.*2019, 55, 9801.
Google Scholar

94 Y. Li, G. Huang, X. Zhang, B. Li, Y. Chen, T. Lu, T. J. Lu, F. Xu, *Adv. Funct. Mater.* 2013, **23**, 660. Google Scholar

95 Z. Liu, J. Liu, X. Cui, X. Wang, L. Zhang, P. Tang, *Front. Chem.* 2020, **8**, 124. Google Scholar

96 S. Cho, A. Kim, W. Shin, M. B. Heo, H. J. Noh, K. S. Hong, J. Cho, Y. T. Lim, *Int. J. Nanomedicine* 2017, **12**, 2607. Google Scholar

97 K. H. Didehban, L. Mohammadi, J. Azimvand, *Materials Chemistry and Physics* 2017, **195**, 162. Google Scholar

98 H. Qiao, J. Jia, W. Chen, B. Di, O. A. Scherman, C. Hu, *Adv. Healthcare Mater.* 2019, **8**, e1801458. Google Scholar

99 S. Rittikulsittichai, A. G. Kolhatkar, S. Sarangi, M. A. Vorontsova, P. G. Vekilov, A. Brazdeikis, T. R. Lee, *Nanoscale* 2016, **8**, 11851.

Google Scholar

100 J. T. Auletta, G. J. LeDonne, K. C. Gronborg, C. D. Ladd, H. T. Liu, W. W. Clark, T. Y. Meyer, *Macromolecules* 2015, **48**, 1736. Google Scholar

Download PDF

## About Wiley Online Library

Privacy Policy Terms of Use About Cookies Manage Cookies Accessibility Wiley Research DE&I Statement and Publishing Policies Developing World Access

## Help & Support

Contact Us Training and Support DMCA & Reporting Piracy

## Opportunities

Subscription Agents Advertisers & Corporate Partners

## Connect with Wiley

The Wiley Network Wiley Press Room

Copyright © 1999-2022 John Wiley & Sons, Inc. All rights reserved

M( L, 2, 7

www.acsnano.org

ACCESS

# Lipid Nanoparticles—From Liposomes to mRNA Vaccine Delivery, a Landscape of Research Diversity and Advancement

Rumiana Tenchov, Robert Bird, Allison E. Curtze, and Qiongqiong Zhou\*

Cite This: ACS Nano 2021, 15, 16982–17015



Article Recommendations

s Supporting Information

ABSTRACT: Lipid nanoparticles (LNPs) have emerged across the pharmaceutical industry as promising vehicles to deliver a variety of therapeutics. Currently in the spotlight as vital components of the COVID-19 mRNA vaccines, LNPs play a key role in effectively protecting and transporting mRNA to cells. Liposomes, an early version of LNPs, are a versatile nanomedicine delivery platform. A number of liposomal drugs have been approved and applied to medical practice. Subsequent generations of lipid nanocarriers, such as solid lipid nanoparticles, nanostructured lipid carriers, and cationic lipid-nucleic acid complexes, exhibit more complex architectures and enhanced physical stabilities. With their ability to encapsulate and deliver therapeutics to specific locations within the body and to release their contents at a desired time, LNPs provide a valuable platform for treatment of a variety of diseases. Here, we present a landscape of LNP-

III Metrics & More



related scientific publications, including patents and journal articles, based on analysis of the CAS Content Collection, the largest human-curated collection of published scientific knowledge. Rising trends are identified, such as nanostructured lipid carriers and solid lipid nanoparticles becoming the preferred platforms for numerous formulations. Recent advancements in LNP formulations as drug delivery platforms, such as antitumor and nucleic acid therapeutics and vaccine delivery systems, are discussed. Challenges and growth opportunities are also evaluated in other areas, such as medical imaging, cosmetics, nutrition, and agrochemicals. This report is intended to serve as a useful resource for those interested in LNP nanotechnologies, their applications, and the global research effort for their development.

**KEYWORDS:** lipid nanoparticle, liposome, cationic lipid, solid lipid nanoparticle, nanostructured lipid carrier, immunoliposome, *"stealth" liposome, drug delivery* 

ipid nanoparticles (LNPs) have emerged across the pharmaceutical industry as promising vehicles to deliver a variety of therapeutic agents. The application of LNPs has also been extended to other fields, such as medical imaging, cosmetics, nutrition, agriculture, and other innovative areas such as nanoreactors. Currently in the spotlight as a vital component of the COVID-19 mRNA vaccines, LNPs play a key role in effectively protecting and transporting mRNA to cells.

Liposomes, an early version of LNPs, are an extremely versatile nanocarrier platform because they can transport hydrophobic or hydrophilic molecules, including small molecules, proteins, and nucleic acids. In fact, liposomes are the earliest nanomedicine delivery platform to successfully proceed from concept to clinical application. A number of liposomal drug formulations have been approved and successfully applied to medical practice. The next generations of LNPs, including solid lipid nanoparticles, nanostructured lipid carriers, and cationic lipid—nucleic acid complexes, exhibit more complex internal architectures and enhanced physical stabilities. With their ability to control the location and timing of drug delivery in the body, LNPs can be used to deliver treatments for a variety of diseases. Increasingly, scientists are moving beyond traditional biopharmaceuticals to more complex and specialized therapies that can fight disease at the genetic level.

 Received:
 June 11, 2021

 Accepted:
 June 21, 2021

 Published:
 June 28, 2021



<u>~</u> @ €





Figure 1. Schematic representation of (A) liposome, (B) liposome encapsulating hydrophobic and hydrophilic drugs, (C) immunoliposome functionalized with targeting ligands, and (D) sterically stabilized ("stealth") liposome functionalized with inert polymers such as PEG.



Figure 2. Suggested structures of lipid nanoparticle nucleic acid carriers: nucleic acids organized in inverse lipid micelles inside the nanoparticle (A); nucleic acids intercalated between the lipid bilayers (B).<sup>26–29</sup>

In this review, we provide an overview of the current knowledge regarding LNP structures and properties, primarily from the viewpoint of their pharmaceutical applications. We then discuss the multiple applications of LNPs, including drug delivery, medical imaging, cosmetics, and others. Furthermore, we present a landscape of LNP-related research based on a thorough analysis of the CAS Content Collection.<sup>1,2</sup> The CAS Content Collection is the largest human-curated collection of published scientific knowledge, proven useful for quantitative analysis of global scientific publications against variables such as time, research area, formulation, application, and chemical composition. The growth and diversity of LNP-related publications and their distribution among research areas and applications, as well as countries and organizations, are examined. Lists of the most widely used chemical substances involved in LNP formulations are provided, including phospholipids, PEG-lipids, and cationic lipids. We hope this report can serve as a useful resource for those interested in LNP nanotechnologies and the global research effort for their development.

### LIPID NANOPARTICLE BASICS

**Liposomes–The Earliest Generation of Lipid Nanoparticles.** The term "liposome" was coined in the 1960s, shortly after it was found that closed lipid bilayer vesicles (Figure 1A) form spontaneously in water.<sup>3–5</sup> The term "lipid nanoparticle" came into use much later, in the early 1990s, with the beginning of the era of nanoscience and nanotechnology. Since liposomes are made of lipids and in most cases are nanosized, they are rightfully considered as the earliest generation of lipid nanoparticles.

The potential of liposomes as drug delivery systems was recognized almost immediately after their discovery. For example, it is known that over 40% of small-molecule drugs



Review

Figure 3. Schematic presentation of a solid lipid nanoparticle (left) and a nanostructured lipid carrier (right).

for cancer treatment exhibit low solubility in water, so the benefits of drug delivery systems capable of encapsulating these drugs and enhancing their aqueous solubilities was immediately appreciated. Liposomes were the earliest nanomedicine delivery platform to successfully proceed from concept to clinical application, with a number of approved pharmaceutical preparations. For example, the earliest approved liposomal drug was Doxil, a lipid nanoparticle formulation of the antitumor agent doxorubicin, which is used to treat ovarian cancer.<sup>6</sup> Another liposomal drug, Epaxal, is a lipid nanoparticle formulation of a protein antigen used as a hepatitis vaccine." Many other liposomal formulations have been approved for use as drugs and vaccines, as shown in Table S1 in the Supporting Information. Liposomes have been used in numerous clinical trials to deliver anticancer, anti-inflammatory, antibiotic, antifungal, anesthetic, and other drugs and gene therapies.

Phospholipids such as phosphatidylcholines, phosphatidylethanolamines, phosphatidylserines, and phosphatidylglycerols, along with stabilizers such as cholesterol, are common liposome substituents. Liposomes consist of one or several lipid bilayers, ranging in size between 20 and ~1000 nm. Hydrophilic drugs can be enclosed in the aqueous interior of liposomes, while hydrophobic drugs can be entrapped in the hydrocarbon chain

# Table 1. Common Ingredients Used for the Preparation of SLN and $\rm NLC^{36,40-43}$

Lipids	Emulsifiers/coemulsifiers
Triglycerides	Lecithin
Trimyristin (Dynasan 114)	Poloxamer 188
Tripalmitin (Dynasan 116)	Poloxamer 407
Tristearin (Dynasan 118)	Tyloxapol
Mono-, di-, and triglyceride mixtures	Polysorbate 20
Witeposol bases	Polysorbate 60
Glyceryl stearates (Imwitor 900)	Polysorbate 80
Glyceryl behenates (Compritol 888 ATO)	Sodium cholate
Glyceryl palmitostearates (Precirol ATO 5)	Sodium glycocholate
Waxes	Taurodeoxycholic acid sodium
Beeswax	Butanol and Butyric acid
Cetyl palmitate	Cetylpyridinium chloride
Hard fats	Sodium dodecyl sulfate
Stearic acid	Sodium oleate
Palmitic acid	Polyvinyl alcohol
Behenic acid	Cremophor EL
Other lipids	
Miglyol 812	
Paraffin	
polymer corona	18-29



Figure 4. Cubosomes are nanoparticles comprising lipid in a bicontinuous bilayer cubic phase (either primitive or diamond type).

region of the lipid bilayer (Figure 1B), making liposomes a versatile drug delivery platform. The structures of liposomes depend strongly on how they are prepared. Liposomes may be either unilamellar (small unilamellar vesicles (SUV) with diameters of 20–100 nm, large unilamellar vesicles (LUV) with diameters of 100–1000 nm, or giant unilamellar vesicles (GUV) with diameters >1000 nm) or multilamellar vesicles (MLV), with diameters of >500 nm, in which concentric bilayers form an onion-like multilayer structure (Figure S1) in the Supporting Information.<sup>8</sup> Drug delivery systems primarily use SUV and smaller MLV, while GUV are used mainly as models for cells.

Size is a critical parameter in determining liposome drug encapsulation and half-life in circulation, with smaller liposomes having more chances of escaping phagocyte uptake.<sup>9</sup> It has been generally accepted that particles used for pharmaceutical purposes, and especially those for parenteral administration, need to be  $\leq 100 \text{ nm.}^{10-12}$  The size of nanoparticles can be measured using a variety of techniques such as dynamic light scattering, size exclusion chromatography, nuclear magnetic resonance spectroscopy, and microscopy. The particle size distribution of LNPs can be controlled using manufacturing methods such as extrusion, sonication, and homogenization; more recently, microfluidic methods have been successfully used for LNP manufacture and size control.

The surface charges of LNPs are generally determined by the lipid head groups, which may be either positively or negatively charged or zwitterionic. The surface potential, which depends on the surface charge density, controls the interactions between particles and the adsorption of counterions and hence the stability of the nanoparticles. Uncharged particles or particles with low charge densities tend to aggregate over time, while more highly charged particles repel each other, preventing aggregation. The surface charge of nanoparticles is most often expressed by their zeta potentials, the electrical potential of a particle measured from a plane just outside the layer of fluid bound to the particle; it is commonly calculated from its electrophoretic mobility. Zeta potentials vary linearly with the fraction of ionic lipids incorporated into the liposomes; zeta potentials < -30 mV or >30 mV are generally sufficient to maintain interparticle repulsion and stable particle suspensions.<sup>13–15</sup>

Cationic Lipid Nanoparticles, Complexes with Nucleic Acids. Progress in understanding of the genetics of cellular pathogenesis has made possible therapeutic targeting of numerous genes involved in human diseases.<sup>16</sup> Nucleic acids have a variety of roles in medicine, including gene therapy agents and RNA therapeutics.<sup>17</sup> However, the development of nucleic acid therapeutics is hindered by difficulties in their cellular delivery. The negative charges and hydrophilicity of nucleic acids impedes their passive diffusion across plasma membranes. In addition, the association of nucleic acids with serum proteins, their uptake by phagocytes, and their degradation by endogenous nucleases interferes with their efficient delivery. As a result, nucleic acids require delivery vectors to protect them from degradation and to deliver them to the target cells for efficient uptake. Viral and nonviral vectors are used to deliver nucleic acids to cells. Cationic LNPs, comprising stable complexes between synthetic cationic lipids and anionic nucleic acids, are the most widely used nonviral delivery system for nucleic acid drugs.<sup>18,19</sup>

A large number of cationic lipid amphiphiles have been synthesized and tested for use as nucleic acid carriers. The molecular architecture of the cationic lipids is similar to that of natural lipids, except for the presence of an ionizable (cationic) head group instead of the zwitterionic or anionic head group of the natural lipids. They comprise a hydrophobic part with two alkyl chains or a cholesterol moiety, a positively charged polar head group, and a linker connecting the polar group with the hydrophobic moiety. Ionizable lipids which are positively charged only inside the cell and uncharged in the bloodstream due to a change in pH value are preferred because they are less toxic than nonionizable cationic lipids.<sup>20</sup> The structures of the most frequently used cationic lipids in LNP formulations according to the CAS Content Collection are presented further in this review (Table 12).

Complexation with positively charged lipids (Figure 2) stabilizes nucleic acids and increases their resistance to nuclease degradation, allowing them to be delivered to their desired target cells. Nucleic acids enter cells by adsorption of the LNPs to the

### Table 2. Example Ligands and Receptors Tested as LNP-Targeting Agents in Cancer Therapies<sup>88–92</sup>

Targeting ligand	Target receptor	Targeted cancer
Folate <sup>93,94</sup>	Folate receptor	Cancers overexpressing folate receptor
Transferrin <sup>95,96</sup>	Transferrin receptor	Cancers overexpressing transferrin receptor
Granulocyte-macrophage colony-stimulating factor (GM-CSF) <sup>97</sup>	GM-CSF receptor	Leukemic blasts
RGD (Arg-Gly-Asp tripeptide) <sup>98</sup>	Cellular adhesion molecules, such as integrins	Vasculature endothelial cells in solid tumors
NGR (Asn-Gly-Arg tripeptide) <sup>99</sup>	Aminopeptidase N (CD13)	Vasculature endothelial cells in solid tumors
Anti-VEGFR antibody <sup>100</sup>	Vasculature endothelial growth-factor receptor VEGFR (FLK1)	Vasculature endothelial cells in solid tumors
Anti-ERBB2 antibody (Trastuzumab) <sup>101</sup>	ERBB2 (erythroblastic oncogene B2) receptor	Cancers overexpressing ERBB2 receptor, such as in breast and ovarian cancers
Anti-CD20 antibody (Rituximab, Ibritumomab tiuxetan) <sup>102</sup>	CD20, B-cell surface antigen	Non-Hodgkin's lymphoma, B-cell lymphoproliferative diseases
Anti-CD22 antibody (Epratuzumab) <sup>103,104</sup>	CD22, B-cell surface antigen	Non-Hodgkin's lymphoma, B-cell lymphoproliferative diseases
Anti-CD33 antibody (Gemtuzumab) <sup>105,106</sup>	CD33, a sialo-adhesion molecule, leukocyte differentiation antigen	Acute myeloid leukemia
Anti-CD25 antibody (Denileukin diftitox) <sup>107,108</sup>	Interleukin-2 receptor	Cutaneous T-cell lymphoma
Antitenascin antibody <sup>109</sup>	Extracellular-matrix protein overexpressed in many tumors	Glial tumors, breast cancer
Anti-MUC1 antibody <sup>110,111</sup>	MUC1, an aberrantly glycosylated epithelial mucin	Breast and bladder cancer
Anti-TAG72 antibody <sup>59,61</sup>	TAG72, oncofetal antigen tumor-associated glycoprotein-72	Colorectal, ovarian and breast cancer
Anti-CEA antibody <sup>110,112</sup>	Carcinoembyonic antigen (CEA)	Colorectal, small-cell lung and ovarian cancers

Table 3. Examples of Stimuli-Responsive Liposomes #	for Enhanced Anticancer Drug Delivery
---	---------------------------------------

Stimuli	Anticancer Drug	Liposome Composition	Tumor
Temperature	Doxorubicin	DPPC:MSPC:DSPE-PEG2000 (86.5:9.7:3.8, mol %) <sup>126</sup>	Ovarian cancer
		DPPC:MSPC:DSPEmPEG2000 (21.6:2.6:1.0, molar ratio) <sup>127</sup>	Breast tumor
pН	Doxorubicin	DOPE, DSPE-PEG- $H_7K(R_2)_2$	Glioma, Glioblastoma
		(lipid–peptide conjugate with the pH-sensitive peptide $H_7K(R_2)_2^{128}$	
Magnetic field	5-Fluorouracil	Phosphatidylcholine <sup>129</sup>	Colon carcinoma
Laser irradiation	AMD3100	Soybean phosphatidylcholine <sup>130</sup>	Osteosarcoma, Breast cancer

cell surface followed by their endocytosis and release of the nucleic acids into the cell. Adsorption of LNPs to and fusion with the cell membrane are electrostatically promoted because cell membranes commonly bear negative charges and the nanoparticle lipids for nucleic acid delivery bear positive charges; their attraction thus drives membrane fusion and endocytosis. Once the nucleic acids have entered the cell, release from their complexes with cationic lipids is necessary for nucleic acid delivery. The cell's anionic lipids likely help to release nucleic acids from LNPs by neutralizing the charge of their cationic lipid carriers, disrupting the electrostatic interactions between the lipid carriers and the nucleic acids. Binding of anionic lipids to the cationic lipids also disrupts the nanoparticle architecture, leading to formation of nonlamellar structures.<sup>21,22</sup> The efficacy of cationic lipid vectors in delivering nucleic acids has been proposed to correlate to their ability to promote the formation of nonlamellar lipid phases.<sup>19,23</sup> Short-lived nonlamellar structures are believed to mediate the processes of membrane fusion; the intermediates that form in membrane fusion are similar to those that form during lamellarnonlamellar phase transformations.<sup>24,25</sup>

Solid Lipid Nanoparticles and Nanostructured Lipid Carriers. While liposomes are useful as drug carriers, they require complex production methods using organic solvents, exhibit low efficiency at entrapping drugs, and are difficult to perform on large scales. Solid lipid nanoparticles (SLN) and nanostructured lipid carriers (NLC) were developed to address some of these shortcomings (Figure 3). While conventional liposomes comprise liquid-crystalline lipid bilayers, SLN comprise solid lipids,<sup>30,31</sup> and NLC comprise mixtures of solid and liquid-crystalline lipids.<sup>32,33</sup> The particle sizes of SLN and NLC vary between 40 and ~1000 nm. SLN and NLC exhibit enhanced physical stabilities, addressing one of the main limitations of liposome-based formulations. SLN and NLC also have higher loading capacities and higher bioavailabilities of their cargoes, are produced easily on large scale without the use of organic solvents, and are more stable to sterilization than other LNPs. In addition, the reduced mobility of molecules in the solid state allows SLN and NLC to control the release of their drug payloads more precisely. However, on long-term storage, crystallization of SLN can expel the incorporated drugs into the surrounding media.<sup>34</sup> NLC were then designed by introducing small amounts of lipids liquid at room temperature into SLN, reducing the degree of crystallinity of the lipid core. The reduced crystallinity of NLC suppresses expulsion of the drug from the matrix and enhances the drug-loading capacities and physical and chemical long-term stabilities of the nanoparticles.35,36

SLN and NLC are composed of lipids and stabilizing agents such as surfactants and other coating materials (Figure 3). Typical lipid constituents are shown in Table 1, including fatty acids, fatty alcohols, glycerides, and waxes. Surfactants, located at the lipid–water interface, reduce the interfacial tension between the lipid and the aqueous phases and improve the stabilities of the resultant formulations. A list of commonly used surfactants/emulsifiers in LNP preparation is also included in Table 1. SLN and NLC are usually produced using various organic solvent-free methods, such as high-pressure homoge-

Review



Figure 5. Timeline of liposome/LNP advancement. (Upper part) Technological advancement. Publications on LNPs, correlated to the timeline of LNP advancement: The discovery of liposomes;<sup>3</sup> Enzyme entrapment into liposomes;<sup>136</sup> Immunoliposomes;<sup>80,137,138</sup> Procedures for liposome formation;<sup>139,140</sup> Thermoresponsive liposomes to local hyperthermia;<sup>124,141,142</sup> pH-sensitive liposomes;<sup>121</sup> Liposome targeting;<sup>77,143,144</sup> Cationic lipids for gene delivery;<sup>18,145,146</sup> Long-circulating ("Stealth") liposomes;<sup>115,116,147</sup> Folate receptor targeting;<sup>81,84,144,148,149</sup> Solid lipid nanoparticles and nanostructures lipid carriers;<sup>31,35,150,151</sup> HER2 receptor targeting;<sup>152–154</sup> Transferrin receptor targeting;<sup>155–158</sup> Temperature-sensitive liposomes;<sup>122,142,159,160</sup> Stimuli-responsive liposomes;<sup>123,149,161</sup> Cubosomes.<sup>46,47,50,162</sup> (Lower part) Examples of FDA-approved LNP drugs. The earliest approved liposomal drug Doxil;<sup>6</sup> The earliest FDA-approved LNP-based nucleic acid (siRNA) drug Onpattro;<sup>163</sup> LNP-based mRNA vaccines for COVID-19 approved;<sup>164,165</sup> Useful general reviews.<sup>166–173</sup> For a full list of approved LNP-based drugs, see Table S1 in the Supporting Information.

nization, high-speed stirring, ultrasonication, emulsion/solvent evaporation, double emulsion, phase inversion, and solvent injection.  $^{31,37-39}$ 

**Nonlamellar Lipid Nanoparticles.** Other types of LNP structures have also been investigated for use in drug delivery. Technologies relating to the use of nonlamellar lipid phases in drug delivery and the use of inverted cubic and hexagonal liquid-crystalline phases in controlled release formulations for delivery of inhaled drugs were published in the 1980s.<sup>44,45</sup>

More recently, cubosomes, highly stable nanoparticles formed from lipid cubic phases (Figure 4) and stabilized by polymerbased outer coronas, were developed as lipid pharmaceutical nanocarriers.46-50 Liquid-crystalline lipid cubic phases consist of single lipid bilayers that form a bicontinuous periodic lattice structure with pores formed by two interwoven water channels. Cubosomes are highly stable under physiological conditions. The composition of a cubosome can be tuned to customize its pore sizes and to include bioactive lipids; the polymeric outer corona can be used to control where the cubosome payload is released. Cubosomes provide a significantly higher membrane surface area for loading of membrane proteins and smallmolecule drugs than do liposomes. This combination of properties allows cubosomes to be used in a variety of applications, such as drug delivery systems, membrane bioreactors, artificial cells, and biosensors.

Cubosomes are composed of amphiphilic lipids and a stabilizer. The amphiphilic lipid is the major component; upon hydration, the lipid spontaneously forms a cubic liquid-crystalline phase. The stabilizer is typically a polymer that prevents the reconstitution of the cubosome into a bulk cubic phase. The most frequent compositions of cubosomes use monoolein (glyceryl monooleate) as the lipid component with poloxamer 407 as a stabilizing surfactant; the monoglyceride/

surfactant mixture makes up between 2.5% and 10% of the total weight of the dispersion. Polyvinyl alcohol is also used in addition to poloxamer 407 as a stabilizer for the dispersion.<sup>51</sup>

Hexosomes are another type of LNP, in which lipids form a nonlamellar phase—the inverted hexagonal phase  $H_{II}$ . Their compositions are similar to those of cubosomes, containing amphiphilic lipids, a polymeric stabilizer, and water.<sup>52,53</sup> Micelles are nonlamellar lipid nanosized particles with a hydrophobic core and hydrophilic shell; they have been used successfully to solubilize poorly water-soluble pharmaceuticals.<sup>54,55</sup> Reverse micelles, with a hydrophilic core and hydrophobic shell, have been used to encapsulate hydrophilic molecules such as nucleic acids in complex lipid carriers.<sup>26,27,56,57</sup>

**Ethosomes.** Ethosomes are phospholipid nanoparticles containing a high proportion (20–45%) of ethanol. The added ethanol increases the permeabilities and elasticities of the ethosomes, allowing them to perform transdermal delivery of drugs and cosmetics by squeezing through the pores of stratum corneum, the outermost layer of skin. This delivery route offers an alternative method to deliver liposomal formulations, avoiding the complications caused by the gastrointestinal tract in oral drug delivery.<sup>58</sup> Commercial products using ethosomal formulations include anticellulite (Cellutight EF, Noicellex, Skin Genuity, Osmotics Lipoduction) and antiaging (Decorin) agents, hair growth stimulants including Minoxidil (Nanominox) and Acyclovir (Supravir), and topical creams for the treatment of herpes virus infections.<sup>59</sup>

**Echogenic Liposomes.** Echogenic liposomes are acoustically active liposomes utilized as ultrasound contrast agents.<sup>60</sup> They have been developed following the discovery that microscopic bubbles of gas reflect diagnostic ultrasound waves. Gas-liquid interfaces provide a large discontinuity in

density and reflect sound very efficiently. Encapsulated into liposomes, gas microbubbles provide improvements in medical acoustic imaging.<sup>61</sup> Echogenic liposomes also offer additional therapeutic applications, such as ultrasound-controlled drug delivery<sup>60,62,63</sup> and ultrasound-enhanced thrombolysis (sono-thrombolysis).<sup>64,65</sup>

**Procedures for LNP Formation.** A wide variety of techniques are used to control the properties of LNPs, including their sizes, numbers of concentric bilayers (lamellarity), and their ability to encapsulate various compounds.<sup>66–69</sup>

The film hydration method represents the simplest and oldest method used for liposome preparation. Lipids are initially dissolved in an organic solvent and then dried down to yield a thin film at the bottom of a vial. The lipid film is hydrated to produce a liposomal dispersion. The hydration conditions affect the structure of the formed vesicles—giant unilamellar vesicles (GUV) are formed by gentle hydration, while multilamellar vesicles (MLV) with poor size homogeneity are formed upon intense agitation. Probe or bath sonication can be used to produce small unilamellar vesicles (SUV). Consecutive extrusion through polycarbonate filters of defined pore sizes can also be used to control liposome diameter; the number of extrusion cycles is important in determining the homogeneity of the liposomes formed.<sup>70</sup>

Another traditional liposome preparation technique is reverse phase evaporation, involving formation of a water-in-oil emulsion between an aqueous phase and an organic phase containing lipids. The mixture is briefly sonicated to homogenize it; removal of the organic phase under reduced pressure yields a gel and then a liposomal suspension.<sup>71</sup> The solvent injection technique for liposome formation involves the rapid injection of a lipid solution (in ethanol or diethyl ether) into an aqueous medium.<sup>72</sup> The detergent removal liposome preparation technique involves dissolution of phospholipids in an aqueous solution containing detergents at their critical micelle concentrations (CMC) followed by removal of the detergents by dialysis or other means. Dilution of the resultant suspension with water or aqueous solutions reconstitutes the formed micelles; over time, the micelles convert to liposomes." In the heating method for liposome preparation, lipids are hydrated and then heated above the transition temperature of the phospholipids in the presence of a hydrating agent such as glycerin or propylene glycol. This method is attractive because it does not involve an organic solvent.<sup>8,73</sup>

A successful recent liposome production technique is microfluidic hydrodynamic focusing, in which a stream of lipid in alcohol solution is forced to flow in the central channel of a device, intersected, and sheathed by coaxial stream(s) of an aqueous phase. Reciprocal diffusion of alcohol and water across the focused alcohol/water interface causes the lipid to precipitate and self-assemble into liposomes.<sup>69,72,74</sup> Other recently developed techniques for producing liposomes include cross-flow injection<sup>69</sup> and methods using supercritical fluids.<sup>68,72</sup>

Similarly, preparation of other types of LNP, such as SLN, NLC, and cubosomes, includes various methods for homogenization (high-shear homogenization, hot or cold homogenization, high-speed homogenization), ultrasonication, and microfluidization.<sup>75,76</sup> Ultrasonication, extrusion, and microfluidic methods have been most often used to control LNP size, according to the CAS Content Collection.

Functional Modifications of LNPs. Despite their advantages, unmodified LNP drug delivery systems have significant limitations such as lack of targeting selectivity, short blood circulation time, and instability *in vivo*. Improved LNP formulations were designed to overcome each of these shortcomings.

Targeted Liposomes. Targeted liposomes were designed with surface-attached ligands (Figure 1C) to recognize and bind to specific receptors on cells.<sup>77</sup> Generally, targeted liposomes are prepared by conjugating small-molecule ligands, peptides or monoclonal antibodies to the surface of LNPs.<sup>78,79</sup> Antibodies were initially used to construct actively targeted liposomes (immunoliposomes). For example, the efficiency of liposomes modified with an IgM ligand was 100 times higher than that of unmodified liposomes.<sup>80</sup> Certain receptors, such as the folate receptor and the transferrin receptor, are overexpressed on many cancer cells, and their corresponding ligands have been used to direct liposomes to these types of cells or tissues.<sup>81-84</sup> Folate receptors bind strongly to their ligand, folic acid, allowing for specificity for tumor cells over noncancerous cells. The lack of immunogenicity of folic acid and the ability of its conjugates to be taken into cells nondestructively by endocytosis make folates preferable to protein-based targeting ligands. Folate receptors are also overexpressed on macrophages, which are present in inflammatory diseases such as psoriasis, Crohn's disease, atherosclerosis, and rheumatoid arthritis; thus, folate-mediated targeting can also be used to deliver antiinflammatory drugs.<sup>8</sup> Transferrin receptors are overexpressed in rapidly proliferating cancer cells to meet the increased iron demands of tumor cells, making possible the development of transferrin receptortargeted anticancer therapies.<sup>86</sup> The epidermal growth factor receptor (EGFR), a tyrosine kinase receptor, is overexpressed in many solid tumors, including colorectal, nonsmall-cell lung cancer, squamous cell carcinoma, and breast cancer, making it an attractive target for therapeutic drug delivery.<sup>87</sup> Examples of ligands used in LNP targeting are shown in Table 2.

"Stealth" Liposomes. While immunoliposomes were highly selective for specific cell types, they were rapidly removed from the blood flow by phagocytes. To remedy this, liposomes were coated with biocompatible inert polymers, typically poly-(ethylene glycol) (PEG), making them invisible to phagocytes ("stealth" liposomes) (Figure 1D). PEGylation (covalently attaching PEG to a compound) was initially invented to help protein drugs to avoid the body's immune response<sup>113,114</sup> but was later found to be also very effective at improving the surface properties of the liposomes by preventing access to their surface through steric hindrance.<sup>115–117</sup> The circulatory half-life of liposomes depends on the length and density of the polymer chains on the liposome surface, allowing stable, sterically stabilized liposomes to be prepared.<sup>118</sup> The increased circulation half-lives of sterically stabilized liposomes also increase their passive accumulation in cancer tissues by the enhanced permeation and retention (EPR) effect, further increasing their effectiveness.<sup>119</sup>

*Stimuli-Responsive Liposomes.* Another useful liposome modification includes formulations designed to release encapsulated drugs controllably when exposed to physicochemical or biochemical stimuli (stimuli-responsive liposomes). These drug delivery systems respond to specific triggers to release their cargo where needed, increasing drug efficacy and reducing adverse effects. Liposomes responsive to temperature, changes in pH, enzymes, light, magnetic and electrical fields, and ultrasound have been studied.<sup>120</sup> Among these stimuli, pH change is the most promising due to the existence of multiple pH gradients in the body.<sup>121</sup> When triggered by a stimulus, LNPs

Review



Figure 6. Approved LNP drugs and the diseases they target (more details in Table S1).



Figure 7. Key players operating in the global LNP drug delivery market according to a recent market analysis<sup>180</sup> and the summary of the LNPbased marketed drugs (Table S1).

undergo a phase transition (either between the gel and liquidcrystal phases or between lamellar and nonlamellar phases), increasing their membrane permeability.<sup>122</sup> Temperatureresponsive systems have been studied extensively for anticancer drug delivery.<sup>120,123</sup> When exposed to mild local hyperthermia, the lipids approach their liquid-crystalline phase transition temperatures, creating disorder between their solid and fluid domains and becoming more permeable to water-soluble molecules. This results in burst release of the entrapped drug within the tumor.<sup>124,125</sup> Table 3 provides examples of stimuliresponsive liposomes. **Toxicity of Lipids Used in LNP Formulations.** Since LNPs are mainly composed of natural lipids, they have been considered pharmacologically inactive and minimally toxic. However, in some cases, LNPs are not immunologically inert<sup>131</sup> while LNP constituents are unnatural compounds which may be toxic to human cells.<sup>132</sup> For example, while cationic lipids offer great promise as carriers for the delivery of fragile compounds such as nucleic acids, some cationic lipids cause cytotoxicity.<sup>133</sup> In some cases, cationic lipids reduce mitosis in cells, form vacuoles in the cytoplasms of cells, and cause detrimental effects on key cellular proteins such as protein kinase C.<sup>134</sup> The cytotoxicity of cationic lipids depends on the structures of their

www.acsnano.org

## Table 4. Lipid Constituents of the LNP Carriers of the COVID-19 mRNA Vaccines<sup>164,165,195–197</sup>

Lipid Name	Role	Abbreviation or Lab Code	CAS Registry Number
BNT162b2 vaccine (I	fizer/BioNTech)		
(4-hydroxybutyl)azanediyl bis(hexane-6,1-diyl)bis(2-hexyldecanoate)	ionizable cationic lipid	ALC-0315	2036272-55-4
(2-hexyldecanoate), 2-[(polyethylene glycol)-2000]-N,N-ditetradecylacetamide	PEG-lipid	ALC-0159	1849616-42-7
1,2-distearoyl-sn-glycero-3-phosphocholine	helper lipid	DSPC	816-94-4
cholesterol	helper lipid	Chol	57-88-5
mRNA-1273 vacci	ne (Moderna)		
heptadecan-9-yl 8-((2-hydroxyethyl)(6-oxo-6-(undecyloxy)hexyl)amino)octanoate	ionizable cationic lipid	SM-102	2089251-47-6
1,2-dimyristoyl-rac-glycero-3-methoxypolyethylene glycol-2000	PEG-lipid	PEG2000-DMG	160743-62-4
1,2-distearoyl-sn-glycero-3-phosphocholine	helper lipid	DSPC	816-94-4
cholesterol	helper lipid	Chol	57-88-5



Figure 8. Structures of the lipid constituents of the LNPs of the COVID-19 mRNA vaccines<sup>164,165,195–197</sup>

hydrophilic head groups; amphiphiles with quaternary ammonium head groups are more toxic than those with tertiary amine head groups.<sup>134</sup> The effect of the hydrophobic chains on the toxicity of lipids is not well studied, hindering the design of less toxic lipids. The hydrophobic portions of lipid molecules strongly modulate their phase behavior and their usefulness for LNP, but the presence of certain lipid phases also correlates to membrane damage and cytotoxicity.<sup>25</sup> PEG-lipid conjugates may also cause undesired toxicity, while LNPs containing PEGlipid conjugates are known to interact with immune cells to generate undesired antibodies against some PEGylated lipids.<sup>135</sup>

**Timeline of Liposome/LNP Advancement.** A timeline of liposome/LNP advancement is shown in Figure 5.

### APPLICATIONS OF LIPID NANOPARTICLES

**Drug and Vaccine Delivery.** *Clinically Approved LNP-Based Pharmaceuticals.* Liposomes have been recognized as a powerful tool in medicine for over 50 years. Their ability to encapsulate and deliver therapeutics controllably to specific locations within the body makes them useful for treating a variety of diseases. A number of LNP drug formulations have been approved and used in medical practice (Figure 6).<sup>88,174–179</sup> More information on these formulations is included in Table S1 in the Supporting Information. A selection of key players operating in the global liposome drug delivery market according

to a recent market analysis,<sup>180</sup> as well as from the summary of the LNP-based marketed drugs (Table S1), is shown in Figure 7.

The largest single application of LNPs in drug delivery is in cancer treatment (Figure 6), because of the improved bioavailability and selectivity of LNP-encapsulated antitumor agents over the free drugs. Lipid-based nanocarriers reduce the toxicity of anticancer drugs to normal tissues, increase the water solubilities of hydrophobic drugs, extend the drug residence time, and improve control over drug release.<sup>92,181,182</sup>

LNPs also improve the efficacy of cancer therapies through the enhanced permeability and retention (EPR) effect.<sup>183</sup> Rapid but defective angiogenesis in tumors leads to blood vessels that possess large fenestrations (>100 nm in size) through which LNP can readily pass. The tumor blood vessels are thus much more permeable to LNPs, allowing their selective accumulation in tumors when administered intravenously. In addition, dysfunctional lymphatic drainage in tumors reduces the rate at which LNPs leave tumors and thus improves their retention. The accumulation of LNPs in tumors as a result of the EPR effect allows the nanoparticles to release the antitumor agents selectively in the vicinity of tumor cells.

Doxil was the earliest approved anticancer nanoformulation and the earliest approved liposomal drug. The formulation was designed to improve the pharmacokinetics and biodistribution of the anthracycline drug doxorubicin, which is a potent

Review

### Table 5. Clinical Trials of LNP-Formulated mRNA Drugs and Vaccines<sup>208,210</sup>

Disease	mRNA/encoding sequence	NCT Number/Phase
J	nfectious disease vaccines	
Rabies	mRNA/Rabies virus glycoprotein (RABV-G)	NCT03713086/Phase I
Zika Virus	mRNA-1893/Structural proteins of Zika virus	NCT04064905/Phase I
	mRNA-1325/Zika virus antigen	NCT03014089/Phase I
Cytomegalovirus (CMV)	mRNA-1647 and mRNA-1443/Pentamer complex and full- length membrane-bound glycoprotein B and pp65 T cell antigen of CMV	NCT03382405/Phase I
hMPV and PIV3	mRNA-1653: Fusion proteins of hMPV and PIV3	NCT03392389/Phase I
Tuberculosis	GSK 692,342/Immunogenic fusion protein (M72) derived from <i>Mycobacterium tuberculosis</i>	NCT01669096/Phase II
Influenza	VAL-506440/H10N8 antigen	NCT03076385/Phase I
	VAL-339851/H7N9 antigen	NCT03345043/Phase I
COVID-19	ChulaCov19 mRNA/SARS-Cov2-spike protein-binding IgG antibody	NCT04566276/Phase I/II
	self-amplifying mRNA (SAM) platform/anti-Spike IgG antibodies GMCs	NCT04758962/Phase I
	Chimpanzee Adenovirus serotype 68 (ChAd) and self- amplifying mRNA (SAM) vectors/Spike (ChAdV68-S)	NCT04776317/Phase I
	Cancer immunotherapy	
Melanoma	mRNA-4157/personalized cancer vaccine targeting 20 tumor- associated antigens	NCT03897881/Phase II
	RBL001.1; RBL002.2; RBL003.1; RBL004.1/malignant melanoma-associated antigens	NCT02410733/Phase I
Ovarian Cancer	W_ova1 vaccine: Three ovarian cancer tumor associated antigens mRNAs	NCT04163094/Phase I
Triple-negative breast cancer	IVAC_WAREHOUSE_bre1_uID; IVAC MUTANOME_uID/personalized cancer vaccine targeting tumor-associated antigens	NCT02316457/Phase I
Solid tumors	mRNA-4157/personalized cancer vaccine targeting 20 tumor- associated antigens	NCT03313778/Phase I
Melanoma, Colon cancer, Gastrointestinal cancer, Genitourinary cancer, hepatocellular cancer	NCI-4650/mRNA-based, Personalized Cancer Vaccine	NCT03480152/Phase I/II
Melanoma, NSCLC, Bladder Cancer, Colorectal Cancer, Triple Negative Breast Cancer, Renal Cancer, Head	RO7198457/personalized cancer vaccine targeting tumor- associated antigens	NCT03289962/Phase I
Relapsed/Refractory Solid Tumor Malignancies or Lymphoma, Ovarian Cancer	mRNA-2416/OX40L	NCT03323398/Phase I and II
Solid Tumor Malignancies, Lymphoma, Triple Negative Breast Cancer, Head and Neck Squamous Cell Carcinoma, Non-Hodgkin Lymphoma, Urothelial Cancer	mRNA-2752/Human OX40L, IL-23, and IL-36γ	NCT03739931/Phase I
Adult Glioblastoma	Autologous total tumor mRNA and pp65 full length lysosomal associated membrane protein (LAMP) mRNA loaded DOTAP liposome vaccine	NCT04573140/Phase I
Pr	otein-replacement therapies	
Propionic Acidemia	mRNA-3927/ $\alpha$ and $\beta$ subunits of the mitochondrial enzyme propionyl-CoA carboxylase	NCT04159103/Phase I and II
Isolated Methylmalonic Acidemia	mRNA-3704/methylmalonyl-coenzyme A mutase (MUT)	NCT03810690/Phase I and II
Ornithine Transcarbamylase Deficiency	MRT5201/Ornithine transcarbamylase	NCT03767270/Phase I and II
Cystic Fibrosis	MRT5005/Human Cystic Fibrosis Transmembrane Regulator protein (CFTR)	NCT03375047/Phase I and II
Carnitine Palmitoyl Transferase 2 Deficiency	CPT2 mRNA/Carnitine Palmitoyl Transferase 2	NCT00336167/Phase I
Hereditary Transthyretin Amyloidosis with Polyneuropathy	Cas9 mRNA/NTLA-2001 (CRISPR/Cas9 technology)	NCT04601051/Phase I

anticancer agent but is cardiotoxic.<sup>184</sup> Doxil takes advantage of EPR, using sterically stabilized nanoparticles (~100 nm) to extend the circulation time in human plasma while reducing doxorubicin's cardiotoxicity. It was developed as an intravenous injection for the management of advanced ovarian cancer, multiple myeloma, and HIV-associated Kaposi's sarcoma.<sup>6</sup> The LNPs used for Doxil are composed of hydrogenated soy phosphatidylcholine, cholesterol, and DSPE-PEG2000.<sup>185</sup>

The second largest group of liposomal dugs comprises fungicides (Figure 6). Amphotericin B, a broad-spectrum polyene antibiotic, has been in medical use for decades and is considered the gold standard for treating invasive fungal infections. It targets cell membranes, exhibiting higher affinity for ergosterol-containing membranes typical of fungal cells than for cholesterol-containing mammalian cell membranes.<sup>186</sup> While it has high antifungal activity, amphotericin B also has severe side effects, particularly nephrotoxicity. It is amphipathic and characterized by complicated self-association behavior, with different types of aggregates displaying different solubilities and toxicities; the aggregation state also correlates to drug efficacy.<sup>187</sup> Thus, controlling the aggregation state of the drug may enhance its therapeutic effect and lower its toxicity. Such aggregation control has been achieved via lipid nanoformulations.<sup>188,189</sup> Several lipid-based nanoparticle preparations of

www.acsnano.org

Review

Table 7. Notab	le Patents from the CAS Content Collection Rela	tted to the Use of LNPs in Food and Nutrition Formulations
Patent #	Title	Key Feature
EP3417846	Food and/or nutraceutical composition, in the form of liposomes, comprising endocannabinoid	A food and/or nutraceutical composition, for example in the form of liposomes, which comprises an endocannabinoid, an active ingredient and an excipient.
WO2014140268	Solid lipid nanoparticles	Food-grade SLN comprise a solid lipid phase core comprising lipophilic and/or amphiphilic active ingredient and an emulsifier comprising mono- and diglyceride citric acid ester.
WO2017095138	Curcumin-containing lipid nanoparticle complex comprising ginsenosides	Curcumin-containing lipid nanoparticles containing ginsenosides exhibit improved stabilities, dispersibilities, and bioavailabilities. They can be used in curcumin-containing products such as antioxidant food compositions.
WO2004064805	Lipid-based cochleate preparations of fragile nutrients for the food, cosmetic and pharmaceutical industries	Cochleate-containing nanoparticles including one or more cochleates of fragile nutrients such as $eta$ -carotene are disclosed.
US20100196543	Microencapsulated citrus phytochemicals and application to beverages	A beverage includes citrus juice, microencapsulated citrus phytochem, ≤90 mg unencapsulated hesperidin, ≤150 mg unencapsulated naringin, and ≤0.9 mg unencapsulated limonin. Phytochemicals (such as limonoids and flavonoids) are microencapsulated to conceal their bitter taste.
EP1894477	Food protein and charged emulsifier interaction	A coated denatured supramolecular protein core with food applications comprises an electrostatically bound lipid monolayer. Thus, heat- denatured whey protein aggregates may be coated with sulfated Bu oleate to form liposome-like structures.
WO2013008261	Food product of the type to be stored and consumed refrigerated or frozen	A food product of the type to be stored and consumed refrigerated or frozen comprises an active ingredient encapsulated in liposomes, thus increasing its stability and its antioxidant capacity. Liposomes containing vitamin A are formulated with <i>a</i> -tocopherol, rosmarinic acid, and lecithin.
WO2011119953	Orally bioavailable lipid-based constructs for delivery of biotin derivatives	Lipid-based compositions facilitate efficient oral absorption of biotin compounds for inducing weight loss. An orally bioavailable composition comprises gelatin, liposomes, and lipid particles and a biotin-derived targeting agent.
US20170127712	Dietary supplement compositions with enhanced delivery matrix, gummies, chocolates, atomizers and powders containing same, and methods of making same	A dietary supplement composition includes liposomal vesicles, an active ingredient, a phospholipid contained in the liposomal vesicles, and a coating material. The liposomal vesicles have a barrier coating made of a biopolymer, polyethylene glycol, and/or chitosan. The dietary supplement composition may be incorporated in gummies, chocolates, atomizers, or powders.
WO9922601	Enhanced infant formula containing liposome encapsulated nutrients and agents	Liposomes are used in an infant formula to improve the delivery and stability of nutrients, and they enhance their bioavailability. The formula more closely resembles the ultrastructure and infrastructure of natural human milk due to the presence of liposomes. The phospholipid concentration is the same as that in human milk.

16992

Table 8. Notable Patents from the CAS Content Collection Related to Use of LNPs in Agrochemical Formulations

amphotericin B have been developed (Figure 6; Table S1), which exhibit favorable pharmacokinetic profiles and significantly reduce the side effects of this drug.<sup>188</sup>

Nucleic acid therapeutics are an emerging class of drugs showing potential for treating various diseases. However, since nucleic acids are polyvalent anionic and highly hydrophilic molecules, they are hardly taken up into cells. They are also easily degraded by nucleases in the blood. Therefore, they require a delivery vector in order to enter cells and to be effective. LNP carriers are one of the successful methods for delivering nucleic acid drugs.<sup>190,191</sup> The nucleic acid drug Patisiran (ONPATTRO), an siRNA formulated in LNPs to reduce transthyretin protein formation in the liver, recently received FDA approval for the treatment of hereditary transthyretin-mediated amyloidosis. It is the earliest approved siRNA drug and the earliest LNP-formulated nucleic acid drug, marking an important milestone in nucleic acid therapeutics development.<sup>103,192</sup>

LNPs in the COVID-19 mRNA Vaccines. The latest successful use of LNPs is as the delivery vehicle in the two recently approved COVID-19 messenger RNA (mRNA) vaccines by Pfizer/BioNTech and Moderna, which have been developed with unparalleled speed and have shown notable effectiveness in disease prevention.<sup>29,164,165,193,194</sup> The vaccines deliver mRNA encoding for the SARS-CoV-2 spike protein into the cytoplasm of host cells; the mRNA is translated into the spike protein, which acts as an antigen and leads to development of an immune response to the virus. The mechanism of action of the mRNA mediated vaccines is depicted in Figure S2 in the Supporting Information.

The compositions of the lipid nanoparticles of the two mRNA vaccines are very similar. Both contain an ionizable lipid which is positively charged at low pH (enabling RNA complexation) and neutral at physiological pH (reducing the potential toxic effects and facilitating payload release). They also contain a PEGylated lipid to reduce antibody association (opsonization) by serum proteins and clearance by phagocytes thus conferring longer systemic circulation. The phospholipid distearoylphosphatidyl-choline (DSPC) and cholesterol help to pack the cargo into the LNPs (Table 4).<sup>164,165,195–198</sup> The molar ratios of the cationic lipid:PEG-lipid:cholesterol:DSPC are (46.3:1.6:42.7:9.4) for the Pfizer and (50:1.5:38.5:10) for the Moderna vaccine.<sup>199</sup> Those nanoparticles are 80–100 nm in diameter<sup>200</sup> and contain approximately 100 mRNA molecules per lipid nanoparticle.<sup>201</sup>

Proprietary cationic lipids—ALC-0315 (Pfizer) and SM-102 (Moderna) (Figure 8)—are used in the COVID-19 vaccine nanoparticles; both lipids are tertiary amines which are protonated (and thus positively charged) at low pH. Their hydrocarbon chains are connected through biodegradable ester groups, enabling safe clearance after mRNA delivery. The cationic lipids used in the mRNA vaccines contain branched hydrocarbon chains (Figure 8), which optimize the formation of nonlamellar phases and the mRNA delivery efficiency. The PEG-lipids are both PEG-2000 conjugates. The LNPs are prepared at low pH (pH 4.0), at which the ionizable lipid is positively charged, so that it can easily form complexes with mRNA.<sup>202</sup> A microfluidic device is used to mix a stream containing mRNA in water with a stream containing a lipid mixture in ethanol. When rapidly mixed, the constituents of these two streams form nanoparticles which entrap the negatively charged mRNA.<sup>203-205</sup>

LNP-Based mRNA Vaccines and Therapeutics in Clinical Trials. mRNA vaccines and therapeutics hold great promise in

	ces by breaking down the cell walls of disease-causing bacteria.	eeds. The formulations can be applied to pre- or postemergent crops and to soil, plant	hosphatidylcholine or diacylphosphatidylethanolamine having a cationic hydrophilic s also comprise an amphiphilic quaternary ammonium ingredient.	formulations. Boron-containing materials formulated according to the invention may	nine cation or a lipid vesicle, adsorbed on a clay mineral. Suitable in particular for neg. of the herbicide to deep soil layers, thus reducing contamination of underground water smaller dosage may be used.	h light causes the vesicle membranes to break, releasing the biocidal agents. Preferred particles such as titanium dioxide, iron oxide, and biocides such as Ucarcide 25 and
Key Feature	A fertilizer using rhamnolipid-containing liposomes eliminates disease in plants, bushes, and tree	Liposomal formulations comprise pesticides, nematicides, or herbicides for control of pests and we media, plants, plant tissues, and seeds.	Formulations comprise the active ingredient and a liposome-forming excipient such as a diacylph moiety and a hydrophobic moiety comprising two hydrocarbon acyl chains. The formulations	Liposomal microencapsulated boron-containing products are disclosed to be used in agricultural f be applied to agricultural field crops and fruits.	An herbicidal formulation comprising an herbicide incorporated in a micelle using a quaternary am charged herbicides at pH above 6. The formulation provides slow release and reduced leaching or and soil. Furthermore, because the herbicide stays near the target, efficiency is enhanced and s	Biocide-filled liposome vesicles contain photosensitizers. Irradiation of the liposome vesicles with biocidal agents include hydrogen peroxide, benzalkonium chloride, and photooxidizing nanop Ucarcide S0 (Dow Chem. Co).
Title	Cure and prevent diseases in plants, bushes and trees using rhamnolipid liposomes	Liposome formulations	Formulations for enhancing the effi- cacy of pesticides, especially herbi- cides	Lecithin-microencapsulated boron pesticides	Controlled-release formulations of anionic herbicides	Photolytic release of biocides for high efficiency decontamination through phospholipid nanoparticles
Patent #	US20190104734	US20150150245	WO9817110	WO9821945	WO2002052939	US20100233224

www.acsnano.org

prevention and treatment of diseases. LNP-enabled intracellular delivery of mRNA allows the expression of virtually any desired protein inside the host cells.<sup>206</sup> An important feature of mRNA-based therapeutics is the low risk of insertional mutagenesis.<sup>207</sup> Unlike DNA therapies, mRNA does not need the machinery of the nucleus to perform its task. Because mRNA does not integrate into the host genome, the risk of carcinogenesis and mutagenesis from mRNA-based therapeutics is reduced, improving their safety. Lastly, the manufacture of mRNA is more readily standardized than the production of DNA and affords much better reproducibility.<sup>208</sup>

mRNA vaccines have revolutionized vaccine development because of their high efficacies, accelerated development cycles, and potential for low-cost manufacture.<sup>209</sup> The rapid development of mRNA vaccines would not have been possible without advances in LNP technologies to deliver nucleic acids. LNP-based mRNA vaccines have entered clinical trials against a variety of infectious diseases, such as nucleoside-modified mRNA vaccines for Zika virus, cytomegalovirus, tuberculosis, and influenza (Table 5).<sup>210</sup> mRNA therapeutic vaccines have great potential in cancer immunotherapy against melanoma, ovarian cancer, breast cancer, and other solid tumors (Table 5).<sup>208,209</sup> LNP vectors are crucial for the successful intracellular delivery of mRNA to the cytosol of immune cells, particularly antigen-presenting immune cells, which are responsible for triggering the desired immune responses.

The use of mRNA for the expression of therapeutic proteins bears promise in treating a wide range of diseases. Protein replacement therapy is a medical therapy that replaces or supplements a protein which is deficient or missing in a patient.<sup>211</sup> It is achieved by engineering mRNA to code for the protein of interest.<sup>212</sup> LNPs are the preferred vehicle to deliver mRNA to cells, but LNP-based mRNA drugs typically require repetitive dosing through prolonged time-periods and thus need careful safety analyses and tests. The earliest study using LNPformulated mRNA for protein replacement therapy was published only in 2016, using LNP-entrapped mRNA encoding human frataxin as a potential therapeutic agent against Friedreich's ataxia.<sup>213</sup>

**Medical Imaging.** Medical imaging plays an essential role in modern precision medicine. Medical imaging is used to improve disease diagnosis, monitor drug delivery, verify response to therapy, and guide minimally invasive procedures. Traditional imaging methods such as magnetic resonance imaging (MRI), computed tomography (CT), positron emission tomography (PET), and single photon emission computed tomography (SPECT) have limited resolution and specificity. Nanoparticle delivery systems such as LNPs and their versatile surface functionalization provide opportunities to enhance the resolution and specificity of those imaging methods.<sup>214</sup>

Due to the EPR effect, liposomes are more likely to accumulate in tumor tissue than normal tissues. Radiolabeled liposomes have been applied for imaging of various cancers. A recent application of the radiolabeled liposomes is in early detection of cancer metastases, by localizing the sentinel lymph node, the initial lymph node receiving metastatic tumor cells.<sup>215</sup> Various PET and SPECT radioisotopes have been conjugated to liposomes for use as imaging agents.<sup>216</sup> The most common radionuclides for radiolabeling liposomes are technetium-99m (<sup>99m</sup>Tc), indium-111 (<sup>111</sup>In), and gallium-67 (<sup>67</sup>Ga).<sup>217–223</sup> These radionuclides have different half-lives and photon energies, so they may be applied to meet the requirements of a particular application. For example, <sup>99m</sup>Tc has a half-life of 6 h

and allows imaging up to 24 h after injection, while <sup>111</sup>In has a longer half-life of 68 h and is useful when delayed imaging of a slow physiological process is needed. There are various methods for liposome radiolabeling. Radiolabels may be encapsulated in the aqueous core of the liposome during the manufacturing process or nonspecifically attached to the liposome surface. A chelator with high affinity for the radionuclide may be covalently attached to the head group of a lipid and the lipid–chelator conjugate added to the liposome formulation during production, this way enhancing its stability.<sup>216</sup>

Liposomes can also provide a suitable biocompatible nanocarrier platform for developing MRI diagnostics.<sup>224</sup> For example, liposomes comprising a gadolinium-chelating lipid, such as 1,2-distearoyl-*sn*-glycero-3-phosphoethanolamine-N-diethylenetriamine pentaacetic acid (PE-DTPA (Gd)) have been administered intravenously to visualize thrombi or obstructions in blood vessels.<sup>225</sup> One of the important advantages of entrapment of MRI contrast agents into liposomes is the reduced toxicity of the formulations.<sup>226</sup>

The term theranostics was recently coined as a portmanteau of therapeutics and diagnostics. Theranostics combine pharmaceutical and diagnostic techniques to simultaneously or sequentially diagnose and treat diseases at their earliest stages.<sup>2</sup> LNPs incorporating diagnostic and pharmaceutical agents are called hybrid LNPs. Diagnostic probes such as fluorescent dyes or quantum dots can be encapsulated into liposomes;<sup>228</sup> at the same time, pharmaceutical agents such as doxorubicin, docetaxel, cisplatin, asanginex, or endostatin can be entrapped in LNPs.<sup>229,230</sup> For example, liposome-quantum dot hybrids loaded with the cytotoxic drug doxorubicin have been developed as theranostics. Encapsulation of quantum dots into the lipid bilayers of LNPs makes the quantum dots soluble under physiological conditions while liposomes loaded with doxorubicin are retained by tumors and more selective for cancer cells than the free drug, resulting in LNPs capable of both labeling and killing cancer cells.<sup>229</sup> Notable examples of patents from the CAS Content Collection related to the use of LNPs in theranostic formulations are listed in Table 6.

**Cosmetics.** The cosmetics industry was among the earliest to recognize and employ nanotechnology advances in various product development. Anticipated advantages of liposomal cosmetic formulations include enhanced stability and efficacy of these formulations, as well as successful penetration of the ingredients into the skin. A variety of marketed liposomal cosmetics are currently in use. The earliest product incorporating liposomes, Capture, was introduced by C. Dior in 1986. It contains thymus extract, collagen and elastin peptides, and hyaluronic acid in soya lecithin liposomes.<sup>231</sup> Another product containing hyaluronic acid in a liposomal delivery preparation is the Advanced Night Repair Protective Recovery Complex introduced by Estée Lauder. The formulation neutralizes and repairs the damage caused by UV-generated free radicals and moisturizes as well. L'Oréal has introduced an antiwrinkle liposomal product, Revitalift Double Lifting, containing pro retinol A.<sup>232</sup> Royal Jelly Lift Concentrate of Jafra Cosmetics International includes liposomes with a complex mixture of amino acids, vitamins, and minerals, to stimulate cell renewal and prevent skin wrinkles.<sup>232</sup> Liposomes are also formulated in commercial products with various extracts, moisturizers, antibiotics, and proteins, for uses such as wound healing, sunburn relief, hair conditioners, antiaging products, and longlasting perfumes. A summary of marketed LNP cosmetic products is included as Table S2 in the Supporting Information.





**Nutrition.** LNPs are increasingly prominent in the food industry and in nutrition.  $^{233-235}$  LNPs have been used to control the delivery of functional components such as proteins, enzymes, vitamins, and flavors in various food and nutritional applications. The term "nutraceutical" is used to describe formulations potentially providing both pharmaceutical and nutritional benefits.<sup>236–238</sup> These formulations may involve nutrients, dietary supplements, herbal preparations, and genetically engineered and processed foods. Recently, the use of solid lipid nanoparticles (SLN) and nanostructured lipid carriers (NLC) in food and dietary supplements has markedly increased due to their advantages in higher loading capacities, higher bioavailabilities of their cargoes, and easier large-scale production. For example, SLN are used to incorporate foodrelated bioactive compounds including essential oils such as peppermint oil, vitamins such as vitamins A, B<sub>2</sub>, B<sub>12</sub>, D<sub>2</sub>, and E, palm oil, coconut oil, copaiba oil, rosmarinic acid, resveratrol, and hesperidine.<sup>239</sup> NLC have been used to encapsulate foodrelated ingredients such as rutin, curcumin, quercetin, astaxanthin, vitamin C, vitamin A palmitate,  $\alpha$ -lipoic acid, and green tea extract.<sup>239</sup> Notable examples of patents from the CAS Content Collection related to LNP formulations for use in nutrient and nutraceutical encapsulation and delivery are presented in Table 7.

**Agriculture.** LNPs have been studied in agriculture as delivery systems for agrochemicals and as model membrane systems. A list of notable patents from the CAS Content Collection related to LNPs in agrochemical formulations is presented in Table 8.

**Nanoreactors.** A recent application of LNPs is as nanoreactors, nanoscale chemical reactors applied to nanotechnology and nanobiotechnology. For example, LNPs have been used as nanoreactors for the size-controlled synthesis of metal nanoparticles.<sup>240–242</sup> Metal nanoparticles are used in electronics, biosensors, and catalysis and are also used in biomedical applications such as imaging, drug delivery, and photothermal therapy. The sizes of nanoparticles determine many of their properties; thus, control over metal nanoparticle size is important in controlling their properties and in determining their suitability for use. For instance, nanosized liposomes encapsulating tetrachloroauric acid were used to prepare 2–5 nm gold nanoparticles.<sup>240</sup> The controlled diffusion of the reducing agent—sodium borohydride—through the liposomal membrane regulated the particle formation kinetics and resulted in ultrasmall nanoparticles with a narrow size distribution. In another example, stable palladium nanoparticles with sizes between 1–3 nm were prepared by reduction of a palladium precursor within liposomal nanoreactors using glycerol as both the reducing agent and stabilizer.<sup>242</sup> Palladium nanoparticles ~5 nm in diameter were prepared in the aqueous mesophase channels of lipidic cubic phases by reduction of Pd<sup>2+</sup> salts and used as supported catalysts for Suzuki–Miyaura cross-coupling reactions.<sup>243</sup> Similar methods using nanoreactors have been used for the synthesis of nonmetallic nanoparticles. For example, monodisperse nanocrystals of CdS, ZnCdS, and HgCdS have been synthesized in the cores of liposomes, using them as nanoreactors for precipitation or crystallization.<sup>244</sup>

Nanoreactors have also been proposed as tools for treatment of disease and eliminating harmful substances by allowing the production of therapeutic agents in situ. For example, the antioxidant enzyme catalase has been encapsulated inside liposomes comprising a cisplatin prodrug-conjugated phospholipid, for enhanced chemo-radiotherapy of cancer.<sup>245</sup> The liposomes protect the enzyme from proteolysis and enhance its stability. The enzyme has been able to trigger decomposition of hydrogen peroxide produced by tumor cells thus producing oxygen in order to overcome hypoxia-induced treatment resistance of the tumor. At the same time, the entrapped cisplatin prodrug is oxidized, releasing cisplatin, and subsequent radiation therapy results in successful tumor growth inhibition.<sup>246,247</sup> Polymeric dots (Pdots) loaded in liposomes have been used to reduce inflammation through in situ photocatalytic hydrogen generation.<sup>248</sup> Pdots containing  $\pi$ -conjugated polymers generate hydrogen when exposed to light, while liposomes hold the reagents and Pdots together. As hydrogen is formed in the liposomes, it diffuses across the lipid bilayer to reduce reactive oxygen species (ROS) abundant in diseased and damaged tissue.<sup>248</sup> In addition, liposome-based nanoreactors may also be useful for delivering enzymes for eliminating harmful substances. For example, the ability of the exogenous cholinesterase enzymes to act as scavengers of organophosphate toxins has been explored. Butyrylcholinesterase has been encapsulated in liposomes, which protect the enzyme from proteolysis. The organophosphate toxins can diffuse through the **ACS Nano** 

www.acsnano.org

Review

liposomal membrane and be neutralized by the encapsulated enzyme.  $^{\rm 249,250}$ 

**Membrane Models in Basic Science.** Lipid models have been used for decades to investigate membrane-related processes and characteristics. While biomembranes are heterogeneous multicomponent structures with sophisticated molecular organization, model LNP systems are much simpler and more stable, and therefore amenable to study of the structure and function of biological membranes. Virtually all of our current understanding of membrane lipid phase behavior results from the use of lipid membranes as model systems.<sup>251–260</sup>

# INSIGHTS ON LIPID NANOPARTICLES FROM THE CAS CONTENT COLLECTION

In what follows, we used the CAS Content Collection to get an overview of the current LNP research landscape, classifying and



Figure 10. LNP-related patents (%) in the top research areas over time in the years 2000-2020. The percentages are calculated within the given research area.

quantifying all documents related to LNPs from the years 2000–2020. As the largest human-curated collection of published scientific knowledge, this data collection curated by CAS



Figure 12. Number of LNP-related documents (patents and nonpatents) in the CAS Content Collection in the years 2000–2020, with respect to different types of LNPs.

scientists is particularly useful for quantitative analysis of publications with respect to variables such as time, research area, formulation, and application, as well as the details of chemical compositions.

Landscape of LNP Research Publications. Currently, there are over 216,000 LNP-related scientific publications in the CAS Content Collection, including patents and nonpatents (journal articles, books, dissertations, meeting abstracts, *etc.*), of which over 170,000 are from the period 2000–2020. The distribution of these documents among the top research areas is presented in Figure 9. LNP-related studies are dominated by pharmaceutical research in both patents and nonpatents. The research areas of cosmetics, genetics, and immunochemistry have the highest percentages of patent publications (Figure 9).

The evolving distribution of documents within these research areas over the past 20 years is shown in Figure 10. The research areas with the fastest growth are pharmaceuticals, food and feed, and cosmetics. The decrease in the number of documents in genetic research in the past decade may be due to the limited success of delivering DNA for gene therapy using lipid vectors (lipofection). A review of gene therapy clinical trials performed worldwide before 2017<sup>261</sup> reported that only 4.4% of the trials used lipid vectors in gene delivery, while most trials used viral vectors. Although LNPs have many advantages in gene delivery (low immunogenicities, facile production on a large scale, and



Figure 11. Number of LNP-related documents per year (%) in the CAS Content Collection in the years 2000–2020, with respect to different types of LNPs. The percentages are calculated within the given type. The inset shows the LNP vs liposome documents (%) per year.

Review



Figure 13. Distribution of documents in the CAS Content Collection related to LNP pharmaceutical formulations with respect to their target diseases.



Figure 14. Distribution of documents related to LNP drug delivery with respect to their delivery route.

the ability to deliver large genes), viral vectors have been used more often because current LNPs are not as efficient as viral vectors in delivering genes.<sup>262</sup> The recent rise in interest in RNA therapeutics may hopefully change that perception. While gene therapy requires delivery of DNA into the cell nucleus through the nuclear membrane, entry into the cytoplasm is sufficient for RNA drugs and vaccines, enhancing their chances for success. The effectiveness of the recently developed mRNA vaccines using LNPs as delivery agents may reawaken interest in LNPs for nucleic acid delivery. Indeed, the number of nucleic acid delivery-related LNP patents filed during the first quarter of 2021 is more than half of the number of such patents published in all of 2020.

Table 9. Advantages	and Disadvantages	of the	Three Major
LNP Administration	Routes <sup>175</sup>		

Administration route	Advantages	Disadvantages
Parenteral	Good bioavailability	Painful, causing discomfort
	Appropriate for all LNP types	May require administration at medical facilities
	No liver toxicity	
	Good reproducibility	
Oral	Comfort of use	Low bioavailability
	Acceptable by patients	Hepatic toxicity
		Inconsistent reproducibility
Topical/ transdermal	Comfort of use	Limited penetration
	Acceptable by patients	Lag-time delay
	Satisfactory reproducibility	

Distribution of Research Documents with Regard to the LNP Type. As discussed above, there are various types of LNPs, with different properties and applications; their usage has changed over time and with improvements in the understanding of LNP properties and technologies. The distribution of the types of LNPs in related documents published between 2000 and 2020 is shown in Figure 11.

The terminology used for lipid nanoparticles has changed over time. Many more publication records in the CAS Content Collection contain the term "liposome" (~147,000 for the period 2000–2020) than "lipid nanoparticle" (~26,000 for the same period), even though "lipid nanoparticles" forms a broader class of nanoparticles than "liposomes", including also formulations such as solid lipid nanoparticles (SLN), nanostructured lipid carriers (NLC), cubosomes, *etc.* While "lipid nanoparticle" is a more general term than "liposome", the term "liposome" was invented earlier, when these lipid vesicles were

170	parenteral/ injections	topical/ transdermal	oral	nasal	ophthalmic	inhalation
immunoliposomes / ligands	1878)	682	797	353	193	260
stealth / sterically stabilized	234	15	23	1	6	7
solid lipid nanoparticles (SLN)	204	514	433	50	82	51
nanostructured lipid carriers (NLC)	78	281	147	37	58	20
cationic liposomes	293	47	34	37	21	18
lipoplexes	272	50	28	26	15	22
ethosomes	8	329	12	5	2	2
cubosomes	11	17	11	1	5	0

Figure 15. Correlation of the number of documents for the various LNP types with their delivery routes.

	antitumor	gene therapy	anti- inflammatory	antiviral	anti- bacterial	anti- infective	vaccines	anti- diabetic	fungicides	cardio- vascular	analgesics	immuno- therapy
immunoliposomes / ligands	18289	1987	1729	896	499	386	975	382	398	329	341	1861
stealth / sterically stabilized	5253	273	645	331	171	108	235	169	212	144	158	311
nanostructured lipid carriers (NLC)	181	13	92	14	35	10	3	15	29	2	13	2
solid lipid nanoparticles (SLN)	508	76	171	<b>S</b> 4	78	24	9	56	68	2	34	n
cationic liposomes / lipoplexes	1208	1916	105	116	53	22	214	п	13	11	15	145

Figure 16. Correlation of the number of documents for the various LNP types and therapies they have been applied to.

discovered in the 1960s. The term "lipid nanoparticle" was coined only in the early 1990s (the earliest document in the CAS Content Collection referring to lipid nanoparticles is from 1992), at the beginning of the era of nanoscience and nanotechnology. The more rapid increase in the number of documents using the term "lipid nanoparticles" than in documents using "liposome" (Figure 11, inset) may arise from its more recent coinage.

In the LNP subcategories, immunoliposomes and cationic liposomes are reported in the largest numbers of documents (Figure 12), while the fastest growth in publication is observed in the most recent areas—solid lipid nanoparticles (SLN), cubosomes, and especially nanostructured lipid carriers (NLC), which are steadily becoming the preferred formulation type for many applications (Figure 11) due to their advantages including higher drug-loading capacity, long-term colloidal stability, enhanced oral bioavailability of hydrophobic drugs, and improved drug release properties.<sup>263</sup>

**LNP-Based Drug Delivery Systems.** Distribution of Documents in the CAS Content Collection Related to

Pharmaceutical Formulations with Respect to Target Diseases. As seen above, LNP-related research is dominated by scientific areas related to drug delivery-pharmaceuticals, pharmacology, and also biochemistry, biochemical methods, immunochemistry, and genetics (Figure 9). Documents using LNPs in pharmaceutical formulations were classified by their target diseases to understand how different LNP types are used in practice. The distribution of treatment areas using LNP formulations in drug delivery-related documents in the CAS Content Collection is presented in Figure 13. The use of LNPs in antitumor drug formulations dominates the use of LNPs. Antitumor LNP formulations are used to treat a wide range of cancers; the largest single use (>25%) was in treating breast cancer, with more than 10% of antitumor formulations used for ovarian and lung cancers and significant proportions used for melanoma, leukemia, and prostate, pancreatic, colon, and stomach cancers (Figure 13, inset).

Distribution of Documents Related to Drug Delivery with Respect to Their Delivery Route. Most of the LNP pharmaceutical formulations are for parenteral, oral, or dermal www.acsnano.org

Review



Figure 17. Distribution of LNP-related documents with respect to cosmetic product types.

(

Count	ry/Region	Organi	zation	
34:6	USA	1.10	University of California	USA
24.9	China	0.56	Massachusetts Institute of Technology	USA
7.2	Japan	0.55	China Pharmaceutical University	China
4.6	S. Korea	0.49	Fudan University	China
4.3	Germany	0.45	Shenyang Pharmaceutical University	China
3.0	France	0.37	Zhejiang University	China
2.6	Canada	0.34	Sichuan University	China
1.7	India	0.33	Suzhou Zhiweitang Biotechnology Co., Ltd.	China
1.6	UK	0.33	Shanghai Jiao Tong University	China
1.4	Israel	0.31	Boston Scientific Scimed, Inc.	USA
1.4	Switzerland	0.31	Peking University	China
1.7	Russia	0.29	Genentech, Inc.	USA
1.2	Taiwan	0.29	University of Texas	USA
1.1	Italy	0.29	United States Dept. of Health and Human Services	USA
1.1	Denmark	0.27	Abbott Cardiovascular Systems Inc.	USA
10	Conin	0.26	The Johns Hopkins University	USA
0.0	Spain	0.26	Harvard University	USA
0.9	Drazii	0.25	Novartis AG	Switzerland
0.8	Netherlands	0.23	Schering Corporation	Germany
0.8	Belgium	0.23	Centre National de la Recherche Scientifique	France
0.5	Australia	0.22	Immunomedics, Inc.	USA
0.3	Norway	0.22	Bristol-Myers Squibb Company	USA
0,3	Hungary	0.22	Massachusetts General Hospital	USA
0.2	Turkey	0.20	Yale University	USA
0.2	Mexico	0.20	Duke University	USA
0.2	Poland	0.20	Merck & Co., Inc.	USA

Figure 18. LNP-related patents classified by the top countries and organizations, presented as percent of the total number of LNP-related patents in the years 2000–2020.

administration (Figure 14). The major advantages and disadvantages of these routes are summarized in Table 9.

*Correlation between Various LNP Types and Their Delivery Routes.* The correlation between the various kinds of LNP preparations and their delivery routes is illustrated in Figure 15. The strongest correlation was in the use of immunoliposomes for parenteral applications. Some formulations such as ethosomes are designed mainly for topical administration, while solid lipid nanoparticles and nanostructured lipid carriers can be applied topically, orally, and parenterally.



Figure 19. LNP-related patents per year for the top patent offices presented as percent of the total number of LNP-related patents in the years 2000–2020.



Figure 20. LNP-related patents per year in the years 2000–2020 for the top five countries presented as the total number of LNP-related patents. Inset: Percentage of the total number of LNP patents for the given country.

Correlation of the Various LNP Types and Therapies They Have Been Applied to. Different types of LNPs have different advantages and disadvantages and thus are appropriate for different therapies. Figure 16 illustrates the correlations between LNP types and the therapies to which they have been applied. Immunoliposomes, sterically stabilized liposomes, and cationic liposomes are the most commonly used LNPs for antitumor therapy. Understandably, cationic liposomes are the preferred formulation for gene therapy, and immunoliposomes are preferred as delivery vehicles for immunotherapies, including cancer immunotherapy. **LNP-Based Cosmetics.** In cosmetics, LNP formulations are most prevalent in patents for sunscreens, antiaging preparations, and perfumes (Figure 17). Nanostructured lipid carriers (NLC) are the preferred carriers for sunscreens because of their ability to enhance the photostability of normally photolabile UV absorbers and to allow their sustained release over time, reducing skin irritation.<sup>264</sup> Various active ingredients are used to prevent, delay, and treat skin aging, such as antioxidants, biological growth factors, herbal ingredients, and retinoids. Such preparations have been termed cosmeceuticals, because they are intended to have both cosmetic and pharmaceutical benefits.

### Table 10. Number of Patents for the Four Most Widely Used Phospholipid Classes in LNP Formulations<sup>a</sup>

R1 / R2	Phosphatidylcholines (PCs)	Phosphatidyl- ethanolamines (PEs)	Phosphatidyiglycerols (PGs)	Phosphatidylserines (PSs)
		1	2.	
	1		~	~
	1000	"	A	A
	1		1.	2.4
				1 A A A A A A A A A A A A A A A A A A A
	********	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	$\sim \sim \sim \sim$	
6:0/6:0	37	19	7	3
7:0 / 7:0	14	8		*
8:0 / 8:0	30	5	5	5
11:0/11:0	29			
10:0 / 10:0	82	16	8	5
12:0/12:0	406	104	154	18
13:0 / 13:0	12		1	
14:1c9 / 14:1c9	23			
14:0/16:0	95		11.00	10.000
14:0 / 14:0	1407	445	612	176
14:0 / 18:0	41			
15:0/15:0	41	5		
16:0/2:0	10		122	2
16:0/14:0	88	1997	4	2
16:0/16:0	2507	827	755	314
16:1c9 / 16:1c9	45	21		
16:4me3,7,11,15 /	47	116	3	
16:4me3,7,11,15	110			
10:0 / 10:0	130	2.4.4		
16:0 / 18:209,12	100	11	107	<b>10</b>
16:0 / 18:109	DBU	217	455	68
16:0/20:465,8,11,14	10			
17:0717:0	18	3	4	
18:0 / 14:0	21	20		
18:0 / 16:0	99		15	
18:0/18:0	1930	841	417	199
18:0/18:109	14	00	0	1
18:0 / 18:209,12		10	2	
3:0/22:6c4,7,10,13,16,19	<u> </u>			
18:1c9/14:0	9	4	100	
18:1c9/18:1c9	1391	1547	430	271
18:109/16:0	40		9	
18:109/18:0	11	10		
18:109/18:109	139	- 50	6	2
18:1y1//18:1y1/	1000	1010	100	2
18:209,12 / 18:209,12	H	42	8	11
18:209,12 / 10:0	4			3
10:0 / 10:309,12,15	b	21	5	
19:0 / 19:0	12			
20:405,8,11,14 / 16:0	64 C	100	2	1
20:0 / 20:0	83	18	8	9
20:4c5,8,11,14 / 18:0			2	
20:405,8,11,14 /		8	13	
21.0 / 21.0	10			
22-1012/22-10	40	10		3
22.1015/22.1015	12	10	1	4
22:07 22:0				
24:07 24:0 3-6ed 7 10 13 16 16 / 16-0	34	¥		
		2	2	2
22-6-4 7 10 13 16 10 /			14.1	,
22-6-4 2 10 13 16 19	33	28	5	2

"The structures of these phospholipids are shown at the top of the table. Designation nomenclature: All acyl chain residues are fully specified, using a systematic nomenclature, as follows. The two chain lengths, in units of carbon atoms (and with the first carbon of the chain defined as the one bonded through an oxygen atom to the glycerol backbone), are given, each to the left of a colon (:). The two chain descriptors are separated from each other by a backslash. In the default configuration the hydrocarbon chains are saturated. Modifications to each chain are indicated to the right of the colon and are listed according to number, kind, and location. First, to the right of the colon appears the number of modifications on that

### Table 10. continued

chain. A zero (0) indicates that the chain is in the default configuration, with no modifications. Following the number of modifications, the modifications themselves are listed. Following each modification is a number indicating the carbon atom position on the chain where the modification is located. The letters "c" and "t" denote the cis and trans configuration, respectively, of the double bond, followed by a number or set of numbers identifying double bond position; "y" denotes triple bond; "me" denotes methyl isobranching.

Carriers for such cosmetic formulations include liposomes, solid lipid nanoparticles (SLN), and nanostructured lipid carriers (NLC).<sup>265</sup> The use of nanoencapsulation in fragrance products improves their efficiency and allows sustained release of scents over time.<sup>266</sup>

# INSIGHTS ON LNP-RELATED PATENTS FROM THE CAS CONTENT COLLECTION

As of June, 2021, there are over 45,000 patents related to LNPs/ liposomes in the CAS Content Collection, over 41,000 of which

# Table 11. Number of Patents for the Most Widely Used PEG-lipids in LNPs

R1/R2	Common/ Commercial Name	CAS RN	Numbe of patents
	PEG-PI	E <sup>a</sup>	
18:0/18:0	DSPE-PEG	145035-96-7; 170931- 04-1	483
16:0/16:0	DPPE-PEG	145035-97-8; 170931- 03-0	94
18:1c9/18:1c9	DOPE-PEG	145035-95-6; 262601- 19-4	43
14:0/14:0	DMPE-PEG	211567-66-7; 211733- 74-3	38
18:1c9/16:0		170127-34-1	5
12:0/12:0		2055341-27-8	4
18:2c9,12/18:2c9	,12	736998-47-3	4
	mPEG-glyc	erides	
14:0/14:0	DMG-PEG	160743-62-4	245
		1397695-86-1	
18:0/18:0	DSG-PEG; Sunbright	308805-39-2	36
	DSG 2H; Sunbright DSG 20H	850628-36-3	
16:0/16:0	DPG-PEG	162409-28-1	17
18:1c9/18:1c9		160743-61-3	5
	mPEG-1	PE	
18:0/18:0	DSPE-mPEG; Sunbright DSPE 020CN	156543-00-9; 247925- 28-6; 474922-77-5; 459428-35-4	329
16:0/16:0	DPPE-mPEG	205494-72-0	29
14:0/14:0	DMPE-mPEG	474922-82-2; 261764- 82-3	33
18:1c9/18:1c9		226940-29-0	20
	amino-ml	PEG	
14:0/14:0	ALC-0159	1849616-42-7	6
12:0/12:0		1849616-44-9	1
12:0/14:0		1849616-45-0	1
16:0/16:0		1849616-43-8	1
18:0/18:0		741737-56-4	1
	Chol-PH	EG	
PEG-cholesterol	PEG-cholesterol	27321-96-6	54
mPEG- cholesterol	mPEG-cholesterol	99559-58-7	11

<sup>a</sup>For the structures of the various PEG-lipid subclasses, see Figure 21, lower panel.

are in the years 2000–2021. The majority of LNP patents come from inventors in the US and China (Figure 18). The largest recipient of LNP patent filings is the World Intellectual Property Organization (WIPO). While the proportion of patents filed with WIPO has stayed nearly constant between 2000 and 2020, the share of patents filed with the China National Intellectual Property Administration (CNIPA) has increased significantly, from less than 1% of patents in 2000 to over 33% of all patents in 2020. Over this period, the fraction of LNP patents filed with the US Patent and Trademark Office (USPTO) decreased significantly, particularly between 2010 and 2018 (Figure 19).

**Distribution of LNP-Related Patents by Country and Organization.** The top five countries contributing to the growth in LNP patents are the USA, China, Japan, South Korea, and Germany. While the involvement of USA, Japan, and Germany in LNP research has remained stable after the initial growth in the years 2000–2005, the involvement of China and South Korea in LNP research has increased consistently during the same period (Figure 20).

Most Widely Used Lipids in LNP Formulations in Patents. There are many components used in LNPs, with the composition determined by the intended morphology and application. Along with the most common constituents— phospholipids and cholesterol—LNPs frequently include cationic ionizable lipids and PEG–lipid conjugates (PEG-lipids), as well as various other components. A collection of ~45,000 LNP-related patents were identified in the CAS Content Collection. The most widely used members of various lipid classes were identified in these patents.

*Cholesterol* (CAS RN 57-88-5) is the lipid component used in the largest number of patents—over 3,200 patents have used LNP formulations including cholesterol.

*Phospholipids* (Table 10) are the most prevalent class of lipids involving LNPs. Phosphatidylcholines (PCs), phosphatidylethanolamines (PEs), phosphatidylglycerols (PGs), and phosphatidylserines (PSs) are the most common phospholipid constituents. Preferred phospholipid species with respect to their hydrocarbon chains include saturated dimyristoyl (14:0/14:0), dipalmitoyl (16:0/16:0), and distearoyl (18:0/18:0) chains, as well as unsaturated dioleoyl (18:1c9/18:1c9) chains (Table 10). Phospholipids from natural sources, such as soya total phospholipids, soya phosphatidylcholines, hydrogenated soya phosphatidylcholines, and egg phosphatidylcholines, have also been commonly used in LNP formulations.

*PEG–Lipid Conjugates.* Since the discovery that PEG–lipid conjugates can significantly increase the circulatory half-lives in the sterically stabilized "stealth" liposomes, PEG-lipids have been widely used in pharmaceutical LNP formulations. The major classes PEG-lipids found in patents are listed in Table 11, with their structures depicted in Figure 21.

*Cationic Lipids.* The most often used cationic lipids in LNP formulations were identified and listed in Table 12. They typically comprise various amine derivatives, *e.g.*, DOGS and DC-Chol, quaternary ammonium compounds, *e.g.*, DOTMA,

Review



Figure 21. Number of patents for the most widely used PEG-lipids in patents on LNPs.

DOTAP, DORIE, and DMRIE, cationic phosphatidylcholines such as EDOPC and EDMPC, combinations of amines, e.g., DOSPA and GAP-DLRIE, and amidinium salts, e.g., Vectamidine.<sup>18,19,267-275</sup> Cationic multicharged head groups such as DOSPA and DOGS have been reported to be more effective than single-charged cationic lipids such as DOTMA, DOTAP, DC-Chol, and DMRIE.<sup>276,277</sup> The increased effectiveness may be related to the greater ability of highly charged cationic lipids to condense and protect nucleic acids, but the increased binding of multicharged ligands to nucleic acids may also obstruct or inhibit nucleic acid release inside the cell. In addition, the combination of quaternary ammonium salts and polyamines enhances delivery efficiency. Indeed, the earliest cationic lipid incorporating both quaternary ammonium and polyamine moieties, Lipofectamine (CAS RN 158571-62-1), comprising a 3:1 mixture of DOSPA and dioleoylphosphatidylethanolamine (DOPE), is a highly effective transfection agent.

### SUMMARY AND OUTLOOK

**Insights on LNP Compositions Inferred from the Research Landscape.** Based on the landscape analysis of the LNP-related documents in the CAS Content Collection, the following aspects may be worth considering when selecting lipid compositions for LNP formulations.

- Biocompatibility. Naturally occurring lipids are preferable, because they are likely to be metabolizable in the target species. The most widely used class of lipids in LNP formulations are phospholipids, which are also the major class of biomembrane lipids.
- Fluidity. Cholesterol is well-known as a powerful modulator of lipid bilayer fluidity; it is able to enhance the fluidity of solid bilayers and to reduce the fluidity of liquid bilayers. It is also one of the major components of biomembranes and is highly biocompatible.
- Phase state and phase transition temperature. Phase state is an important characteristic of LNPs—it contributes to their stabilities and encapsulation efficiencies and controls

their interactions with biomembranes and cargo release. The phase transition temperatures of the individual lipids in the LNP as well as their miscibilities should be considered. Generally, lipids with longer alkyl chains and higher degrees of saturation have higher transition temperatures.

- Electric charge (zeta potential). The electric charges of LNPs affect their stability, their rate of cargo release, their circulating half-lives in the bloodstream, and their fusion with biomembranes. Naturally occurring membrane lipids are either zwitterionic (PCs, PEs) or negatively charged (PGs, PSs). In many uses, such as in nucleic acid delivery, the presence of positive-charged lipids is beneficial, leading to the development and use of synthetic cationic lipids. Since cationic lipids are not natural constituents of cells, their biocompatibilities and the toxicities of their degradation products should be considered.
- Toxicity is especially relevant to formulations including cationic lipids, which are synthetic and whose toxicities may not be known or have been observed in biological systems. In many cases, the effectiveness of a cationic lipid in LNP formulations correlates to increased toxicity. For example, multivalent cationic lipids have been more effective than monovalent cationic lipids in LNP formulations but are also much more toxic to cells. Identification of cationic lipids with similar structures to natural lipids known to be effective in LNPs such as cationic ethylphosphatidylcholines or cationic cholesterols may yield LNPs with reduced side effects.
- Size is a critical parameter in determining LNP circulation half-life and drug encapsulation. The size of LNPs strongly depends on how they are prepared. Ultrasonication, extrusion, and microfluidic methods have been most often used to control LNP size.
- Circulation time and phagocytic uptake. Coating LNPs with an inert polymer such as PEG considerably extends their residence in blood circulation by preventing phagocytes from reaching the surface of LNPs and

### Table 12. List of the Most Widely Used Cationic Lipids in LNPs in Patents

CAS Registry Number	Chemical Structure	Common/Commercial Name	Number of References
3700-67-2	·····	DDAB	2532
113669-21-9	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	DOTAP	2422
137056-72-5	with	Cholesterol (2- dimethylaminoethyl) carbamate; DC-Chol	904
112-99-2	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Dioctadecylamine ; Armeen 2-18; Distearylamine; Genamin SH 200	821
104162-48-3	t	DOTMA	806
105488-80-0	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	CLONfectin; Vectamidine	585
153312-64-2		DMRIE	357
124050-77-7		DOGS Transfectam	323
127512-29-2		1,2-Dl(oleoyloxy)-3- (dimethylamino) propane; DODAP	303
871258-12-7	manuburn	DLinDMA	245
1224606-06-7		DLin-MC3-DMA; MC 3; RV 28	238
168479-03-6	and the state of t	DOSPA	229
183283-20-7		EDOPC	204
1190197-97-7	maninoly	DLin-K-XTC2-DMA; Dlin-KC2-DMA; XTC	200
104162-47-2		DODMA; MBN 305A; N-[2,3- Di(oleyloxy)propyl]- N,N-dimethylamine	181
16724-63-3	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Armeen 2-16 Dipalmitylamine	174
17361-44-3	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Alamine 205 Dimyristylamine NSC 91530	122
1169768-05-1	merentope	DLin-K-DM4	91
874291-25-5	manufana	DLenDMA	90

www.acsnano.org

### Table 12. continued

CAS Registry Number	Chemical Structure	Common/Commercial Name	Number of References
183283-19-4		EDMPC	88
1220890-25-4		C12-200 Tech G 1	87
178532-92-8	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	DOSPER	87
179075-30-0	~ udother	GL 67 N4-Spermine cholesteryl carbamate	83
182056-06-0	in which the	BGTC; Bisguanidinium tren- cholesterol	73
908860-82-2	all the second and the second a	CLinDMA	52
1019000-51-1	manutépung	DLinDAP	49
230949-32-3		EDLPC	48
153312-60-8		DORIE	44
1351586-50-9		L 319 RV 92	41
124076-29-5			39
1226778-72-8	maranta pr	ALN 100 ALNY 100	36
1208381-69-4		Octyl CLinDMA	36
2089251-47-6	mutul	SM-102	36

www.acsnano.org

### Table 12. continued

CAS Registry Number	Chemical Structure	Common/Commercial Name	Number of References
1318793-78-0	marino-	YSK 05	35
908860-85-5		DMOBA	33
200337-52-6	mundat	CDAN GL 138	31
1415795-37-7	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	HGT 4003	29
760939-62-6	- Linger and the	MVL 5	29
1169768-13-1		DLin-C-DAP	28
30656-75-8	andothen	Cholest-5-en-3β- oxyethane tosylate	28
1361106-13-9	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Compound 32	28
1260141-95-4		y-DLenDMA	28
449791-79-1	multiple	HisChol	28
1413010-97-5		KL22	27
1413010-89-5		KL10	27
396727-98-3	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Dimyristyloxypropyla mine	26
789482-14-0	gor 		26
1208381-72-9	company		25

#### Table 12. continued

CAS Registry Number	Chemical Structure	Common/Commercial Name	Number of References
1208381-70-7			25
908860-83-3	mand to the	CpLinDMA PCLinDMA	24
200337-57-1	munder	СТАР	21
1169768-15-3	maxima	DLin-S-DMA	13
1169768-10-8	manglim	DLin-2-DMAP	13
959664-11-0	Hat the constant	Dioleylamine-A- succinyl paromomycin DOSP	13
1192257-55-8	manufuna	C2-DLinDMA	11
208040-06-6		GAP-DLRIE	10
1217306-47-2	menericany	DLin-K-C4-DMA	9
1217306-46-1	mentille	DLin-K-C3-DMA	9

inhibiting their ability to uptake LNPs through steric hindrance.

- Cargo release. Effective LNPs rely on a delicate balance between stability and cargo release. LNPs need to be stable enough to safely transport their cargo to their targets yet capable of falling apart to release their cargo at the desired location. In many cases, external stimuli can be used to facilitate drug release. For example, when the pH at the desired location differs from the pH at other sites, ionizable lipids can facilitate drug release at that desired location. Cargo release from LNPs containing cationic lipids can also be triggered by lipid exchange with biomembranes, inducing the formation of nonlamellar phases.
- Encapsulation efficiency and stability. Replacing traditional liposome formulations with solid lipid nanoparticles (SLN) or especially with nanostructured lipid carriers (NLC) may enhance the stability and encapsulation efficiency of lipid nanocarriers significantly.

**Perspectives.** Nanotechnology has significantly widened the horizons in science and particularly in medicine. Due to their small size and high surface area, drug nanoformulations such as the LNPs have different properties than the corresponding bulk materials, and the changes in the biochemical, electronic, magnetic, and optical properties of nanoparticle drug formulations have been used to therapeutic benefit. As a result, nanomedicine has brought impressive progress in modern drug therapy against many diseases. Application of nanotechnological strategies to drug delivery has improved the effectiveness, selectivity, residence time, and biodistribution of conventional drug carrier systems while reducing their limitations. Furthermore, nanoparticle drug formulations have reduced the toxicities and improved the solubilities and bioavailabilities of conventional medicines. The continuous efforts in synthesis and screening of functionalized lipid nanomaterials by chemically optimizing their molecular structures to enable tunable biodegradability *in vivo* would promote the development of more versatile, highly efficient, and biocompatible delivery vehicles.

As ongoing research attempts to address the needs of personalized medicine, more sophisticated and multifunctional nanocarrier designs are being developed. LNPs with complex structures are being designed to overcome biological barriers specific to individual patient or disease status as demanded by precision, or personalized, medicine. The objective of precision medicine is to utilize patient information such as genetic profile, age, lifestyle, environmental conditions, or comorbidities in order to develop an individualized treatment approach. Tailored nanocarrier designs, adapted by patient data and engineered to permeate particular barriers, can markedly improve the delivery of and response to precision medicine therapies.<sup>278</sup>

The use of LNPs in medicine is likely to expand significantly. The development of LNP types and varieties with enhanced drug delivery properties such as the nanostructured lipid carriers and the ionizable cationic nanoparticles brings further advantages to the LNP formulations and enlarges the prospects of their applications. LNPs hold great promise in genetic medicine where gene editing, vaccine development, immunooncology, and other genetic therapies rely on the ability to efficiently deliver nucleic acids into cells. LNPs have advantages over other gene and vaccine delivery systems because they are easier to manufacture, are less immunogenic, can carry larger payloads, and can be designed for multiple dosages. Nucleic acid therapeutics are an emerging class of drugs showing potential for treating disease. LNPs have come out as successful and efficient carriers for such drugs. The successful use of LNPs as a delivery vector for the COVID-19 mRNA vaccines will likely broaden the horizons for research in mRNA vaccines.

From a materials science perspective, the success of LNPs in medicine is important, as it motivates further fundamental and applied nanoparticle research. The use of LNPs in the controlled synthesis of metal nanoparticles may also be important in expanding their use in display technologies and other uses. Expansion of the LNP technologies in other areas is also noticeable. Numerous cosmetic products are already in the market, with much more in development. Additional areas such as nutrition, nutraceuticals, agrochemistry, and nanoreactors are already exploring the benefits of lipid-based nanoencapsulation. Further, LNPs may have environmental applications, such as in metal detoxification. Based on the current progress and success, LNPs can certainly be recognized as one of the most advantageous and promising areas in modern nanotechnology.

### ASSOCIATED CONTENT

### **Supporting Information**

The Supporting Information is available free of charge at https://pubs.acs.org/doi/10.1021/acsnano.1c04996.

Table S1. Clinically approved LNP formulations. Table S2. Marketed LNP cosmetic preparations. Figure S1. Classification of liposomes according to their size and lamellarity. Figure S2. Mechanism of action of mRNA mediated vaccination. (PDF)

### **AUTHOR INFORMATION**

### **Corresponding Author**

#### Authors

- Rumiana Tenchov CAS, a division of the American Chemical Society, Columbus, Ohio 43210, United States; © orcid.org/ 0000-0003-4698-6832
- **Robert Bird** *CAS, a division of the American Chemical Society, Columbus, Ohio* 43210, United States
- Allison E. Curtze CAS, a division of the American Chemical Society, Columbus, Ohio 43210, United States

Complete contact information is available at: https://pubs.acs.org/10.1021/acsnano.1c04996

#### Notes

The authors declare no competing financial interest.

### ACKNOWLEDGMENTS

We sincerely appreciate Zachary Baum for proofreading, Laura Czuba for project coordination, and Peter Jap and Cristina Tomeo for insightful discussion. We are also grateful to Manuel Guzman, Gilles Georges, Michael Dennis, Carmin Gade, Dawn George, Cynthia Casebolt and Hong Xie for executive sponsorship.

#### VOCABULARY

Lipid nanoparticle (LNP), nanosized particle composed mainly of lipids, used predominantly in drug delivery but also in cosmetics, nutrition, etc.; liposome, a vesicle comprising at least one lipid bilayer; major types of liposomes are small unilamellar liposomes (SUV) having a single bilayer and multilamellar liposomes (MLV) having several lipid bilayers; solid lipid nanoparticles (SLN), LNPs comprising solid lipids; nanostructured lipid carriers (NLC), LNPs comprising a mixture of solid and liquid-crystalline lipids. Both SLN and NLC are widely used in drug delivery because of their enhanced physical stabilities, high loading capacities, high bioavailabilities of their cargoes, and facile production on a large scale; cationic lipid, synthetic lipid compound similar to the natural lipids, except for the presence of an ionizable (cationic) head group instead of the zwitterionic or anionic head group of the natural lipids; invented and applied mainly for delivery of nucleic acids; "stealth" liposome, sterically stabilized liposome coated with biocompatible inert polymers (mostly PEG), making them invisible to phagocytes, thus exhibiting long circulation half-life; immunoliposome, targeted liposome generated by coupling a ligand, typically an antibody, to the liposomal surface, allowing for active tissue targeting through binding to cell-specific receptors.

### REFERENCES

(1) CAS Content Collection. https://www.cas.org/about/cascontent (accessed 2021-06-09).

(2) CAS Data. https://www.cas.org/cas-data (accessed 2021-06-09).

(3) Bangham, A. D.; Standish, M. M.; Watkins, J. C. Diffusion of Univalent Ions across Lamellae of Swollen Phospholipids. *J. Mol. Biol.* **1965**, *13*, 238–252.

(4) Gregoriadis, G. Liposomes in Drug Delivery: How It All Happened. *Pharmaceutics* **2016**, *8*, 1–5.

(5) Weissig, V. Liposomes Came First: The Early History of Liposomology. In *Liposomes: Methods and Protocols*, 2nd ed.; D'Souza, G. G. M., Ed.; Humana Press: New York, 2017; Vol. 1522, pp 1–15.

(6) Working, P. K.; Dayan, A. D. Pharmacological-Toxicological Expert Report. Caelyx. (Stealth Liposomal Doxorubicin Hcl). *Hum. Exp. Toxicol.* **1996**, *15*, 751–785.

(7) Bulbake, U.; Doppalapudi, S.; Kommineni, N.; Khan, W. Liposomal Formulations in Clinical Use: An Updated Review. *Pharmaceutics* **2017**, *9*, 1–33.

(8) Laouini, A.; Jaafar-Maalej, C.; Limayem-Blouza, I.; Sfar, S.; Charcosset, C.; Fessi, H. Preparation, Characterization and Applications of Liposomes: State of the Art. *Journal of Colloid Science and Biotechnology* **2012**, *1*, 147–168.

(9) Harashima, H.; Sakata, K.; Funato, K.; Kiwada, H. Enhanced Hepatic Uptake of Liposomes through Complement Activation Depending on the Size of Liposomes. *Pharm. Res.* **1994**, *11*, 402–406.

(10) Nagayasu, A.; Uchiyama, K.; Kiwada, H. The Size of Liposomes: A Factor Which Affects Their Targeting Efficiency to Tumors and Therapeutic Activity of Liposomal Antitumor Drugs. *Adv. Drug Delivery Rev.* **1999**, *40*, 75–87.

(11) Allen, T. M.; Everest, J. M. Effect of Liposome Size and Drug Release Properties on Pharmacokinetics of Encapsulated Drug in Rats. *J. Pharmacol. Exp. Ther.* **1983**, *226*, 539–544.

(12) Nanoscience and Nanotechnologies: Opportunities and Uncertainties. https://royalsociety.org/-/media/Royal\_Society\_Content/policy/publications/2004/9693.pdf (accessed 2021-04-25).

(13) Smith, M. C.; Crist, R. M.; Clogston, J. D.; McNeil, S. E. Zeta Potential: A Case Study of Cationic, Anionic, and Neutral Liposomes. *Anal. Bioanal. Chem.* **2017**, 409, 5779–5787.

(14) Freitas, C.; Müller, R. H. Effect of Light and Temperature on Zeta Potential and Physical Stability in Solid Lipid Nanoparticle (Sln) Dispersions. *Int. J. Pharm.* **1998**, *168*, 221–229.

Qiongqiong Zhou – CAS, a division of the American Chemical Society, Columbus, Ohio 43210, United States; o orcid.org/ 0000-0001-6711-369X; Email: gzhou@cas.org

(15) Honary, S.; Zahir, F. Effect of Zeta Potential on the Properties of Nano-Drug Delivery Systems - a Review (Part 2). *Tropical Journal of Pharmaceutical Research* **2013**, *12*, 265–273.

(16) Venter, J. C.; Adams, M. D.; Myers, E. W.; Li, P. W.; Mural, R. J.; Sutton, G. G.; Smith, H. O.; Yandell, M.; Evans, C. A.; Holt, R. A.; Gocayne, J. D.; Amanatides, P.; Ballew, R. M.; Huson, D. H.; Wortman, J. R.; Zhang, Q.; Kodira, C. D.; Zheng, X. Q. H.; Chen, L.; Skupski, M.; et al. The Sequence of the Human Genome. *Science* **2001**, *291*, 1304– 1351.

(17) Sridharan, K.; Gogtay, N. J. Therapeutic Nucleic Acids: Current Clinical Status. *Br. J. Clin. Pharmacol.* **2016**, *82*, 659–672.

(18) Felgner, P. L.; Gadek, T. R.; Holm, M.; Roman, R.; Chan, H. W.; Wenz, M.; Northrop, J. P.; Ringold, G. M.; Danielsen, M. Lipofection -A Highly Efficient, Lipid-Mediated DNA-Transfection Procedure. *Proc. Natl. Acad. Sci. U. S. A.* **1987**, *84*, 7413–7417.

(19) Koynova, R.; Tenchov, B. Cationic Lipids: Molecular Structure/ Transfection Activity Relationships and Interactions with Biomembranes. In *Nucleic Acid Transfection* Bielke, W., Erbacher, C., Eds.; Springer-Verlag: Berlin, Heidelberg, 2010; Vol. 296, pp 51–93.

(20) Hajj, K. A.; Ball, R. L.; Deluty, S. B.; Singh, S. R.; Strelkova, D.; Knapp, C. M.; Whitehead, K. A. Branched-Tail Lipid Nanoparticles Potently Deliver mRNA *in Vivo* Due to Enhanced Ionization at Endosomal Ph. *Small* **2019**, *15*, 1805097.

(21) Tarahovsky, Y. S.; Arsenault, A. L.; MacDonald, R. C.; McIntosh, T. J.; Epand, R. M. Electrostatic Control of Phospholipid Polymorphism. *Biophys. J.* **2000**, *79*, 3193–3200.

(22) Tarahovsky, Y. S.; Koynova, R.; MacDonald, R. C. DNA Release from Lipoplexes by Anionic Lipids: Correlation with Lipid Mesomorphism, Interfacial Curvature, and Membrane Fusion. *Biophys. J.* **2004**, *87*, 1054–1064.

(23) Koynova, R.; Wang, L.; MacDonald, R. C. An Intracellular Lamellar - Nonlamellar Phase Transition Rationalizes the Superior Performance of Some Cationic Lipid Transfection Agents. *Proc. Natl. Acad. Sci. U. S. A.* **2006**, *103*, 14373–14378.

(24) Siegel, D. P. The Relationship between Bicontinuous Inverted Cubic Phases and Membrane Fusion. In *Bicontinuous Liquid Crystals*; Lynch, M. L., Spicer, P. T., Eds.; Taylor & Francis Group, CRC Press: Boca Raton, 2005; pp 59–98.

(25) Koynova, R.; Tenchov, B. Phase Transitions of Lipids. In *Wiley Encyclopedia of Chemical Biology*; Begley, T. P., Ed.; John Wiley & Sons: Hoboken, 2009; Vol. 2, pp 601–615.

(26) Scheideler, M.; Vidakovic, I.; Prassl, R. Lipid Nanocarriers for MicroRNA Delivery. *Chem. Phys. Lipids* **2020**, *226*, 104837.

(27) Evers, M. J. W.; Kulkarni, J. A.; van der Meel, R.; Cullis, P. R.; Vader, P.; Schiffelers, R. M. State-of-the-Art Design and Rapid-Mixing Production Techniques of Lipid Nanoparticles for Nucleic Acid Delivery. *Small Methods* **2018**, *2*, 1700375.

(28) Kulkarni, J. A.; Thomson, S. B.; Zaifman, J.; Leung, J.; Wagner, P. K.; Hill, A.; Tam, Y. Y. C.; Cullis, P. R.; Petkau, T. L.; Leavitt, B. R. Spontaneous, Solvent-Free Entrapment of Sirna within Lipid Nanoparticles. *Nanoscale* **2020**, *12*, 23959–23966.

(29) Li, Y.; Tenchov, R.; Smoot, J.; Liu, C.; Watkins, S.; Zhou, Q. A Comprehensive Review of the Global Efforts on Covid-19 Vaccine Development. *ACS Cent. Sci.* **2021**, *7*, 512–533.

(30) Paliwal, R.; Paliwal, S. R.; Kenwat, R.; Kurmi, B. D.; Sahu, M. K. Solid Lipid Nanoparticles: A Review on Recent Perspectives and Patents. *Expert Opin. Ther. Pat.* **2020**, *30*, 179–194.

(31) Muller, R. H.; Mader, K.; Gohla, S. Solid Lipid Nanoparticles (SLN) for Controlled Drug Delivery - A Review of the State of the Art. *Eur. J. Pharm. Biopharm.* **2000**, *50*, 161–177.

(32) Haider, M.; Abdin, S. M.; Kamal, L.; Orive, G. Nanostructured Lipid Carriers for Delivery of Chemotherapeutics: A Review. *Pharmaceutics* **2020**, *12*, 288.

(33) Iqbal, M. A.; Md, S.; Sahni, J. K.; Baboota, S.; Dang, S.; Ali, J. Nanostructured Lipid Carriers System: Recent Advances in Drug Delivery. *J. Drug Targeting* **2012**, *20*, 813–830.

(34) Mehnert, W.; Mader, K. Solid Lipid Nanoparticles - Production, Characterization and Applications. *Adv. Drug Delivery Rev.* 2001, 47, 165–196. (35) Muller, R. H.; Radtke, M.; Wissing, S. A. Solid Lipid Nanoparticles (Sln) and Nanostructured Lipid Carriers (Nlc) in Cosmetic and Dermatological Preparations. *Adv. Drug Delivery Rev.* **2002**, *54*, S131–S155.

(36) Montoto, S. S.; Muraca, G.; Ruiz, M. E. Solid Lipid Nanoparticles for Drug Delivery: Pharmacological and Biopharmaceutical Aspects. *Frontiers in Molecular Biosciences* **2020**, *7*, 587997.

(37) Bondì, M. L.; Craparo, E. F. Solid Lipid Nanoparticles for Applications in Gene Therapy: A Review of the State of the Art. *Expert Opin. Drug Delivery* **2010**, *7*, 7–18.

(38) Hörmann, K.; Zimmer, A. Drug Delivery and Drug Targeting with Parenteral Lipid Nanoemulsions - A Review. *J. Controlled Release* **2016**, 223, 85–98.

(39) Duong, V. A.; Nguyen, T. T.; Maeng, H. J. Preparation of Solid Lipid Nanoparticles and Nanostructured Lipid Carriers for Drug Delivery and the Effects of Preparation Parameters of Solvent Injection Method. *Molecules* **2020**, *25*, 4781.

(40) Severino, P.; Andreani, T.; Macedo, A. S.; Fangueiro, J. F.; Santana, M. H. A.; Silva, A. M.; Souto, E. B. Current State-of-Art and New Trends on Lipid Nanoparticles (SLN and NLC) for Oral Drug Delivery. *J. Drug Delivery* **2012**, 2012, 750891.

(41) Mishra, V.; Bansal, K. K.; Verma, A.; Yadav, N.; Thakur, S.; Sudhakar, K.; Rosenholm, J. M. Solid Lipid Nanoparticles: Emerging Colloidal Nano Drug Delivery Systems. *Pharmaceutics* **2018**, *10*, 191.

(42) Puglia, C.; Bonina, F. Lipid Nanoparticles as Novel Delivery Systems for Cosmetics and Dermal Pharmaceuticals. *Expert Opin. Drug Delivery* **2012**, *9*, 429–441.

(43) Borges, A.; de Freitas, V.; Mateus, N.; Fernandes, I.; Oliveira, J. Solid Lipid Nanoparticles as Carriers of Natural Phenolic Compounds. *Antioxidants* **2020**, *9*, 998.

(44) Engstrom, S.; Larson, K.; Lindman, B.; Engstroem, S.; Larsson, K. V. Controlled-Release Composition for Biologically Active Material - Comprising L2-Phase Containing a Monoglyceride, a Triglyceride and a Polar Liquid. WO8800059-A, 1988.

(45) Engstrom, S.; Larsson, K.; Lindman, B.; Engstroem, S. Preparation of Controlled Release Composition for Biologically Active Material - from Amphipathic Agents to Give Cubic Liquid Crystal Phase. WO8402076-A1, 1984.

(46) Barauskas, J.; Johnsson, M.; Johnson, F.; Tiberg, F. Cubic Phase Nanoparticles (Cubosome): Principles for Controlling Size, Structure, and Stability. *Langmuir* **2005**, *21*, 2569–2577.

(47) Spicer, P. T. Progress in Liquid Crystalline Dispersions: Cubosomes. Curr. Opin. Colloid Interface Sci. 2005, 10, 274–279.

(48) Garg, G.; Saraf, S.; Saraf, S. Cubosomes: An Overview. *Biol. Pharm. Bull.* **2007**, *30*, 350–353.

(49) Karami, Z.; Hamidi, M. Cubosomes: Remarkable Drug Delivery Potential. *Drug Discovery Today* **2016**, *21*, 789–801.

(50) Barriga, H. M. G.; Holme, M. N.; Stevens, M. M. Cubosomes: The Next Generation of Smart Lipid Nanoparticles? *Angew. Chem., Int. Ed.* **2019**, *58*, 2958–2978.

(51) Rarokar, N. R.; Khedekar, P. B. Cubosomes: A Vehicle for Delivery of Various Therapeutic Agents. *MOJ. Toxicology* **2018**, *4*, 19–21.

(52) Hirlekar, R.; Jain, S.; Patel, M.; Garse, H.; Kadam, V. Hexosomes: A Novel Drug Delivery System. *Curr. Drug Delivery* **2010**, *7*, 28–35.

(53) Yaghmur, A.; Glatter, O. Characterization and Potential Applications of Nanostructured Aqueous Dispersions. *Adv. Colloid Interface Sci.* 2009, 147–48, 333–342.

(54) Torchilin, V. P. Lipid-Core Micelles for Targeted Drug Delivery. *Curr. Drug Delivery* **2005**, *2*, 319–27.

(55) Gill, K. K.; Kaddoumi, A.; Nazzal, S. Peg-Lipid Micelles as Drug Carriers: Physiochemical Attributes, Formulation Principles and Biological Implication. *J. Drug Targeting* **2015**, *23*, 222–231.

(56) Groo, A.-C.; Matougui, N.; Umerska, A.; Saulnier, P. Reverse Micelle-Lipid Nanocapsules: A Novel Strategy for Drug Delivery of the Plectasin Derivate Ap138 Antimicrobial Peptide. *Int. J. Nanomed.* **2018**, *13*, 7565–7574. (57) Zatsepin, T. S.; Kotelevtsev, Y. V.; Koteliansky, V. Lipid Nanoparticles for Targeted siRNA Delivery - Going from Bench to Bedside. *Int. J. Nanomed.* **2016**, *11*, 3077–3086.

(58) Touitou, E.; Dayan, N.; Bergelson, L.; Godin, B.; Eliaz, M. Ethosomes - Novel Vesicular Carriers for Enhanced Delivery: Characterization and Skin Penetration Properties. *J. Controlled Release* **2000**, *65*, 403–418.

(59) Sudhakar, C. K.; Upadhyay, N.; Jain, S.; Charyulu, R. N. Ethosomes as Non-Invasive Loom for Transdermal Drug Delivery System. In *Nanomedicine and Drug Delivery*, 1st ed.; Sebastian, M., Ninan, N., Haghi, A. K., Eds.; Apple Academic Press: New York, 2012. (60) Huang, S. L. Liposomes in Ultrasonic Drug and Gene Delivery.

Adv. Drug Delivery Rev. 2008, 60, 1167–1176.
(61) Alkan-Onyuksel, H.; Demos, S. M.; Lanza, G. M.; Vonesh, M. J.;
Klegerman, M. E.; Kane, B. J.; Kuszak, J.; McPherson, D. D.
Development of Inherently Echogenic Liposomes as an Ultrasonic Contrast Agent. J. Pharm. Sci. 1996, 85, 486–490.

(62) Huang, S. L.; Hamilton, A. J.; Pozharski, E.; Nagaraj, A.; Klegerman, M. E.; McPherson, D. D.; MacDonald, R. C. Physical Correlates of the Ultrasonic Reflectivity of Lipid Dispersions Suitable as Diagnostic Contrast Agents. *Ultrasound Med. Biol.* **2002**, *28*, 339–348.

(63) Buchanan, K. D.; Huang, S.; Kim, H.; MacDonald, R. C.; McPherson, D. D. Echogenic Liposome Compositions for Increased Retention of Ultrasound Reflectivity at Physiologic Temperature. *J. Pharm. Sci.* **2008**, *97*, 2242–2249.

(64) Holland, C. K.; McPherson, D. D. Echogenic Liposomes for Targeted Drug Delivery. *Proceedings. IEEE International Symposium on Biomedical Imaging* **2009**, 2009, 755–758.

(65) Shekhar, H.; Kleven, R. T.; Peng, T.; Palaniappan, A.; Karani, K. B.; Huang, S.; McPherson, D. D.; Holland, C. K. *In Vitro* Characterization of Sonothrombolysis and Echocontrast Agents to Treat Ischemic Stroke. *Sci. Rep.* **2019**, *9*, 9902.

(66) Nkanga, C. I.; Bapolisi, A. M.; Okafor, N. I.; Krause, R. W. M. General Perception of Liposomes: Formation, Manufacturing and Applications, Liposomes - Advances and Perspectives. In *Liposomes - Advances and Perspectives*; IntechOpen: London, 2019.

(67) Has, C.; Sunthar, P. A Comprehensive Review on Recent Preparation Techniques of Liposomes. *J. Liposome Res.* **2020**, *30*, 336–365.

(68) Patil, Y. P.; Jadhav, S. Novel Methods for Liposome Preparation. *Chem. Phys. Lipids* **2014**, 177, 8–18.

(69) Koynova, R.; Tenchov, B. Recent Progress in Liposome Production, Relevance to Drug Delivery and Nanomedicine. *Recent Pat. Nanotechnol.* **2015**, *9*, 86–93.

(70) Pattni, B. S.; Chupin, V. V.; Torchilin, V. P. New Developments in Liposomal Drug Delivery. *Chem. Rev.* **2015**, *115*, 10938–10966.

(71) Machado, A. R.; Assis, L. M. d.; Machado, M. I. R.; Souza-Soares, L. A. d. Importance of Lecithin for Encapsulation Processes. *Afr. J. Food Sci.* **2014**, *8*, 176–183.

(72) Maherani, B.; Arab-Tehrany, E.; Mozafari, M. R.; Gaiani, C.; Linder, M. Liposomes: A Review of Manufacturing Techniques and Targeting Strategies. *Curr. Nanosci.* **2011**, *7*, 436–452.

(73) Mozafari, M.; Liposomes, R. An Overview of Manufacturing Techniques. *Cell. Mol. Biol. Lett.* **2005**, *10*, 711–719.

(74) Carugo, D.; Bottaro, E.; Owen, J.; Stride, E.; Nastruzzi, C. Liposome Production by Microfluidics: Potential and Limiting Factors. *Sci. Rep.* **2016**, *6*, 25876.

(75) Mukherjee, S.; Ray, S.; Thakur, R. S. Solid Lipid Nanoparticles: A Modern Formulation Approach in Drug Delivery System. *Indian J. Pharm. Sci.* **2009**, *71*, 349–358.

(76) Rizwan, S. B.; Boyd, B. J. Cubosomes: Structure, Preparation and Use as an Antigen Delivery System. In *Subunit Vaccine Delivery*. *Advances in Delivery Science and Technology*; Foged, C., Rades, T., Perrie, Y., Hook, S., Eds.; Springer: New York, NY, 2015.

(77) Torchilin, V. P. Liposomes as Targetable Drug Carriers. *Crit. Rev. Ther. Drug Carrier Syst.* **1985**, *2*, 65–115.

(78) Deshpande, P. P.; Biswas, S.; Torchilin, V. P. Current Trends in the Use of Liposomes for Tumor Targeting. *Nanomedicine (London, U. K.)* **2013**, *8*, 1509–1528.

(79) Byrne, J. D.; Betancourt, T.; Brannon-Peppas, L. Active Targeting Schemes for Nanoparticle Systems in Cancer Therapeutics. *Adv. Drug Delivery Rev.* **2008**, *60*, 1615–1626.

(80) Weissmann, G.; Bloomgarden, D.; Kaplan, R.; Cohen, C.; Hoffstein, S.; Collins, T.; Gotlieb, A.; Nagle, D. General Method for Introduction of Enzymes by Means of Immunoglobulin-Coated Liposomes, into Lysosomes of Deficient Cells. *Proc. Natl. Acad. Sci.* U. S. A. **1975**, 72, 88–92.

(81) Lee, R. J.; Low, P. S. Delivery of Liposomes into Cultured KB Cells *via* Folate Receptor-Mediated Endocytosis. *J. Biol. Chem.* **1994**, 269, 3198–3204.

(82) Guo, W. J.; Lee, T.; Sudimack, J.; Lee, R. J. Receptor-Specific Delivery of Liposomes *via* Folate-Peg-Chol. *J. Liposome Res.* **2000**, *10*, 179–195.

(83) Leamon, C. P.; Reddy, J. A. Folate-Targeted Chemotherapy. *Adv. Drug Delivery Rev.* **2004**, *56*, 1127–1141.

(84) Sudimack, J.; Lee, R. J. Targeted Drug Delivery *via* the Folate Receptor. *Adv. Drug Delivery Rev.* **2000**, *41*, 147–162.

(85) Kularatne, S. A.; Low, P. S. Targeting of Nanoparticles: Folate Receptor. In *Cancer Nanotechnology: Methods and Protocols*; Grobmyer, S. R., Moudgil, B. M., Eds.; 2010; Vol. 624, pp 249–265.

(86) Li, X.; Ding, L.; Xu, Y.; Wang, Y.; Ping, Q. Targeted Delivery of Doxorubicin Using Stealth Liposomes Modified with Transferrin. *Int. J. Pharm.* **2009**, *373*, 116–123.

(87) Kim, S. K.; Huang, L. Nanoparticle Delivery of a Peptide Targeting Egfr Signaling. *J. Controlled Release* **2012**, *157*, 279–286.

(88) Lian, T.; Ho, R. J. Y. Trends and Developments in Liposome Drug Delivery Systems. J. Pharm. Sci. 2001, 90, 667–680.

(89) Yoo, J.; Park, C.; Yi, G.; Lee, D.; Koo, H. Active Targeting Strategies Using Biological Ligands for Nanoparticle Drug Delivery Systems. *Cancers* **2019**, *11*, 640.

(90) Toporkiewicz, M.; Meissner, J.; Matusewicz, L.; Czogalla, A.; Sikorski, A. F. Toward a Magic or Imaginary Bullet? Ligands for Drug Targeting to Cancer Cells: Principles, Hopes, and Challenges. *Int. J. Nanomed.* **2015**, *10*, 1399–1414.

(91) Large, D. E.; Soucy, J. R.; Hebert, J.; Auguste, D. T. Advances in Receptor-Mediated, Tumor-Targeted Drug Delivery. *Advanced Therapeutics* **2019**, *2*, 1800091.

(92) Allen, T. M. Ligand-Targeted Therapeutics in Anticancer Therapy. *Nat. Rev. Cancer* **2002**, *2*, 750–763.

(93) Lee, R. J.; Low, P. S. Folate-Targeted Liposomes for Drug Delivery. J. Liposome Res. 1997, 7, 455-466.

(94) Gabizon, A.; Horowitz, A. T.; Goren, D.; Tzemach, D.; Mandelbaum-Shavit, F.; Qazen, M. M.; Zalipsky, S. Targeting Folate Receptor with Folate Linked to Extremities of Poly(ethylene Glycol)-Grafted Liposomes: *In Vitro* Studies. *Bioconjugate Chem.* **1999**, *10*, 289–298.

(95) Ishida, O.; Maruyama, K.; Tanahashi, H.; Iwatsuru, M.; Sasaki, K.; Eriguchi, M.; Yanagie, H. Liposomes Bearing Polyethyleneglycol-Coupled Transferrin with Intracellular Targeting Property to the Solid Tumors *in Vivo. Pharm. Res.* **2001**, *18*, 1042–1048.

(96) Derycke, A. S. L.; De Witte, P. A. M. Transferrin-Mediated Targeting of Hypericin Embedded in Sterically Stabilized PEG-Liposomes. *Int. J. Oncol.* **2002**, *20*, 181–187.

(97) Salvatore, G.; Beers, R.; Margulies, I.; Kreitman, R. J.; Pastan, I. Improved Cytotoxic Activity toward Cell Lines and Fresh Leukemia Cells of a Mutant Anti-Cd22 Immunotoxin Obtained by Antibody Phage Display. *Clin. Cancer. Res.* **2002**, *8*, 995–1002.

(98) Ruoslahti, E.; Rajotte, D. An Address System in the Vasculature of Normal Tissues and Tumors. *Annu. Rev. Immunol.* **2000**, *18*, 813–827.

(99) Pasqualini, R.; Koivunen, E.; Kain, R.; Lahdenranta, J.; Sakamoto, M.; Stryhn, A.; Ashmun, R. A.; Shapiro, L. H.; Arap, W.; Ruoslahti, E. Aminopeptidase N Is a Receptor for Tumor-Homing Peptides and a Target for Inhibiting Angiogenesis. *Cancer Res.* **2000**, *60*, 722–727.

(100) Brekken, R. A.; Overholser, J. P.; Stastny, V. A.; Waltenberger, J.; Minna, J. D.; Thorpe, P. E. Selective Inhibition of Vascular Endothelial Growth Factor (Vegf) Receptor 2 (Kdr/Flk-1) Activity by

a Monoclonal Anti-Vegf Antibody Blocks Tumor Growth in Mice. *Cancer Res.* **2000**, *60*, 5117–5124.

(101) Noonberg, S. B.; Benz, C. C. Tyrosine Kinase Inhibitors Targeted to the Epidermal Growth Factor Receptor Subfamily - Role as Anticancer Agents. *Drugs* **2000**, *59*, 753–767.

(102) Borisch, B.; Semac, I.; Soltermann, A.; Palomba, C.; Hoessli, D. C. Anti-Cd20 Treatments and the Lymphocyte Membrane: Pathology for Therapy. In *Verhandlungen Der Deutschen Gesellschaft Fur Pathologie* 85. *Tagung: Pathologie Fur Das 21. Jahrhundert*; Kirchner, T., Ed.; Urban und Fischer: 2001; Vol. 85, pp 161–166.

(103) Leonard, J. P.; Link, B. K. İmmunotherapy of Non-Hodgkin's Lymphoma with Hll2 (Epratuzumab, an Anti-Cd22 Monoclonal Antibody) and Hu1d10 (Apolizumab). *Semin. Oncol.* 2002, 29, 81–86. (104) Messmann, R. A.; Vitetta, E. S.; Headlee, D.; Senderowicz, A. M.; Figg, W. D.; Schindler, J.; Michiel, D. F.; Creekmore, S.; Steinberg, S. M.; Kohler, D.; Jaffe, E. S.; Stetler-Stevenson, M.; Chen, H. C.; Ghetie, V.; Sausville, E. A. A Phase I Study of Combination Therapy with Immunotoxins Igg-Hd37-Deglycosylated Ricin a Chain (Dga) and Igg-Rfb4-Dga (Combotox) in Patients with Refractory Cd19(+), Cd22(+) B Cell Lymphoma. *Clin. Cancer. Res.* 2000, 6, 1302–1313.

(105) Jurcic, J. G. Antibody Therapy for Residual Disease in Acute Myelogenous Leukemia. *Critical Reviews in Oncology Hematology* **2001**, 38, 37–45.

(106) Stadtmauer, E. A. Trials with Gemtuzumab Ozogamicin (Mylotarg (R)) Combined with Chemotherapy Regimens in Acute Myeloid Leukemia. *Clin. Lymphoma* **2002**, *2*, S24–S28.

(107) Duvic, M.; Kuzel, T.; Olsen, E. A.; Martin, A. G.; Foss, F. M.; Kim, Y. H.; Heald, P. W.; Bacha, P.; Nichols, J.; Liepa, A. Quality-of-Life Improvements in Cutaneous T-Cell Lymphoma Patients Treated with Denileukin Diftitox (Ontak (R)). *Clin. Lymphoma* **2002**, *2*, 222–228. (108) Olsen, E.; Duvic, M.; Frankel, A.; Kim, Y.; Martin, A.; Vonderheid, E.; Jegasothy, B.; Wood, G.; Gordon, M.; Heald, P.; Oseroff, A.; Pinter-Brown, L.; Bowen, G.; Kuzel, T.; Fivenson, D.; Foss, F.; Glode, M.; Molina, A.; Knobler, E.; Stewart, S.; et al. Pivotal Phase Iii Trial of Two Dose Levels of Denileukin Diftitox for the Treatment of Cutaneous T-Cell Lymphoma. *J. Clin. Oncol.* **2001**, *19*, 376–388.

(109) Reardon, D. A.; Akabani, G.; Coleman, R. E.; Friedman, A. H.; Friedman, H. S.; Herndon, J. E.; Cokgor, I.; McLendon, R. E.; Pegram, C. N.; Provenzale, J. M.; Quinn, J. A.; Rich, J. N.; Regalado, L. V.; Sampson, J. H.; Shafman, T. D.; Wikstrand, C. J.; Wong, T. Z.; Zhao, X. G.; Zalutsky, M. R.; Bigner, D. D. Phase Ii Trial of Murine I-131-Labeled Antitenascin Monoclonal Antibody 81c6 Administered into Surgically Created Resection Cavities of Patients with Newly Diagnosed Malignant Gliomas. J. Clin. Oncol. 2002, 20, 1389–1397.

(110) Goldenberg, D. M. Targeted Therapy of Cancer with Radiolabeled Antibodies. J. Nucl. Med. 2002, 43, 693-713.

(111) Epenetos, A. A.; Hird, V.; Lambert, H.; Mason, P.; Coulter, C. Long Term Survival of Patients with Advanced Ovarian Cancer Treated with Intraperitoneal Radioimmunotherapy. *Int. J. Gynecol. Cancer* **2000**, *10*, 44–46.

(112) Behr, T. M.; Liersch, T.; Greiner-Bechert, L.; Griesinger, F.; Behe, M.; Markus, P. M.; Gratz, S.; Angerstein, C.; Brittinger, G.; Becker, H.; Goldenberg, D. M.; Becker, W. Radioimmunotherapy of Small-Volume Disease of Metastatic Colorectal Cancer: Results of a Phase Ii Trial with the Iodine-131-Labeled Humanized Anti-Carcinoembryonic Antigen Antibody Hmn-14 (Retraction of Vol 94, Pg 1373, 2002). *Cancer* **2015**, *121*, 2290–2290.

(113) Davis, F. F.; Van Es, T.; Palczuk, N. C. Non-Immunogenic Polypeptides. NL7409770-A, 1975.

(114) Davis, F. F. The Origin of Pegnology. *Adv. Drug Delivery Rev.* 2002, *54*, 457–458.

(115) Klibanov, A. L.; Maruyama, K.; Torchilin, V. P.; Huang, L. Amphipathic Polyethyleneglycols Effectively Prolong the Circulation Time of Liposomes. *FEBS Lett.* **1990**, *268*, 235–237.

(116) Blume, G.; Cevc, G. Liposomes for the Sustained Drug Release *in Vivo. Biochim. Biophys. Acta, Biomembr.* **1990**, *1029*, 91–97.

(117) Zalipsky, S. Chemistry of Polyethylene-Glycol Conjugates with Biologically-Active Molecules. *Adv. Drug Delivery Rev.* **1995**, *16*, 157–182.

(118) Hassan, S.; Prakash, G.; Ozturk, A. B.; Saghazadeh, S.; Sohail, M. F.; Seo, J.; Dokmeci, M. R.; Zhang, Y. S.; Khademhosseini, A. Evolution and Clinical Translation of Drug Delivery Nanomaterials. *Nano Today* **2017**, *15*, 91–106.

(119) Andresen, T. L.; Jensen, S. S.; Jorgensen, K. Advanced Strategies in Liposomal Cancer Therapy: Problems and Prospects of Active and Tumor Specific Drug Release. *Prog. Lipid Res.* **2005**, *44*, 68–97.

(120) Rahim, M. A.; Jan, N.; Khan, S.; Shah, H.; Madni, A.; Khan, A.; Jabar, A.; Khan, S.; Elhissi, A.; Hussain, Z.; Aziz, H. C.; Sohail, M.; Khan, M.; Thu, H. E. Recent Advancements in Stimuli Responsive Drug Delivery Platforms for Active and Passive Cancer Targeting. *Cancers* **2021**, *13*, 670.

(121) Yatvin, M. B.; Kreutz, W.; Horwitz, B. A.; Shinitzky, M. Ph-Sensitive Liposomes - Possible Clinical Implications. *Science* **1980**, *210*, 1253–1254.

(122) Mills, J. K.; Needham, D. The Materials Engineering of Temperature-Sensitive Liposomes. *Methods Enzymol.* 2004, 387, 82–113.

(123) Mura, S.; Nicolas, J.; Couvreur, P. Stimuli-Responsive Nanocarriers for Drug Delivery. *Nat. Mater.* **2013**, *12*, 991–1003.

(124) Yatvin, M. B.; Weinstein, J. N.; Dennis, W. H.; Blumenthal, R. Design of Liposomes for Enhanced Local Release of Drugs by Hyperthermia. *Science* **1978**, *202*, 1290–1293.

(125) Papahadjopoulos, D.; Jacobson, K.; Nir, S.; Isac, T. Phase-Transitions in Phospholipid Vesicles - Fluorescence Polarization and Permeability Measurements Concerning Effect of Temperature and Cholesterol. *Biochim. Biophys. Acta, Biomembr.* **1973**, *311*, 330–348.

(126) Needham, D.; Park, J. Y.; Wright, A. M.; Tong, J. H. Materials Characterization of the Low Temperature Sensitive Liposome (Ltsl): Effects of the Lipid Composition (Lysolipid and Dspe-Peg2000) on the Thermal Transition and Release of Doxorubicin. *Faraday Discuss.* **2013**, *161*, 515–534.

(127) Han, H. D.; Jeon, Y. W.; Kwon, H. J.; Jeon, H. N.; Byeon, Y.; Lee, C. O.; Cho, S. H.; Shin, B. C. Therapeutic Efficacy of Doxorubicin Delivery by a CO2 Generating Liposomal Platform in Breast Carcinoma. *Acta Biomater.* **2015**, *24*, 279–285.

(128) Zhao, Y.; Ren, W.; Zhong, T.; Zhang, S.; Huang, D.; Guo, Y.; Yao, X.; Wang, C.; Zhang, W. Q.; Zhang, X.; Zhang, Q. Tumor-Specific Ph-Responsive Peptide-Modified Ph-Sensitive Liposomes Containing Doxorubicin for Enhancing Glioma Targeting and Anti-Tumor Activity. J. Controlled Release **2016**, 222, 56–66.

(129) Clares, B.; Biedma-Ortiz, R. A.; Saez-Fernandez, E.; Prados, J. C.; Melguizo, C.; Cabeza, L.; Ortiz, R.; Arias, J. L. Nano-Engineering of 5-Fluorouracil-Loaded Magnetoliposomes for Combined Hyperthermia and Chemotherapy against Colon Cancer. *Eur. J. Pharm. Biopharm.* **2013**, *85*, 329–338.

(130) Li, H. P.; Yang, X.; Zhou, Z. W.; Wang, K. K.; Li, C. Z.; Qiao, H. Z.; Oupicky, D.; Sun, M. J. Near-Infrared Light-Triggered Drug Release from a Multiple Lipid Carrier Complex Using an All-in-One Strategy. *J. Controlled Release* **2017**, *261*, 126–137.

(131) Szebeni, J.; Barenholz, Y. Adverse Immune Effects of Liposomes: Complement Activation, Immunogenicity and Immune Suppression. In *Harnessing Biomaterials for Nanomedicine: Preparation, Toxicity and Applicationns*; Pan Stanford Publishing Pte Ltd.: New York, 2009; pp 1–19.

(132) Inglut, C. T.; Sorrin, A. J.; Kuruppu, T.; Vig, S.; Cicalo, J.; Ahmad, H.; Huang, H.-C. Immunological and Toxicological Considerations for the Design of Liposomes. *Nanomaterials* **2020**, *10*, 190.

(133) Dass, C. R. Lipoplex-Mediated Delivery of Nucleic Acids: Factors Affecting *in Vivo* Transfection. *J. Mol. Med.* **2004**, *82*, 579–591. (134) Lv, H. T.; Zhang, S. B.; Wang, B.; Cui, S. H.; Yan, J. Toxicity of Cationic Lipids and Cationic Polymers in Gene Delivery. *J. Controlled Release* **2006**, *114*, 100–109.

(135) Yang, Q.; Lai, S. K. Anti-Peg Immunity: Emergence, Characteristics, and Unaddressed Questions. WIREs Nanomedicine and Nanobiotechnology **2015**, *7*, 655–677.

(136) Gregoriadis, G.; Leathwood, P. D.; Ryman, B. E. Enzyme Entrapment in Liposomes. *FEBS Lett.* **1971**, *14*, 95–99.

(137) Manjappa, A. S.; Chaudhari, K. R.; Venkataraju, M. P.; Dantuluri, P.; Nanda, B.; Sidda, C.; Sawant, K. K.; Murthy, R. S. R. Antibody Derivatization and Conjugation Strategies: Application in Preparation of Stealth Immunoliposome to Target Chemotherapeutics to Tumor. J. Controlled Release 2011, 150, 2–22.

(138) Park, J. W.; Benz, C. C.; Martin, F. J. Future Directions of Liposome- and Immunoliposome-Based Cancer Therapeutics. *Semin. Oncol.* **2004**, *31*, 196–205.

(139) Szoka, F.; Papahadjopoulos, D. Procedure for Preparation of Liposomes with Large Internal Aqueous Space and High Capture by Reverse-Phase Evaporation. *Proc. Natl. Acad. Sci. U. S. A.* **1978**, 75, 4194–4198.

(140) Deamer, D.; Bangham, A. D. Large Volume Liposomes by an Ether Vaporization Method. *Biochim. Biophys. Acta, Nucleic Acids Protein Synth.* **1976**, 443, 629–634.

(141) Anyarambhatla, G. R.; Needham, D. Enhancement of the Phase Transition Permeability of Dppc Liposomes by Incorporation of Mppc: A New Temperature-Sensitive Liposome for Use with Mild Hyper-thermia. *J. Liposome Res.* **1999**, *9*, 491–506.

(142) Needham, D.; Dewhirst, M. W. The Development and Testing of a New Temperature-Sensitive Drug Delivery System for the Treatment of Solid Tumors. *Adv. Drug Delivery Rev.* **2001**, *53*, 285–305.

(143) Lammers, T.; Kiessling, F.; Hennink, W. E.; Storm, G. Drug Targeting to Tumors: Principles, Pitfalls and (Pre-) Clinical Progress. *J. Controlled Release* **2012**, *161*, 175–187.

(144) Low, P. S.; Henne, W. A.; Doorneweerd, D. D. Discovery and Development of Folic-Acid-Based Receptor Targeting for Imaging and Therapy of Cancer and Inflammatory Diseases. *Acc. Chem. Res.* **2008**, *41*, 120–129.

(145) Farhood, H.; Gao, X.; Son, K.; Yang, Y. Y.; Lazo, J. S.; Huang, L.; Barsoum, J.; Bottega, R.; Epand, R. M. Cationic Liposomes for Direct Gene-Transfer in Therapy of Cancer and Other Diseases. In *Gene Therapy for Neoplastic Diseases*; Huber, B. E., Lazo, J. S., Eds.; 1994; Vol. 716, pp 23–35.

(146) Lasic, D. D.; Strey, H.; Stuart, M. C. A.; Podgornik, R.; Frederik, P. M. The Structure of DNA-Liposome Complexes. *J. Am. Chem. Soc.* **1997**, *119*, 832–833.

(147) Papahadjopoulos, D.; Allen, T. M.; Gabizon, A.; Mayhew, E.; Matthay, K.; Huang, S. K.; Lee, K. D.; Woodle, M. C.; Lasic, D. D.; Redemann, C.; Martin, F. J. Sterically Stabilized Liposomes -Improvements in Pharmacokinetics and Antitumor Therapeutic Efficacy. *Proc. Natl. Acad. Sci. U. S. A.* **1991**, 88, 11460–11464.

(148) Leamon, C. P.; Low, P. S. Delivery of Macromolecules into Living Cells - A Method That Exploits Folate Receptor Endocytosis. *Proc. Natl. Acad. Sci. U. S. A.* **1991**, 88, 5572–5576.

(149) Torchilin, V.; Multifunctional, P. Stimuli-Sensitive Nanoparticulate Systems for Drug Delivery. *Nat. Rev. Drug Discovery* 2014, 13, 813–827.

(150) Schwarz, C.; Mehnert, W.; Lucks, J. S.; Muller, R. H. Solid Lipid Nanoparticles (Sln) for Controlled Drug-Delivery 0.1. Production, Characterization and Sterilization. *J. Controlled Release* **1994**, *30*, 83– 96.

(151) Muller, R. H.; Mehnert, W.; Lucks, J. S.; Schwarz, C.; Zurmuhlen, A.; Weyhers, H.; Freitas, C.; Ruhl, D. Solid Lipid Nanoparticles (SLN) - An Alternative Colloidal Carrier System for Controlled Drug-Delivery. *Eur. J. Pharm. Biopharm.* **1995**, *41*, 62–69. (152) Hayes, M. E.; Drummond, D. C.; Hong, K.; Zheng, W. W.; Khorosheva, V. A.; Cohen, J. A.; Noble, C. O.; Park, J. W.; Marks, J. D.; Benz, C. C.; Kirpotin, D. B. Increased Target Specificity of Anti-HER2 Genospheres by Modification of Surface Charge and Degree of Pegylation. *Mol. Pharmaceutics* **2006**, *3*, 726–736.

(153) Shmeeda, H.; Tzernach, D.; Mak, L.; Gabizon, A. Her2-Targeted Pegylated Liposomal Doxorubicin: Retention of Target-Specific Binding and Cytotoxicity after *in Vivo* Passage. *J. Controlled Release* **2009**, *136*, 155–160.

(154) Laginha, K. M.; Moase, E. H.; Yu, N.; Huang, A.; Allen, T. M. Bioavailability and Therapeutic Efficacy of Her2 Scfv-Targeted Liposomal Doxorubicin in a Murine Model of HER2-Overexpressing Breast Cancer. J. Drug Targeting 2008, 16, 605–610.

(155) Huwyler, J.; Wu, D. F.; Pardridge, W. M. Brain Drug Delivery of Small Molecules Using Immunoliposomes. *Proc. Natl. Acad. Sci. U. S. A.* **1996**, *93*, 14164–14169.

(156) Li, H. Y.; Qian, Z. M. Transferrin/Transferrin Receptor-Mediated Drug Delivery. *Med. Res. Rev.* 2002, 22, 225–250.

(157) Qian, Z. M.; Li, H. Y.; Sun, H. Z.; Ho, K. Targeted Drug Delivery *via* the Transferrin Receptor-Mediated Endocytosis Pathway. *Pharmacol. Rev.* **2002**, *54*, 561–587.

(158) Singh, M. Transferrin as a Targeting Ligand for Liposomes and Anticancer Drugs. *Curr. Pharm. Des.* **1999**, *5*, 443–451.

(159) Kong, G.; Anyarambhatla, G.; Petros, W. P.; Braun, R. D.; Colvin, O. M.; Needham, D.; Dewhirst, M. W. Efficacy of Liposomes and Hyperthermia in a Human Tumor Xenograft Model: Importance of Triggered Drug Release. *Cancer Res.* **2000**, *60*, 6950–6957.

(160) Needham, D.; Anyarambhatla, G.; Kong, G.; Dewhirst, M. W. A New Temperature-Sensitive Liposome for Use with Mild Hyperthermia: Characterization and Testing in a Human Tumor Xenograft Model. *Cancer Res.* **2000**, *60*, 1197–1201.

(161) Ganta, S.; Devalapally, H.; Shahiwala, A.; Amiji, M. A Review of Stimuli-Responsive Nanocarriers for Drug and Gene Delivery. *J. Controlled Release* **2008**, *126*, 187–204.

(162) Spicer, P. T.; Hayden, K. L.; Lynch, M. L.; Ofori-Boateng, A.; Burns, J. L. Novel Process for Producing Cubic Liquid Crystalline Nanoparticles (Cubosomes). *Langmuir* **2001**, *17*, 5748–5756.

(163) Akinc, A.; Maier, M. A.; Manoharan, M.; Fitzgerald, K.; Jayaraman, M.; Barros, S.; Ansell, S.; Du, X. Y.; Hope, M. J.; Madden, T. D.; Mui, B. L.; Semple, S. C.; Tam, Y. K.; Ciufolini, M.; Witzigmann, D.; Kulkarni, J. A.; van der Meel, R.; Cullis, P. R. The Onpattro Story and the Clinical Translation of Nanomedicines Containing Nucleic Acid-Based Drugs. *Nat. Nanotechnol.* **2019**, *14*, 1084–1087.

(164) Emergency Use Authorization (Eua) of the Pfizer-Biontech Covid-19 Vaccine to Prevent Coronavirus Disease 2019 (COVID-19) in Individuals 16 Years of Age and Older. https://www.fda.gov/media/ 144414/download (accessed 2020-12-22).

(165) Emergency Use Authorization (Eua) of the Moderna Covid-19 Vaccine to Prevent Coronavirus Disease 2019 (Covid-19) in Individuals 18 Years of Age and Older. https://www.fda.gov/media/ 144638/download (accessed 2020-12-22).

(166) Allen, T. M.; Cullis, P. R. Drug Delivery Systems: Entering the Mainstream. *Science* **2004**, *303*, 1818–1822.

(167) Allen, T. M.; Cullis, P. R. Liposomal Drug Delivery Systems: From Concept to Clinical Applications. *Adv. Drug Delivery Rev.* 2013, 65, 36–48.

(168) Szoka, F.; Papahadjopoulos, D. Comparative Properties and Methods of Preparation of Lipid Vesicles (Liposomes). *Annu. Rev. Biophys. Bioeng.* **1980**, *9*, 467–508.

(169) Torchilin, V. Tumor Delivery of Macromolecular Drugs Based on the Epr Effect. *Adv. Drug Delivery Rev.* **2011**, *63*, 131–135.

(170) Torchilin, V. P. Recent Advances with Liposomes as Pharmaceutical Carriers. *Nat. Rev. Drug Discovery* **2005**, *4*, 145–160.

(171) Barenholz, Y. Doxil (R) - the First FDA-Approved Nano-Drug: Lessons Learned. J. Controlled Release **2012**, *160*, 117–134.

(172) Radler, J. O.; Koltover, I.; Salditt, T.; Safinya, C. R. Structure of DNA-Cationic Liposome Complexes: DNA Intercalation in Multilamellar Membranes in Distinct Interhelical Packing Regimes. *Science* **1997**, 275, 810–814.

(173) Chan, C.; Du, S.; Dong, Y. Z.; Cheng, X. L. Computational and Experimental Approaches to Investigate Lipid Nanoparticles as Drug and Gene Delivery Systems. *Curr. Top. Med. Chem.* **2021**, *21*, 92–114.

(174) Manchanda, S.; Das, N.; Chandra, A.; Bandyopadhyay, S.; Chaurasia, S. Chapter 2 - Fabrication of Advanced Parenteral Drug-Delivery Systems. In *Drug Delivery Systems*; Tekade, R. K., Ed.; Academic Press: London, 2020; pp 47–84.

(175) Chaubet, F.; Rodriguez-Ruiz, V.; Boissière, M.; Velasquez, D. Pharmacology: Drug Delivery. In *Encyclopedia of Biomedical Engineering*; Narayan, R., Ed.; Elsevier: Oxford, 2019; pp 440–453. (176) Bobo, D.; Robinson, K. J.; Islam, J.; Thurecht, K. J.; Corrie, S. R. Nanoparticle-Based Medicines: A Review of FDA-Approved Materials and Clinical Trials to Date. *Pharm. Res.* **2016**, *33*, 2373–2387.

(177) Jiang, W.; von Roemeling, C. A.; Chen, Y.; Qie, Y.; Liu, X.; Chen, J.; Kim, B. Y. S. Designing Nanomedicine for Immuno-Oncology. *Nature Biomedical Engineering* **201**7, *1*, 1–11.

(178) Sainz, V.; Conniot, J.; Matos, A. I.; Peres, C.; Zupancic, E.; Moura, L.; Silva, L. C.; Florindo, H. F.; Gaspar, R. S. Regulatory Aspects on Nanomedicines. *Biochem. Biophys. Res. Commun.* **2015**, *468*, 504– 510.

(179) Weissig, V.; Pettinger, T. K.; Murdock, N. Nanopharmaceuticals (Part I): Products on the Market. *Int. J. Nanomed.* **2014**, *9*, 4357– 4373.

(180) Liposome Drug Delivery Market. https://www. transparencymarketresearch.com/liposome-drug-delivery-market.html (accessed 2021-01-05).

(181) García-Pinel, B.; Porras-Alcalá, C.; Ortega-Rodríguez, A.; Sarabia, F.; Prados, J.; Melguizo, C.; López-Romero, J. M. Lipid-Based Nanoparticles: Application and Recent Advances in Cancer Treatment. *Nanomaterials* **2019**, *9*, 638.

(182) Pucci, C.; Martinelli, C.; Ciofani, G. Innovative Approaches for Cancer Treatment: Current Perspectives and New Challenges. *Ecancermedicalscience* **2019**, *13*, 961.

(183) Matsumura, Y.; Maeda, H. A New Concept for Macromolecular Therapeutics in Cancer-Chemotherapy - Mechanism of Tumoritropic Accumulation of Proteins and the Antitumor Agent Smancs. *Cancer Res.* **1986**, *46*, 6387–6392.

(184) Blum, R. H.; Carter, S. K. Adriamycin - New Anticancer Drug with Significant Clinical Activity. *Ann. Intern. Med.* **1974**, *80*, 249–259. (185) Mamidi, R.; Weng, S.; Stellar, S.; Wang, C.; Yu, N.; Huang, T.; Tonelli, A. P.; Kelley, M. F.; Angiuoli, A.; Fung, M. C. Pharmacokinetics, Efficacy and Toxicity of Different Pegylated Liposomal Doxorubicin Formulations in Preclinical Models: Is a Conventional Bioequivalence Approach Sufficient to Ensure Therapeutic Equivalence of Pegylated Liposomal Doxorubicin Products? *Cancer Chemother. Pharmacol.* **2010**, *66*, 1173–1184.

(186) Kamiński, D. M. Recent Progress in the Study of the Interactions of Amphotericin B with Cholesterol and Ergosterol in Lipid Environments. *Eur. Biophys. J.* **2014**, *43*, 453–467.

(187) Starzyk, J.; Gruszecki, M.; Tutaj, K.; Luchowski, R.; Szlazak, R.; Wasko, P.; Grudzinski, W.; Czub, J.; Gruszecki, W. I. Self-Association of Amphotericin B: Spontaneous Formation of Molecular Structures Responsible for the Toxic Side Effects of the Antibiotic. *J. Phys. Chem. B* **2014**, *118*, 13821–13832.

(188) Faustino, C.; Pinheiro, L. Lipid Systems for the Delivery of Amphotericin B in Antifungal Therapy. *Pharmaceutics* **2020**, *12*, 29.

(189) Juliano, R. L.; Grant, C. W.; Barber, K. R.; Kalp, M. A. Mechanism of the Selective Toxicity of Amphotericin B Incorporated into Liposomes. *Mol. Pharmacol.* **1987**, *31*, 1–11.

(190) Yonezawa, S.; Koide, H.; Asai, T. Recent Advances in Sirna Delivery Mediated by Lipid-Based Nanoparticles. *Adv. Drug Delivery Rev.* **2020**, *154–155*, 64–78.

(191) Dong, Y. Z.; Siegwart, D. J.; Anderson, D. G. Strategies, Design, and Chemistry in Sirna Delivery Systems. *Adv. Drug Delivery Rev.* **2019**, 144, 133–147.

(192) Adams, D.; Gonzalez-Duarte, A.; O'Riordan, W. D.; Yang, C. C.; Ueda, M.; Kristen, A. V.; Tournev, I.; Schmidt, H. H.; Coelho, T.; Berk, J. L.; Lin, K. P.; Vita, G.; Attarian, S.; Planté-Bordeneuve, V.; Mezei, M. M.; Campistol, J. M.; Buades, J.; Brannagan, T. H., 3rd; Kim, B. J.; Oh, J.; et al. Patisiran, an Rnai Therapeutic, for Hereditary Transthyretin Amyloidosis. *N. Engl. J. Med.* **2018**, *379*, 11–21.

(193) Loh, T. The Vaccine Revolution Is Coming inside Tiny Bubbles of Fat. https://www.bloomberg.com/news/articles/2021-03-04/the-vaccine-revolution-is-coming-inside-tiny-bubbles-of-fat?cmpid=socialflow-twitter-business&utm\_campaign=socialflow-organic&utm\_medium=social&utm\_content=business&utm\_source=twitter (acccessed 2021-04-19).

(194) Cross, R. Without These Lipid Shells, There Would Be No mRNA Vaccines for COVID-19. *Chem. Eng. News* **2021**, 99.

(195) Pfizer-Biontech Covid-19 Vaccine- BNT162b2 Injection, Suspension. https://dailymed.nlm.nih.gov/dailymed/drugInfo. cfm?setid=908ecbe7-2f1b-42dd-94bf-f917ec3c5af8 (accessed 2020-12-22).

(196) Miller, K. What's in the Pfizer and Moderna Covid-19 Vaccines? https://www.prevention.com/health/a35002158/pfizer-vs-modernacovid-19-vaccine-ingredients/ (accessed 2020-12-22).

(197) Vaccines and Related Biological Products Advisory Committee Meeting. Moderna COVID-19 Vaccine. FDA Briefing Document. https://www.fda.gov/media/144434/download (accessed 2020-12-22).

(198) Zhang, X. F.; Zhao, W. Y.; Nguyen, G. N.; Zhang, C. X.; Zeng, C. X.; Yan, J. Y.; Du, S.; Hou, X. C.; Li, W. Q.; Jiang, J.; Deng, B. B.; McComb, D. W.; Dorkin, R.; Shah, A.; Barrera, L.; Gregoire, F.; Singh, M.; Chen, D. L.; Sabatino, D. E.; Dong, Y. Z. Functionalized Lipid-Like Nanoparticles for *in Vivo* mRNA Delivery and Base Editing. *Science Advances* **2020**, *6*, No. eabc2315.

(199) DeFrancesco, L. Whither Covid-19 Vaccines? *Nat. Biotechnol.* **2020**, 38, 1132–1145.

(200) Sabnis, S.; Kumarasinghe, E. S.; Salerno, T.; Mihai, C.; Ketova, T.; Senn, J. J.; Lynn, A.; Bulychev, A.; McFadyen, I.; Chan, J.; Almarsson, Ö.; Stanton, M. G.; Benenato, K. E. A Novel Amino Lipid Series for mRNA Delivery: Improved Endosomal Escape and Sustained Pharmacology and Safety in Non-Human Primates. *Mol. Ther.* **2018**, *26*, 1509–1519.

(201) Yanez Arteta, M.; Kjellman, T.; Bartesaghi, S.; Wallin, S.; Wu, X.; Kvist, A. J.; Dabkowska, A.; Székely, N.; Radulescu, A.; Bergenholtz, J.; Lindfors, L. Successful Reprogramming of Cellular Protein Production through mRNA Delivered by Functionalized Lipid Nanoparticles. *Proc. Natl. Acad. Sci. U. S. A.* **2018**, *115*, E3351–E3360. (202) Schoenmaker, L.; Witzigmann, D.; Kulkarni, J. A.; Verbeke, R.; Kersten, G.; Jiskoot, W.; Crommelin, D. J. A. mRNA-Lipid Nanoparticle Covid-19 Vaccines: Structure and Stability. *Int. J. Pharm.* **2021**, *601*, 120586.

(203) Sealy, A. Manufacturing Moonshot: How Pfizer Makes Its Millions of Covid-19 Vaccine Doses. https://edition.cnn.com/2021/ 03/31/health/pfizer-vaccine-manufacturing/index.html (accessed 2021-04-19).

(204) Hope, M. J.; Mui, B.; Lin, P. J. C.; Barbosa, C.; Madden, T.; Ansell, S. M.; Du, X.; Lin, J. C. P.; Barbosa, C. J.; Madden, T. D.; Lin, P. J. Lipid Nanoparticle Used for Administering Therapeutic Agent to Patient Comprises Cationic Lipid, Neutral Lipid, Steroid, Polymer Conjugated Lipid, and Therapeutic Agent or Its Salt Encapsulated within or Associated with Lipid Nanoparticle. WO2018081480-A1, 2018.

(205) Chen, D. L.; Love, K. T.; Chen, Y.; Eltoukhy, A. A.; Kastrup, C.; Sahay, G.; Jeon, A.; Dong, Y. Z.; Whitehead, K. A.; Anderson, D. G. Rapid Discovery of Potent Sirna-Containing Lipid Nanoparticles Enabled by Controlled Microfluidic Formulation. *J. Am. Chem. Soc.* **2012**, *134*, 6948–6951.

(206) Kowalski, P. S.; Rudra, A.; Miao, L.; Anderson, D. G. Delivering the Messenger: Advances in Technologies for Therapeutic mRNA Delivery. *Mol. Ther.* **2019**, *27*, 710–728.

(207) Sahin, U.; Karikó, K.; Türeci, Ö. mRNA-Based Therapeutics — Developing a New Class of Drugs. *Nat. Rev. Drug Discovery* **2014**, *13*, 759–780.

(208) Gomez-Aguado, I.; Rodriguez-Castejon, J.; Vicente-Pascual, M.; Rodriguez-Gascon, A.; Solinis, M. A.; del Pozo-Rodriguez, A. Nanomedicines to Deliver mRNA: State of the Art and Future Perspectives. *Nanomaterials* **2020**, *10*, 364.

(209) Pardi, N.; Hogan, M. J.; Porter, F. W.; Weissman, D. mRNA Vaccines - A New Era in Vaccinology. *Nat. Rev. Drug Discovery* **2018**, *17*, 261–279.

(210) Clinical Trials. https://www.clinicaltrials.gov/ (accessed 2021-03-10).

(211) Gorzelany, J. A.; de Souza, M. P. Protein Replacement Therapies for Rare Diseases: A Breeze for Regulatory Approval? *Sci. Transl. Med.* **2013**, *5*, 178fs10–178fs10.
(212) Vlatkovic, I. Non-Immunotherapy Application of LNP-mRNA: Maximizing Efficacy and Safety. *Biomedicines* **2021**, *9*, 530.

(213) Nabhan, J. F.; Wood, K. M.; Rao, V. P.; Morin, J.; Bhamidipaty, S.; LaBranche, T. P.; Gooch, R. L.; Bozal, F.; Bulawa, C. E.; Guild, B. C. Intrathecal Delivery of Frataxin mRNA Encapsulated in Lipid Nanoparticles to Dorsal Root Ganglia as a Potential Therapeutic for Friedreich's Ataxia. *Sci. Rep.* **2016**, *6*, 20019.

(214) Lamichhane, N.; Udayakumar, T. S.; D'Souza, W. D.; Simone, C. B.; Raghavan, S. R.; Polf, J.; Mahmood, J. Liposomes: Clinical Applications and Potential for Image-Guided Drug Delivery. *Molecules* **2018**, *23*, 288.

(215) Morton, D. L.; Chan, A. D. The Concept of Sentinel Node Localization: How It Started. *Semin. Nucl. Med.* **2000**, *30*, 4–10.

(216) Goins, B. A. Radiolabeled Lipid Nanoparticles for Diagnostic Imaging. *Expert Opin. Med. Diagn.* **2008**, *2*, 853–873.

(217) Laverman, P.; Boerman, O. C.; Storm, G. Radiolabeling of Liposomes for Scintigraphic Imaging. In *Methods Enzymol*; Duzgunes, N., Ed.; Academic Press: Cambridge, MA, 2003; Vol. 373, pp 234–248.

(218) Espinola, L. G.; Beaucaire, J.; Gottschalk, A.; Caride, V. J. Radiolabeled Liposomes as Metabolic and Scanning Tracers in Mice. Ii. In-111 Oxine Compared with Tc-99m Dtpa, Entrapped in Multilamellar Lipid Vesicles. J. Nucl. Med. **1979**, 20, 434–40.

(219) Ogihara, I.; Kojima, S.; Jay, M. Differential Uptake of Gallium-67-Labeled Liposomes between Tumors and Inflammatory Lesions in Rats. J. Nucl. Med. **1986**, 27, 1300–1307.

(220) Kubo, A.; Nakamura, K.; Sammiya, T.; Katayama, M.; Hashimoto, T.; Hashimoto, S.; Kobayashi, H.; Teramoto, T. Indium-111-Labelled Liposomes: Dosimetry and Tumour Detection in Patients with Cancer. *Eur. J. Nucl. Med.* **1993**, *20*, 107–113.

(221) Oyen, W. J.; Boerman, O. C.; Storm, G.; van Bloois, L.; Koenders, E. B.; Claessens, R. A.; Perenboom, R. M.; Crommelin, D. J.; van der Meer, J. W.; Corstens, F. H. Detecting Infection and Inflammation with Technetium-99m-Labeled Stealth Liposomes. J. Nucl. Med. **1996**, 37, 1392–1397.

(222) Ogawa, M.; Umeda, I. O.; Kosugi, M.; Kawai, A.; Hamaya, Y.; Takashima, M.; Yin, H.; Kudoh, T.; Seno, M.; Magata, Y. Development of 111in-Labeled Liposomes for Vulnerable Atherosclerotic Plaque Imaging. J. Nucl. Med. **2014**, *55*, 115–120.

(223) Lamichhane, N.; Dewkar, G. K.; Sundaresan, G.; Mahon, R. N.; Zweit, J. [(18)F]-Fluorinated Carboplatin and [(111)in]-Liposome for Image-Guided Drug Delivery. *Int. J. Mol. Sci.* **2017**, *18*, 1079.

(224) Nakada, T. Clinical Application of High and Ultra High-Field Mri. *Brain Dev.* **2007**, *29*, 325–335.

(225) Šimečková, P.; Hubatka, F.; Kotouček, J.; Turánek Knötigová, P.; Mašek, J.; Slavík, J.; Kováč, O.; Neča, J.; Kulich, P.; Hrebík, D.; Stráská, J.; Pěnčíková, K.; Procházková, J.; Diviš, P.; Macaulay, S.; Mikulík, R.; Raška, M.; Machala, M.; Turánek, J. Gadolinium Labelled Nanoliposomes as the Platform for Mri Theranostics: *In Vitro* Safety Study in Liver Cells and Macrophages. *Sci. Rep.* **2020**, *10*, 4780.

(226) Navon, G.; Panigel, R.; Valensin, G. Liposomes Containing Paramagnetic Macromolecules as Mri Contrast Agents. *Magn. Reson. Med.* **1986**, *3*, 876–880.

(227) Wang, L. S.; Chuang, M. C.; Ho, J. A. Nanotheranostics-A Review of Recent Publications. *Int. J. Nanomed.* **2012**, *7*, 4679–4695. (228) Svenson, S. Theranostics: Are We There Yet? *Mol. Pharmaceutics* **2013**, *10*, 848–856.

(229) Al-Jamal, W. T.; Kostarelos, K. Liposomes: From a Clinically Established Drug Delivery System to a Nanoparticle Platform for Theranostic Nanomedicine. *Acc. Chem. Res.* **2011**, *44*, 1094–1104.

(230) Muthu, M. S.; Kulkarni, S. A.; Raju, A.; Feng, S. S. Theranostic Liposomes of Tpgs Coating for Targeted Co-Delivery of Docetaxel and Quantum Dots. *Biomaterials* **2012**, *33*, 3494–3501.

(231) Gross, U.; Roding, J.; Stanzl, K.; Zastrow, L. Phospholipid- and Fluorocarbon-Containing Cosmetic. US5643601, July 1, 1997, 1997.

(232) Wu, X.; Guy, R. H. Applications of Nanoparticles in Topical Drug Delivery and in Cosmetics. *J. Drug Delivery Sci. Technol.* **2009**, *19*, 371–384.

(233) Gibbs, B. F.; Kermasha, S.; Alli, I.; Mulligan, C. N. Encapsulation in the Food Industry: A Review. *Int. J. Food Sci. Nutr.* **1999**, *50*, 213–224.

(234) Mohammadi, A.; Jafari, S. M.; Mahoonak, A. S.; Ghorbani, M. Liposomal/Nanoliposomal Encapsulation of Food-Relevant Enzymes and Their Application in the Food Industry. *Food Bioprocess Technol.* **2021**, *14*, 23–38.

(235) Reineccius, G. A. Liposomes for Controlled-Release in the Food-Industry. In *Encapsulation and Controlled Release of Food Ingredients*; Risch, S. J., Reineccius, G. A., Eds; ACS Symposium Series 590; Washington DC, 1995; Vol. 590, pp 113–131.

(236) Acosta, E. Bioavailability of Nanoparticles in Nutrient and Nutraceutical Delivery. *Curr. Opin. Colloid Interface Sci.* **2009**, *14*, 3–15. (237) Espin, J. C.; Garcia-Conesa, M. T.; Tomas-Barberan, F. A. Nutraceuticals: Facts and Fiction. *Phytochemistry* **2007**, *68*, 2986– 3008.

(238) Huang, Q.; Yu, H.; Ru, Q. Bioavailability and Delivery of Nutraceuticals Using Nanotechnology. *J. Food Sci.* **2010**, 75, R50–R57. (239) Katouzian, I.; Esfanjani, A. F.; Jafari, S. M.; Akhavan, S. Formulation and Application of a New Generation of Lipid Nano-Carriers for the Food Bioactive Ingredients. *Trends Food Sci. Technol.* **2017**, *68*, 14–25.

(240) Genc, R.; Ortiz, M.; O'Sullivan, C. K. Diffusion-Controlled Synthesis of Gold Nanoparticles: Nano-Liposomes as Mass Transfer Barrier. J. Nanopart. Res. 2014, 16, 1–5.

(241) Gudlur, S.; Sanden, C.; Matouskova, P.; Fasciani, C.; Aili, D. Liposomes as Nanoreactors for the Photochemical Synthesis of Gold Nanoparticles. *J. Colloid Interface Sci.* **2015**, *456*, 206–209.

(242) Clergeaud, G.; Genç, R.; Ortiz, M.; O'Sullivan, C. K. Liposomal Nanoreactors for the Synthesis of Monodisperse Palladium Nanoparticles Using Glycerol. *Langmuir* **2013**, *29*, 15405–15413.

(243) Duss, M.; Vallooran, J. J.; Manni, L. S.; Kieliger, N.; Handschin, S.; Mezzenga, R.; Jessen, H. J.; Landau, E. M. Lipidic Mesophase-Embedded Palladium Nanoparticles: Synthesis and Tunable Catalysts in Suzuki-Miyaura Cross-Coupling Reactions. *Langmuir* **2019**, *35*, 120–127.

(244) Korgel, B. A.; Monbouquette, H. G. Controlled Synthesis of Mixed Core and Layered (Zn,Cd)S and (Hg,Cd)S Nanocrystals within Phosphatidylcholine Vesicles. *Langmuir* **2000**, *16*, 3588–3594.

(245) Zhang, R.; Song, X.; Liang, C.; Yi, X.; Song, G.; Chao, Y.; Yang, Y.; Yang, K.; Feng, L.; Liu, Z. Catalase-Loaded Cisplatin-Prodrug-Constructed Liposomes to Overcome Tumor Hypoxia for Enhanced Chemo-Radiotherapy of Cancer. *Biomaterials* **2017**, *138*, 13–21.

(246) Mukerabigwi, J. F.; Ge, Z. S.; Kataoka, K. Therapeutic Nanoreactors as *in Vivo* Nanoplatforms for Cancer Therapy. *Chem.* - *Eur. J.* 2018, 24, 15706–15724.

(247) Li, Y.; Zhou, Y.; Han, W.; Shi, M.; Zhao, H.; Liu, Y.; Zhang, F.; Zhang, J. Novel Lipidic and Bienzymatic Nanosomes for Efficient Delivery and Enhanced Bioactivity of Catalase. *Int. J. Pharm.* **201**7, *532*, 157–165.

(248) Zhang, B. Y.; Wang, F.; Zhou, H.; Gao, D. Y.; Yuan, Z.; Wu, C. F.; Zhang, X. J. Polymer Dots Compartmentalized in Liposomes as a Photocatalyst for *in Situ* Hydrogen Therapy. *Angew. Chem., Int. Ed.* **2019**, *58*, 2744–2748.

(249) Schumacher, I.; Arad, A.; Margalit, R. Butyrylcholinesterase Formulated in Liposomes. *Biotechnol. Appl. Biochem.* **1999**, *30*, 225–230.

(250) Koyani, R.; Pérez-Robles, J.; Cadena-Nava, R. D.; Vazquez-Duhalt, R. Biomaterial-Based Nanoreactors, an Alternative for Enzyme Delivery. *Nanotechnol. Rev.* **2017**, *6*, 405–419.

(251) Koynova, R.; Tenchov, B. Phase Transitions and Phase Behavior of Lipids. In *Encyclopedia of Biophysics*; Roberts, G. C. K., Ed.; Springer Verlag: Berlin, 2013; pp 1841–1854.

(252) Nagle, J. F.; Tristram-Nagle, S. Structure of Lipid Bilayers. Biochim. Biophys. Acta, Rev. Biomembr. 2000, 1469, 159–195.

(253) Simons, K.; Vaz, W. L. C. Model Systems, Lipid Rafts, and Cell Membranes. *Annu. Rev. Biophys. Biomol. Struct.* **2004**, 33, 269–295. (254) van Meer, G.; Voelker, D. R.; Feigenson, G. W. Membrane Lipids: Where They Are and How They Behave. *Nat. Rev. Mol. Cell Biol.* **2008**, *9*, 112–124.

(255) Kinnunen, P. K. J.; Laggner, P. Phospholipid Phase Transitions. *Chem. Phys. Lipids* **1991**, *57*, 109–408.

(256) Handbook of Biological Physics; Lipowsky, R., Sackmann, E., Eds.; Elsevier Science: Amsterdam, 1995; Vol. 1.

(257) Mouritsen, O. G. Life - as a Matter of Fat. The Emerging Science of Lipidomics; Springer: Berlin, 2005.

(258) Cevc, G.; Marsh, D. Phospholipid Bilayers; John Wiley & Sons, Inc.: New York, 1987.

(259) Marsh, D. Handbook of Lipid Bilayers; CRC Press: Boca Raton, London, NY, 1990.

(260) Gruner, S. M. Intrinsic Curvature Hypothesis for Biomembrane Lipid-Composition - A Role for Nonbilayer Lipids. *Proc. Natl. Acad. Sci.* U. S. A. **1985**, *82*, 3665–3669.

(261) Ginn, S. L.; Amaya, A. K.; Alexander, I. E.; Edelstein, M.; Abedi, M. R. Gene Therapy Clinical Trials Worldwide to 2017: An Update. *J. Gene Med.* **2018**, *20*, No. e3015.

(262) Capone, F.; Nappi, F.; Galli, M. C. Chapter 11 - Gene Therapy Clinical Trials: Past, Present and Future. In *Second Generation Cell and Gene-Based Therapies*; Vertès, A. A., Smith, D. M., Qureshi, N., Dowden, N. J., Eds.; Academic Press: Cambridge MA, 2020; pp 285–301.

(263) Khan, S.; Baboota, S.; Ali, J.; Khan, S.; Narang, R. S.; Narang, J. K. Nanostructured Lipid Carriers: An Emerging Platform for Improving Oral Bioavailability of Lipophilic Drugs. *International journal of pharmaceutical investigation* **2015**, *5*, 182–191.

(264) Damiani, E.; Puglia, C. Nanocarriers and Microcarriers for Enhancing the Uv Protection of Sunscreens: An Overview. *J. Pharm. Sci.* **2019**, *108*, 3769–3780.

(265) Souto, E. B.; Fernandes, A. R.; Martins-Gomes, C.; Coutinho, T. E.; Durazzo, A.; Lucarini, M.; Souto, S. B.; Silva, A. M.; Santini, A. Nanomaterials for Skin Delivery of Cosmeceuticals and Pharmaceuticals. *Appl. Sci.* **2020**, *10*, 1594

(266) Vijaya, N.; Umamathi, T.; Baby, A. G.; Dorothy, R.; Rajendran, S.; Arockiaselvi, J.; Al-Hashem, A. Nanomaterials in Fragrance Products. In *Nanocosmetics*; Nanda, A., Nanda, S., Nguyen, T. A., Rajendran, S., Slimani, Y., Eds.; Elsevier: Cambridge, MA, 2020; Chapter 13, pp 247–265.

(267) Plank, C.; Mechtler, K.; Szoka, F. C.; Wagner, E. Activation of the Complement System by Synthetic DNA Complexes: A Potential Barrier for Intravenous Gene Delivery. *Hum. Gene Ther.* **1996**, *7*, 1437– 1446.

(268) MacDonald, R. C.; Ashley, G. W.; Shida, M. M.; Rakhmanova, V. A.; Tarahovsky, Y. S.; Pantazatos, D. P.; Kennedy, M. T.; Pozharski, E. V.; Baker, K. A.; Jones, R. D.; Rosenzweig, H. S.; Choi, K. L.; Qiu, R. Z.; McIntosh, T. J. Physical and Biological Properties of Cationic Triesters of Phosphatidylcholine. *Biophys. J.* **1999**, *77*, 2612–2629.

(269) Farhood, H.; Serbina, N.; Huang, L. The Role of Dioleoyl Phosphatidylethanolamine in Cationic Liposome-Mediated Gene-Transfer. *Biochim. Biophys. Acta, Biomembr.* **1995**, *1235*, 289–295.

(270) Felgner, J. H.; Kumar, R.; Sridhar, C. N.; Wheeler, C. J.; Tsai, Y. J.; Border, R.; Ramsey, P.; Martin, M.; Felgner, P. L. Enhanced Gene Delivery and Mechanism Studies with a Novel Series of Cationic Lipid Formulations. *J. Biol. Chem.* **1994**, *269*, 2550–2561.

(271) Li, S.; Huang, L. *In Vivo* Gene Transfer *via* Intravenous Administration of Cationic Lipid-Protamine-DNA (Lpd) Complexes. *Gene Ther.* **1997**, *4*, 891–900.

(272) Zabner, J.; Fasbender, A. J.; Moninger, T.; Poellinger, K. A.; Welsh, M. J. Cellular and Molecular Barriers to Gene-Transfer by a Cationic Lipid. J. Biol. Chem. **1995**, 270, 18997–19007.

(273) Hofland, H. E. J.; Shephard, L.; Sullivan, S. M. Formation of Stable Cationic Lipid/DNA Complexes for Gene Transfer. *Proc. Natl. Acad. Sci. U. S. A.* **1996**, *93*, 7305–7309.

(274) Boukhnikachvili, T.; AguerreChariol, O.; Airiau, M.; Lesieur, S.; Ollivon, M.; Vacus, J. Structure of in-Serum Transfecting DNA-Cationic Lipid Complexes. *FEBS Lett.* **1997**, 409, 188–194.

(275) MacDonald, R. C.; Rakhmanova, V. A.; Choi, K. L.; Rosenzweig, H. S.; Lahiri, M. K. O-Ethylphosphatidylcholine: A Metabolizable Cationic Phospholipid Which Is a Serum-Compatible DNA Transfection Agent. J. Pharm. Sci. 1999, 88, 896–904.

(276) Behr, J. P.; Demeneix, B.; Loeffler, J. P.; Mutul, J. P. Efficient Gene-Transfer into Mammalian Primary Endocrine-Cells with Lipopolyamine-Coated DNA. *Proc. Natl. Acad. Sci. U. S. A.* **1989**, *86*, 6982–6986.

(277) Ferrari, M. E.; Nguyen, C. M.; Zelphati, O.; Tsai, Y. L.; Felgner, P. L. Analytical Methods for the Characterization of Cationic Lipid Nucleic Acid Complexes. *Hum. Gene Ther.* **1998**, *9*, 341–351.

(278) Mitchell, M. J.; Billingsley, M. M.; Haley, R. M.; Wechsler, M. E.; Peppas, N. A.; Langer, R. Engineering Precision Nanoparticles for Drug Delivery. *Nat. Rev. Drug Discovery* **2021**, *20*, 101–124.



USPOIND Crot 14

# 2) United States

### 20) INDERIGAN PERSONAL POICHS

- (i) Applicates PRANDAMPROLOMO, INCOMP. MALESCHORDUN CORRUNN VITED LONG INFN TON, MALEST
- (45) maging (PRAMPORTED INSOLUTION DA). MALESCHORDAN ODRIGAN VILO LONG INCS TON, MA (LS)
- Appl. Not. 15955254.
- TT: 44.6 NUMBER OF TAXABLE PARTY.

#### Referred Loss upplication flans

 District of replication No. 12099/206 Election King. 4 XTR

# org Puls Date:

#### Publication Constitution

::1)	Тш. ∢I.	
	601001576	.70466.005
	1220.5 (5-02)	12240-0212

("ALLING CL CHC CLEAR CARP SHARED COUNTY FROM SAV (50500)

12.54 GENERAL DE

The little of the own to be excluding the soft even to ref." aparticipation and a process in the starting state of plantamental of and of a spatial statement of a reguliteration in traisman, formation parameters multiple on order plation, so this of Control Sector and Manual Control year la terra plattoria electricitive distantificiti, concorri ca tree case planets increasing cases prothe set where transfer continue built a trace more we service privatide efficiency of a fixed laters over and all we do no pour boa illy indicipity illing i dato to, con Transmission











Figure 4







Increasing Magnetic Field

Figure 6

## INTELLIGENT SENSOR PLATFORMS

#### MELLOCH CONTRACTORS

[000] This is the source (particle) SRED P109 of the first STN - 1970/000 with the first P1000 SMC first NAME ARTER TO THE MIDNEY of grady the only an 2009 and a more priority of white The first management presentation for the first only grady and the first management of an active first of and grady and the first management of an active first solution reasons the strain of the first subsection of the first of the first first of the first of subsection of the first solution of a subsection of the first subsection of the subsection of subsection of the first subsection of the subsection of the subsection of the first reason of the subsection of the subsection of the first subsection of the first

#### BACKOROUND OF THE DOVENTION

(000) International technological area deviated of a comparison of the technological deviation of techno

[009] A basis y the ing providing york the agent technic the environment is received a some 1.5. But Net 2042/04 for 1.1.2046, which are environment is the age and age states we develop environment of the matter 
[004] If the instant investige statements only prover is the factor function of any problem behavior of prover is the metanique from roles prot in a total caccupactor emitted system from the factor of a gradients. For example, the factor optimality of additional for gradients. For example, in Fig. 1 and All this is agree for a metaning from Table Rep. No. 2023/201, and prove a biogeology resplants that is form a system of the factor of a gradient of a biogeologic test of a new proposed of a gradient of the system of the analysis of provident of a gradient of a biogeologic test of the proposed of a gradient of a biogeologic test of a new proposed of the gradient of a biogeologic test of a new proposed of the provident of a factor of a biogeologic response of the provident of a gradient of a biogeologic test of a new proposed of the provident of a biogeologic test of a new provident of a gradient of a biogeologic test of a new provident of a gradient of a biogeologic test of a new provident of a gradient of a biogeologic test of a new provident of a gradient of a biogeologic test of a new provident of a gradient of a biogeologic test of a new provident of a gradient of a biogeologic test of a new provident of a gradient of a biogeologic test of a new provident of a gradient of a biogeologic test of a new provident of a gradient of a biogeologic test of a new provident of a gradient of a biogeologic test of a new provident of a gradient of a biogeologic test of a new provident of a gradient of a biogeologic test of a biogeologic test of a new provident of a gradient of a biogeologic test of a biogeologic test a new provident of a gradient of a biogeologic test of a biogeologic test a new provident of a gradient of a biogeologic test of a biogeologic test a new provident of a gradient of a biogeologic test of a biogeologic test a new provident of a biogeologic test of a biogeologic

[1118] In motive contrast, the mainting of an each states is considered exception many of a planting of the legest is contrast, as contrast, in the motive contrast, the second exception of the secon

[Out-i] The subplace in fulfile constants of the interlity over metric genus a cays there are a note on a case over the decents cay a solution are a note on a block of many case or the solution. Nampla case of the solution devices of passed action of the base Nampla case of the many classes of speech of the base. Nampla case of the many classes of the base of the transformer are solved and the least classes for the resting of the base of the solved metric scale of the solve of the base of the solved and the least classes the observer we have been at some the heat solved contrast, we be a solved and the solved and the base of the solved of the base of the base of the solved the base of the solved of the base of the base of the base base solved of the solved of the base of the base of the base the base of the solved of the base of the base of the base investments and whether of the base of the base of the base interview of the base of the base of the base of the base and the base of the base of the base of the base of the base interview of the base of the base of the base of the base interview of the base interview of the base interview of the base interview of the base interview of the base of the

[1107] There is a latence who see we mean where a presenequestion curvature of the transposed with the ratio correction equipted the second control in which the transpose is been as results if any even in the transpose and the taken is we have been even as the transposed in the transposed to the event is results. There events during the transposed to the event is results if any even in the transposed to the transpose rate elements are yearly to end discuss the transposed to the events of the supposed in the transposed to the transposed to the in the type, the design control of the transposed to the transposed of the transposed by the transposed of the transposed to the transposed of the transposed by the transposed of tr

the finish for the first investigation for each of going for the first sector of the first of th

[0008] In medicine case, distort deep of more presents and or the multiplear decision in which own particular relation only minimal constitution of the effective equilibrium may not the investigation of the types of the treatment for the provide line edge.

[1199] I in president monormany and provide a near nearly and the nearly represents and structure of the sector structure period and the nearly of the near the near the sector structure of local near whith contrasts of the twenth of the early structure.

[0619] The set for embedded in the structure formality of provide set of the 
[0911] For the first system in your least of point at the original system to a life and the original system to a life in the large struggly on the original state in the original system. For the integral system is a system to a system to a system in the system is a system in the system.

Licenset is near incomposing posingles have different concording of Annual design of the first of the first of the set in the set of the tage consistence weight concern the off the constability of both the other first of the set of the off the constability of the tage of the first of the set of the off the set of the set of the tage of the provide set of the off the set of t

(CD). I in the adjudication on any gring in a theoperation and so what is a principal constrained in the second re in met erreich ending the hards Niterry nei et element. ICOS - These with a constituted parameters on the ICOS - These with a constituted parameters on the dig ly famille one photo chat a coast or cost at fill م محمد او رائمون و رائمون و (آند کرد و آند کرد و آن و آن و ا fer nementi instant heis, nur esta i deget espan te de technices de souge d'aig la doer l'antre enhas me ra In one that to we shall be on the transmission way to in mandel coord-all seaschrone conductions. [Cf by the method contribution of planting the doctors in the second sec servers on an expression, while two processes had a sentity to the excludion entity in elements and entity the nearly ne avijevace, ona usi bolenca sreda u njekena ne jezpally builted in the latent system of rest system if we all diamonts in that send the entropy Sach refine diamonts have rys w vetras privata + Marca et sur renty, succedent angla ta encine encolories y action-tribule i crue rup luceria - i re and on an environte non-anyonhee elements, agen as desertenersina partickataba sela satas inaces da genefityfal straugerja GD; no dischtliges of tagental ப்பைப்பட

[LLIA] The cool of entrophysical three entrophysical sectors are called by function in the entrophysical sectors are called by function in the entropy of th

[COO] In one embodiment, the instant or ention theless the summer scenario, tractioning please to with the summer addition that construction in prior may be a summer with the sumstances of traces in a mapping any public part to give in the prior action construction of the descent of the relation prior action construction of the descent of the relation prior action construction.

[0017] Pitta techtor osside, Cachilla, ergensteide de techtor in festivations also it least techtor for fordy spectra in festivation. Enforcement of grain the system commutivation and the festivation interation technology and the stypes of elements again and track structed in a system to a track the certs again and track structed in a system to a track the certs again and track structed in a system technology and the against and an a second strucsource technology and the against and an a second structed at the technology and a system and a many second structed at the system and structed and the second strucsource technology and structed and a second structed at the system and structed at the second structure system and structure at the system and a second structure system at the system at the system and a second structure system at the system

[0038] The intention further function to coperation and far its ends entries from the complete tage demonstree for spaces. Even the analysis group of provident for element of most in star making danged survey so in mean of the maximum intention for star and segment or of the making so while process that is known.

(E10) The real error beats of the commence demonstrative constration of the metry test in the real provided entry of the test tages in the order of dempities and the order of energy softwares, including for a tage of the test of energy softwares, including for a tage of the test of the order, high provident tage.

(FF3) If non-embodiment, the local discount is inacted the output released on the local part exercise of the second se and type of extending the standing searching transiting of filping optimity symmetry to sear this you have a transfer of the transferration for the film for the off hyperbolic control of the same to be the body to the filest the graveree matrix somethous the body to the filter control of the same to be the body to the filter control of the same to be the body to the filter control of the same to be the body to the filter control of the same to be the body to the filter to the filter body of the body of the body to the filter the filter body of the body of the body of the body of the same to be filter to be body of the body of the body of the filter body of the body.

[1161] In one maximum on communication of model demany, with only them telephoneral demand, the missing encountervalue of the much mean advantage on the conhetter and system methania poor (alter the observation formalists of one mean telephone, Alter all of the term point means basis, equivalently, these were measurable to Methaney probes serve by earlier courses (good no Methaney probes serve by earlier courses) good no Methaney probes serve by earlier courses is printer this response to FBB, and the light summises in the course down. Only impose pulse of an earlier by BBP.

[Fux2] In one exclosioners, the lowerskip environment of the matrix state of version of control support of the transition (Note for matrix states) in a network with a reaction would a set viscours in following and the reaction of the control support of the matrix states of the control states and such operations from the states of states in the reaction of the states operation in the matrix of states in the reaction of the states operation in the states of states in the reaction of the states operation of the states of the states of the local states of the States of No. Accessive and states of the

[0029] Tay internative internatively solutions inglish for optimating of the principal optimizing of the principal model of generating methods in one content of the office contexpedences with a contained point of the flavor generative print set on the protein operatives represent we have remaining contains and not represent on the enternative.

[OC4] Provide decomous contracting active of this opcharacterization call officers using reacting on nove or maniistaneous age elements that in the contestaneous decimation invention trackets on Uniquitad calling or a constrainmedenical files.

[Do25] The communication also revealed provide interrelation of any entropy second content on any distributionentropy of any entropy and normalisation of a second base and the other second second second second second second second relative and plants many the destroyer of the second processing which any destroyer of the second second second processing which any destroyer of the second second second influences in a and other gives on plants may

[f003i] The still sensitive work for a logarity from an analyconstructed mean factor comments the Tonic time still the still a track so non-typed of intervals at the still still applications.

#### ALMINARY DOLL, UNROWING

[E037] The meaning through spectra and extremetical and the picture by reacting modified in the contesystems, no many problements of some on which may a monoton remains, carbon source which and which an end of new elements between the two structures and end of new elements between the two structures between the community of the transmission of the between the community entremetics of the approach between the community entremetics is not to the transmission where the community entremetics is a forming in where the community entremetics because and share the source of the community and the community and share the source of the community and the community of action of forwards on the conductive and the community.

[00/36] It is a first the constraint for investigation ingers a neutrony state to explore ondependations in the second system (ipped net), picts any straight of either system of an

- -reflors cadenickan Followaren mit einen bie manopartiel istan free provincet formasse that manufacture address managing free mit provide the
- [0029] Saajili Jamo, av Dicertoo
- [6600] completes any cost of ender the systematic mark.
- [BO1] Collins against biometry, mit administration (accord)

[0073] I. A. O'guri, "grand concentrality".

- [0039] Interaction control, and regarding of well-hall process while conduct scales, young mittake matitiving and signaling mean animation between addemeters are gold to conduct strong to control or to fumeters are gold to conduct strong to control or to fumeters are shown as shown in a
- [6034] Ellering, the CVS metricing to single be based to forburner addression as a single scheme /0 managepetric initial scheme.
- [1805] Crack concerns a concern for computer with transit of an article in the concern operations of the product with a frequencies with energy field and concerning the
- [0036] Kyleid av entien stem internation for an opportunity of entire grant for entire of formal states grant as found advances.
- [607] Bell-riccitority archeving all scars all in minimation environments are presented as a set of a promotion careful contains.
- [0068] Kolla yre i'r Llwad, defe ffly righrifans,

(112) In one particular control intenti, and or mention we wanted the solution of the intention of weights and experimentation of the intention of the inten

[0040] If the formation is the interval of the American System of th

[004] The one intraarding control and the optimized eleinguity has a tracking satisfied and According to this balance is confeediment, one can not care such as meaning to be control. [1115] The optimization of the such as meaning to be control of the violations, and do not care such as means as well as the such as a set of similar to the optimization of the such set of the care such as the optimization of the support of the such set of the balance of the optimization of the support of the optimization of the superconducted as the support of the optimization of the superconducted as a support of the optimization.

[6645] I. Samani, "Environmentation and sounds in second metric and generation of the sould fit with generating of the path associating of the quark ingle of the generating of the genkning states and equivariant coefficies."

[114] The regime range of the proceeding water rewrite region (g), receive an expension fraction region.

[ff45] I is subalized used in enformational .

point in the set of a second set of the and any an tim nectorized nectorized principal executive examples the explosion of sterright set the life.

(EE44) The interacting in the environment, provide the temperature shore executions and managine directory much be functional energy by local enough on the user of works in the many or an element.

(FF17) Additional to an electron one of the electron energy years' represented and a segmentate defective 1. On your out composition community of our community states in fault ognessioners at the color and the assistant of the states.

[0043] The action control of a set process of a set of process for the trajection of the other compare devices and control of a set of an end of the other compare well as only one of the other of the polyther of the trajection of the transformer of the control of the structure of the trajection of the set of the other of the other of the other of the trajection of the set of the other of the structure of the other of the set of the set of the other of the structure of the other of the set of the set of the other of the structure of the other of the set of the set of the structure of the set of the set of the set of the set of the structure of the set of the set of the set of the set of the structure of the set of the

[D49] In constant on National Contents in an one structation (general content and content and structure) in the issues the model for chatware and over an delivery of item change, the coording systems.

[0099] sanoheri si indige of heits actours hat is put in material, see not establic externelly, represently.

[0051] The child of some has been as the contrast of the second s

[0957] The second of a finance band open disent of the contract of the finance band open and the contract of the second s

[0959] The second of the second contrast dependence of a cosy bandwidth of each consect we second the second secon

[0054] The constrained contracts are completed in the conjugation of the constraint of the constrai

[0097] In another table function to calibration the task cost in the global ordered plane meet to build the relation waves, "To regressive metric with minimum lifetime demonstration participations in the sector calibration times."

[0066] The one-carbo finited: the optimizer origin of thems threads in the of pack() for yet heric and to prevention at obcorrect.

[Ow7] The control and the operation of the endowing operation 
[D983] In the end of measurements of the rest of passe enders and an endpoint ryange of menor comprise trypped effectives of free an interaction of.

[1159] In one-archeding of each interval allocation for each intercorporation in conversion payolettical set.

[Enfer] — In one encode uner n'encode ensemble: composirespondentiers based of anticativation on a intervane y and reinstand possible of the vierball configurations.

[000] The constrained contracts are constrained in the organish coefficiency constrained in the distribution of a state of elements are group to the state of the linear protocol and constrained appropriate state of the linear protocol and the state of 
[E065] In plante, the prove excluding a pre-trained exclusion and the exclusion of the exclusion of the planter of the planter of the exclusion of the exclu

 and part with electric by methods bit answerb key matter where solutions are been as an entry pro-

(004) To inclue illustrative eightshears, the termere wernant, in one of more contigorations, compute the ormere again triansporte, and may athetic material contrasts those transport press in one transport or phases in whether he pre-

(Cost - Technic Corectionen, and methods we demonstrate and satisfy of a main. Expansion (353) the older, thema by Mickled relevation (1) states (2), and the files an school or an analysis and increases on a set ignoring.

(Cost — In varies, can lead receive, and a recovered mental engy of of recirculation for the relationation of yes, and endocreasing mere than our type of ormetical and y.

[LL97] The second sector of sensitivity of a measure sector remains an experimentation of a measure the second sector of effective angles of the sizes of agric of the flat, but two funited press.

[LEP8] If a contract on the structure research in the close of the scheme of the main contractive conduction over a manufactured structure conducting pack.

(1) We the provide contract much values of more electronics in where the import scorperized stopp in community of and on stopped set in stange y-set in a product memory relation in a memory way to be a specified in the memory of the memory processing point stanges and we function.

[1170] In one can see manufacture contrast a single should be made a provident of the second structure of the manufacture of the second structure o

[EEV1 According to the attended scenario see to see in this, and see the cost the two to the product. Here are snot the their platter is that be function form the bottlers, prove sky elementation of According to Structure only Administration that it relates the option to be the Eboot model of the too of mole cost costs, cleaned, for the Boot model of the too of a fit relates the option of the triangle of mere the option of cultures of background of form of the of mere the option of cultures of background of form of the of the of

[00.2] The one constrained the astrantization to obtain the least the subcommence of the memory to be contractly as Seried framework drawn betterned on the outloant optical defined in excemptions; in where of in particular of memory state field and the Statement Contract statement of the series that the indicategories of intervents. The series of the series may be represented optically a statement of the series of the term of the series of the series of the series of the term of the series of the series of the series of the term of the series of the series of the series of the term of the series of the term of the series of the series of the series of the series of the term of the series of the series of the series of the series of the term of the series of the output of the series of the

[0077] I. Standard as at some of a standard stay with multy comprise a type of a sector sector. Science is immore an elleptimetry sector missions.

[6076] The many rest to result which is even one even many the maximum scheduler is the mass of the type of type of proventies of a scheduler in the first of the of seven Net, we first hyperparent even we prove us of the or

[0075] It cannot be "in a most back size or index onemonon in the system before and the back size of particular solutions. 7. The bit the system 17 by the back should be backed example entropy the most back structure of the schedules the output to configuration of scheduly solutions and structure. Chalman 1997 statutions and \$5 bits statution between the first of the first of the first statution between the statution of the first st

[1054] They reliable to the relation of the relationship like the element of the relationship of the formation in the presence of the endothered side of the relation of the relation of the endothered side of the relation provides the relation of the original side side of the relation of the subscreece is an endothered side of the relation of the subscreece is interaction of the off side and the relation of the relation of the original side of the relationship of the subscreece is interaction of the side of the relation of the relation of the original fill be descreece and the subscreece is a subscreece in the relation of the relation of the relation of the original fill be descreed and the second side of the subscreece is second report of the fill of the relation is fill the relation of the original fill the relation is fill the relation of the relation of the relation of the subscreece is second report to the fill the relations is fill the relation of the relation of the relation of the subscreece is second report to the relation of the relation of the subscreece is second report to the relation of the relation of the subscreece is second report to the relation of the relation of the subscreece is second report to the relation of the relation of the subscreece is second report to the relation of the relation of the subscreece is second report to the relation of the relation of the subscreece is second report to the relation of the relation of the subscreece is second report to the relation of the relation of the subscreece is second report to the relation of the relation of the subscreece is second report to the relation of the relation of the subscreece is second report to the relation of the relation of the subscreece is second report to the relation of the relation of the subscreece is second report to the relation of the relation of the subscreece is second report to the relation of the relation of the relation of the subscreece is second report to the relation of the relation of the relation of the relati

[D077] In the strategy set of virtual orders, in order science. compared of Costoner (COPLANECORD) reteny, when a miel izverský palikov, provihou houhivate stanizáci na sealing as a fill letter produce violating on the scarphy centre elemente de la reneración des elementes de la able dan dis berof Childsin, Couparis, Fill en fast ossenas may an easier mere en led racety, se compared outrie of manufactal way and, gamma dota sparso and or ota-ວກັນແລະ DiEnco ຈາຍປະກິດແລະ ເປັນເຮົາແຫຼ່ມແລະ ແມ່ນແ te cars, o i léa Cort, are composed, the aday, (sum Ers) Conservation for a 1997 a na menovično i čano no saskembo ten huter entry defined Ciff is alfait to electeristic in our contrate inertials, cay be then received ends treating storing addressingling the two topeoficies a separeveryphilder.

[HC4] Distribution in parameter data y to an other real CIVEN ACTIVED AND ADVECTOR OF THE ADVECTOR AND A DATE F a loss companyons may allor-surface the providence. circle group is a supplex desires and there exist forms. prestrip advice several appropriate proving the service of the lacted to acquire impact mean in the any to engineered. an mars "Clade mass or Courses a resonation, for show ole francistic fold and a 2007 the based is fingli allow and too ance that components fair added to days panel antediment in entitle demonstration and ally fronti al, fighters and the analysis of spectra. In advect the financial distance of the second House applications in proster entry memory access in M. Kontov, grien vied i an igel Hues, 11 recepting as a memory of some with instruction propagation or that Generality has needed to be interval to the hormal of hide, e.g., for the registered, because for I carately ensemble any prior any physicilla and the second structure of where the specific management of the set of the states constituents are writted after types of temperate features and residences and formation measurements of inter incoherents are formed as input sharing as have in included æ.

[0079] Unik aggressing and sold leave ensure hereign a schematic manager. With a distance any marginal instatisfication applies tally in and stations, a substitution (if call with the isotropy with the substitution and second with the material software with the functional version of the substation call elements with constraints under the substatic cost elements with constraints under the substatic cost elements with constraints under the subLieux level. Egy by many pour enpresentative Conet manor grant Remark from a many a Many days of C. Contra a frances presents South from the Dirac many distributions.

regenerates with prevention to the transmitter of contract says there with preventions to a contract remember with union selecteric motifully asystem bits rates are written of one of motifications with a reaction data written to the motification of the data may be a minibate to the formation source data and the data with a minibate data and the source of the relation of the data with a minibate data and a version of the source data with a minibate data and the a version of the source data with a minibate data and the a version of the source data and the source of the source of the source data.

[1109] Additional solution for an end provint solution more structure to structure the solution of a structure to a solution of the structure solution of a structure to a solution of the content ly device and the structure to the means of the content ly device and the problem to the structure of the content of a structure the solution of the solution and formal solution of a structure the solution of the structure of the solution of solutions. Structure is interfering content and may be to actionally solution structure to the structure of a structure of solutions. Structure is interfering the content of any sign of the solution by the

[LEN] If the endermonic mean interview cheronic tranrough we contain cardinary non-initiative contrast type support, one or board on y non-initiative contrast type support, one or board on a network to be easily support, and by support of the converse of ingly cardinary system to the support.

[0082] Constructioned including a dedection as any intripated electron satisfy to including which can be fundin the new control efficiency detectes for other of this construction in a critic behing may detect that produces an air model of a transmitteness and an and detection.

[0080] According to one in size apprication for decaded reduct regaring period gradients for decaded in realion connects a and the line of sering of enceds (in the onlythe NKK constrained softworky constrained) (2010) advected basis gradients of accessing to the access basis connection of sing the connecting of the seriline connection of sing the connecting of the series.

infigitans.

[LLP4] In chief remains her version was entropy and an entropy and second an entropy and second an exact second as a second s

[0085] It can be if all the vertical of a new set of a construction of the basis 
[003a] I have been body in the accession of y in the resonant cases by strop unwhole on a gampie of an elogence entreple certs shall no entreple the charge relement install obtained to solve mean on protocords and the Have start by CAS including passing the Next of me man in Sector 12.5 including passing the Next of me maxim Sector 12.5 including passing the Next of me maxim Sector 12.5 including passing the Next of the treatment of the spectral starts are in the Contract of the version of the spectral starts are in the contract of the secne in spectrum requires in the spectral starts for the sector 15 passing requires in the spectral starts for the secption of passing.

[0027] These second gravities to make a statistic homotopological production of the second gravities of the first of the second gravities of the secon

Tage examples a lateral, and to may arele to the total exments. After a new lyces in efficiency of the formation of the solve is mean in the end of the area with four and the formation of mean sectors are the end of the end of the end of the elements are new formation of the growth of sectors and elements are new solver the end of the end of the elements are new solver to the end of the end of the elements of the end of the there end of the lateral solve the end of the end of the there end of the lateral solve the end of the end of the end of the end of the lateral solve the end of the end of the there end of the lateral solve the end of the end of the end of the end of the lateral solve the end of the end of the end of the end of the lateral solve the end of the end of the end of the end of the lateral solve the end of the end of the end of the end of the lateral solve the end of the end of the end of the end of the lateral solve the end of the end of the end of the end of the lateral solve the end of the end of the end of the end of the lateral solve the end of the end of the end of the end of the lateral solve the end of 
[Fu9b] Some contributively near the one functional sections. Notice that the under interpose is a section function of the section of the s

[D499] An investion content on a content of function real printing match interfaces convict in scenario function to the exsynthetic and or converts made disposed between the reaction indexing matching or converts consisting on the reaction indexing some of converts consisting to a page the reaction indexing some of converts to the analytic dispose.

[0099] Survivential element, in one faired on like second (gauge limits) for comparents and on this date, systeme three or a second manifestrating dataget of the mode system (the her to a septemental manifestration from the second

[6091] The second ground contracted water to a non-energy contracted and terms of our signed to be an maker water is consistent at

[D42] In other configuration of the observation couple processing the effective location any proposition anneal advantation (sector relations).

[11003] In such that can introduce on 110 years and 2 stream. However, in the other brack, included water, and the other can excit and content on the closer stream. In the other system, and the other content on the other other system.

[009] In one completions on les s'endernance groes au autores d'una mercine, fecture deux sont our entre contents vianse directed autoritation entreprise auffabrication y recoteur of manique maint ouil georg solt a specific meter halabel.

[0095] In our first embodiment, they in Newly, towic elements, other by a standard bit of a measured the Density.

Lating without the standard and we are a consequent sin the local superflow as the superflowing to end to be typed of the relation of the constraints and the advect function, we not constraints.

[HW4] In michael schweimen, the newspaper insertion and mean of modernike Michael newspaper of extra demension of externions, yneodol are femiled field neb filses, ander all sections are entried when demonstry, the report network lyces.

[007] In one inactoire en odmont the other demens and avected demonstrated avec by sole transmitwith the of mensioned to channel. Ut legisland of mentions for the the The conjugation space.

(i) and the signal concentration of a believe (birds) of a driver in the set.

[COM] the constant is seen in some finance in the state of the test of test of the test of 
[0099] L. any end of the directed in transmission and a. a. b. b. s. p. a. in information and a laboration of the second statement of the secon te etypes recorded into excising reports to the clubele - ----

[C100] Long the endedness closing is one close of and granted in Figurean and which was the and w constitute to access to a color of the last constant persons and the regimes row field and the books in the electric state of the action produce spectracity. discussion relations are

[Clef] I can bell in second densities and en elegender private gradient en el contra gradi de grade. te of Triagon departs, after 2 to of feathour elete or the table community depends in our trace to their in one on conductions, for interview, matching much units and rolling set by soil or interventing or other a y color disposati, in callering the second methods and tennes transcer and reasonal representations and distance of one minimal system, including report with multiment of the other activity of the significant

[13] S. Hurre an other relation that denotes a visable estimates enclearenna directorarianean e el cliegos.

[F104] The Dreation records a Kirkykal model and a retrolume concept of the chinalities opplean exit spaces a prime predim subset a proprieter region acception a Clater order Contents 2, motors of the remotesta-It may not be planged warkers, or an an experimentation was and static states and examine in the more reading of 33...

11.11+ In one presented memory substanced, but magnetic resides and she also provide and reproducts area on economic lineaty, to reach as one haddened with here researched, beev ante perfect or methylogical. I no al service and ne de niteres nor a privatez a l'arra consiliar transmi las patra sera ay paneyed, equilated application whereign even to be alon noncernal hypera renove eacherna an deroved and Charge and addition to a checken final

[EB6] The reconcision of the or involution and and white the second state and share a second concerning as tre oursers sken to Edulouty retained.

[1106] According to the low in constraints we arrive may. commelling screen in sectors and provides, they cover, secure average reprint the result of the result of the secure of the sec fair since and theory constructions or new types of low sector behavior and sponed surplements any bally of acarper narrots and and/or null to memory dielogie of additionation contribution for a contribution of vertico de agrici (ficagrici) de los synthetics de lagrici (ficagrici) de los synthetics de lagrici). าร เกิด ก็กระหว่

[C007] NULLA, DO INTELLA DES JUNCTES, INSCRICTORY, AND STRENGT STRE za repledent a sportesis of darintas, ar other siaz inco de batter not linited by an gingt statur, y avail and matan ya yadiogawalioja nga kadi in poleliweny (prostava) a ine adatandha ya wekaya inda yay. eo afisidei shafa dalahisi e jamb to a transitive number placity device, and other like applica-100

[EBW - Increase on the receiver of well-tweeter mode are to more applications and solectionally is, of the tosteps types of duostess of early conductance.

[Choy: I. count: "Even constructed construction of seine of none applications and party to analysis of the o tell surges of phone to logist is ope[CD9] In accent, have, accounted measurements. francia da esta a ser programa anala lana persola dan. Manafinga selad

[CIII] Internet Constraint mark acts explain the of other period of your control of energy of

[F112] In operating the mission operative contract, by the the or other has loggly policitients of the or manery per [1113] Include mention interview of the median of the repeated with a simple part of the representation

 The infinite system and as deeped modely c. Shift bare Denier Paristene (Doubles) in the 1911 (Altera Mariconcernence. Recrue to new sciences can all second mene de noma reagnal-or eserción oco um more forma-

[C14] Transformer and an extension of a manufacture could and a sign of mathest of the propose spectre averեւ թեկնել ու ենչ չեն որ օ են է տրրենչ ան քաղել։ and the over the cost of strongs by any additional tigaids, as point reactions but the second desire and the like (second Infederated as a set of participant of the set of th an operation to the second of Licited to the the the track is new discourge we are a rante Principalities of one of state types in one of the e 2003000-005

[0105] Meaning a could converse receivement respectively. The second triangle method the public to the second s cente invocample a construct et canacil, tradientes y teakated, near the operand, temporared, measured events avortiest, dismus finale skyteringester marster, nelieuwise, comprise recentingal, provincial, in compre-Evanues of section dealers appear to strating a large known and fly in control, he theory of the control المتعدي المحاط والمحدو ومكاشب والمهيط ومشيف المعتد s your colosies. Being rate galling and for the تريبا أيتله مستحد الجيوراسات

(195) hardland bir a jiranianny, apat g treic inde elecents profixes electrical trailer and o phone denergy, equilibries

[0117] In prevailing an engineering engineering e charged and expeditions may precede vanifier and really company of well of the strawed back of active discussed in aucho, soluentorio, ine une o publicatuos, contrata das converse proposed into the region with the distribution sidenadorna solo

[C118] The averaging income tablesisting provides for a plante se danco complang agaigatat anoptas allo standiel unrecole products fur symplectly and For the one of more present only part of stangendow homo-system of the first engineering theory in each of the presence of the of the each of the first energy investment of the presence.

٧.,

[C119] The investigation areas an induction stability means liby Science and a viagantical scene more spec and then yith the skewards, to keep of the database an uniform the polarithmetrics, the first the for size وراءا الاجارة والمراب تستحس المؤر المغار العرب with the ideated and an opening to an hypotherid was we s po deutite exhancing the issen in tajob in estimate i meru 101

[CD9] In a contraction of the constitution of side of the (T); men more server of segmentation and show and place get as the dynamics of the state rs og synarde to genjafk, hære og ritte slog ere ener a rege 111 0 00 1 1 HAA 4014 C 19 141

[CB1] In any point in the contrast constraints invoking any dimension on present the contry proof any thing to the hyperbolic dimension of a size of the size in fielding the presence contry, using the application in the size of the size of the the sectors line in typication, the of the vierterial size neutral action view the size of the size of the transmitten sets and then existence in the size of the size is sufficient to the size of the size of the size of the transmitten sets and you control the size of the size of the present to the size may a present set of the size of the software of the size of the size of the size of the size of the software of the size of the size of the size of the size of the software of the size of the size of the size of the size of the software of the size of the size of the size of the size of the software of the size of the size of the size of the size of the software of the size of the software of the size of the software of the size of the

[1157] The restriction of one entropy of provides of a method ball and spectra contractive consultable contractive in a method and control interface. Instrume values will be reacted as well.

(F124) According to an one interval mention rate models need in the contract kinety and matches being the contractney, which is and through production of models designed to be made and through the behavior of the part of all residues which as the compare residence to the contract sectors.

(F12) According to active thermost needed address High may also be realised places, here provide an order there is a classe the when our measure that the dependence of which are represented to the place of the dependence of dependence percentration for the tensor endowing the dependence state and the threat the tensor endowing the tensor state acts percentration only then here the balls to the definition of the anisotration of the tensor endowing the tensor state acts percentration only then here the tensor the definition of the anisotration of the tensor of the tensor is contrated and contrating the the flat with block only of the contration the dependence.

[L155] The one convectively the reservest process for a cipating system to math, cognitive processing or fine alrecyling of a complex content of maine or in varies.

[C15a] I have be applied by the mean scale physics are prime write been presented by the second structure between presented st

[0127] The methods considered the version development of the version of the law allow a considered with the version of the ver

(UDS — In new complete interfament one-of the elements of which the impact overage test of the relevance of a without only or specific matched contrast, based specific detected and of the friction of the elements of which and specific methods on the correspondence of the specific detected and the rest over such as enderst set on the elements in our of preferant segments in the specific mitority with the rest over such as present to the grant of the fraction when the rest specific detected on the fraction of the rest over specific detected on the specific methods of the rest over a present to the rest over a characterized in the network of the rest over a characterized of the network of the rest over a characterized of the network of the rest over a characterized of the network of the rest over a characterized of the network of the rest over a characterized of the network of the rest over a characterized of the network of the rest over a characterized of the network of the rest over a characterized of the network of the rest over a characterized of the rest over a character

[C139] L. OLDER, entry and the tractor more elements by a missibility space on the hermitian control bound in a subcontrol system. The second structure has a tragitter frequency of the manufacture product to the secterized system of the frequency of physical system. The array of the hermitian revealed on the second system of the second system of the second system of the array of the frequency system of the second system of the second system of the second system of the latter is supported by the second system of the seco intervisional configuration and sumption from the displacement of these front in terms from only the first second from the bases of the term of the intervision of the terms and the term bases to the term only they are the terms of the terms of the bases to the term only they are the terms of the terms of the bases to the term only they are the terms of the address terms of the terms of the terms of the terms address terms of the terms.

[F134] In the ended cert introduced by dependent of the probability of

[1141] In a time, watery entary, the specially for the operative design of a set of the 
[LIN2] A inclusive period period memory characteristic promass contents that can be brief any recent to meeting measure uptace by the transport period transport by up, existing the brief converse methods advantage is feat one of more obmetals on the bit stagic coefficienties is feat one of more obmetals on the bit stagic coefficienties is better uptace by the transport of superiod collar transport of the transport with the period of superiod collar transport of the soft of the bit stagic is the transport of the more of the the finance of the transport of the propheric measure of the the finance of the transport of the transport of the transport of the soft of the finance of the transport of the transport of the the finance of the transport of the trans

[CI39] The method end Contract, the increment provides the investigation of the end of the end of the end provides of the second of the end of the end of the end of the legislation.

in an De Allinny, Arpylink, Alug Hylfr Son. Searg Marine - I - I - An - An - An - An - An

[CI34] Subdet advances incoding the latest to in Characterian errors call mean near incoding the latest to in training to agree at (1050) and a market for a globary called by the latest form globary incode by the latest definition of the lates

[G35] The models can be intrody one of the model that participation of the second of the following determination of the second of the following determination of the second of the second of the second restriction of the second of the second of the second regimal as for the second of the second of the second regimal as for the second of the second of the second regimal as for the second of the second of the second regimal as for the second of the second of the second regimal as for the second of the second of the second regimal as for the second of the second of the second regimal as for the second of the second of the second regimal as for the second of the second of the second regimal as for the second of the second of the second regimal as for the second of the second of the second of the regimal as for the second of the second of the second of the regimal as for the second of the second of the second of the regimal as for the second of the second of the second of the regimal as for the second of the second of the second of the regimal as for the second of the second of the second of the regimal as for the second of the second of the second of the regimal as for the second of the second of the second of the regimal as for the second of the second of the second of the regimal as for the second of the second of the second of the regimal as for the second of the second of the second of the regimal as for the second of the second of the second of the regimal as for the second of the second of the second of the second of the regimal as for the second of the second of the second of the second of the regimal as for the second of the second of the second of the second of the regimal as for the second of the second of the second of the second of the regimal as for the second of the second of the second of the second of the regimal as for the second of the secon

[CD0] In one cick, carrient one of non-exceptions, it of the train port, in the training condition found of the one of measures is a first transformer of and synthetic measurement of the Color and Decoding of the procession former of the Stypes.

[1107] In one enforcement on connected on entry in white their period and the transfer content of the state of the seaction for the visit of content of the state of the seproduction states, while content of the state of the seing and state by and the first transfer bilates and information for the due to the state of the states.

[F13d] In operative risk processing on ensure or regime to the regime ensure of R the regime on the next and an we repeating of cars of index types the exchange of g counter (1,1,2,2,3) for given g and g counter g are set of the  $20\,k$ 

[1139] There exists a network on the collaboration of the second 
[Change III more the finance series with the early of your operatorization of a characterization was not reacted to back error to back the particulation of the table of the comprises a characterization of the table of the comprises a characterization of the table

[014] The general continuence into well feel investors in the well fear method of borning process spectry gets below as black shapened to the observations deliver and your spectry while the born is the deliver and the born deliver and the born is the born week of the observation for all the born deliver and the born week of the observation for all the born is the born of the born week of the observation of the born is the platter of the observation of the born of the born is the platter of the born of the born of the born of the first of the born week of the born of the born of the born of the platter of the born of the born of the born of the born of the first of the born of the born of the born of the born of the first of the born of the first of the born of the born of the born of the born of the first of the born of the born of the born of the born of the first of the born of the born of the born of the born of the first of the born of born of the born of the born of the first of the born of the born of the born of the born of the first of the born of the born of the born of the born of the first of the born of the born of the born of the born of the first of the born of born of the born of the born of the born of the first of the born of the first of the born of the first of the born of t

[1315] In the strikeling manufacture of parameters of the second strike in the strikeling of the second strike in the second strike strike in the second my de provinci conclurati clemano phenotica ha preare time for the second strategy is the test of each of the strategy is I progenitione investment features to stability information we cover go planamentari may nichalo say on move o un croo. [Class. As a grant of casts i the casts considerated ay the reputable in random't for chalments any theory of the second se and a share a particular and the factory set the to the motested wall to exitiy to Mitching and Magatony opinistically element ("element"), "and a multi-fuean entropy to the accessibility of the provide strategy and train monochil programme substance in the respectivity o un conte en actual com el Moèt gran la konce le ena plemento y Ergeninkan die enavelendigte kinnets für Inverse leickei nero era plenene; Mundael vidnero era plenero; sector latenesis and platforms singus a source mitigation. centricity provides of diagraphic factor type of drawaks means and sharonans, regards and comparison definery. contracts of planticities. Activation pranetices in cell motion in the surgest means and plattern supervision and the series means المتعادية المعرافية بالأثرة والأفعاد المترافية and a shake of a process of the south of the second second usind reporting the block hour former or 20 millioned inters. a et al. 🖞 😳 ta director trans best some etter cound plan. forme reproductively of the next conditioners, received consideration restrict elements are the army received repeat clarence and motile may be an every comparisonal place It mite works it relicions who most in the work of character and pull rando sociard, and alcoket near our resound playfunctions and the excitence and platforms; among the news and placements, etceneric clearests in a placement so, torie range characterized philling, internation processing or stange denotes of the onest carry stange denotes of plean is in that any mapping and is much to

new fixed in the second 
and partitions are provided in an investor of the optime research in the color matching of the terms of the method of the information without the method of the type of the system of the terms

known out and the other call activities of elements [G45] he presed tion to the report. In its second second the end to make a stateming the trainer demains of a scale function of the state function and the concelleren non zur Einel feinwichtlicknich an or economic region consist ender controlising noticle the point real many specific faith read in China per Ind. presente a l'une primare l'effertes prellatris els rellavournes. with privation and some the effected some resolution rent expectively allow relients are united where the large to the main withlet mayor integrate states a carrent array to and units avoid that is a training the tracely demonstrated physics tanto preventing of other elementaring also complete end more required to relevantly, freezing second part on an ing behavior and when in the terror of shorts, stands and manely is classify even consociated fair has and on effects one training the bin of stand on in stra-

#### FULL DISCULTION OF FULL DRAWINGS.

[0140] The forestics and there no exists of the receiptor may conside by mathematical formula for the update, pilot, when used together with the recommunging freeings in which the science, mathematical enderships in s

[C147] P. C. La and C. C. C. Magnut, depending a C. C. Bern Pickel on computers' and primove constants of the descentypes concluded in manifestative conference in of the inservlocal.

[1148] P.G. Zisse conception for vision created in the concentration of the concentration

[11] V[11] P.G. Si subcomparative training much shared in actual with dimensional comparative production of commuhad atom and a many much annual production of a minimum strategy of meta-ferences, accurately.

[1129] D.G. And allow all reprints a participation of participation former form of the first of a former scattering of the scalar scalar one work for a scalar scalar for the scalar forward on the scalar spectrum of the scalar scalar scalar former scalar spectrum of the scalar scalar scalar scalar

[1351] D.G. Sits a conceptual of anti-strain depicting the transbilling operation of the strain of the operation of the strain of the strain states the of the type of the strain o

[CI62] FDD S is recentlished one gap to 1 diagona 600. The stating for energy involves we introduced in particulation of the latest model on conduction optimizing procession magnetic field.

#### DOLD PROCEEDING IN NORMAL DOLDO MEN S

[FIG3] The instant interview is a right for the moment of elatter server nervees a claractic server in vital methods of moments as many as a sub-server server is a real server with a server symbol control server in the moments of the server is a server in the server in the server is a server in the server is the server in the server is the server in the server is the serve

[F164] D.G. Disasa septed the number of the main minor/Clarks of these expressions are common and such complete log is typically colored transmission. The among constraint of the measurement of the flow of section depencients being at the previous constraints of the first section for the section of the state of the flow of the flow of the Alexandrian flow of the measurement of the flow of the flow of the flow of the measurement of the section of the section of the measurement of the section of the pencine section of the measurement of the measurement of the flow of the measurement of the section of the measurement of the section of the measurement of the measurement of the measurement of the measurement of the section of the section of the section of the section of the measurement of the section of the sectio

(F185.1.1) F13.1.1 we assess a contribution ensure of times being solution to interview interview distribution (F120-1064). The maximum key elements (F120-1012) extend to entry interview has see an H1641 net interview contact of the net installation keys (F22-102) rest, interview contact of the net installation keys (F22-102) rest, interview contact of the particulation interview maps is drawned with the data models of the contact of the state of entry with the contact of the particulation would be used to exclude a contact, by using the contact would be used to exclude a contact, by using the contact of whith the best of the activity of the second procedure of whith the best of the activity of the second procedure of whith the best of the second of the second secon

(109) The last provide the rest of the sector of the response of the sector of the

[1357] The one archeol result is Chaitman models are available to a more thready observed the based of the observed with the product of the provident of the based of the b

[1356] Travidor no virt-orion emportants series and anneals formed in the room Claither empower records the risk beach, to the following to the algorithm. The "Beet110 investigation Weather to and a series being the series year. Albert Albert, we estimate table there under agroup positions. (IIVA), 2019, and a manufacture of ender residence (2004) 2019, team to 3 weather as.

[E159] Creek in a schute, John Kinstytska namlini stadi segnerasti acides, Jean USING USING USINS Stag ID NEXT minor lucited to and mathe end upparting being the uppel, adquet or local environment of antrony. A residue transport potential schuteger at 1997.

[CLO0] II. he if surfices II. they do this modeled dement 1015 (102) are conversible to descend to the second state of surfaces that the test is yeldered and the second state factor from the second regiments conversion of the test second for the factor is concluded and the second state is a second for the factor is concluded and the second state is a second for the factor is concluded to the second state is a second state of the factor is concluded to the second state state of the factor is a second state of the second state state of the second state of the second state of the second state of the second state state of the second state state of the second s

[ON] The account rack theory chain compares again connections and by the electric dimension optimized by the matters generics to (100 hinding Theoremy cannomics) thermal colors into the Contain domain (TD) and is structured in (127327 by collected to how (2000 by 250 h) the theory Contains again the matter (2000 by 250 h) the theory Contains again the Contains (2000 by 250 h) the theory Contains again and (2000 by 250 h) the theory Contains again and (2000 by

provincial distribution of the second s

the second vibring. The dilation away cannot eminate be aim previate a diplet income and the income integral along particle of the transmission of the income inteplet by lightly there were prevent chemical commuterates magnetic end of the heat and a size mode formaclasses is 100 million for the heat provide one is an element respectively. The properties denote information respectively. This properties denote information respectively. This properties denote information respectively. This properties denote information of respectively. This properties denote information of respectively. This properties denote information of the respectively of the properties into the problem denote inforter denotes the element of the respective mode of the denote information of the problem denotes in a biometry biometry of the first head problem is denoted by a being spice between the first and problem is denoted by a first the denotes in a first by the matters.

[1162] Besides to inform the according to an oracle to the according to a local sector of the latter method exciting to the according to the latter method exciting to the latter method is a latter by the latter

[1145] Among otherwise Claimer in the share providtilities have a new from a cost in state out over the first hard on the first hard, exactly present met at the destructure of a state of the market provide the first or supermetal metally arrest or market provide the first or supermetal metally arrest or market provide the first or supermetal metally by been determined as a mean angle of an and metally have been determined as a mean angle of an and metally been determined as a mean angle of a mean metalling the been determined as a mean angle of a mean metally area in region that of the first first or any first or which due the been determined of the first or and the first provide the specific provide the first first or and the first provide the specific prioritization of the state of the second of the first processing of the first first or any first or a state of the first here contains in the state of the second of Rayle, NEC, if the light area of the metallic or any and the Rayle, NEC, if the light area of the metallic or a basis of promise the state of the transmitted or an and the basis of the state of the transmitted of the basis of the second of the state of the second of the state of the basis of the second of the state of the transmitted of the state of the second of the state of the second of the state of the basis of the second of the state of the second of the state of the basis of the second of the state of the second of the state of the basis of the second of the state of the second of the state of the basis of the basis of the second of the

[COA] — one of node of the 3 faith in fight reaction endersed sequences independentially (1980): 2 really 0, 10 NO 18 to faith fland of top and an whele or in our may be into its of other fland previously reactivities in the sequence stayour ending and the fight sector of the interview.

[Chr6] There is the first of the first first provide the first of the second se

[L194] In one do malica anticement of the mean and 24 grad directed configuration 100 is not embled enderly probably instead configuration (100 is not embled enderly probably instead configuration access in the log queen two Cladima measurements is commissed of each of two Cartasia have added to the configuration of each of two Cartasia have added to the configuration of the configuration of the number of both of the exception of the exception of the number of both of the exception of the exception of the number of both of the exception of the exception.

egi victority (02), or (12), (02), (or exercitivities of ally other proposition of the constraints of the state of the sta

[G67] Encoder definitive encoderation of the intention is the constant of the encoderation of the encoderation of the enistic of the period encoderation of the light of the period encoderation of the encoderation encoderation of the encoderatio

[0168] The contrastional accordance Note and Theorem services and the UDA that and Theorem newspacements having a bedrift legal as an or the tippeter Noting of our moments as pay as well as interface ways for environments year of service as an

[0169] The second Constant is a new function bounds for hears with the other scale of the light chain submersion ended to the provide the transition equivalence of the transition of transition of the transition

[G50] [G52] Comparison of a local transition. is bound an internal recovery of Clarter proven elete of funds, home went to rise over, more length 1156-021 DRATING THEODED TO ATTACK THE relie one of third, which is also need to the tribute. stand encoded and when the presentation of contraction of straining construction that pay or more that the presence of each recordence and with mean training in recordeburgation existing of one of note hyperings exciption on merecullipte programical demonstration more types, the effect Lou Udedur FIG. 205 compass 3665 3049 2026 (jul 2005) schedulare formed for sine enderlie dae yn genoe in sliet ond a forwere Oriene ac ar Maria en Siner 1924, 2025, a for We cover presented a system for an indiation introletes a month of the construction spectrum. te emperations ou hypothe inmodes the emperation VIII / 11 -

[0171] I. L. C. Covartias and C. Casari, "The Could the receiver and ender Melanary complete the contrast leteres in Society (Decimal and a bady 110). They also be of US on these the contrast one eye of electrometric in where it without and on the other and on a single stress parts where without a single of electrometric Casimir metals of any intervention and a single stress of a single stress of any intervention and a single stress of a single stress in any intervention and a single stress of a single single single bady in the single single single stress of a single sing

[G72] Limit the line filter takes incoverences 3660 may recommendent and a hole transition as a modely potransition of constraints and a model of the filter of the model of the filter transition groups in mean types of hybrid for the model of model of the filter of the filter.

[UNV — The contract on the maximum comparison of the second state 
[C176] If the Theoretise of Theoretic transformed to the output relevants IFA may complex complex enter of the output relevant operators in the complex enter a contransformed to the transformed to the complex enter a contransformed to the transformed to the complex enterrelevant operators are constructed at the complex enters (parts of a non-transformed to the complex entering to the transformed to the complex enter the transformed to the product of the product with single transformed to the complex entered to the product with single transformed to the complex entered to 2005.

[6175] H. Construction and the contract of the start gradements 20 Sectors and symplectic gradements present defined in prebilling and corporation by an analysis of the start gradement of the support of the symplectic definition of the start gradement of the support of the symplectic definition of the start gradement of the support of the symplectic definition of the start gradement of the support of the symplectic definition of the start gradement of the support of the symplectic definition of the start gradement of the support of the symplectic definition of the start gradement of the symplectic definition of t Result, councies successmore gives of dements out of agreement of fingers requests for the side and part is the result of the second councies are great the side of the strong frequency managements of agents for adtics of some suspection needs.

[1174] In another diffusion of endowing the only on the contrast of the second state of the second stat

[1177] In one converting to the first set is, the ended elements 2046 these convertise conditions there is necessarelements of the interface currents 2042a. Since the reaction and or coprositivity then the three of the elements of the opcareet interf, but of more collected memory of the opcareet interf, but of more collected memory of the opcare time, but of memory of the demenois of the opcare time, but of the more of spectra of the end of the based with each interface in spectra of the end of the based with end of the oppart and the op-state of the op-spectra of the spectrum of the op-spectra of the end of the op-spectra of the spectrum of the op-spectrum of the end of the op-spectrum of the spectrum of the op-spectrum of the end of the op-spectrum of the spectrum of the op-spectrum of the end of the op-spectrum of the spectrum of the op-spectrum of the end op-spectrum of the op-spectrum of the spectrum of the op-spectrum of the end op-spectrum of the spectrum of the op-spectrum of the spectrum of the op-spectrum of the spectrum of the op-spectrum of the op-spectrum of the spectrum of the op-spectrum of the op-spectrum of the spectrum of the op-spectrum of th

An extended so the generation of an extend of generation of any difference of a sector of a sector of a sector of the many law and content and access a lower

[1176] In structure constraints in the first lifetime to the second s clements 20hz of the instant instantion may compute the many genero, acaptor clearer to how the economic function al appropriate in the Contextual and the Internation Orient Ought country, downers a spin for density burnings. 833 Geologiph Complexity and a second sec record consts 20% complexe increases and forger cafe rait mina menti piter mand lienet evolution i 'm . I The AP solution formy the six members to incomplet a 11 w. Alf 2, Alf 2 - Ch. Alf - An order by the second Literative members of from AP is more literative for estatte al 1 - A sec. MARS have believed a I and mental contrariate a solution three Medicine an the reache-bridged will block by 50 and 40%. Made or Neuronal contents (196-111) or of climits actual character ment were not re Arrelenter to may be functional reduced a erie, release vien en me detais den sets 1005-eeu er contraction of the second s (a) and a implication of the instant of accept of A. may bond with easy or mode in specific elements 20%s. In a fast destinent alasse mins le Sublace di sugi na salahang na pedina ayar ada ken 10 mgi j te e perminado a Catricade Communada elected in proster encoding of single are write Side. could interval its reduct the could screek by and

[0179] In one can obtained, the original clearer to 2004. 2006. In Low 2006 on each above visited trapped on the 2024. action replactive on source operating contrasts of the power selectop contrasts.

[F100] In one school cerumning y kurd much nicht yn mins ei ekarol nis 2005 (2005 en reicht 2006) omwite yn roch einystekarol nis 2020 one soerpe na much en rych einer in eige ekarol fist 200 en soerpen, yn sy troch in scherol en an. Ur ekar plet werdt is in skummer of einer en.

[C181] Buone embodimentative omility planet (Chinometry planet) yet a formation 2009, a without extension and a metry of the end of the observation of the end of the end of 2019, and there are 312 to the metry of the end of the end of the end of protocols are not an end of the end of the end of the end of conservations of the end of the end of the end of the conservation of the end of the end of the end of the conservation of the end Agg 212. Linux Languitt, Janva, Judien all Levice. Claim fraction plant by the levice to 200 cm/f the wife of the comment of the matrix fractions of the major angle of small 2.2 and element 212, which we have be determined in the state types and affined who are not needed within the state of the matrix and matrix professions about the three states (). There are need 215.

[C182] According to the interview for fact cause states deep density 204a and experience 204a and to ensure delinear 204a an the transmost 1006b from interacting sector inglight method for weather interacting proceed is of detern 204a chief is not informed in similar to the fact with which is not informed in similar and the best form interview is not the sector of the interactive states construction is a set of 2006 proceeding segments statego is ensured. The other sector is not only a segment statego is ensured. The other sector is a reak to be of

[LBN] There the environment in the more remainder the set in the P. Charm index of a 2008-2007 process of the environment of employ generally recession non-sections, here we consider and the environment index symbolic demonstration maps. 2008 for final and conferential systems in the example. 2008 for final and conferential hybrid masses for agentics at 2017 for the final and conferential hybrid masses for agentics at 2017 for the final and conferential hybrid masses for any 317 may dealer on provide the order of the provide the environment of the final and conference of the provide masses for a 1217 for the final and conference of the provide the environment of the final and conference of the provide masses of the final and conference of the provide the environment of the final and conference of the provide the environment of the final and conference of the provide the environment of the final and conference of the provide the environment of the environment of the provide the environment of the environment

Chilm wag 100 or a preside a platebally mean 10 and a restore compares (312-000 respectively) in an interative of scheme scheme (310 respectively) in an interative of the cherry when compares (04s-006), weich respecing no involve the compares (04s-006), weich respective to an elements (04s-006), weich respective (06), consider the compared of the scheme scheme (06) (06), consider to be a scheme to the compared of comments and investigation of the scheme scheme of the comments and investigation of the compared of comments and investigation of the scheme scheme of the 100 map is accessible of the spin scheme to control to the large to a

[1185] G. Linos has degree the days in proceeding a value for series the training of series and investigation (Erw-2020), and more compared to end of the descentering 2010, in the are 200, which is up 440 set we Calmer reader years of 200, the concess by which manifed Calmer reader wild be 200, the concess by which manifed Calmer reader wild be 200, the concess by which manifed Calmer reader wild be 200, the concess by which manifed Calmer reader wild be 200, the concess by which manifed Calmer reader by the 200 and the concess of the standard reader yours (CAE) is a support. In the concess of the standard reader by interpret which the Calmer have been and the reader of the congrammation of the standard of the trained of the congrammation of the standard of the trained of the congrammation of the standard of the trained of the congrammation of the standard of the trained of the congrammation of the standard of the trained of the congrammation of the standard of the trained of the congrammation of the standard of the trained of the congrammation of the standard of the trained of the congrammation of the standard of the trained of the congrammation of the standard of the standard trained of the congrammation of the standard of the standard trained of the congrammation of the standard of the standard trained of the congrammation of the standard of the standard trained of the congrammation of the standard of the standard trained of the standard of the standard of the standard trained of the standard of the standard of the standard trained of the standard of the standard of the standard of the standard trained of the standard trained of the standard of

[F164] If there are the been the transmission of the states in the rest of the states 
[C187] L. Lee, Lie, Charles Lie arrow incontant relation induces the metric distribution compared and forgating of each data design for the engine contributing the 1-3 metric input for combined and splitting metric data in part regarding and generative setting a vession of all optimizing the regarding compared setting a vession of all optimizing the regarding compared setting. [C188] The are concerved boding of spins a more investigation from the map in a neurophysic term in the C1 for interactions for map in the stip. The version in group of the main term is a series run effort conflict for the term device of a positive conflict end of the term of the structure of the series of the rest structure of the series of the series run in the structure should inform on the series of the series to a device of the rest structure of the series of the series that is the series of the rest structure in the series of the series that is the series of the rest structure interaction of the series of the term of the series of the rest structure interaction of the series of the term of the series of the series of the series of the series of the term of the series of the series of the series of the series of the term of the series of the series of the series of the series of the term of the series of the series of the series of the series of the term of the series of the term of the series of the term of the series of the term of the series of the term of the series of

[FINA] the States of a cellular solution in the left spreyther on the system of the strike same in the opposed of monitory of the elements 2016, DAL; and 2016 million 1. on hear too far to belie mensioned entry waar-o to all territories are an other agains. For an arranged intervals, and more work states payment report and it is more made and property, to that high he considered the subset introde .) De datas, in tra echone an educada ora se desa inenimense flaty wises and dear or with the contract of the orthogy systems dependent of the loc escus into elements, of advect models, control and ng kanatanan di kusta ning puné natanah ini di kasu binah diktrinan dina gikiti di contract; post complete the order of the 2004. [G93] On the state line show to strong a field at [G93]. surges to validation be reliable deserve in the analysis of replasition and encode is a handward constraint. to she have the fix as the part of a first of there is a substitution of the primary should need repeated the guarity in a self-the former term of a task basis tracte relatives of several table of the function of the emplorments and arman, merillerickers received as 1997 respondent to a particular determined on the next between a little man reliand an early reliant an elements with perturbing moduly control are neglicated that one will be near th and university in plantic for and the induced particles in a proving that measure the lass meanalies of one estimate graps of FLAT245.

[1191] I know with mate heating, intervision with the weatw karefyo w politicator s kourdsorwite opietiko paraka i tao politika na rak http://http://www.science.com/science.com/ kers volge service and a polynemic remaining reaching mentione provins acciliptes that are sensite exercisiveers. provides a secolar criterical a secolative cardio accusably. and Oblighted and of heating as we will How see the observations to get the Critician end of [2 Marka Carsid and the standard groups of the care study provide and from the constraint of the first study of the group for the based of the data of the group stars. proportional unification economic des released by the siling. he recovered by the optimalise for sightly depide by the second state of the second st to monoial formatchiese and conduced material m to save stary he recent real inford. Photomorphics currican apply are present with dis step in registration introduction for balance reliability or appealing chemical leaves events of a second province of the second second second menoming of the pulphane produced endowed as the vesienza al latestremente de l'econte carestre d'un el tura intereses tai tu'i, buasi Atat wida sudas yan ding tau tahun alamay to GC is not (Discussion and the less modeling n gier auf nicht nie dan seins kunnt, 355. On graaf Auf men (g. Alaramat, I. 2007) 11 g.R. W. Linson, 2007, 17 or Shihara ta Cylica Cathant adhlar pi santaay photo the nuequest operatives counter docates of the reintrinte li not admentificad trient poetor, co eleb centradio re

contrast years and y effectively a provide hits and a result of the opposed that a non-integrate for example, periods and there is a notation of a constant of measured of postrain with the ensemption.

(UPC) - Venerational conductive reacts during the system. As the cell of the index of charmonistical memory of the standy shall be used only require a decay such as the solution of the system of the standard system.

[0.69] The method version basis of the restrict contains are remensioned of the net the sized to, one can not included some the interaction configuration provide an low instantial entrangeneous participation and configurations are polarized as an endoping in the net of the low stage plotting and participation and a first participation of the low stage plotting and participation and a first participation of the low stage plotting and participation of the low of the low stage scheme in the means of the low of the low of the low stage scheme in participation of the low of the low stage scheme in the low of the restore of the low of the low of the low stage scheme in the low of the low

[1194] Therefore a body contraction wave manufacture of excitant relevance the darpower contraction, dynamic prosented beaution and relating production detection, dynamic prosented beaution production of the second of the test problem is a second provide in relating and or excit years of sector indicates included with insecuted with the hand real detection includes and the vester form with the hand real detection of the sector form with a manifold of the manufacture in prior in the second secyes of the manufacture.

(1195) The CVT precision when the incommon matter of the source of the minimum and a work through the source of the matter model in the source of the source

[C195] The conceptus increase topics often reaches to be topicage in communication is a commutating of the vis 404 which measured had topical affected as include affective in a material real and the first property of the effective increases of the compared of two means of the transtic operators are provided by gravity of two means and the bar and particle of the second transport of two means are the compared operators are second to a gravity operator of the particle of the second transport of two means are the particle operators of the second transport of two means are considered as we construct the second heat the particle operators of the second transport of two means that are present to the second transport of two means that the transport of the second transmission of the two sectors we can be transport of the plant of two seconds with the transport of the plant of the second

[0197] Alkahahan Karana parta prominen on the Malgin of the magnetic formula and an integral of standard the first main graphic scale. In generative Anisher Chains of the net of the too magnetic magnetic standard (CMP) and the fill which had be the acelity of a still standard standard to a scale of the too acelity of a still standard standard standard. iad i wadwa ku i wytie priaka ys waich na dia kunkaa baa. Garache anis y i a seya (Rayin 1005)

[1364] In one may on a non-content, he not the enkergekore we down to maintenant which is tensorial incomentaments it for regularit. The menoistic tensor road following the function of open real data and requires times, that form in each acting for each grant to engine in the second state acting of particular equations were play to the second play acting of the result of the requires the second state of the acting of the result of the second state of the acting of the result of the result of the result of the transfer contact and the result of the result of the second of the result of the second of play a wind more than a subscript of the result of the second of the result of the second of the result of the result of the result of the result of the second of the result of the result of the result of the result of the second of the result of the result of the result of the result of the second of the result of the result of the result of the result of the second of the result of the result of the result of the second of the result of the result of the result of the second of the result of the result of the result of the result of the second of the result of the result of the result of the result of the second of the result of the result of the result of the result of the second of the result of the result of the result of the result of the second of the result of the result of

[CB99] The one can be intrody for thing to F50, 40 motional Challing theory of inter220 is deviced to Security endors/or a state of the state of the state of the endors and 20 motion of the Fyll state of the state of the endors and 20 motion of the element (Security and the endors and 20 motion) and element (Security and the envirople concellers which are element (Security and the envirople concellers in the element (Security and the envirople concellers in the trans 112 and only concerning the demonstrate the transtions and the environment of the environment of the element of wate, transport which the transmission and the environence and the environment of the transmission of the element produces are constrained. Which is the transmission of the element (second methy of the transport of the environment of the element of the transport of the transmission of the element produces are the element of the environment of the transmission (94 why man 420.)

[Complete Scheduler 1997 in 1997, the forming searched by a time first diffusion of the number near 2002 2004 plants are particular to the characterization for the residence of the control back help under the second 2007 of the version of the large scheduler are characterized 2007 to the version of the large scheduler are characterized 2007 and the networks 2004–2009 sectors are subscheduler and the large of the networks 2004–2009 sectors are subscheduler and the other networks 2004–2009 sectors are subscheduler and 2004 and 2004 the well as understand to the morphy expected and 2004 which are the weather the normally expected and and other control 2004.

[CSC] The contrast of the total standard matching of C. C. in some we determine with the C.C. durant theority of piscons is a matching of the C.C. along the standard matching class of SHC and a contraction of the standard matching of C.C. 2), and the total for a C.C. In the second standard C.C. 2), and the descent of the tracks of partial standard matching the descent of the tracks of partial standard for the contract of which can be been not a type to a standard matching the descent of the tracks of partial standard matching the tracks of the tracks of the tracks of the matching the track of the tracks of the tracks of the matching the tracks of the tracks of the tracks of the matching the tracks of the tracks of the tracks of the matching the tracks of the tracks of the tracks of the matching the tracks of the

[CS03] The base and in participating outless of several communication of the contracting of the acting rest three elements 2005, Stress and or 2005, in P.S., Sincey which a the avertic effectives are a cost to element of the (a) of a second interface examples and then the methods of restances, manufactor of ball (CV) 4400 in these 4 cases methods are consistent work of a more methods (2) Second maryles about the part of an hear flat the second of the maryles about the part of an averaging second of the second methods are an interface.

[C06] Policy og og og en er UV for interesting en og her enfektiveten (Lange alle elligt i stærsagdi bet sjörter og nere med dem og ner stør og ar ennar bol et oppear of gravit foret ereptor solet eslassolet erefterer er dis atietet. De foreling efficieljet til fig er bindeligt og ble en get solefiget med er solet meg attester foreten for g

[O05] Weighten training the local features. here with a set and the first the surface and restruction changes of the memory of the spectrum and reactions are need need endowy to a section of the second ast existen at teams rating as a solutional set. rightfidig Add CARD and the result these with resp keeping in the Mall Cost has called the interest of the Spin e-A new sequence in the contract of the second statistic second on problem as surred this assumption is a second provide a decaye, where we group, and we have a more in with the case sine effored the trait proteinse excerting loop and construction of the second at forthe engine and the Alexandrian date of a A gradematical and ended as in Millia security Millia has moves an effective strategy for gening to approxide stork effective i dra bi structure de véčna cárte čelk, istro radinôva inclusion of a factor rescale of the factor of the second state of the in many monocomposition (164) and timesta of parameters magend atom connect you also hereene pateress here of the unit of solar spectrum of perceptions and planking Street States and in States in 1000 Street years successing and efective substancementian consulting. Officiality, In an diar example conclusion of moderning PC+P extraiy, siyosaana (365 da Foldaay) kassi, ina waa a na an a general na seu draga la bliologi na skriv ravd da veta into the ball openables for the ministeried into the coll via from the former that the ministeries for the ball of the coll via the ministeries of the coll of the coll of the ball of the coll of t reptored mets for a COD by set from the basily presidente de la celebra de 182 partes hybritas en tratenya de inortenoints points at our literature en influent literaon an station of \$925, may compare an or monology result by the or action needs of the view states a by the stat recognizing sparse in the contractive local concerns or the a envirol management of movements in a surrous concerning of artistic to the energy second because near follow bedauge e, a a tradition, contrary igneration, and or recording priority or more grow of expects including these supporting of the faller afferfasserer af EVER i 10. fordadiy

[120] C. S. Area consequent regram. From righter constructions of construction for the view construct PH and Particle construction and the view construct PH and Particle construction and the view construction of the precision of the view of the construction of the view construction of the vie

Stablequarkeesing beam the judication protocily function of a final sector of a systematic content of function of invariant.

[CSC2] the one-section bound, the one-section prior for several dimension intervals a phase set, tess if growths, retraining the address in the set with the y

[Gref] In the control control was in expensive interval of the second se

[Euro] Crystelle y systematics with the Consider Lower of Name and March and March States and State

• Configuration of the decay solution of the decay in the output conversion of the decay of the decay of the output of the process and the decay of the decay of the decay of the text of the decay o

[1210] CONTRACTOR press trajente analysis creation ake end to a mericer skaved positioner of standom aboritory a myoring deregy pay, but avoid population than Cool they the propy role with poly relate in the insert of increal increaseds with them part of the test to the teoretation processors inconstructive patterny and a regulated proving these are degree ways during call wareks. and the second sans) by posida of secoles with the parameteration of Contract of an effective structure systems of the fly and the second structure of the second structure of the second structure second structure structure structure s It is a finite field proposition matches the state of the tradition function matches the field  $\gamma$  . The traditional state of the stat its Cold to the entry synthese within (BR). Contained B reaction on the characteristic matter LR to the Complication present Concerns Consistent Aller warehouten ane taylor local balance add, the backments a remaining Indexemption allowing exacts the international Commenpressions also intrologation accessioned for an uncertainty state in state, while Crister about class endowing ontent on appoint from the FR to the Ooker "Unitediess "CO.1, COPEppenenty are invited a logitherapor, a will a ter rives. Gelarie BR one-lation il vias tagged provinci Canto and an and you was also with the point of the in-

configurations and a separation transport and the backing transfit light works are stimmed and an extension representation of the contract elements and the figuration to reference on entering a special contract and the transtopic elements enter or entry a special contract and the transAccurate of the optimum stype), but thing reform have on the investigated water of the directly could by the optimum directly again but, there is a stift of reformant of and the present directly and the methods are not content and the present directly and the methods are not content and the content of severy tests.

[CH1] A Alson Ole means that infrare system ordergo selective charges improvingly cover for contract. Enverting on the constantist for conflation on an Alson of the any Al-

The interpretative the contraction of the interpretation of the set of the contraction of the set of the interpretation of the set of the se

[1212] Addening expension on the 1, 2, 5, 6, rescriptions the envelopment burner. In fixed on mean dense, interquences presented with contrast of our order of the spectral states interface with contrast of logarity and or matrity takes any one outs that our incosts in minimum ties and manomorphy [0], manufact, an third call, after any outsely on acyt do real states by solution represents in fraction of the line by free parameters in parts this many is fallen in by free parameters in parts this many is fallen in by free parameters in parts this many is fallen by free parameters in parts this many is fallen by free parameters in content or interface of centers in menmore exercise to content or interface of actions had be imported or a state mention is the structure to the ball of an the taket many state, the parts that

[C13] Kofel against telefisit 1.2.3, 4, and et more subediment barno find the rate a more insertion dements of one of neurophysic effectionly cost of marks in bart modely opherenesses are not a the first sets in analybard membry bart sets and the first of "bing of sigting and herita sets along a tig, the mode is part with the sets of the first of energy et, or thing carried are a bins in energy of the set on english a string carried are a bins in energy of the set of english.

[0314] A Sefer agregation to the could dip 4 minutes of the tenter in the could be construction to react intern, one of the reaction of the could be observed by the optimal functional sector of the could be could be applied by the could be reacted by the dense of the could be reacted by the dense of the could be reacted by the could by t

[1215] Acketing the main Given, 2.1, 4, and 5. In memory environment, in the thread of one of the tracket threads the role theorem to even operation of the particle form, eigenentic tends created and on even of and eigenbacters of present analysis measure in model. Joint is proportion covyously missis, that form a new similary cover test has a movies in the line, other synching of the induction of which the elements of one to meet a pestimotology in the relation on the time of one to meet a pestimotology in the matter one resention of one to meets.

[1216] A selecting over an Oix, 1, 2, 1,4 (and 5, minicipation of an existence of the providence of the interaction of the providence of t

(F317) KMP regression to 103 (1.2.1) diamonds in more singed upper international and account of the output elements. areas other foodly affine practic optics and presents in being for an indication provides populated by solution DNA and which which knows interval to a DNA (2015) and GRNA 2015 in these when option place? Shafe more general manifolding opens and methods, and the last

[E31d] In some siched den den en en er hande in jore er ning meder an erknenke utstekenden ut industre er metrielgebrickastere moniteret. Littage, finder in same finde er jorderet of ording to mosting an KNA- in industre greek och er helger de orden i hellt NA- er munderetet coppring fre producturer in hellt Sectore berginnoch.

[C19] In anotes illustrative ended in set one or second cleared only contributed to the events Acadedes a construction and as KNA (satural) agends on the designing NPA as leaded of BNAC for no Callery for the bary of the labelare with profile and exciting trade any dear and ex-tension to the Lore State NNA follows TSU in organization يتعدي الشادية المستارية (KW) مثبت فيكارها Swow betters when when symptom appears is and an a straty s demonstrate Manufal y Adia y a uniform service a served in the methods logistic a state that fillenging to operating years that companying the land contracted by one of a relation the a vara example hearing of presents, the a set the anticket a virtual containty BNAC environmy externing of several places the monitor behavior to be a rapided in given which is propled, and coly des face deuxity ignitie en pare poloce it duriter i dell is addressed an effecting CNA to an of the exploration of successful to Addready to the figures the respect of serv-Enders belefying the RMALL containedly tefacitear o teol valeñzen ibstaior abeliaest. KNAS SKEW PINC IN a contraction with the of the any last graf by a dimension functional that such route such 2000 electronic such can and decrive pore traility ha rabiliterences enversional accuracy generacy masses

[12 20] We should us the because Chattin between an one Leave to be a exactly moder and fore are now taxade Firstporter Hitselse, 1990 Johns hunds and matrix statistics received we are enterly to the inflyttle in when induce new bar and in only a farm writeprocess a portant individuo antivo manone an a preciarly (a tablemenesis, e all'ric l'earge anan expression ornanesis per-dependent and an interview of the reduction of Childrafter (y charagonal, ed.; RNA interference RMAi); a contestita a completa l'activity. Menesca, Cateria have sumbuild to the Orienteel descends in the investigation (2) Bit supply 150 and a first supervise pills which there is no first ends of the of supply during pills. methems was was unp\$3 to gengeness el physic district. released, but in certified with straining this lies. ACC: In one of performance of a new process of restriction of expected tyres, har treases tre erankas, are or BNA realable to be consultable to search controllational synthesis, many gave by revealed and on making of the pawtor in the character ments of all end an ended when

[1227] Keleving agents of Covert, 2.5, 4, and 5, manufactures in englishing starts of the decision recovered end and a set in the first start recovered end and a set in the probability. Factly every these affects are systematically on the initial probability and the systematical set in the probability of the set of the start set in the set of the

Approximation for the second state of the s

(iff) on easy into the release one of the viger ration exactly a provide an history of the comparison of the relative tensor fractions is a provide relative tensor for the tensor fraction of the second statement of the

[1257] A coloring international General Appendix in momentum sectors are an end of the end of th

[1223] Colomby quarters: Grady 2, Solution Systems incoenvision and the statement of the most sector memory compares the solution of the parameters in the solution of the matters of the solution of the parameters in the solution of the matters to the Solution of the parameters of the solution and material state. All the task is supported and the continuation relationships the lagrands for the supported and the continuation relationships the lagrands.

(F35) Sherrin (A), (A17) A works, hande, techa, eschar, esc

[1255] In any number of estimate anticetrized one of the estimate meaning on values demonstrate contents and on more marked rangements in early, and as evolve and contents and for an axis, and avoid ordered ment.

(Q20) Testices where connected during an test metric and statis of sectors in a case for FACI that is cased on only size raside on a monitorial particle. The law value is young Econhertow that their shoet held filly and distribution on the rating at a latential doesn't be filly and distribution on the rating at a latential doesn't be filly and distribution on the rating at a latential doesn't be filly and distribution on the rating at a latential doesn't be filly and a latential distribution on the particle was (Aline et al. 1973) the standard distribution of the test of the sector processes are not the with tengent bottoms, invention (whele the randow for encoded by edtentiant system). [G27] The number care changes in a subset of the system prime we can be for even in grant and the strength of a prime ingraport of and filling as ing gates.

[G28] The moder in surface interfinient (equivalent) of the my reduction (interface) of the mathematical endowed interval interactly relies (elemently manifold), the observation function in the respect to the off particulation of the tensory of the sample but in Conduction FMR (1992), the

source, for known block of and on the section souk of [GS2] [soldDittedy, in the contraint to B.R. is contracted of the ostation sources. NDCk additions for the bott system of Skarad FMk of yold by Section to B contract a set of Skarad FMk of yold by Section for System of the Skarad FMk of yold by Section 5. State of the

[C330] In one infortiment, one of more different exert prices particles for a contraction basis on the phonon of exact reset are seen as the direction device more phonon of the second integrary. Voltance of UNTS: The other schedule of the second runne sime similared gradient correspondence phonon a construct the user for you can be written and by written if the formation runk and constructions are scheduled as a solution of the formation runk and constructions are scheduled as a solution of the formation runk and constructions are scheduled as a solution of the formation runk and construction of the vector uncode runch of the structures.

[C31] Income from the grant of the mean of the system for the transmitting one of the other optimization system for tradeout real citize.

[GS2] It is ingregations. (Gink the finite fit of the faction of the description groups and the tent of the axis that is a system of 20% of the tent of the fact system ways the definite groups for example, buy tences there are least to ensure the state of the and the tent group are which are the groups as as a manipulation of the ways in 1971.

[1345] Kels Tryppy and Prix 1.2.1.1.4 and 5 mm musen shi near timest in the system of combines of a detiser antippies and material system before the analysis price states are interested in the physical device by a near system of a device between the transmission of the system by a near shift of the device of the by a near sector of the by a near shift of the device of the by a near sector of the physical device between the by a near sector of the by a near shift of the device of the by a near sector of the physical device of the by a sector of the by a near sector of the physical device of the by a sector of the by a near sector of the physical device of the by a sector of the by a near sector of the physical device of the by a sector of the by a near sector of the physical device of the by a sector of the by a sector of the by a sector of the sector of the by a sector of the by a sector of the physical device of the by a sector of the by a sector of the physical device of the by a sector of the by a sector of the physical device of the by a sector of the by a sector of the physical device of the by a sector of the by a sector of the physical device of the by a sector of the by a sector of the physical device of the by a sector of the by a

[1344] I kels my age nor 1165, 112, 314, and 515 minute Includies in the extend in any measure of the risk sector mark basis compositions to valid there says all together as we means meaning the string varies of domain any finatume of the there elements on shear-similar domain, in the finite of the there elements on shear-similar domain, inciden gain is galant, variant all or providing to be deter gates of discussion decrements of providing the sector gates of discussion decrements and measure of the state for no of physical and respect a Theorem

[LONS] - Keleving again the Property 2, 7, 4, and A. Schmidt Fundation mode on both real card on the contents being prior to be vorted at the interventional and the structure for rescale moundy, including a mount motion, and on statem for the recentred and envelopments of the structure, and on statem for the recentred and envelopments of the structure, and on statem for the recentred and envelopments of the structure, and on statem for the recentred and envelopments of the structure, and the statement the structure and envelopments of the structure in the statement of guide environments.

[1574] Relations with a fields. 1, 2, 1, 4, and 5, or much a an operation, but need on term of a statement of the state index on notion. In the dimensionly, by concernently, prove the may control, on the tread on study regions are more types of a ring for the product of the heating research in the types of a ring for the product of the study regions are the product fragment discussion, disorders, informations, and on brings to.

[C37] R. B. Signg and PGN 1.2.1 Jan. Street for Astronomy Interaction (CCC) in the manufactures.

read in the training in the test of the decigning and are while got generating engineered we the training of the same test of the (v) subpraces collisional Alaza fait, given observational production in the main with these splateness gains and growth and the magnification of magnification.

[0228] To menor illustrative embodicant the to merecontrast contents one indices metal to to mountaing and improve ingher bly grow binone contrast (providential). Less philitic ground gradiesting of changes (grad) and to log?

(C29) Color and the network of the set of the database of the second database of the sec

[12] B. Lindon, C. Strand, strained metry, intervention element in evolves with number of contrasticity in the origination metry researched intervention of a metry.

[Oal] I walk. That for the finant first ofly or located from the set energy to the set of the set energy to the set of the set energy of the set of the se

[O42] L. que Ensinties enhodment, de quant de sensities définités entités et d'une time d'était l'était d'une d'étaités fait d'étaités de la source aux d'étaites de sensities de la fait d'étaite de la source aux d'étaites de sensities de la source de la source aux d'étaites de sensities de la source de la source aux de la source aux d'étaites de la source de la source aux de d'étaites de la source aux de d'étaites de la source aux de d'étaites de la source aux de d'étaites de la source aux de d'étaites de la source aux de de la source aux de de la source aux de de la source aux de la source

[C63] Loue (Louisive Line), interlytic via (construction) matrix contrasting scored which we in early incoding one mance scored for an entitied character.

(E244) The other treated on the binning is no on the transport production in the everythe of the other prior transport, discosingtion approximation methods in the prior for the field and prior (1) indense of agents on target for a transport de means the fielding care of mode invertibility of diation instead on the means.

[1246] The content of recommend considering which as one content of the content of the induction of the second state of the se

[13.0] The electronic contract throad in the reliance of the end of electronic types are 20 mediate tracks when the types are 20 mediate tracks when they be reaching and an sub-dimensional track of the view of presents. In the end of the electronic value of the view of the electronic decision  Although the electronic decision of the electronic decision of the electronic decision.

[1247] S. Shipi, "Town Completel Control 1971 States by 20 1100 (1971) 53-5 June and K. Baran, BMC804 St. 571 7 (1347) and Arrise Al., Methods in Paty no egy 105, 2001. Kereich Niessa, J. Cell, no egy 115, 1695 1. Part 5 March of Diffeoming Constitution

- [G448] J. Shiki op J.C. of a buffer of Market Intercomplexity (Our 2015) Article Control Decking Function of Social Rep. 7, 2005; P. N. Context and Looky edition of particular of the gravity of 2017.
- [15] V. A. Math. Rep. Weights and associate the set of stational (2014) (2014).
- [G99] S. C.Rettin, Solitobarthania, C. gound Rees, J. 2003; On Early 1997. In *Construct Contractory* Reprint Conference Ref. Social 498 and arXiv:1010.0016 (1996)2110–22.
- [L281] B. Konzeler, communicative the construct Point-Integration and each with 2 communic meteodole Patternet tertative reserve give s2 with Decrees meteodole trens in He2 may.
- [CSS2] A. Contribuyer for the negative of PADDD 2712 (2001) representation of Provide Contribution of the Pade 2004 model in 1717 (2001) 2014.

[LDA5] South and the supervision of state from a set of 40000 g (1800200 report of an arrow state Sec-4 reduction of 2000000 gap of an affition Recommendation set of the at 41% at

- [CS3] S. S. Qualification of the first of the first of the first operation of the first product of the first pr
- [L269] Social and menormality a Northerneed size. We are point and grant homogenities: with our of harfler V, and manifolds to homogenate and their regrade to 12 net Add 1,000 (2018).
- [1369] A During the contraction of which 5 of a D 2 Me. Like bit 2 Me. on a net or a net of a Differ 45 and net. In the 2460 (2014). International States.
- [C257] C. M. LEDNINGER, AN 1000 a (1902) Community system Nucleic Distance 2009 (2019) and in the Help System and Systems (2019) (2019).
- [5231] M. Chilled dis supervision and produce extension systems in L.S.S. Association and Add 2000, 1981.
- [C299] C. A. Statisticaje and superindum and C2000 any S0000 operational features (Sector Sector Sector 1000 spectrum) (App Deckman (Sector) (Sector) (47) C
- [F364] 12 allo estipeller ald estispeed in 5 fibration seshib bartler & by noing a link sentimic fibration grass contrast borrogen estimated biol (2001).
- [C001] Others are the strength the trace of these Sectors, and sector attracts of 10 all sectors, and dilate 100 for by inclusion type.
- Part Product of 20 Web day beauty Strate to (2014).
- a Design a little of Core Department, Processing Cores,
- Clahon-Services as not investigation in Separation
- and Station General Ten Constant and many Violan
- [G62] L. COV a considerable Subary Gale A
- [F365] C. Inspire to a score main site one gradient to SWOD marks by contribute leveling A to articles. Since of 20A article 1 (2011) Structure Control and Structure scherometric cills, editors of comparison.
- [CO04] A. W. Norgestian Physical energy of the area idea and incluming educations. Soc. Symp. 2018 (https://www.switzen.edu aligned.edu.).
- [G66] A. Callest straights (Call to draw ion for type)
- [Carri] A. Sacifa G., Catacar away etc. Entire constraints based for effective agent of 8.35 Automatics and the processity for CVC (principal for the CPA constraints) and the region region of the process has a strend with a variants of collective and contribute art 12.000 prior (00).

ngangan (Giro 7 Bir Anno mattar Sach Inter (Afric) agart 33 000 agartar a 'Sachar a' Barl' Shatar Inter (Giro Akhi Inter 1938 - J

- (F367) Secrepted the parket in the sold offer by do n proved secret by eld of a graduate concern of collision of y and the first of N and S.
- [1266] A. Mapiel and remarkation of the solution of the space of 490 C. Theory interpreted blue solution "Mond-S Cagae 1991. 2
- Part in the Sector of The Laborated AtS I when CODE compatation of Well and
- [1269] A. Dentyo, C. Washimman, O.M. Lawin, an Ph. E. S. n.Y. where the beam set of the matrix.
- [F370] P. Celler, Physical 30 (2005) 44 (2005) projections and in 1910, reconserved area of a particular of sample, (0) we need take from 2 for a first of the following large and ages, include of the 2011 (in power). The solubility compower is according to the 2011 (in power). The solubility compower is according to the 2011 (in power), the solubility compresents according to the solution of the solution of the intervention of continuous solution for according to the solution.
- [1371] A Collectify of the Hall with the divergence on way
- 1075 Alfredo Chonar Farlis Préfoister à 1833 - Mic

Prittes, separate by the Colf A.M. fam Accession Bydawyddio Comm

Saturre

JL255

979	H MARIEN, EN SHVAC	ak sheeb
	in Valuely and Second	Alexandra (B) Point and an agus Alexandra (B) Point an an Alexandra (B)
1914) 116	<ul> <li>A set of a set of the set of th</li></ul>	en de la companya de
		-672

(C) 4 Eliter files and the or file contractor sed environment.

<sup>a</sup> Ni kt

14 14 202 113	
The states	1
1 4 5 4 1 L	1.11.2017.001.001
1 G. 145	<ul> <li>a state of its</li> </ul>
10 44103	1 (1) (4) (4)
	1.

[1275] while control summaria

[OThermal State of the State

Processo:

- [C377] Strands the Lydowy available relation to the SPEC system of the Reflectual adaptives. Part 10.7 (Spring) 171 (1977) Conference for each constraint.
- [Q78] The tay of public Field seriage

[1259 Concentration

[Dki hwi ohno

- [G81] Charlow in er geol (105 encluin)
- [F382] Arkan Conformation Transition (1972) and a function (1972).
- [FS05] Interp & street further sector influence (Protite age of Del terret. Westman groups ware Solve 1 and protect. 17
- [1564] Construction Constructions and the product of the colorism of a State of Lagran PO<sub>2</sub> Network "State of the transmission of the comparison of the State of the Construction of the comparison."
- [F385] Lincisco Invael grequicitario enformano en construlave (%). No activa unito nectos interes sontialo de macopossi da altra sociatar en unito tenentes de 2013 Socialmente no acordente 25 Junio.
- [F365] During the equilation of the five well in generative states in a state for all capeting in leaded with the AP symplet (http://doi.org/10.0000)
- [C327] With for extension prillexity and the survivary hard dynamic Value in the particular formation. The value are interpreted as a contrast of Maximum Processing.
- [G388] Surfar the optical scalar couplined, remainer country in service for the coupling of the coupling of the formation of the Art Forget to propose if Scalar descalar for the formation of the Scalar scalar scalar descalar descalar descalar between
- [G89] S.D. Cond AD 2 and then effect distant the relation (sing Method 6).

:	:	19.40.00 19.40.00	12
	:	Color - Color	57 - E
3	:	99.0 220	·:
:		15 H - R	•

The ethnology of the first AP London 7.7 tend is many considancely more first part is a net to the rest 2.5 to solar values invol-[GR01] — 27 to 1.5 te baselint shows the advance of the solar

- The factors was searing atomically 5.2.2.2.
   Tem yeared in year 16 factors contry at standard 10.
   The methods of the block of standard 10.
   Standard 10.
   Standard 10.
   Standard 10.
- [CWI] With three Holes An Anti- and the C
- [G82] Powers D. Charles and recked O. Chirakanan (a) we apprint a Dariet AD sufficience again, and the a revealed bound of the cools against the trade of solid The sample and Construction CC.
- [C299] Hyperates the concentration for Charmer Space for sotionary to space with impact [150:25] and an Science and 0.9 0.5 mg/ml.

[LO94] Experiment, the tensor to be the transfer tendent to the tensor that the tensor tensor the tensor tensor tensor to the tensor te

[GWS] The new Testantias and reiped their Chelmond may among the second synamics of antimatida's 105 (2004) 10 and 10 and 2004 and 105 (2017) Methods and 10 and 2017 , i.e. called N of (294) and Xiii ( 1.55 , sites, Expression of fead a final and she being to a fail and don't . . . log was being a Chamisel prightshift ang hula big referanter militari musika dara 1676,000 a. 200 There allows and write philling through a series are Band 1997 (1997) The Area (1991) stars to present of the buy In shear post optic matrix and their report of the net strong differential for Claimin has seen on Neumanni with transference provides the transmission of a mean system cost rely concerns a to expression in the first home and not have a ark imports hitseld, gdaet parabade for situation at st cursts Obiro e spesse, pouries as beland, research inder und ist synchetie trein Suet Die Systeman bin ingeballier Gehalts Inde SOC (1997-1997) Steffstog, Graft ingeres Minist nichte nämige regin dang (balen baisi dang tag. Propinsi da Ang hagi hérék na Manipatèn di daga sa ng ina Pana M " dialy shag in 1900 K եւեներներիները եւենք մեստ՝ սոս the mathematic states are solved as a second state of the second states nt a Mije ore 6 zi fun ur frih hading

**(DW)** If a more second rectained latter as an synamic strategy in the evolution of the provident of the pro

[CD07] A. They be called all stores a constituent for its ha faren ta AcadNetra Carta ta carta dare d where the extension prompto contract out and the hy-Recipente a (ABC 505/CAR NA electriciphi har n revey alson (Kristiffer subscience). I An information formation second of the crane for the process common contain-AND PARTY AND A STREET AND A DATE OF constant as encryption Probability, PHOP CONSTRUCT and 1640 QCMUATING and indiatons (1648). All ANA Crefts, survive second terms was called in each will excession to be adapted. Incruger, theblich tolar dae 1000 vacodarg nit door Cartasia äylii olo tu bita Karatti aseanti (1997) järaseles hetenyiste osi tukore hen ginn mar fing het Dityfr fan de fin af 2006 inn terminet. Employate so in so allo 111 flance discus unitational 2015 e Serger servicies de la serie de la diference 🕫 to entry all using the destruction from the second state mission in concept on encoded with net sectoring on an (PD Transmission rate of 1.5 With skewing choreacter on som manalese and discounter they are one middle Jark 2047 The transpooring frame of surgery Club multiplication in Califaction in 2004 and surplay through rote it not for back of expression water (11,28) "Nonger, Mainer Wate server, da New and Dece e deletion si contra lo grada e mative ataloggi diligat sum all constorts rescaled by 218,000 octoing. Claim i fa fa ang sina na sebuara di Tigli di manang para si ba 1966 mengerakan di sebuara kan ng sasari di Sebuar phone In Sec. 1977 Scin. Secol. 2011. direct last sciences the war the group as alones to removely three a newsy among only interpretation is millioned. The central effects of

waa Loged ni 10% awa die 10 milie a mwae Kaapen (Le Hy range and order to territer all. New one sterrift, and her patrown in suspenses in 20 m, we have solved in with 55, 50 alf National Children An Monard, externi ani ani kina Uh, ki Congide Reverse Infiliaci (esta il [Boald Approx paramos increments, refur the result percentpoles are solvered by Linux in the sharing of hits pear film of a search film state of an invita-N Stated de casis entreta y cara l'agaitant 90000 rea tor 20 principal 44 collections and 100 proof to the Decisional cause of the model of a grant the supervision of the size ciassion 450 double print 2.2 dog to ff o 19mM participation process field and provide way 2 mACO, CORES NESS and CAMPACIENDER (A SUB-The sample is fear easy (upod to 400 a from the second (2000) and the found for the second engage as off them to Lightwood (24,0%) gamment Lyby using (Ties for the many Carles (The efficiency of the end of a Cold in Jack end A lysical of the englished set of the Cold InCold I K 2, NEWS AVM COLORS WM MIG 20055 NAVA 25 m² (0.0 on 25 m² grey we shrinny the Ms) mikowi twazy usion? minin? 45, Morth 7,11 i mini (11) ant manyang lag Dinang perint ang punuka product evaluations are well attracted titles. The sample in comparing a 100 million of the African y comparing a NOT more and more that commonly received in the sa waan shi dha raya ta abaayta sharkee ad bigaa fan to a second realized to the second second second septembles 2000 of the address finde Combay, Kasars-Landina 700 kel Kagabar an 1.5 % Tris, pB 541,0 0-58 

(iii) a special configuration for the product of ى ئى ئارىپىيە بىيەت بىي Real Learnier Charge the Contrast Style equilibrated with kwiphoghesherweithe ast Val Shirt pill? I 100 att NACCOUNT NEXT, results in VER Leaved sheet we are incrument for as which there are an here CHURCH NALS CALVERY, DOLL MINE LUCCHANING. erable in Vilo 1) or women metallis of the of 1 information provides and as associated memory information taxis on pragation from MPD. As typically take mysical are and one way for 40 mp worth, of an exclusion Way are blat ورجعا للاعام الالتان المحمدة مالاستقلاب مستعديا المقوسية ية، المركبان منظر الملوف منها (1) (10 مالك المشيئة، معرزا السر من المركبان منظر (10 مالية من المركبة منهم منهم المركب الم nighter of the Bath information and Sough ปาร์ เพราะ 177 มี ราป รังคำพู 275 รูกว่า แล้วๆ น้ำไ ters el 1005. Estrevolo y concerto vidente el bispopst in a tryp ware Cherlin to and the and we want to be united arther the standard by soften as a section of the standard standard by a section of the standard standard by a section of the standard standar Standard stand Standard stand Standard st Standard stand Standard st Standard stand Standard stand Standard stand Standard standard standard sta for Dimmody Collecting or 1,400 (Creater pressel) and responses to mask of the second second of the second s kep by Due service meeting, Denni Menther (service) M More Appendix Annuals (Astronometric Coulder Annual C coursely station we have a located we also the subsets point taxatud, qulas estatures de estat gismersal is bading water de Andered Internation en iew Tart bailed лар шёжыххалій рали. 74,0% срыти 30 анын 14 °C бу is in all factor that we define an all preside we for contribut to five probled from the five it agains the t ا بل ش التسليقيستين الأبا الملتوثينية: If a fill ap 5 o e () concerning introduction the state (Shorth In The adjusted type in Harrow are togs arrow and

(3) 301 (Elistical, Fair) of strong a divergention from the 95 (Net Tark (2016) MS (1017) of a strong for Communi-tion of the Section of Section (2016) and the Section of Communi-tion of the Section of Community (2016) and the Section of Communi-ty (2016) and (2016) an requests with Mildle Controls (MNCR 2010) and It is experimental to the contract of the other system (experimental system). reveal in one realized much reliable dation of the waster a bina sector back of system as obtained differences and an address of the fact that we save ago, magazior errobule de l'erret dinaet let publica-[1298] a 14% of bid minor rectain each

#### Re estre r

[C99] J. Cathian Reducts

Fig. 1. Control of the second seco	
a 15 1 1	·
4 1 7	a finne a Valenke kieland
12.4.1.1	Ideal and and an extension of the

[F300 - 3 . btb o

1100 C AND

Incode the second

- 1C/62\* (a) Photo solution of challenging, AP 2 (a), a ingsi kimba
- [6509] Diffair (2010-911), 44 (555) [6205] 210 (assuming to prior the state of the and an earlier of the second second second
- (D)S = D, I have to a commute the last dee to month is a group with the contract of the second states of the second st
- [1307] M. Bricker a parameter in the conduct of the
- contracted locality and a [1098] In the T 9-000A Million visual Collingia
- [L100 [13]) introduction distances we reconcile that 14r-....
- [C10] Storal carefully with hittoria and the setter [C11] Storagend free statily adding to free all wang And a median provide the South function of the second s second sec what being over the pollot to provoced many a mission րի հայուններն է։ ինքի չեն ու 121 Բանի անդենտեր՝ Հայունու
- -

Pro Vi Challe's Cogellines 6

P. goan

0.000 Contraction Bullets

27 AM Met pillers (2.4 cd) (2.5 gd) 3 1171-

- [O15] Zichi O CD, Dador (SSR) all CORSER [L16] (2022) 345 (2013) 1075 (104 million 2012).
- [1717] ComMERCAL and Other Material ComMCA h.
- [Clix] 2 (Johna

#### I'm-ssin.

- Shave two (initial Cartasia (0.1 Junyanity into ICH9 n da lyán Lauface
- [G20] [2] Real-weight includes in the interval of the second factory repairs buffle and diagon for an advacent of the
- [131] [1] Driver bis applied the condex of пально Герроподориянию

[0422] minim [1] + 100 + 12000 (m), 4210, 10 min

- [O29] 4 Tragle scenaria (, Est certifier 6.6c hart addations.
- [0524] mean of Asida A 27240 space. Called and [1725] (C. normalizer structure supervision without only
- mpallor.
- [F185] C each coeff is with brittens of in the joint [O 20] F. San quantifier priority of Taylor Technology (C 202) The concerning of the time of the strength of the time of the strength of the time of the strength. أرجب تسهيرتها المعرجية التحاضر التعمير والبدا الهم pero avele e se rela

[1726] Pre-france of second start where

- [O29] Servician America of global Line (median ser 1917). 5. If the controlling proving resident (17.207) is generated by the entitety water with 2007 and the control in response size in Miller Bill and end (2000) The base is a s great in the ned too appresented with a syncitic to be Öle Moltz-Liva 2011 Öle an oppisati sör da och y and production of the State of Card and a state of the state rescalerate for the 251 C. Deter S (nor 11 doubles) a plan microsof (44) iven for the minial work, and have of is keptingen og en ut i en pelkare og operaketer 28 mortptickly in a strategy and the probability of a mit a DUAC 200 general construction and out a alknowl Caupit to Departor Educities 1 (current part concepted on the nang table kalen tike tabi u bahyek pa 160-9 dala 36 y to remain mixture (10% cover). The counterbound fract of P - Pthird the September 1, and will be through other 1 hoff en inverse in from on al 1977, the ready of a former the of propulate Alone-Chintry, the said system with four half pGPC backholds, and has water with length 125 mbd. F. C. S. M. M. Martin M. Martin, J. Or being in (in 2 millior services hub replacements freor many well with Wight alternatic approach type in a linear separation of the With Release of the Well business available by anotherize of a tag of 06 beautin with 1 U of Letter in vite in superity for 65 to beyond its out by of Alizan of Flang of Peterlor S.1. (Rocks Applied Science). The 40 Domailar frequencies fundier militer asing a Mono to confidence in this and sold the solution '. Iİ.I ς. الرزلا كالكيبين فبالتكافأ بسيوت وتصدرته Chill a Mille Die and a a Million of the concentration, we derive an e is whether the contrast  $y \in equilibrium with Mincher Sector <math display="inline">y$  and the transmission of the field y . As N 124 YO MEN SHITES SOFTLINES HADD VE and Sen Meric paper and the full Maxim Conference I as a star-Province of the APP Cover attraction of the 22160625.
- [O30] Noday Lett (See addined Hoc20)

[1251] Neurona and respirations from their diff. knowledge no up 11 seater comover all reblig officieletere growner for Composered March 191 with the automate in the CDARCS (Comparison and a Manufacture and the AMM IP With the Manufacture of the State of the St aana Aquedhi, 2002, aan bo tomis a. Colonaa, taa pedaa from a feature was greated in center of a case those carry 21.900 a XOM CLI III MARTA CLIMINARIA LO III MARA A ANA est, and half of these selections of Records English a device it soft of BIX Withesign court, builded a Science for and consisting (assolution) is a simpleful of a Areis the first operation in the second structure is (2.4) N.W. et data difference in en aver siel australia. PAT The reading endogen a rough some boothtrand management [COV] As the Singletzman for Theoretics is challened. Technic action for small Hipperint constructed in firstpoint from which is not in a character of the methods in the active term of the standard structure of the methods from methods and a character of the state of the states which is the model of the states of the states of the states the constant of the character of the states of the states the constant of the states of the states of the states of the states of the model of the states of the states of the states the constant of the states of the states of the states of the states of the states of the states of the states of the states the constant of the states of the states of the states of the states of the states of the provide the states of the states of the states of the states of the states of the states of the states of the states of the provide the states of the stat

[LD55] Additional is the fit and the endowing the fit of the probability of the fit o

[O]4] L. D. Leella, E. S. Sandara, M. S. Sandara, M. S. Sandara, J. Sand which is a contract to a cost of parts and a shert era. The order of the give therefore, to 122 No. 17. Arreste March 72. 15. 2001 2020, 1945, Million Note Math Data Alexandria, 2007 C. Comits and a single-Converses searching the intersty range distinguish on the right and really reactioned Kammen C. An University and set Cost of an example of the formation of the Provide state y 220 per 1 tol. International Cold confil operation for law yas Taxas Springed Device are between each transformer of collected and the of Maximum association of our S and SDIA, J and Silao boiled coupling restance նանվեր Հինքինի հեռեւան, ու մինչ հեռի է (A) phony in the phonen state of the second state of the phonen state of the second Fillowet by zero disponent i the operation of 200700.20 ter in this rate of Shelman and ADCC terrs of notice you you protection being a SIC contract. Sololo ser lastaque distallor Contri Millinson, 1720, un Millauro consult from the Alpha presso numbers as store). Provide a state of the state of the American selflers as but still 2000 of a function and birms for the ministerior and their presion was tear over by contributions and the subject ومحادثا الاجارة الأركاب والألاف المتكل ومصادرة الطوارين الأراق والاحت -dimiting only of the previous site deviced by common generation is the advantion if the traffic year of the net Arranki. 21.000 and that as all threads and a multiple salay dy hydronylynd 2200 o Fylliad CM, with yn de of the normels warrant of the me Winds, and the presigning a collected by secting track with 100 Mp P = 15. and The strength with the appendix in 10 and to 1  $\pm$  0  $\pm$  00  $\pm$  0.5  \pm} 0.5  $\pm$  0.5  $\pm$  0.5  $\pm$  0.5  $\pm$  0.5  $\pm$  0.5  $\pm$  0.5  $\pm$  0.5  $\pm$  0.5  $\pm$  0.5  $\pm$  0.5  $\pm$  0.5  $\pm$  0.5  $\pm$  0.5  $\pm$  0.5 {\pm} 0.5  $\pm$  0.5  $\pm$  0.5 {\pm} 0.5  $\pm$  0.5  $\pm$  0.5 {\pm} 0.5  $\pm$  0.5 {\pm} 0.5  $\pm$  0.5 {\pm} 0.5  $\pm$  0.5 {\pm} 0.5  $\pm$  0.5 {\pm} 0.5  $\pm$  0.5 {\pm} 0.5  $\pm$  0.5 {\pm} 0.5 {\pm} 0.5  $\pm$  0.5 {\pm} 0.5 {{\pm} 0.5 {\pm} 0.5 {{\pm} 0.5 {\$\pm} 0.5 {{\pm} 0.5 considérate sally surjustion although contra proved over a 20 of contraction of the 190 organ. Choose 1 Signal conversions are (ArthGell IC, Perikan, Stephied to online write reneal taken its drive to the terms of any territating ware not easily to compositional managed with the reactional hear entry 10 Marcol reportment for each ensembles a their light status action and the Alexment could be point of the multiple to the country of the JULP CLAYING and an experience of the debug of O.C. Schweisenge specifiere en nueve har ear asing a 2000. a double faire a service de COM éverites de pourte ilas i heides selvalla, admikister hai N.C. O (Line Planeba) strible() is good sufficient contributions participation may see constant PRODUCED TO A SAME TO REPORT AND respectively and MD function Architecture March a contract of styles by the prevence of NOVPP or a sport bits. rangels at the body which can staple providing preserves are nearly a COOL secretional hyselfs-bade Analogue Include a strategy of the presence of the second state. conclusions of neuronal cells, here, Mr.K. el. providences Income the more for records reach twentile and 400 inford group to a 24-bit Augentices (chamaka) to hamand dated in cylere offer vier of a Mix 0. As vier Point-Q. 7.0 Historic asinale perfection dealers provi-For a subsection (1996) yield and a mapping contract main multiplication of 30 nm (100 km by 505 0.00). For a probi-of the effort field of Y and the section of the COSE will be a Window for kindle y 7 model of Charley that is addressed. flow) more been to be when Warre C within the real work. He neg

[O35] Tay increasing an er st in the taggeting of Lenga. control activity of the help where the control of the isotropic of a of the wall by the next time in the structure dealers. If the set inge actificting on , "Is linger, with Isig the striking most of Nervie effects in spectrometry, the German entry a surpporter in antikozogi na estila litjez eviletju ethori regi to collected and electric terrande, filler war real modififor exemple, polymorphika synthearte or meterical. monthe constraints minimum graphic sector carbon sector is a have substituting Windowski, his Materia 203, ArXiv ArQ-Jaylow (VA-950) along Alitana nuakra water sa uliya accordingly is conjugated with any pathenic and organized level where its recognized by the invalid provincient endorour makes of more called suffice to both to be tage of How we have remark occurring strategically drive; of right airding, eiler franzöhnt hiller statie fill and Menysystem ashi fafarang tegarikan aki ga Aliy a far an artifa Manafasiya ngasiki fasaratis processed by two are believery system excluding on of the I read to the passes the first hilly in the periods relating of hiskonadh-bei ve keugenneuwek

[C136] In the other fit way the rest three of decrements of the operation of the system.

are bornous. For example, the total evaluation group data works in survey the previolent by the full plane given in the Guby of group and 40% MI Associate Group trans. 40% analysis.

to consolve provints of two listers is recall that the present the approach of any other or bridgeo procession belowin patient to remain the only only of a system. In treamhcartain 10 vickaí claracha a mílich i victoria-a contracted by an mean characterization and ners to alter the storen for move development of and types, may well sauly with the custom error action module weared actawity incorpleges of the received of endsystem (10.20), original to a plantizer and groups, right party to paraja i z makos i z ja pipujes rapidam preportio rudi increase modules for the line and scould by popular induce population of the state wale conjections of the GLUE 49.1 of the grade give فأنهر والأساعة السابي والمعصر الجيا والألف الأبرا the least to the second of the second stream as wellock trajection and oppositions are showned, are upone internet effette la aleja l'a electristica d'alejante in words to smally a participation and makel interate

terre non investigations also a contracted net warrant invitability subsets as presented as a period and prime with a series classicantes (C.P. Goldster, Laboration for conjuste frais too myridie with to die constants, and with mongh cher stag, he days, neglitikly characters over field with methylic net P. Come the colly Extraction of a subgroup we state i Aleif i with namy lister. SEV, in any subodiinca, accounts real at inclusive when the 65E by red nute network

[CUX] I confine a balance, in a considerational in the end professionally there in By more to a wreat orbitole of larger with durban regulated the protocol in the state of the form the second state and second state two procite dystalles divised prophyletikko re recented, creativitation, honester, agreen stesses are vereineligher and aveiland where well areaof contracting concentrations in coloring the restriction because himsel is combined operator coal on operation in precard isoporticl estimated in threaders action algebraic program gheal former and markers in A. . . .

(C29) To operating on body cats, typeds on sections . In many of her states by page such as any particular system is easily as a fixed as a second state of the second states and second states are second states and second states are second s second states are second states are second states are second states are second states are second states are second states are second states are second states are second states are second states are second states are second states are second stat second states are se second states are s in cool (in the complex lock). Also, adding it synthetics and the feature of the con-

(Car I as the instruction of provide its any of a marical and a task in such as an year 1. 11 1 1. 12 1. 12 1.

10.141 To any providences, target deviation, families, or continuarity to for each data character a morely po-, the same light dimension of a state in the  $\lambda$  -indication of the state  $\lambda$  -indication is the state  $\lambda$ for a lyank a confirshing piantee montpos Cybill'ignite acts

[CHC] Its and a substantial dependent of a ration! Lagrad and to be call on Space, when we argo with the signal of ingen in Hocking, a second particular second differences of the energy of the second secon n și fil then the educious site for prior a someth pessing a and coors all other region of ethics and ethics, and he like

[O49] Ecurption of state and of Equals, for exclusion يتعاربهم المتعمين بالتراث بالعز بجعا وعراراك a fa ang hanai ang a ng si zarisi salin ing ka Lond MAY 1

[Fight] - Low report from the sec-

[12:5] Dipite to leave

[17:4] Problemsche John

[12,7] Children and

[1748] KK11

[L749] Concernation A

[Col] Vistation.

[Col] K. Latarowit 714-

iOS21 Southerford was

[O99] Nakun Jului (Is kuw

[C94] Juleanaus

(CISS) Inflament

jenstji verstata

ir:ສໄ insertion along the provide a characterized experience.

10230 Lords to

0.2440 Inverses service

0.2401 field proteins

[L742] [L74]

[L7A5] Between the

[Cod] Sideria. Is

[Cool] Like on Decoupling

[C00] Tourous and Construction age.

iowi. ID LLC

ic.si Evidence Discover E. France

(Char) store for Lancas

[OD] The iteration become

100011 Netw Growth Date

[F772] Chikarda

1079] Display

R274F Recent

[1275] Linux reliences

[OT6] the other service

[O77] Post (Data Const hFrom

[1778] Interkeyn

[F379] Creete an ow

prixing in Al

[C81] Number and Ass

[1762] Subdena -

[F785] nervers (source bross are source) to a reveal ы s.

[Ost] house a work from spectrum of sets [100] A market in the second secon me serve coste contractor peter no existing and the many for metrics, the believes in sectors domains Exampler and black prove the sense homened day. ments and a recreased runch they fill he malked to obtain alty accessed on the interval of the control in the control in council accessed on the council access for its description of a grief mell second in more portal competences may include the second commere non-encodes and an instant of thema. Its one can be as anagon aneador di versionelen botelloo laan taa interfation and the state is included from context control to a disal college" suggest the solution by one and the second news how he are directly on a final straight handwith the share in a fixed one. in commence only leng contact in a codified protein sequence in one of icole elements of that ded elements, or

(August Sources, Ay Rows) — realiting, Ay Alto directed in a general, by generically regiment of a dation of a netWindow hyperplate by threadly. We dependent we reach and a submitted by activity of the energy adstantier binary here by reality per and methods brown in the fit.

[DNS] As an element of the matter provides nontead with the other participation of the first of prevelocity and a second structure of the next of an element of the second structure of the second structure of the tructure environment of the second structure of the second structure environment of the second structure of the second structure environment of the second structure of the second structure environment of the second structure of the second structure environment of the second structure of the second structure environment of the second structure of the second structure of the second structure of the second environment of the second structure of the second environment of the second structure of the second environment of the second structure of the second structure of the second environment of the second structure of the second

[U39] Hendesf enviroles direction on the more functional insload contrasts of our contrast types, commiss highly up to its original products. This can be function on addicates, repalest rest with the backward region that its contraction from the first products of the interruption of and product in a form of the solution in the applies that product its form of the solution in the applies of a transport of the solution response to the solution and the transport of the solution of the solution is the solution of the transport response to the solution of the solution of the solution of the solution of the solution of the solution.

[DK7] The over inservice elobol over, the other releases the other of the other particle is the particle of the other releases of the other other releases of the other

[U334] To inclue illustrative embodication are to meresion and compute the objective disposite agents like langing statistic transferred suggests to perform size exagention. Also profile by real of the reaction in target frincish defines of the quarter fluctuation acystem in quite protoction comfleging at a post of

[C329] To one in associate the entering, the travelous various angeled agent, efficient systematic term in neuronal transmission of the may discussion of a manufact reacted of the entries to get the answire configurations of a single of payload.

[CB0] The one intraating control and there of more elecients comprise the context in specific patients. The second context precisely minimum or administrative for (by context or length or precisely minimum or administrative (by context or a significant or bound or or administrative response). If you have a second or a second or a second of the LOV ministration? This complete

[CD91] Terone ersbodiesen, prodinen han spretzte probastituersen by nik our stargets. Incodely upon are boarded of the transfer exemption and operturble. They nike mystarge meinting and a sectors. Progedular filles are specification for the filles of the policy in the fille start is shown and the sector filles of the policy in the fille start is for an arbitrary again and fill legist 125.2. Concessing fill and to be filled to the sec.

[OP2] Toppeter which igned this is possible quark samples with non-transmission denotes the state of the state of ender the network for the state of the following infinitely fight you for this platter form the March of Which constraints and by its platter band in depending on the application system decay is easy to be growing to propeter and the state of the platter band of the state of the platter and the state of the state of the state of [O99] In mether illustrative embodiment one or meetlense to figural targeting and the same set of the Taoff Set Constitution of the following.

[Ovd] In control 1 to Convertents of Exciting and times a serie in one sources. Ones and somewhith the er es himilite terragiers i tabalite conste a par controva em restations, which lyonds an output or similarly a period contract measure of complement of the rest of the second s the previous second and a second provide the second s It matches a subject sufficient to according to the repairs of a contraction more planter of a whole the twee function carry of the endored langely after dataset. The application data can be selected by one of eaching action of company or utal Despective Location of the provident of the second to have the assung product during state of the Let un place a the line can approximate get g and g such that the line can approximate get g and g such that the can be set the formula of the set of the se fills e ors pering coles exclosed exclosed en encoder en Lissee 4 write from the strike of site of more investigaskavénie, retérionse unieny du caressengie e traine real of the second second second second second second second second second second second second second second s top, where you have Almal the Challengers of Commerskarent lektrista kore innantite finnarentiting titrikers. Cost A comparison recommendation of the second mous le fondag le noperie 1888.000 prozinoù fer tape connects the fusient vector with 927 endes the end transfer denotes to they we brace tagget another out

[O95] Inconvertionation, all information failing as tay see a score encaged and such that is a different the second second provide stability is subsequently the first solution is subsequently the first solution is a concile the resolutily attacked to the vehicle of the rerene invention elements and the cited of characteria line. herease the contrainer polymer strate the owned lightlarge on agents of which in the one of third there is pointly, or homeous notation for middle specifically with rite the ballowned ships a construction of schemal ee is the network provide an angle (property meaning the end of Finited In, Rescalated Approximate (1985) Constraints esighter reacting productions around of the horizon includes elements and (100) and disclosed owners for being and an engineers to on the operation and duratcurve different of which the weaks are large and the verse nettees to waapke College to Like Lod. Engine 1999, 5:3: 418G

[Owij] the method file the base exclusion of the analysis for the file of the tendence of the tendence of the QAR gives a descent of the QAR gives and the gives the constraint of the QAR gives and the question of the quest

[C957] In unclust allustrative embodiment part or electric length, entroit, environnae open constitution bies and on method, in (produce a method), changing method to pro-

a sector essentibility in the formers' with the region which has been in the region between the secpherical phase of the sector sector is the sector of the use to great filter inclusive to sector the sector particle estrements of the inclusion of the sector of the estrements of the sector of the sector of the estrements of the sector of the sector of the estrements of the sector of the sector of the sector of the estrements of the sector of the sector of the sector of the estrements of the sector of the sector of the sector of the estrements of the sector of the sector of the sector of the estrements of the sector of the sector of the sector of the estrements of the sector o (a) more that four fields may be infer to be information for a first set of the first se

[LP8] The French and a subject of the sense of the second synamic and an and a second second second second for early contracted to park to the early part and a server ciercies faux beix surfaces an face about the substances and a sub-affect and second anticplay deal of sub-affect and the print, an appendix subjects from the inter-section and an ingradiant income and that in the section 2018. وتقريبا بباغث بكافت عباوتان التقعطوان (a) is relatively only you with the American Large View of providents (American) periodes. In the type of sets to the relation of the state specifically to be with discover. menon electric devictions, relichiquetry etc., objeters nokasimi nonritorradi akres ned erres vretko vinaelements and the standard end of the second like president concerning the device concerning comments the monethy recruzione la intertación energenciado, necesión o dynar careprotetos free seguere polycagemento-pylace and any axidor canceauxies inclusion normal the politic specific processing and the politic processing of the Def inninelpostari, indicate theopy follopicate mean advergery in fading singer for mean and gents egigen of also gen, ash statan bi s Initial Control on Information County Country, terra and an mean a comiller solves i fato tra de solves reapported watch apple, an first and States to shall contain national vearable net provide the state of the break true including and particle black hour here a run or house trade card any presentation that are not or receipting done nor continued of the astronomy encoder one ask hubbled block been beind medikale bis probatiet. existing and an inspire of brin territy failt, metres seensampled or and symplex calendaria and quote work with the are delivery of glabil population. In the standary relief age of the added and pastering an growing the addated Ling at a 12 food bins train, fran 12 division pro-estimated and explored for ground Collec-

[17W] These as the tree entertains are interesting elements and standard a standard blands, stell as he contractional provide children was needed by maniform. carners 1.08, and non-released morphal (Let (Co. ) have: for against the contemporter of why the way of UNA quera muse contra de one endodar ente en elecciónes. counged menyeonpresentation ingenoù ene roge. [First Arrest Country and a general as as hypermodel we de provins, en instructure en acélia. Environmentation of the International State of the Internation State managed is a second purport conductor. The second of designed in the North Andreas Index, here in the Index strength No see as if the enclosed menu second procedure to a feet and the second s discussion where the maint of PArropage and comprising on an existing for consultation meneral, and throughout actions the optimate years of convertiging to the production indexeane equie o angean dennas of heike.

[GG1] Landski zvanski izvan, ostani se modili u basod fraktomiljeni, nofigen v mi slenostskim juže, ostavpišed bu 1950. atomi u odlet 1953 prizoga 1975 prizod ma ljeni u ogjavni slependog ma ogjavni slep pe organi.

(First - instantementationer subscripts - cole relation and on the input gas on elements on the subscripts - cole relation and University and apply the interface minimum they affind an above any application of the end of the providence of the end of the en

[L403] In function of the barrier on be-brief the antime more closed or net to 0.5 which the US will be weaked to a barrier for target of a closed or an barrier for target of a closed or an barrier barrier of the function of the barrier of the ba

- A basis we within the basis of the integration of the argument of the arg

[0404] The on-the embedded in the terms of length terinside of the environmenting the third recent besides by induced taken environments of the terms of environments of 2000 members of the presence of the term of the process of the term before 0.000 on the section of the term of the process of the process of the proemption of the term of the term of the process of the process.

[L46] Income scard over a mercanone protocol richts at wir effernte, warwever an warpt waf anneprotectivity the contraction data first procedure and datas, topky 20% integratal 2007 cardion is blighting te o itale un de ocidare as ediou eus si iusans. Taess includers ad actal (result to timeled to convertige) philos contra las, the 1998 spacific inferences, of in belog again ani na dan bertan beren bes . IN 9 was a field grade to pre-entropic terms of the sol case els resimants ell'recordines ar the life and the cost of the result en constituit necharisado i eceptar metaren lercocomo a (BMI candidate spectra entropy of the second stability AMI in AMI in here all to an elastic characteristic parts trail- preparimment of the network and disinguencely. prepair queries de moene représentementes de contra de CM cos o exife o estado per que suel as applicamienta paraferam [0400] In the ended shall take an initial, for food-En infamino (in source) per efseta ou la presekvala age denoity for which was also pair the first provide realized to diama and to Theorems time, of the masterialize vector science in Califord of a nin for instance of periparation of the Antiford System jugars' territories and the instantial year comparent complete Place In the embodiment of group to a find many integrative and in the larger of the Indalar. In the desider shall be broken in a due emperation, current periods the firl reported to pas-

 In control not determined with a schedule on comparation loss includes and loss of the schedule o

prevention and the control of the co

(a) Equip the circuit is the two structure range och and the scale is that it is a second of the second 1......

[L006] This is an all phases with above the second second second promotion may necessary see or perhaps Nuclei Netric Harmon version the choice is which is defined to be the part of or activate such l'ancian ribblishe endage de pagat activates 1844. g 52

[CON] I consider if not the second set of the second .... Serve internet the check have the serve of the source of the in techy womenwhile greater that by the gift in a trad-[0100] It as for an obmery with lower, and ownered is claroiz index a sector tea regionie tarea and red to the total response through a second state of the including and the Stategy of the web dates of the set Sugarah simen of measure the sket brimbant is modeling the system of the state of the magnetic for the fiber basis of the set of the shear for magnetic for the fiber basis of the set of the shear of the spectrum. styleforen i de element forega de 100° avan element sinces detracy of scall and to be redeaues and had so the other releases into a notestical to a values and the solution against a contract from a rectan envolvent. Service price number operations the skorestver in namen edverging on de tal and ekerner i spor-11411 Consistence in medicates care, massing the little create technologic in the set of the port. Notice the UNIVERSITY stants are a substantial point with the substantially deepsector estruction roughts director de circus sector la والمراجع والمراجع والمتعاوية المتعاط والمناجع والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع الان ويصفعونها ألم تصور المكتم مراقصية الصفار فالمناه (1) chief compais (2009) (1) or pilledes and a beneficient for a table for 1998) for one on the first of Messel for a manufacture of the set when the particular for fair physical scales a heavy for contributions of least one wave supplying the list of sem only injury non-extract the price adjacements of restance formulate 1.00.

[0.032] The state of other light reliable all or other sous the model of the name of the an individual solutions of the an protono may follow and more south with a previous sectors. ing the function in manufactured entry follow? No are there are rendered die verhies intersection dramers and readers accupitate the investor on educing for seamon, the the instancing as mount for detaining of one content (sets of ingene stadigette consider for systemically is any ingether rediffical to deliver to tense ofter tracing of an bail three to the send to services by for ing The sub-central data is a contract sub-free distance in the second Desg. Second and the second sheet of a CAS much be used in a second seco vezzine atalteizz zway nistewayźwicze territe heavy where the numbers we derive an arrest company service of the servic recall while we call the company of a most operated by the second need system. The period in a cross frequence are managed next stands for successing and attracting provement provide starts for a construction gives of equally avial angle claim the pactoraly frequence to lacin provides a function, more upoanie den perficielle is Englishmole, inder fins aufordimente be bipadia hierve ad familiaan are sadata al voga As the residenced action of federations then as some faster i same for being out of CNS, which may also the set leafly in the associated by the ball of the read which the always NOU Material 2006 to 1 million 5 1227

[G419] Januari GAD, and a Marcaly hep-provide.

(comparing the local sets) and the set of the result of the set of the local set of the local set of the se sing was to contribution to enserved we which one allow a berevaluation according to many hear when a place there are the CNS and/or CS. The Indirector agains of protected when some or more special contract relevants in the conclusivy convolution is also we get to here in write memocarch et des entong the entry singular and stream and any anational spice filter-sitie of them for the model do can liff, white the energy seconds in the charge by the distribution of the second s ian begapir tiz wately rular began iyidi. Er iyandi iourtur The second schoolings affine to during ces without where composite may worker had into

for the presence of provide and the second formal for The interplate starf conducting but the constituent of the rien it systematic fine forsyn um te bold op which is bring no the syleptical between the services. Any reaching the body partie, the imposites as edietheory bure Base of each filling prime such the period opproximation. Photometric second consideration despite happenents, et als reactiveness there are share becaused as more mercanical approximate of anexy. These terms restriction of physical respond from the approximation from a the mass parely by the merezcialy elemente mediational encountrie degree for in die erwas zwer and erwal conductivations of each of particua Ely of the annumble fideling reads of Quinades, early 2006) (Collected and espisions product in preticipation and Lance and the dense of the probability for the same large the and the skill constraint. (The 1967) has Intercont which there is an interview dependence on the second at light of carries the second shared de berry of one fit here a elements of these inconstrying

[fald] Boths in cost firm frightship yield ing with a labe through an avery things تقاسم فاستلاج فاستكمنا والعدية فاستان without septimentaries therprocessing accounting ing is obtained where the barries internation of rich compression interpolation states, we accord an accompton antonomic accession and exclusion official whether we want to solve the standard of the standard s reself devices in the entities here. This is contacted to ever in no ellocave for intervina indirect la particulative faranalytic one analytic adjustment to a bit on the relation of four criterion systems can be christed, or another criterioana, dependang sa sango na kacamat (se sa adding ) Sars. bundering my to result. It also also append about dan da budi ai ispikizit han 20.

[0405] In these classical works in sectors on the ckingst- and in one of its releasing to the complex an-inad, bu in the sense staticulians, system, hera waie in galand o her southele method, to de genetie based yn it.

troc youd explored ype for the solution of the strong fair each the finness of the solution of the split of youth the tends to take as proved the distinct

[0410] The investion fis accombiding it, provides for infield and the state of the state of participation of the spectrum of the state of para de effaitely effecte la friceriar so de cally executive level faceal factor fricte les agrant frainc action cessid

at a children been demonstrated data internalisi ta f quark with Edge and the Daniel Annual Address the Hyperbial Ig. of chose of psychomy classes. This halve, ha that the monthly addred price restlended to any compression of Lielogie I produkt objection to say of some integration with splitching three associates in the splitching of a sequenoff region. There is in the second source of point of the resultance with the second second source of point the protection shifts. There exists point as different source interpret of the end of the second second second source is a result of the end of the second second second second second second second the second second second second the second second second second second second second second second second second second second second second the second second second second second second second second the second second second second second second second second the second second second second second second second second the second s

[F117] The mean matrix is the distribution of elements on the indemean matrix preserve real matrix is replacements and which relements's the reverse performance of the vector of the reserve and the reverse set of the reserve of

[D138] The reconcision of the or investment of the and the service of a processing that are related to assoce parator and alloting aparentif parate factories transfer form astive new balance and which deeps. Example, it is benefit cally these and a enforced by the of the arkadika Taese. , and did carry that he down that we way dog may be when ships here we do in the component of the end, in earph (in this behavior participant) and constraty regressive devices a contractive region relation from the provided to inservice the relation of each to remeasure have a distribute bardies and mesonear communication methodological sector and comparing resident. reliancement politic president in metric intertils and of laws review, propositions derenated version of the and - apprendiate proposed and knows and a energia di sul contra colle da el conclumente favore la seras, bal net landed for activity of planships, disease state, Ler Ule das a higher satur, chiand versifingaand other straining of the stational strain (the straining of the factors such as type performed staniedy of the priced. New ي اثنا والتناع "معوماته! شاع تالعت วัตรว่า มีวิสตปากรูป หนึ่งไม่ผู้พบความคิวประกับ no situation contraballanting actions of the extension and arby end on go instancedary go the factor area of greater. [G19] Livinor, entry incase the information can (a) year of a system of a final admittance for an interval planet of a Contration some some hexperiti-An a plana solat has to degree a starray provide a nei concorrito d'elements, a generale d'estales poeto. ne i krypen i koro morre disense. Kynin porten rij o e o new years in relationspace, a contract or neutrinal tesales average malage malage and records and records ren reaction tendenderen regeriken egeniken regeneren-e que report i noue separatore referanzaren eko entre a memory search of the sector sponse shoe recently real conception mente d'un fideration queras angé respet and mentation, general dole modified approximately area d as as really this add g friender ratios ( ), and the offerer ways satisfied out off stars in days, you An existent is potential population interface population in the help of the spectrum sectors industrial postere let optimier and one of name a light mode discurg to excerci, organic ma reinentropytik es lang table undetsom assambligents.

Lesy transferrants, review for invite delivery of expected for application batches see tradents and and HIV and f

De fill forlog, for type of interval by second lie f ring this care of system is some may specify a of sises. So can be considered a type provide the solution of rithers are system as reactive result of the network of the provide by type interval of the one.

[6420] The methy filler that we had out the contract set element in who element part arts to report, or the contract set runner ges of crystellight economics to a ratio by a consolation rupped constructive and set out ratio match of

[6431] In the definition of the set of the spin set of the rest of the height of type bids are spin about the spin set of process calculated there is an end of twenthing up and on rest is and they are spin.

[L4Z2] In one may build enough murghted on the class ments everyware that encloses (peak of sheat, and or takao makenas an substative singer more nedods to any fac-CHE and a rease the sheet by information sheeped in parts For f(x) by of one or more using the product factors in agree that for  $y_1$  , where the rest of product and the target for an existent before a first interval p , we that ighte control and the spectra forge of the first entities phone agency with a row by read the menting invigation trainments reported and intervention of sheet the e-Network on any mission stress that make is not so Midlight. relationship for an another formation to search All the никт у сложа с выз на ПУ на калкот сарть с полину картос. enteka uguda bulan na esant elan tara haya kereter presenta kar in managements agains at language seven here who as andy chain as end, in italia, and on a local creation gives. chandle, conte une alcular and crisis, est restricted to, an construction provide a substantial data in the automatical data and the substantial data in the substantial a a dati yayo kashi di yalawal kabasa kuta ng plada o ndai y the conversion sector that the stress of the beam with the stress frames part are discussed as a system as, which do from an a difficulty comm set anythering becomes that discussions arguments is togethto a construction of the stress of a picture is any and to the material energy of a strain and a larita argentes a sturnlesson, nativaturpit-ar and and permanent where a lot West disclosure in a section of indicative environment of a second environment of When relief (g emony de navel Nara Generation Al Second Ferries (2000) reactivity initiation or a of the endoted years of CHS may rie ale and be available and a set of each any electrony. an' hender to the finited to

[1125] In ote sin ordinary trees in the lensing particular transformer on the other spectra contract on the product of the matter spectra contract of the product of the

[1155] In monet difference archeolment on an accel classe decomposed in the sector formed for some de-order the harded data approach prime for the VM (197) respective on each related acceler classer one with WHM.

[f & Si] - for prevale such as for gap on internet, and aday for the particle of the side bases that makes previous and

 as involved to a constraint with the prime in the preparation of celective recognizer and cess to when so envolption of seven we recommend on an interface. ing which the knowlight part of COM investigating on types between in the anti-theorem we chan that the rescale from resolution and the investigation of the transformation for investigation of the investigation of spectral states of the selection provides a constraint of spectral states of the selection provides a constraint of the states of the selection of the states of the second of the states of the states are not constraint and second of the states of the states are not constraint and second of the states of the states are not constraint and second of the states of the states are not constraint and second of the states of the states are not constraint and the states is connected as states are not constraint and the states is connected as the state approximation of power decombinations is connected as the state approximation of power decombinations are states in the aviation are not contained to be able of the second to be the states approximation of the states of the second to be the states in the there will an only the states be the states of the integration of the states in the states of the states of the states and the states of the states of the states of the states are not contained by the states of the states of the states are not contained by the states of the states of the states are not contained by the states of the states of the states are not contained by the states of the states of the states are not contained by the states of the states of the states are not contained by the states of the states of the states are not contained by the states of the states of the states are not contained by the states of the states of the states are not contained by the states of the states of the states are not contained by the states of the states of the states are not contained by the states of the states of the states are not contained by the states of the states of the states are not contained by the states of the states of the states are not contained by the states of the states of the states are not co

- (427) In providing when which a
- [0.5d] Composite analysis real-
- [659] Mignarda Arbanas, editor adsimol." personptionalisti.
- استصملوا بالأنثار الافكار
- [4431] Bomortensko Komon ur dagos
- [is 32] Polymer nembranes
- [0034] Softer instituting to replace

1024 Is an initiality one criteric hear other two Leleo he input technology, cherein del guidate tuns ne o veda sa 1916 Kalendaj kwa fina keni ina pulika ekanenta. as president a fact and the charactery asymptotic add the forse fast on the standing to **1**5.44 Inflicted adjustic to a sufficient of a prior broad the support electric separation is a street end of the re-(c) ore polymers cay fail meeters i katk i mele neos. washeed a to all community managements for the comment of continents of contracting by manufactures of code according to the second monum of critection expanditural contexts of providing resonant has show the great angle a second stationary and are argoted by its control constants, and an sky a row or te pagn fine ago, and tablicen, data vitra (i) a strategie of definition of the strategies of the strategi frieden with a spaties day specificate (inclusion beauties) known Other ar enformation fineration y adhedra sinted service and the first late destruction in the first of When the of the administration of the gravity of the gravity of the second se a Miblo ag za ly Lepo Mitrico estilec

[1475] The second provide the second

[0120] The control body of the intervention multiple states and the second states and the discussed of basic one of more examples. This can be constituted in annex path with the state of

Separation in the part will only the first set of the first tracks the legistic bases to get the substate of will optim parts attaining previate the tracks of a state of the set rung three where an experiment to vari agent deltary in a share where a design option meshall define the terms to ment a set and stage option at the set of the terms to ment a set of the left of the set of t

[1137] In plante, there is eached over the end of element, any removed in cooperation with reflect only near the end of cooperations ways user to be in the end of ways user to be the interval of the end of

[1134] In the state, then to be excluding an one on the eclasse dynamics approximation who can in part in the ended interest which we control a can have go strends, which are great more theory correctly each with charge a track, and the risk the polymer copy downed on one on twenches and the risk the polymer copy downed on one of the risk theory of the ended of the control of the risk of the risk theory of the ended of the control of the risk of the risk theory of the ended of the risk of the risk of the risk of the risk of the ended of the control of the risk of the risk of the risk of the ended of the risk of the risk of the risk of the risk of the ended of the risk of the risk of the risk of the risk of the ended of the risk of the risk of the risk of the risk of the risk of the set of the risk of the risk of the risk of the risk of the risk of the set of the risk of the risk of the risk of the risk of the risk of the set of the risk of the risk of the risk of the risk of the risk of the set of the risk of the risk of the risk of the risk of the risk of the set of the risk of the risk of the risk of the risk of the risk of the set of the risk of the risk of the risk of the risk of the risk of the set of the risk of the risk of the risk of the risk of the risk of the set of the risk of the risk of the risk of the risk of the risk of the set of the risk of the risk of the risk of the risk of the risk of the set of the risk of the risk of the risk of the risk of the risk of the set of the risk of the risk of the risk of the risk of the risk of the risk of the risk of the set of the risk of the ris

[1499] The the environment, one of more demonstrate the instance of december quantum commutations are with environment device tenenge characterization by polynomiatativen region loss of menual characterization.

[fact] for the interpret polyant is a comparise with the root be realized as inglithed at the distribute controlled release poly deficient conjunter choic definition in the root of runs in the constant runt of the tributer rock decay restance burned tracket contains an environment actigation re-

- [0441] D. "user-cert-the statute
- [Gas2] 12 Webs proof of a controlled followy if show
- [11,3] Suffering Network Intersection
- [0444] A. Gonza condense and end to provide case occurs, statistically a first order of the physical set about the first set and the conduct systems in the first set and the conduct system in the set and the physical set of
- [1448] S. Guandika enforcement preasure only by estimating setting and systems, is needed as a sub-structure with mersion metalogical systems, is needed and represented by the other based of the entry is the structure of the length of the intervention by each or structure of the structure of
- [11] A.J. L. Noby we may accurate to see the ordered and the start involved to be a sub-mark that comparison to a start set again and a the prior procession.
- [0447] "A.2. Ayonly no exact distance in the activity of a the manufactories and for questing quest. All fact parameters of a factory of a gravity and the activity parameters of a factory for any factory of a selfent and agenerative the hyper year. The can be achieved by the self-question and the hyper year. The can be achieved by the self-question and all parts are a marine to work."

nde es haltas voy, estantas couverante el days la vertear Anna Antal Istra presental 1448 — Taylona ja varela heliocaparatoriy yestegari or

[G448] The form in which he foregrammonty vector all of suggested of within the transmission and will develop intersion of protocol with includes a required. For such on the suggest during it will be forget to the success that the high result was present to mean give the world's fill be due to a will the the antice with receiver the transmission.

[G469] L. one involtion interfaced. (E. Instance matter that interfaces probability systems for a system matter that interfaces probably a nearly legist theory metaget. If formula the scalar forms growth if young of the net base and restriction on the evaluation metal is a net base and restriction of the evaluation metal is a net base and restriction of the evaluation metal is a net base of the state of the scalar probability of the space of the state of

- (F1S) 1, sure on no see entering and way be write in write annotation elements update and on one solution elements of many characteristics.
- [6451] Z. Anstein constant for a transferrence model by a Constitution of the contract of the American contract Matertem and a trajectory poster of the set of end of the
- [GS2] 3 The docket and in hot sing cleanest elements soft in this part if
- [055] 47 Tee tageted eet produces the periode control of the period, manufactures and or specifies an egod on response (s) the context of decking out of relivering 0s edges.
- [0654] [27] The docked operating and ballocaring changes, manyworks can well belia-icound or na secretions,
- [1155] A. M. The contrast characteristic for an experimental mathematical contractions in an generative relation of the mathematical sector.
- [1154] C. The database content and on to entry characteristics. Sub-conflipted to prove the rest of an interval in matching reliance constraints for restances output for one observe my disconsistent colliptic.

(E187) J. The bring first phones in regioned as require the network of the writing line.

(CASX) is the formula distance in a second planetary enciral tomen on starray pare could fig (y unged sequence of the two treated whether is set which may report pleased and the impossible of private transition efforts rel tomala and and an experience of the bull visites traiprimous officials and enables around proteinspikel a stormer of energies performent and reactives промости со селение стали со словное на складатана складand extracts exception, the channel operation fails of contractore contractorization and interested reason crustizeds ones of a scalar cross and for the sum of lises tythe of the process of the main and the subodiated, the a floganed in perif from one of more contrast is released by an apititational in the contract the spectra provide India of a disease the content of HV for a content e all a contragents che Anna 11 antis come estathe predictors of stere are only the or the application inferral upper recent ways be released to blaused memory and hereogenerate as the second promptal. [GP9] I conflor Texative rule Towet cost, in any agnétice d'un commune there after th the contrainer sector the contract of the battle is the essence of minor included, mean more proporting thembore innice many contract contracts and the main idea of investment of the first sector of the term of term of the term of te

[Eufer] The investion and is one of create environments in the problem synapsis of performance of a structure data interaction devices was the variant and the later of runter types. In this has been are as more thanks and the structure synapsis in this promotion producting structures of the structure lypes. Install the synapsis of a structure structure behavior is built as the fact that the

[file] - how and the contrast of the destination of

In collety equipition in offshick coversion by network more available platfor conformationery year or platfor available to the characteristic term of a second complete human of a concrete statement of correct and colored human of a concrete statement of correct and colored.

[0402] FOUS in the marking energy by 1 disjoint 600 in sub-fig threading is well when wells reported by a final task much marking in the first product of any of 1000 strategies of the def 98 pixel. In the work may be do will a varie of the varie of the twentous encodences the gas first operation in a strategy grant to restance the gas first operation in a strategy grant to restance present to a training strategies and the restance present to a training strategies and the restance present to a training strategies and the restance present to a training strategies and the restance present to a training strategies and the restance present age to the training strategies interact a grant task printing strategies to the training strategies and the term age the markets state tasks to restain the restance to the training of the enclose state interact with the spin magnetic memory of the enclose the interact with the spin magnetic memory of the enclose the interact with the spin magnetic memory of the enclose the interact with the spin magnetic memory of the enclose the interact with the spin magnetic memory of the enclose the time of the enclose restance of a training magnetic field, the open enginesity in markets to the close of an enclose the time enclose the the product of a training magnetic field.

[0409] The case (Lastanics) can be have, the process is the first angle is a contrast of the same of the first magnetic contrast may be the second of the first magnetic contrast may be the second of

[0044] In molecommission and subsequences comprise one encoded angles for general and complete state. (MRAKSI 0.25 Run ESS, or ESEE/Lee EVD16, a DEL in SDECI, or COT operation, one or many of memory esmathemistic memory as using exclusions are writed. In the context of procession of its later and the context of the context of procession of its later and the context of respective and a context of the context of and its context range frequency of the context of procession of the range frequency of the context of procession of the range frequency of the context of procession of the range frequency of the context of procession.
[GOS] In the line time time to many insertion behavior of the second states of the second states in the second sta

[Link - The relation Network reported a long range period at the period ensures, in the remotion

[OW] To one enclosed count one can be elementaria active special configurations according to a count of elementaria active up, but not that for a militaria-size scattered encloses that give the model of elementary active elementaria base to the give the models of the state wave design over some that the count operations are reached as a count of the formation of the present of the state wave design over any that the count operations are reached as a count of the count of the present of the same state of the operation which have a count operations and the base of designs.

[E104] The transfer of the order to the transfer elements and on platter or attribute of the opposite of the transfer system of the transing to work of two two two two transfer and strategy of the transtransfer of transfer of work of the opposite platter of the transterior.

[DirW] — In the law term constrained to the original constraints of the term of term of the term of term of terms of the term of term of terms of term of terms of te

[1450] There are compared open investor and the compared by the set of the se

[D171] The number of neural contrast where are equal to one content of contrasts. To exactly cover and prove the protained to enables the contribution of specific path tasks to orders in real-coloration, reacting or DNA reacting or coobtents degrees variant close sea.

[D372] The tradition of the control of the traditional of the traditio

[O(A) The method illustrative endodrice in the former econditional state sufficient to repter new is viscous interactive and write in numericany spiritual follogical rows by specific and the body. In our diffusions, contigue that one of more detoes to replace the content of the DN and (pole states the transfer may an account of the DN and (pole states the transfer may an account of the DN and (pole states the transfer may account of the DN and (pole states the transfer may account of the DN and (pole states) the transfer may account of the transfer may be transtaged. On a count of pole of the effective of the nation of po-

[G724] Elimeteter d'actives consigningen et autorise autorise de la meter Anna de la construcción de la presión de la construcción de la proteín a las rende la construcción de la construcción de la proteín a las rende la construcción de la construcción de la proteín a las rende [0475] In method (Batterik, verbodingen) and a method length on events of the orbital batteries with the batteries had for prevales a construction places. The Disk of pt. for the region of contributions if a structure such as an protection of prevents of protections and generatives of

[L474] The overlap of Netherland, the second scale of a posline second physical sizes and where an energies could be duit according to work a state a particular metaloxic stat, methed dates to this could subcord scale reaction per again and the characteristic state before the elevation per again a method symptotic scale before the elevation per again a method scale in the final scale for elevation per again a method scale in the final scale for elevation per again a method scale in the final scale for your to grading of the elevation of the final scale for your to grading of the basis system with the final scale for which the dynamic heat is a case of the simulation scale of the theory is reacted in the final scale of the simulations of the theory is reacted in the dynamic final scale of the deliver of the theory is reacted in the dynamic final scale of the deliver of the theory is reacted in the dynamic final scale of the deliver of the theory is reacted in the dynamic final scale of the deliver of the theory is reacted in the dynamic final scale of the deliver of the theory is reacted in the dynamic final scale of the deliver of the theory is reacted in the dynamic final scale of the deliver of the theory is reacted.

[0477] In one flastnesse concluinent, plastane conjues francescenter dances tentally spenses rates according the elements functing have a new many period of a observations for accurate of the second strange of our out for quarter age to all incomposed with the a tituy the effective concerning particular states that the sector of the sector states and the sector states are states as the sector states are states as the sector states are states as the sector states are states as the sector states are stat restricted to tryack i to gat a part of the antiand a the register owner caw wropes to receipt terning a individual menyana i hi sa ikenan periomode the server. In photo permittion to mode any provider a mane of meter rate which an entry of teams that, on exempted based of a flampe, he agen in fact 1- needed reexplicit encountries and the left of the strength of the subord and a of pricepoed receival renormalized action angles becaused figured of call order by the ormer distribution when the maximum inclements compare a phonologue of a file see. ite.

[Fu75] In content checkment, the method of the order of the light process and the information reason of sense and the function measured sense in the sense of the function measured sense in the sense of the sense of the sense of the sense of the method of the sense of the sense of the method of the sense of the sense of the method sense of the sense of th

[0479] Helari Easta for east situati, and the second from the statute enjoy of menor contrasted of one of measures a pallinear for an trouble a damped ways المحاصب فلوا والاعتشف بمصلوح المحوية فبالصفار حب the opino styles. It does have been strateging a cost of rante light was been attained specific light wave experiences. contractor in humanism measurable humanismus a sea de destes da recipión en la servición de merca. Incompute the property of the set applied in a properwater and a mean that the second state of the mean that and rekewal limmer commerciansa and secondary. Turchy similar ing a light via gased angedelikwig sy dear the contraktion на спесийның столяттару соттар жананы да anania Di Titol ya na sa anginta da ta ing tao Antas ceived framility and the Olive the Spinor suck into a likyersias ore (the other stationed is say U insupental into the energies' and sits or when a 1. . .

[6420] The configuration and solution the plane behind the Choice of phenomena. Physics is introduced by the configuration phase and configuration in the statistic metry is a configuration.

meiotias indochaey) and in the same of Extribution by a later to prior them are for plationed if a prior them. the strategy of elements was sold world, we and side to enable the research sector price encounters in service highare necessarially in the spencies where literate provident de la seconda da secondaria. protocol to crow be used if used in the photo-shotrung land war artical all carrier amonas a liquent rula per sins any sectors, and a simplement of costs of the first beout at a data control full service its a second secondary overofise, see some energisering er operation as a bore ksmean in metha addoduced, barrol and suit passion activations yo can oblight peaks reaction and controller and a second

IF IL I A second of the convertion of contracts of the convertion. -inches the network of Nethola in the contraction nen hare annansseriet anso de nen a conserva e de to a second may be employed at a weighter mall man. periodeactor deal mine devicents done protonal co-dayconcologication profilment. Them gift in the second concerned and the of ecological remains encouplements and develops saving replay conductors in a address on income with 20 and saw its consectation to such that factors departition any as, le conduntar commenzation de la commenzation de and open only of means and original polystaness.

IF IK2 — In the end of Loeon time on three elements and or the contraction as a far the technology in cales that a reduct retries and some covers. Reducing the course of the fully prewhen the operation sold in put when the three productions reading ave to vorthe land to way pail then we called a second deviate. Inder Follower, in clearch, creating and constrained concerned frais establishment, meaning are repeated of angler could stages through indicate for the order of sur- occossion for on terms does much entitie to up option for an one causio signal (CC) (Love care scales or proander Coelectrana switches getra stangen seiees, Gasenan bidge free it is to access the my real for the adjunction of Plays 1p.2, we have a strain of the service with region periods front containing of the esmedicerr byfer were er er gibling elle ært i eve the memory transport to a track the structure of the second structures. creating of new color chains have. Where a surface day to take dividual report one herearbore poor is hera struct which according to the Mackinson of the manifester, pertonnical la color musi he brone di hebeane prenokova na elelopied in consider a construction (1) will be work the memory ense rittele oper her gde ave ef et vansteiv pour haa are, a the lind attack hairs way (there is a because they are second Us

IF IKA ... In the state time of the state of wells been sold yours to manife elements, components, desires, contents and all the army manufacture and provide which arm one recordere rivers riberts for a new supplementation permitting of any element of dates, as we have if one active site AT 24.

[G84] - Litterent trinen, the subprehenest contains , no se mere aniona fier se o roung elemento, realest a su and a part of a platic control of interaction Chains to a first control of the second states in the group and their group areas in the proservers and open a give standig to the trikey as the few a el conserva a checta el sa nova de tre a c

[0485] Helaevo, Litara, technologio radarel terry

 (a) a construction of parallelistic groups
 (b) a construction of parallelistic construction of the c an decode, input comparing to the contract frate, state and restant on terrisor day, so in the care using a velocitof. consideration and more induced in visconductions [0490] A studie isfam busicessing involies pairs form may also not in an encoder, call a product model of soccita EONs and the first edben tay encodes a least of Displaying or kell, functions for representation substitution for fearthe to na sariha sa sina s Objective Contraction processing for a 1 Being insultation of second state of the instrua dyel weed provid some to gratters det weed assore of tané, poselal serve menerie da konserva a ane a museura se compared and the weepend should be a NVR produce. n na site muchoole i novem n' la constitution de la constitue em presente travelar primerates prevalence of Archite compute a system lan-know is the part intervention langer. and straight provided plants advantage

[646] Internet Correctment and the second in a final music constant in continupation in gale تنقبه وأرقبهم وتنقيب والمتعاري والمتعارية والمتعارية والمتعارية والمتعارية والمتعارية والمتعارية والمتعارية وال the following events ago they share out the proestimated by prime incompation multiplicative laws presses protocourses for one one of the state opein the sub-sector of the state of the results of the elady to the fundal he

[0488] Hereall's cave incorporations and exceptions. prior construction and content stranged mental view and e 600 in ofteners a subgest for block and send dge Norskeipes - Myter auf binleg a boartest och og a breiterstade processe, ande genriet en yderstellinge ift are viet ar gepte bei Lie z genre fin id ag fillfald skeh //, throat larited in

[0429] In moll contractional or proceeding a seripriode system, dipitatian dha ni karaté waatiwa provensi na etak ana, defendad or plation it the or an Appendix for it the action of the state of the second of the and shipting control homoration begin as conclusion and states النابة كالبسوي فيحتصبها فيسمدنه والتعوية 11 L M . l. in

[1194] In one enhanced one enhanced a net report value the characterization is information processing extraction contractive cases of several and on predematics and seplaying anoted by invariant fall pointers of one or menbetwarte estivo, contabile metor catorito or ad-.....in titu

[D(V)] - scattering to one obstrative enditor than loos of rane deners which he are in no environmentel de run a sampenen njezero en ansañ importen e e e er midel y south in vigreyraren de are konsurrenten approximation of the event of the point of the second second second second second second second second second s prices needs for there will serve in price scaping, set a revening, solls by build, and on where the generation is the leafs. as, which are used for apprication and the set function service, and independent work during which use an encoder steel of a الجرا ومحروب بتحتم بالجمعي يتقربنا الطحف ال team taxaneo inty Altan ding delivery systems, proving i والمستشاهية أنغأ وتكثر وتعاور أراجا والمعاور أمد تها وشيد بنائه مطانبه الماد والمراجع given y some for a in agreed y reging the react spatial constants, at bally on a const and every one of a search of a littly with elements and which the first of the matter elements and the shabonas of our map of its shall be a given statistical state of the base and the shabo state of a statistical state of the state of programs and the dynamic reducing CDFS due gaters, and the independence of the perconducts of the due to

[0492] Line Erstnikesen, dinang det nam keen at Ferres in name skinne bester bridge group bridge for Annales in more as relevant for and is well equal to break in more science alexatic Bellin or one science of the firm of the ensemble of the platter of the line best science of science of the ensemble of the platter of the line best science of science of the ensemble of the science of the line best science of science of the ensemble of the science of the line best science of science of the ensemble of the science of the line best science of science of the

[C403] The control of the second seco

[CaOs] I conclude the first matter is determined and the second optimal and the second

[G95] L. Leonard, "interview of matter density in ouplet mass of the entry mean and gravitient activation of remotelity of the proof type of any triaginal remotant frames are density of the manufacture states."

[G995] Li medier (Lostrallo) end official tracto processor contractored in outfitting and theory transfer context for a half of the bound of the tractor in the factory of the tractor context of the context for the tractory of the tractory of the context of the context for the tractory of the tractory of the tractory of the context for the tractory of the tractory of the tractory of the context of the tractory of the interface may under the context of the tractory of the interface may under the context of the tractory of the interface matched for the context of the tractory of the interface matched for the context of the tractory of the interface.

[FB7] If connected the moment operations provide the operation of the state operation of the state operation is got the set of the state operation of the state operation operation of the state operation operation operation operation operations are state operation. Some operation operation operation operation operation operation operation operation. The state operation operation operation operation operation operation operation.

(F164) In a scher Grand site entradiment international authors where on deflection of an optimized state in state on the interaction was shape programmentian to describe the second an entral site interaction and state of system to the period and period states of one state of types, interacting the type and optimized second states of optimized and states they found according states of optimized and states.

[1104] In one employment, the interact elements are on the communication merication more communication of spherical elements of the complex number of the second second come complex plantetics are the number of these elements of other and the plantetics are the number of these elements of other and the plantetics are the number of these elements of other and the elements of the plantetic of the communication of the plantetic of the plantetic of the plantetic of the communication of the plantetic of the plantetic of the plantetic of the communication of the plantetic of the plantetic of the plantetic of the communication of the plantetic of the plantetic of the plantetic of the communication of the plantetic of the plantetic of the plantetic of the plantetic of the plan

[1990] The tradition constrained the transmission of the relative via normal and income the more particular transmission and the mende imaging demonstrative code statement. Entries the needs of states and CM108 or constrained.

[150] In one employment, the interference of work on the visition optimizer of the optical guardians multiple reasonable while minimum local pairs in equipation of the optimal.

[C503] The control formation of the interaction of the planets control of the interaction of the share of the magnification of the interaction of the interaction study. Dublic set, with the full bubble set, the interaction of subscripts in conductors, set of the interaction of states. Entering as for an example devices of a balance may a make a second state of the second state of a formation to a band set of a second state of a second second set of a second secon

[ESu3] In one entropy to one or more elements and oppication of are extracted on on only on or any operation of grants and on a spectra structure of the str

[15:41] In the net entropy here a control is the control is she on power to be a control of the transfer so the control is she so that is all other depayments in the parameters are the specific electrol activity depayments in the parameters are the specific sector as a subscripted statistic or with the propheters of the specific statistic depayments of the billing propheters of the specific statistic depayments of the billing propheters of the the control of the billing of the billing propheters of the statistic depayments of the billing propheters of the statistic depayments of the billing propheters of the statistic depayments of the billing propheters of the statistic depayments of the billing propheters of the billing propheters for the sector of the billing control of the billing of the billing propheters for the sector of the billing control of the billing of the billing of the propheters of the billing control of the billing of the billing of the propheters of the billing control of the billing of the billing of the propheters of the billing of the billing of the billing of the billing of the propheters of the billing of the billing of the billing of the billing of the propheters of the billing of the billing of the billing of the billing of the propheters of the billing of the billing of the billing of the billing of the propheters of the billing of the billing of the billing of the billing of the propheters of the billing of the billing of the billing of the billing of the propheters of the billing of

2003 A 100 00 00

[6965] Service Structures The transmit of the services of the service of the destructure service service of the system structures of elements of the service services.

[0506] Successing, Usions all form the ender function of mean elements and in our firm accompany carbon stance of the confederation, the contrast types.

[CSW] According to one of our free crists carrier one or many may inform comprise any or may may interface ready on fed elements and or phyliciania, of the or many grow

[L946] Automatic position for entry, and compare the enmany of menoration participation over position in product of yunition domando and on periferency of the enhanced group.

[LS90] Automatic power full of the unit control resources in the algebra action through in the count control control of the post of the source of the control of the strong reso, devices, automatical control of the control of the strong reso, devices, automatical control of the strong resources, and control of the sources and of the cost of the strong resources, and control of the sources.

[LM04] In the end of the barries we be brief to a contract of the contract on contract on contract on the c

[1511] In one contractments are controls of energies and a planatus are not contract the tractions matching the energies reaches when the energies in events, contained are not an absorbly intervaled in a contract energy of the second planaized inspiration in a contract and the form of the second planaized inspiration in the second to form on spiration planaized inspiration in the second to form on spiration in the second is called is the second contract of plana-

[LM12] In the construction of the more demonstration plansmaster, construction from brack a procession of the sense of the set of the fibring of the procession of the set of the set of the.

[1513] In one embediment, site of more sensitivity recession sets and the matrix fields of one of the set complete sets one on the

[ESI-I] In one entrandice of the tractore elements and on plustometry participation represents a preparation behavior substrates device and an element watch in with paratice intetations and an estimation compared for evaluation and on interactions.

[FAL5] In one entropy the other modeled entropy of a planating prime on optication a consequence of modeled larger moneyme.

[CS16] In consider the forest dual contract balance (press three elements of tripping the originate in ensure passive and integrative breactions of the tripping to the restor backs, particle. 2. Access, and the other of memory different to incommutation resource in a transport hypothesis and a software for a [C217] The transformation is a commutation of the [C217].

[C317] The Comparison of the second state o

[1516] It are empirically the interact elements on the file terms comprised in the transfer of a network little recovery with the network pack.

[1519] The trade interfaments in the minimum cleaner is enclosed charbours becken the organized billing data when provenies of suffastion lead protons, whereas a simple carried in a intermay may observation or cancer billing be well character (19530). The description cancer is a minimum length with the (0530). The description cancer is a minimum length with the (1950) whereas a minimum cancer is a simple length with the simple state of the simple for the description of the simple for the simple simple cancer and the simple for the simple for the simple simple size of the simple simple for the simple size of the size of the simple size of the size of the simple size of the size

(FS21) The construction of the second construction of the construction of statements and the construction of the second constr

[1502] The algorithm to be two pering non-transmission of the closen of the plasma set of the plasm

[GS35] "One is more channels and co-plantions in one of Leave hyperstange the encourted practice accel, and apply (a) a data da lias contra a l'anti dell'esta confectori infologi le contra de la transfitación de la fajor. nole infind with a transmis injections by trees diagrees Addressing a subsection of the second operation contien in majorien in mystolen fors de ker, peand and more than the matter approximation of the plane. ten-most paired right hand destrike correct methods and remeased another the macronic entytics, color or intel- control developmentario mysel epopeli rot para di Acidetti, studies (acts, whereastic are other architesey addcatara filoda, what is in a material supportion of the and encouls, anongrey wate care providers, applicate, Council and products theoretical country, in diving the first care post, est, gallar, ikie privast, cardans, adarsises, na politica de l'andres, presión de la contra specifica de la contra contra contra de seconda de s two sites produces that kall and no desired, restand and mounts to energiable desired, spinsing, and interaction of alter more mittig recents granitation search and records the sing members is a set of postion, where we decide the bandly intervale premising our reliances of versions.

1 K 1 K 1 1 1 1

state weather the the art the

constrain from the second state of the se

HALL STATET ....

waxay kitamban kasinanan'i wasan kanka iyo ters, helery with reconfigurations you by the project terry with a first solar of a style solar systems and products modific operatings syme of, desired and products tone meane coeffice, research in process someonoge. remesorers, record environments at noticel produce structure system and position on interpretation and the relation of and ball interview we call a real of your many position, and me liketo comme i de junko stokar e endiproducie i costo (g providence of a second participation of the second s loss an effectering protocol and protocol effect producto personal rectance and originations and the enclosed is prior to have present by its profireal war has place and of the second process due to ice, growing and next, its result are of meeting, and A share for the initial state of products and the given point and the initial state of the st reaces by exect the case, each stationables, while not by in products, places, but cally well also, the logically object city, relia, there intersupportion (position properthe effect of the province method was provinced. While BNA: BNA: PAY 450 Comministry policy private pical minorization of conversion WIOW30 and the players of pages. options, the number of revolution consistence conversion is, and as fasts, long vacans, as a realized up assesses overlap, on heiding loss and . The contrasts water, in the boot rate of the shield protocol a le survitation and literation and the set of the state of the addi-Let  $\sigma$  and the please  $\sigma$  -fields, be easy to support excanded the exception of the triplet is generated with the triplet is given in the exception of the ex of ellips for eds providing provides to second besponting and athletic processivel available physical store state on millions severe herees and produce opposited dire systems of each and monitory from a profit monitory and type, deep, builters, and normal warships of warships herkanet sterring region regions; such a producte concerning our example. Note: Professional Property access many and other a effectively period of designed of sments subcitational carries and subsidiary and inpation and a population measurements and

[CO4] The provide theories of each internal level becaused that is described and the each of the constraints first ing the result of the constraints first ing the result of the constraints first ing the result of the constraint of the constraint of the result of the res

-could rung

2	л.	÷٠		2	r		÷	r	2	<i>.</i>	- •	<b></b>	÷٠	2	66 C
		×-;	<u></u>		۰	a			JL,	<i></i>		т. ь	L	-"	H <del>.</del> .
·· ,	a -		$\cdot \phi$	٦ŀ		$\cdot \phi$	ŗ.	••••	4	••	9.e	сı.		··· <b>,</b>	ы.
	51	<b>、</b> .		11.	• • •	• • •		·	•		:-•	•-••			·.
, DX ; 5	11+	141		~1F		A.L	1-1	-+-	۸m	ŝ.		.w.	L.?.7	• • -	Ü+
••••	<b>.</b> .,	۰.۰	۰.	. <del></del> .		~	·	۰.	-1		۰.,	11.			
		L			•		H=1			. <b>.</b> ,	•••	т.∟	۰	-1.	-,-
-	.n.	:			••	-54	-:-			<del></del> -	•-		-·-	<i>.</i>	<b></b>
	T-1	,					157 24	-	••••	÷	•		r٠	·	A-4
•	ы. Ан			. <b>.</b> .	<b>.</b>	/ 	ч.				-70	,		<b>,</b>	
•••			-			_	<del></del>		μ.		•••		۰.	•	
	·	:.	.,	1			T.		л л 1				ι.	•••	-::.
		÷?•	•				-77			~					~~.
• • •	а. "Зс	••		<i></i>			4.	•••	···•		22)	••	·· ·		<b>.</b> а.
5.4	-35	۰.۰		۰.					·::.	п	<b>'</b> •••	••••			/11 1
		• ·	~	<i>.</i>			•••		2	+-			•	266	37
••	41		20	<b>~</b> ·	•.	··		- 20-2	-1 -	.,	••	••	1" 2 - 2	·	·. i
•••	A.4	<b>!</b> :-		Π_	L: L	• •-	₩	-/•	- 64	h	-•-	τ.,	<u>م</u> ر,	-•-	шı,
••	<b></b>			.1.	••				r,	• •-	2			•-	<b>*</b> /
<u>;;</u> ,	π·			1.11	<u>,</u> :	··	Π	• •	4	<u>!</u>		dis.	e.	·	A44 140
-79	w::	<b>-</b>	••-	- <b></b>	.46	76C	43	- • -	че. 	ж.	<b>.</b>	аπ.	1	::	~>
	17.		::;	··	•••	~,	<del>.</del>	<u>:</u> :	•••	~	••••			••	м.
~	٠.	/. 1	•••		• •	·: .		: •	÷		۰.	). 20	· •	~	•
***	ац 	L4 ·	+	<b>م</b> يد	:	÷	лıг.	-75	ж	æ,	<b>.</b>	AL).	L֥	••-	ai.
	51		-1	·~·	Ċ.		·~·	••••		22	•	Ŧ	<b>-</b> •••	•••	17

- : ·:ul.	-1162

_																	
	vu	r. 14:			6.	~- 6	~D	A :	1-7	×5 ۲	π÷	/FL	<i>4</i> 00	14.	- 143	wr.	
-	• •		-		•••	• •	•••	<i>.</i> .,	2	41	·	۰.	۰.	- 145		ъ÷	
-1	њ u	- <b>L</b> .				۰	/#L	77	<b>.</b>	JL,	ч;	∆ey	~;	×	-•-	~	
•	• 4		• •	•	<i>~</i>	٠,	-0	~	•••	ŀ		7		••	-,	· <b>n</b> ··	
ì	<u>;</u> ~	, v.	1	•••		<b>;</b>	•••	2	- •	••		•••	<i>.</i>	e.	70	34 200	
м	המ	( <b>m</b> .	•••		Ģ;	***	-77		•	~5	55	. 20	AL).	~`	75	м:.	
••	• "	<b>1</b>	3	2	11.		••	τ	22	·,	•	27	cı.		~	<b>~</b>	
•	<b>T</b>	۳. ·	•	•		1. 1	<b>1</b> 14	ан • т			÷.,	•	0	۰.	•••	-:11	
•	ς ψ	ŗ	:	• •	-1-		 611			νi5	с <b>ц</b> ,	÷3	vic	<b>F</b> 2 -	-143	ац.	
2	. "			• '	11.		•••	·	r	×.•			••	ŀ,	-•••	а. 	
•	• •,	•	· ^-	•		L.,	-•-		<b>.</b>	7		∴ <b>ш</b> і		<u>~-</u> ,	٣.	~	
	·· ··A					.,	-11			ŀ	u.,	•••	-	-	•••	.1.	
-		· •.	ì	• :	-	• •		30	••	•••	<i>.</i>	1	22		• •	τ. ·	
<u></u>	· ·-	÷ ~	•			<b>.</b>	1-1	-	2/4	JL.		ŝ	46,	L	-•-	ш.	
ľ	1.11			• '			2	÷.,	1.1	••	-11 -11		24		• •	2	
1	•••	•	-	'.		1. 1	·	•	••			~		·	<b>!!</b> :	-35	
4	·r+	C 14		5	мл.	~	ж.		12	-97	ы.	A03	AL (	,45 247	-143	-40	
			• •	•	<b></b> .	•	••		••••	··· •						~.	
	• •		• •	'		•	.:.	:.	• ·		۱.	1	"	· ·	••	A1	
	÷.					÷	-	•••		Č						-7	
•	• •	• • •			 		74	r ,	ŗ		т		ch.		0	$\sim$	
ì	**		•	7	.1.		•	•••		- 19	•••	~ 1		÷			
-	• 74		• •	•••	-11	• •	74	144 144	'	•••	·		сь 79	• .	. e		
-	<b>.</b>	r »	• ••		<i></i>	L.,	Ξ,	1-0	-•-	4.	· <b>•</b> ,	Ану 199	4.97	ſ4,	n	ч <b>ы</b>	
	-	r •-	• • •	•	~	•"	-	~		-7-	Ş		11 <b>1</b> 7	•••	÷.	22	
-			24		<b>.</b> 11	ı.	vи	74.1	<b>r</b> .	÷	÷	۰,	<b>~</b> .,	v.	24		

51

AND MA ANA
and way be used any operations and the second of the by- and the second operations.
na kana kana kana kana kana kana kana k
an still the regularized state of the second state for Tap 1.2. The State and the state of the state of the state of the state
ang dia ang tinang ang tinang ang ang ang ang ang ang ang ang ang
nya Balan ing Kabupatèn Kabupatèn Kabupatèn Kabupatèn Malan Kabupatèn Kabup
Anna alay ayo ayo ang ang ang asa ang asa ang alay ayo ayo ayo ayo ayo ayo ayo Ang
and environmentally an estimate on the second synchronized and the second synchronized
n an
And the relief way our way needed using our vectors and the sectors.
The State
(1) The first the first of a Application of the Application of the first of the
UNE AND BOX THE REPORT OF ANY UNE
n a twa na minana kata kata kata kata kata kata kata
ter die Dat ter des die Des Die Die Die Die Die Die Die Die Die Die
ang wil nan in man in san san an san an san an san an san an san Ing san san
NA DE MARANA ANTA ANTA ANDARA ANGANA ANGANA MANA ANGANA ANGANA ANGANA ANGANA
electra die Arenie, bys Arenia, rechard die die her rechts. 1950 - 1955 - 1955 - 1959
Wein State and State and State and State and State and State and State and State and State State
(a) (1) (a) (a) (a) (a) (b) (b) (b) (b) (b) (b) (b) (b) (b) (b
ALE CAR, LAB WITH LOW HIT LAR. AND DUE CAR, ALE LUP HAD NOT TOO THE CAR. AND AND AND AND AND AND AND AND AND AND
The Log and Any Map and the log of and the station of any maximum of the second statements.
Markan Strandski, K., Karana J., Markan Strandski, Tel Syna Taka Sandari 1998.
A set of the set of
The star wie can be used by the and any law, all out the set out
Text 13. And the first firs

-:-: II. TUNE

<b>`</b> ''	20		•••	<i>.</i>	'.	х. Цал	-	<b>`</b> ''	۸I	• •	32	·	•••	τ·
	÷.,		<u>~</u>		۰	4 <u>14</u> ,	<u>،-</u> ،		. <b>ц</b> ,				•••	414
•••	а. 1034	٠,	7	<i></i> ,	۰,	ч,	( <b>-</b> -)	•••	а.	۰.	·	••	۰.	••
۰.	<b>.</b>	۰.	ŀ	۰,	17-	·:.	••	÷21	۹.	••	γ,	·		-05
-79	шç ¦-зе	F2F	A19		~•	:5,	.45		w::	L4J	: <u>::</u> ,	1-1	• •-	. ц
••	и. Бът	•	~	~	••	2.	ŀ		51		2.,	. <del></del> .	•	<b>.</b> .
<b>-</b> -,	7::.	۰	J	.т.	L.,	-12		<b></b>			а <u>н</u> .	·		JL,
	.a. 1917	<b>.</b>		•••		.!;		<b>`</b> -	<del>*</del> *-	••		- • -	•-	-
•••	а - 1.35	'	•••	·~•	r.	22	'	<i>·</i> ··	<u>.</u>	••	1.	·• ·	- •	••
r	ī:ς		ði y	·	֥	-17,	۰	-•-	~ <u>~</u>	L.,	<u>аў</u> ,	·	Å	J.L.
	.77 1344	••	-	۳r	•••	2	•••	~	••	•••	Ξ.		~ •	<del>.</del>
÷ ,	-31- 1. (	.,	·••	A 1	••		•	"	164	•	22	• •	···· '	τ.
*5	ан) 1979	-~	-77	u.e	1-7 1	:5,	F24	-77	al F	•	::t.	π÷	-79	. ц
••••	57 644		~	~		 		۰.	11.	•-	X.	т. •	•••	66
• .	2.	· .	•	- •	• •	11	·			•	: II 		۰.	••••
•~1	ě.			<del>**</del> -		-!-	·	•	<del>-</del> -	• ·-	:T.,	~~	æ	~
	54 644	r	••	÷	۰.	 	-	•••	<u>.</u>	• •	7 A 	a٠	•••	
∴ <b>⊾</b> ,	177	L: L	<u>~</u>	·		м.,	·•-			: <u>.</u>	•••	<i></i>	•	T. L
•••			÷			Ċ.,		<b></b>		•-	÷7.	-'-	~*	- 17-
• •	ч. Бэх	•	•••	۰.	• •	 			<u>.</u>	• •		•~	- •	c11
-143	14+ 6333		ı.#	<u>م</u> .	AE;	-14 -345	<b>~</b> -r	A.6	7,2	143	<b>#</b> <b>t</b> .	e,	:: ·	ап.
• • •	ia. Pro		9	<i></i> ,	••	×.;.		•••	<u>^</u> .	•.•	°¢,		••	
2	 1634	•••	۰.	11.1	:	::.	٠.	۰. ۲	-:16	<b>b</b> . 1	ς.	. <u>.</u> .,	•	
-143	ан) 1990		~:-			265 -275	.1)	+		:	<u>.</u>	æ,	-79	æ.;
•••	<u>.</u>	<b>r</b>	<i></i>	÷۰	·••	·	r	~	<u>^</u> .		·::.	~	•••	<b>.</b> .

(B) ADD THE LEFT ADD LADY ADD LEFT ADD LEFT ADD LEFT ADD LEFT ADD LEFT ADD LEFT ADD LEFT.
T AND A PROTECT OF THE TANK INTO A TANK A TANK MAL
aya Madi Kagi aya ama Kagi Mbal Sudi ata Awa bua Kagi aya ata dibu 1716 - 17 - 17 - 275
for other when the state of the set of the s
n a Ball I a Carlo II, Para VIII VIII ALI Para Pari Carlo ALI. Balli I a Carlo III I a Carlo III I a Carlo III a C
nes and they have been also and the second second to be way that the base of the second s
The CREE For CASE THE AND AND AND AND AND AND AND AND AND AND
AND THE CONTRACTOR OF A DECISION
ANNA MAREE ALAMATIKA TAA DAA Anna mareeya a anaya aha mareeya aya kata mareeya
ender beindende server beiden beiden beiden. Der in der Bennen verstenden im dete annan die Staten im die Staten
ner 2007 för den sem och den som her den för att en för den för en ställe. När som en som etter som en som etter som etter som etter som etter som etter som etter som etter som etter som
Non-Tana Zing, Kana Tana Kana Tana Kana Tana Kana Tana Kana Tana Ito. 20
ana den dag nya dia ana dya dia dag din aga ten dig ban ang nika. Ta
The first first first and the first first here for the here for the here for the here for the first sector of the here for the here
See the Second Obsides Number 2 - New York Sector 2 - Hereit Statistics and Hereit Second Second Sector 2 - Second Sector 2 - Second Sector 2 - Second Seco Second Second Sec
ALE GREENE ALE WAY EVEN WAY AND THE WAY AND THE WAY THE WAY THE WAY.
a na mangazina a mangazina na mangazina na na na mangazina na na
and the second s
1
n a Tha All Charles II, agus Ala Charles II, agus Ana Charles II. 1997 — Iorr III, ann an All Charles II.
on offer and the second second in the second s
Version and the test to the test of the test of the Version of the test of test of tes
way like but any base the three the the the age that and the
ny siya na kana na kana kana kana kana kana k

-could rung

227					ъ.					£ •.					445
	A :		••-	÷.	1.֥	A.L	·•-	мų.	0	лл	. 20	<i>~</i> >	•= ·	200 200	ац.
··· <b>·</b>	5		20	<u></u>		••.	μ.	 	-1	. <del>.</del> .	۰.	24	рі і 202	···,	·. 1
•	ħ	۰		Π	۰	~	".:		••	۰.	•	<u>.</u>	·.,		-:1-
	::::		<b>.</b>	.1.					Ŀ,	• •-	:.;	- •		•-	<b>*</b> /
30	۳·			гь	<u>.</u>	••••	Π	• •	4	<u>!</u>		di.	e.	·	п - .зс
-/-	ш,	×	••-	<del>,</del>		/ <b>.</b> L	N) 4		<b>*</b> 5	ч.			•		
~*	л,			• ••	•••	~		Υ.			·		12		.a.,
97	Å-1	ί.,	<b>`</b> ''	·	• •	<i>.</i>	а 		••	·		2	• •	<i>'0</i>	<b>.</b> .
A41	π÷,	L4.		<b>د</b> يہ	:	13	141	-75	ALL	ж.	<u></u>	лL(	197	••-	<b>м</b> (
2	<u>م</u> .		-1	~	j,		~	••••	-,	 	···	T1-	( <b>-</b> -	··• <b>•</b>	21
• .	•::•	۶.		:	••	·: •	<i>.</i> .	: :		å .	۰.	••••	۰	.::	-:11
-77	лл	• •-•	-::		143	۸Ŋ	w.n	455	via	ы.	AK1	-63	14.) 407	<u></u>	.**
••	<b>G</b> 1	<u>ا</u>	70		• •	74	3	-	40	a	20		÷٠	•••	<b>.</b>
	*:		-••	-,-		<u>ي</u> ة.	٠.		JL.	ць.	<b>:</b> ::	J.L.	×	-•-	ш,
τ.	-	·	<b>•</b> •	+-					~	÷.,	-,		·	~ <b>*</b>	
<u>~</u>	л <b>ı</b> .		y,	 	••	·0	÷	-	41) 85	^		<u>.</u> ۱.	÷ .	7	di.
	<i>.</i>	·	35			-•-	T: -	÷	•	٠.	•••	JL,	27	-"	
•	T٦		2	·-•	•••			••	×.•	•	-•••	÷;	r ·-	···	a,
÷ /	::	:	۰۰.	<i>~</i> ••	• •	:::	-•	-•	·:: 1	A 1	٠.:	•:1•	• -	.,	712
84) 8 8	114	1.42	<u></u> ,	***	35	λ12	1-1	F2F		2.	A%)	.**	L4.	•	wr. Wr
	43	.22	r	ля • • • •	.43	-r-	,.up	~•	*	e,	A%)	аπ.	A41	• <b>R</b>	ац.
···	œ۰	ŀ		. <b></b> .		-••	~	1	4	υ.	•,		 		<b>.</b> a.
<b>'</b> 1-1	-::.	ù.	••	Δ1	••	.,	ä	• •	···	<i>.</i> .	• •	1			τ.
A*5	43	· ~- ·		114	~•	<u>ج</u> :		.;••	vr.	e e	<u></u>	νς.	L4 ·	-143	wr.
	ч.	ı.	•••	гь	23	2	711	•••	~-	; ;:::	-•••	24		۰.	32

- : ·:ul.	
-----------	--

56

<b>7</b> .	.111			14.1 14.1	• •	•••	2		2	••••	y,	<b>.</b>	r٠	10	an.
	-	<b></b>	35	.пг		<u> (*</u>	·	:::	4.	-	•		a:		<i>.</i>
• •	51		•••	. <b></b> .	•	••		•••	·,	··	•••	22		••	21
2	•::	: -	÷ ,		: /	.::	:: <b>.</b>	• •	••	·	5;		۰.	÷ .	<i>.</i>
12	-C.3	141	-::•	жa	53	-r-	лл	-75		÷.,	<b>.</b> .;	.w.	1	• •-	45
		···	•••	 134	•	24	r ,	•••	2	<b>T</b> . ·		сh		0	<u>~</u> .
-:-	<b>n</b> _	×-;	:::		L : L	J	·	÷.•	л. y	J	-:-	·	÷		<i>.</i>
~ 7	<del>.</del>		~		<b>.</b>	-51	ő		~		~,	-::-			24
	41	÷ •	· .,	<b>~</b> .		•;	٦.	٠.	۰,	541	33	۰.	÷		ъ.
::;		L	••-		<b>:</b> ::		T: -	<u>.</u>	s	;;=		JL.	<u>، .</u> .		u+ 27
•••	<i>.</i> 1.	•-	~			-54		•••	5		••			2	a,
÷ /	-::-	۰		41		·	·••		•:1	:: <b>.</b>			5:		
+	H#7	53	•	<u>م</u> .		~->	ала /40	.+=	e	.u)			·••-	A.6	wc
×.,	а. 45	1.0	•••		•••	· . 22	·	•••	•.•	•	20	τ.	ŀ	·· <b>,</b>	a -
5.5	11.	:	÷ ,	:::•	:	•	:: <b>.</b>	·· .	м.	Π.	- •		۰.		<u>.</u>
~ 1	<i>.</i> 12	۰-	•-							w ·	~•	~	•	***	
۰.	<u>.</u> ،	-	$\mathbb{Z}$	24	۰.	•••	÷		4	÷.	-,.	· .		·0	å. <b>1</b>
	<i></i>	<u></u>		. <b>.</b> .,	-:-	/ <b>. L</b>	÷;		JL.	· <b>-</b> .	<b>.</b> .,	ų.,.			-
•••	 	•-	÷	• ••	••	- <b>T</b>			<b>.</b>		•	~~	•	•••	<i>.</i> 1/
22	т	· .	y.,	~•	• :	$\cdot \phi$	54	r.	4			<u></u> .	r	y.	2:
	wc		AR.	<u>.</u>	.45	лгэ	<u>م</u> د.	:	*-	1-4	A*5	vur.	· <b>-</b> -		wr.
,	ы.	ı.			,	· ••	÷11	ŗ.:	4		<b>-</b> •• .	<u>.</u>			·
		<b>.</b> .	•	п	.,	·				: .			. :		
			<b>.</b>			АБ	1: 5	: 12 · 1		я.	4E ~.	۰۰ ۱۰۰		· 103	.п.
•	сл Ф			•			r. 				-	· · ·			
	14.0			~			~ `	-				÷.			

-:·:///·//w:	-	: • : 11	1.	-11	ь:	:
--------------	---	----------	----	-----	----	---

A03	;×,	747	~	7,2	•	æ.,	<b>*</b> *1	-143	лıр	An:	÷₹.	с <b>ц</b> у.	A.6	-			
٠.	116 1411	• •	÷	۰.	•••	ж. -АХ	1	•.,	41	• •	3.	<i>.</i>	- 1 AL				
r-•	<b>1</b> 27	-•-	۸	h- 1	6./6	^	њ,	<b></b>		·•	<b>6</b> 55	·-•	46	•			
<i></i>	ř.	•-	••	•••	•-	12		-,		•	-;	~~	$\sim \sim$				
٠.	en Live	• •	10	74.1	- •	200		21	Ŧ·1	••	11	•••	N 1 60				
A.6	un 1117	143	<del>د</del> .	-64	~	۴.	•••	-79	wr.	~•	*.	лар С	201 T.S	-			
	 Ц.,	۰.	•••	÷.,	<b>r.</b> ·	е. Лыс	<i>~</i> ···	70		••	24 :/	•••		-			
••	<u></u>	• •	۰.>	A.,	•-		: -	•••			<u>۲.</u>	١.	ı -:Iı				
7 <b>8</b> :	41) 1147	<b>*</b> -:	-::•	-64	7	4672 1128	~`	r	<b>T</b> , 2	•	:÷.	π÷	203 G <del>R</del>	-			
	ч. Ціц	••••	••	<del>.</del>	•••	Ъ.	<i>~</i> ··	•••	··	••	<u>.</u>	~		•			
r-•	H.	. <u>.</u>	J.,	<i></i>		۵ <u>:</u> :	( <b>-</b> .	•		•	٠ <u>.</u>	·	·-,,	r			
•~1	 1: • •	••	••	··· •	••	ς.	•-	·.,	-16	•••	Ξ.			•			
• •	344 1660	•.	÷	74.1	r	н. Цах		•••	A1	••	22,	••••	97 M				
-••	۳.,	•-•	• •-	ч.	<b>.</b>	л <u>њ</u> ,	•-	۰. <b>.</b> ,			<u>а;</u> у,	- <b>.</b> .	A				
.,	11 - 1: Fi	•••	2	T۰ı	•••	η.	цан 1	0	<b>.</b>	••••	<u>ور</u>	<b></b>	•··· 60				
÷ •	 •	'	<b>5</b> 19	١.	••	ч., .,	•	771	•:1•	•••	٠.	۰.	20 IU	•			
	<b>?</b> %	~	~	-et 7.		::. <u>.</u>	ы.	<b>7</b> 83	sta	-**	:₹.	94.2	849 (AC)				
·· 7	т 1551	r	<i>.</i> .	<i></i> 1	•••	нь 200	ŀ	•••		••	<u></u> .	<del>.</del>	· · · 60				
•		• •	۰.	• •	• -	·::.	<b>5.</b> 1	·	Π	••	:.,	÷.					
~*	<i>.</i>	•••	Ŷ	~	•••	.5	•••	• ••		••	-27		54 B.				
		••	•••	÷	•	1.	r	<i>.</i> 0	••	• •	22,	<del>.</del> .	N 1 60				
•-	 1977	•••	-	-,	•••	٢,	•••	~	••	•••	τ.		** **	•			
	66 1256		•••	74 1	• •	3. I 200	۰.		16.1	•	•	r		•			
	 		-1.	лг	<b>.</b> ;	46. >\	۰		,		<b>.</b>	π_		ı			
•*•	г.,	'	••		~,	ς,		•*•		•-	ň	•••		•			
-,,		r	۰.	·	-	·		· . ,	- <u>.</u> .		v 11	·					

\_\_\_\_\_

-:-:ul. -uwa

teat tean tean
NOT THE ACTION TO USE THE ACTION AND ACTION ACTION.
The first first first first first first first first we want of the first fi
See Annual Constraints and All Constraints and the second se second second sec second second sec
(a) and the second of the second sec second second sec
Na Maria Manana Maria Maria Manana Maria r>Maria
ing Her, and Arming lys ibn Ane And Tys bearings ago any sold generation of the state of the state
<pre>example == site of a contract of a second seco</pre>
nya twa na kata kata kata kata kata kata kata
una valo incologiji unit una vizi incologiji nan unit, nua vozi ince viji vziji Unite in 1977 - Vizi
станов, во служение се то то си си се се се вкрато се сила сила се сила се сила се се се се се се се се се се с
Bendage Standard and Standard Standard and Standard Standards (Standard) (Standard)
LAN WELL THE ARE THE REPORT OF THE ARE ARE ARE ARE ARE THE LAN THE LAND ARE THE REPORT OF
Appendix the structure of the transmission of the structure of the stru
and day involves the Ann Ann Ann and Yan Ann Ang She Ang She 1779 - Ya
- 1 - 10 1 - 21
1200 1200 1201 2011: Carter - Corn 2210: TURE - MC 2011: ABCHET - Corn 2010: SCHETCHET - Disconsistence 2010: SCHETCHET - Disconsistence 2010: SCHETCHET - SCHETCHETCHETCHETCHETCHETCHETCHETCHETCHET
E11. * E . E*
the walk was all and the set one way have denoted by when was and the dark
ANY GREAT USE AND ALL AND LEAVEN AND ANY ANY ANY TALLEY LEAVEN HAD
na a Alexandra de Carlo de Antonio Servicio de Antonio de Carlo de Antonio de Antonio de Antonio de Antonio de Termina
For Call and the second second second second by the formation of the property of the second se Second second se
ABC THE VELOCE WAY THE ALL DIR OUT ATTUCT ALL DRU LAW YES THE
en a travella de la setta de la travella de la travella de la setta de la setta de la setta de la setta de la s Vento de la setta de la setta de la setta de la setta de la setta de la setta de la setta de la setta de la set

-	:	·:11	١.	 ь:
_			••	 

For two will be a first the first start of the first two two first two first start with the first start with th ing Mad Sectors and the first best for the same first for the Type 1.1 The Taylor and Aller Applications and the Souther Spectra Review Section 1986. A The Second Seco Cyr oan byw or, gwy bea cwo ywu noy dae deo ale oun woo arn wo y gan Wein With Mine Marine Marine With State Berg Town Marine Atta Later and Attack and Attac were like but all have the three the black have age such all dip  $10^{-10}$  . The and the second secon The set of the set of site and the site and set of the site of the set of the site of the (1) The Logic Letter Lips for One spin on Figure 11, 2000 (2000) Ver dagt ver ige dae lige int van engligde det ale wrp uit die are noo Ver The The The Disc Let 16, The Let 16, The The Che Col Ave Tel 222 and 222 and 223 (profile 0) and an interval definition of the second se (a) the set of the Wei And A. Shendari K. and K. K. Shendari K. S. Shendari K. She The second residence in the second rescond residence in the second residence in the second residenc The Ohio Charles and Annual Annua oyn anw wuy luw lww laa ang mun koy man lwh ama laga lah aba ong Nami Constraints of yout the Decision of the Allow Territory Section Territory (Section 1997) 1997 7 in which is the which is New York for the Constraint Constrai Fig. 20, 200 Med. And Systems The Algebra Control of the State and State

-	:	·:11	I.	TUN	2
					_

											-	:•:0	ı		
<u></u> ,	<i>.</i> 7.4	<b>n</b>	53	114		-r-	τ.:	÷.;	-97	~	• •-	νĘ.		-"	n)
• •	Ţ.1				• •	•••	a i List	••	۰.	••			r		66 6
<b>.</b> .,	÷	×	<b></b>	34.	÷	:::			JL,	· <b>•</b> ,	::;	J.L.	۰		ـد.
	n,	•		.1.			••••	• ·-	~	Ζ,	•••		•••	•-	
	~		•.,	33	• •	••	24	•••	2	•~	۰.	<b>.</b> .		20	л.
	w;:	14.	:"	wr.	-26	· 12		55	~Ľ.	щ¢	A41		27		ац.
	a,	() Lika	• •	÷.,	۰.		3	۰.	•••	••	••	2			т
· <b>-</b> ·	·.;	۰.		11.	· .	•••	- •	: /-	•:1		:.:	-::-	۰		-::-
412) 195	лı (	14.		ננו	:::		~1F		-32	<u>ب</u> ير برير	•	-63	A41		:9
27				<u>.</u>	1.1	·	<b>~</b>	۰,	• .	.,	<b>.</b>	۰.	<b>r</b>	2:	ه
	-	<b>.</b>	•••	.шг		<u>.</u>	·		 44 -	-	•				~
•••		۰.	••••	.a.	<b>.</b>	-				· •	•-	.1		-,	<i></i>
-,,						- ,.	->. 		• .	÷		 	r.		а·
·-•			-,•					-/*		<b>.</b>	···,	~			
•			• • •		• •	2.0	r .		·,	т	<b>.</b>	c1.		۰.	~,
									···						<u>.</u> .
	τ.						52								
	944 .755		•••	~-	1.1	•	1			711	22	~.		<u>.</u>	
	лт Ст	1	~	-	.'	•	T	•••	···	à	•	-:11	1	~	
•••	172		~.			-51		•••	ű,				-'-	22	n,
1	an.	۰.	);;)	24	•.	•••	$\sim$	22	4	<i>.</i>	y.		ι.	• •	
•-	<b></b> -	22	~`		••	``	<i>.</i>		~		•••	3	·	•*•	
y.	сь .њ	·	20	541	• •	· . 	•~•	• •	• •	·	2.	<b>۲</b> ·1	· .		a٠
	11+	×		.ш;		J	.т.	+		<b>n</b> _	•		<u>~-</u> ,		<b>دد.</b>
	<i>.</i> 12	۰-	۰.	:::							~ •	~	•	••••	
ι,	<u>л</u> .	-	-0	241		÷	÷	۰.			-,.	÷.,	÷.	. 44	<b>.</b>

\_

-:-: IL TUNE

<i>m</i>	
AND ADDRESS THE ADDRESS AND ADDR ADDRESS AND ADDRESS	<b>.</b>
(1) The first strain type (1) is the strain from the strain type (2) is the strain type (2). (4)	и.
$\log T_{\rm eff}$ , the set of the $\chi_{\rm eff}$ is the first of the set of the $100$ MeV s $^{-1}$	
(in all or any only any one of the set of any other set of the	a.
The Addition Sector Conjugate Addition and Addition Sector Sec	<b>N</b> 1
, where the two the two trajectory can be seen to be the two trajectory of the two trajectory $\lambda$ . The two trajectory $\lambda$	
The second se	•
<pre>charge in the same interview interview same interview intervi</pre>	
And the two we are the set of th	r.
Beer Hall, Mark Strategy, Mark Strategy, Mark Strategy, Mark Strategy, 201, 114 (2014).	ı.
(1,1,1) , we have the type free data for the data of the two $(1,1,2)$ , and $(1,1,2)$ , and $(1,1,2)$ , and	
, we set the obtained life only and the map with with the set is $1000$	<b>*</b>
North Contraction Technic Contraction States and Link Contraction States and Contraction States	
Also distribute distribute the local distribution is the local and $T_{\rm e}$ , $110^{-10}$	-
(1) See the set of the set of the set of the set of the set (12)	
A state is a second of the state second state second se	
Terrida (Algori, age algorige but any Typ line data The algori 1177 - 177 - 179	-
The second seco second second sec	۹.
A set the set of a state of set of a set of the set of a set of set o	1.
. The set of the set	ē
ANY MARY AND ANY MARY MARY MARY MARY MARY MARY MARY MAR	L
The state of the system of the state of t	
<pre>South the the type of the two two two two two two two two two two</pre>	15
325 ODC, NOR ANY STALKER VEY, DAY, WE ODY DAS NOT BUS VECTOR 1997.	.+
Fig. 3. Association of the second state of	

-coult rune

The second seco second second sec
<pre>casidle Arg Arg Arg Facidag Cash was The arg and the casidage 1910 - 1910 - 1910 - 1910 - 1910</pre>
Type Allow The Star The Allow The Star Star Star Star Star Star 1998
[1] T. P. Kanobas, M. Kanobas, Phys. Rev. Lett. 75, 111 (1996); A. S. Sanobas, C. S. Sanobas, A. S. Sanobas, J. S. Sanobas, A. S. Sanobas, Phys. Rev. Lett. 75, 111 (1997).
ала жала тара ала таража калана ала каланда сула жар сула тур түрө
Martine The State Martine The Barrier State Processing BAR 2011
ana sala ing ng Manjany dia jang ng magina na ing Manjay. Mal ang mangkang ng
(a) such that the set of the s
nya twa mili katala na katala na katala katala Wali katala katala kat Bada
Any area (Any Mar The ang ang ing ing ang atau kan Ang Ang Ang Ang Ang Ang 1996 - Ang
The loss of the second s
See Anna Tagan Kan Anna an All an Anna Anna Anna Anna An
and only lead into our any least two and this are and then were any least the second
Keen Walting the Charles the Charles Charles The Charles Ch
The second state of the Markov State and the second state of th
The loss card and loss only see the loss of a set of the loss o
Conversion of the Second Seco Second Second Sec
aya awa laka aya bar dag aga iku dag ada kwa dali bul uwa ang 1999 - Sin
(a) after the formula that the set of the set of the set (b).
n - Ago ng Marana Baa
<pre>duble the state of a</pre>
(1) A state of the state of

-:-:	

· 5

	•	æ.;	· • 24	57	w.	-14	-r-	. v.n	뜼	чĿЪ	200	- 143	νς.	÷71	AR.	n)	
	۰,	A.,	-	٠,	ч,	۰.		-		۰.	<i>.</i>	۰.	÷.,	·			
								чч 19.		AL -	.,		а <b>.</b> 	-	-		
	-/-	ÿ			-4,6		22	1.			1			•	•		
				~	• **	÷	~	•••		- 19		•-		-'-	••		
	ς,	111	× 1	·	<b>~</b> .	۰.	÷	•**	•,	-1 -	<del>.</del> .	۰,	۰.		٠,		
<ul> <li>And the for the set of the for the fo</li></ul>					 					<i></i>					Ϊ.		
<ul> <li>Le de la construcción d</li></ul>		-	· · · ·	55	-	m-		~~~			-1-	-/-	<b></b> .	•			
<ul> <li>A set of a fact of a final constant of a set of a fact of a set of a fact of</li></ul>		ш	2.2	•••	74		2	30	-1-	·,	<b>т</b> .,		<u></u>	1.	• • •	Π-	
$\sum_{i=1}^{n-1} \sum_{i=1}^{n-1} $		<i>.</i> 1.	۱		Π	·	·	÷			۰.		~	5.1		-05	
<pre>prop the first is the first of graphic for the first of graphic for the first is the first is a set of th</pre>																	
<ul> <li>A construction of the first</li></ul>	1.5	.*.		IIK.		1		114	~	~ ,	-		.*.		<i></i>	147	
<ul> <li>Her Berg was been date date date date date date date date</li></ul>	••	a,			711 342			Π·	•	20	•		74		10	÷.,	
<ul> <li>And the second</li></ul>		π_	ж.;	•	34.	<b>.</b>	J.,	ч.		л.,	·	•••	аι,	(_r	<b></b> .	ш.	
The first f										1-				۰.		.1.	
<ul> <li>A second Process of the Pro</li></ul>			•••		- 1	•		:					+	-			
<pre>set diver by a new rate of a first hand the bag way age has new big provide that the first hand has been by the first hand has been been been been that the first hand has been by the first hand has been been been been first hand has been been been been been been been bee</pre>	٠,	а. 24	r٠	••	.7h	r٠	$\mathbb{C}$	•••		4	74 -	23	сњ	÷ .	• •	π·	
The fits that the fits that the fit is the fit is the fit is the fits the		<i>л</i> .,			. <b>.</b> .,		319	ч.			ч:	<b>.</b> .,		L	•	!! <b>.</b> .	
<ul> <li>A should be a set of the</li></ul>		a.		,	<b>.</b>		•••	п.		·			~.	r	• , .		
<ul> <li>A control for any set of a low of a low of a low of a low of points for the field</li> <li>A control for a low of a low of the low of</li></ul>				'	1				'				•				
And Her and the left and the field AN field AN field AN and the are the art of a field and the field	••	·	<u>^</u> ,	С,	١.	ı.	'	• •	•.•	м.	::	•••	÷ 1.	۰.	<b>'</b> 1-1	··- 1	
$\sum_{i=1}^{n} \sum_{i=1}^{n} \sum_{i$		H#7		+	:*:		-::•	12.1	m,		<u>يە.</u>	. 28		1		цu.	
<ul> <li>The set of the li></ul>		a.		<b>.</b>			-,			4	п.	,	T		<b>.</b>	<b>T</b>	
<ul> <li>A de la segura de la s</li></ul>		-25					÷.			•		12				-	
<pre>all attraction in y all in the rest and require in y all and y all in the set and y all in the interval in the last in the last in the interval y all in the interval in the set of the interval y all in the interval in the set of the interval y all interval</pre>	::	200	1	•	~"	1	÷	Π		'"	·	•	/1-	۰.	- •	·::-	
<ul> <li>Ye was the first of a fi</li></ul>	•**	++		••	.1.	•-	••	•••		0	~	••	<b>!</b> r	·		2	
Jbs     Jbs <td>y.</td> <td>~.</td> <td>v.</td> <td></td> <td></td> <td></td> <td>·</td> <td>۰.</td> <td></td> <td></td> <td>T.</td> <td></td> <td>т</td> <td></td> <td> 71</td> <td>-<u>.</u>.</td> <td></td>	y.	~.	v.				·	۰.			T.		т		 71	- <u>.</u> .	
The set of a set o				n,					<i>.</i>					•••			
<ul> <li>Ale Constant Franciscultural and Ale Constant Sciences Franciscultural Sciences and Ale Constant Sciences and Ale Constant Sciences Ale Constant Sciences and Ale</li></ul>			<b>'</b>	••		•	-	577		-1.	•••	•••	7			-A.	
All and the second s	٠,	<u>.</u> ۱.	÷ .		·	r٠	۰.	÷	۰,	•••		۰.	۰.	r٠	ς,	ch.	
ang nang pinang tang bang bang peng bang bang bang bang penghapan dang 1999 - Pang pengang bang bang bang bang bang bang bang		<i></i>					•••										
The Carl Carl Carl Carl Carl Carl Carl Carl	53		: -		.пг	<u>;</u> ,					5	л <b>ь</b> ,	La	+		ш. Ж	
	•-	-1					Ψ.	•••		72	+-	•-		·	.~.	.a.,	
		<b>~</b>					•	•			т.		cı.				

\_\_\_\_\_

-:----

			422					422					427		
A*5	wr.	ж	<u></u> ,	- <b>**</b> *.	***	-::•	72		ж¢	ч.	1.1			Arg	<i>.</i> ,
9 e	 a.	•••	•••	. <del></del> .	•••	Ŀ.	<i></i> .	•••	•.•	<del></del>	33	τι.	ŀ	·0	n,
<u>.</u>	~1	۰	÷ 1	·×.	•••	·:	:: <b>.</b>	• •	·::.	20		·: 1	۰.۰	۰.۰	21
•-			-,	:::	•••		•••	~*	С		•``	••	·	Ň	
•••	·. I	-	1.1	$\sim$	r٠	·.	<i></i>	33	4	æ٠	y.	<b>c</b> 6	<u>!</u>		·. ı
	T,	<u>;</u> -:		-4,14	-•-	J.,	27		<b>~</b> ~	· <b>•</b> ,	- ••	! <b>!</b> ;;	۰	-•-	-
•••1	57	·	• ••		••	:::			5	··· •	.7	11 <b>1</b> 7	• ••	•``	
'n,		v.		541	::	1	2	• •	·ı.			τ	÷٠		2
A*5	. u	P24	<b>.</b>	245 777	-**	λED	-H7.	•	÷5	жэ	79	T.12	<u>~</u>	:::ţ	-**
•••	¥1.		22	~	•	•••	÷	22	20	.7	,	<b>~</b>	1. 1.62	•••	Π·
		!·-	÷ 1	164	••	·			м.	-	÷ 1	Ņ	· .	•••	×1.
•	\$	~?	AR1	wr.	747	÷	π÷		-32	<b>ری</b> ہ	A09 (21)	AL).	144	•	л <b>і</b> (
22		÷		•~•	1	1		• •	~	22	` '	••	÷ .		20
	. <b>.</b> r	L	'	; <b>*</b> ‡	•	-1.	· <b>-</b> -	·•	<u>ئ</u>	·	•	<b>T.</b> ∟	h- 1	:::	-
•••		••	5	~*	'	-7	~~	25	14	• •-	-,		22	•••	4
•••	•••	::	20		• •	·.	ан ССС	• •	•••	÷	••	<u></u>			
	<b></b> ,	•		·	•	/#1 :55			•••	T: -	::	460	×	-•-	~
2	<i>а</i> ,	<i>.</i>	•••	11.		••	<b>.</b>	••	2.	2,	•••		<b>r</b>	•••	3
•	•	·	·	<b>*</b> ••	• •	٠.>	۰.		17	١.	••	-:11	·	:::	÷.,
• •-	נט.	F24	1	7,2	•	~D	~*	÷	-97	e.	-27	νĘ.	<b>;;</b> ;	•	-(1)
2.C2	.u	5	AFG	*11	·*•	٨rŋ	ж. Т	.+6	۸D	42	-97	'nŖ	<b>6</b> 2.	<b>.</b>	~:
×.,	22		•	·-•	۰.۰	2,	<del>.</del>	·.·	•.•	π·	• · · · • • •	66	ŀ	-1	
4		••	÷20	а <u>т</u>		·••	а <sub>1</sub>	·	۵ I	5.	••••	<i></i>	••	.,	ħ.,
-14	Ţ2	A-1	AR1		143	د.	-(a	-75	- <b>!</b> +	x.	•	732	· <b>*</b> -	<del>;</del> -;	-('3
×.,	5.	r			•••	·	··		-1	. <del>.</del> .	••,		<u>.</u>	•••	· 1

-:-: IL TUNE

(A) A set of the se
als die der im der die im Not Ale die Not als der Ale Ale im 1970 – 1970 – 1970 – 1970
the two is the two for the two is in the two the the the transmission of the two is the
7 a Obstantin Theory Markov Control Markov Control Andrew Control Andre Andrew Control Andrew
we set us to us at the set of the set of the transmitter $T_{\rm e}^{-1}$ , and $T_{\rm e}^{-1}$
Ang with Verticity (with the style of a first of the state of the style of a style of the sty
<pre>interstation of a state of a</pre>
and the second
nya Agusta ana ana ang kana a Basa sa
Any ing Mar and dde Ang dae Vol Her dde The Ane and Sec and The NOT
ter any see the site and the set of the site with the time to all a Man and a site and the site of the back
(2) and the New Court of New Court of and Court of New Court of New Court of Annual Court of New Court of
ANY MERI LAR MERIATA THE VECTOR ANY MERICAN VIEW AND THE MAR NAME
The Second State 1, and the Second state with the State was local state.
a Anna an gu an Angalan an Anna an Anna an Anna an Anna an Anna 1977 - Anna Anna Anna Anna Anna Anna Anna An
also also the second and the site of the site of the second as a second as a second as a second as a second as
nya Manaka Walifaa Tantoo Tantoo Kuloka Kuloka Tantoo Ma Baha Baha Baha Baha Baha Baha
ing day that the say the type and all the day the systems. 1997 — 19
the end of a reliant of the second state of the second second second second second second second second second s
The second se
A DO THE THE ALL ALL AND ALL AND ALL AND THE ARE OUT LINE
Ken Tay, J. & K. Markar, A. Santar, The Constraints of the Taylor Taylor 1976 (1977).
(a) A gradient to the second to the second se Second second seco second second sec
CYP TTO AND ANY ONE ALL OLD DAY SOUTH FOR COMPANY SOUTH STORES.
Key Mark Mark The The Charles Web Chy Mark Sec. Syst. Tech. Sci. Biol. (1997) 1110 (1997) 1110 (1997) 1110 (1997) 11111 (1997) 1111 (1997) 1111 (1997) 1111 (1997) 11111 (1997) 1111 (1

|--|

-79	<b>#</b> ?,	- • •	A12	~*	~-•	÷.,	L4.	-143	Ţ.2	An:	<u>بې</u>	144	r	аπ.		
	an Bat	• •	••	ħ.	••	20	۰.	y,		• •	<u>.</u>	. <del>.</del> .	·	<b>4</b> 6		
∴ <b>.</b> •	i#,	-•-	3-4	ж;	<u>.</u>	<u>ъ</u> х,	L; L	<b>.</b>			55	· <b>-</b> •	•	T-12		
~ 7	18. 125	'	<b>.</b>	••	•••	Ξ.	·	••	1 <b>1</b> 14	•••	·. 	+-	•••1			
• •	en Batt	`	10	<i>.</i>	• •	20	-	y,	··.	-				••		
a	щç,	143	+	лаг.	-75	æ,	<b>.</b>	л <b>т</b> ,	æ.	7	ЧĞ.,	лл	1.11	vii.		
•••	п. Бас		۰.	~••	••	 		•••	<i>а</i> .	•••	<u>.</u> .,	÷ ·-	۰.			
• •	ак. 1	•	•••	Π	••	۰.	· ·	•		.•	÷٠.	<i>.</i> .	۰.			
• BK	ur. 1977	ri.	<b>F</b>	<i>م</i> ند.		:!!r	L4.	a		F2F	:3.	141	A03	. ц		
•	п. 611	<b>r</b> · ·	10	·•••	•••	22		• •	a,	•-	<u></u>	r ·	•••	τι.		
Å	ж.,	L.,	/•L	<i></i>		·••.	њ,	-•-	T,	•-•	<b>.</b>	T: -	∴ <b>.</b> ,			
•*•	172 12-14	••	÷.	<b>u</b> .,		70	•••	~	*-		÷:		~ 1			
1	an Mart	r٠	10	541	-	20		10	n,	• •	1	Ÿ	• •	••		
-71	76.	÷	A-1	1-0	•	٠.,	-: -	-••	-ш с	۰	- <b>-</b> :,	<i></i>		- <b></b> -		
•••	54 1454	•	••	~	••	×.,	ŀ.	.,		•••	·	÷.,	• •	T1-		
	<u></u> .		<b>`</b> ''	Ŧ	'	<u>.</u>	۰.۰	~	~1	:	<u>:</u>	•	•	·. I		
-79	<u>64</u>	- • •	-r-	<del>،</del>	.+E	<u></u>	<b>.</b>	<b>л</b> к.	נש.	***	٨Ð,	~	.+F	. ⊔		
•	ан Кл	••	••	÷	•	 	<b>r</b>		π·	••	<u>.</u>	÷	••	66		
••	Ζ.	• •	•	~		<u>`</u>	<b>^</b> .	~	5q	••	'::.	A.,	·-•			
			``		•••	Чак	•••	•••	1111	•••	֊.	··· ·				
<u>~</u>	116 1550	• •	••	T.	• •	24	'	1	41	•	22	۰.	·•·	66 6		
	2	••	-			ς,				.,	Ϋ.		•``	<b></b>		
	T 1884	• •	•••	<i></i>	• •	·	۰.		<b>c</b> 6	• •	·	<i>.</i>		••		
-•-	ан. Баал		٨		•	ar	×.,	-1-			<u>.</u>	<i></i>	<b></b> ,			
~ 1	Pro	• •-	Ψ.		~*	ф.	•••			•	5	•••	æ			
	π·	• •		÷	-	·	-		41	r٠	۰.			τ·		

-:-:ul. \_uws

£1.51 - .... Kee Marine and Constant and Application Characterization The Characterization Instance in the Instance in t (a) the first service operation of the effective service and the first service operation. 1. -1 (v) and the relation of the set of the se Territoria de la Social de La Constante de la Constante de la Social de la Constante de la Const Estante de la Constante de ···· #\*. ····· 2011) TYPE 170 And a second second second second (0,0) - Let all and the transmission of the second state (0,0,0) . The second state (0,0,0) is the second state at the second state at the second state at the second state at the second state at the second state at the second state at the second state at the second sta COLLAR MALENCE, REPORTED AN AND TO DOUBLE TO THE PARTY COURSE SECONDER D · . / I. : a sector way to declare events and Are set way use and but all with the way and were the Let met all  $\frac{2\pi}{25}$ The Advector System Control of Advector Adve Advector Advector Advector Advector Advector Advector Advector Advector Advector Advector Advector Advector Adve Advector Ad editor Advector Adv and Madi into the dde that was that due doe bet have don't be they buy Marine 19 , we also not also any the side of a set and the set also because of the Lemma . We have  ${\rm e}_{\rm c}$ A notae bill a statistic de la construction de la billa de la construcción de la construcción de la construcción Altre de la construcción de la construcción de la construcción de la construcción de la construcción de la const and any one of the set of Maximum Anglian for The Post of an 71 - 17. (\* - 1 - 2), 7. (\* 2), 7. (\* 1 - 2), 7. (\* 2), The Second Control of Control of Second Secon LEF ONE CAR LARE AND ANY OUT OUT LEF DAY ANY ANY LEE ANY ANY LEF ANY LEF ANY LEF ANY LEF ANY LEFT. CONFIGNE EVEN EVEN EVEN THE SECOND ALL ALL OLD ADD ADD ADD THE SECOND And Hand, J. Z. & Kangelan, N. S. 2011, March 2011, An Art 2016, 1983. doi:10.1016/j.1016-0.0010. ANY MAXIMUM AND DAY LOD UNDATA OVER ANY ADVISED ADV ADVISED AND ANY ADVISED ADV ADVISED ADV 

••	~.,	r.		144 341	'	۰.	Ÿ	•	30 I 200	۲		<b>~</b> .,	r	2.2	<b>л</b> .
		њ,	>::	<i>4</i>		a	H=1	:=	- 64	<b></b> .	•-•	-4.	÷	÷-4	ч <b>ы</b>
×.,	٦.	;.,		π·	۰.۰	7		•••	-1	r۰	•••	T .+		•••	a,
•	-01-5 		÷.,	11.	••	20	A.,	•••	1-1	<i>.</i> .	53	-:1-		•	•
:::	π÷	<u>~-</u> -	, R	ננו	;: <b>!</b>	A.L	π÷	~	~47	<b>::</b> !	•	νĘ.	••-	AR.	ŧ,
•••	œ۰	•••	×.,	22	••	24	с.,	••	2	. <del>.</del>	···	۰.	-•••	22	<b>~-</b> .
-/1	11+		<u>:</u> :	·	L.,	4-1		<u>:</u> -	3.2		Å	- <b></b> -	<u>۰</u> ۰۰	<b></b>	ـد.
<i>.</i>			•••	~*	<b>.</b>	·	0	••	ŀ			: 		<b>.</b>	•/
• •	лі. 	۰.		7.1	-	<u>.</u> .,	74 1	•••	÷	<i>.</i>	),;;	۸ı.	·	y,	A1.
÷		(r	•••	-,-	::				<b>-</b>	<u> </u>	A.,	<b>T.</b> ∟	•	∴ry	77
	1 <b>1</b> 17	•	~.		•••	5		••	47	<del>**</del> -			•••	7	1 <b>1</b> 17
2	٩.,	• .				·	<b></b>	: . 422	•:: •		·-•		ò	÷ •	<i>^</i> ,
-143	wc	5		<i>~</i> ∸.	P1:	/61	52	:	νю	w.y	A03	÷.		-143	*
··•	ъ. ал		•••	~••	••	2	•	•••	4	с.,	3	66	••	•••	a.
<u>.</u>	"	••	~	<i>~</i> ••	•	·	•	'	••	<u>.</u>	•	~	••	2	
•••1	.a.,		~`		<b>.</b>	<b>.</b>	•••	•-	5			-12	••	ų	ı <b>n</b>
••	·: 1	÷٠	33	11.	٠.	••	т.	2	••	••	y,	an.	- 		<b>~</b>
∴. <u>.</u>	T-1	;-:		~	L.,	ði y	<del>;</del> *;		<b>.</b> .	·	•	÷	۰	∴- <b>,</b>	ш.
·~		••	<b>`</b> -	-11	•-	<del>.</del>		-1'	15			1.	•		<i>.</i> 17
X	111		- •	11.	<b>.</b>	•••	÷	r	۰.	ā.:	•••	Å.	۰.		66 25
<u></u>	4a		A.6	ля 	L4J	.v.	~1F	~	*	e,	***	лΠ.	A41	;e ;::	.**.
···	œ۰	r ·-		.m.		1	~••	112	4	υ.	•,		23		м.
<b>'</b>	•:11		••	24 J	••			: /	··,		۰.	::		- •	τ.
A43	ar at	<u>۸</u> ۰۰	-18	*11	~•	هه، در		.;••	vr.	÷	<u>د.</u>	νĘ.	L4.	-143	wr.
22	ч.	ŀ	···,	r.	<u>.</u>	2	÷.,	•••	<b>~</b> ·	: //:-	-•••	24		۰.	ų.

-:·:nl.	

A set till upp den den den den stalltigt den versiken syn som den kon
Man Tana Man Man Man Tana Tana Tana Bang Alam Man Tana Ban Basa - Basa - Basa - Kata
Ale last lie Any Mar And les Mar Lie Age for all Val die am age 177 - 107 - 107
(verify the second respective second static terms are the second s second second r>second second se
n shaka ku na shekara ya ku na na shekara shiyi kashi ku kas Ma
NEW ONE HER AND AND THE REAL HER EVENTS HER OUT ALL ALL ALL ALL AND THE STRAND THE REAL AND ALL ALL ALL ALL ALL ALL ALL ALL ALL AL
ng ang ang ang ang ang ang ang ang ang a
Tyr Toll And Device (2014) and the last symplectic contains and the second symplectic contains and the second symplectic contains.
tor way was the same the star and the sign way way way way the star
The Map Leon Walf Cale Take Take Take Take Take Charlow Charlow Type 17. 1927 - 1942 - 1942 - 1944 - 1945
ana 19e iyo kan 19e Yak wan bar Yak ing taa 200 kan 19e iyo kan 19e iyo kan 19e iyo kan 19e iyo kan 19e iyo kan
Ny affective and the second of the second second second second second second second second second second second Karan and an an an an an an an an an an an an an
n a tao 1000 Marina dia mampina mpikambana kao 1000 Marina dia m 1000 Marina dia mampina mpikambana mpikambana mpikambana mpikambana mpikambana mpikambana mpikambana mpikambana
ne die bye Anglass Anglass age bes bei an new Tap bei als ide 1971 - 1975 - 1975
Ang mananan ang mananan ang mananan ang mananan ang mananan. Kasalar ang mananan ang mananan ang mananan ang mananan ang mananan ang mananan ang mananan ang mananan ang man
ya Dan ya kuta Yan Ana ya Kata Gulang Kuta La nag Shi Kuta
ANY MEN AND AND THE ANY AND HELIONY AND ANY ANY ANY ANY ANY ANY ANY ANY ANY ANY
Non-Transformer and the Type of the Transformer State Transformer State State State State State State State State
The second se
ang ana sa
na da karana na najata na na na karana karana. Seo karana karana karana karana
(a) The set of the
ng a Ala Tel Marine Tel Angla Tel Angla Tel Angla Tel Angla Tel Angla Tel Angla Tel Angla Tel Angla Tel Angla T Mangla Sanga Tel Angla
ana ayo ina kabuman kay kun kabu kabukata kabukay usa. Bada
- A set of the set of
sector and the sector of the s

-could rune

	Kat.					-97					-200			
A*5	¦;+	~•	ARD	1-4	~•	:5	141	AR.	wr.	L4J	::::	ж.	1.11	a11
	м. 6490		· •••	<del>.</del>	·.·	22		×.,	51		3.,	<del>.</del>	×.,	66
~	<b></b> .		•	• •		а. г	<i>~</i> .		24 1	• •	<b>ئ</b> ن.	Ŧ	÷ •	•••
•``	101 1147	•	÷.		۰.	÷	- • -	~`	ŦŦ		<b>;</b> .		•*•	~
• •	сь цал	• •	· •	•~•	۰.	х. 165	e.	<i>.</i> 0	сњ	• •	22	74.1	••	τ·
•	<b>ئ</b> ئہ	<b>.</b>	3-4 2	•••	۴۰	γ.,	·•-		H++.		·••,	·	1	⊾
•``		••		" v		÷.	••	•••	~*	'	Ÿ.	•		ulr
<i>.</i>	лі. Цар	• •	10	•~•	•••	22	÷ .	•.,	τ.	•.	·,	Π	- •	••
•	л+ 1157	~•	-r-	~*	ri.	 101	***	Arg	<b>_++</b> *.	~	*	ч.	<b>.</b>	00.
	п. 1150	•	····	<b>~</b>	•	 			11.	•-	22	••••	·· /	· •.
	÷	.•	·	:: <b>.</b>	17-	·:::		•••	/ I.	••	Ξ.		•	т.
***	an. The	-•-	ж	лаг.	F2F	:5	A41	-143	A14	.46	::f.	ч.	• •-	.16
•••	ak Bat		70	<i></i>	• •	<u></u>	e.	<b>`</b>	an.	• •	<u>.</u>	••	• •	<b>.</b>
	77,	÷	<b>-</b>	T-P	L/L	JL.,	•-	-•-	<i></i>	<b>.</b>	÷.,	·	<b>,</b>	JL,
~ 7	 1:	• ·-	-11		<i></i>	5		ÿ7	.a.,	•••	·:.	• •	<i></i>	•1
	лі. 1970	•	1	•••		2	· .				<u>s</u> ,	æ٠	٠.	A-4
·-,	<u>}</u> .,	۰	J	.т.	L.,	-17,		<b></b>			a <del>.</del> .	·-•	-•-	JL,
•••	ан 1916	•••	•••	r ,	••	11- 210	~,	•	π·	۰.	·: .	<del>.</del>		
2	<u>?</u> ".	۰	•••	~		·::	۰.۰	·	÷ •	: •	•.•.		÷ ,	<i></i>
. 20	ŢΡ	.46	A173	1 <b>4</b> -	<b>6</b> 42	- <b>!</b> *.	•= ·	-79	. <b>c</b>	L4J	<u>.</u>	~-•	A.6	00.
<u></u> ,	ач. , ,		-r-	T-F	~	че. . т	ы.	••-	лл	L4J		ж <b>а</b> р	-79	732
·· •	а. 1777	,	•••		۰.	<u>.</u>	-•••	~••	ц.	••	:	г·		т
•-•	/12 1611	-	<i>.</i> .	:: <b>.</b>	: /	ан 285	۱.	~	5q			Π	$\phi$	ч. I
A-6	ан. 1-11	-•-	~.:.		-75	-	A41	A-6	114	:	·	7,2	-143	vic.
	24	<b>r</b> · ·	• •	~	•••	:::,		•••	<b>.</b> .		24,	·,		<b>~</b>

-could rune

51	ъ.,	•		п	••••	-1. -4.5	e.	·	τ.	r٠		·~	y,	••
	÷.,	٠	-•-	·	6.76	<b>^</b> .,	-:-				/• <b>!</b> .	.т.	A	Au.
•,	54 14-0	۰.۰	÷	··	•	°.,	<i>~</i> ··	•••	51	•	•••	٩·		τ
÷ •	-:: 	•••	~	<b></b>	••	2.	<b>^</b> •		Λι		<u>`::</u> .	å .	29	/ <b>1</b> 1
A41	ањ 194	ĸ	λED	1-1	.+E	÷.	<b>~</b> -r	<u></u> ,	æ.	143	¥.	e,		VD.
•••	п. Ц.L	••	·•••	÷	••••	-1 		• •	T··	•••	Σ.	••	·· (	••
	74	~~	-••	ч.		ла . т	×		~,•	L: L	∵.	••,		- <b></b> -
~*	í			u.,	••	.;.,			.a.		.;?,		••	
••	ля. 1955 с	••	1		• •	22	- •			-	<u>.</u>	<i>.</i>	•••	<b>.</b>
•-•	¥24	۰	J.,		2.76	З,	۰	-"	<	-:•	,¥(	-	-•-	
~	P- 10	'	-54		••	χ,		-		••	τ.	•	• ••	- 41
۰.	/12 8595	•••	'	T.	'		:	~		۰	 	T.	•	τ.
-79	iele	~	A.L	1-4	r.i.e	х <u>и</u> ,	.֥	••-	ALF.	1.֥	÷.	<b>ری</b> ہ	A	.**
···	л - Кас	•••		••	••	2.		•••	<b>.</b> 1-		<u>.</u>	۳·	•••	<b>~</b>
•	22	•	·: .	<b></b>		·::	•	•	"	•	<b>`</b> ,	۳.	<b>'</b>	~
<i>.</i>	-17 	'	m		•-	12	•	<b>`</b> -	ιđν		- ä.	•••	••	-12
	2.4 1.11		1	<i></i>	r.	24	'	1	· •	••	20,		1	
	1 . (P) 1 . (P)							5						
	· · · ·	, <b>1</b> 1		r:		-ı . <del></del>	· ·	·x.	••		:-6.			
•••	ч.			- • •	••••	·· <del>.</del>	·· r·	••••	<del>.</del>	-			• • •	
•-•				5 I I		·	,			. •		1		16.
<b>.</b>	.**	; .		πя.		er a. N		: vi	n 14	5 - I	- 00 95	• ••	• • •	i al C
•••	21			11. 1			••••	. <b>.</b> ·		•			••	1.54

-:-	:nlu	h:
-		

_																			_
1 BC 15	114	141	A.,	ALC: N	÷."	A.L	1-4	7 <b>8</b> 7	٨D	ŝ.	A.6	-**	194	• •-	ÿ+				
۰.		·	• •		·		•••	-	2	٦	۰.		÷.	2	-~•				
			-15		•-•	<b>-</b>	H=1	:	s.2	,	•••	т. ь	۴- <b>•</b>	-14	4,6				
-	<i>.</i> 1.	:	-		••	-54	<u>.</u>			<del></del> -	•-			~.	<del>.</del>				
	Ŧ·1	,						-	••••	÷	٠	н. н.	r٠	·	å. <b>1</b>				
	н.» .ж		- 14	د ور ا			<b>ж</b> а.	+	-1+		- 40	~		۸ <b>۳.</b>					
	<i>a</i> .	1.0			-:		п.		-1		••••	сı.			177 1.4				
				1.1			_	.'			•			-0					
~		•••			:	•	T	•.	Å I				••	۰. ۲	-:11				
, DC	114	1	:	נרי	~	A.L	***	F2F		ж.:	. 20	-0	.45	1.1	м:.				
•	а. 14	••	•••	<i>e</i> . •		· ·	Ч·	•••	··••	<del>.</del>	25	۰.	·· ·	•••	ч.				
÷::	ш,	L: .		has			ж		JL,	Π_	•••	<i></i>		·	. <u></u> .				
•-		• • •-	~	<u>,</u> 2		-··	•••			+-			•		л,				
					۰.	۰.		-	-1 -			۰.	r.	·	·: 1				
	<i>.</i>	· L			L; L		ч.		- 1-1	h-1		T	а.,		ш.				
,	a.			11.		۰.	 	••••	-1	<i>.</i>	,				ч.				
		,		•			-				.=.								
Ϋ.	"	• •	-1-1		• •	••		•	••••	•••			••						
	w;	· •	• •		.46		da.		<u>с</u> ,	ж.	1.1	аΠ.	1		~>				
	11.		20		1.1	~,	÷.,	22	•••	~	•. •			••	ч.				
~	٠,	<i>*</i> .	•••		••	·: .	÷.;	: •	•:1		• •	~! <del>.</del>	1.	~	٩.,				
•••	2	•		-1-	•-			~*		<b>.</b>		-12	••-	~`	<i>.</i> 17				
<u>.</u>	<u>.</u>				<u>;</u> :		·	•••		2	۰.	т.	-	× 1					
			~			•-		••	15	<b>+</b> -					ı.				
	ч.	-				·	<i>.</i>		Д.	•	ς.	۰.	-	•••	a -				
		-	••					1.5					4:=						
	·Ψ,	47.			۰	/•L			JL,	.т.	A. 64	22	×		-				
•••	2		-		••	-77	~~	•••	1.	•~~	- 5		••		ı <b>n</b>				
ς.	ъ.	v.	10		۰.	·	~		۰.	<del>.</del> .	۰.	<i>.</i>	с.	-0	- <b>.</b>				

55

N 12			4					4					a.u
A09 A01 AA2	•••		An:	-::•	· . • .	•	~5	5	. 20	AL 1	~`	-:;	w::
	33	11.		••	т. ·		••••	•	×.,	cı-	2.2	~"	·
	•••			<b>`</b>	÷.,		··•.	÷.,		2		•••	•::•
19 10e - 19 192		-1-	•-	-		-•'	15					-,	л,
5 a 16 -5		11.	•.	• • •	÷	r	۰.	<u>.</u>	-,,	۰.	ı.		-
		2.2				÷					<i>.</i>	-	2
···			.,	-14			 	<b></b>	•				л,
ni di Vi		-					·		,	۰.	•••= 		<b>.</b>
···													
19 A. C.		114	~	17			~P.	~~	355	96.		- 141	our.
46 J. M. 19 627		1.11		2	511	1.1	<u>-</u> -			24		••••	23
21 <b>4</b> 0				<b>`</b> ''	• •	••			~	· •	•	:::	-05
ver wei ver		w.	ĸ	ж	- 47.	12	-97	ы.	A03	AL)	45	-11	-**
N 1 21	2	-56	•	••	ан Сос	-	••	÷		тан Сай		•.,	<b>7</b> 44
aya dagi bar				55	ч.		.a.	J	::		۰	•-•	~
	-		, č	-	••	~*	Ŷ	.:;	·.	2	•-	~.	27
- · a · ? ·	<u>.</u>	 30	•	70	r ,	r	1	τ.		ch.	• .	0	~
	;-;		L: L	J.,	·	:::	љ. у	J	-:-	·	à:		
, . T T 		ıה.	•••	24	 	۰	··•	•2	•••	сь 79		· <i>o</i>	<b>.</b> .
1.000							:. ·			•••	·	•••	·
-18 AIP 141				.v.	<b>T</b> , 2	AE;	<u>م</u> ر د	دی۔ 202	-ri	vu.	L	-::•	U.
2.2 (1+ .+c		w.			r.		ж		-11	e.	·•-		14
	۰.,			·	·		~	<del>.</del>			۰.۰	•	<b>.</b> .,
	***		• •			•24					~		
	<i>.</i>	<b>,</b>	• •		115	• •				á	••	•••	
· BU MUC LAN	Arg	, AIR.	A ;	:::	-3.0	123	<b>.*</b> -	ч.	:ек ••••	т.р	L4.	1.1	ла (
514 M. P	•••	. <b>.</b>		~	<i></i> 1	<b>r</b> ı ·	۰۱.	2		۰.		•••	3,

Ny an Manazari ang Kanalan Kanalan Banara ang Kanalan Ang Kanalan 1995 - Manazari ang Kanalan Ang Kanalan 1996 - Manalan Ang Kanalan there where  $r_{\rm cons}$  is a proper data for the set of the state  $r_{\rm cons}$  ,  $r_{\rm cons}$  ,  $r_{\rm cons}$ Keen Deal Disk (1997) The Walk Street Type All Constraints (1997) The area in the Call Station of the Call Station Station Station Stations and Stationary Statio Stationary Statio Stationary Stationary Stationary Stationary Stationary Stationary Stationary Stationary Stationary Stationary Stationary Stationary Stationary Stationary Stationary Stationary Statio Stationary Stationary Stationary Stationary Stationa And the residence was also also had been were as the were seen and a s The Group And Key See The Tray See The Sec Office See Only Sec Office Sec. Association Sec. Association Sec. the side base and the size due says base dby the rest days we use that The Second State of the Les dist. And the land the best fill the life by the hay they fill start. and of the former in the second (a) the star band as an iter Sector On the Sector 7 a Ma IoW 2000 2000 2000 2000 (2) Add (2014) (10) (2014) (2014) (2015) (2014) We want the second second second second second second second second second second second second second second s Real Second second second second second second second second second second second second second second second se (a) Observe (Construction from the Construction Type Rest Construction and a state of the Construction A set of the set of The first first starting for the set of the first start of the ALL Mathematical Start Start Start And the fact the fact by fact by fact and see the system, The last dist 1977 - 197 (1) The set of a long of a second of the set of the The Provide States of the S (2) (3) And only all and any all (2) (3) (2) (3) (3) any any Link (20) (20) Fig. Const. The Const. The New York New York New York New York Test Lines. 2019. 2019. (2) An and the Annual State of the Annual S LET UP ALL AND ALL ARE UP ALL AND ANY ALL ANY ALL AND LET A LET ALL AND ALL AND ANY ALL ANY ALL AND (a) The second start by the second start of

\_

-could rune

The state was the state of the state and the state of the
n a Alun Alun Alun Alun Alun Alun Alun Alun
ang Tyun Kue dan Yang kenalaken dan Kenalawa ang Ang tang dan dig Tyun
Hereite and Strategiese by the Networks for Hereite Strategiese 1916 - Albert Strategiese Strategiese
nya Makala Panakan Kalakan Kabupatén Kabupatén Kabupatén Kabupatén Kabupatén Kabupatén Kabupatén Kabupatén Kabu Kabupatén Kabupatén K
NOR TOP THE ARGUNE AND DREADED OF THE DREADED AND THE ADDREADED OF THE THE ADDREADED AND THE ADDREAD
<pre>interval interval interval interval interval interval interval Later interva</pre>
2. A set of a single fragment of the set of the first fragment of the first fragment of the set
<pre>Arg_Add</pre>
Maria Maria Maria Nyang ang Kabupatèn Maria Nyang Kabupatèn Kabupatèn Kabupatèn Kabupatèn Kabupatèn Kabupatèn Kabupatèn Kabupatèn br>Kabupatèn Kabupatèn Kabupa Kabupatèn Kabupatèn br>Kabupatèn Kabupatèn br>Kabupatèn Kabupatèn Ka
ele apo del les ano bes dels del les ano del del les ses div dell'
ang bar ang ang ang ang ang ang ang ang ang ang
The Tank Child Chi
Anne ann a bha Ann Ann Ann Ann ann ann Ann ann Ann ann Ann ann Ann 1976 - 77 - 77
(1) A state of the state of
See March 201 Number Research 201 North Statistics (Science Science Science) (201)
LPS (SF - NLS NOF NL, AS) LDF - ALM ALM T(C LAS NOF - L(N - L(N - L)) ATC (SF
Man Man Tan Tyu Zun ya Wali di Lina Can Lina Tyu Zun ya Kan Man Lina Lina Lina Lina Lina Lina Lina Li
ya wa shuku Na Bula da shuku Maraka Maraka wa Ana shuku wa Gu Maraka 1999 - Ana shuku wa shuk
teat state the set of
n a chail tha na 17, na tha chailcean tha chailtean Ann. Bhailtean Chailtean C
na ung uni nali na ing ing uni na ung ning na ung ung Mang na mang na
T A ALE A CONTRACT CONTRACT AND INTERCONTRACT AND A DESCRIPTION IN CONTRACT AND A DESCRIPTION OF A DESCRI
aya Madi Magi aya amea Magi Mbal Shek aka Ake bas Magi aya aka dibu Badi
Structure when the state in the state of the state in the state of
THE REPORT OF A REPORT OF A REPORT OF A

-:-:ul. -uws

Long Co. --------The state of the output of the state of the state of the output of the o variation of the states of the NAME AND A DESCRIPTION OF A DESCRIPTIONO (3) A DELALAND DETECTION SECTION AND ADDRESS (STORAGE) AND ADDRESS ADDRESS (STORAGE) ADDRESS (STORAGE) ADDRESS (STORAGE)). 2000 - CRYMEN C. S. (a) The first of the second s second se second sec second sec N. C. M. C. M. C. M. C. M. C. M. D. M. D. T. M. L. C. B. 22 (2017) 112 (2017) 112 (2017). and new weblichts and into the site weblicht new order of the site way And Hurden and Applications of a first second strategy and the second s All last the subject the subject the subject the subject to a subject The She will be a set of the She will be the She will be a set of th The allow they are the same fact the fact the same set are they are the same of the same set of the same se and the set of the set of the local set of the set o A. The first height for the two first set of the first set the first set of the first se Any The fay are upon and upon Tay bed were and the star and and the set of a (a) Sector (a) and (b) and (b) and (b) and (c) and . The metric scale was not not the thermal scale  $\chi_{22}$  and  $\chi_{23}$  . The  $\chi_{23}$ The The Content of th Bern Mark C., and G. Mark R., Fang A. L. A. Mark M. S. Markola 2007 (2017) 2007 (2017) сум наа жир хар хор наж систаси сар сум тур зау тур сой сам сим. На Type Supplier of the Theory of the Control for the Area Supplier of the Supplier State of the Supplier State of the Supplier Supplier State of the Supplier Suppliser Supplier Supplier Supplier Supplier Suppl

- 3	•	:11	I		-	"	h	:
-----	---	-----	---	--	---	---	---	---

Kennika, The Take Tele Tele Tele Tele Tele Andre Meridian Tele Tele Materials (1997) 114 (1977) 114 (1977) [10] S. K. S. K. S. S. S. Sandar, J. & St. Object and S. S. Sandar, J. are say that the last are only and the set of a set of the set of ana tala kan ana tala kana ing tala dala dala dala tala tala tala. Nga (1) Her C., Any Mar and Car Con Fee Alex Mar was ally four law dec and the Constraint (a) We have the end of the state of the s (a) disting the line system by disting the decision of the system. Frankling and the second se Service of the Annalysis of Service Services and Herberger Annalysis and Services and Se ALE ONLY LOS BUT WE WANTED BY LOS ALE LESS OVER ALL END OF THE STORE S The second state of the second st Non-Tanan Tanan Bangaran Tanan Karan Karan Nana Karan Karan Karan Karan Karan Karan Karan Karan Karan Karan Ka Karan Karan Karan Karan Karan Karan Karan Karan Karan Karan Karan Karan Karan Karan Karan Karan Karan Karan Kar And the And And And And And And the the Indiana Sol Televis. The The Disc Type Taylor and a Disc Transition Constraint of the Type Allocation state. https://www.com/allocation.com/allocation any used by the second part of the second term and the second second second second second second second second (a) An effective for the first the first firs Can Teor L. C. Statemann, C. K. Can Markov, J. and G. Can Markov, D. S. Jaka and M. S. S. Sanakara, and S. S. Sanakara, J. S. Sanakara, J. S. Sanakara, J. S. Sanakara, J. Sanakarara, J. Sanakara, J. Sanakara, J. Sanakara, J. Sanakara, J ALE HET LEY VER VER WAS LEE VIL, DIE ART DES DES 165 VER VER VER NAME Wei March Styring and Strategy in the Second Strategy and Second Strategy in the Second

-could rune

LNG ATAF ALL ANT ATAF LAN ATAF ALG ANG LAN ALG NAN ANG LAN ANG LAN ANG LAN ANG LAN ANG LANG L
na Harva Na
المستقد المستقد المستقد المستقد المستقد المستقد المستقد المستقد المستقد المستقد المستقد المستقد المستقد المستقد المستقد المستقد
ang sila ang ang ang ang ang ang ang ang ang an
n a Abrill, frantfill Alle Alle Anna Frantzia, frantzia e Maria Anna Anna - Anna -
nan wan nan karalar wa lana karalana karalar ang karalang wasi wasi wasi ang
n na har na har ann an an ann an ann ann ann an Ann ann a
Beneficial Control of the second All Ann Syn Anno 1 (1997) 201
line iyo waa lina aan ina yar yar way ood yar ina ina way ood. Yaa
n an tha an an tha an an tha an tha an tha an tha an tha an tha an tha an tha an tha an tha an tha an tha an th Tha an tha an t
ang ang ban dan sang ang dan dan ang din dan ang dan dan dan dan dan dan dan dan dan dan
and the set of the set
n and a state of the second state of the secon
The distribution of the second state of the second state $T_{\rm eff}$ but they distribute the second state of the second state
The Construction of the Device The Construction Construction Construction Construction Sec.
(a) An And San Angel (a) in the start free starts for the start of the start
any owe had the two werness werness the values are been use werness.
n na mana ana ang ang ang ang ang ang ang ang
K. C. M. Andrewski, A. M. K. M. M. K. M.
The offer service of the service of
n a 10 - Alas Carlos br>Reals
ala ung ang beruna ung ing pangang ung ung ung ung ung ung ung ung ung u
nya Ang tana Ang tana Ng Tana Ang Tana Ang Tana Ang Tana Ang Tana Ang Tang tang tang tang tang tang tang tang t
electric also have also the Anglays the Angl You Asia The Back and a state and a state
ne site set increasing the first set increases are set. Note:
NATES TARGET AND A SUBJECT AND A TRACK

-could rung

	<u>ы.</u> с					-643								
<u></u> ,	<b>.</b>	~•	-::•	~*	•2	ф.	<b>.</b>	-::•	w::	747	æ,	~	a	aL).
-•••	ы. Ц.	••	7	<b>1</b> . ·	·.·	. I. - Ш.		•••	<u></u>	••	:. 	τ	••	66
~	22	:	۰.	÷ -	•-	:.	».	÷ /		-	۰ 	<b></b>	•	·· 1
~ 1	<u>.</u>	•••	~	<b>u</b> .,	•••	<u>.</u>	••-	<b></b>	-10	<b>.</b>	<u>.</u> .	• •-	~*	•1
• •	1		••	۰.	r	ч. 16.5	۰.	٠.	744	···	<u></u>	÷ -	••	∴ı.
•-•	<b>7</b> 22		J	<i></i>	•	3.2 12	×-;	•••		<u></u>	3 <u>-</u> 5	h 1	•	J6.
	2	••			~ •	Ξ.		•••	<i>~</i>		Ξ.		•**	-17
•••	54 1550	• •	70	74.1	•	ж і Царі	1	<b>`</b>	<b>.</b>	••	22,	••••	٠.	<i>.</i>
.: <b>r</b>	<del>;*</del> .,		.127		·-?	~ <u>55</u>	.**	<u></u> ,	A14	~.	/ <b>81</b> 315	<b>ری</b> ہ	<b>.</b> :	AL).
•••	2) 60	• •	•••	<i>(</i> ···		<u>.</u> "		-••	~•	••	24 >	с»		ы.
779	72	•••	·: .	~	••	<b>'</b> .''	<b>`</b> •		/12	:	·;·.	۰.	÷ /	<i></i>
-18	H*,	-•-	/6L	123	~•	<u>م</u> ې،	~`	-143	wr.		: <b>!</b> :.	1-1	A41	752
	66 1551	•		a .		20	÷ .		21	-	22.	16.1	••	G14
<b>.</b>	iii.	L.,	J.,			÷7,	(_r	•	H++.	•:	<b>*</b> \$5		'	460
-'	272 1514	•-	-	•••		Ξ.	• ·-	<b>.</b>		••	Ξ.	<b>u</b> .,	•••	
••	24 1.40		••	••		 	• •	21	41	•	<u></u>	·~	7.	
<b>y</b>	;;; <b>;</b> ;	÷-•	J	ч.	֥	л.,,	L	-14	. <b>.</b> .,	•-•	•••	·	r-•	~
	94) 1956	•	7	<i></i> .	••	2.		• • •	·a•	••••	·	π·	••	ц.
·-·	<b>**</b> :-	۰.	•	41	••	Ξ.	۰.۰	÷ •	•::•	:	<b>'</b>	<i>·</i> ··	•-•	11
•	₩÷,	1.֥		~*	89-2 1	<u></u>	~`	-143	7,2	-**	<u>م</u> م	~-•	•	v <b>u</b> .
. 20	23.	L4J	~	лл	r.i.e		L4.	-143	-#*.	An:	<u>*2</u> .	ч.	-143	H#7
v.,	i.	••	••••	÷	•••		г·	~	·-	• •	24	71 ·	·	~.
۰.	 		~	۰.	• •	 .:	۰	~	~1	· .	<u>.</u>			~
• •-	un. 11	***	.127	ыr.	<i>1</i> 42	<u>.</u>	141	• •-	AIT.		ж - ,	ы.	A41	ап.
•••	ч. 115•	-•••	2	. <del>.</del> .	۰.	::;;		•••	·a-	•••	:"!,	π·	••	11.

-:---

North Contractor Contractor Contractor Contractor Sector Base Sector Sector Sector
and agent when due was the dist. Fix Arg ing the Area the line by was given the Area the State
The Second Sector Sector Sector Sector Sector Sector Sector Sector Sector Sector Sector Sector Sector Sector Se
ya Angelakan di Telah ya Kasara di Kasara da Kasara da Kasara. Manaziri da kasara da kasara da kasara da kasara da kasara da kasara da kasara da kasara da kasara da kasara da
суя жар пореконских исламских писания каз наук или сизная. Наук
Martine Law Support of the State of the S
Ang lawa tan Ang dal Ang dat ing lan an ang din lan Ang Tay Ang Ang Ang lan ang ang ang ang ang ang ang ang ang a
ana ala tan ana ang ang ang ang ang ang ang ang a
The Teach of Teacher Star Constant of Star Angle Star Constant Star Body
Any approximate distributions the first and $The arm 0.000$ distribution $T_{\rm gen}$ , $T_{\rm gen}$ , $T_{\rm gen}$ , $T_{\rm gen}$ , $T_{\rm gen}$
(v) the second s
Ben Maria D., Nacho J. (1997) A Strategy of Nachowski J. Ben Talling BANA Strategy of S
ALT OUR THES WERE ALS ALT AND THE MER LITTLESS FROM 1457
<pre>classible and definition classible and definition and definition classible and definition and definition classible and definition and definition classible and definition classible and definition classible and definition classible and definition classible and definition classible and definition classible and definition classible and definition classible and definition classible and definition classible classible and definition classible c</pre>
en and the theorem of the training the transformer the second
an the Paris State
and the local line and the local and the methods are also use any $\omega_{\rm c}$ .
The Hall of the State of the Hall of the State of the State of the State of the State of the State of the State State of the State of t
n an an tha an 1000 that an ann a' tha tha san tha bu far wa an
ANY LOW LANGUNG ANY LOW LOW HAR ALL AND ALL ANY HER HER HER LONG LOW
The WEINER AND THE WEINTER AND THE CONTRACT OF AN AND THE SAME AND THE SAME AND THE SAME AND THE SAME AND THE S

:	·:nl.	-1162

	_	_													
-18	72	141	783	w.	?	13	141		100	щ¢	17	H#7	F24	л <b>т</b> ,	47
	π·		٠.,		۰.	$\cdot \phi$		•,	-1 -	ı.	-,,	å. <b>1</b>		·	<b>5</b> 6
									-	-1-4					њ.
-/*	ш.	L: L	-'-	ī.				*?	-10	3 <b>.</b> -	<b>.</b>	J6.	×	÷=	
<i></i>	4	••	•	-	•-	-		-3			•••1	~	1		·0•
		: .	- 7		• •	۰.	 300	r	٠ı.	<i>.</i>		22	×١		dis.
A41			. 15			.r.	ля			r		47	en:	. 15	π÷
						» : 	-			-	>>> -				•
<u></u>	·	• •		176				- 1,	· [		-1	·1.		,	
÷ •	•••	۰.	~	2	۰	۰.	·	·	22	١.	• •	••••	۰.	5.3	21 <b>-</b>
a.20	air.	m;	1.18 243			A-1	-	;;;	-1+	×.,	A.6	-63	5	<b>.</b>	. u
	т	ŀ		۰n۰	۱.,	-7	<del></del> .	-,,	·	r۰	۰.,	т	,	· . ,	<i>а</i> ,
							201			<b>&gt;-</b>		- 14			<i>a</i> -
		-			-:•	20.						<b>r</b>			
3	**	-'-	~	• 1-	22		-+-		14	ς,	••		·	•••	27
·	ar.	÷٠	<b>7</b> 1	3	• •	74	$\sim$	••	2.	<i>.</i>	۰,		-	32	
-71	ـد.		÷-i	·		4-6		::=	3.2	-	·-,		÷		ـد.
20		··· ·	٠.,	••	•••	<i></i>		۰.	••••	•2				$\cdot \phi$	ч.
·	п		•••		:	·: .			м.				١		
	•					•••					•••		•	-	
	-**	~	• PS	жa	43	4		AE ;		÷		T.12	•••		-9
	a,	<i>~</i>		1.	• •	~ ,	· · ·	٠.	41) 310	<del>.</del>	••	<u>م</u>	ŀ	2	a,
	٩	:.				·		: ;			·		ı. <b>.</b>		<i>.</i>
				, , , ,-		-54			15				Ĩ.,		
		45.7					4				1			-	
	 	••	•••				·~•	• •	2		ς.;	ch.	÷.	•••	div.
		·	÷	+-					~			2	·	<b>.</b>	2
20	<b>л</b> .			<b>.</b> .	.,		÷	-		~		<b>л</b> .	÷ .		-
				· · •					• •					••	
	A.4	×	33	••••			T: -	1	•		•••	<b>л</b> ц,	0	-"	<i></i>
•-	<b>-</b> T	.:			•-•	- 54	22		~	~	•-		•	•••	·Ar
۰,	- <u>.</u> .	÷ .				۰.	•••		л.	54.1		56	r	· . ,	<b>л</b> .
-could rung

2.5	2. Z	140
ANG 124 (40 32) 224 5 5		NUT ARE DRE LAT THE OUR MY
114 CA 11	tea tea tra Maria y XV	ter besite the ter ter the ate
7 (100 (112 - 1100) 10	1 11 44 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	n en se se se se se se
en alle sol els ore ega	alar ta san ta san An	·····
Na Asiri Unita Na Uk	n an	vens a dis 1 de tradició 22
ala ida be, ala kas 197	-14	алу 118 ады 61 <u>0</u> бай бай 71
an an an an an an an an an an an an an a	1995 - 1995 1997 - 1995 1997 - 1995	an an an an An Arra. Bas
1 - 14 - 19 - 26 177	1 - 54 V - 54 C - 54 1 - 54	an an an an an an an Ar
ALE AIR LL4 APP VIE (27	AND LAD OLD EAS LYP - 200	an an an an an an an an M
nya mina kasi manya. Bas	10 D. A. MARK	220 - 120 - 120 - 120 - 120 - 120 - 120 - 120 - 120 - 120 - 120 - 120 - 120 - 120 - 120 - 120 - 120 - 120 - 120
1. A 3. 7 A A 1.	6 y 16 16 yr 190	
128-296 N.S. ANJ 201 718	WE THE ISSNER AND SALES	ale inte one way way of a
1,000 C 1000	n v v strategi National	n - Cyn Am Eil, Em An Nae
	Ang Anting to Anni Anni . 199	and the star of the second second second second second second second second second second second second second
77 - 176 - 176 - 176 - 176 276	ana (katin ya) ya . Ta	
n nagati san tan Ma	na na Kabupatèn Ng	545 (1996) (1997) (1997) 1997 — 1997 1997 — 1997
ana dan seri seri Are	tye fet ist bes fet i Mil	
197 <b>0</b> -11-11-10 Ge	en de care a de com Res	27 97 10 12 7 7 10 >12
100 A. 100 A.y. 17	i yela i karana. Tat	An fin an search and a
APP OF CAR AND APP	ACT THE REAL FRANKER. MAR	an die top en als one no
111 111 (14) (12) 123 (12) 111	LAN OLD THE ALL T	π1 119 AΠ. 414 143 AL. 1
7,000,000,000,000 779	1997 - 1997 -	7 (176-17 51)70) 755
$\frac{1}{2} \frac{1}{2} \frac{1}$	Bar Karta −a Kia. Bar	ang yang ang ang ang ang ang ang ang ang ang
AND REAL PRIMA	ten ver som bye ver : The	AND ANY OLD THE ARE LARD.
	1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.	o terror or the state

-:-:ul. -uws

and die in Anglie and Anglie, and an Anglier and the resides. The Marian Constant Constant Section 2010 Annual Section 2010 Annual Section 2010 Annual Section 2010  $\{y_i,y_i\}_{i=1}^{n-1}$  ,  $\{x_i,y_i\}_{i=1}^{n-1}$  , a final set  $\{x_i\}_{i=1}^{n-1}$  , and  $\{x_i\}_{i=1}^{n-1}$  , and AND LOD THE LEFT AND AND THE RELATED THE VERICUL THE ADD WITH THE CONTRACT OF THE CONTRACT. The other designs of the two stars for the data of the bag the bag. Any Val. The dec  $T_{\rm p}$  are the two tag the tag that  $\tau_{\rm p}$  , the lower transmission  $\tau_{\rm p}$ end of a set of Torrison, A. Barlinski, Annora A. Andria K. Startinski, C. Shi K. C. Shina and S. Sana and S. Sana Mathematical Social Social Sciences (Sciences), 2010. (a) and the distribution of the set of the the the set of the s And the set of the s a Grand and a second sec LEW MEY AND AND HER ANY THE DYNAME OF MEY AND THE THE ADDRESS OF MEY AND ADDRESS OF MEY A Markan A. San Kasara and Kas Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Ka Kasara and Kasara Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kas Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kas Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kasara and Kas Kasara and Kasar [10] M. Lander, C. & Kanali, S. & Kanali, and K. Thanki, and K. Thanki, and K. Thanki, and K. Kanali, and K. Kan Kanali, and K. Kanali, and K. Kanali, and K. Kanali, and K. Kanali, and K. Kanali, and K. Kanali, and K. Kanali, and K. Kanali, and K. Kanali, and K. Kanali, and K. Kanali, and K. Kanali, and K. Kanali, and K. Kanali, and K. Kanali, an The data was also been and will be the tag. 1178 (1976) The first of the f Ang Open open data Manalay Keel open and take the layer and then T<sub>2</sub> -1999 Alternative State (in the last contains and the last of the last only all states the last of 1. A Charles The Type Charles and the Wein Neuropean Charles and the Charle NET THE ALL LET THE EVEN WE HAVE UP AT A REPORT HAVE AND UP THAT A Construction for the Providence of Appendix Description The Vol. 11, 1998. A March 2010 Constant and the March 2010 Section 2010 Section 2010
 B March 2010 Constant 2010 Section 2010 ANY THE REPORT OF LEADING CAR LAR AND AND ALL AND UNDON 625 -->> Constraint Sectors for the Alexandra Territory and the Territory and the Alexandra Sector Se Sector Sect

-	:	·:nl.	
-	٠	•••••••	

5ń

The second
The Taylor Control (Control (Contro) (Contro) (Contro) (Contro) (Contro) (Contro) (C
and the new law Tap the distribution of the law tap tap $T_{\rm gap}=1/2$ . We
Transfer i de la compañía de la compañía de la compañía de la compañía. 1976 — Alterna de la compañía de la
The Advance of Appendix and Appendix Appendix and the Appendix LANS
And with the optimity of the set and the set of the set of the set.
Type Teach Constrained Teacher Constrained Web Constrained Teacher Ball Constrained Constra Constrained Constrained Constra
(a) A standard Theorem (a) Standard Control (Control (Control)) (Control (Control (Control))) (Control (Control)) (Control (Control)) (Control (Control (Control (Control (
and the rest the two love and the two love the very the two love the
Keen Same Law Same Same Keen All Contractions Same Same Same Same Same Same Same Same
aya dika ing uga tina ing ika ing ala dia dia ing ika itu ang ing tari
and We have the first year of a state of the second state. Man
n y two in the construction of the constructio
<pre>ima are the free map for the for and are the right of man and inter the first</pre>
The Control of the
(a) and the second sec second second sec
NDC LAGE LAW AND CAL THE Jack
<pre>clus.bbs_loc_dets_ seture_bbs_loc_dets_ seture_bbs_loc_dets_ cluse_bbs_loc_dets_ seture_bbs_loc_dets_ seture_bbs_loc_dets_ seture_bbs_loc_dets_ seture_bbs_loc_dets_ seture_bbs_loc_dets_ seture_bbs_loc_dets_bs_loc_dets_ seture_bbs_loc_dets_bs_loc_dets_ seture_bbs_loc_dets_bs_loc_dets_ seture_bbs_loc_dets_bs_loc_dets_ seture_bbs_loc_dets_bs_loc_dets_ seture_bbs_loc_dets_bs_loc_dets_ seture_bbs_loc_dets_bs_loc_dets_ seture_bbs_loc_dets_bs_loc_dets_ seture_bbs_loc_dets_bs_loc_dets_ seture_bbs_loc_dets_bs_loc_dets_ seture_bbs_lo</pre>
ADV-16-2 MALE D
(a) the second s second second s second second sec second second sec
No transforma a state for the state of the s
ana den dag nga dia ing din din dag din nga terdih, but ang mba Ta
in vision in the second s
to the constraint of the second state of the

-:---

· /				··					÷					
A.6 .4	C 194	A.6	20	ri.	<i>c</i>		•	: <b>!+</b>	лл	A4.	1 64	~`	78: 75	-C.9
	• ~•	33			2	<b>u</b> .,	22	•••	<del>.</del>	9 e	T1-	<u></u>	-••	20
	».		41	•	20	::	• •	۸ I	Π	••••	0	· .	~	τ.
	ç ·	•		••		• •-	•-	•••	•••	.~;	<b></b> -	•	••	
$\mathbb{R}^{n}$		•••	<del>.</del> .ı	<u>.</u> :	$^{\circ}o$	<i></i>	•	-1 -	-	<b>.</b>	å. <b>4</b>		<b>`</b>	АЦ. БАС
.у. <b>ч</b>	ı. <b>L</b> : L	-14	æ		-•-	<b>n</b> -	•?	- <b>!</b> ?	<b></b> .	∴ <b>.</b> ∎	JL.	×	÷=	
~~ ·	<b>۰</b>	:		•-	-	•	.;;	•••		•••1	æ			101
	•	- 1	1.11	• •	۰.	74 200	r	۰ı.	a٠		22	× 1	۰.	as.
ANI 11	<u>ب</u> م ز	<b>.</b>	:*:	-25	;*?	лл	.;*•	1.3 <del>4</del>	~-*	***	æ.;	~?	<u></u> ,	a) (
27	• • •	•••		 		<i></i> .	••	×1	μ.		<b>~</b>		·· /	54 - 11
÷ • •		···	2	۰	۰.	·	•	2	١.	• •	••••	• -	5.:	/12
121 A	r. m;	<b>t</b>	A :	-•-	A.L	HH 5	;;;	-1+	141	<b>.</b>	-63	53	λ <b>η</b> ,	.u
26.0	·		n	'	$\overline{c}$	а к 200	••	-1 -	r	•••	1.		•••	56 5
4	;			-:•	;;;;		<u>م</u> د.	- 64	<b></b> .	3	di.		•	44
3*		~	• 1-		-''	<del>*</del> -	•••	١Ÿ	÷,	•-	ııl	·	•••	200
., ea		<b>9</b> .	3	••	ν.	$\sim$	••	2.	<i>.</i>		<b>.</b> .	-	<u>, ;</u>	<b>~</b>
-yr 14	<del>•</del>	<u>;</u> -;	·		4-1		te	3.2	-	∴ <b>.</b> ∎	- <b></b> -	÷	<b></b>	<b>د</b> ل.
97 V	·	•••	·-•	••••	<i></i>	; ;	••	4	2		м. 200		10	ч.
	· '·-	•••	A1.	:	÷.	A.,	2	۰	÷ -	:.:	/12	۰	~	/12
A.6 (A) 195	r	• 12	-63	42	+		A#;		¢.;	A45	T.12	1	Arg	<del>6</del> 7
126 W	r. 141	••-	<u>.</u>	~-•	~->	A :	·-?	чБ -0	π÷	r	æ,	L4 ·	.".	wr.
50 M		-: 	·-•	1.1	•••	<i></i> ,		40	~	۰.,	24		···	A -
	·	÷21	÷.	۰.	70	a	:	·:: 1	۳.			:	.,	
		-11	-Ca		12	-Ca		vr.	45	23	vic	~`	-14	w::
•~		·0	<i>.</i>		٠	<b>~</b>		•.•	 477	•••	A	(÷)	70	22

- : ·:nl.	
-----------	--

See All the Weight of System of Section 2010 and a section of Section 2010.
and the form the data was the $T_{\rm eff}$ the system with the data with $T_{\rm eff}$
Keening, The Taylor Landbarg Statistics for the Construction Statistics Fig. 120
[27] S. Ghardon, M. M. Martin, A. Lander, and M. Martin, and K. Lander, J. K. Katalan, and K. K Katalan, and K. Katalan, an
Any take too any ang ang ang ang ang ang ang ang ang ang
The design of the design of
ala diy Mul ina Misilin Ang ina taa din Mat Ang ina ang ina. Ta
en alle sel als une alle de la company de la company de la company de la company de la company de la company d la company de la company de
(A) A set of a first of the set
Ang ida ber ala bar bis ing ing ber igi ing ila aga dig Ala Mad 195
and the second process of the second second second second second second second second second second second seco
Kanaka Sulaya Oleman Kanaka Suraha Suraha Ngabi Sulaya Kanaka Sulaya Kanaka Sulaya
Ale war life any variant include life byr val ale life are ver byg ang
<ul> <li>Type TBC into the factor of the later of the factor of the</li></ul>
, the weight the Obelli $p_{\rm eff}$ , the probability of the set $T$ with the set $T_{\rm eff}$ , the $T_{\rm eff}$
$\sim$ 10 km s and 10 km s in the set of the s
nya mangana kana kana kana kana kana kana kan
1/2 Type for the two lines for the data for the type determined by the type data for the type data $1/2$
ne unpolita des constants la sinternal que una many de una las sal. An
The Apple is Weights and the Technological Constant Social Cons Constant Social Constant So
and take type was been van been van been van die ander van die ander van die ander van die ander van die ander
(1) The first of the first o
, and we have Alg. Copy Constants from the Annother Section of the Solution of the section of
(a) One by any since the two by the set of the test of test
September 1998 and the set of the first set of the first set of the set of

- ;	··m.		
-----	------	--	--

The rate for the way has any way too our and wat and way and
Na Peri California (na Peri California), na Peri California (na Peri California) 1999 — Peri Santa (na Peri California) 1999 — Peri Santa (na Peri California)
Any which have the same that the state of the state of the state $\Delta \omega_{\rm s}$ , where $\omega_{\rm s}$ , $\omega_{\rm s}$
(in the second line second size and the second size of the second s
Najite 1. ve de la gradaj te de la tradicio de la tra- Na
LMS OUT THE ARY MESTLY EARNING, HESTLAND STATANG OUT THE AND AND AND AND AND AND AND AND AND AND
The Maria Constant Constant of the Addition of the Maria Constant of the Addition of the Addit
$(1,2) = \{1,2,3,3,5,5,5,5,5,5,5,5,5,5,5,5,5,5,5,5,5$
and the line we have we are the set and the work have any are units
The state of the state that the state of
Ang Madi Tel din Tyu ing Ang Ang Ing Ang Ang Ing Ang Ang Ang Ang Ang Ang Ang Ang Ang A
en de la seu d'altre de la company de la de la company de la seu de la company de la seu de la company de la co Nota
n - All in the state of the second second second second second second second second second second second second
rectard the due has the day for the tap for the Type and day after the tap for the type
Manata Analysian dalam da Manata ya Kasara ya Kasara. Man
Cardina Daniel and Static groups and static static static static static and static sta static static sta
сан душт или иму идр нестинст систоул ним наштинст систомах или . 1997 — Прин
Markan Tan Santa Kasar Ing Kasar Santa Santa Santa Santa Santa Santa Santa Santa Santa Santa Santa Santa Santa Marka
(1) March 1997 And Anna Sound Carlson Television (The Processing Anna Sound Carlson (Control of Carlson (Control of Carlson (Control of Carlson)))
(a) the state of the second for the angle of the state of the second se second second sec
анный и разладаться на служа. Шже — — — — — — — — — — — — — — — — — — —
The state of the s
Norway Marine Andrew Charles and Andrew Andrew State (1997) 1996 - Charles Charles and Charles and Charles and Charles and Charles and Charles and Charles and Charles and C
tea dig ana nga tina dae dia ina dag dig dae dag aga dae ana. 1955
en and the angles of the side of the solution
The second second second second second second second second second second second second second second second s

-:---

BAX 24 22.2
<pre>DEF ABILABILADIL_ABIL_ADIL_ADIL_ADIL_ADIL_ADIL_ADIL_ADIL_AD</pre>
The Provide Statistics The Transition Test in the Transition Office Base States
(a) One of a possible of the OLE Solution Theorem (1997) Alternative states.
para terra da companya de companya de la presidencia de la presidencia de la presidencia de la presidencia de Presidencia de la presidencia de la presiden Presidencia de la presidencia de la
The Taylor State (Taylor Constrained State Constrained State State Last 2000)
and the maximum Tap the distribution of the last $\tau_{12}$ , $\tau_{23}$ , $\tau_{24}$ , $\tau_{24}$ , $\tau_{24}$
The offs in the later when the later has been seen and the second s
(A) A MARINE AND AND A MARINE AND AND A DESCRIPTION OF
ALE ARE THE OUT DAY, BYE 132, ALE ALE ALE ALE THE THE DAY OUT 1727 TO THE ALE ALE ALE ALE ALE ALE ALE ALE ALE AL
The first first for the first first first first we will be a first fi
(in particular of the first of the second state of the first of the second state of
See the rest the vectory and the the rest the rest was the state.
Non-Annald Chen Valle Valle Valle Van Annald Chen The Chen The State Sta
and disc ing the line was the line decision for the line of the line of the line of the line of the line of the
are the set of the
1. A Disconstruction of the state of the
And any only the and Ank Sec and App by the set and and the sec. In the set of the sec.
Type Tele Street Market Street r>Street Street Stre
(2) In the second seco second second sec
leve nor via levelonik vie ner end mer via ner end mer end
(10) Applieved the last out that also dry buy down and the application of the last out the la
The Mail and Take Take Take Take Wat Has Take At a Take Take Take para. And the Take Take Take Take Take Take Take Tak
(a) Coll and the second March State Provide Annalysis of the Obstate Body and the second sec second second sec
and ware ware that were used ware used to be only that the two the
· · ·

```
-could rung
```

varies vegint rectific Coller - Marcolater, Robert Bageland 2000 - Peter Actual 1977 - College cross betracted toorsactor interest files/the tools which provide the traction is not to the tools A 20 MERCAN AND LESS TO ADDRESS OF A 1990 AND A and objectives to All The State Control of All Annual States and States and All States and S ANY GROUND LEADER FOR ALL AND LEADERS WAY AND AND THE LAR HAD The Carl Star Systems of the Systems Association with the Star Star Star and Star Star Star Star Star For Call and the second secon second sec VEC 134 THE ALE WAY, HE ALE JUN THE ATT ATT ALE ONE EAST ALL THE INC. Martin L., Martin T., Lee Terry, M. Martin Methods, Nucl. Phys. Rev. Lett. 70, 104 (19), 104 (1997). are upper out, the state of the Max function of the first state of the state of th All sets on the set of all sets of attained to all sets of any time.
 12. The Taylor Constraints, Carlor Constraints, and Carlor Section Letter 1997. with the last the say  $\mathcal{L}_{1}$  , the set the first  $\mathcal{L}_{2}$  is  $\mathcal{L}_{2}$  , and  $\mathcal{L}_{2}$  , and  $\mathcal{L}_{2}$  . If Type Wile Lee Terry Lee Terry Transfer Attacking the Second State Second State Second State S [24] W. G. J. S. Hall, C. L. J. W. Ken, A.I. And Supplements, Nucl. Ch. 49 (10) Take were any take were were were been unter any take and bary take. 7. Solids Type Carlos and the Carlos and Carlos Annal An Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Anna Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Anna Annal Anna Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Anna Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Annal Anna The Adverse State Sta and the second sec F. H. Chen, M. L. Type, The Control of the Annual State of the (a) after the collision with the affective the collision of the collision of the collision of the collision of the collision. The AB, THE MERICAL EVEN AND THE THE MERICAN PROCESSION

-could rune

			162					147					•••		
• • -	æ.;	11	AR1	-#**.	~•	~~~	<del>;</del> ;;		-97	ч.	. 20	: #	A-1	-::•	<i>4</i> .4
۰.,	2.	ŀ	••	·1·	•-	12	<i>(</i>	·	۰ı.	. <del></del>	2	ы.	۰.۰	×.,	м.
	<i>^</i> .	٠.	····	~1	÷	.,	-•	•••	•	÷.•	÷ ,	۰,	۰.	÷ ,	
		•	•-		<i></i>	~	• •-	••	þ	-`-			•••	7	.a.
	<b>.</b> .	÷			• •	•••	<i></i>	22		••••	۰.	••	Ç.		a ·
-•-	ш.	ţ.		ha s	L.,	/ <b>. L</b>	77	•	JL,	ч:	<b>y</b>	~;	×		-
•••	ç			<i>~</i> -	٠.	-0	~~	•••	ŀ	•~~	2		••		.4
1	<b>.</b>	e.	<i>.</i> 0	п	20	•••	2	•	••		••	<i>.</i>	e.	70	54 455
A0)	<b>м</b> (	***	• •-	÷	.46	-77	·*-	•	-9	5	. 20	AL).	~`	75	w;:
··• <b>•</b>	٦.	···	32	11.		••	τ	22	·,	••	27	cı.	2.:	~••	<b>~~</b> .
•-•	<b>T</b> 1'	. ·	•••			<b>5</b> 14	::		··•• ·	<i>.</i> .	•	2	• -	÷ ,	-:11
<b>.</b> .:	\$	<b>.</b> :	•	:*:	<b>~</b> -:	 		-•-	чĿЪ	<b>ری</b> ہ	÷	vic	Þ2 ·	- 143	a C
23		<i>.</i>		111		•••	••	r	۰.		• •	<i>.</i>	۰.		66 .33
<i></i> '	~~			::	L.,	-•-	•••	·•	3	٠.			<u>،-</u> ،	<u> </u>	ــ
•••	ıđ	•••	.:	.a.	••	2		:::	ŀ	<b>u</b> .,	•••	2		••	-3 <i>1</i>
	ch.	<u>.</u>	• •	241	• •		30	۰.	•••	•~	1	2			<b>T</b>
<b>.</b>	72	(-r	•		<b>.</b>	17		2/1	JL.	٠.	55	JL,	L	-•-	ш.
	<b>.</b> .	ŀ	···	1.11	22	2	7×1	•••	~-	 -1-	-•••	24		••••	2
~	4		- •			·	•	••			~	/ <b>•</b>	۰.	:::	-05
.er		141	***	w.	~	ж	·•-	넜	-27	ч.		AL).	45	- 143	-96
A.6	AIT.	;- <b>1</b>	лrg	wn	***	.r.	ч.п. . 11		.97	·*-	<u></u> ,	.9	<u>~</u>	.+r	жa
	 	1.0	··• <b>•</b>	·-•	۰.	2	<i></i> .	۰.	•.•	•••			<b>r</b>	···	A -
5	~1	».	4	~1			١.	2	·••	c	÷ /	~		~	/11 .30
. 28	.**	<b>.</b>	λ <b>η</b> ,	e,	ĸ	/6L	121		÷	T, 2	•	vur.	<u>.</u> .,	<u></u>	49
•••	Π-	۰.	;;	11.	۰.۰	~	··	.;	· •	1	••	۰.	 	••	

-:-: IL TUNE

nya Teor na manaka kana kata kata kata kata kata kata
ing the loss for the size due that is, the the start of the start of the start of the start of the start of the
n a Ngala ing kanalar na na manaka ka na ka na da da da da na na na na Residu - Residu - Res
$-7$ is the $\gamma_{\rm e}$ , we can be a finite set of $\gamma_{\rm e}$ , as the $\gamma_{\rm e}$ , and the $\gamma_{\rm e}$ , as the $\gamma_{\rm e}$
and with the the weight of the set of the the test of the
The Ball Street was a set of a street of the street of
(a) die bye Argonasi Angonasi aya bas ber an was Tup bas ana Awa 20
ing the first backward in the second states in the second states and the second states and the second states and the second states are second states and the second states are second states a
nya Balan ing Kapita na Kabupatén Pangalan ng Kabupatén Pangalan 1995 - Pangalan Pangalan Pangalan Pangalan Pangalan Pangalan Pangalan Pangalan Pangalan Pangalan Pangalan Panga
Anno ada ayo ayo ang ang ang ayo ang aka aka ang ayo ayo ayo ayo ayo ayo Ayo
are explored on the particular on the test from the second s
(2) A set of the state of the State of th
And the set was and the support of the set o
The distribution of the providence of the second s second second s second second seco second second sec
a Alexandre in Second Decision and the second second second second second second second second second second se
an da ser en ete de las de las las las las las de las de las de las de las de las de las de las de las de las d
The Two is a visit of the two is a visit of two is a visi
<pre>iss dist And the last the Del that Ale like by the task they find that the set of t</pre>
این داده در در دو بروی به این این این این این این ورد. این این در در این این این این این این این این این این
Norther Content of Content of State of State of State of State 1975
NOR THE REPORTED BY THE AND THE ARE AND THE ORDER.
Mar was the second second second second second second second second second second second second second second s New York Second second second second second second second second second second second second second second second
(a) All and a start of the s
Ale car, leas with boar and least over the car, all list with the last of the car.
na se la propio de se composi a sub marca de Tra

-could rung

ALE ONE HELE AND AND TOY FRIT ANY LANS OVER LANS ONE. The second state of the second s
<ul> <li>All Andrew State Taylor and Taylor Andrew State Taylor and Taylor Andrew State</li> <li>Base State State State State</li> </ul>
Lie allow the leaf why by the theo they Val are did they and they 1177 - 177 - 177 - 177 - 177
<pre>condition and the second of the second</pre>
and and an end of the set of the
(1) The second s
ESE Los Los Los Contra de Este
and the wey and we were than the wey bad den the set the
The second second second second second second second second second second second second second second second s
1975 - Line Line Line Line Line Line Line Line
and and an an an an an an an an an an an an an
1916 – Vik II. S. De Carlo de Cardo
Dee yes of the second sec
Firstler (a) Sterior and A. Ling on Hold Constraints and the Transmission of the State of the
1978 1979 - Collogi Collogi Angeler (Collogi Collogi Collogi Collogi 1978 - Collogi Collogi Collogi Collogi Collogi Collogi Collogi Collogi Collogi Collogi Collogi Collogi Collogi
<pre>big ter ter ter ter ter ter ter ter ter ter</pre>
ye war fille in die Staar Verster ander fan Verster Berline. Berlin
ang bar ang ang ang ang bar bar bar bar ang ang ang ang ang ang ang ang ang ang
The Tank Chine Mind (1999) And The Mark Chine Mark Chine Mark Bank Later Later Later
and the second
nya dalah siya dalam yana sina kata dalam sina dalam ya dag Baya
Anna May Ang Ang Ang Ang Ang Ang Ang Ang Ang Ang
na ang ting tang ang tang tang tang tang tang tan
NATE OF A REPORT OF A REPORT OF A REPORT

-:-:ul. \_uws

1.41 0.50 by Let we are not the subject when are one the weight  $\lambda_{\rm eff}$  , and the one is the set The March Performance Provide Technology and a start of the Start provide BLN Control Colling Start Provide St 7 A March 1997, And Sympositive and Annual Astronomy and the state of the second se (a) any control of the first state of the second state of the s C. A.M. A. BARTS, F. THARTAN, W. BRUCK, M. C. AND STRUCTURE STR -->> • Mg 200 000 1-3 5 2122 - 1822 - 1823 2811 - 1877 - 1977 Compared Tubble (1997)
 Compared Tubble (1997) CARL AND A CARLEN AND A PARTY AND A CARLEN A ander beinderen Better Lander beinen der Staten Die Stehender der Beiter beiter der Staten der Staten im Staten im Staten der Staten der Staten der Staten der .......... The walk was all and the set and way have yet with any and was any and the star of a size  $\mathcal{L}_{p}$  , the star of the star of the star of the star star  $\mathcal{L}_{p}$ (a) All And the set of the set Territoria (Narray Participal) (1997) An Archivelle Victoria (2017) An Archivelle (2017) (2017) An Archivelle (2017) (2017) An Archivelle (2017) ( (a) The Star Star The Data Base The Star Star Web The Free Test Test The Star Star Star Star a. Hurber of Antonio Mathematical Theory and Antonio Technology (1997). LER TER CAL THE MARK ANY WALLARD ALS ADD CAL BY HAR AND ANY ANY 124 LER DRE NAS LAN WAR HER OVER LER LER WAR DRY WAR HER MAN NA (a) Charles Territor for the Theory Theorem Standard Charles And Net 148 An Martin , Anna Hailling I. The Bank All Anna Anglian Kan Alla Martin Laboration and All Anna Anglian Kan Alla AND THE REPORT OF THE ADDRESS FOR ADDRESS FOR USE THE SECOND. 

Thy Give I. In the Disc. The California of The Teacher Teachy Association 2227 - California Disc. Sec. 2000 and die Roe was die beelfen fen dag dat die voe die Roo and die 1997 - 1997 - 1997 na an tao tao tao tao tao 12 Martina tao 12 Martina tao 12 Martina 12 Martina 12 Martina 12 Martina 12 Martina 12 Martina 12 Martina 12 Martina 12 Martina 12 Martina 12 Martina 12 24 Martine 11, The Law 2004 (are back on the Annual Octave) 10 The off the life the the rest we have been any one the life and Ver miller free free free free free de la state de Juiz de la state de la state de la state de la state de la state de la state de la state de la state de la state aya diy baa yea awa awa yek ûye yea dia daa aasaa aasaa aa daa daa Tara (a) and (b) and (c) are seen as the set of a Anno 1996 Anno 1997 ann dhe ann an Anno 1997 Anno 1997 Anno 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 all the set of the local set of the set o Construction of the second se second sec na da ser en ante de la companya de la companya de la companya de la companya de la companya de la companya de Na ser en ante de la companya de la companya de la companya de la companya de la companya de la companya de la c 7 A. Walter and M. K. Marketta and M. S. Kanada and M. Marketta 1999 April 1997 April 25 04 041 (1997) 241 244 444 (1977) 244 244 (1977) 247 (19777) 247 (1977) 247 (1977) 247 (1977) and that for any distance the  $T_{1}$  , the symmetry  $dI_{2}$  , the distance  $dI_{2}$  , the distance  $dI_{2}$ and any first one sets and are and for any first one set offer the set of Thy Charles The Charles March 2010 Feedback and the Charles Allowed State of the Charles Allowed Sta ang lan lab ala ang kalinan lat bir ang kalinan kat bir ang kalinan. Ang FOR OWN AND ALL MADE LIFE MAY BUY ANY OLD THE WARE LED THE THE ALL LED THE ALL ALL LED THE ALL THE ALL LED THE 

<sup>-:-:</sup>ul. TUNE

-could rung

A03 (35	аI (	L4.	1.13	נרו	<u>:</u> ::	<i>c</i>	ALC:	111	-35	22	•	-63	A41	A.6	:9	
<b>7</b> 1	.111			141	• •	•••	2	- •	22	••••	<b>7</b> 1	<b>.</b> .	-	20	dis.	
	-	<b></b> .		.пг		<u>.</u>		:::	4.	-	Any		<u>a</u> .		~	
•**			•••1		<b>.</b>	-	:::	•-	÷	•••	•-	.:	- · -		<i></i>	
	 	÷.		•••	۰.	2	<i></i>	• •	••	۱	ī.;	••	r٠		a٠	
13	-C.1	141	ı.ı <b>b</b>	345	1	-r-	лл	-75		÷	<b>.</b> .:	-**	1	• •-	аņ	
		···	•••		•	24	r ,	<b>r-</b> -	2	τ	-•••	сı,		10	<u>^.</u>	
$\phi$	Π	:.	5.	11.	۰	÷	·	•.•	••••	۱.	÷,,	÷.,	: -	٩.,	<i>.</i>	
	7,2	44	• 14	w.	<b>~</b> -:	181	\$2	<b>8</b> 43		ы.	-79	<u></u>	<u>~</u> -r	-:•		
		···	· · •	~-	•••		<b>1</b> . ·		••••	<del>.</del>	33	~.		<b>~</b> ·	·	
•==	. <b>.</b>	L	•••	~	-:•	-•-	T: -		a	. <u>.</u> -		J6.	L; L		5	
•••	a.	•-	~.	::::		-54		•••	j.		-,		·	2	n2	
٠,	an.	۰.	2	54	•.	·	~•	2	4	541	21		ι.	<b>`</b>		
•	-	<i>,</i> ::	•••		<b>.</b>	4-1	e.			,		÷	•-	<b>.</b>	шu	
27	сц.	۰.۰	•••	÷.,	•••	· . 	·	•••	•.•	~	 	τι.	ŀ	···	ы.	
		۰.	÷ ,	:::•	:	÷	:: <b>.</b>	·· .	м.		- •	<i>.</i> •	٠.		25	
-79	+11	.*:	•	<u>.</u>	.46	٨Ð	лаг.	<b>8</b> 43	:3	ж.	A03	20 <b>4</b>	L4 ·	Arg Ng	wc	
۰.,	<b>~</b> .		Ъ,	÷.,	••	•••	·•••	22	41	••	-,,	~,	 	$\cdot \phi$		
•-•	• •	<u>.</u>		<u>م</u> ا.	:	20	÷;	2	•:1	÷.,	÷ ,		:	•••		
•••	3	•-	•••		.,	1						÷	•		<i></i>	
$\mathbb{R}^{2}$	۳v	۰.	91	<del>.</del>	::	·0	24	<b>r</b> .	4			di.		97	21	
		•	•		.,	-14		•••	ç,	··-	••		·	2		
	<u>.</u> ۱.	ı.		.56	,	<i>.</i> .	24	r, 94-	4	<i>.</i>	y,	<i>.</i>	с. 192		ч. I	
-:-	ـد.	ŀ-•		п_	<b>.</b>	s.,										-
•••		,		ı				,-			-,			•••1		
.,	сь сь		۰.											·	r	

-coult runs

6435	-2.5	22.2
A69 . CL - 242 V.C. T(C. L. 1417	in and the line way to	a line was was and They
6	n tha con Sin Galle Than	e nasional contra da la sub- contra da contra da c
in a star in the Argon. And	e ter da ve da . Tr	r Kari Ali, 24 (46) 174
and the second sec	- 19	n an an an An
аларын түүлэг т Шуу	e Maria di Sana Tajar Sana	n Allan San San San San Tanàn
Alle Alle. Des Alle age a. 1997	e van de la calendaria. Nationalista	
in one sin one or an 1955		e esta de la secola de la se
NAME OF STREET	ten di statute. 1995	Type The Constant Sector
the same way by a grant 1977	a ang ing ing ing the state of the second second second second second second second second second second second	one an an an
en e su de la companya de la companya de la companya de la companya de la companya de la companya de la company La companya de la comp	a na shekarara Tan	1211 - 121 - 111 - 601 1440 -
A set the set of a set of a set of the set o	. Sec. 2014 - 1000 - 1 199	2010 - 12 20 A. 2010
Type New York Live May only at	n lan ling an an air Tha	аныр нарынатуу Түрү
NAME AND AND A DATE	All Contractions Lat	n The Call Viel 106 Gale
د دیک درد مید ایران معد ا	an an an an an an an an an an an an an a	. Any 1910 And 1111 A N
ne aktor and far any so ICAs	na (n. 1577) ya 4774. 188	n yn ord an olo. De
Type Charles The Congress of Back	en en verser Se	1911 - 1917 - 1917 - 1917 1927 - 1917 - 1917 - 1917 - 1917 - 1917 - 1917 - 1917 - 1917 - 1917 - 1917 - 1917 - 1917 - 1917 - 1917 - 1917 -
ana sala ing dan ama a. Taon		e 122 Aug 1999
na presidente da la compositione de la compositione	n filo for en filo i Ver	111, 714 144 GH
and a star water of a	ion sa nam a P	· <i></i>
The rest from the rest of the	o yan aya tersel, a Tay	a ann an sao ann 1999
CONTROL ON ANY CALL AND CALL A	e da ante de la ser de la ser de la ser de la ser de la ser de la ser de la ser de la ser de la ser de la ser La ser de la	AND ALL ALL OUL
1999 	and an an an an an an an an an an an an an	1.76 - 70 - 76 - 70- - 56 - 56 - 56 - 76 - 76 - 76 - 76 - 76
n ander og som Ander Lave	n den som en den so Lande	- Nacional Antonio La Calina
ang sala lag ayr san a a sa		ο πο .γε

\_

-could rung

The Two is the first
Charge and the Charge Charge Charge and Charles Type From Charge and the stage of the Stage of t
(1) A set of the se
See Annie Lyncker, Marine Station, Stationary and Annie Company. Annie The Annie Stationary and Stationary Annotae and Stationary and Stationary and Stationary and Stationary and Stationary and Stationary and Stationary Annotae and Stationary
and only leaf the out all left at the the left and the weight ${\rm M}_{\rm eff}$
Keen Mark, Anna Mark, Anna Mark, Mark Mark, Anna Ma Anna Mark, Anna M Anna Mark, Anna
ing the sign for the Angline for the Typ bas for the system, and the set of t
tera and the year's terms in the second second second second second second second second second second second s
Tye Twent Control Bell Tomor Strand Stran
leasted and declare the disk of your and and declare the system. Here
Here we want of the second sec
Bendage et d'al de Charles d'anne d'anne d'arte d'arte d'arte d'arte d'arte d'arte d'arte d'arte d'arte d'arte 1990 - 1990 - 1990 - 1999
A DE VALO, FRE A POLITICE POLITICE AND A BUILDER LEVE AND THE LEVE AND THE LEVE
Type 10.1 And Type 201 And 101 And
Frankling and the second state of the secon
Varia, 2002 de la la Cale - Leisue - Leis Varia, Tampi - Tam Cale - Marcines, Roma esperat Varia, ante - Roma esperat
A Line (An Arrows, Arrows) (A Line (Arrows), Arrows, Arrows (Arrows), Arrows (Arrows), Arrows (Arrows), Arrows (Arrows), Arrows (Arrows), Arrows (Arrows), Arrows, Ar Arrows, Arrows, Ar
A DOMESTIC AND A DOMESTICA AND A DOMEST
<ul> <li>All a consequencies de la sector y all el consequencies</li> </ul>
(a) The second system is not size in the size in the second second size.
NAMER CONTRACTOR AND A STREET AND A STREET AND AND A STREET AND A ST
Any discrimination is the implicit discrimination of the set of $\mathcal{A}_{i}$
ing after the second the try we want strike the activation of the sec of the second to the second to the second to the second to the second to the second to the second to the second
$\tau$ y due to the due to the due to the $\pi$ -th or $\pi$ -th due to the due

-:-: II. TUNE

	41	
The over size the same set the set take	n ang san ang san Tre	1961 <u>- 19</u> ANG 1613
no de la contra o de sec se	1.070 85-100	taji mini kana di n Lit
ing with the Alexandrian second	· · · · · · ·	
<ul> <li>The series are set of the second secon</li></ul>	<u></u>	400 00 al 0 000 140
in a war war na stag in a na stag awa	- 1,0 - 1, a - 100 - 200	24 2 4 200 X 1
ные мар, ну стория мал настика. Эр	. <b></b>	And the standard
also also in the device of the The	and to see the	w 10 +
<ul> <li>A state of a state state state state</li> <li>A state state state state state</li> </ul>		An Children
NAME AND ADDRESS AND THE DAY	i nes constants constants	an an an an an
and the second sec	1	
And Table 11.		
<ul> <li>A production of the second seco</li></ul>		
<ul> <li>Andre State State (Sector State)</li> <li>Andre State State (Sector State)</li> <li>Andre State State (Sector State)</li> <li>Andre State)</li> <li>Andre State (Sector State)<td></td><td></td></li></ul>		
<pre>All and all and all all all all all all all all all al</pre>		 
<pre>&gt;</pre>		с- 1999 (тр. в) с. но 2010 (тр. с. р. с. с. 2010 (тр. с. р. с. р. с.)
<ul> <li>Andre Sterner Andre Sterner Scholer (1998)</li> <li>Andre Sterner Andre Sterner (1998)</li> <li>Andre Sterner (1998)</li></ul>	<ul> <li>Contraction of the second secon</li></ul>	
<pre>&gt;</pre>	<ul> <li>Company of the second se</li></ul>	an All go and all All go and all All and and all All and all a
<ul> <li>A state of the second</li></ul>	<ul> <li>The second strategy of the secon</li></ul>	
<ul> <li>Andre Galler Andre Saller and A</li></ul>		
<ul> <li>A the product of the left of the second se</li></ul>	<ul> <li>C. And A. A. A. A. A. A. A. A. A. A. A. A. A.</li></ul>	
<ul> <li>A second secon</li></ul>		<pre></pre>
<ul> <li>A constraints of the late of the second se</li></ul>	<ul> <li>C. And A. C. AND AND AND AND AND AND AND AND AND AND</li></ul>	<pre></pre>
<ul> <li>A set of the</li></ul>		<pre></pre>

## -:-:IL TUNE

T A ALE TO MANY THE THE TAXABLE THE THE SIX TO DO THE LAW SET OF A DATABASE AND A DATABASE AN and apply we doe that besides they have doe doe up to deal apply the first state of the second state. (a) See Ten Wei Ger Berning Ten Der Will Verlagen Armiten Syn 606 19 - Control State State State State an tartin Karda. Ali varies and the second 241 - 149 14 - 244 29 - 1 - 1719 - 171 cdus = WebCounce Robust Englished control Petrol Robust Englished control Petrol erden berrahan röcksamte dienen bilder berrahen. A DOM ANY CONTRACT OF All F. Charley F. Bark Sock a Park Sock Type Market System Association and the second system of the second system. also also any second of the description of the second sec second sec (2) On A state of the Algorithm A state of The only with the sets of the set we are the set we the set  $\mathcal{M}_{1}$  $(1)_{ij} = (1)_{ij}  (1.20) C. Markey, J. Carker-O. 1970 Area a region in (a) when the frequencies of the set of th September 2. A state of a feature of a fe and Tap the And the set way the and the the type The Lyb And Lab. 1971 - 1971 - 1971 - 1971 - 1971 - 1971 - 1971 - 1971 - 1971 and one of all opportunity the opportunity of the opportunity of the second state of t The Case of the Case of the Table of the Case of th Ken Des Lies and Conference (Conference) and Conference ye av i Carlandi, Sirka ferieriye Varieri Civ 200 200 200 200 And An Annal and Annal annal and Annal annal and Annal and Annal and Annal and Annal a 28 YO MERSON DOWN AND AND AND A DESIGN OF A

(3) Constraint Month and Constraint States, 2010; 176-33-20, 2010; 20 And ARER-ARE SAMPLE BY THE CASE IN THE SAME AND A DESCRIPTION CORPORATION OF The area and any other and the area blocking. The area was been used for (a) the process of the set for the set of The Shell is the September September 2, The Section Constant Section 2, and a section 3. and the way any way way and the ang only line any and line and way way Constraints, Martineau Albar, Capital Capital Constraints (Capital Capital Capit Capital Ca ANY THE LEE WAR AND LEA HER DAY, ONE HER THE LEA WAR AND AND THE Kee May Die Ten 11: Kee Mai Ten Kee Die Wei der Ver Ver Ver Ver Lauf das das LL (a) Mad Let use MB; whe first have trye field Made by the Sold wave size and the second se Verify The Track Track County Coun where the first the the star disc the star the star in the star  $\pi_{\rm eff}$ The same the Weight is the structure of the structure structure of the (a) The Annual A Any map and and the less the tap and that and and the less and tap and the tap and tap and tap and the tap Constraints and the Annual State of the S (a) set of the set See Alg. D. S. See Rev. For W. Harris, K. S. S. See Rev. Lett. An above: 200 (200). na to she she also also na secolar ing se she sel farana na also NG 1.5 September 2. Sector 1. Sector 2. (a) All the line and the set of a set of the set of a test of the March and the March March Part of the March

<sup>-:-:</sup>II. TUNE

-could rune

	• •					• • •									
AR) 195	-**-	~`	AR.	:*:	÷.	·:=	-up		-22	<b>7</b> 5	•	~>	L.?.7	λ <b>η</b> ,	÷.
•		···	•••	22	•	•••	<b>~</b>	••	49 54-	••	•••		<i>~</i>	2	
•	/ I.	••	23	·	••	<b>`</b> '''	41		•••	å .	~	<i></i>	22		16.
•••		5		·1·			4			w ·	•-	÷,	•••	<b></b>	4
• •	21	r	·	~'	•	١.,	۰.	r		<b>.</b> .	33	Ŧ	÷	<b>`</b> '	
	-	<u>~-</u> .	۰. <u>.</u>	. <b></b> .	÷.	<u>(*</u>	J			÷	∴ <b>.</b> ,	u.	×		**
•••1	**··	•••	•*•	2	'	<b>.</b>	•••			•••	~ 7	<del>.</del>	·	1	<b>-</b> T.
• •	۸١.		<u></u>	<i>.</i> ,	-	71	<del>.</del> .	!:	••	<b>.</b> .	•••	.111			·. I
•	4a	ţ:	A19	-C.A	L4J	лт <u>э</u>	÷;		-27	22	•	<u>.</u> Ц	~`	AR.	+LI
•••	2	1.0		. <del></del> .	• •	2:	711	••	20	<i>.</i> <del>.</del> .	25	~.	-•••	70	π-
.:	Λι	<i>^</i> .	- •	11.	۰	e.	÷ -	-•	••	<b>n</b> 		( <b>1</b> ,	۰.	÷ /	
•	47		-143	<u>.</u>	143	, ro	1-1	-75	<u></u>	π÷	A03	. ц	L.?	ä	AIT.
• •	·: 1	-	20	•••	•	1	<i>.</i>	2.		2	21	·: 1			
<b>.</b>		;-:	•-•	<i></i>	L: L	٨	<b>5</b> 7	L.,	л <b>ь</b> .	•	•	÷.,	<u>~-</u> .		T,
••	181 17.	·		• 1-		2			-1.	~		•1	••		
2			70		ζ,.	9	•~•	۰.		2.		·: 1		•••	-11- - 7-
r	u.	L: L	۰. <u>.</u>	<b>;::;</b>	L: L	<b>-</b>		۰	3	-	<b>.</b>		×	343	ш,
•,	17.	••		7 <b>1</b> -	•••	~	<del>.</del>		·	<del>.</del>	•••	٠.	2.2	9	51
779	<b>T</b> 1'	; -	~		• •	•	<u>.</u>	••	••		÷ •	a,	<i>*</i> .	- •	-:11
•	:2	~`	-+:	da.	- **	3	÷.		-97	202	43	лīр	1.5-1	- 63	.**
1		.**	- 143	***		~~	лаг.		~F.	ŗ	- 143	æ7	197	7 <b>8</b> :	H#7
•••	<b>I</b> 1.		···	<u>.</u>	•••	<i>.</i> 0	711	••	20	<del></del> .	••	T··-	···	12	ч.
•	τ.	۰	2	а <sub>1</sub>		۰.>	:: <b>.</b>	12	<u>،</u> ۱	۰,		<i></i>	5	•••	·>.
<b>.</b> .;	wr.	÷	.er		~•			-25	ALL	~-•	<b>r</b>	ч <b>ч</b> .	~?	-141	лар
·· ,	2		···,	<i>.</i>	•••	20	<i></i> .		··••		35	сь	۰.۰	•••	π-

-:-inf. Thes

The Design Constraint Constraints (Constraints) and the Design Constraints) and the Constraint Constraints (Constraints) and the Constraints) and the Constraints (Constraints) and the Constraints) and the Constraints (Constraints) and the Constraints) and the Constraints (Constraints) and the Constraints) and the Constraints (Constraints) and the Constraints) and the Constraints (Constraints) and the Constraints) and the Constraints (Constraints) and the Constraints) and the Constraints (Constraints) and the Constraints) and the Constraints (Constraints) and the Constraints) and the Constraints (Constraints) and the Constraints) and the Constraints (Constraints) and the Constraints) and the The Heri Far Les and the Num Tap For the last and Val Ser 1,1 May 1977 - 317 - 317 The first of a straight of the (a) Apply the state of the state of the Charles of Tapping Tapping Tapping and the state of t Construction From The Decision Construction of the Characterization of the Theory Theory allows and the Characterization of the Characterizatio of the Characterization of the Characterization of Ang Mad Bar, ang ang bag din ama Pan Pan Muk lung nup num ama din 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -(a) and (b) and (c) T y The A - Territory T + T + T + T + Territory T + Obstant - Territory ( δ<sub>1</sub>, δ<sub>2</sub>), δ<sub>2</sub>, δ<sub>2</sub>, δ<sub>2</sub>, δ<sub>2</sub>, δ<sub>3</sub>, and offer and fighted the fact that the second second second second second second second second second second s The second second second second second second second second second second second second second second second sec A DE LANG LANG LANG LANG AND ALL AND ALL LANG AND ALL ALL AND A (a) An Ali Mar See Mar Val Wall, for See 19, Her Mar The Wall Sea 2002 100 100 100 (a) an a star profile for a Theorem 5 and the de-terminant of the star star star star. The The last dynamic and the two the base for the and The set of the set o The same spin compared spin the families that the same same default of the same spin the same same set. The Control of the Builds that the last real ball was been added as a set was been able to be a set. (a) The second s second secon second sec LEN LAND THE ALL VIEW ALL LIFE AND A POINT AND ALL THE ALL LIFE LIFE LIFE LIFE 11/2

T y Alis T, Type A., The Alis T, Type State T, The Alis State S The residue the size dig type Aug Van die dig the Aug file (1997) 110 (1997) 210 2003 1800 10 BC 30 2010 1900 10 10 10 (2.2) TARE SIDE VERSION DEPENDENCES (1997) ander anderen ander en bester det i Konne bester en somer sind bester ander bester bester anderen anderen bester bester bester bester bester bester CORE DECEMBER 2010 LELE DECEMBER 1 .......... the man not the fact that the the the week of the most we that we had not The file for the factor for the fact the distingting the try MeV bys the last the top bys whe tap The structure by the unit ungestion the unset the long optimized in the end of the structure of the structure structure structure structures and the structure structure structure structures C. A. NAR, M. M. S. M. Mark, "And Solid Type Control of the System State State State State of the State S where the large Que has the The has been the set of the two the set of the  $10^{-1}$ (a) Apple (a) Barris (A) Types (b) Constraints (Constraints) (Constraints) (Constraints) (An intervention of the weater the second starting that is a second starting the second starting starting that is a second starting sta The THE CONSTRUCTED VIEW STATE OF A SHORE THE VIEW SHOP we first the second system to grave the first and all one and all and in the local set and and in the set. The second se Халар Саламан Салтар Калара Саламан Алатар 100 — 200 — 210 — 216 — 216 — 216 (c) define any off of the off of the second seco n kwa wa na bijini interwa kao na wa kao na wa kao na na wa

1	200	4.5
ADD ADD ICH ADD AC.	HER TRANSPORTATION	- LEW SETS AND LEWS AND - NAME
n an an an an Araban. 222		2017 - 101 - 100 201
ang dia 2 gi tan Mg	(1,0,0,1,0,1,0,1,0,1,0,1,0,1,0,1,0,1,0,1	A CARACTER AND A CARACTER
an an an an an an		· · · · · · · · · · · · · · · · · · ·
a secondaria da secondaria. No	en de avere en en av	The College States
ann Tha Call Mar Labo Ann Ann	212 (212 112 - 21 122 123) 171	and the day die der
and the first second	190 - 190 - 190 - 190 - 190 - 190 - 190 - 190 - 190 - 190 - 190 - 190 - 190 - 190 - 190 - 190 - 190 - 190 - 190	10
	e de la companya de la companya de la companya de la companya de la companya de la companya de la companya de l Belan	Na an Alina an Anna Na
tar ang sa tag sa Tar	ALE ANY AIR AS: 104 AL 457	- No. 200, AND AND HAD
1 (A - 1) (Com) 144	ter to velocito a sit	The The Local You Wall
e a contra contra da servica a contra da servica da	·····	and a second second second second second second second second second second second second second second second s
ana ang ang ang ang Si	ANC - ANC - 314 - 125 - 141 - 347 475	an in an an ga
September 2017 September 2017	el avenue en el avenue. Sec	$(\gamma_{1},\gamma_{2},\tau_{1})\in V_{1},  \tau_{1}\in T_{1},  (d,r)\in T_{2},
ан .32 Ал, бы 390 733		n aya dan gun ang Yad Mar
······	1-1 1-4 1'4 1-1	e de la compañía. En
September 200 Also 200	en transformation a la companya de la companya de la companya de la companya de la companya de la companya de l Nova	an na h-syrmet Wa
	115 J.	ан, тор бак ан, 14 <del>4</del> Об
	ina na manga wa mi wa	ang na tao ng sa Na
and the second	en se de quise :	and the second s
NN 121 221 221 224	194 (14 202 143 ALL 24 477	The second second
AND ONE OF LEADING	THE PERSON AND ALL UN	ing the style second
an an an an an an an an an an an an an a	in the second second second second second second second second second second second second second second second	
and a state of the second second second second second second second second second second second second second s	l,= e ∧y t – ke =. 	
ARE DEPICT OF AD	ter on the state of the	- сиз атр кар сум авт. Т
1179-12 171-1 179	ay an an an an an ar Ann	114 GH 744 7 4 GH

-	:	·:nl.	

n environ e construction de la construction de la construction de la construction de la construction de la cons La construction de la construction d
where we are the data the day that has defined as the tag has the Hermitian $\pi_{1,2}$
(a) The transformed probability of the transformed to the Maximum Maximum State
(17) The Control Control All Age in the Lynchronian Sector (19) 100 (19) (19) (19) (19) (19) (19) (19) (19)
soy our les per ser des contras des aux des aux des dis les aux tex
(1) The distribution of the state of the distribution of the state
الدي هذه المراجعة المعالية المراجعة المراجعة المراجعة المراجعة المراجعة المراجعة المراجعة المراجعة المراجعة ال المراجعة
And the second sec
n kana ali na yata na kata na kata na kata yata na kata. Davida shaka kata kata kata kata kata kata kata
Are tap the Ang dde Ang the Ave any the Max ang The Sec and tap $e^{i\omega t}$
all sufficiency the set are the set of the barrier the state of the affect decision of the set o
ande van de Lander van Systemet Franker, for tij Ver
ang titu kun sisi sigi bas kup ban keci sisi kun tika ang tita kan sisi 2000 - Kan
nay na interna y zaviena na interna na internativa van na internativa. Naviena internativa internativa internativa internativa.
$\tau > \pi$ , so that $\pi \to \pi^+$ , the $\pi^+$ -by-state $\pi^+$ , we derive the test $\tau$ .
and the first of the second state of the first second state of the
N A GERVENT Y MENTER A DESTRUCTION AND A DESTRUC
and the spectrum and the the transformation was been assumed as $2\pi^{-1}$
no una pendio de notare de terrer os tepulos (y un Por se secondo de terrer de terrer de terrer de terrer de terrer de terrer de terrer de terrer de terrer de ter
nya walio walio walio walio walio walio walio walio walio walio walio walio walio walio walio walio walio walio Mali walio walio walio walio walio walio walio walio walio walio walio walio walio walio walio walio walio walio
жаўцына наріана куралаўскага саліста наріону цумінан ора Бара — — — — — — — — — — — — — — — — — —
(1) All the set of
(1994) A. San Andrya Gharibian and S. Shakara S. C. San Awara 1996 (1994) Anna San Angela San Ang Angela San Angela S Angela San Angela San Ang Angela San Angela San An Angela San Angela San Ang Angela San Angela San
LER THE TER OVER ALL ALL AVER AND ALL AND ALL AND THE AND ALL AND THE AND ALL AND A
Markovski stani protoko i tekstoval zakona zakona zakona zakona zakona zakona zakona zakona zakona zakona z teksto zakona zakona zakona zakona zakona zakona zakona zakona zakona zakona zakona zakona zakona zakona zakona z teksto zakona zakon zakona zakona z kona zakona r>zakona zakona z kona zakona z kona zakona r>zakona zakona zako

LEN ANY THE REPORT AND ANY ANY ANY ANY ANY ANY ANY ANY ANY ANY
Mar Mar Mar Mar Mar Mar Mar Mar Mar Mar
aya ama kan Ala Ala kan Kan Ala Til Kan Ala Ila Kan Ang ama 1915 - 192
Hereite and the second se
n a tao ang ang ang ang ang ang ang ang ang ang
ANY TRU AND LET AND LED AND LED AND LED ALL ALL ANY TRU 1977 - 1977 - 1977 - 197
Bay Description of a first Value of a
Fig. 212 (Construction of the construction
The second version of the second second second second second second second second second second second second s The second s
<ul> <li>A state of the second</li></ul>
AND A CROME TO US
e en transforma y e transforma de la companya de la En la companya de la companya de la companya de la companya de la companya de la companya de la companya de la c
A second second system in the first second s
and war ben any wap and was the the and and and and and and and and and and
(1) The first stry for the log of a first standard strategies. (4)
na Marka, Karibbelo y Sandaji ya selitu ya Witi na marka M
and and any set of the other and an all a set of the se
na presidente de la construction de la construction de la construction de la construction de la construction de La construction de la construction d
and see the second second second to be set on the second second second second second second second second second
nya wala kacha Alson a kacha nya walaki nya Alson a kacha kacha De
na Tha San Ang ang nga Keb Seo Ang Ang Ang Alan ang Keb ang Lan ang kab
and any set in the set of an and the set of
VERSE A DATE OF A DESCRIPTION OF A DESCRIPTION

-could rune

			-27					-27					-··		
- <i>:</i> r	лιр	<b>:</b> ;;	• •-	÷	1.֥	.127	\$7		vr.	w.;		:2	A41	<b>.</b> .:	.u
۰.,	12		• •	٦ŀ		<u>.</u>	π·	••	·	~	33)	··. 1	<i>~</i>	·· (	м.
:::	ð ir	٠,	÷ ,	·	·:-	••	۰,	•••	··•.	4	÷ •	~	۰. ۰	••	11
•••	1		<b>`</b> **		<b>.</b>	·~	•••	~*	æ		<i>.</i>		••-	•** >***	4
		r	22			••	۰.	5	•••	<b>74</b> -	••	ch,	22	·0	а÷
•		5:	-••		·•-	<u>~</u>	\$2		<b>-</b>	ч:	•••			<b></b>	
•••1	-::	•••	•-		• ·-	.0	•••	•-•	-1.						
;;;	<b>ч</b> ,		۰.	.a.s.		•••	<i>a</i> .	۰.	۰.	<u>.</u>	<b>9</b> .	••	ı	•••	сь .ас
A03	wc	<b>4</b> 40	• 14	::;	-:•=	A.L	1 <b>4</b> -		:5	22		<b></b>	149	- 	.u
•••	¥1.		2	·-•	•••	~,	~~	5.5	··••	÷••	••	. <u>.</u>	1 225	•••	··. 1
••	··- 1	<b>5.</b> 1	÷ ,		• 、	٠.>	".:	• •	. •	١.	••••	÷.	۰.	•••	16.
.+r	ų	***	• R	~ <b>1</b> ~		<u>جې</u>	~*	- • -	<b>.</b> *.	ч.		T.12	AL 1	A.6	-96
2	<b>.</b>	÷ .	<b>`</b>	4	 382	$\overline{c}$	54	• •		л. П		<b>~</b> .,	·	<b>`</b>	AL. 350
<b>,</b>	~	×	۰ <b>_</b> ,	6;		a	<i></i>		aly N	- <b>-</b> •	∴ey	~	<b></b>	:-ų	-
••	л,	·	5	• ••	•••	-11			Ŷ		<i>.</i>	20		•••	<b>w</b> -
	a٠	5	•••	11.	·	•••	14.1 141	••	•••	<i>a</i> .	• •	T	•	·0	·. i
1	÷	۰	۰ <b>_</b> .	С, 4	<u>.</u>	4.EE	J-8	۰	•		13	т. L	×-:	×	-
1	••		•••	7 <b>1</b> .	 1-2	÷٠	1		•••	2	•	·: 1	···	•••	21
	Π	•	••	22		~	۰.	• •		·	.,	τ.	••	:	T I'
.+ <b>r</b>	а (	An;	58: 535	:*:		/60	~*	뜏	<b>.</b> *.	~-•	-79	.ıLı			-96
79	~>		'n	<b></b> +*.	-25	A.L	÷	- 6-	-14	5	A41	-7	L?*	-143	лір
• •	22		• ••	11.		÷.		-•••	· •	•••	23		۰.	۰.	<b>т</b> ק.
20	•:1•	».	÷ /	·		.,	Ŧ	•	ŀ	<u>.</u> .	·-•	4	•	~	n.
A-6	.u		r	:w::	м	.127	×:	•	- <b>!</b> †	~ <u>-</u> 2	.:r		m;	-M3	~>
-•••	Ŧ· -	(s.)	20			·0	<del></del> .	 110	•••	··	-, ·	~•	•••	•••	

-could rune

	~			<del>.</del>	•.	••	<b>n</b> 	-	•••	2		сь . Л	r٠	·0	<b>.</b> .
-/-	P	(_r				ŶΫ	- <b>.</b> .	-/•	3-2	ч.	55		h		wш
20	51		<u>'</u> 0	·-•	2:0	····	<i></i> .	••	-1	1'. 717	• •	т	ŀ	•••	22
0	-05	•	<b>'</b> 1-1			۰.	-•		17	·	<i>.</i> •	< 1.	: -	.::	Π
A0)	л <i>+</i>	141	- M3 - KN	~ <b>1</b> *	143	~	44	12	٨D	1-1	1.U	1 64	50	-143	wc
۰.	<b>.</b> a.	12	• •	·-•	•	•••	 	•	·	τ.,	···	22	ŀ	·· 7	a,
••-	<b>دد</b> .	L	-•-	·ш.	<b>-</b> -:	<u></u>	h_ 1	<b>.</b>	-14	·	::;	H <b>.</b> .	·:•		ш.
••••	**…	•••	•••	••	<del>ا</del> ت				$\sim$		~*		•-	77	
• •	21	÷ .	9		•••	10		•	1	۱	• •	ch.	-	3	-~•
	H <del>.</del> .	<b></b> .	;;	ha s	-:•	4-1		÷		T: -	-••	JL,	\$:	••-	<b>~</b>
•••		2	•••1	·1·	•••	<b>.</b>		**	١v	w ·	**		•••	•'``	<b></b> -
•		· .	••	Π		÷.;	-•	•	-::	:: -	:,;	-:1-	>.	••	~
::; ;;;	π≟	F24	λ <b>η</b> ,	A :	븘	-77	u.e	-::	-1+	¢.;	A43	1 64	m;	• 14	an Vi
۰.	~•	ŀ	•••	.774 154	<b>r</b> · ·	••••	<del>.</del>	<b>r</b> . ·	ан Ак	<b>.</b>	-1			2	51
••	•••	•	.::	Π		<b>«</b> .•	~	•7	•••	١.	÷ ,	-05	••	•	/1 <b>.</b>
	<i>.</i>	à	<b>.</b>	.a.,	••			•••	-1.		•-		•-	••	**
y.	as as			.a.v.	-	γ.,	<i></i>	•	۰۱.	<i>.</i>		ch.	۰.	<b>`</b>	66 6
ŝ	ш,	۰	•••	.пг	÷.	<b>-</b>	.т.	<b>-</b> -?	<b></b>	2		<b>r</b>	(_r	-••	₩
~ 1	ı <b>n</b>	••	•••		••		" v	-	÷	•••	•••			2	.4.
••	<b>~</b> .,	r	7,7		•		24	٢.	4	<del>.</del> .	• •	dis.	; ;	٠.	GD
A43	w:.	624 2	•	ιc.	•==	• **	π1 >10	r.i.e	~15	π÷	.HT	200 200	.22	a.20	+LI
-••	0		• • •	<i></i>	•-	 	<b>~</b>	••	•••	r ·				·· /	<u></u>
	·:I·		••	164			-•		•••	:: (••,	~	-05	••	•	-::-
. 28	w:.	<b>6</b> 2.7	-::•	202 200	:	.v.	лл		чњ 4.5	π÷	-97	AL).	A41	::	æ.;
,	Π-			<b>. 1</b> .	•••	·	c.,	12	·	<i>.</i>	••	т	22	-0	· .

-	:	-: 11	1.		•	
---	---	-------	----	--	---	--

-could ruse
ANY NET AND UTS LOTS AND ALL THEY LAND LOT AND ALL THEY ALL THEY ANY NET ANY LOTS
n y fan de la constante de la constante de la constante fuerte de la constante de la constante de la constante Ballio de la constante de la constante de la constante de la constante de la constante de la constante de la co
and new one can be any up to be and day for the fact the cycloter and the second second second second second second second second second second second second second second second
ang san lin a sa na sa
na shekara ta shekara ta shekara ta shekara ya bayan 1999 - Davis Santa Santa Santa Santa
DYE 134 THE OLY LAR THE YELF HER LAR MAR ALL LYE LAR LAR LAR LAR LAR LAR LAR LAR LAR LAR
nya Manana ang ing ing ing ing ing ing ing ing ing i
ya Manana Aleksi ya kata 200 Mantu kata 200 Aleksi kata 200 Manana
una se y luce ale lans and lans her sin loga bas byr lad new loga 1919
The Mar Mar Tel Mar Mar I of The Constant of Station State Tel Tel Tel Late
en die verlage die die die die die die bester die die die die die die die die die die
Na Lie and Yerlang Walangson for the Lie Law was in Law 19-6 - I-B - 20
na na seu na seu na seu na seu na seu na seu na seu na seu na seu na seu na seu na seu na seu na seu na seu na Na seu na seu
aya ɗan teo daa aya biya ƙan ƙasi dagi ƙasi ƙiti ƙasi ɗan ɗan ƙasi 1977 - 1977 - 1977 - 1999
na mana ang kana ang Kana ang kana
7.2 An example 1.1 Control of a state of the control of the Con
Van Nel Ville Tol Nel 17 Note State State State
22 ( . TATE - TAT Adam - Mérici Leo, Koll, Egylen, 2000 - Merici Leonar and I. Calar
A ANN AN
A NYA ARGERITA AN
<ul> <li>The Discrete Address of the Control of the Control of Address of the Control of the Control of Co</li></ul>
and the set of the set
n y Ary Managara ang mangarang na kanang br>Tang mangarang na kanang na kana
ing and fair any the bye less for any the law the time ing the set of the set
na vitana na velite vezana ne la vezana ne vitana en vitan Statuta en vez
n e marte a nevel marte a presenta de la seconda

91

-:-:ul. -uwa

				**					11					67	
<b>.</b>	H#7	1	- <u>83</u>	ιc.	·**	A12	~*	175	<i>1</i> 279	-0	A*5	-**-	æ;		A.)
•,	a,	<u></u>	-•••		٠,	÷٠	т - 150	•••	· 1	٩·	•••	2	1.0	•••	~•
÷ ,	<u>:</u> ;;	: -	.,		: •	<b>'</b> ::	-•	• -	•	å .	.:	·.,	· .	÷~•	
.;	<b>н</b> .		••	• • •		-54				-	<i>.</i>	20		•-	147
		-	20	544 200	r.	1	r ,	• •	20	2	٠,	۸ı.	r	33	<b>3</b> 1
•	An.	<i>(</i> 4,	<b>~</b>		-•-	a_,	.т.	<b>י</b> פ	3-2 2			si je	•:•	۸ıy	
•'``	•/		• ••		••		1	·	5		•••1	-12 +	•••	••	<b></b> -
•••	a) M		20	11.	•	20	Ÿ	•	•••	٦	33	4	•	•••	56 6
-M3 >>5	.u	1	•	we.	5	+	τ	r.i.r		52		AL),	***	• 15	**
•••			•••	74.) 342	-•••		с.,		2.	÷	•••	••	···	<u></u>	
۰,	•••	· ·	С,	~'	.'	•	÷ -	• .•	·::.	п	•	·: 1		.,	<i>^</i> ,
.+F	ан (	5	-• <b>r</b>	~4*	•	-77	77	~•			29	Τ.,	1	лт <u>,</u>	<b></b> .
	16 -35	'		4	•	2	74 1	••	••	••••	22	·: 1	۰.	<b>`</b> ''	A-4
1	11+	×	-••	-0-	÷:	A	<i></i>	·•	AL.	<del>.</del>	<b>y</b>	υ.	L	י	::tŗ
	2		••	); •	•••	- **1	•••	•••	<i>.</i>	*-	~	- 41	•••		2
<b>`</b> ''	-~-	'	20		-	••	<b>.</b> .	ж	•••	·• ·	21	<i>.</i>	ζ.,	21	Ar i
••-	ш.	<u>}</u>	-••	·	•	/**	77	L./L	•	ч.	•••	! <b>!</b> ?	L: L	-"	
•,	2	<i>·</i> ···		1.11	••	:::	π·	•	·,	т. •	23	6h	ŀ	•••	
22	Π	•		~~	÷-	٠.٠	·	•••	•••		•-•	11-1	· ·	••	
••-	+11	P2 -	•		:47	~	лл		Ť	с <b>ц</b> ,	A*1	аπ.	~.	^:ţ	AL 1
A.6	AI (	<b>*</b> *;	3			·+	·*-		vr.	~*	•	vur.	<u>,</u>	•	лір
•,	••	453	•••	·-•	-•••	24	л. Ч	·.·	×.•	~	···		<b>r</b>	••	м.
•	a. a.	».	~	~1		ć.	۰,	• •	м.		;; ;;;		•		-::-
27	4a	141	r	.сэ		A12	1-1	•	ж	÷	7 <b>8</b> :	T.12	~`	•	<u></u>
•••		ŀ	··,		-•••	••••	1	•••	10	<i>.</i>	•••	11.	۰.۰	'ę	a.

-could rune

• •	dis.	÷ .	22	·~•	r	1	<i>.</i>	33	-1 -	Π	y.	dis.	<u>.</u> .	97	GD
-/-		,':	-"	.пг	·•-	J.,	27	-/•	A66	<b>n</b> _	•	÷	(_r		<i>.</i>
.,	ą			π·	۰.۰	Ċ.	<i></i> .	۰.	•••	÷ ·-	20	<b>~</b>	ŀ	•••	a.
<b>'</b> .:		•	•••	:::•	•••	•••	١.		м.	ثن	۰.	<i></i>	<i>•</i> .		".
-14	π÷	L÷7	•	22	143	лrg	<b>T</b> , 2		<u>ئ</u>	ч.	••-	v <b>u</b> r.	<b>~</b> .	2	жч
•••	a,		2	٩·		•••	<i></i> .	2	×.•	~	•••	щ٠		~••	<b>11</b> .
-•-		<b></b>	<b></b> ,	-,-		<u>~</u>		۴۰	•••		***	۰ <b>.</b> -		۰. <u>.</u>	. <b>.</b> r
••	ŝ		•••1	·1·		ā	·~~	•••	<b>.</b>	•••	-1 20		••	<b></b>	<b>.</b>
33	<b>.</b>	× 1	<b>`</b>	24	.,.	•••	74.1	۰,	4	2	50	ch.	<i>.</i>	•••	а - .яс
•	H <del>.</del> .	L		:# <b>;</b>	L: L	-•-	тг		4L-	٠.	-•-	~	×	344	-4, e
•••		••	j.		<b>.</b>	-54	<del>**</del> -	-1 <sup>-</sup>	5		••	- •	:	•-	
• .	16.	:	.,	Π	••	~	ан 	: •	··•.	4	7/1		: -	•••	-:11
. 20	wr.	L4.	r	<b>_++</b> *.	.43	<u></u>	~*	-+-	~42	лас С		v <b>u</b> r.	A41	-77	wc
5	п.		-1	•-•	1	÷	••	•••	•••	2	97°	T1-	···	•••	п - 
	•	».	•••	:		~	÷ -	: •	25	T.	~	4	••	:::	-:11
~*	<b>b</b>	•-	::	~*		-54	•••	З,				*~~		•-	**
•••	ch,	1	70	п	• •	1	20	• •		·	• •	÷.	۰.	10	<b>.</b>
••-	\$;	L: L	•••	<u>م</u> د	۰	<b>::</b> ;	<b>n</b> _	L.,		<i></i>	::;	<b>r</b>	۰	·•	
	<i>.</i>	-'-	•••	• • •		-54	- •	-,	~	С,	•••		•-	•-	<b>:</b> ;
1	A4 1	-	97	<b>.</b>	•	7.0	4	۰.	ж	<b>n</b> .	• •	Å 9	• •	22	$\sim$
• • -	.u	L4.	201 222	~u¢	•	.127	1-1	м. 	-14	щ¢	A45	732	7	<u></u> ,	A)
۰.	Π-	22	~"	7×1	۰.	~	à	••••	40	μ.	-••	ы. Се		•	a,
• •	-::- -#-	<i>י</i> .	~	·	•	/ 11 555	A4 1	•	··,	11.1	ä.	/ <b>1</b> '	•	•••	ð P
2		<b>.</b> .:	-:•	+11		-::•	141	-::	٨D	нк ( •.	-79	-74	14.	r	ар 
·· ,	~,		•••	::: :::	۰.	~	e.,	۰,	3	μ.	۰,	ы.	<b>-</b>	1	T· -

## -:-:ul. Tuma

ALE ALT THE LEW WAR HER WALL WE ARE THE THE LEW WALL THE ALT THE STATE OF ALL THE ALE ALL THE (a) See The Shire Tay See Say Caroline With Street See Sea Say Say See Sec. is suggesting the symbol of the two sets and the state  $\lambda_{\rm eff}$  ,  $\lambda_{\rm eff}$  ,  $\lambda_{\rm eff}$ 199 21 111 19 24 112 19 19 11 11 11 1 1 2003 (1803) (1803) 2010 (1807) (1804) (2.2) TARE SIDE VERSION DEPENDENCES (1997) ander statistical de la filienta de l 2000 : Partes a socre antisticare i su su su parto ender beindere Briter Litter beiterbarde Die Gebeuten von die Gebeuten von die Gebe ......... the read for the the the second the first manual second the map For the two second frequencies of the transformation to the two second are needed by Alle Wig and Ank Vie for any and with distance  $\pi_{\rm eff}$  , (a) All such that the first set and set of the only of the site of the set The William State (Section 2010) and the S All a fille of a start way for a fing of a start of a final start of a fille of a start of a fille of a start of a fille of a start of a sta C. Hurber, and K. Steffing, "A start of the groups of the Tay." Any logic level of the line of the set of the set of the line of the test of the line of the set of A model for a static production of the static st en une sine free line free ingeneren fre versie werde versieren in unge nige and the set of the 1 (16) 7 (17) 7 is all is the day is day be and here is the the the Tap and the two (a) set the set are set in the new by the set and and the set of the set o Negro Pice any construction of the Article Construction of the Society of the

-:----

		£ •.					200					<b>.</b>			
<b>.</b> .:	75	An ;	1.3	.w:.	.46	αt	1-4	- 6-	-97	ч.	t::	æ.;	~`	<u></u>	~>
2	ш	<i>.</i>	•••	74	11	•••	<del></del> .	·.·	-1	: 	-••	ы.	1.0		23 C
÷ ,	·	:	÷ ,	۵ <b>1</b> -	••	·	~	••	:::	۳.	•-•	/12	: -	:	~
••		••	<b>.</b>		•	-		З,	<b>.</b>		•	··I··		<b>.</b>	
	<b>T</b> . •	<b>!</b>		Π	-	· •	Ľ.	•	••••	74 ·	• •	<u></u>	r٠	21	·: 1
••-	÷	×-:	∴ <b>-</b> ,	:ш:		:17	J		•••	π_	<u>;</u> ;;	H <b>.</b> .	(_r	-•-	
	<i>.</i>	•	<b>*</b> -	ιđν				••	Ÿ	÷.,	-	-12	•••	••	ζ,
• •	ch.	-	• •	10	• •	1	4	•	7 86.	۱	y,	••	-	С	744
A41	<i>A</i> .4	L?**	::: :::	-C.A	L	ж	лл	\$ <u>-</u>	.50	<b>ری</b> ہ	. 20	νĘ.	ħ:	<u></u>	-96
-•••	T· -		···,	n.	•••	••	л. Ск	••	· •	<i>(</i>	×.,	•••	·· ·	•••	м.
۰.	Σ.	·	••	44	••		:: <b>.</b>	• •	1-1	÷.		11.,	: -	•	-:11
• EX 35	-Ca	144	•	лл	Ä	ж	-up	.+6	vų:	459 459	- 143	. ц	·*•	•	<b>?</b> }}
- •	сњ	÷ .	•.,	31	r٠			۰.		·	••	сњ	•	2	<b>.</b>
<b>.</b>		×	*::	<b>n</b> _	•-•	J	ч:		<b>-</b>	ч.	A.,	JL,	<b>;</b> ;	•-•	- <b>-</b> F
•``	•/		~`		••	•		•-	ŀ	•	<i>.</i>	ς,		·	24
	2	-	<b>`</b> ''	~	r.	2.2	τ.		•••	24	25	Å .		•••	A.
2	T,	•-	·-,	:ш:	#:		·		- 64	;;;:	•		с <b>ь</b> ,	Δıγ	77
••	T	ŀ	•••				<b>~</b>	•••	3	÷	•••			.:	a.
•-•	~1	: -	::	A 1			<i>.</i> .	2	۰		•	·: 1	<u>}</u> .	~	
1.J	7,2	.;;	r	~ <b>4</b> ~	-•-	<b>H</b>	ź,	AE:	λŋ	лл	r	***	<u>~</u> -r	λ <b>η</b> ,	-C.9
• • -	÷	<u>۴</u> ۲.	r	***	P1:	1	u.e	•	<i>1</i> 29	π÷	<u></u>	. ц	<u>~</u> -r		<i>44</i>
 :25	a,	1.0	··• <b>•</b>	. <b>.</b>	<b>.</b>	9	<i></i> 1	•-	۰۱.	ž		·. 1	<i>.</i>	~	22
<b>'</b> 1-1	•:1•	• .		1. 	••	•	× -	• •	-:::-:		÷ /	•:1•	۰	2	
A.6	7,2	<b>.</b>	- M3 1		-•-	~:-	~*	<u></u>	ж;	x.	<u></u> ,	-62	;÷)	-:•	vur.
•••	<b>.</b> .	 ,	•••		-•••	÷٠	 	· <b>·</b> ·	41	٩·	··,	23		··.,	a,

Type Take 10 and 10 an Ale des des Alestado des des Ans des uns Alestados des Alestados 1975 - 1977 - 1977 - 1977 - 1977 - 1977 - 1977 Bay Says C. S. Yang, K. S. Wall, C. S. Territov, Nucl. Phys. Rev. Lett. 11 (1996) 3248 (y) We wanted that the set of the Algorithm Strike growth at the set. AND AND ANY MAR ANY ANY ANY TAL OVE DRUNDS OVER OUR AND OVER ANY 1977 - 1977 - 1977 - 1977 - 1977 - 1978 - 1978 - 1978 - 1978 - 1978 - 1978 - 1978 - 1978 - 1978 - 1978 - 1978 -Weinberg and The Second Sec Ale die Sei les lie Aug for Thi ale 151 Ale And and be on dig 1991 we see the wine the set of a first set of the set of t Any case we for the distribution  $d_{\rm eff}$  and  $d_{\rm eff}$  day for the way due to  $d_{\rm eff}$  and The  $d_{\rm eff}$  The first of the set of the set of the set of the set of the set. an Ale Server The Andrew Charles Server Let 7 in an Andrew Charles Server Ale Ale and the way the sep was the NUM the viewedy the wep the life way. nin Marilan Barrista Anno 1977 (1978) Anno 1977 1977 — 1978 — 1979 . . ... vanne offensterne in i offer biological deficit constructions and a personnel construction of any state of a grant 2000. (BYTE) - 12 ner en elle de les secondos de colores del regulars de sel. No The GM Comparison of the Comp ALE ADVESTIGATE AND ADVESTIGATION OF ALL ADVESTIGATE AND ADVESTIGATE ADVESTIGATE ADVESTIGATE ADVESTIGATE ADVESTIGATE ADVESTIGATE ADVESTIGATE ADVESTIGATE ADVESTIGATE ADVESTIGATE ADVESTIGATE ADVESTIGATE ADVESTIGATE ADVESTIGATE ADVESTIGATE ADVESTIGATE ADVES Konstanting and the first f A. Hard, L. & Karakar, Karakar, New Terrer, New York, and M. Karakar, Annual Sciences, and American Lange and American Sciences and Ame American Sciences and American Sciences and American Sciences and American Sciences and American Sciences and American Sciences and American Sciences and American Sciences and American Sciences and American Sciences and American Scienc Let out for the and the list of the Ary way the late out of the  $\lambda V$ The My Decker And Market Structure Systems and Weighted Structure (NY 10) 30

-:-: IL TUNE

-25	<b>دل</b> .	:: <b>:</b> ;	••-	***		+	67	•	٨m	φ.	-79	<u> (</u> 2	***	л <b>к</b> .	wr.
	АН. Цах	1	• •	4	• •	<u>.</u>	÷		<b>-</b> 1 ·	·~	25	T·1	÷ •	•••	dis -
-	~	<b>&gt;</b> •-	•••		•=•	<b>-</b> -			JL,	<b>'</b> ;:		-4-	×-:	•••	127 127
~ 1	a,		~ <b>*</b>	;-:		·~	" v		7		~*		•-	.7	18
• •	34 J		32		٠.	10	۰.	3,	•••	τ.	- •	Å.	<u>.</u>		~
• •-	wr.		-143	we.	·-?	.127	77	:	٨D	•••	r	÷	<u>.</u> .,	r	<i>.</i> +
••	27	••	•••	<u></u>			<b>1</b> . ·		· 1	<i></i>	33	٠.	·· ·	~"	··. 1
	11.,	•	- •	200	•:•	r	T.	•••	•	:: <b>-</b>	۰.	۰.	۰	•••	<u>.</u>
<b>.</b> .;	H#7	~`	лrg	15	-~	.77	·*-	~•	÷	ч.	A07	νς.	141	AR) 355	alf.
v.,	<b>.</b> a.	ŀ	20	T··	•	~	<del></del> .	 	-1	1	9 C	24	1+ 3+2	,	14
•-•	шı,	۰	∴ <b>.</b> •	H+4.		A	**	<b>.</b>	a	ъ:	-/-		•	-••	
~ 7	": 	•	••	• ••	•-	2	- •		~	~	2	<b></b>	••	••	37
7.3		•	<b>`</b>	.a.v.	<u>)</u> :	1	•••	<b>r</b> ,	••	<u>.</u> .	y,	••	••	<i>·</i> ··	dik Jac
	<	×		<b>T</b> c;	۰	4_1	<b>n</b> _	•	÷	h 1	A		<i>(</i> 4.	÷3	
	·. 1	( <b>~</b> .	"	<u>.</u> .	۰.	•••	. <del></del> .		••	1		т	 142	• •	ш
••	"	<b>`</b> •	•••	~1	<b>b</b> . 1	'"	".:	• •	м.	::	÷ •	•••	<u>, ,</u>	••	712 
-:•	цр.	141	.er	we.	-:•	÷:	1-1	A#;	vr.	141	889 1911	-**	1	••-	-C.9
2	٦.	• •	•	ч·	1 162	~	••	·.·	20	21	•••	<u>.</u>		7	а. ж
••	•:1•	».		5.	: /	·: .	١.	• •	.:	÷.	~	~·•	».	С.	201
·~	2	-'-	2			2	r	425	~	<b></b> ·		.12		•••1	(12) (12)
••		а. 40.	•••	•~•	-		20	-,	•••	54.1	• •	415 445	÷ .	•••	·. (
~ 7	Ŷ		7	·Ar	••	5	••	• • •	Þ		.3	<b>-</b>	•••		.4.
'n,	·: 1	۰.	٠,	7.1	- 1-=	<i>.</i>	Π	-	4		y,	Ŧ 1:	÷ .	<b>`</b>	as Na
•	шı,	<i>(</i> 4,	×	л. •``	•-•	/#L		<b>.</b>	46. 800	J	1	466		3	-0-
••	·n··	•••	-5	•••	••	-7-		::	Þ	~	••		;;;	~	
<b>.</b>	<b>.</b>		$\gamma_{ij}$	т.	۰.		a .		-1 -	÷	۰.				<b>5</b> .

\_

-could rung

1 124 Aut	
AND AND LEE THE THE LAST LAST DUE OF AND DIS NOT ANY STATES OF ANY STATES	AND AND LARD
The first of a first sector of the first of the first sector and and the first sector of the first sector of the first sector.	1000 Contra 10
Statistics for the second sec second second sec	1
<ul> <li>A set of the set of</li></ul>	
and the second sec	1.50.51
See The Asy was the size Any size and the line line dis 10 (1) (2)	. La. 32, 484
<ul> <li>The process of the late late is the late is the late.</li> <li>Bits and the late is the late is the late.</li> </ul>	11.19.20
na na serie de la composition de la serie apresida. Nas	5 G.S.
. All out with the law law law with any the same of $\frac{1}{100}$	nan aka sec Ma
and a second second of the second second second second second second second second second second second second Second second	1. 5.00
(2) A full constraints of a providence of the statement  >. // ¶0	
The car will the control of the control of the second	wat hie with
See Sec. 7. A State of the Sec. Sec. 7. April 20 Value of the Sec. Sec.	n na da 197
ter den die ter tas bie den Tap die die das der der Right	<u>+</u> :
te on die stoude de le die wer nooeke traege tes internet in 199	· · · • • •
<ul> <li>The Second Se Second Second Sec</li></ul>	v. tyrau
and the for $\Delta u_{0}$ and $\Delta u_{0}$ for the low distribution of $u_{0}$	
(A second contraction of the second contr	
(a) An a statistic of the statistic terms for the statistic statistic statistics.	λ. 100 <b>Π</b> 10
A RETAIN LAR AND AND ARE ARE THE ALL ARE ARE AND AN AND AN AND AN AND AN AND AN AND AND	Line of the
The one particle and the set we set out the one of the set of t	. Anj Ang
The Min Tee The See Lee Lee See Ann The See Ann An Ann Ann Ann Ann Ann Ann Ann Ann	
NOUT Description of the second state of the NET SECOND	

And a second contract of the second second second

-:-: II. TUNE

<u>99</u>

ADVICEVED LINE
the Vad bar issues the Ale Vad by: the spectre distribution of $\tilde{\mathcal{T}}$
Wei Wei Ziel die Berlinstein der Berlinstein gefühlten Beglützung der Geschler Ziellen Ziellen 10.
(17) A. S. Martin, Phys. Rev. B 199 (1996) (1997) (1998). Annual Statement and Statements (1997).
<pre>Abl OBC LOS SUB-SHO AND AND THE ABL LIGHT OLD ABL HAR ALL UNT AND LABL V</pre>
Type II. And the The The The The Section Section The The The Section For the Section Sec Section Section S
and The Let May are the factory results for all $T_{\mu\nu}$ May the $r_{\mu\nu}$
Tradit is any other in the set of a set of the set o
The Apple Control March 1998 Apple Control
and the day line when the dat MeV day for the size due by a feature $10^{-10}$
and the set and all the fraction and the line set of the set of t
nag i va Million Standon Charles Anglis 2000 (1996) ang da 1990 - Line -
and the set with the order of the order of the order of the set of the $100$
(1) The second state of the second state of
(a) Cardy, San Alexia, San San San San San San San San San San
alo se ser manifo ale genito son in sel am ser sol seg 225 - 200 - 200 - 200
Nyanaka ing katalan na katalan katalan yawa ing katalan katalan katalan katalan katalan katalan katalan katala Babili katalan katalan katalan katalan katalan katalan katalan katalan katalan katalan katalan katalan katalan k
Any The Sec and the last $\mu_{1}$ HeV are the All way fibring the data $0.0$
ne vilano con los los de sons lo etc. As etc. los dos sus los unas Reel de sons de sons de sons de sons de sons de sons de sons de sons de sons de sons de sons de sons de sons de
Number 2, Number 2, Wei Zurit and A. S. Min Milling A. 200 (200) 200 (200)
The two way way by: the object the way bet the the way way way for $200$
A second seco
n Marine - An Olas Marine - Marine Sey yang Kasabatan Ang Dan Kasabatan Kasabatan - Marine - Marine - Marine - Marine - Marine - Marine - Marine - Marine - Marine - Marine - Marine - M
NEW YES THE ARE END AND THE WEY HEL DAY UP, MEY EAR YES THE NEW YES

The state of th
-could rune

4	w		***	:	63	<b>\$</b> \$	76L	лаг.	•	vr.	53	1.11	-**			싔문
• •	2	•	÷ .	•••	tan KKE	•	7.0	Ÿ	-	Си СК	١		••	r	2	dis.
•••	ч		(e	33	·	•	J.,	.т.	₽.	3.2	ж;	•-•	T	ŝ	•	·*r
			 	•••	**-	•••	••	77	~ 7	~		<i>.</i>	::;		•'``	<i></i>
• •	2		1	1		• •	<b>.</b>	••	••	-1 -	÷.	33	<b>G</b> 10	r	<b>`</b>	41
:::	л	*	<b>.</b>	• •-	wr.	35	ж	лл	-•-	æ	£	-79	аπ.	.*:		ал. 77
	a		( <b>-</b> -	~	34 34		2	<i></i> 1	••	2	<i>.</i>	•.,	<u></u>	r	22	<b>.</b> -
۰.	Λ	•		·.:	Π	•	·••	-•	-•	•••	<i>.</i> .	2	•::•	. ·	.,	
		2 1 2 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	0		 K.A Mari 10 J.A.N.B. Maria Maria			4. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4.				•				
• •	••		:~P		::											
2	<u>،</u> ،		÷ .	20	÷.	• •	7 A	÷.	-	2	١	• •	<i>.</i>	-	27	
•••	-	~	њ,	37			2-4		2	JL,			44	<b></b>	÷-4	A.4
•••	•	•.	1. 17	•	<i>.</i>	<b>r</b>	÷.	7) 4	<b>r</b> ı ·	40	··	•••	7		۰.	·n.
~	÷	•		~	<u>.</u> ۱.	: ;		÷ -		<u>،</u> ۱	<i>.</i> .		-:11	۰.	~	•:1•
7#: :*	π	<u>-</u>	A-1	-"	<del>،</del> ۵۰	;;*	~:-	ж;:		*-	ş,	A.6	2.7 <b>4</b>	<u>۴</u> ۲.	-79	*
••	Y	•		,	х, ч	•-	ч,	π·	<b>r-</b> ·	2.) 72	.7		66	<i>.</i>	27	
2	•••	ı	•	·.:	•	•	÷	~	• •		16.1	~	<i></i>	•		Π
~ 1	-'	•	,	•••	·1·	•••	••	77	•••	ŀ	<del>*</del> -		6	•••	<b>`</b> -	
<b>N</b> 1	ï		-		.au	- •	2	÷	• •	••	<i>.</i>	33	۰.	÷ .		a٠
2	"	•	••-	<b>N</b> -	- ·r	12	2	••	•••	Ŷ	-;:	•••	112	·	•``	ы йл
• •	τ.	•			54 ) 1-4	•.	•••		• •	ņ	۱	<b>N</b> 1	τ	r٠	Т.,	ch.
<b></b> .		۲	<b></b> .	57	. <b>п</b> г		-1.	·	5	љ. <sub>9</sub>	. <b>_</b> r	•••	·	<u>.</u>	-"	ш.
•••	2		•:	•*•	<i>~</i>	<i>.</i>	••			- 19	~	•*•		۰.		.a.
								<del>.</del> .	-	4	•	٠, .	<b>л</b> .	r	٠,	ч.

-:-:ul.	

- 64					222					227				
226 275 mi	. 624	•-::	:*:	;4E	A.L	·*-	.+E	~15	24	r	T.12	<u>~</u> -r	A	÷
· n	• ••	~"	11- 351	-•••	~	π·	•	22	<b>~</b>	•••	·. 1		20	м.
444 / I.	1.	:::	~~	: :	<b>'</b>	<i>~</i>	<u>ان</u>	м.		<i>.</i> •	<i></i>	• .	••	~
·		~`	- ·r	<b>.</b>	Y	17		÷		**	;	••	·÷	.4.
 	× 1	•.,		••		<i>a</i> .	۰.	•••	Π	55	ch,			
tau An 115	(_r	•••	<i>4</i>	÷.	a_,	H=1		~	<u>}</u>	•	H <b>.</b> .	L: L	•	<del></del>
54 A	•-	57		••	<b>.</b>	" v		÷	··· •	·	20	••	:::	w-
	r	20		-	۰.		30	-1 -	4	• •	<b>.</b> •	<u>.</u> .	70	as.
AD) 134	-	-143	ננו		~	ыr. W		۸Ŋ	÷	-79	<u>ې</u> ې:	••-	<u></u> ,	
Тара 201	•••		<del>.</del>		:::	·	·.·	•.•	٦ŀ	2	ч.	••	••	<b>.</b> .
	•	~	A.,	ŀ٠	••	~	• •	•••		~	/ <b>•</b>	>.	•••	
17 . U	14.	-::•	T:	A4:	-r-	u.n	-:E	 12	w,	<b>.</b>	.**	F24	;	A)
· • Ħ	-	2	~•	-	•	4	2	•••	a	• •	a.	/ 145	<b>`</b>	ч. I
Allen III	÷		.пг	L.,	J_1	45	<b>.</b>	a	-		÷	( <b>4</b> .	÷.,	ч <b>ы</b>
11 (h) 14		•-		•••		• •-	••	•••	··· •	•2		·	•-	ı <b>n</b>
	۰.	٠,		<b>.</b>	•••	r,	•	•••		51	<b></b>		•••	66 410
	L	•••	÷#		3-4 2		L.,L	٠ <del></del>			JL,	<b>.</b>		шu
	• ••••	:::	. <del>п</del> .	•-	••••	<del>.</del>	 .:.	··•	٦ŀ	-1	·: 1		×.,	<u>.</u> -
• . • .	2.	~	~1	••	~	2:	•-	1-1			<u>.</u> :	۰.۰	~	Π
ين . درد رو	m;	<b>.</b> .:	лаг.	.46	, 10 611	·*-	AE:	1.3 <del>4</del>	141	÷	vic	.22	r	<i>a</i> *
- M3 - C	. en ;	-::•	T: 2		+									
	P.()	· · · · · · · · · · · · · · · · · · ·			54. 10 - 3.4 - 4. 2						•			

-:-inf. Thes

Ang die in, was ang tra aya ang Ang Ang Ang Tyu ang dig ing akin Di Marchael Charles and Marchael and Charles and Charles and Charles and The Charles and C (a) Call Constraining Constraining the second system of a constraint of a c ling and the rest of the set of the set of the line of the set of Constant The Way Service Constants And Service Advantage (Constants) (Stational Service Constants) Any map for the two the distance tag they the the design as that is and will be any other than the size and we will also be the type way that is a size of the size of and any Sectory of The Alexandra. The first differences and the loss stay of the first sector of the and the market of the set of the 7 A Super Contrast and Contrast on the Action of Velloy and Action States and Action of Velloy and Action of Action The only we are the set of the one of the the the set of the the set of the the set of the the set of the the set of the the set of the the set of the the set of the the set of the set o Type Har Net is a Ohr Cory New Type to A Net A to The Oly Hear stands and the second state of the second s The set are set by the set are the bar bet an are set of the set are set. (a) and the set of a set of N 1 2 1 1 1 1 1 1 1.10 Constant of the second 2011 CONTRACTOR COMPLEX. AND A DESCRIPTION OF A DESCRIPTION алынын аларыкан карыматын каралуу башанын каралуу башанын каралык жана каралык каралык каралык каралык каралык where the provide the state of ADVICE VELICIAN We have the star for the two have the two have the start of the start

-	:	·:nl.	

A45	w	. 14.	<b>*</b>	ALC:		-77	лаг.	÷	1.74	τ	•	νĘ.	1	-77	wr.	
	~	Ξ.	<b>`</b> ''	56	• •	· ·	<u>.</u> -	••	•••	•••	• •	л а.	r		Å-1	
∴ <b>.</b> ,	÷	×.,	٨ıy			<u>.</u>		-/-	љ.,	·	-2		·		·	
Ľ,	٠.	۰.	~`	• ••	::·			•-	<b>.</b>				- • -	~	. <b>.</b>	
۰,	ch.		<b>.</b> ,	<u>.</u>	•	•••	÷.	•		•••	۰.		÷ .	2	÷.,	
A07	<b>д</b> ць		-:!		~	~~		w.	×.9	a.	- • :	.*.	-		.u	
۰	·:. 1		• • •	п·		·	<u>.</u>	•••	<b></b> .	<del>.</del>	۰.	÷	. <b>-</b>	$\cdot_{\alpha}$	÷.,	
			•••		• • •	۰.			·	÷.		4	:		a.	
	 			π∸	~		π≟		~65	1-4	_F3				лар	
•••	۰.	,	• • •			• , ,	<i></i> .		·,			сњ	,	· . ,	147 341	
				3.1										- ''		
			÷									+				
		۰.	- /		r	20	<i>.</i>	•			33	τ.	۰.	•.,	ch.	
;;;;	-,-	( <b>4</b> ,	<b>.</b>	has	it:	( <b>•</b>	h	**-	^	1:5	-/-	360	• •: •		::;;	
•••	a,		•••	- 14 - 2 - 24 -	•	1	~		·	. <del>.</del> .		<b>.</b> 1.	r ·-		ч.	
2636868			- 10		,, ,, ,,		- 			~~~v	, 					
••	•••	• • •	•	·												
:	.1.	•	~	• *	•				5						1	
٠,	ch.	۰.	3	541	•.	.0	541	2	•••	τ.		di.	2	70	ch.	
	••••		•••	10.	•••	``	Ţ	-•	<b>.</b>			÷	•	•••		
۰.		÷ .	50	54	•.		·	-, ·	•••	<b>.</b> .	3				A-4	
::-	A.4	· *-:	•••	·	<b>!</b>	3- <b>2</b>	лг		•••	÷		~	(_r	•••	шс .х	
	.a.	-'-	~`	7		×	- •		ų, V		•'``	11.	••			
.,	۳·			п	۰.	Ζ.	۰.		۰.	•~	۰.	۰,		۰.,	44	

-:-:---

			-12	'	
an ar ng	nte ver	144 - 277 - 26 177	the way way a	19 AP AP	al C
		**2.**	5-31 A.F.	3 <sup>10</sup> 20 20	a.
€	r 1.41	· • ~ •	10 C	· • ••• · · · •••	å
** *****	т ул 14		495 - 19 M - 4 199	· · · · · · · · · · · · · · · · · · ·	<b></b>
N 1 40 F	$\mathbb{C}^{n}$		Den de la composition De	1966 E 1999 	21
na an ray		-14 May 124 177			-
-r (ðr ()- 1:	-1.182	·••	····		
- 1	No M	5- <sup>1967</sup>			66 295
are da les	ARI (IŞ	626 A <b>1</b> 2 A2.	tes Attuants AV	120 TJ2 ALV 180 222	-44
•••					
	, - , - , - ,	. NG SKOT			
<ul> <li>Albert Mitteller</li> <li>Albert Mitteller</li> <li>Albert Mitteller</li> <li>Albert Mitteller</li> <li>Albert Mitteller</li> </ul>	100 - 200 - 1 100 - 200 - 1 100 - 200 - 1		, 1940-001.100 . 10 200 - 01 - 1	7.7 PSI	
<pre>&gt;</pre>			, 194000140 . 11.200 04 . 4 01.001 05 . 4	na. Na	<i>л</i> ,
<pre>&gt;</pre>	100 (000) 100 (000)			enan Inst Carolis C., Eye Tanle (J. 198	A1 2
<pre>&gt;</pre>		renerie dan Serie  <ul> <li>Construction of the second seco</li></ul>	nan 1920 Sandos S., Ely Hande (Sandos Nan Politika Sandos S.	20 200 20	
<pre>Access complexity access /pre>		renerie internet second distribution table and states second second second reneries internet reneries internet reneries internet second se		1999) 1999 - Alas I., 7 y - Alas I.,	∧. 
<pre>&gt;content of the second se</pre>		<pre>prove that is a set of the is a set of th</pre>		1999 1999 - Aller (1997) - Aller (19	20 20 20 7- 21
<pre>&gt;</pre>		<pre>project table </pre>	<ul> <li>Construction (Construction)</li> <li>Construction (Constructi</li></ul>	С. 200 (12) С. 2005 С. 27 ус Полове (12) в С. 20 С. 2016 (12) - 10 С. 20 С. br>20 С. 2016 (12) - 10 С. 2	20 20 70 70 70 70 70 70 70 70
<pre>&gt;</pre>		rene und dud 		<ul> <li>(12)</li> <li< td=""><td>лі 200 П., 217 217 217 217 217</td></li<></ul>	лі 200 П., 217 217 217 217 217
<pre>&gt;</pre>	<pre>construction construction /pre>	<pre>main set in the set in the set of the set in the set of the set in the set of the set in the set of the set in the set of the set in the set of the set in the set of the set in the set of the set in the set of the set in the set of the set in the set of the set in the set of the set in the set of the set in the set of the set in the set of the set of the set in the set of the set of the set in the set of the set of the set in the set of the set of the set in the set of the set of the set in the set of the set of the set in the set of the s</pre>	<ul> <li>Construction (1999)</li> <li>Construction (1999)&lt;</li></ul>	<ul> <li>(12)</li> <l< td=""><td>20 20 70 70 70 70 70 70 70</td></l<></ul>	20 20 70 70 70 70 70 70 70
<pre>&gt;constant ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) (</pre>		<pre>main set in the set in the set of the set of the set in the set of the set of the set of the set of the set in the set of the s</pre>	<pre></pre>		An 2000 Tan Tan 2017 Can An P
<pre>&gt;</pre>	<pre>&gt;</pre>	<pre>mprove trials </pre>	<ul> <li>Construction of the second seco</li></ul>		An

-5	. u	An2	:::	-		~	~	<b>A</b> .	AC	141	A45	ап.	-1	763	.u
- ,	• •• •	5.	۰.	·	۰.	••	544 300			Ÿ	20	11		<b>`</b>	Å.1
	÷.;;		۰ <b>_</b> ,	4,4	·•-	57	3 <b>.</b>	6.76		Π_		d un	×.;	-•-	-0,0
		• •-	•``		,:: ;::	-	<b>u</b> .,	•-	- 19		•'`	2			2
- ,	- Ch	÷ .	<b>`</b> ''	204 244	••		54	• •	22	·		÷٩	r٠	- 	50
2H	14	ы.	A19 >:5	лаг.	ri.	.127	2.5	:::		·•-	-77	VD.	Ż	A.6	-**
•••	11.	цан 3 на	•••	·-•	•••	<i></i>	с., 310	••	۰۱.	••		22			ч.
~	25	••	.,	::11	1. 1	22	».	• •	۰	-	/:	/12	· .	.,	÷ •
3	, and	*	• •-	≁.	с:Ę	.r.	лаг.	r.i.e		÷;	783	-63	144	• 12	:*;
•••	• •• •		•••	2	•	••	711	•••	2	÷1.	•••	·: 1		22	
A.L.		·•-	:::	. <b></b> ,		-•-			<b>-</b>	Π_	-••	-	L: L	-"	ш,
-,				.1.		-14	 >r:		<b>.</b>	w ·	•-	5		<b>`</b> -	<b></b> -
• •	сь 	-	•.,	54		30	·	••	× 1	÷	";;;	<b>c</b> 6			ъ÷
÷.,	-	· : •		4,4	<u>ع:</u>	<i>4</i> 12		L/L	AL.	:::	•••			۰ <b>_</b> ,	47
۰.,	ч.		••	21	•••	~	. <del>.</del> .	۰.	4	٦ŀ	···	т	1	ų	ч.
		·.,	23	11.		۰.>	۰.	••	÷	:: -	•-•	~	<u>.</u> -	٩.,	~1
a.2	π÷	53	-143	:*:		.v.	52			1-4		: <b>P</b>			<i>.</i> 7.+
,	15.1 365	ŀ	۰.	π·	•••	 	~		•.•	••	5	сh	••	··,	· · ·
2	Π		•••		•••		т		۰	j.		τ.	۰.		33
<i></i>	20	۰.	••		۰.	-51		<b>.</b>	5	-·-	æ				л,
•••	• •••	÷	۰. بار		•	,	۰.	<u>.</u> .,	۰.	•	• •		!:	y.	- <u>-</u>
-		;::		• ••			:"			<i></i> ·	æ			•••1	л,
		-	· .,	541	•.	۰.		-	۰,	<i>.</i>	۰, .	л.	ı.	·	лı.
<i></i>							п_		~	J		JL,	L		,
				<b>-</b> -		_				·· ••••	~ *	,		•	~
				• • •					·~						
· · · ·		ς.	- 11		• •	- I.			÷ •	<b>.</b>		-11			- 11

-:-:ul. -uwa

222 - 222 - 222 - 222
NET THE REPORT OF THE ALL OF ALL AND ALL AND ALL AND ALL THE ALL AND ALL THE ALL AND ALL THE ALL AND ALL THE ALL AND ALL THE ALL AND ALL THE ALL AND A
Berg With the second state of the second state with the second state of the second
T is the $G$ . The matrix is a set of the first the $G$ -the $M$ -th $G$ -the $M$ -th +H -th -th $M$ -th $M$ -th +H -th +H -th $M$ -th +H -th
The second of the second of the second state of the second s
(A) a the set of th
The last but the two line that the factors due to the distribution $\rho_{\rm eff}$ , $\rho_{\rm eff}$
and be and the state of the set
na na manana na kaoka na kaoka na kaoka na manana manana manana amin'ny fisiana. Ny INSEE dia mampiasa mampiasa manana man
When $\mathcal{C}_{22}$ and the last the the state of the set $\mathcal{C}_{22}$ and $\mathcal{C}_{22}$ with
The The Construction of the Construction of the The Construction of the Construction o
(a) On Alexandra Oharway, and March and Society and Ohar Lyncols (Burgers) (1997)
the two was the one was and the way was the set of the
ng a She She Tao Dha tao na She Tao Tao Na Tao Na She She Ab. Nazi a She ang ang ang ang ang ang ang ang ang ang
we ally detunes the last type does and say one due was type but they also give $\gamma_{\rm eff}=-\gamma_{\rm eff}$
and an only and you are the standard the second standard Kar Rin Rin Sta
We find the try SNET in the first the Wildow Field Area to the fact ON. NAME AND AND AREA
<pre>implication The Tex due tool the Abs ray and and but and and We have have here here here here here here here he</pre>
naverski naverski naverski se stratevni se se se se se se se se se se se se se
<ul> <li>A. C. C. C. C. MARKAN, AND AND AND AND AND AND AND AND AND AND</li></ul>
A DOM SEGRET IS
A set the fight of the set of the set of the distribution of the set of the set of th
we are set us the rest of the two we we used the out of where $\gamma$
The Discrete State The Discrete State S

-:-::d. 7962
--------------

	20	-	•••	τ.	• •	::	541	-	4	<i>.</i>	<u>.</u> ,	<b>`</b> •	÷		π·
÷	<b>. ا</b>		•-•	. <b>ц</b> ,	÷.	۸.		·•-	<b>-</b>	₽.		4. <del>17</del>	×		÷.
•	a,		•••	7	•••	۰.	с.,	•••	22	π·		~~	••		п.
•		>.	÷.:	аı		.,	۰.	-•	••	<i>.</i> .	۰.	<i></i>		~	ðir.
:47	π÷	.::ţ	-77	we.	~	/6L	55	AZ;	~42	љ.	A	14	A-1	A.6	<b></b> .
••	te Lit	•••	~	711	۰.	2.	μ.	•••	~	<del>.</del>	3	66		70	щ
÷	ш.	( <b>_</b> r		<u>۰</u> ـــ		-••	·		~	÷		~	<b>)</b>	<b>.</b>	5
~		•		12		-	~	••	1	•••	••	•1	·	.:;	
			52	<del>.</del> .ı	-	<i>.</i>	<del>.</del> .	52	•••	.,	• •	Å.	<u>.</u>	<i>·</i> ··	·. I
1	T,	<u>-</u> :	∴ <b>.</b> •	~	<b></b> ?	/#6	77	-/•	AL.	-	∆ey	*\$	<i>(</i> 4.	۵ <b>.</b>	
	л. Т	·		<i>~</i>		.7			$\sim$	<del>*</del> *-			••	-1	<i></i>
22	•:11	۰.	••	τ.	55	•	••		<b>`</b>	<u>.</u>	••	^1	1	.,	
-79	wc	.22	<b>.</b>	~! <b>!</b>	·-?	.127	u.e	.+6	÷2	ч.	. 20	лīр	F24		wc
.,	<u>^</u> .	ŀ	22	÷.,	•.•		<i></i> .	 284	2.1	1	·	сh	 	۰.	
••	• •••	•	- •		۰.	<b>`</b> ''	<b>*:</b>	'	м.	÷.	÷ •	0	· ·	<b>'</b> 1-1	/12
~	<i></i>	·			•••	Ň								-1	
32	л <b>ı</b> .		y.	<del>.</del>	22	••	74.1	۰.	ж I		1	••	ı.	•••	а. 200
<b>.</b>			Å-•	% <b>;</b>	֥	-•-		L.,	*:-	· <b>-</b> -		167		ŝZ	<i>.</i>
•••		• • •		-11	••	-			~	**-			1.2	74	ıđ
• •	сњ	ί.,	• ••	÷	•	1	20	`	••	.a •		 	1		·. 1
	шс 	1		~1F		::	-C.1	-•-		·*-	:::	v <b>u</b> r.	<u>~</u>	•	.**
		:	··• <b>•</b>	~	ς.	••••	÷ ··	·.·		02	97°	щ٠	~,	~"	72
•	<i>^</i> ,	<i>•</i> .	·		• •	•••	Δ1	• •	-a. -1-	١.	÷ ,	τ.	۰. ۰		/12
•	. u	m;	3	***	•	ж	1-1	- 1	vr.	ж.	A41	æ,	S,	r	жa
·· ,	а.	j.: Jei	•••	7 <b>1</b> -		• •	÷.,	۰.	··••	1	···,		<i>:.</i> ,	···	

-could rung

		_		_	_		_				_	_			_
-27	3	L4.	A.6	π÷	ri.	-::	-H7.	-14	. <b>*</b> -	ч.	13	-63	~ '	4-1) -	<i>x</i> ,
32	π·	r	97	<b>~</b> ·	1.2	$^{\circ}o$	т.	-	•••	2		۰.		<b>N</b> 1	
•••	-	×	÷,	Ш-		/ <b></b> L		<b>.</b>	<u>مب</u> د		••-	~	(_r		
~,	٠.	۰.	•••		<b>.</b>	•.								~~	
۰.	<i>a</i> .	-				• • •			• • •	-	э.		•••=	· · ·	
•		·			-		ä	-			~				
-26	77	-*-	-141	ыr.		÷.	U.R.	•	×.9	2.5	25		14.	<u>ак.</u>	ан (
20	T· -		2	7	<u>.</u>	••	π·	-•	2.	 	-1	cı,	~•	•••	23
۰,		۰.	÷ ,	<b>T</b> .	•		:: <b>.</b>		<u></u>	:: <b>-</b>	<i>.</i> ,,	•-•-	۰.	•••	
-79	.*	1	:5	_++*.	~	<b>r</b> :	~^	<u>}</u>		лл		vur.	533		wc
<b>-</b> • .	п-	1.	210		,	.,.			·,	•,	۰.	- <b>.</b> .		٠.,	<i>а</i> ,
•-						_		• -				. <b>A</b>			
<b>.</b>		r		-11-					-14	<i>i</i>	::;	1.17		<b>-</b> 1	11+
1. 1. i i i		•••	·•-	~				•••	1	2		<b>*</b> ~··	••	•'``	2
٠.	<b>c</b> 6	-			•••	10	۰.	۰.	22	16.1		τ		1,	•••
•••	A.4	×	<u>.</u>		-:-			-::				JL.	5		шu
•,•	· 1		20	. <del></del> .		<i></i>		.,	۰	<i>.</i>	-,.	сњ 1.11	с <b>.</b> -	· .,	
÷.,			.,		<b>.</b>		-71		·.,	::	••••	-:		÷.,	T.
	••				<b>.</b>						•••				
			APJ			13		<i></i>	120			. ப	·		4
		÷.•	~	ш. 131	•		Π·	••	2	711	••	•	r	10	Π-
÷ /	··- 1	۰.	:::	::16	•••	·: .	τ.	·	•••	:: -		·. I	<u>.</u>	÷ ,	20 P
			57					•-	15	~	<i>.</i>	4	••-	~	
	<u></u>		ς.	т.,			÷		·	п		-			ch.
			_			···,					·	. ا.			
			-1		•	<b>.</b>	~~	.,			.,				20
	•••			1	۰.	۰.	<i>.</i>	۲.	5	<i>.</i>	20	<i>.</i>		23	·. I
***	ш.	( <b>4</b> -	75			A	<b></b>	L	-4-		<b>.</b>	JL,		<b></b>	·
•			•••						- 14		•••			•-	
ч.	<b>n</b> .	~~ ~ .					- 11			-	•••	•••		ч.	
		- I									- 11			- F	

-:-:nl. TUNE

1.1 ...... 300 and a second de las 2011 : Tarres de las CONTRACTOR IN a serie de travesta close THE To see THEATS Deep close to a sector of manage of the close of close processing the close of the close of close processing the close of the close of close of the close of the close of the close of close of the close of the close of the close of close of the close of the close of the close of the close of close of the close of the close of the close of the close of close of the And ARRENDA COMPLETES IN CONTRACT OF A 1997-1998 ADDA DE VIEL LA SU The life in the system of the start of the day was the set of the start of the set of the set of the set of the er die vellengedie inter versiele die Versien en erstelle Gester in 25 - 75 - 75 A set the Property of the P View Conditioner Warn Least View Conditioner Links Links Links (View Condition) 201 (201) 121 (201) The May Weit Wait for the first the first the Charles Charles and the First Charles Single Provide a Had we will be The Had Mark and The Lee Had had been dealer. (a) ACT LYS ARS ALD ACT LPD ACK HEL ART LCS THE LEFT ACT LTP CAR TOX The Aven P. C. Syntaer L. Sterner, F. Churthe, The Type Barrier Aven and Aven Barrier Barrier Annual State (200) (a) the ball of Maximum distribution for the analysis of the set of the se (in the set of a site of a set of a sequence of all of the set of the set of a se Verifies 7 and a March 1 and a first factor decide of the AL action of the State of the State of the State action of the State of the State of the State of the State action of the State of the Stat ly die bei Ale die Ale deb bei wei der Will bei der Syn des der The first first business by the birst Will first first the first type (3.3) 199 (a) The state of the first first first first first first first state of the stat ANY WHILE INFORMED ANY ALL THE LAR ANY ANY ALL LAR THE ANY ALL LAR THE SALE INFORMATION ANY ANY ANY ANY ANY ANY LOT LARE BAY LYR THE REPORT OF ANY LARE ANY ANY BAY BAY THE LYR IN 1999 114-13, 222 (2017) 223 (2017) 224 (2017) 224 (2017) 225 (2017) 227 And Mark Control Indian Statistical Cycle Charles and you first Statistical Statistics Statistics (SSN) (2016) 

	ı	ά.
L	L	

-:-:ul++=
-----------

na ana amin'ny tanàna mandritra dia mampika dia mampika Ny INSEE dia mampika
The distribution of the field of the last the field of the last set $0.0$
The Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Tana Serie Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo Carlo
[1] J. Barry, A. S. Mayara, M. Lakova, A. S. Marka, A. M. Karra, A. S. Marka, A.
are the two are law, whe can are the statistic and the set $\gamma_{\rm eff}$ , and $\gamma_{\rm eff}$
The Alexandra Constant of the Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annu Annual Annual
ana Madi Ang Ang Ang Ang Ang Ang Ang Ang Ang Ang
The set of a set of a set of the set of t
(2) Strength of the All of the Carl Strength of the Telephone Telephone Strength of the All of t
ala ayo bil namilay basily. Sai na dio ami Ala Tur din an Ha. 1937 — 1977 — 1977 — 1977 — 197
also allo in any attain the constant of the also of the second second second second second second second second
Statistics of Algorithm New Original Facility States (Constraint) 2000 and 100 and
ALE THE REPORT OF ANY ALCONG THE SUPPORT OF ALCONG THE ALCONG
an an an an an an an an an an an an an a
na wa ƙwallon da kata ƙasar ƙwallon ƙasar ƙwallon ƙasar ƙwallon ƙasar ƙwallon ƙasar
and approximate the provide of the state of
The THE COUNTRY THE VIELANCE, THE VIELANCE OF A FAIL and also be
where $T_{\rm period}$ , the state of the transmission of transmission of the transmission of the transmission of the transmission of t
The preparation of the previous sector of the sector of th
na matala a servici da br>1929 - 1929 - 1929 - 1929 - 1929 - 1929 - 1929 - 1929 - 1929 - 1929 - 1929 - 1929 - 1929 - 1929 - 1929 - 1929 -
сул одо жир воз трание систося жир систося нестахо нистисе жар работ на селотося и систося на селотося
The Ball of the System of System Section 2018 State Market Section 2018
(a) ON ALL THE LED ALL AND ALL ALL ALL ALL ALL ALL ALL ALL ALL AL
Dye that be not a contract the ray and the ray bye are being any met the
n a beaution for the second state of the test beaution for the second state of the second state of the second s

## -:-: II. TUNE

Con they be not any star and we way buy the way the loss of any of the star of the star and Neg George Charles I and Angeler Will The Annother Market. National Anno 1997 - Anno 1997 - Anno 1997 Any decides and the besides too the cleaned the besides the day of the et a ver til etter ..... VALUE TOTAL TOTAL - Second State (Second State) and Second State (Second State) and State (Second State) COLOR MALENCE, RESILIES LA RESILIENCE DE LA COLORA DE LA COLOR CLUSS SECCEDUS: 55 the state of the s LAN 194 FAR WE WE WE WE WE WE WE WE WE WE WE WE WE ine effectively and end and the control of the control of the second states of the second sta ۲.  $\frac{1}{2} \frac{1}{2} \frac{1}$ the after fact and then the HeV besides the Val but to  $\omega_{\rm e}$  ,  $\omega_{\rm e}$ Francisco De Construction de Carlos des Charles de Carlo de Car 21 Apple 17 A March 11 Construction and Theorem 18 and the second state of the seco ADD THE ALM THE ALL THE ACCOUNT AND THE ACCOUNT THE ACCOUNT AND THE ACCOUNT AN 194 and the second second duale Tubbi and. Valida Martinetta an . ... 333 - 2011 A. DR. 188 - 56, 108 (3) A DECEMBER SHOP OF A DECEMBER OF A DE 2 334 SECTOR 35 Conditioning the place of a structure product in the structure All we are set as the try of the set of the set of the set of the set of the  $\frac{1}{2}$ The Alexandrian Control of the Alexandrian Section (Type The Control of Alexandrian) 197

-:·:01.	-11h2
---------	-------

y.	2	-	•••	54	•	2	a .	•••	•••	·	<b>.</b> .	۸ı.	'	70	The second
2	·*r		~	<i></i>	<b>;</b> ••	~ <b>•</b> .			JL,	÷	••-	£.#	×	-•-	÷.
×.,	ч.		·0	π. .,	••	•••	π·	••	7:	. <del></del>	-•••	<b>.</b> 1.	<b>r</b>	21	a.
	16.		.:	·	.•	~		• •	1.1		•	•••	•	2	··- 1
• • -	w::	1	~+F	<b>T</b> , 2		ARD.	345 197			ч.	7 <b>8</b> 2	<b>*</b>	••-	-143	π÷
••	Ľ,	<b>r</b>	···	<i>.</i>	•••	<u>.</u>	r ,	••	•.•	÷	3	۰.	(s.)	···	20
2	T-1	L		.пг	֥	~ <b>•</b> .	•••	<b>-</b> ?		n.		чы	L	۵ <b>-</b>	шс 1.1
•-	1		·		'	~		••	.C)		~	ulr	••	с,	a2
	-~•	v.	33	••	• •	··	541	5,	1		••	Ŧ	<u>.</u> :		a ·
••-	ـد.	<b>~</b> :	••-		<b>.</b>	<u>~</u>	77	6.76	JL.	ч.	•	**	,		-
	ç.,														

in several representation of the complete

d. An intelligents more confirming the mining to make their transitions from the solution from the grant influence of the solution of the solu

3. The intelligent school phaloen of character stretche for self-shares integrability but if is one of these region has indicated that is the installer of integrability of the self of the edge integrability of the other self is and the edge.

3. The coefficient reason profile in order or insure entries are entries a deal congruptive action in other entries are extended in the contract of the barriers address provides the teams, a districtly, a distribution of address provides and barry solid constraints a anti-use extending the address barry solid constraints and the constraints are address or extended according to a second second matching to decode according to a second second matching to decode according to a second second matching to decode according to a second second matching to detaction.

4. The multiplicate sense production of them 1, is never the surface final neuron is solvated from an entration, tables, rangcommand as the transmight externation as equip, interivative daggeoing, the evidation for the networking processing, thereing interivation is a solver the transmitted sensing taggeting. Tables (ing function)

S. The intelligent concepts from of character outside the answer classes the first structure of the single formula to ing more all the place dynamics.

- for The shell good to be plot for an information where in the server is ensured to a second considered system in the second system is a large study of a second system. Talling of the second problem with other and the second sec

X. The mostly are concerptified of chains to search the senses of a new and/or the fact is fact, smally or learning have to show how remark clearents, evices and process that

9 The intelligent school partition of elam 1, which an E. E.A. is a moderning incompany on internet description of the aggregist of wind metwork. Ensemptimizing moderation the elametric forminal procedure in the metwork paper of plate of a physical gradient operation methods of the elam of the aggregist of the engenteen methods of the elam of the aggregist.

In the methy menor particle mole of where the server is time ways, we fibeling manpolate intra a spear rende once of, methods of a galaxie strategies of this later there are not type.

11 There is a size of participation of the light of white the super-indexes of the backshe elements on the tespendeness of the second structure.

12 then always an environment of the Hills ender the contribution of a second control of the matter and the rest of the posterior of the methanic of the factor, the idea are notice to control methanics of the factor of the idea are notice to control methanics of the factor of the idea are notice to control methanics of the factor of the idea are noticed by the photonic of the idea are not respectively of the factor of the idea (the factor principal of principal of the idea (the factor).

13. If a fulfing a case photon taken to show influence the state of a set of the photon of the state of th

14 The of Lipsch school of the residual *I*, sherein the experimental of the fact of the function of the fact of the function of the least of the school of

1977 Send Fig. 1. An A.B. and J. B. B. Bahemin for energy in fact, if her main least investigation for contains.

16. The the light cherron photomorphic of the end of service photomorphic end of photomorphic ends of end of the end of interview construction work of the service end of the 
17 the relationships of a physical data in the second s

18 Taylor dipentions of historic default7, where intersense in any feleral repressing hera time yout the feltra lease transform as gardenice for turning on presenting radiaence or with on an disc de-

Write and generative justice on a sub-17 was sold female on compassion principal or restricts where a compassion methods for several methods the solution for experient contraction and the level of the wave the experient contraction of the wave methods to be

20. A method or contract actuation provider the end provider of the contract of the end of the e

. . . . .