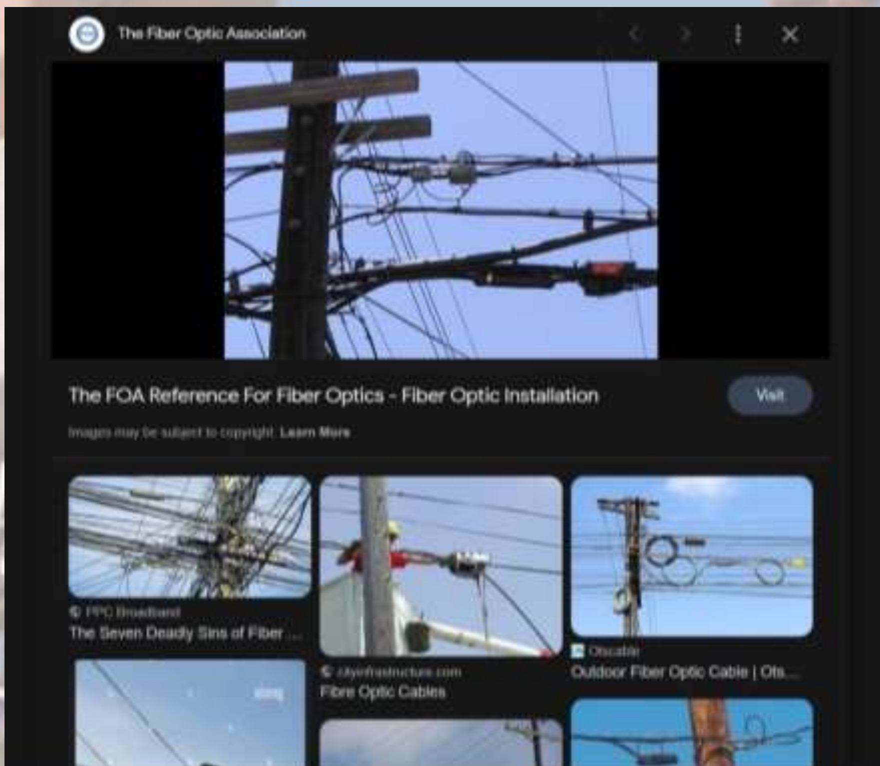
FIBER OPTIC, 5G/6G & TERRAHERTZ



Simona Panaitescu
Aug – Sep 2023

rumble.com/v339d9r-radiaii-microwave-rf-wireless-4g-5g-extrem-de-periculoase-n-bucureti-iulie-.html

rumble

Search

RADIAȚII MICROWAVE (RF/ WIRELESS) 4G-5G EXTREM DE PERICULOASE ÎN BUCUREȘTI - Iulie 2023

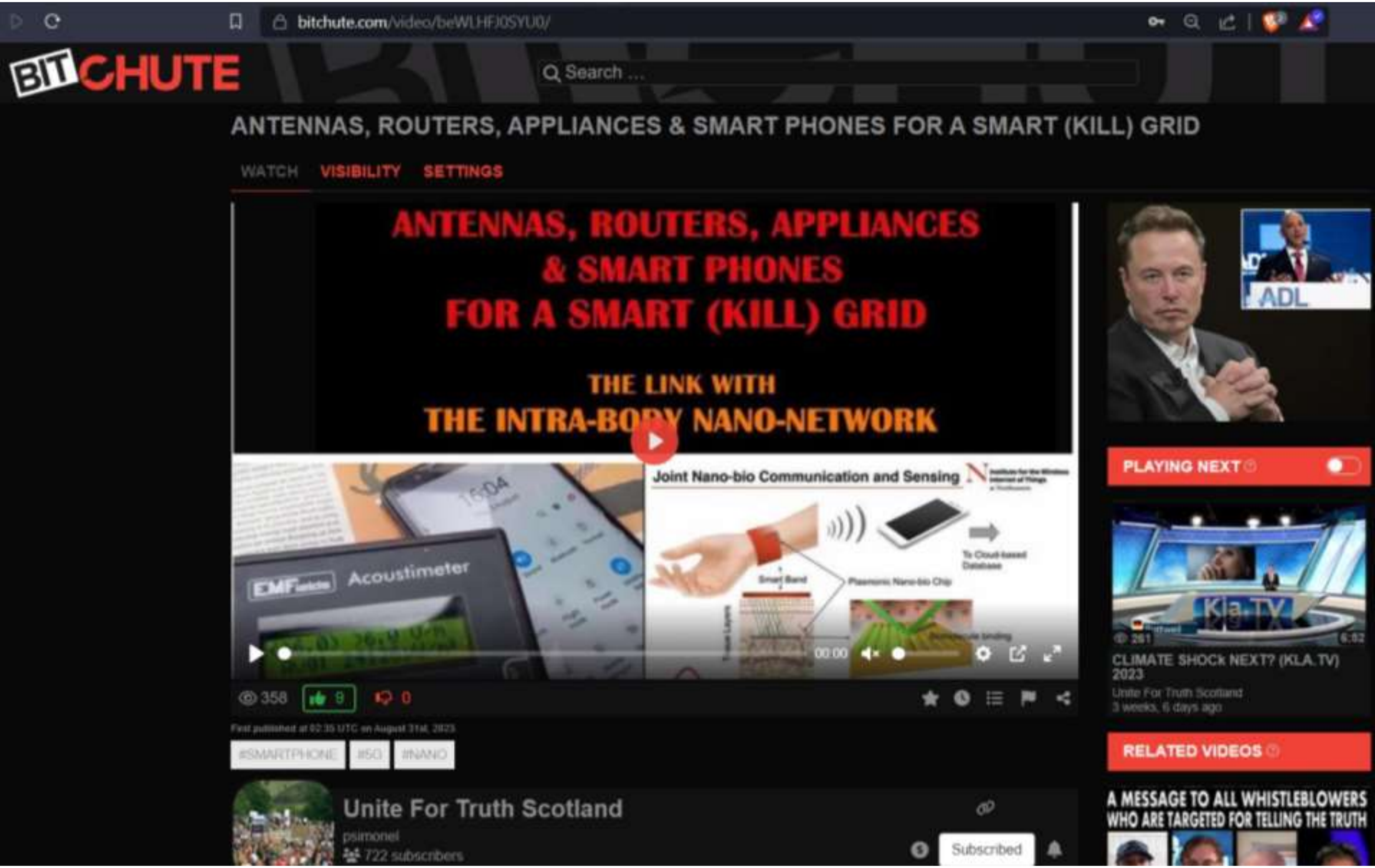
Unite For Truth Romania
41 followers

Unfollow

5 0

Comments

Embed


bitchute.com/video/beWLHFJ0SYU0/
BITCHUTE
Search ...
ANTENNAS, ROUTERS, APPLIANCES & SMART PHONES FOR A SMART (KILL) GRID
WATCH
VISIBILITY
SETTINGS
ANTENNAS, ROUTERS, APPLIANCES
& SMART PHONES
FOR A SMART (KILL) GRID
THE LINK WITH
THE INTRA-BODY NANO-NETWORK
Acoustimeter
Joint Nano-bio Communication and Sensing
Smart Band
Plasmonic Nano-bio Chip
To Cloud-based Database
00:00
358
9
0
First published at 02:35 UTC on August 31st, 2023
#SMARTPHONE
#5G
#NANO
Unite For Truth Scotland
psimonel
722 subscribers
Subscribed
ADL
PLAYING NEXT
Kla.TV
CLIMATE SHOCK NEXT? (KLA.TV) 2023
Unite For Truth Scotland
3 weeks, 6 days ago
RELATED VIDEOS
A MESSAGE TO ALL WHISTLEBLOWERS WHO ARE TARGETED FOR TELLING THE TRUTH

powerwatch.org.uk/science/intguidance.asp

Hotels.com YouTube Addons Store _The Information A... Apply to the EU Set... » Other bookmarks Reading list

1800 MHz Public Exposure Guidelines	PFD	Equivalent	c.f. speed
	μW/m²	V/m	m.p.h.
FCC (USA) OET-65	10,000,000	61	3000
ICNIRP (1998), WHO	9,000,000	58	2847
Belgium (excluding Wallonia)	1,115,000	21	1002
Italy (sum of frequencies)	100,000	6	300
Russia, PRChina	100,000	6	300
Switzerland, Lichtenstein, Luxembourg	95,000	6	292
Belgium Wallonia	24,000	3	147
Typical 100m from a base station (0.2 to 6 V/m)	10,000	1.9	95
Vienna (sum GSM)	10,000	1.9	95
Italy (single frequency)	1,000	0.6	30
Salzburg 1998 (sum GSM)	1,000	0.6	30
EU-Parl, GD Wissenschaft, STOA GSM (2001)	100	0.2	9
Median level, 15 US cities 1977 (mainly VHF & TV)	48	0.14	7
Salzburg GSM/3G outside houses (2002)	10	0.06	3
Salzburg GSM/3G inside houses (2002)	1	0.02	1
Burgerforum BRD proposal, waking areas (1999)	1	0.02	1
Burgerforum BRD proposal, sleeping areas (1999)	0.01	0.002	0.1
Mobile phone handsets can work down to about	0.000002	0.00003	0.0015
Natural background level (all RF frequencies)	0.000001	0.00002	0.001
Cosmic background at 1800 MHz average approx	0.00000000001	0.00000006	0.000003

Note that it is very rare indeed for broadcast radio signals to exceed 1 V/m inside residences, with VHF/UHF ones rarely exceeding 0.05 V/m, being typically less than 0.01 V/m.

Mobile phones can work down to less than 0.00003 V/m.

BioInitiative 2012

A Rationale for Biologically-based Exposure Standards for Low-Intensity Electromagnetic Radiation

Report Updated 2014 -2022

BIOINITIATIVE 2012 – CONCLUSIONS Table 1-1

Overall, these 1800 or so new studies report abnormal gene transcription (Section 5); genotoxicity and single-and double-strand DNA damage (Section 6); stress proteins because of the fractal RF-antenna like nature of DNA (Section 7); chromatin condensation and loss of DNA repair capacity in human stem cells (Sections 6 and 15); reduction in free-radical scavengers – particularly melatonin (Sections 5, 9, 13, 14, 15, 16 and 17); neurotoxicity in humans and animals (Section 9), carcinogenicity in humans (Sections 11, 12, 13, 14, 15, 16 and 17); serious impacts on human and animal sperm morphology and function (Section 18); effects on offspring behavior (Section 18, 19 and 20); and effects on brain and cranial bone development in the offspring of animals that are exposed to cell phone radiation during pregnancy (Sections 5 and 18). This is only a snapshot of the evidence presented in the BioInitiative 2012 updated report.

BIOEFFECTS ARE CLEARLY ESTABLISHED

Bioeffects are clearly established and occur at very low levels of exposure to electromagnetic fields and radiofrequency radiation. Bioeffects can occur in the first few minutes at levels associated with cell and

BioInitiative 2012

Biologically-based Exposure Standards for Low-Intensity Electromagnetic Radiation

The continued rollout of wireless technologies and devices puts global public health at risk from unrestricted wireless commerce unless new, and far lower exposure limits and strong precautionary warnings for their use are implemented.

EMF AND RFR ARE PREVENTABLE TOXIC EXPOSURES

We have the knowledge and means to save global populations from multi-generational adverse health consequences by reducing both ELF and RFR exposures. Proactive and immediate measures to reduce unnecessary EMF exposures will lower disease burden and rates of premature death.

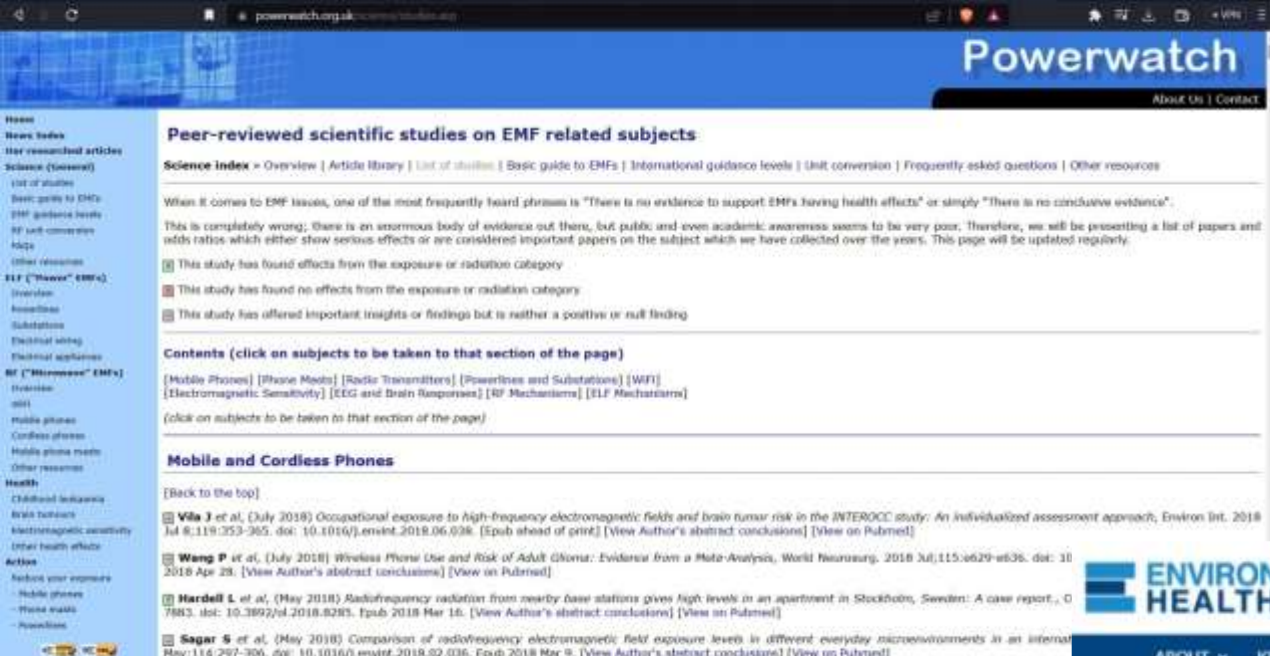
DEFINING A NEW 'EFFECT LEVEL' FOR RFR

1000 uW/m2

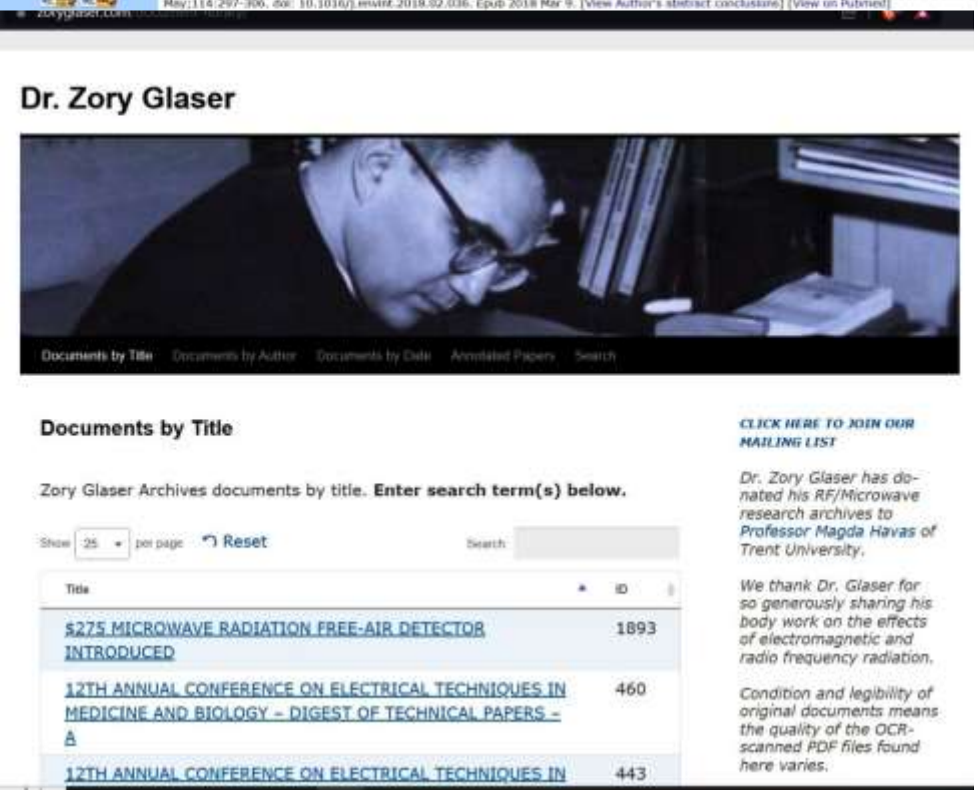
On a precautionary public health basis, a reduction from the BioInitiative 2007 recommendation of 0.1 uW/cm2 (or one-tenth of a microwatt per square centimeter) for cumulative outdoor RFR down to something three orders of magnitude lower (in the low nanowatt per square centimeter range) is justified.

A scientific benchmark of 0.003 uW/cm2 or three nanowatts per centimeter squared for 'lowest observed effect level' for RFR is based on mobile phone base station-level studies. Applying a ten-fold reduction to compensate for the lack of long-term exposure (to provide a safety buffer for chronic exposure, if needed) or for children as a sensitive subpopulation yields a 300 to 600 picowatts per square centimeter precautionary action level. This equates to a 0.3 nanowatts to 0.6 nanowatts per square centimeter as a reasonable, precautionary action level for chronic exposure to pulsed RFR. These levels may need to change in the future, as new and better studies are completed. We leave room for future studies that may lower or raise today's observed 'effects levels' and should be prepared to accept new information as a guide for new precautionary actions.

3 - 6 uW/m2


Powerwatch
About Us | Contact
Peer-reviewed scientific studies on EMF related subjects
Science index » Overview | Article library | List of studies | Basic guide to EMFs | International guidance levels | Unit conversion | Frequently asked questions | Other resources
Contents (click on subjects to be taken to that section of the page)
Mobile and Cordless Phones
[Back to the top]


Oceania Radiofrequency
Scientific Advisory Association
Team
Resources
Contact


Dr. Zory Glaser
Documents by Title
Zory Glaser Archives documents by title. Enter search term(s) below.
Reset
$275 MICROWAVE RADIATION FREE-AIR DETECTOR INTRODUCED
1893
12TH ANNUAL CONFERENCE ON ELECTRICAL TECHNIQUES IN MEDICINE AND BIOLOGY - DIGEST OF TECHNICAL PAPERS - A
460
12TH ANNUAL CONFERENCE ON ELECTRICAL TECHNIQUES IN
443
CLICK HERE TO JOIN OUR MAILING LIST
Dr. Zory Glaser has donated his RF/Microwave research archives to Professor Magda Havas of Trent University.
We thank Dr. Glaser for so generously sharing his body work on the effects of electromagnetic and radio frequency radiation.
Condition and legibility of original documents means the quality of the OCR-scanned PDF files found here varies.


ENVIRONMENTAL HEALTH TRUST
ABOUT
KEY ISSUES
SCIENCE
POLICY
RESOURCES
GET EDUCATED
SCIENTIFIC EVIDENCE THAT 5G AND 4G DENSIFICATION IS NOT SAFE
5G

THE ALLIANCE PUBLICATIONS MEDIA EU INSTITUTIONS UN/WHO APPEAL 5G & BEYOND NEWS

EMF Scientist Appeal to the United Nations

This page is dedicated to advocating support for the International EMF Scientist Appeal to the United Nations and the World Health Organization.

Announcement from the International EMF Alliance

Request to NGOs worldwide to support the International EMF Scientist Appeal to the United Nations

UPDATE: See February 4, 2016 letter from Sissel Halmøy, President of IEMFA, to the leaders of the UN, the WHO and UNEP advising them of widespread international NGO support for the International EMF Scientist Appeal.

The International Electromagnetic Field Alliance (IEMFA) has received a statement of support for the International EMF Scientist Appeal submitted to the United Nations on May 11, 2015, from 105 NGOs in 25 nations, including for-profit entities that market physical shielding materials and EMF detection equipment. See the Appeal at: EMFscientist.org

To date, 220 scientists from 41 nations have signed the Appeal. Each has published peer-reviewed research on biological or health effects of non-ionizing radiation, including extremely low frequency fields (ELF) used for electricity or radio frequency radiation (RFR) used for wireless communications.

These EMF scientists are raising serious concerns regarding the risks for humankind and nature ... ing exposure to EMF sources (electromagnetic fields and

INTERNATIONAL APPEAL
Stop 5G on Earth and in Space

SIGN HERE DONATE THE

Read as PDF in:

Organizations

Organizations

As of January 7, 2020, 188,653 people and organizations from 203 nations and territories have signed this Appeal.

FREIBURGER APPEAL

Interdisciplinary Society for Environmental Medicine e. V.

Out of great concern for the health of our fellow human beings do we - as established physicians of all fields, especially that of environmental medicine - turn to the medical establishment and those in public health and political domains, as well as to the public. We have observed, in recent years, a dramatic rise in severe and chronic diseases among our patients, especially:

- Learning, concentration, and behavioural disorders (e.g. attention deficit disorder, ADD)

- Extreme fluctuations in blood pressure, ever harder to influence with medications

- Heart rhythm disorders

- Heart attacks and strokes among an increasingly younger population

- Brain-degenerative diseases (e.g. Alzheimer's) and epilepsy

- Cancerous afflictions: leukemia, brain tumors

Scientists warn of potential serious health effects of 5G

September 13, 2017

We the undersigned, more than 180 scientists and doctors from 35 countries, recommend a moratorium on the roll-out of the fifth generation, 5G, for telecommunication until potential hazards for human health and the environment have been fully investigated by scientists independent from industry. 5G will substantially increase exposure to radiofrequency electromagnetic fields (RF-EMF) on top of the 2G, 3G, 4G, Wi-Fi, etc. for telecommunications already in place. RF-EMF has been proven to be harmful for humans and the environment.

(Note: Blue links below are references.)

5G leads to massive increase of mandatory exposure to wireless radiation

5G technology is effective only over short distance. It is poorly transmitted through solid material. Many new antennas will be required and full-scale implementation will result in antennas every 10 to 12 houses in urban areas, **thus massively increasing mandatory exposure.**

With "the ever more extensive use of wireless technologies," nobody can avoid to be exposed. Because on top of the increased number of 5G-transmitters (even within housing, shops and in hospitals) according to estimates, "10 to 20 billion connections" (to refrigerators, washing machines, surveillance cameras, self-driving cars and buses, etc.) will be parts of the Internet of Things. All these together can cause a substantial increase in the total, long term RF-EMF exposure to all EU citizens.

Harmful effects of RF-EMF exposure are already proven

More than 230 scientists from 41 countries have expressed their "serious concerns" regarding the ubiquitous and increasing exposure to EMF generated by electric and wireless devices already before the pubmed.ncbi.nlm.nih.gov/34778597/

PubMed®

Advanced

Save Email

Review > J Clin Transl Res. 2021 Sep 29;7(5):666-681. eCollection 2021 Oct 26.

Evidence for a connection between coronavirus disease-19 and exposure to radiofrequency radiation from wireless communications including 5G

Beverly Rubik [1] [2], Robert R Brown [3]

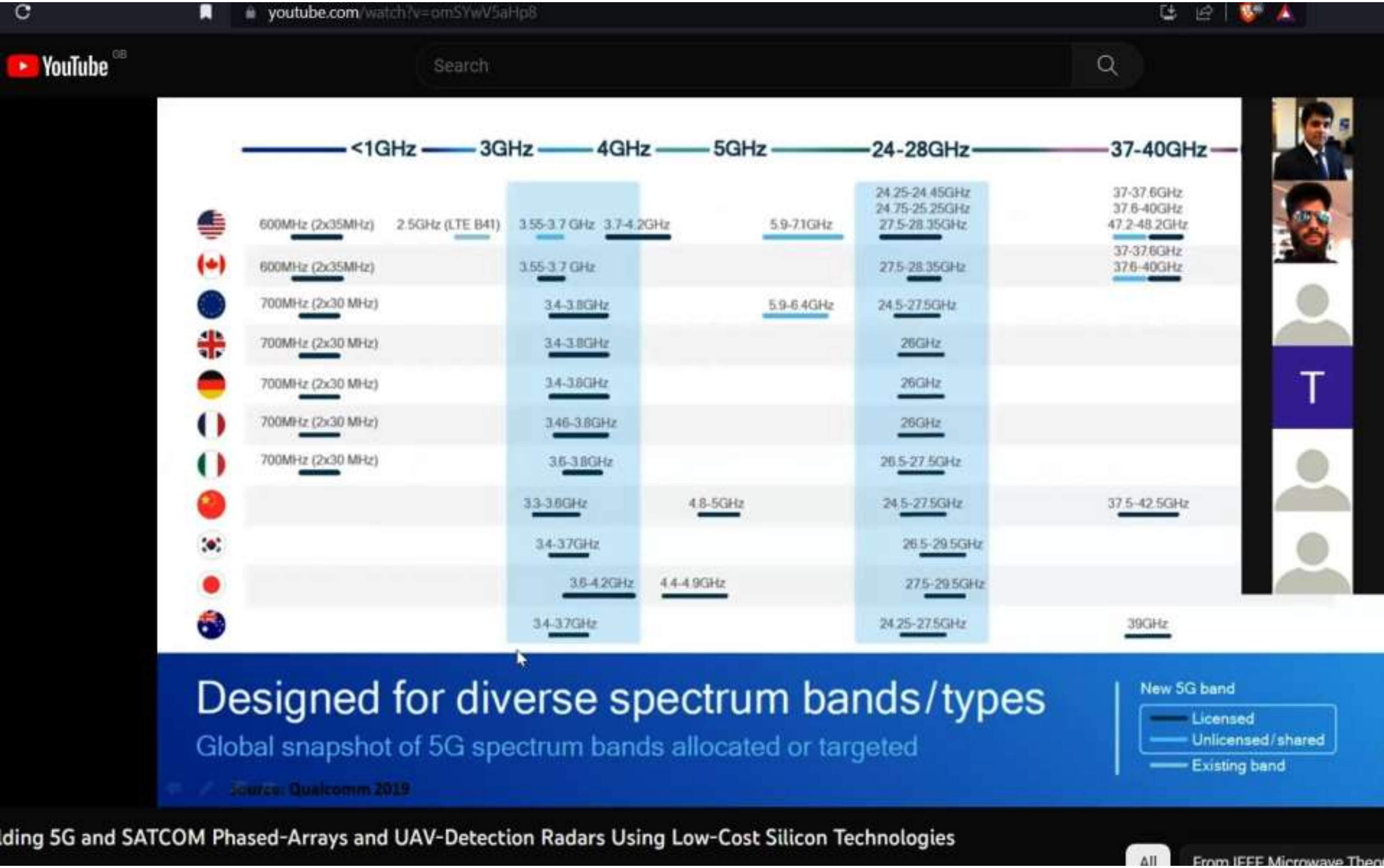
Affiliations + expand

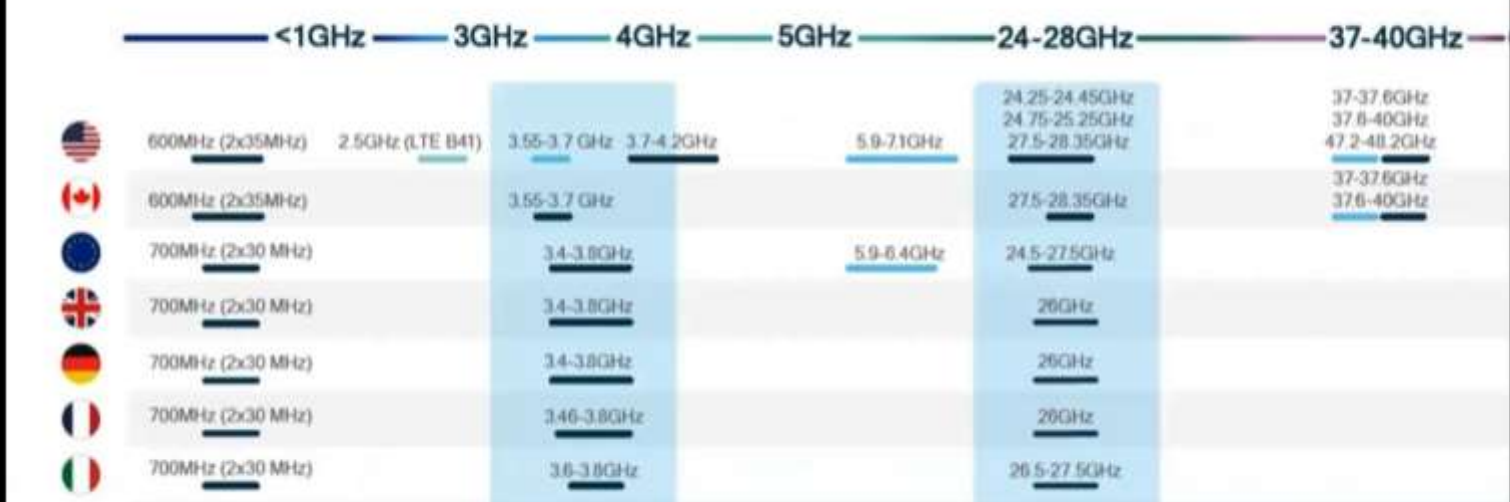
PMID: 34778597 PMCID: PMC8580522

Free PMC article

Abstract

Background and aim: Coronavirus disease (COVID-19) public health policy has focused on the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus and its effects on human health while environmental factors have been largely ignored. In considering the epidemiological triad (agent-host-environment) applicable to all disease, we investigated a possible environmental factor in the COVID-19 pandemic: ambient radiofrequency radiation from wireless communication systems including microwaves and millimeter waves. SARS-CoV-2, the virus that caused the COVID-19 pandemic, surfaced in Wuhan, China shortly after the implementation of city-wide (fifth generation [5G] of wireless communications radiation [WCR]), and rapidly spread globally, initially demonstrating a statistical correlation to international communities with recently established 5G networks. In this study, we examined the peer-reviewed scientific literature on the detrimental bioeffects of WCR and identified several mechanisms by which WCR may have contributed to the COVID-19 pandemic as a toxic environmental cofactor. By crossing boundaries between the disciplines of biophysics and pathophysiology, we present evidence that WCR may: (1) cause morphologic changes in erythrocytes including echinocyte and rouleaux formation that can contribute to hypercoagulation; (2) impair microcirculation and reduce erythrocyte and hemoglobin levels exacerbating hypoxia; (3) amplify


youtube.com/watch?v=omSYwV5aHp8
YouTube
Search
<1GHz
3GHz
4GHz
5GHz
24-28GHz
37-40GHz
600MHz (2x35MHz)
2.5GHz (LTE B41)
3.55-3.7 GHz
3.7-4.2GHz
5.9-7.1GHz
24.25-24.45GHz
24.75-25.25GHz
27.5-28.35GHz
37-37.6GHz
37.6-40GHz
47.2-48.2GHz
600MHz (2x35MHz)
3.55-3.7 GHz
27.5-28.35GHz
37-37.6GHz
37.6-40GHz
700MHz (2x30 MHz)
3.4-3.8GHz
5.9-6.4GHz
24.5-27.5GHz
700MHz (2x30 MHz)
3.4-3.8GHz
26GHz
700MHz (2x30 MHz)
3.4-3.8GHz
26GHz
700MHz (2x30 MHz)
3.46-3.8GHz
26GHz
700MHz (2x30 MHz)
3.6-3.8GHz
26.5-27.5GHz
3.3-3.6GHz
4.8-5GHz
24.5-27.5GHz
37.5-42.5GHz
3.4-3.7GHz
26.5-29.5GHz
3.6-4.2GHz
4.4-4.9GHz
27.5-29.5GHz
3.4-3.7GHz
24.25-27.5GHz
39GHz
Designed for diverse spectrum bands/types
Global snapshot of 5G spectrum bands allocated or targeted
New 5G band
Licensed
Unlicensed/shared
Existing band
Source: Qualcomm 2019
T
ding 5G and SATCOM Phased-Arrays and UAV-Detection Radars Using Low-Cost Silicon Technologies
All



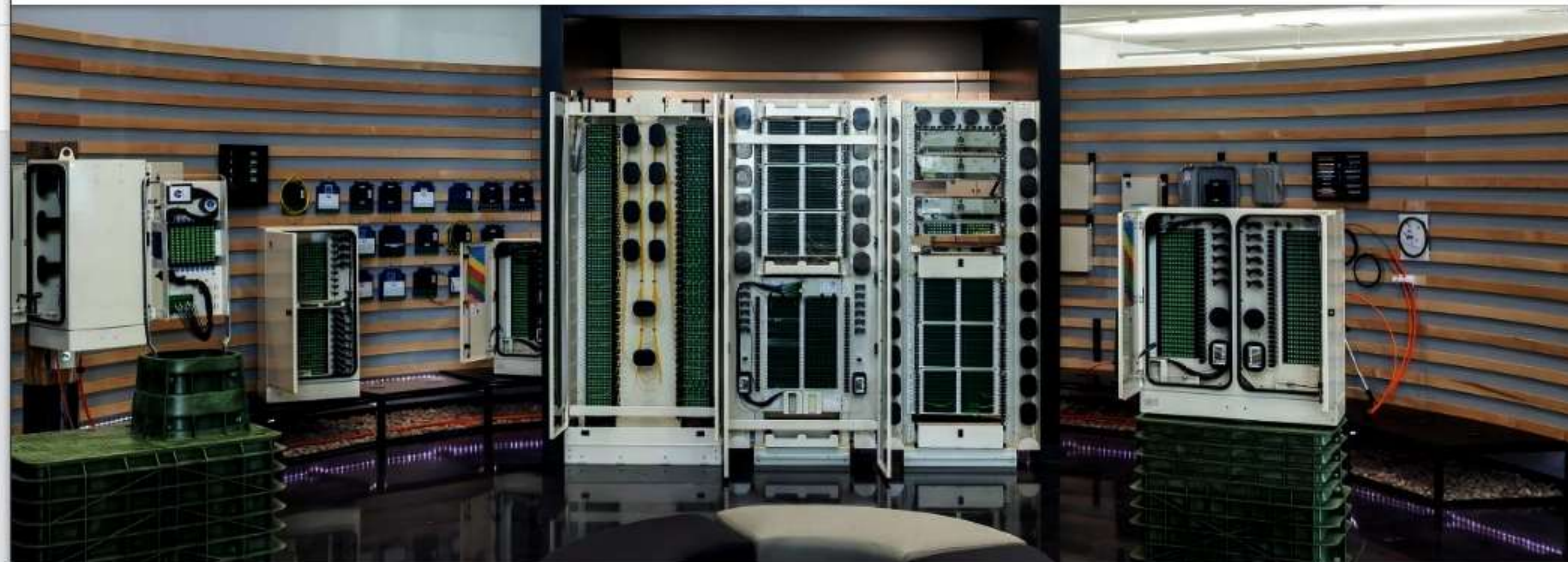
Low Band 5G	600 MHz - 850 MHz	• Similar to 4G Cellphones. • The low band cell towers have a coverage area range similar to 4G cellphone towers. • Speeds are 30 – 250 Mega Bits per second
Mid Band 5G	2.5 GHz - 3.7 GHz	• Frequencies used are in the Microwave range • Cell tower coverage is up to several kilometers in radius • Speeds are between 100 – 900 Mega bits per second
High Band 5G	25 GHz – 39 GHz	• Frequencies used are in the Microwave range • Limited coverage range and needing many small cells

MMW
Millimeter Waves

Feature	1G	2G	3G	4G	5G
Start/Development	1970/ 1984	1980/1999	1990/2002	2000/2010	2010/2015
Technology	AMPS, NMT, TACS	GSM	WCDMA	LTE, WiMAx	MIMO, mmWaves
Bandwidth	2 kbps	14.4 - 64 kbps	2 Mbps	2000 Mbps – 1 Gbps	> 1Gbps
Access System	FDMA	TDMA/CDMA	CDMA	CDMA	OFDMA/BDMA
Core Network	PSTN	PSTN	Packet Network	Internet	Internet

seeclearfield.com/products/applicat...

CLEARFIELD



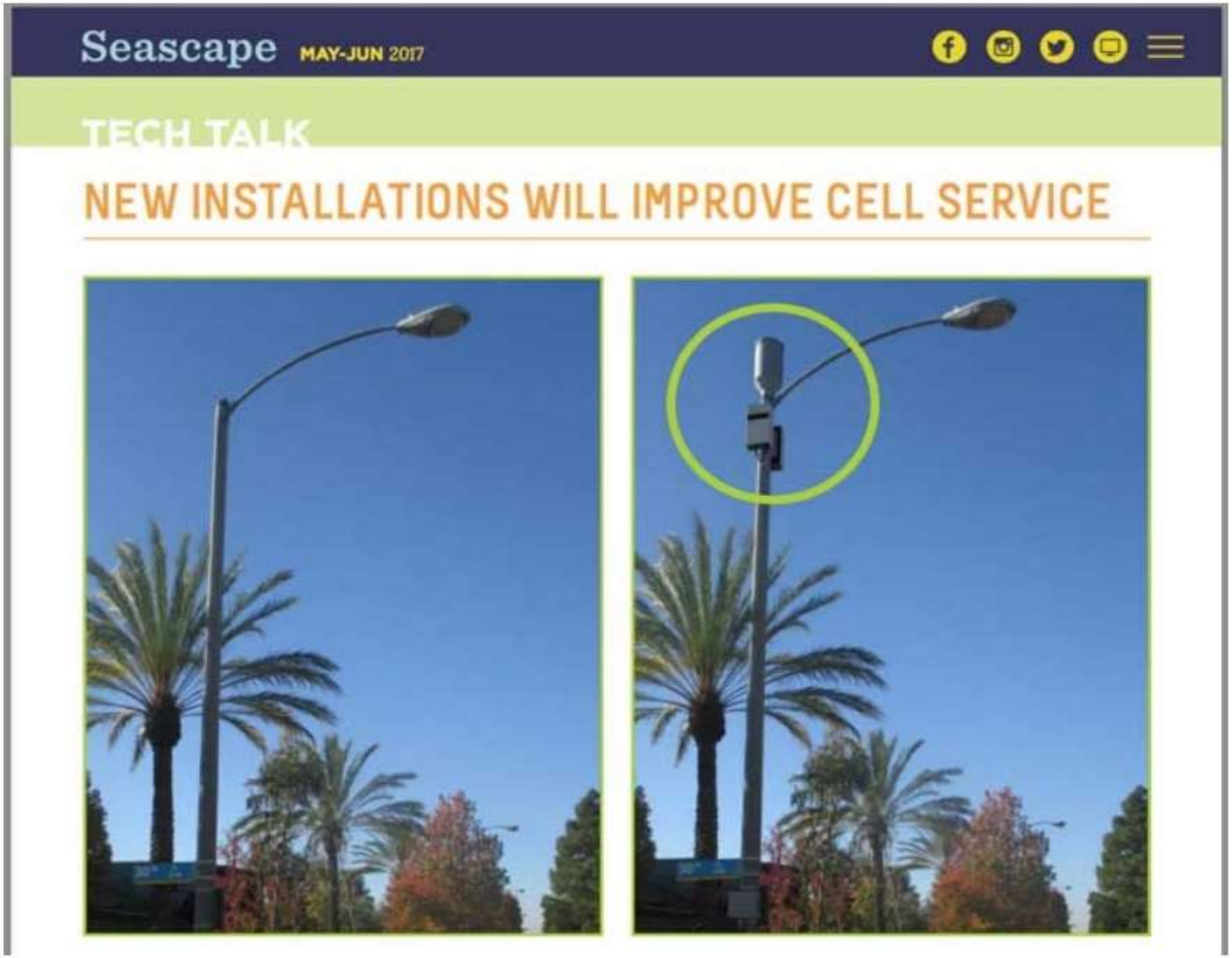
/ Products / Browse By / Application Environment / Wireless / Small Cells for 5G Deployments

Small Cells for 5G Deployments

The Small Cell is another critical component in the arsenal of today's wireless providers as they equip their networks for the dramatic increase in wireless coverage that 5G will demand. Small Cells help to boost an area of weak coverage within a macro cell network by offloading traffic normally handled by the macro cell.

use PONs (passive optical networks - like FTTH) to reduce the fiber needed and electronics near the antenna. You can place several of these small cells in one dome providing extended coverage over many frequencies.

Look at what is happening in Santa Monica, CA. The Santa Monica ***Seascape***, the city's newsletter for its citizens, recently ran this article about small cells.



"In 2016, the City of Santa Monica adopted a new wireless telecommunication ordinance to protect the city from uncontrolled expansion, while streamlining the review process to meet statutory

Other cities are also installing small cells. Below are photos from downtown San Francisco of three different types of small cells on street lights on Polk Street.


Boston also has a number of small cells installed.



NASA CR-166,661

NASA-CR-166661

19810017132

3 1176 00161 6706

NASA CR 166661

ELECTROMAGNETIC FIELD INTERACTIONS WITH THE HUMAN BODY: OBSERVED EFFECTS AND THEORIES

NASA Purchase Order No. S-75151B

APRIL 1981

Country, author	Frequency (MHz)	Maximum permissible intensity	Remarks	
USA: Ely, T.S., Goldman, D. (1957)	3000	100 mW/cm^2	Whole body	10 uW/m2
		150 mW/cm^2	Eyes	15
		5 mW/cm^2	Testes	0.5
USA: U.S. Army (1958)	All	10 mW/cm^2	-	
USA: Schwan, H.P. and Li, K. (1956)	1000	30 mW/cm^2	Whole body	1 - 3 uW/m2
	1000-3000	10 mW/cm^2	Whole body	
	3000	20 mW/cm^2	Whole body	
USA: General Electric	700	1 mW/cm^2	-	
USA: Bell Telephone Labs. (1956)	750-30 000	1 mW/cm^2	-	
USA: Mumford, W.W. (1956)	-	0.1 mW/cm^2	-	
NATO (1956)	-	0.5 mW/cm^2	-	
Sweden	87	222 V/m	-	
	87	25 V/m	-	
Britain	300	0.01 mW/cm^2	-	
West Germany (1962)	-	10 mW/cm^2		
USSR (1965)	0.1-1.5	20 V/m		
		5 A/m		
	1.5-30	20 V/m		
	30-300	5 V/m		
	> 300	0.01 mW/cm^2	6 hr daily	0.1 -0.001 uW/m2
		0.1 mW/cm^2	2 hr daily	
		1 mW/cm^2	15 min daily	
Poland (1961)	> 300	0.01 mW/cm^2	Entire workday	
		0.1 mW/cm^2	2-3 hr daily	
		1 mW/cm^2	15-20 min daily	
Czechoslovakia (1965)	> 300	0.025 mW/cm^2	Cw operation } 8*hr	0.001 uW/m2
		0.01 mW/cm^2	Pulsed op'n } daily	
	0.01-300	10 V/m		
USA (1966)	10-100 000	1 (mW/cm^2)hr	Every 6 min	
Canada (1966)	10-100 000	1 (mW/cm^2)hr	Every 6 min	0.1 uW/m2

*For shorter exposure, see Figs. 39 and 40. (See also Appendix.)

TABLE 4. EXPOSURE STANDARDS FOR ELECTROMAGNETIC RADIATION (FROM MARHA & TUHA, 1971).

NASA CR-166,661

NASA-CR-166661
19810017132

NASA CR 166661

ELECTROMAGNETIC FIELD INTERACTIONS WITH THE HUMAN BODY: OBSERVED EFFECTS AND THEORIES

NASA Purchase Order No. S-75151B

APRIL 1981

Standard	Type	Frequency	Exposure limit	Exposure duration	CW/ pulsed	Antenna Stationary/ Rotating	Remarks
USSR Government 1977 (299)	Occupational	10-30 MHz	20 V/m	working day	both	both	Military units and establishments of the Ministry of Defence excluded
		30-50 MHz	10 V/m	working day	both	both	
			0.3 A/m	working day	both	both	
		50-300 MHz	5 V/m	working day	both	both	
		0.3-300 GHz	10 μW/cm^2	working day	both	stationary	
			100 μW/cm^2	working day	both	rotating	
			100 μW/cm^2	2 hours	both	stationary	
			1 mW/cm^2	2 hours	both	rotating	
			1 mW/cm^2	20 min.	both	stationary	
USSR Government 1970 (42)	General public	0.3-300 GHz	1 μW/cm^2	24 hours	both	both	
Czechoslovakia Government 1970 (42)	Occupational	10-30 MHz	50 V/m	working day	both	both	
		30-300 MHz	10 V/m	working day	both	both	
		0.3-300 GHz	25 μW/cm^2	working day	cw	both	
			10 μW/cm^2	working day	pulsed	both	max peak 1 kW/cm^2
			1.6 mW/cm^2	1 hour	cw	both	
			0.64 mW/cm^2	1 hour	pulsed	both	
	General public	30-300 MHz	1 V/m	24 hours	both	both	
		0.3-300 GHz	2.5 μW/cm^2	24 hours	cw	both	
			1 μW/cm^2	24 hours	pulsed	both	
		30-300 MHz	1 V/m	24 hours	both	both	
		10-30 MHz	2.5 V/m	24 hours	both	both	
Poland Government 1972 (42, 300)	Occupational	0.3-300 GHz	0.2 mW/cm^2	10 hours	both	stationary	
			0.2-10 mW/cm^2	32/P^2 (hours)	both	stationary	P-power density in W/m^2
			1 mW/cm^2	10 hours	both	rotating	
			1-10 mW/cm^2	800/P^2 (hours)	both	rotating	P-power density in W/m^2
	General pulic	0.3-300 GHz	10 μW/cm^2	24 hours	both	stationary	
			0.1 mW/cm^2	24 hours	both	rotating	
Poland Government 1975 proposed (42, 300)	Occupational	10-300 MHz	20 V/m	working day	both	both	
			20-300 V/m	3200/E^2 (hours)	both	both	E-electric field intensity in V/m
	General public	10-300 MHz	7 V/m	24 hours	both	both	

0.01 - 0.1 uW/m2

0.1 uW/m2

0.0001 uW/m2

0.001 uW/m2 pulsed

6 uW/m2 pulsed

0.0001 uW/m2 pulsed

0.02 - 0.1 uW/m2

0.001 uW/m2

TABLE 3. EXPOSURE STANDARDS IN THE USSR, POLAND, AND CZECHOSLOVAKIA (FROM STUCHLY, 1978).

NASA CR 166661

ELECTROMAGNETIC FIELD INTERACTIONS WITH THE HUMAN BODY: OBSERVED EFFECTS AND THEORIES

NASA Purchase Order No. S-75151B

APRIL 1981

Country, and Type of Standard	Radiation Frequency and Waveform	Maximum Levels	Comments and Conditions
USA (ANSI) Exposure Standard	10 MHz - 100 GHz (all waveforms)	10 mW/cm² 1uW/m2	For periods of 0.1 hr or more. Whole and partial body. Reduction in high temperature environments, or for health reasons recommended.
		1 mW.h/cm²	Averaged over any 0.1 hr period.
U.S.Army/ Air Force		10 mW/cm²	Continuous exposure. When power density (*S*) is in the 10-100 mW/cm² range, max allowed exposure time is 6000/W² minutes, where *S* is expressed in mW/cm².
		100 mW/cm²	No occupancy or protective clothing required.
USSR 1976 Industrial Safety Exposure Standard*		0.1 - 1 mW/cm² 0.01 - 01 uW/m2	For a 20 min maximum exposure duration. Standard states: "Protective goggles mandatory. Power density must not then exceed 0.1 mW/cm² for balance of work day". Radiation from adjustable or scanning antennae is allowed at this level for 2 hrs.
	0.001 - 0.01 uW/m2	10 - 100 μW/cm²	For a 2 hrs maximum duration (then 10 μW/cm² for balance of work day).
		10 μW/cm²	Required limit for a 'work day', all sources, except adjustable or scanning antennae (100 μW/cm²).
	50 MHz - 300 MHz (all waveforms)	5 V/m	Levels in "work areas and other areas where personnel are permitted and occupationally exposed". . . shall not, in the course of the work day, exceed this value.
	30 - 50 MHz	10 V/m (or 0.3A/m)	Whichever is the greater.
	3 - 30 MHz	20 V/m	
	60 kHz - 3 MHz	50 V/m	(or 5 A/m in the range 60 kHz to 1.5 MHz)
Czech. Soc. Rep. Exposure Standard	300 MHz - 300 GHz	25 μW/cm² 0.0025 uW/m2	8 hrs/day, for CW waveforms; reduced to 10 μW/cm² for pulsed waveforms.
	0.01 - 300 MHz	10 V/m	8 hrs/day
USA: Product Emission Standard	890 - 6000 MHz	1 - 5 mW/cm² 0.1 - 0.5 uW/m2	Emitted by the product at full power operation; lower level when manufactured ("prior to acquisition").
	(ISM Bands in this range)		5 mW/cm² max in use. Measured with specified load (275 ± 15 ml H_2O at 20 ± 5°C), at full power, 5 cm or more from any external surfaces by an approved instrument with effective aperture ≪ 25 cm², no dimension > 10 cm.
Canada: Product Emission Standard	0.01 - 300 GHz	1 mW/cm² 0.1 uW/m2	Emitted by product at maximum output, at points "at least 5 cm from the external surface of the oven", when the oven is loaded with a load equal to the water equivalent of the minimum operating load, as specified by the manufacturer, at 20 ± 5 °C. Instrument specified in standard.
		5 mW/cm²	Emission at no load, if total microwave output is < 3 kW.
Canada: Recommended Exposure Limit	0.01 - 300 GHz	1 mW/cm²	Average power density limit in any 1 hr period (max 25 mW/cm² averaged over 1 min).

*The reader is referred to the actual standards for more detail. Great caution is required in interpreting and translating standards.

TABLE 5. EXPOSURE STANDARDS FOR ELECTROMAGNETIC RADIATION.

In-House Report
June 1994

RAD!OFREQUENCY/MICROWAVE RADIATION BIOLOGICAL EFFECTS AND SAFETY STANDARDS: A REVIEW

Sc.'tt M. Bolen

Rome Laboratory
Air Force Materiel Command
Griffiss Air Force Base, New York

i. Recommendations

0.5 uW/m2
for 1.5 GHz to 100 GHz

The ANSI C95.1-1982 Standard specifies the maximum recommended RF/MW radiation exposure levels over a frequency range of 300 KHz to 100 GHz. Typically, the standard calls for an exposure of no more than 5 mW/cm² for frequencies between 1500 MHz to 100,000 MHz. The reader should consult with the actual ANSI publication for the detailed recommendations. In addition, the standard limits the whole-body SAR to 0.4 W/Kg and indicates that the spatial peak SAR should not exceed 8.0 W/Kg over any one gram of tissue. For both CW and pulsed EM fields the exposure time should not exceed 6 minutes at the recommended levels. These maximum safe levels are not intended to apply to the medical treatment of patients where irradiation is sometimes useful in combating diseases like cancer. The standard does pertain to the general public and to persons that work in electromagnetic environments. There are two exceptions to the recommendation: 1) at frequencies between 100 KHz and 1 GHz the maximum exposure levels may be exceeded as long as the stated SAR values are not violated and 2) at frequencies between 300 KHz and 1 GHz the exposure levels may be exceeded if the output power of the radiating device is less than 7 W [9].

B. USAF PEL (AFOSH Standard 161-9, 12 February 1987)

1uW/m2
for 1.5 GHz to 300 GHz

Since the early investigations of the Tri-Service Commission, the United States Air Force has recognized the need to establish an RF/MW protection standard. The USAF permissible exposure level (PEL) is specified in AFOSH Standard 161-9 enacted 12 February 1987. This standard stipulates maximum safe RF/MW radiation exposure levels over a frequency range of 10 KHz to 300 GHz. The PELs are shown in Figures 7 and 8 [10].

In general, the USAF protection guideline agrees with the ANSI Standard except that a distinction is made between exposure to persons in restricted and unrestricted areas. No explanation for this policy is given in the USAF Standard. The PEL for restricted areas shows only a slight alteration from the ANSI recommendation. For a frequency range of 1500-300,000 MHz the USAF PEL is given as 10 mW/cm². The PEL put forth by the USAF is intended to protect personnel from harm by limiting the whole-body SAR to 0.4 W/Kg. Exposure periods at the maximum safe levels should be limited to 6 minutes. It is also recommended that exposure in the near zone to RF/MW sources radiating at less than 30 MHz may require a separate evaluation to determine safe exposure levels of irradiation [10].


EMINESCU
100


4Love.ro
magazin erotic


LUKOIL

DIMPORT
MAGAZIN MIXT NON STOP MAGAZIN MIXT
Piața Universității
DHL


tike!
LaDoiPasi


PETROM


30
B 650 CJR

google.com/imgres?imgurl=https%3A%2F%2Fwww.thefoa.org%2Ftech%2Fref%2...

The Fiber Optic Association

The FOA Reference For Fiber Optics - Fiber Optic Installation

Visit

PPC Broadband

The Seven Deadly Sins of Fiber ...

cityinfrastructure.com

Fibre Optic Cables

Otscable

Outdoor Fiber Optic Cable | Ots...

google.com/imgres?imgurl=https%3A%2F%2Fwww.thefoa.org%2Ftech%2Fref%2Fbasic%2Faerial2.jpg&tbnid=GyvIFx6niB...

News - Sun Telecom-Fiber Optic Total Solutions

Visit

Images may be subject to copyright. **Learn More**

Electrical Contractor Magazine

Fiber Technology at Electrical Ut

Telegraph India

Telegraph Right of Way (RoW)

More fiber optics required

A key topic is the network infrastructure with Radio Access Networks and centralized base stations (baseband units, BBU). There is a greater demand for fiber optic capacity to connect the BBUs to the 5G cells. It depends on distance and traffic load. In addition, there is a demand for power supply for active technology.

The construction of fiber-optic connections between the backhaul network and antennas – Fiber to the Antenna (FTTA) – is a complex matter. It's not just about the availability and capacity of fiber optic lines, but also about individual site conditions. All premises are different. Sometimes creative cabling paths have to be found in the most unusual places.

Public and private telecom operators, neutral hosts, and tower companies will in some places be forced to merge parts of their fiber optic networks. The space issue at the antennas and on buildings or the load capacity, wind load, and scalability must be taken into account when planning the installation.

3. Badly Planned Cables

Utility poles are valuable aerial real estate, meaning many attract a huge number of cables, often from different carriers. With no forward planning, copper, coax and fiber cable can be mixed together, making it difficult to identify and access specific cables. And the lack of organization leads to greater problems in the future – what happens if the pole has to be replaced and every individual cable rerouted? In this photo (left), the pole was situated at a main street intersection – so if a truck took it out, communications for a large chunk of the town would go down.

4. Unsuitable Aesthetics

Home owners and landlords care about the aesthetic appearance of their buildings, but too many installations fail to take this into account. Oversized cables that snake across once pristine walls aren't just ugly, but also put consumers off the whole idea of upgrading to fiber if it means damaging their environment. We've seen installations that actually go across windows meaning they can't be opened – as well as blocking light from getting into a home. Planning and sensitivity are key to avoiding justifiably angry homeowners.

Why Fiber?

What is Fiber?

All-fiber networks (sometimes referred to as fiber-to-the-home—FTTH—or fiber-to-the-premises—FTTP) are built to connect homes and businesses to lightning fast Internet connections. The fiber optic cables that make up these networks are the fastest and most reliable broadband technology and are capable of delivering vastly higher bandwidth than traditional copper wires or wireless. All-fiber networks are directly connected from the central office all the way to a subscriber's building. There is no other technology along the path except fiber optics.

Fiber optic cables are made up of thin strands of glass that carry information by transmitting pulses of light, which are usually created by lasers. The vibrations are turned on and off very quickly. A single fiber can carry multiple streams of information simultaneously over different wavelengths, or colors, of light, enabling more robust video, Internet, and voice services. Fiber cables are capable of transmitting multi-gigabit Internet speeds compared to the mere megabytes typical of copper connections.

Best of all, ongoing improvements in fiber optic equipment are constantly increasing the bandwidth that can travel through fiber networks.

4
Conclusion

Already last year, the project group has worked out that practically all access network technologies are based on differently extensive fiber optic expansion. Following up on this, systematic correlations between the fiber optic expansion in the fixed line network and the implementation of 5G are established in this document, since 5G is dependent on high-performance connections with optical fiber as far as possible.

- New challenges remain, for example, on areas with agricultural and forestry use or along mobility routes such as district, state and federal highways, since the activities of broadband expansion in the fixed line network focus on populated areas.
- The identified synergies and correlations between the optical fiber expansion in the fixed line network and 5G can result in additional market potential for fixed line network operators in order to participate in the 5G

electronics

MDPI

Article

Fibre Wireless Distributed Antenna Systems for 5G and 6G Services

Muhammad Usman Hadi [1,*] and Ghulam Murtaza [2]

[1] Nanotechnology and Integrated Bioengineering Centre (NIBEC), School of Engineering, Ulster University, 2-24 York Street, Belfast BT15 1AP, UK
[2] Department of Electronic Engineering, University of Bologna, 40132 Bologna, Italy
* Correspondence: m.hadi@ulster.ac.uk

Abstract: The terahertz (THz) frequency bands are being explored as a potential means of enabling an ultra-high transmission capacity in sixth-generation (6G) radio-access networks (RAN) because higher frequencies offer broader bandwidths. When utilized in wireless communications, high-frequency electromagnetic waves impose several physical restrictions. To overcome these difficulties and to expand the service coverage, the radio-over-fibre (RoF)-based distributed antenna system (DAS), in particular, can improve the usability of future mobile networks with advantages such as seamless media conversion between wireless and optical signal, flexible multi-channel aggregations, and efficiency. RoF technology's inherent advantages are that it improves the DAS network's usability and transmission performance by allowing it to provide both 5G and 6G THz services at the same time over a single optical fibre connection. We experimentally broadcast a single carrier-modulated 6G signal using a 256 quadrature amplitude modulation and a 5G new radio signal across a 10 km single mode fibre optic link. Additionally, the 6G signal is received through a 3 m wireless medium providing, proof of concept for fibre wireless integration. The experimental trials are assessed in terms of error vector magnitude and carrier suppression ratio. The dynamic range of the allowed RF input power for a 6G signal is 10 dB, while the dynamic range for a 5G waveform signal is 18 dB, which meets the 3GPP standardization criteria. Moreover, the bit error rate performance significantly improved as the carrier suppression ratio was increased from 0 to 20 dB.

6G is fiber, argues SDN Communications' CEO

By **Mike Dano**
Oct 22, 2018 01:20pm

6G Qualcomm

SDN provides fiber connections. (Pixabay)

A regional fiber company said it has found 6G, and it's fiber.

"Small cells or 5G—it's still all about the wires and what I

refer to as the 6G fiber optic networks that support such advances," said Mark Shlanta, the CEO of fiber company SDN Communications, which operates a fiber network in locations around South Dakota and the Midwest.

"If I'm going to use my smart phone to send a message to my mother across town or my sister, who lives in South Korea, nearly all that communication will travel fiber in the ground or under the ocean; it's only the very last part of the connection—from the handset to the tower—that is wireless. Today's 4G and tomorrow's 5G wireless do not exist without the 6G fiber that empowers them," Shlanta added

Shlanta made his comments (PDF) recently during U.S. Sen. John Thune's hearing for the Committee on Commerce, Science, and Transportation, dubbed "The Race to 5G: A View from the Field." The hearing focused on identifying existing barriers to broadband deployment and ways to streamline infrastructure siting.

Not surprisingly, Shlanta praised recent work by the FCC to make it easier for telecommunications companies to deploy additional network equipment, including small

The Role of Optical Transport Networks in 6G and Beyond: A Vision and Call to Action

by Dimitrios Michael Manias [1,*], Abbas Javadtalab [2], Joe Naoum-Sawaya [3] and Abdallah Shami [1]

[1] The Department of Electrical and Computer Engineering, Western University, 1151 Richmond Street, London, ON N6A 3K7, Canada

[2] Huawei Technologies Canada Research Center, 303 Terry Fox Drive, Kanata, ON K2K 3J1, Canada

[3] Ivey Business School, Western University, 1255 Western Rd., London, ON N6G 0N1, Canada

* Author to whom correspondence should be addressed.

J. Sens. Actuator Netw. **2023**, *12*(3), 43; **https://doi.org/10.3390/jsan12030043**

Received: 17 April 2023 / Revised: 13 May 2023 / Accepted: 19 May 2023 / Published: 22 May 2023

2. Optical and 6G

Given the increasing performance requirements associated with 6G networks, the role of OTNs is critical in realizing next-generation networking systems. As network complexity and the amount of data the network generates increases, transport networ[...]s must adapt and enhance their networks and technologies to cope with the increasingly stringent re[...]s. To this end, this section will discuss some of the key features and qualities of OTNs in 6G and beyo[...]s that are not currently considered in 5G networks and list some of the critical enabling technologies considered to realize 6G and beyond networks.

Annotate

2.1. Features and Qualities of Next-Generation OTNs

The essential qualities of next-generation OTNs in 6G and beyond networks are high-capacity fronthaul and backhaul networks, long-distance remote connectivity, and deep-rooted AI/ML integration. As networks shift from being traditionally analytical model-based to data-based, a significantly increased amount of network-generated data traffic needs to be transported quickly and efficiently throughout the network. Concurrent with the OpenRAN

The Truth About "6G"

Stephen McBride Former Contributor
The editor of RiskHedge Report

Nov 25, 2020, 12:04pm EST

This article is more than 2 years old.

CHINA NEWS SERVICE VIA GETTY IMAGES

I'm seeing them pop up more and more. Maybe you are, too. Bold headlines telling

your run-of-the-mill upgrade. It's nothing like the jump we saw from 3G to 4G.

All the exciting innovations you hear so much about today: self-driving cars, remote robotic surgery, and the Internet of Things can't happen without 5G. Not just that, we're talking about entirely new mobile networks, up to 100X faster than what we have today.

We're going to need countless new antennas, fiber optic cables, satellites, and other network gear necessary to extend 5G signals beyond city centers. And the tiny filters that go in the phones themselves.

It's going to take decades for a full 5G buildout. 5G is a massive undertaking. We essentially have to rewire the world. People don't

DISRUPTOR

By Patrick Nelson, Network World | 13 SEPTEMBER 2019 13:30 BST

About

Thought-provoking commentary on technologies that are changing the way mankind does things.

How 6G will work: Terahertz-to-fiber conversion

For 6G wireless to become a reality, it must overcome a few technical hurdles, such as connecting terahertz spectrum to hard, optical transmission lines. Researchers at the Karlsruhe Institute of Technology say they have solved the problem.

Introduction: 5G and direct comm applications

What are the applications and what do they demand?

We hear about download speeds, low latency….

From a specifications point-of-view, some items are

wider instantaneous BW (to 400 MHz in FR2 presently)

modest mm-wave frequencies (→52 GHz for now, 6G proposals much higher: 95 GHz → 300 GHz/3 THz ?)

relatively stringent adjacent channel power requirements

many over-the-air test requirements

We've provided the list below of the differences from the third-generation or 3G up to and including the sixth-generation or 6G wireless.

Frequency Spectrum

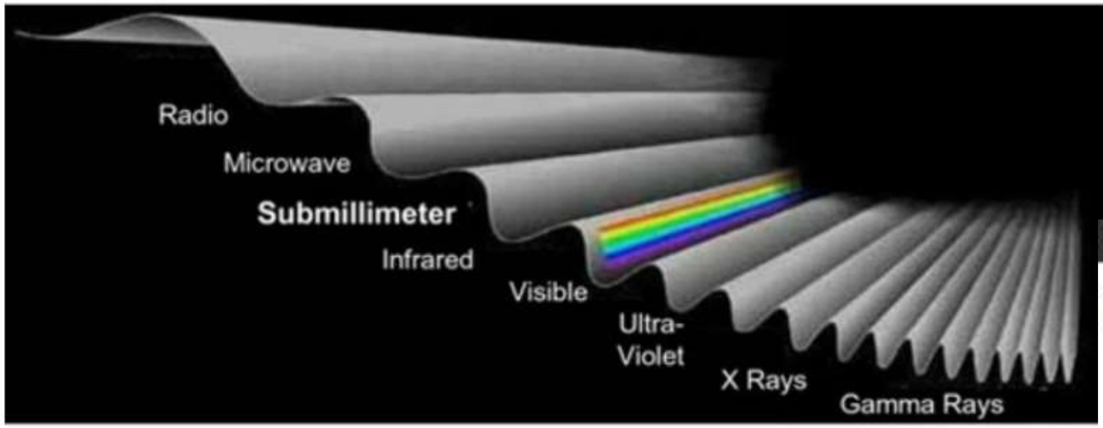
- 3G — up to 2.1 Gigahertz (GHz).
- 4G — up to 2.5 GHz.
- 5G — up to 6 GHz for range one, up to 54 GHz for range two.
- 6G — 95 GHz to 3 Terahertz (THz) or 3,000 GHz.

Network Speeds

- 3G — from 3 to 7 Megabits per second (Mbps).
- 4G — approximately 33 Mbps.
- 5G — 40 to 1,100 Mbps.
- 6G — Up to 1 Terabits per second or 1,000,000 Mbps.

You can readily see the significant differences in each wireless generation. With 6G, the frequencies are in the millimeter-wave range. And the speeds are simply phenomenal. The higher frequencies support wider bandwidth signals, which is the underlying reason for faster data transmission speeds.

Terahertz (Submillimeter) Waves

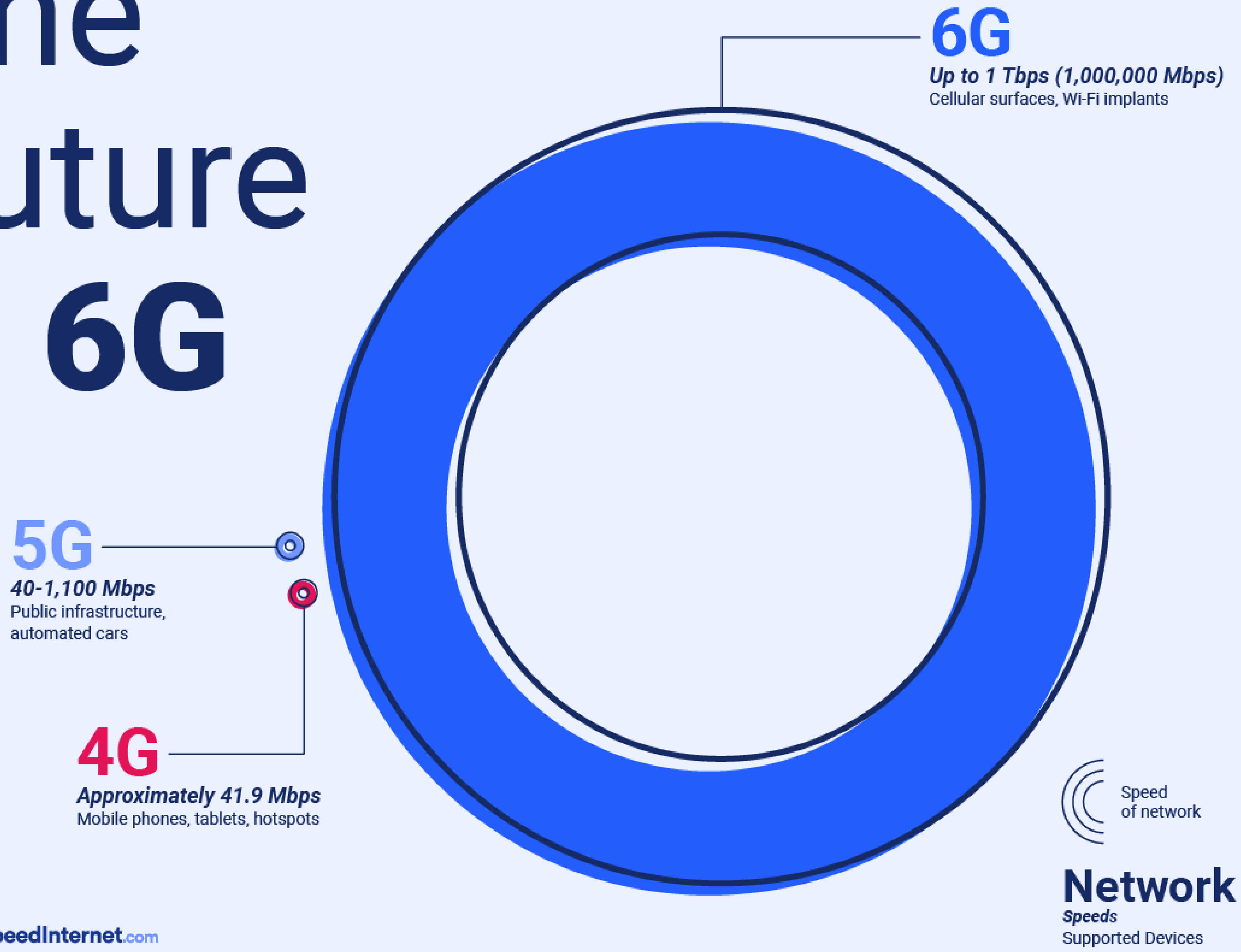


Loosely defined: 1 mm > λ > 100 μm

300 GHz < ν < 3 THz

Most of the radiation in the Universe is emitted at submillimeter-wavelengths, peaking at 3 THz (if we exclude Cosmic Microwave Background).

The Future Is **6G**



HighSpeedInternet.com

google.com/search?sca_esv=562595467&hl=en&biw=1536&bih=758&sxsrf=AB...

Google

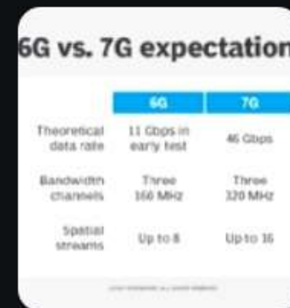
6G Internet coverage

Search by voice

People also ask

Is 6G internet available?

6G internet is expected to launch commercially in 2030. The technology makes greater use of the distributed radio access network (RAN) and the terahertz (THz) spectrum to increase capacity, lower latency and improve spectrum sharing.



TechTarget
https://www.techtarget.com › definition › 6G

What is 6G? Overview of 6G networks & technology - TechTarget

Search for: Is 6G internet available?

Is 6G available anywhere?

No, 6G is not yet available, but 6G networks are currently in development and expected to launch around 2030. 26 Jul 2023

builtin.com
https://builtin.com › hardware › 6g

6G: What Is It? When Can We Expect It? - Built In

Search for: Is 6G available anywhere?

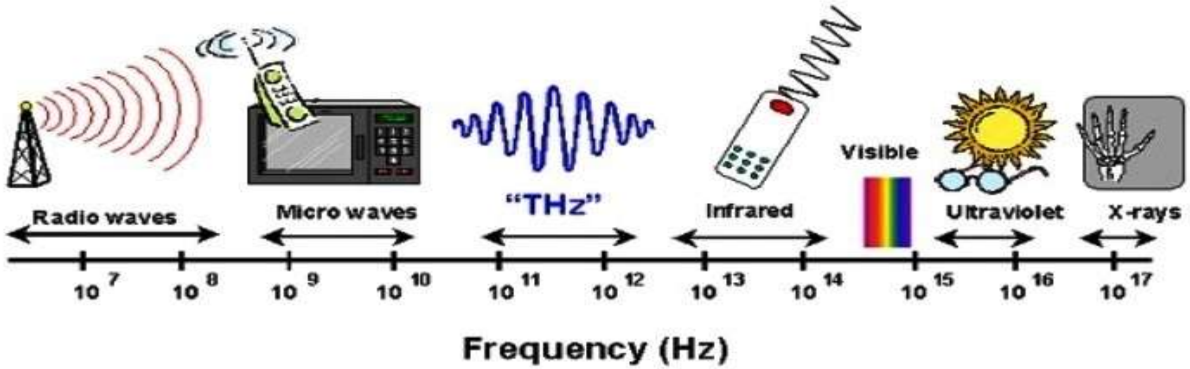
What is the range of 6G?

Print

Why Terahertz Radiation?

TeraSec

Terahertz (THz) radiation is located in the spectral region 0.1-10 THz (3 mm - 30 µm, 3 cm^{-1} - 300 cm^{-1}) between the microwave and the infrared portion of the electromagnetic spectrum. In contrast to visible or infrared light, THz radiation has the potential to penetrate materials such as plastics cloth, or paper products. This feature might be helpful to sense concealed threats inside of clothing, luggage, parcels, and sealed containers. Because THz radiation does not penetrate metals, such a sensor would supplement rather than replace conventional X-ray and metal detectors. It has been shown, that THz imaging systems can be used to image threat items, non-metallic weaponry can be imaged when concealed beneath clothing, and it has been demonstrated that explosive materials have characteristic THz spectra.



The Thz range (Courtesy M.Koch, TU Braunschweig)

THz radiation is non-ionizing

Due to its low photon energy (about one million times less than X-rays) THz radiation is non-ionising and to our present knowledge not dangerous for human beings. In fact an imaging system for medical applications which illuminates the human skin with THz radiation in order to localize skin cancer has been developed by Teraview Ltd.

media for smarter people
since 2010

6G network | The next mobile generation

Last updated: 04.08.2023 Hits: 5182

While some are still in the LTE or 4G network and that 5G Mobile network already masters its introduction with flying colors, throws the **6G network** its shadow to around 2030 already ahead. We present new developments for the upcoming mobile communications standard like that Lighthouse project 6G-ANNA or the world's first bidirectional radio link with Internet connection from the University of Stuttgart. Also the Karlsruhe Institute of Technology **KIT** has the 6G network in its sights and is presenting a Concept for the highest data transmission rates in the **Terahertz Communication**.

networks of the future must consist of numerous small radio cells," explains **Professor Christian Koos**who together with his colleague **Professor Sebastian Randel** researches technologies for 6G at KIT.

Base stations on street lights

Short ways in these **Radio cells** combine high data rates with minimal energy consumption and low electromagnetic immission. The only small base stations required for the successor to 5G can be attached to street lamps, for example.

The connection of the individual cells requires powerful radio links for 6G networks, on which dozens or even hundreds of gigabits per second (Gbit/s) can be transmitted on one channel. Frequencies in the THz range are suitable for this purpose **electromagnetic spectrum** between the microwaves and the infrared radiation.

However, the recipients are still comparatively complex and expensive. They often represent the bottleneck for the achievable bandwidth. Researchers at the institutes for microstructure technology **IMT**, Photonics highspeedinternet.com/resources/6g-internet

VPN

Artificial intelligence and edge computing

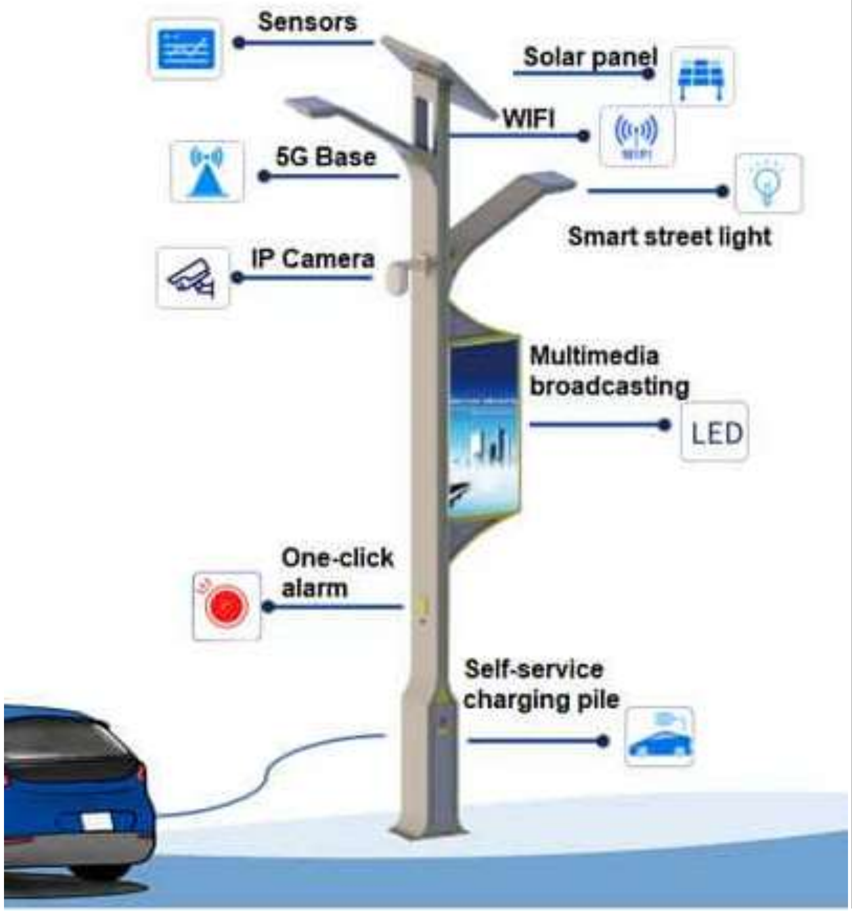
Automated cars and drones, remote-controlled factories, and other uses of artificial intelligence (AI) have been getting a lot of discussion amid the rise of 5G. The advent of 6G is expected to make this even more of a thing—and some experts think artificial intelligence will be required to keep it all coordinated and running smoothly.

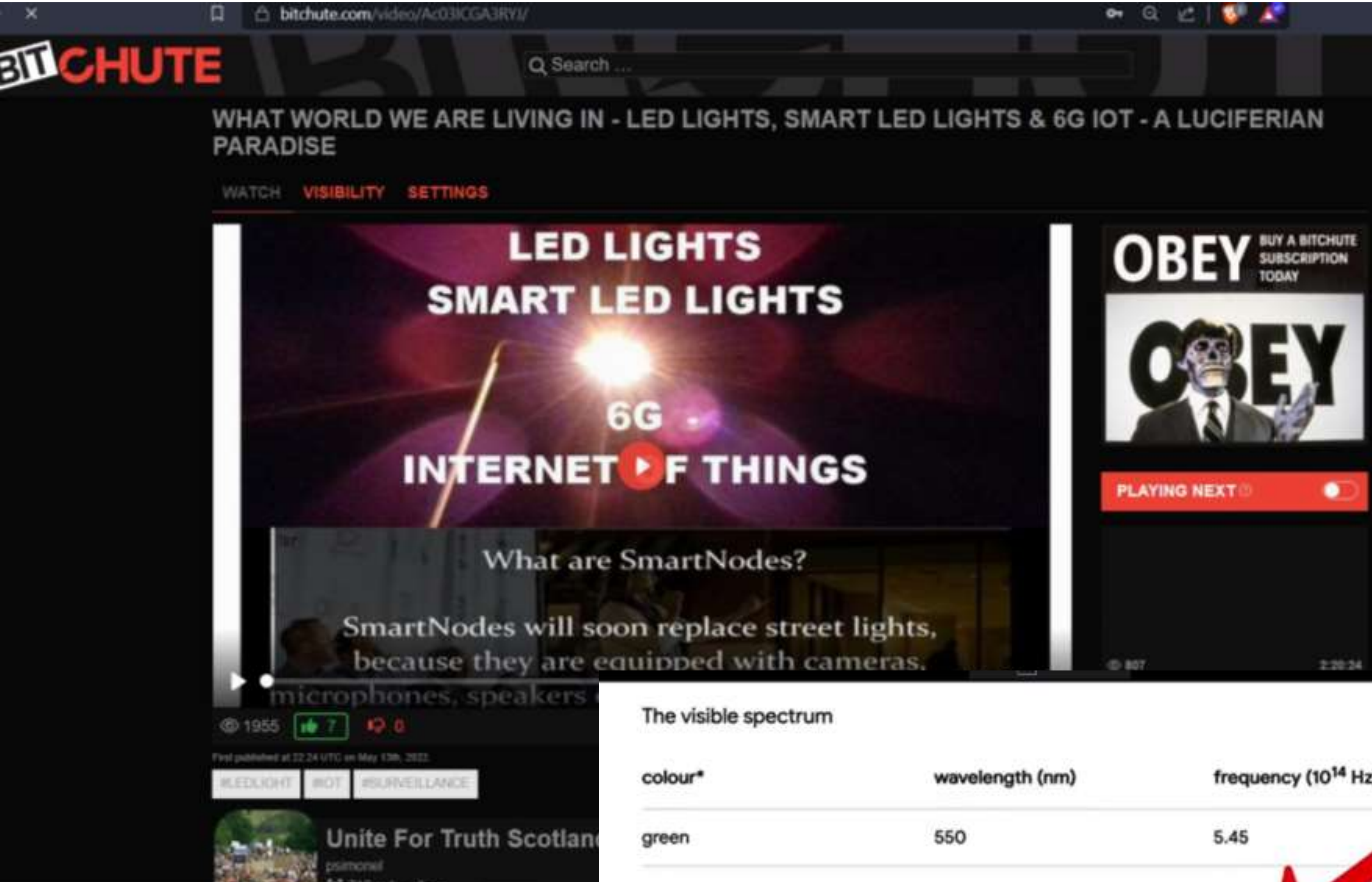
Razvan-Andrei Stoica and Giuseppe Abreu, two researchers at Jacobs University in Bremen, Germany, said that 6G could rely on "collaborative AI" to help self-driving cars communicate with each other, navigate pedestrians and traffic, and determine the best routes from here to there.

It's part of an emerging trend called "edge computing," which moves network management away from centralized clouds towards more localized devices, making everything work way smoother and reducing response times.

Another 6G acolyte, Roberto Saracco at the European Institute of Innovation & Technology, suggested that things like AI and edge computing could help devices themselves become network antennas—maintaining your Wi-Fi connection in a fluid, ever-shifting ballet of users and their devices.

See SMART NODE (YT, Google)

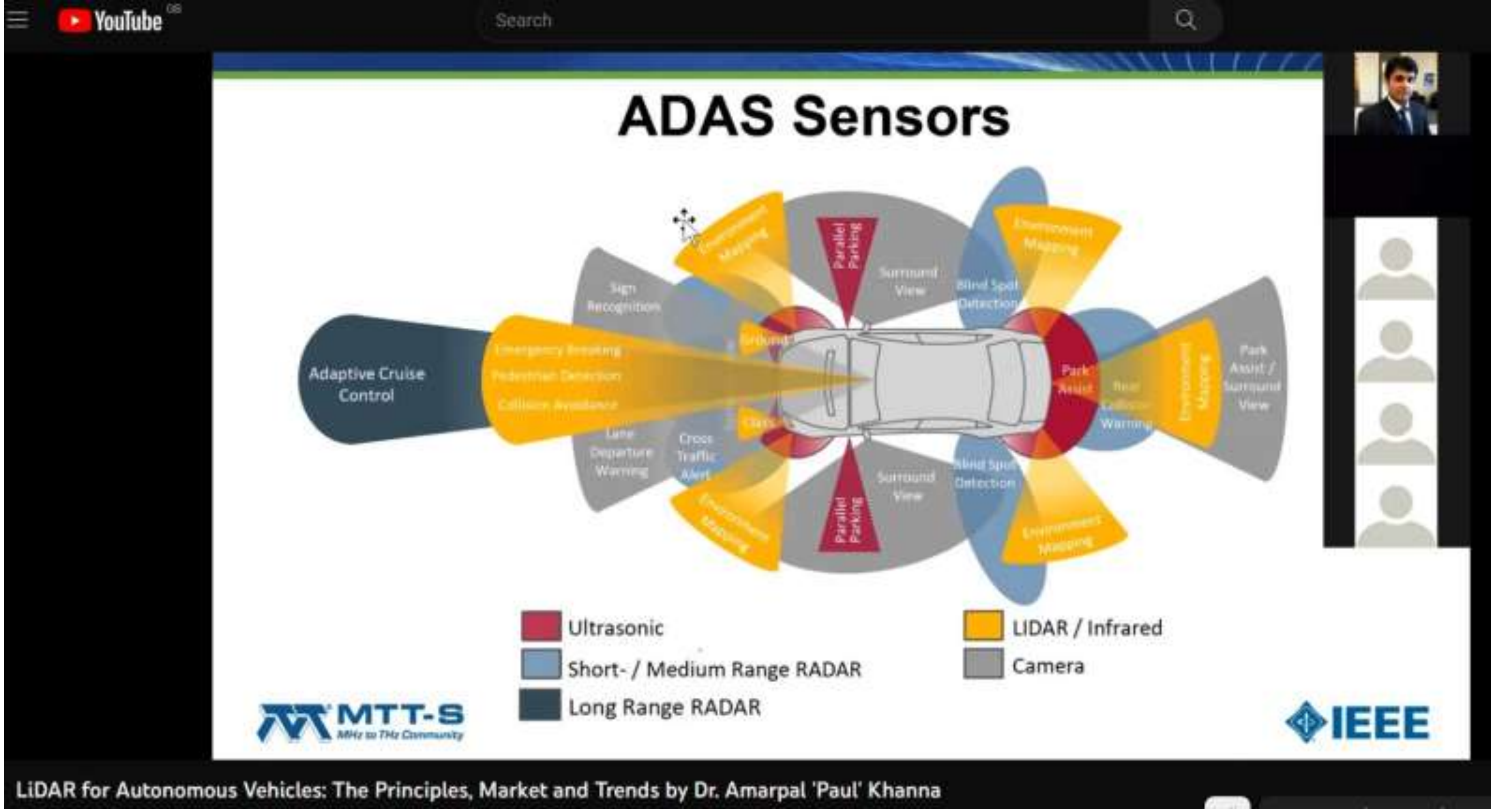


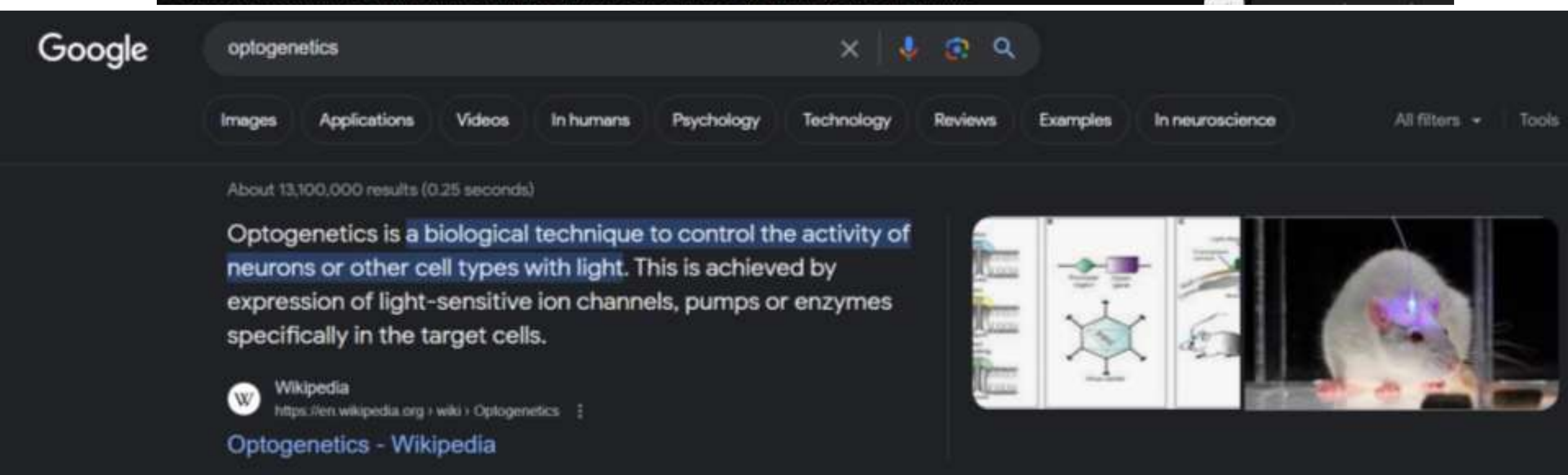


The visible spectrum

colour*	wavelength (nm)	frequency (10^{14} Hz)
green	550	5.45
cyan	500	5.99
blue	450	6.66
violet (limit)	400	7.50

5 more rows


YouTube
Search
ADAS Sensors
Adaptive Cruise Control
Sign Recognition
Surround View
Blind Spot Detection
Park Assist / Surround View
Park Assist
Lane Departure Warning
Cross Traffic Alert
Parallel Parking
Ultrasonic
Short- / Medium Range RADAR
Long Range RADAR
LIDAR / Infrared
Camera
MTT-S
IEEE
LiDAR for Autonomous Vehicles: The Principles, Market and Trends by Dr. Amarpal 'Paul' Khanna


Google
optogenetics
Images
Applications
Videos
In humans
Psychology
Technology
Reviews
Examples
In neuroscience
All filters
Tools
About 13,100,000 results (0.25 seconds)
Optogenetics is a biological technique to control the activity of neurons or other cell types with light. This is achieved by expression of light-sensitive ion channels, pumps or enzymes specifically in the target cells.
Wikipedia
https://en.wikipedia.org › wiki › Optogenetics
Optogenetics - Wikipedia

Terahertz Radiation

Definition: electromagnetic radiation with frequencies around 0.1 THz to 10 THz

Alternative terms: terahertz waves, t-waves, far infrared

German: Terahertz-Strahlung

Categories: nonlinear optics, physical foundations

Author: Dr. Rüdiger Paschotta

Safety Aspects

In contrast to X-rays, terahertz waves have a too low photon energy for the ionization of materials. Non-ionizing radiation is much less likely to cause cancer and genetic mutations.

In principle, health effects may result through other effects than ionization and genetic damage – for example, subtle influence on the behavior of cells. The situation is very similar to that with radio waves and millimeter waves, where there are also some concerns about effects of "electrosmog". So far, extensive scientific investigations have not produced any substantial reasons for expecting health effects, unless at extremely high intensity levels. There is neither solid evidence for detrimental health effects nor a plausible mechanism causing such effects in a non-thermal intensity regime. It is hardly possible, however, to firmly exclude *any* possible health effects of gigahertz or terahertz radiation.

China / Science

Eyes on 6G safety as Chinese scientists find terahertz radiation boosts brain cell growth in mice

- Discovery can help assess new communication technology and also develop therapies to treat brain diseases, Beijing researchers say
- Separate study by team from Xian Jiaotong University finds terahertz radiation can make young mice ‘smarter’ but same effect not found in old mice

Stephen Chen in Beijing + FOLLOW

Published: 9:00pm, 14 Aug, 2022

Why you can trust SCMP

David M Masters

Transfiguration Specialist, author, public speaker, coach, consultant, master trainer

MENU

The Human Body on Terahertz Frequencies

The latest communications methods harness the power of light to instantly move data from here to there. Your cellphone, television, radio, computer, and other devices are all using light to give you that seamless instant flow of information.

As humans age, irregular folding proteins disrupt blood and immune cell production and prevent healthy stem cell production.

Terahertz frequencies excite DNA, and RNA, and strengthen proteins promoting precise folding, expanding their capacity for catalyzing energy, and increasing interconnectivity of the greater neural network throughout the human organism.

The human body requires voltage to function. An underpowered body will not function well if the voltage is low. The power of the body to self-heal is determined by the voltage level of the body.

Terahertz radiation carries charged negative ions throughout the ion channels (we have over 100 of them) changing the voltage across their membranes distributing the energy, increasing the overall voltage of the body, and synchronizing high functioning biological processes.

The interaction between electromagnetic fields at megahertz, gigahertz and terahertz frequencies with cells, tissues and organisms: risks and potential

Sergii Romanenko [1], Ryan Begley [2], Alan R Harvey [3 4], Livia Hool [3 5], Vincent P Wallace [2]

Affiliations + expand

PMID: 29212756 PMCID: PMC5746568 DOI: 10.1098/rsif.2017.0585

Since regular radio broadcasts started in the 1920s, the exposure to human-made electromagnetic fields has steadily increased. These days we are not only exposed to radio waves but also other frequencies from a variety of sources, mainly from communication and security devices. Considering that nearly all biological systems interact with electromagnetic fields, understanding the affects is essential for safety and technological progress. This paper systematically reviews the role and effects of static and pulsed radio frequencies (10^0-10^9 Hz), millimetre waves (MMWs) or gigahertz (10^9-10^{11} Hz), and terahertz (10^{11}-10^{13} Hz) on various biomolecules, cells and tissues. Electromagnetic fields have been shown to affect the activity in cell membranes (sodium versus potassium ion conductivities) and non-selective channels, transmembrane potentials and even the cell cycle. Particular attention is given to millimetre and terahertz radiation due to their increasing utilization and, hence, increasing human exposure. MMWs are known to alter active transport across cell membranes, and it has been reported that terahertz radiation may interfere with DNA and cause genomic instabilities. These and other phenomena are discussed along with the discrepancies and controversies from published studies.

Military Medical Research

Review | Open Access | Published: 02 December 2014

Advances in the biological effects of terahertz wave radiation

Li Zhao, Yan-Hui Hao & Rui-Yun Peng

THz radiation may interact with cellular components at multiple levels, including chromosomes, DNA (deoxyribonucleic acid), genes and proteins.

At the level of DNA and chromosomes, Hintzsche *et al.* [11] have exposed a monolayer-cultured human-hamster hybrid cell line to a 0.106 THz radiation source for 0.5 h, with power densities ranging from 0.043 mW/cm² to 4.3 mW/cm². The results indicated that the THz radiation affected chromatid separation during the mitotic anaphase and telophase. Recently, several studies have indicated that the non-thermal effects of THz radiation may affect the stability of DNA by establishing a system *in vitro*, leading to chromosomal aberrations of human lymphocytes and genetic changes during the differentiation of mouse stem cells [12]-[16].

At the levels of genes and protein, the USA Air Force Research Laboratory [5] has studied the genetic changes in Jurkat cells exposed to continuous THz radiation (2.52 THz, 227 mW/cm², durations of 1 ~ 40 min). They observed that the THz radiation primarily affected genes encoding inflammatory cytokines, including IL2-inducible T-cell kinase (ITK), integrin-linked kinase-associated

Evidently, during the last few decades, large amounts of data have been accumulated regarding biological effects of THz waves. Sometimes, we observed contradicting results of the THz exposure, which poses important problems of adequate designing, planning, and performing of the THz exposure experiments. As described earlier, only a combination of accurate knowledge about the exposure parameters, a number of control measurements (tests), and maintenance of the suitable ambient environment can lead to reproducible and verified experimental data.

Despite a considerable interest paid to the biological effects of THz waves, further research is required for the development of safe limits of THz waves. Obviously, such safe limits should

account for not only the thermal THz-wave effects (as the common ICNIRP standards do)[40,192,193] but also for the nonthermal. Development of the THz dosimetry is of crucial importance for biomedical applications of THz technology in such demanding branches as label-free diagnosis of malignant and benign neoplasms,[3,4,8–16] sensing of glycated tissues and blood in context of diabetes diagnosis,[1,19–21] determining the degree of traumatic injuries[22] and viability[30] of tissues, and even emerging methods of single cells, microorganisms, bacteria, and viruses sensing.[286–291] Also, THz dosimetry is of crucial importance for the rapidly developing 6G wireless communications that will reportedly span sub-THz and THz frequencies.[292] There is no doubt that such a wide range of THz technology applications, which involve interaction between THz waves and different biological systems, would stimulate the development of THz safe limits in the nearest future.

Studies of the THz-wave biological effects involving modern methods of cytology, genetics, and molecular biology can uncover THz therapeutic avenue. As mentioned above, THz waves are capable of regulating the gene expression, changing the membrane permeability, and DNA demethylation. Being adequately studied and regulated, such a versatile impact of THz waves on living cell opens a variety of THz technology applications in medical therapy of cancers, inflammatory, and neurodegenerative deceases. Finally, we notice that development of such THz therapeutic applications would require further progress in THz components, including highly efficient uncooled CW and pulsed THz emitters,[6,7,126–128,130,132–135] elements of bulk (open space) and fiber/waveguide optics[293–299] aimed at the THz-wave delivery to the hardly accessible tissues and internal organs. Such elements are still to be developed.

Terahertz radiation can disrupt proteins in living cells

Date: June 5, 2020

Source: RIKEN

Summary: Researchers have discovered that terahertz radiation, contradicting conventional belief, can disrupt proteins in living cells without killing the cells.

Share: a b e g d

RELATED TOPICS

Plants & Animals

- Biology
- Biotechnology
- Molecular Biology

Matter & Energy

- Biochemistry
- Graphene
- Optics

Earth & Climate

- Environmental Issues

FULL STORY

Researchers from the RIKEN Center for Advanced Photonics, Tohoku University, National Institutes for Quantum and Radiological Science and Technology, Kyoto University, and Osaka University have discovered that terahertz radiation, contradicting conventional belief, can disrupt proteins in living cells without killing the cells. This finding implies that terahertz radiation, which was long considered impractical to use, may have applications in manipulating cell functions for the treatment of cancer, for example, but also that there may be safety issues to consider.

Study 1. In 1991, Ilyina *et al.* examined the effects that THz radiation has on hemoglobin (Hb) bonds [136]. In this work, the authors irradiated Hb bonds to THz radiation provided by a BWO source: 2.65 THz and 3.33 THz, 3 $mWcm^{-2}$, and exposure duration of 240 min. Interestingly, the data shows that THz radiation caused an increase in Hb bond strength at 3.33 THz, and a decrease in bond strength at 2.65 THz. The authors hypothesize that the observed effect is a result of linear or nonlinear resonance effects.

7 Summary & future prospects

Knowledge of the biological effects associated with THz radiation is critical for proper health hazard evaluation, development of empirically-based safety standards, and safe exploitation of new THz devices and applications. The studies reviewed in this report provide data on the effects of THz radiation at an organism, tissue, organelle, cellular, and biomolecular level. Each publication was critically analyzed and the effects observed have been summarized.

For the *in vivo* studies conducted on vertebrates (i.e., humans, rats, and mice), THz treatments stimulated wound repair, enhanced microbial dissemination, increased fibrinolysis factors, and reduced platelet aggregation. In contrast, for the *in vivo* studies using fruit flies, THz exposures induced differential expression of several proteins. In the studies using a plant model, exposures stimulated the growth of paddy rice, black beans, and wheat. In the *ex vivo* tissue studies, visible tissue damage was observed after exposures to short duration (2 seconds), high-power THz radiation (7.16 Wcm^{-2}).

In several *in vitro* cell culture studies, low doses of THz radiation stimulated cellular proliferation, whereas higher exposures caused visible morphological changes, induction of cellular stress response mechanisms, and cell death. THz radiation (both CW and pulsed) caused direct effects on the plasma membrane: increases in membrane permeability, membrane reorganization, and destruction. For the studies examining the effects on biomolecules, THz exposures were observed to affect both the structure and functional activity of several enzymatic processes. Finally, the majority of the genotoxicity studies performed to date show that THz radiation does not cause adverse effects to DNA structure or function.

Dangerous Side Effects of Terahertz Radiation Discovered by Korean Researchers

In Compliance News June 20, 2014

Researchers from the Korea Advanced Institute of Science and Technology (KAIST) announced findings from a research project that exposure to terahertz radiation on an animal showed signs of infections on skin tissue. Previously, terahertz radiation was thought to be harmless to humans, because of its low energy and wider applications than x-radiation.

To test the effects of terahertz radiation, the team developed a high-power terahertz generator and a high resolution 3D laser scanning microscope. A genetically-engineered mouse was exposed to high-terahertz radiation for 30 minutes, and the skin of the mouse was monitored with the microscope. The team found that the number of infected cells increased more than six times after six hours of exposure.

Damage thresholds for terahertz radiation

Danielle R. Dalzell[1], Jill McQuade[1], Rebecca Vincelette[1,2], Bennett Ibey[1], Jason Payne[1], Robert Thomas[1], William P. Roach[1], Caleb L. Roth[3], Gerald J. Wilmink[1,2]

[1] Human Effectiveness Directorate, Air Force Research Laboratory, Brooks City-Base, TX
[2] National Academy of Sciences NRC Research Associateship
[3] General Dynamics, Inc, San Antonio, TX

ABSTRACT

Several international organizations establish minimum safety standards to ensure that workers and the general population are protected against adverse health effects associated with electromagnetic radiation. Suitable standards are typically defined using published experimental data. To date, few experimental studies have been conducted at Terahertz (THz) frequencies, and as a result, current THz standards have been defined using extrapolated estimates from neighboring spectral regions. In this study, we used computational modeling and experimental approaches to determine tissue-damage thresholds at THz frequencies. For the computational modeling efforts, we used the Arrhenius damage integral to predict damage-thresholds. We determined thresholds experimentally for both long (minutes) and short (seconds) THz exposures. For the long exposure studies, we used an in-house molecular gas THz laser (υ= 1.89 THz, 189.92 mW/cm^2, 10 minutes) and excised porcine skin. For the short exposure studies, we used the Free Electron Laser (FEL) at Jefferson Laboratory (υ= 0.1-1.0 THz, 2.0-14.0 mW/cm^2, 2 seconds) and wet chamois cloths. Thresholds were determined using conventional damage score determination and probit analysis techniques, and tissue temperatures were measured using infrared thermographic techniques. We found that the FEL was ideal for tissue damage studies, while our in-house THz source was not suitable to determine tissue damage thresholds. Using experimental data, the tissue damage threshold (ED_{50}) was determined to be 7.16 W/cm^2. This value was in well agreement with that predicted using our computational models. We hope that knowledge of tissue-damage thresholds at THz frequencies helps to ensure the safe use of THz radiation.

Article PDF Available

DNA Breathing Dynamics in the Presence of a Terahertz Field

February 2010 · Physics Letters A 374(10):1214
DOI:10.1016/j.physleta.2009.12.077
Source · PubMed

Authors:

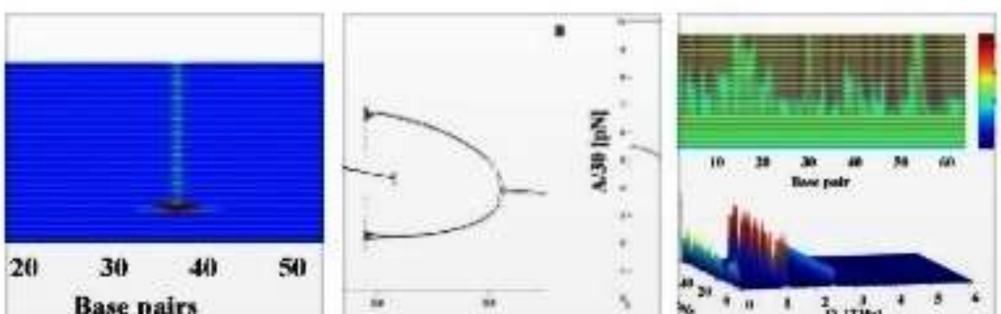
B. S. Alexandrov
Los Alamos National Laboratory

Vlado Gelev
Sofia University "St. Kliment Ohridski"

Ar Bishop
Los Alamos National Laboratory

Anny Usheva
Brown University

We consider the influence of a terahertz field on the breathing dynamics of double-stranded DNA. We model the spontaneous formation of spatially localized openings of a damped and driven DNA chain, and find that linear instabilities lead to dynamic dimerization, while true local strand separations require a threshold amplitude mechanism. Based on our results we argue that a specific terahertz radiation exposure may significantly affect the natural dynamics of DNA, and thereby influence intricate molecular processes involved in gene expression and DNA replication.



Original Article

Exposure Effects of Terahertz Waves on Primary Neurons and Neuron-like Cells Under Nonthermal Conditions

TAN Sheng Zhi[1], TAN Peng Cheng[2], LUO Lan Qing[2], CHI Yun Liang[3], YANG Zi Long[4], ZHAO Xue Long[1], ZHAO Li[1], DONG Ji[1], ZHANG Jing[1], YAO Bin Wei[1], XU Xin Ping[1], TIAN Guang[5], CHEN Jian Kui[6], WANG Hui[1,#], and PENG Rui Yun[1,#]

1. Beijing Institute of Radiation Medicine, Beijing 100850, China; 2. School of Pharmaceutical Sciences, Tsinghua University, Beijing 100084, China; 3. Inner Mongolia University for the Nationalities, Yakeshi 022150, Inner Mongolia, China; 4. General Hospital of Northern Theater Command, Shenyang 110000, Liaoning, China; 5. State Key Laboratory of Pathogen and Biosecurity, Beijing Institute of Microbiology and Epidemiology, Beijing 100071, China; 6. Fifth Medical Center, Chinese People's Liberation Army General Hospital, Beijing 100071, China

Abstract

Objective This study aimed to explore the potential effects of terahertz (THz) waves on primary cultured neurons from 4 rat brain regions (hippocampus, cerebral cortex, cerebellum, and brainstem) and 3 kinds of neuron-like cells (MN9D, PC12, and HT22 cells) under nonthermal conditions.

Methods THz waves with an output power of 50 (0.16 THz) and 10 (0.17 THz) mW with exposure times of 6 and 60 min were used in this study. Analysis of temperature change, neurite growth, cell membrane roughness, micromorphology, neurotransmitters and synaptic-related proteins (SYN and PSD95) was used to evaluate the potential effects.

Results Temperature increase caused by the THz wave was negligible. THz waves induced significant neurotransmitter changes in primary hippocampal, cerebellar, and brainstem neurons and in MN9D and PC12 cells. THz wave downregulated SYN expression in primary hippocampal neurons and downregulated PSD95 expression in primary cortical neurons.

Conclusion Different types of cells responded differently after THz wave exposure, and primary hippocampal and cortical neurons and MN9D cells were relatively sensitive to the THz waves. The biological effects were positively correlated with the exposure time of the THz waves.

MIT Technology Review

SUBSCRIBE

BIOTECHNOLOGY AND HEALTH

How Terahertz Waves Tear Apart DNA

A new model of the way the THz waves interact with DNA explains how the damage is done and why evidence has been so hard to gather

By Emerging Technology from the arXiv

October 30, 2009

The evidence that terahertz radiation damages biological systems is mixed. "Some studies reported significant genetic damage while others, although similar, showed none," say Boian Alexandrov at the Center for Nonlinear Studies at Los Alamos National Laboratory in New Mexico and a few buddies. Now these guys think they know why.

Alexandrov and co have created a model to investigate how THz fields interact with double-stranded DNA and what they've found is remarkable. They say that although the forces generated are tiny, resonant effects allow THz waves to unzip double-stranded DNA, creating bubbles in the double strand that could significantly interfere with processes such as gene expression and DNA replication. That's a jaw dropping conclusion.

And it also explains why the evidence has been so hard to garner. Ordinary resonant effects are not powerful enough to do do this kind of damage but nonlinear resonances can. These nonlinear instabilities are much less likely to form which explains why the character of THz genotoxic effects are probabilistic rather than deterministic, say the team.

This should set the cat among the pigeons. Of course, terahertz waves are a natural part of environment, just like visible and infrared light. But a new generation of cameras are set to appear that not only record terahertz waves but also bombard us with them. And if our exposure is set to increase, the question that urgently needs answering is what level of terahertz exposure is safe.

Intense terahertz pulses cause DNA damage but also induce DNA repair

Date: March 14, 2013

Source: The Optical Society

Summary: Terahertz radiation, a
ground between micr
diagnostics, security,
practical uses for this
risks.

SD

Menu

New research performed on lab-grown human skin suggests that short but powerful bursts of THz radiation may both cause DNA damage and increase the production of proteins that help the body fight cancer. The findings, which are the result of a collaboration between physicists at the University of Alberta and molecular biologists at the University of Lethbridge in Canada, are published today in the Optical Society's (OSA) open-access journal *Biomedical Optics Express*.

"While these investigations of the biological effects of intense THz pulses are only just beginning," said Lyubov Titova, with the University of Alberta and a member of the research team, "the fact that intense THz pulses can induce DNA damage but also DNA repair mechanisms in human skin tissue suggests that intense THz pulses need to be evaluated for possible therapeutic applications."

THz photons, like their longer wavelength cousins in the microwave range, are not energetic enough to break the chemical bonds that bind DNA together in the nucleus of cells. These waves, however, have just the right frequency to energize water molecules, causing them to vibrate and produce heat, which is why microwave ovens are so efficient at cooking food. For this reason, it was believed that heat-related injuries were the principal risks posed by THz radiation exposure.

Recent theoretical studies, however, suggest that intense THz pulses of picosecond (one trillionth of a second) duration may directly affect DNA by amplifying natural vibrations (the so-called "breathing" mode) of the hydrogen bonds that bind together the two strands of DNA. As a result, "bubbles" or openings in DNA strands can form. According to the researchers, this raised the question: "Can intense THz pulses destabilize DNA structure enough to cause DNA strand breaks?"

As shown in earlier animal cell culture studies, THz exposure may indeed affect biological function under specific conditions such as high power and extended exposure. There is, however, a vast gulf between animal research and conclusions that can be drawn about human health.

In a first of its kind study, the Canadian researchers exposed laboratory-grown human skin tissue to intense pulses of THz electromagnetic radiation and have detected the telltale signs of DNA damage through a chemical marker known as phosphorylated H2AX. At the same time, they observed THz-pulse induced increases in the levels of multiple tumor suppressor and cell-cycle regulatory proteins that facilitate DNA repair. This may suggest that DNA damage in human skin arising from intense picosecond THz pulse exposure could be quickly and efficiently repaired, therefore minimizing the risk of carcinogenesis.

Introduction to the Biological Effects of Terahertz Radiation

Submitted: January 22nd, 2023 , Reviewed: March 21st, 2023 , Published: June 16th, 2023

DOI: 10.5772/intechopen.111416

WRITTEN BY

Robin-Cristian Bucur-Portase

5. Environmental effects

Terahertz radiation may be able to penetrate the soil to a considerable depth and, having in mind its effects on tissues of animals and plants alike, disturb local ecological systems. This raises concerns regarding the rising trend of new agricultural tools that implement this type of EM radiation as a means to keep track of plant development or soil content in microplastics [71, 72, 73, 74, 75, 76]. Locations suffering from a generally dry climate or desertification are at the highest risk of being affected by THz due to the lack of water that could otherwise act as a barrier.

Terahertz radiation has also seen therapeutic usage. It can demethylate cancer cells and increase the speed of regeneration at injuries' site [46, 47, 48]. It has even been found to be beneficial against psoriasis [49] and in the recovery from an acute ischemic stroke [50].

However, the use of these therapeutic effects faces barriers due to the adverse effects often caused by terahertz radiation exposure. Most reports describe general inflammation responses and apoptosis that have been recorded across a vast array of cell types and species. Loss of adhesion to basal membrane, cellular permeability increases, lysis and marked increases in cell growth factors and cytokines have all been connected to T-rays exposure, although these seem to mainly stem from its thermal effects [51, 52, 53]. However, there are also reports that contrast these findings, albeit very few [54, 55].

Nervous tissue cells in particular have been found to release their intracellular proteolytic enzymes and suffer membrane protein changes under THz. No great morphological changes such as axon number or size have been recorded [56, 57]. Various types of neurons also show different reactions to T-rays as seen by their marked changes in neurotransmitter production [58]. There also seems to be a threshold of 0.15 THz under which exposure will not induce any detectable adverse reactions [59].

Biomedical Optics Express Vol. 2, Issue 9, pp. 2679-2689 (2011)

- https://doi.org/10.1364/BOE.2.002679

Non-thermal effects of terahertz radiation on gene expression in mouse stem cells

Boian S. Alexandrov, Kim Ø. Rasmussen, Alan R. Bishop, Anny Usheva, Ludmil B. Alexandrov, Shou Chong, Yossi Dagon, Layla
H. Mielke, M. Lisa Phipps, Jennifer S. Martinez, Hou-Tor
Rodriguez

One significant concern surrounding these results is that no comprehensive explanation for how such effects may arise exists. Our suggestion [27,28] is that THz radiation may affect gene expression by perturbing the conformational dynamics of double-stranded DNA. This suggestion is rooted in our prior work [33,34] that establishes a strong relationship between conformational dynamics of double-stranded DNA and cellular function, coupled with the fact that THz photons possess the energy required to influence the dynamics of dsDNA. Given the prior experimental findings and the theoretically suggested mechanism, we designed the experiments described herein to explore the existence of THz related effects on gene expression that can be unambiguously distinguished from thermal effects.

The results of this study shows that mouse mesenchymal stem cells exposed to THz radiation exhibit specific changes in cellular function that are closely related to the gene expression. Our qRT-PCR gene expression survey reveals that some genes in irradiated Mouse stem cell cultures are activated, while other genes are suppressed. The fact that most genes do not respond to the used radiation conditions used here, demonstrates a specific rather than a general response. It is important that these effects where observed under irradiation conditions that caused minimal temperature changes, and in the explicit absence of any discernable response of heat shock and cellular stress genes.

Further investigations involving a large number of genes and variation in THz radiation characteristics and exposure duration are needed to generalize our findings. Also, more direct experimental investigations of THz radiation's ability to induce specific openings of the DNA double-strand are needed in order to fully determine how THz radiation may work through DNA dynamics to influence cellular function.

Military Medical Research

Home About Articles Submission Guidelines Submit manuscript

Review | Open Access | Published: 25 April 2021

Research progress in the effects of terahertz waves on biomacromolecules

Liu Sun, Li Zhao & Rui-Yun Peng

Military Medical Research **8**, Article number: 28 (2021) | Cite this article

Effects of terahertz waves on nucleic acids

Consistent with that on proteins, the effects of terahertz waves on DNA and RNA were determined by radiation sources, radiation frequency, intensity and duration.

At the DNA level, it has been reported that specific terahertz waves interfere with DNA replication and gene expression [3]. Under certain conditions, linear and nonlinear interactions between the terahertz electromagnetic field and DNA resonance might significantly alter DNA replication and synthesis and even induce local bubbles in the DNA strands [48]. Hintzsche et al. [49] found that 0.106 THz terahertz waves prevented the separation of chromatids during anaphase and telophase of mitosis in hamster hybrid cells. Berns et al. [50] showed that exposure to 1.5 THz FEL at 100 pulses directly reduced absorption in DNA molecules and inhibited DNA synthesis in mammalian cells. Studies from Cheon et al. [51] suggested that 1.7 THz high-power terahertz exposure resulted in DNA demethylation in hematological tumor cells. Titova et al. [39] revealed that terahertz radiation caused DNA damage in human skin tissue at a strong terahertz pulse of 1.0 μJ and a repetition rate of 1 kHz. The tubulin beta 3 (Tubb3) and synaptophysin (SYP) genes were downregulated by 0.22 THz and 50 mW /cm² irradiation of Neuro-2a cells, suggesting that terahertz waves could inhibit synaptic growth [52]. Lu et al. [53] radiated C57BL/6 J mouse retinal tissue at the average power density of 80 mW/cm². They observed that terahertz waves could lead to abnormal

Smartphones now routinely include sensors and microprocessors capable of processing large amounts of data in record times

Are smartphones about to get smarter? With terahertz spectroscopy, it certainly looks that way…

Posted on June 16, 2022

The number of UK smartphones users reached 55.5 million in 2021. This means that nearly 83% of the population have access to Mobile Applications, more commonly known as Apps. Today, almost 3.3 million Apps are available on Google Play, with approximately 2.2 million Apps listed on the Apple Inc. App Store. One area of this App explosion is a soaring demand for health Apps, with the worldwide digital health market forecast to be worth £1311 bn by 2030.

JOURNAL ARTICLE

Terahertz Radiation Increases Genomic Instability in Human Lymphocytes

Avital Korenstein-Ilan, Alexander Barbul, Pini Hasin, Alon Eliran, Avraham Gover and Rafi Korenstein

Radiation Research
Vol. 170, No. 2 (Aug., 2008), pp. 224-234 (11 pages)
Published By: Radiation Research Society

Terahertz radiation is increasingly being applied in new and evolving technologies applied in areas such as homeland security and medical imaging. Thus a timely assessment of the potential hazards and health effects of occupational and general population exposure to THz radiation is required. We applied continuous-wave (CW) 0.1 THz radiation (0.031 mW/cm^2) to dividing lymphocytes for 1, 2 and 24 h and examined the changes in chromosome number of chromosomes 1, 10, 11 and 17 and changes in the replication timing of their centromeres using interphase fluorescence in situ hybridization (FISH). Chromosomes 11 and 17 were most vulnerable (about 30% increase in aneuploidy after 2 and 24 h of exposure), while chromosomes 1 and 10 were not affected. We observed changes in the asynchronous mode of replication of centromeres 11, 17 and 1 (by 40%) after 2 h of exposure and of all four centromeres after 24 h of exposure (by 50%). It is speculated that these effects are caused by radiation-induced low-frequency collective vibrational modes of proteins and DNA. Our results demonstrate that exposure of lymphocytes in vitro to a low power density of 0.1 THz radiation induces genomic instability. These findings, if verified, may suggest that such exposure may result in an increased risk of cancer.

The laws and effects of terahertz wave interactions with neurons

 Ma Shaoqing[1,2] Li Zhiwei[3] Gong Shixiang[1,2] Lu Chengbiao[4*]
 Li Xiaoli[5*] Li Yingwei[1,2*]

[1] School of Information Science and Engineering, Yanshan University, Qinhuangdao, China
[2] Hebei Key Laboratory of Information Transmission and Signal Processing, Qinhuangdao, China
[3] Institute of Electrical Engineering, Yanshan University, Qinhuangdao, China
[4] Henan International Key Laboratory for Noninvasive Neuromodulation, Xinxiang Medical University, Xinxiang, China
[5] State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China

Introduction: Terahertz waves lie within the energy range of hydrogen bonding and van der Waals forces. They can couple directly with proteins to excite non-linear resonance effects in proteins, and thus affect the structure of neurons. However, it remains unclear which terahertz radiation protocols modulate the structure of neurons. Furthermore, guidelines and methods for selecting terahertz radiation parameters are lacking.

Methods: In this study, the propagation and thermal effects of 0.3–3 THz wave interactions with neurons were modelled, and the field strength and temperature variations were used as evaluation criteria. On this basis, we experimentally investigated the effects of cumulative radiation from terahertz waves on neuron structure.

The laws and effects of terahertz wave interactions with neurons

 Ma Shaoqing[1,2] Li Zhiwei[3] Gong Shixiang[1,2] Lu Chengbiao[4]*
 Li Xiaoli[5]* Li Yingwei[1,2]*

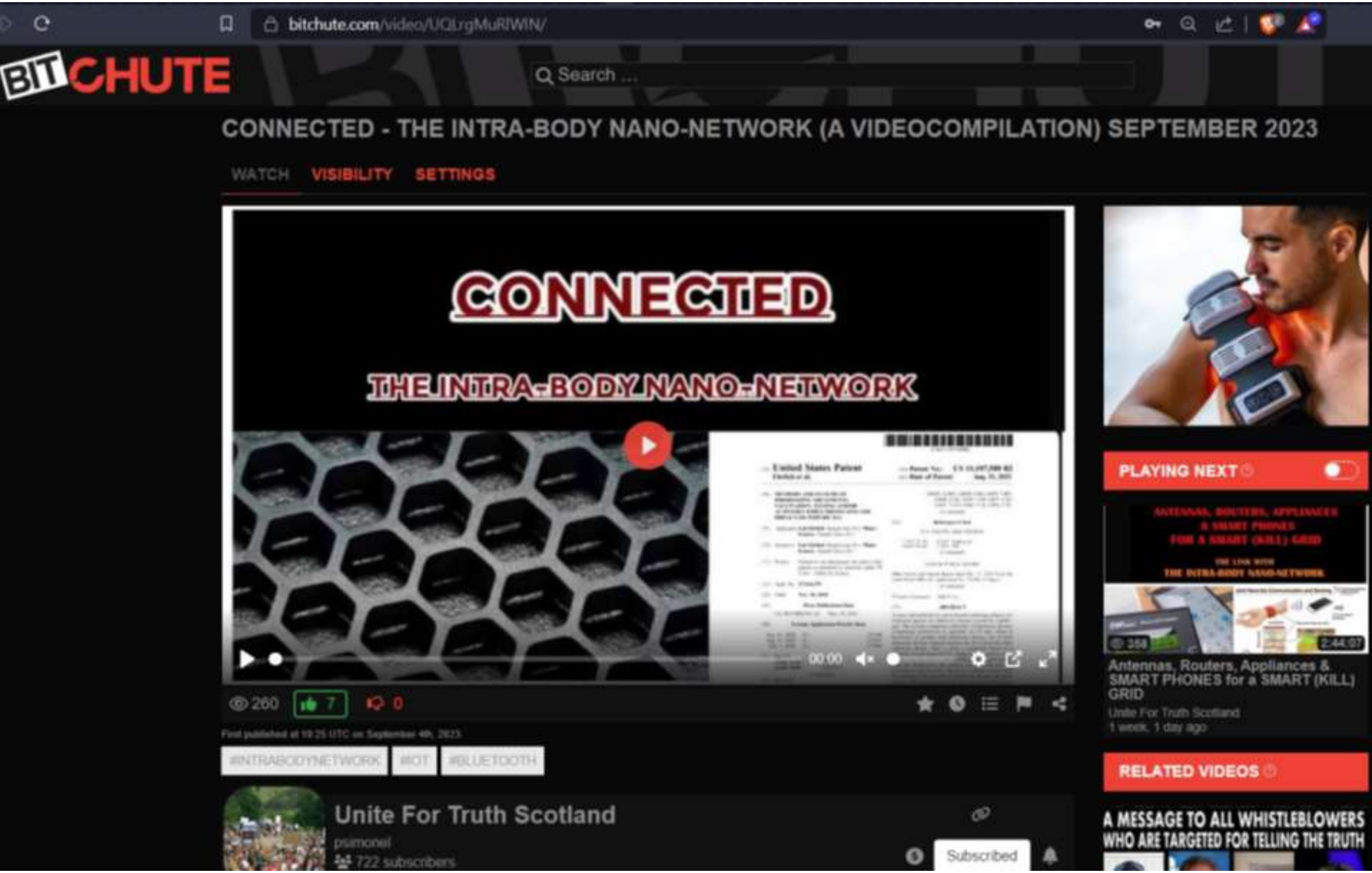
In this study, the propagation and thermal effects of terahertz waves' interactions with neurons were modelled to analyze the main parameters affecting the field strength and temperature variation in terahertz waves in neurons. The field strength and temperature variations are used as evaluation criteria to select the appropriate terahertz radiation parameters. On this basis, we experimentally investigated the effects of cumulative radiation from terahertz waves on the structure of neurons. 1) The frequency and power of terahertz waves are the main factors affecting field strength and temperature in neurons, and there is a positive correlation between them, a phenomenon that is correlated with the relative dielectric constant of the cytoplasm. 2) When choosing terahertz radiation parameters, the frequency can be determined according to the properties of the modulating substance, and an appropriate reduction in radiation power can mitigate the rise in temperature in the neuron. It is also possible to use pulsed waves to keep the duration of a single round of radiation, as well as short bursts of cumulative radiation, to the millisecond level. 3) On this basis, we found that broadband trace terahertz (0.1–2 THz, maximum radiated power 100 μW), short duration cumulative radiation (3 min/day, 3 days) does not cause neuronal death. This radiation protocol can also promote the growth of neuronal cytosomes and protrusions. This paper provides a set of guidelines and methodology for selecting terahertz radiation parameters in the study of terahertz neurobiological effects. Furthermore, it provides verification that the structure of neurons can be modulated using short duration cumulative radiation.

Ian Akyldiz - TerraHertz communication - fragment 1.mp4

Ian Akyldiz - TerraHertz communication - fragment 6.mp4

Ian Akyldiz - TerraHertz communication - fragment 4.mp4

Ian Akyldiz - TerraHertz communication - fragment 7.mp4


bitchute.com/video/UQLrgMuRIWIN/
BIT CHUTE
Search ...
CONNECTED - THE INTRA-BODY NANO-NETWORK (A VIDEOCOMPILATION) SEPTEMBER 2023
WATCH
VISIBILITY
SETTINGS
CONNECTED
THE INTRA-BODY NANO-NETWORK
United States Patent
00:00
260
7
0
#INTRABODYNETWORK
#IOT
#BLUETOOTH
Unite For Truth Scotland
psimonel
722 subscribers
Subscribed
PLAYING NEXT
358
2:44:07
Antennas, Routers, Appliances & SMART PHONES for a SMART (KILL) GRID
Unite For Truth Scotland
1 week, 1 day ago
RELATED VIDEOS
A MESSAGE TO ALL WHISTLEBLOWERS WHO ARE TARGETED FOR TELLING THE TRUTH



VĂ AFLAȚI LA MAI PUȚIN DE 50 M
DE O UNITATE DE ÎNVĂȚĂMÂNT
POARTĂ MASCĂ
purtarea măștii este obligatorie în intervalul
07:45 - 21:15, de luni până vineri
ENGLISH
together
ȘCOALA GIMNAZIALA
NR 108


Raffy


ÎNTRE BINE ȘI RĂU
ZACE SUFLETUL
TĂU !!