Abstract

Purpose: So-called "physical constants" might not be as constant as we think. What are the rules governing absolute quantum metrics vs. covariant emergent metrics? If Newton's Gravitation constant were found to change with the age of the Universe, what would be the consequences? How would that affect our understanding of Cosmic Geometry? Dark Energy? Dark Matter?

Goals: (0) What is the true nature of time? (1) Can Quantum Mechanics be unified with Relativity? (2) Could this also yield a resolution of Dark Energy? (3) Can we calculate precise values of fundamental constants and physical quantities from 1st principles: Fine-Structure Constant, α, Planck Units, "Vacuum" properties, electron, proton, neutron masses & radii?

Hypothesis: Imagine Einstein's spacetime manifold as being an ever-expanding Event Horizon wrapped around a Cosmic Onion. It's adding quantum-thin holographic layers to the Black Whole we call Our Universe. Quantum time is the radial polar coordinate. The so-called vacuum is NOT empty, it is a superfluid (no viscosity & no aether drag). The mass density and energetic oscillations within the elasticity of this superfluid define Planck units, together these define Impedance, Permeability, and Permittivity.

Procedure: I gathered a database of physics equations often rearranging textbook equations to solve for the target quantity of each equation-set. I used the speed of light, *c,* Planck's constant, *h,* to define & calibrate kilograms. I used, α, to calibrate Fundamental Charge,

e. Carefully arranging formulae by dependencies & identifying which formula yielded the smallest relative uncertainty I carried those values forward to other equation-sets, thus validating each formula and cross-checking each numeric value.

Findings: Fundamentally understood the 4 quantum-scale dimensional units (absolutely=1) are quantum-scale [length] [time] [mass] [charge]. There are 5 emergent SI metrics: [meters], [seconds], [kilograms], [Coulombs], and [Kelvin]. Emergent means that as the circumference of the universe grows at 2c, the duration of a second and the length of a meter also grow. The values we associate with Planck time and Planck length shrink as the reciprocal of this linear expansion. With my discovery of the EXACT formula for the Fine-Structure Constant my lifelong quest is, herein, being fulfilled.

Conclusion: The Universe is not flat, nor is it of fixed curvature -- it is ever-decreasing positive curvature. A most surprising discovery is that the accumulation of quantum time $\int \tau \, d\tau$ has units of [time^2]. ==Cosmological Relativity== unifies Special and General Relativity with quantum mechanics by consciously mixing quantum and emergent metrics in the same equations, thus making relativistic math compatible with quantum calculations while eliminating renormalization. These ideas explain phenomena such as Dark Energy, Dark Matter, Dark Flow, and anomalies in the Cosmic Microwave Background. All this is the foundation on which to build a theory of Quantum Gravity. I propose the ==blue-highlighted== calculations herein for CODATA 2022 dataset.

Contents

We cannot solve our problems with the same thinking that created them. -- Albert Einstein

The enigmas of Dark Matter and Dark Energy were created by the false assumption of Flat Spacetime. Since about 1900, the predominate "scientific thinking" has been stuck on this **Flat** Spacetime. geometric assumption.   By 1920s Friedmann–Lemaître–Robertson–Walker metric presented three options: (1) Flat spacetime, (2) constant positive curvature (spherical), or (3) constant negative curvature (hyperbolic).

The Cosmological Principle[A] says that universes must be homogeneous and isotropic.

- **Homogeneous[B]**: on "large enough" scales the mass of galaxies MUST be evenly distributed.
- Isotropic: requires that observers in each galaxy see this same kind of distribution in all directions.

The inverted-bell diagram[C] illustrates that Flat Spacetime **fails** both *requirements*. Observers in central galaxies see the same distribution patterns in all directions, while observers in galaxies near the edge see a different distribution depending on the direction they look.
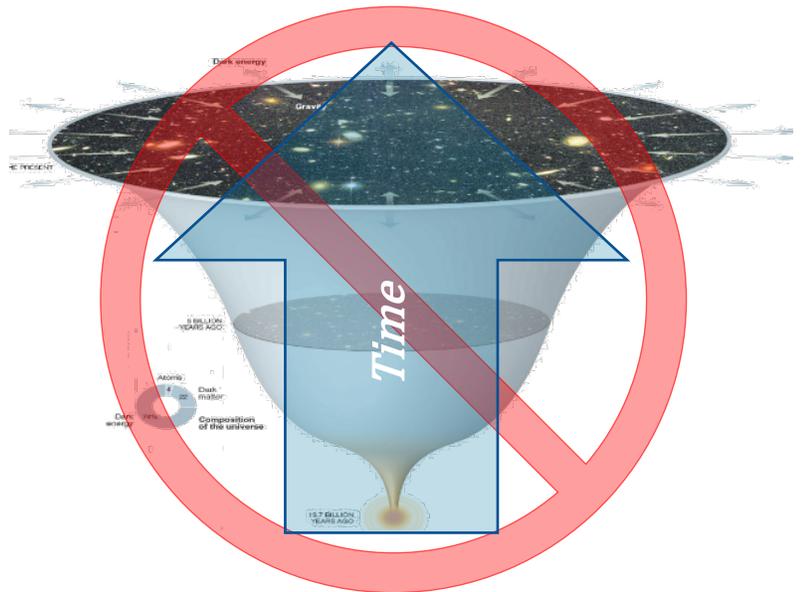
Flat Spacetime	Expanding Spherical Space~Time
Only one **Arrow of Time** for entire universe.	Many Arrows of Time spreading forth in all directions.
Duration of second & length of meter not allowed to change: Δ[Planck seconds]/second = 0	Re Table 1.5, duration of each passing second increases by 4.2709338373892(81)e25 [Planck seconds/second^2]
Conversion factor from time to space is c, speed of light.	Time to space conversion factor is c/π.
Light cone has 45° slope	Light cone has 17.656787° slope = arctan(1/π) and curves around the hyper spherical universe.

These distinctions are discussed, explained & illustrated in the next sections.

The assumption of Flat Spacetime has, for over a century, hindered cosmological breakthroughs.   These papers attempt to quantify "flatness" by mapping the Cosmic Microwave Background using data from these satellites:

COBE (al. G. S., 1992) ; **WMAP** (al. D. N., 2007) **Planck Satellite**. by R.A.R.Ade et. (al. P. A., Planck 2013 results. XVI. Cosmological parameters, 2014)   "...we find [Hubble's Parameter] H0 = (67.3±1.2) km s−1 Mpc−1 & Ωm = 0.315±0.017, for a flat universe." (Planck Collaboration et al, 2014) claims most precise measurements, better than 0.1% for most parameters. ALL these researchers interpret their observations through their "flat spacetime bias" and must adjust parameters in their equations accordingly to make their ΛCDM models fit observations. Their "*EQUATIONS*" need 95% fudge factors. I say the universe does NOT need their equations to exist. If only they were allowed to consider the Cosmic Onion Model with its Cosmological Relativity -- their fudge factors and perplexities would disappear.

What part of "inside-out" are so many people not understanding?

Image credit: Pablo Carlos / Wikipedia

 This beautifully done logarithmic scale illustration shows our Earthbound (center) view looking out in all directions.   The further out we look for more distant those objects are. The more distant a galaxy is the smaller and dimmer it "appears" to be.

 Beyond the most distant galaxies around the outer most edge is the CMB.

 But you must ask yourself, "But the CMB was at a time when the universe was only 380,000 years! How can it "seem as if" the whole universe is contained within it!

 If you really engage your brain here you've got to say, "But that does not make sense!"

 Just like when we view Mars' orbit from our moving reference frame of Earth we see the **illusion** of "retrograde motion." Here, the illusion is caused by not realizing that we & observers in all galaxies are expanding away from the past, therefore, we and all observers are on the outer most edge.

1   Introducing Cosmological Relativity

Cosmological Relativity unifies Special and General Relativity with Quantum Field Theory by realizing that our Here & Now local inertial reference frame experiences Space~Time expansion. This expansion is because each metric and all atoms expand with time, and the math is so simple that it will boggle your mind.

So many equations contain the speed of light squared, c^2 [meters^2/second^2] this becomes [Δarea]/[ΔPlanck seconds/second] - this describes the local reference frame spreading forth its surface area while the number of Planck seconds -- per each new second -- increases linearly with the age of the universe. (Covariant^1st).

1.1   Higher Perspective is the Key to Understanding

To understand a system, it's best to adopt an outside perspective not influenced by the observer's reference frame. Copernicus, Kepler, Galileo, and other pioneers did this when they "<u>envisioned</u>" the Solar System from above and discovered that "retrograde motion" was an **illusion**, as shown in this illustration of Earth and Mars following their orbits uniformly.

Let's apply this idea of a higher perspective to the whole universe. As observers, let's step outside of ourselves long enough to observe the Earth, our solar system, and our Milky Way galaxy as just one speck among billions of galactic specks spread across the expanse of Space~Time. Let's envision the entire volume of physical reality from the outer darkness, unaffected by the dynamics of inertial reference frames and the expanding spacetime.

 To literally, "see out of obscurity" from a timeless perspective.   Note the left image below shows a top-looking-down view that "looks as if" spacetime is flat. It creates the illusion that the big bang originates on the outermost edge with the surface of the Cosmic Microwave Background being the furthest we can see from our central viewpoint.   This surface "of last scattering"- is over 13 billion light years from our telescopes.   Note that the rays of light coming towards us are straight lines through space. But as we tilt this hypersphere that is the universe we see the light cone curves along the time-dimension.

Flat: light rays look straight	**Tilted**: revealing time curvature	**Side view**: reveals light cone shape

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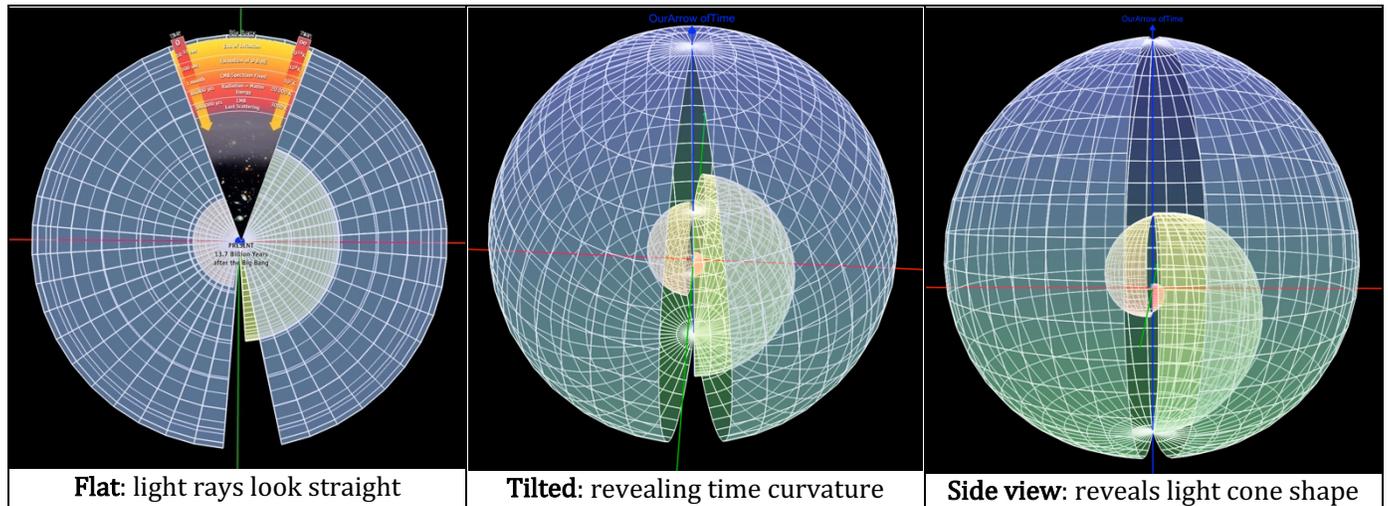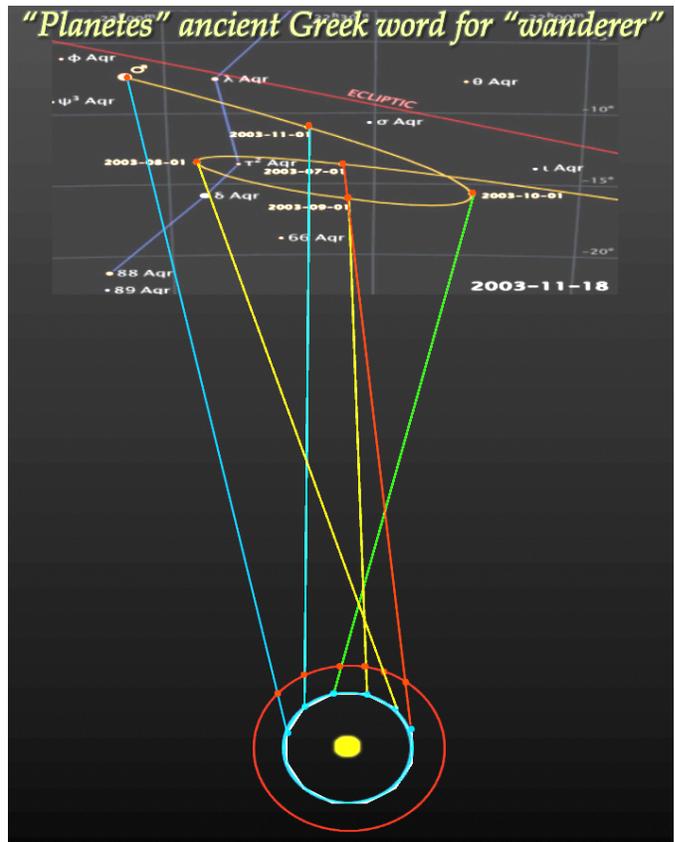
Truth Passes through 3 Stages:

First, it is Ridiculed.
Second, it is Violently Opposed.
Third, it is Accepted as Self-Evident.

-- German Philosopher, Arthur Schopenhauer

Spherical Geometry: FLRW-metric's 4th option: *Constantly changing positive curvature*

Cosmic Onion Model: describes our universe from a perspective above Space~Time. From a higher perspective, we can see the entire cosmos in a single glance. To see the depths of our holographic Cosmic Onion, we must look from its outermost edge back into the depths of times past. From this external perspective we can realize that the Cosmic Microwave Background[D] (CMB)[E] is at the core and all galaxies, including ourselves, are expanding away from it in ALL directions. "Now" is always on the edge of the Cosmic Event Horizon. This purplish neural net looking distribution of galaxies expanding outward in all directions.
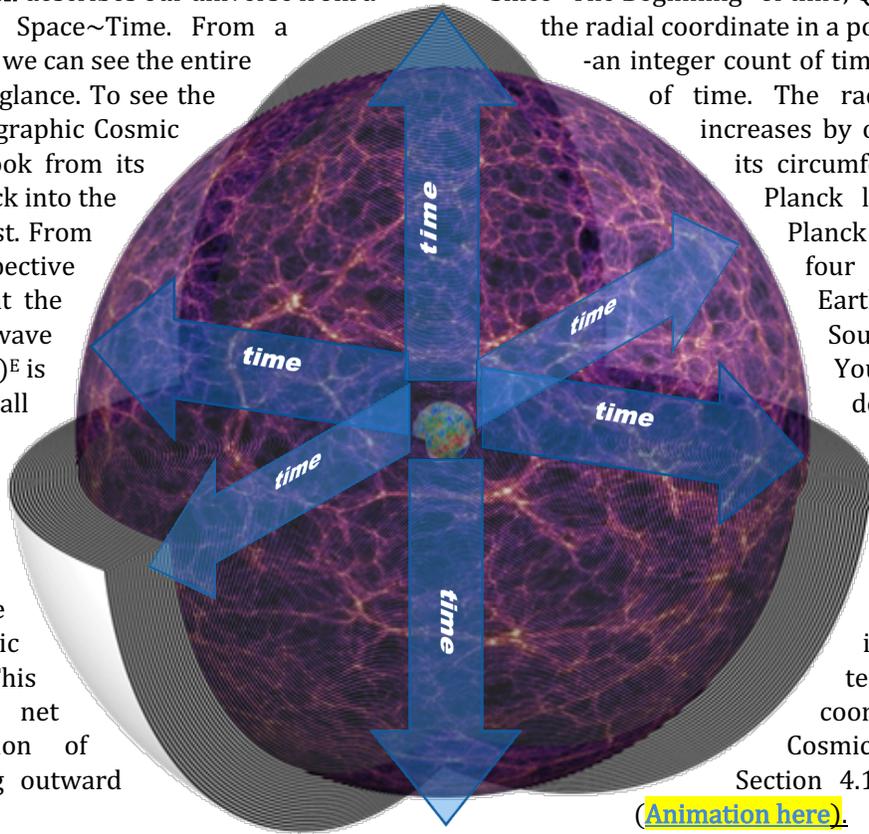
Since "The Beginning" of time, Quantum Time has been the radial coordinate in a polar coordinate system--an integer count of time quanta, Onion-layers of time. The radius of the universe increases by one time quantum and its circumference increases by 2 Planck lengths. There is one Planck length in each of the four directions. From our Earthly perspective, North, South, East, and West. Your (longitude, latitude) determines which way is up. The direction of local time expansion is aligned with this upward Z-axis. On a cosmic scale this (longitude, latitude) idea can be explained in terms of a cosmic coordinate system and a Cosmic Quaternion Equation. Section 4.10: "The Cosmic Egg" (Animation here).

Shown here is our Light Cone in Spherical Space~Time. We are top center, light from all directions coming towards us, traversing ever-expanding Space~Time. Please understand that as we look further out into the universe, we are seeing back into the depths of times past when the universe and everything in it was smaller.
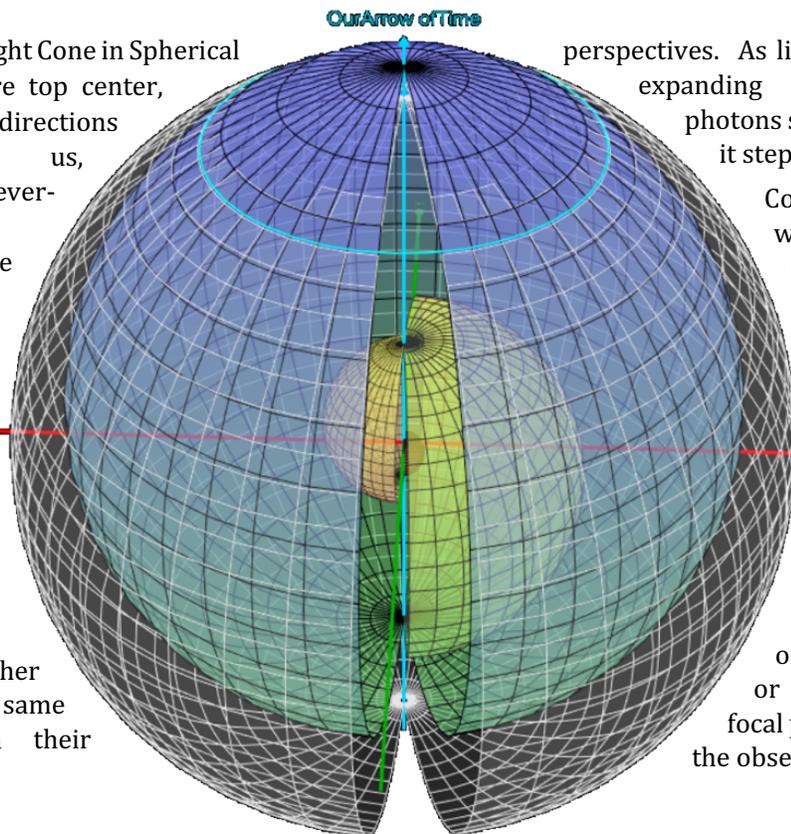
Observers in other galaxies see this same phenomenon from their perspectives. As light propagates on the ever-expanding Event Horizon surface, photons spread forth 1 Planck time as it steps out 1 Planck length.

Cosmological Relativity says with each passing second the duration of a second increases by 4.27×10^{25} Planck seconds. As the circumference of the universe grows linearly, the current values for Planck length & Planck time continually shrink as (Covariant^{-1}), $1/t$.

Dark Flow is a peculiar drift of galaxies merging towards or emerging away from these focal points that are opposite from the observer's perspective.

Dark Flow

Coma Galaxy Cluster

Abell 1689

Abell 667

Abell 520

Billions of Light Years	π	Cluster
0.8 – 1.25	$\sqrt{0.5\pi}$	Coma
1.2 – 1.77	$\sqrt{\pi}$	Abell 667
1.3 – 2.17	$\sqrt{1.5\pi}$	Abell 1689
1.3 – 2.50	$\sqrt{2\pi}$	Abell 520
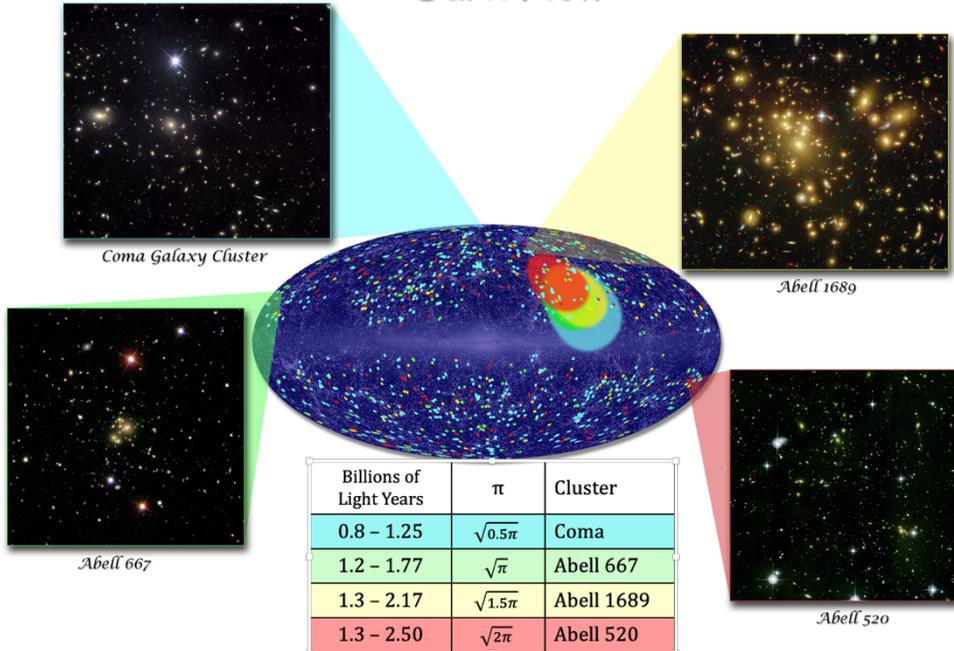
The colored dots are clusters within one of four distance ranges, redder colors indicate greater distance. Colored ellipses show the direction of bulk motion for the clusters of the corresponding color. Galactic clusters images at each distance slice are also shown.

As far as I can tell, at the current age of the universe, our light cone crosses over itself 5 times as it spirals its way around Spherical Space~Time. Each of these focal points are candidates for the mysterious Dark Flow phenomenon.

Alex Kashlinski (Goddard Space Flight Center) & Int'l collaborators reported "large-scale peculiar velocities of clusters of galaxies:..."[F] In Kashlinski's words, "We detect motion along this axis, but right now our data cannot state as strongly as we'd like whether the clusters are coming or going." Cosmic Onion Model says galaxies closer to the observer than the Dark Flow focal point "appear" to be emerging from that focal point -- while those further appear to be merging.

To the right is a close-up of the inner most portions of our light cone. Is the "navel" below caused by the focal point of our light cone? Or is it merely an artifact of the scanning pattern of the Planck satellite? If due to this scanning pattern, there
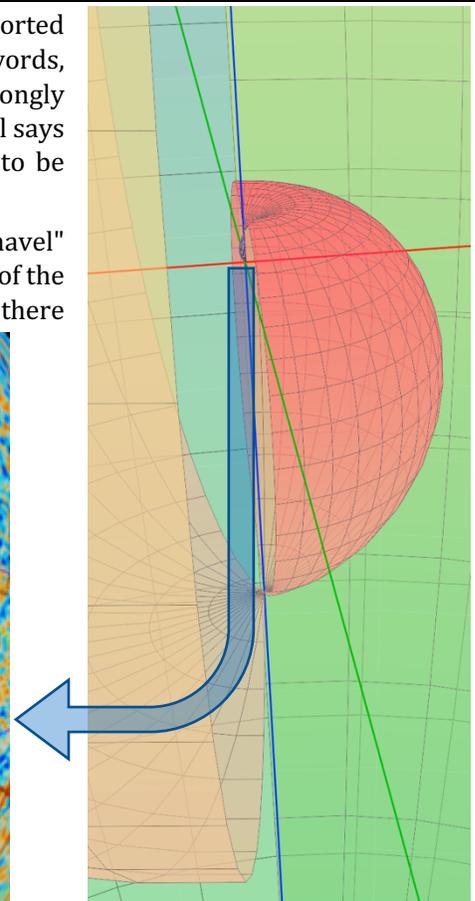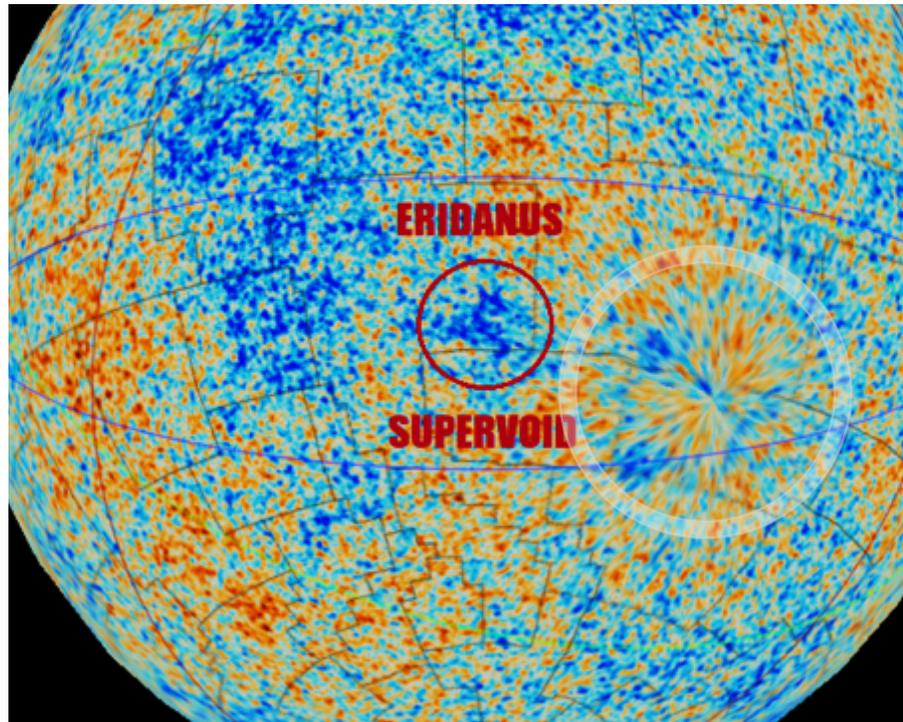
should be a similar navel on the opposite side of this sphere. If not, then CMB has a belly button! *;-)*

1.2   Accelerated Expansion via Decelerating observer's reference-frame.

To us and to observers in other galaxies the passage of time **"feels"** linear.   As each Earth second ticks we experience a unique number of Planck times for that unique second this happens 60 times per minute and 60 minutes/hour thus in 24 hours we experience 86,400 seconds per day. This illustration's vertical axis shows linear time as **evenly spaced** numbers -- each one counts off another billion years.
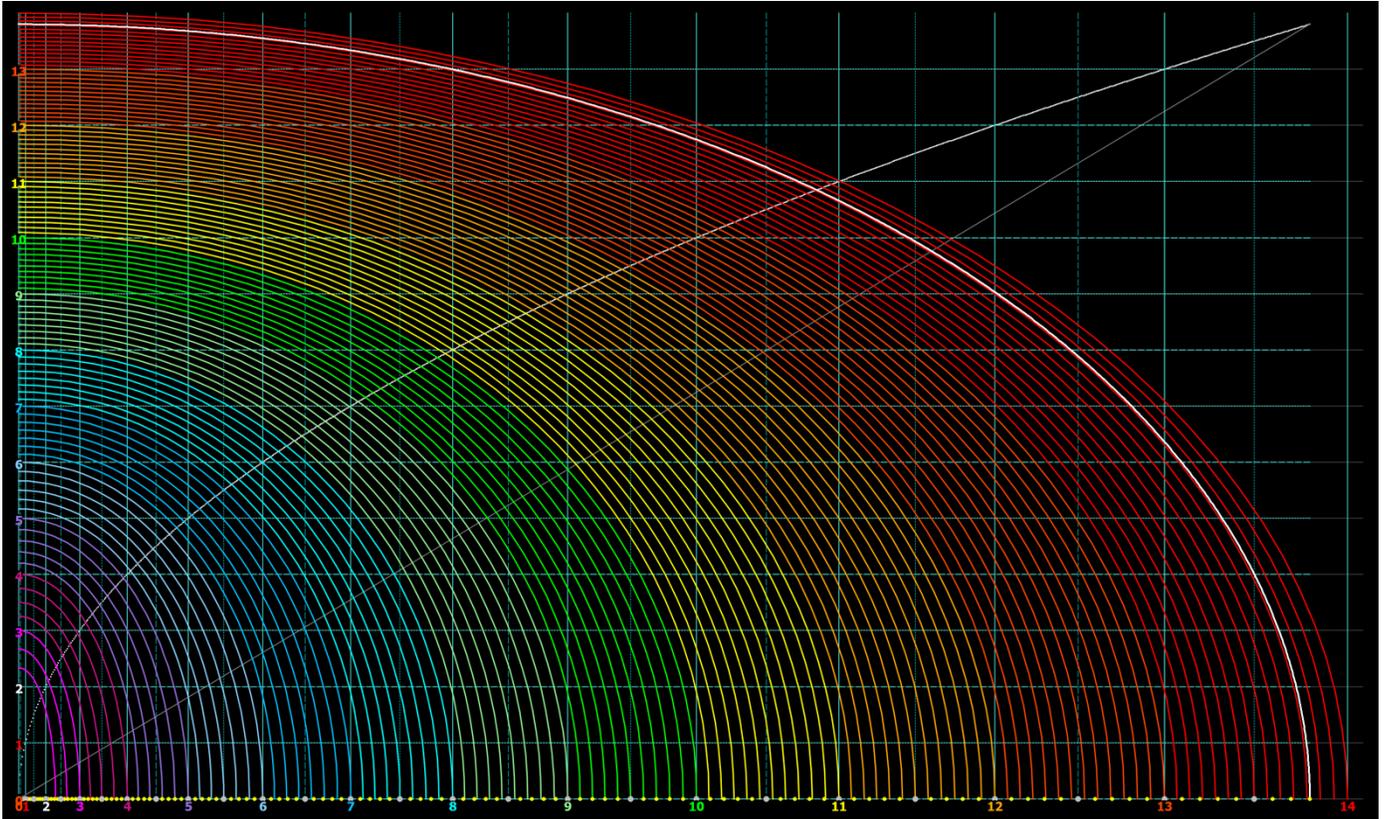
Contrast this with the horizontal axis as being our "*perception*" of accelerating expansion -- where the root cause is an ever-increasing number of Planck times per second. *expanding Space~Time*.   Each **dot** along the bottom axis represents 100-million years -- thus 10 dots per billion. Each Earth orbit defines the **sidereal year** as 31,558,149.54 seconds. Multiply by 100x10^6 we get the idea that each dot is about 3.1558x10^15 seconds. Each colored arc represents 1.3478x10^41 Planck seconds/ 100-million years.

Notice between 2 to 3 there are 3 arcs, 3 to 4 has 4 arcs -- adding one more arc with the passing of each billion years.   Each passing 100-million years add about 1.348x10^41 Planck seconds to each Earth second.

At the "current age" of the universe the duration of a Planck time (aka a Planck second) is this inconceivably tiny 5.39124x10^-44th of a second -- its reciprocal called the Planck frequency, ω_P, pronounced "omega sub-P". is 1.85486x10^43 Planck seconds per second. "Why so big?" The astonishing answer is "It **grew** to be this big!"

  This simplified calibration between linear "perception" of the passage of time verses the ever-increasing quantum units per second or per billion years. The horizontal grid spaces out in accord with:

$$\tfrac{1}{2}t^2 \;=\; \int t\,dt$$

The next page takes this mapping of linear time to accelerating expansion and wraps it around a spherical universe.

2D "Great Circle" Cross-section of Spherical Universe: *We are top-center with Galaxy 2's light path coming towards us. Galaxy 2, far-right, sees our light path coming towards them.*

	Billions_of_Years			Billions_of_Years	
	Lookback	AgeUniv		Lookback	AgeUniv
A	12.500	1.300	N	6.000	7.800
B	12.000	1.800	O	5.500	8.300
C	11.500	2.300	P	5.000	8.800
D	11.000	2.800	Q	4.500	9.300
E	10.500	3.300	R	4.000	9.800
F	10.000	3.800	S	3.500	10.300
G	9.500	4.300	T	3.000	10.800
H	9.000	4.800	U	2.500	11.300
I	8.500	5.300	V	2.000	11.800
J	8.000	5.800	W	1.500	12.300
K	7.500	6.300	X	1.000	12.800
L	7.000	6.800	Y	0.500	13.300
M	6.500	7.300	Z	0.000	13.800

At universe age=13.8 billion years our Milky Way galaxy is at top "z". 12.5 billion years ago we were at "a" when age=1.3 billion years. Meanwhile, Galaxy 2 was at "A". All galaxies expand away from the center of spacetime -- the Singularity. Here we expand straight up while Galaxy 2 expands to the right. 1.57 billion years ago we would have been on the vertical line at age=12.23 billion (left of "W") -- 0.07 billion years later our light rays heading towards Galaxy 2 would be at W. Meanwhile Galaxy 2 expanded along the horizontal axis from its 12.23-billion-year mark while its rays towards us reached as far as "w". From these W-markers a half billion years later our respective light rays would get as far as the X's 1-billion years left before we would see each other as we were 1.57 billion years ago. IMPORTANT DISTINCTION: what we perceive to be a straight line-of-sight "through space" experiences *curvature* around the "*time dimension*" -- do not take this spatial vs. temporal curvature lightly. Each passing half-billion years increases by 6.74x10^41 Planck seconds.

Imagine Einstein, staring at a chalkboard full of physics equations -- contemplating many references to 't'...

The distinction between past, present & future is a stubbornly persistent illusion. *-- Albert Einstein*

Herein, Einstein's "riddle" is solved. I finally understand Einstein's dilemma after pondering physics equations for several years. The dilemma created by being stuck with a flat spacetime where everyone "thinks" all seconds are equal, that the value of 1.85x10^43 Planck seconds per second has been the same since the beginning. I (and we) can now know with 100% confidence level that the previous second was 4.27x10^25 Planck seconds shorter than the current second and the next second will be 4.27x10^25 Planck

seconds longer, thanks to the introduction of Expanding Space~Time. As you realize the first second of this universe was only 4.27x10^25 Planck seconds, you will be astonished! The 2nd second was twice that. The third was 3 times that. To go from 2 to 4 took twice as long as from 1 to 2. As each doubling has taken twice as long as the previous doubling. Today we are between the 201st and 202nd doubling, for the age of the universe is on the order of 4.0278x10^60 Planck seconds (*Equation 3.3*), or about 13.762 billion years.

An interesting feature of this model is that it defines a precise quantum coordinate in time for each event. Yet, there is no preferred reference frame as to WHERE each event occurs! This realization, being both subtle and profound, satisfies Special Relativity's need for "all things to be relative" as well as 2022 Nobel Prize conjecture that quantum events need an ABSOLUTE base from which quantum entanglement can occur.

"Old School" cosmology could not solve the imbalance between matter & anti-matter. The simple solution is that "Time" for galaxies on the opposite side of the universe goes in the opposite direction from us. From our perspective they are anti-matter galaxies. Whereas, from their perspective, we and our neighbors are anti-matter

1.3 The Universe explained from 1st Principles

I had originally assumed that all seconds were equal in duration and that Newton's Gravitation constant, G, was constant throughout time. I needed to comprehend the rules governing covariant metrics. Then I backtracked to rethink all my physics calculations in the context of expanding spherical Space~Time. The Universe does not quantum compute itself using SI units -- rather, it uses

quantum units of 1. We need to know what "1" means. The reciprocal of one is one. One raised to any power equals one. All fundamental quantum metrics have values that equal 1. The speed of light, c, is 1 quantum of length per 1 quantum of time. In SI units c = 299,792,458 m/s. Please refer to **Sections 1.5 & 3.1** for further discussion of this 1st Principles topic.

1.4 Physical Constants vs. covariant Properties

For "charge" physicists handled this "per second" issue Physicists declared the Ampere as a fundamental metric, but 1 Ampere = 1 "elementary charge per second". Elementary Charge is measured in [Coulombs]. The [Ampere] is equal to 1 [Coulomb / second]. Please understand that Coulomb is the base unit, therefore Amperes is the "derived unit." Compare this with the speed of light, c, has units of [meters/second] widely accepted as derived units.

As for mass our [kilogram] "invisibly implies" a per second. This is very awkward. Many physicists who are attached to the old ways will oppose this idea until they read and understand Sections 4.1 - 4.8

This is the fundamental thesis of Cosmological Relativity which relates quantum units of 1 to our Expanding metrics of spatial divergence with temporal divergence. It is easiest to understand quantum mechanics by relating our SI units to quantum-scale units. [kg t_P] is an abbreviation for [kilogram][Planck times].

Let's explain the Higgs Field with this exact mass-time amount that the universe gives up mass-time allocated to counter-space and gives this increment to the "particle". This explanation also suggests where we might find Dark Matter by redefining it as the residual effect of ordinary matter spreading forth as quantum gravity. The model can even explain the Dark Energy enigma away. Is it possible for me to adequately explain everything in one document? Probably not.

1.5   Yellow Brick Road to a Complete Cosmology

I do promise to map out the Yellow Brick Road leading to an explanation of the foundational Space~Time framework for physical reality.   Surprisingly, I also discovered where the other 7 dimensions of 11D M-theory and how they are curled up in the electromagnetic field.

For those of you who want the fast track to the Cosmic Onion Model and Cosmological Relativity I've highlighted key sections in yellow -- these have the essentials to quickly comprehend this new cosmological paradigm.

Many chapters before I can adequately explain the Singularity & Cosmic Quaternion Equations. This is where we'll find 11 dimensions curled up inside the complex 11-density surface of the "Now-Manifold" Event Horizon. Crossing this bridge will take us to a deep understanding of the 11 densities -- you will be able to visualize the quantum-scale and even the imaginary sub-quantum realm (where non-locality exists). It is going to be difficult. You will have to engage your brain every step of the way.

"Philosophy is written in this grand book, the universe,
which stands continually open to our gaze.
But the book cannot be understood unless one first learns to comprehend
the language and read the letters in which it is composed.
It is written in the language of mathematics, and its characters are triangles, circles and
other geometric figures without which it is humanly impossible to understand
a single word of it; without these, one wanders about in a dark labyrinth."

--Galileo Galilei (1564-1642)

Quantities in this table apply to discussion of graph of Planck time vs. Age of the Universe -- next page.

Quantity	Value	relUnc	units	-L -T +M +C +K	dt	
t_P	5.39124334778149e_44	3.7e_16	s	0 1 0 0 0	_1	Planck time
1/t_P	1.85485969653271e43	3.4e_16	Hz	0 _1 0 0 0	1	and its reciprocal
omg_P	1.85485969653271e43	4e_16	Hz	0 _1 0 0 0	1	is the Planck frequency.
secs_p_yr	31557600	0		0 0 0 0 0	0	Seconds per year
ageUniv_s	4.34298391675992e17	1.9e_12	s	0 1 0 0 0	_1	Age of Universe Equation 3.2
omg_P/ageUniv_s	4.27093383738923e25	1.9e_12	/s2	0 _2 0 0 0	2	Differential Planck seconds/sec^2
ageUniv_s/secs_p_yr	13,762,085,572.9204	1.9e_12	s	0 1 0 0 0	_1	= 13.762 billion years
ageUniv_s*omg_P	8.05562582988777e60	1.9e_12		0 0 0 0 0	0	Flat Universe quanta/universe
ageUniv_tP	4.02781291494388e60	1.9e_12		0 0 0 0 0	0	Expanding Univ is half that
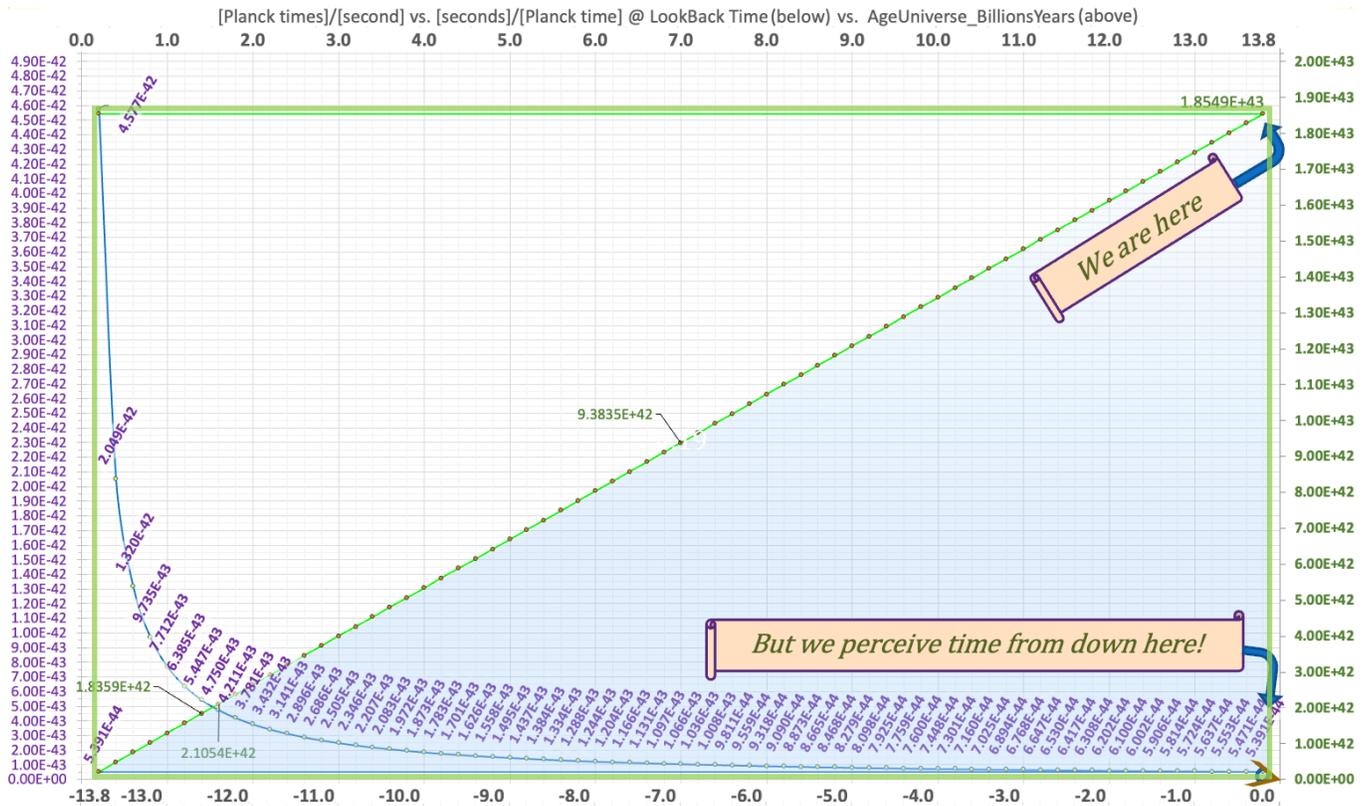
In the previous table, note that Planck time (aka Planck second) is the extremely tiny 5.39x10^-44 number (see lower left corner of graph and purple numbers with blue curve). The reciprocal of the Planck time is the Planck Frequency, ω_P, it has grown to the huge value of 1.85x10^43 (Planck seconds)/(Earth second). (See green numbers and upper right corner of the graph.)

The horizontal green line near the top represents the flat spacetime perspective. This line represents "the belief" that the number of Planck seconds per second had always been the same as today's value ω_P. Given the age of the universe as 4.34x10^17 seconds when we multiply that by ω_P seconds per year. For flat spacetime believers this would say the universe is 8x10^60 times old -- the rectangular, green-bordered area. However, the triangle has half that area. It represents 4x10^60th time-quanta as the value for expanding Space~Time. As observers, we find ourselves at the bottom right corner looking backward into the depths of times past, when everything in the universe was smaller. Looking back only a few billion light years it only "seems as if" time (the Blue curve) is flat. However, the discrepancy becomes greater the further we look back. The James Webb Space Telescope is allowing us to see back 9-13 billion light years into the past, very close to The Beginning. Only now are Earth-bound humans' are becoming conscious of this significant disparity as JWST is magnifying the inner-most depths of time.

The values of Planck length & time follow the 1/t blue curve, whereas the values of Planck mass and Charge follow the linear covariant diagonal line.

The True Nature of Time? Not what anyone expected!

The 1.85x10^43 Planck Frequency divided by the age of the universe yields the number of additional Planck seconds that each passing second experiences. That's a mind boggling 4.27x10^25 more Planck seconds every second! Note this 10^25 number is 98-million times greater than 10^17 seconds for the age of the universe!

The holographic trick here is that each second adds 4.27x10^25 Onion layers -- which contains any new information for the current second AND the first part **of this second** also contains the previous second, which contains the previous one... all the way to the Beginning.

This is how the 2D surface can contain its entire contents. It's as if the surfaces are all one surface spiraling layers of time out from the center.

Holography at its best! We, all planets, all stars are physical holograms. More details about how the universe (Higgs field) imparts mass in Section 4.13 Photon vs. Graviton - Quantum Gravity.

1.6   Brief Summary up through CODATA 2018

Science has made great strides in the precision to which we can measure or compute many physical quantities. Whereas "particle" masses are known to about 8 digits, the Fine Structure Constant, Greek α, to 10 digits and the Rydberg, R∞, is known to an amazing 12-digits of precision. But, in the 333+ years since Newton's 1687 landmark publication "Principia", Newton's Gravitation constant, G, has only been determined to about 5 digits of precision. The standard textbook equations for most Planck quantities have been defined in terms of G. Even as of CODATA 2018 G had the large uncertainty of 2.2×10^{-5}

(The values in this table are valid at the current age of the universe.)

Planck length [meter]	Planck time [second]	$\textit{Planck's}$ $\textit{Constant}$ $\left[\frac{m^2 kg}{s}\right]$	Planck mass [kg]	Planck [°K] Temperature	elementary charge [C]	Planck Charge [C]
1.616254e-35	5.39124e-44	6.62607015e-34	2.17643559e-8	1.41678e32	1.60217e-19	1.875546e-18
$\ell = \sqrt{\hbar G/c^3}$	$t_\ell = \sqrt{\hbar G/c^5}$	$\hbar = m_\ell \ell c$ $h = 2\pi\hbar$	$m_\ell = \sqrt{\hbar c/G}$	$T_P = \dfrac{m_\ell c^2}{k_B}$	$e = q_\ell \sqrt{\alpha}$	$q_\ell = \sqrt{2h/Z_0}$
1 quantum of length	1 quantum of time	1 or 2π of angular momentum	1 second of quantum mass	1 second of quantum Temp.	1 Amp second	11.7 Amp seconds
1.8548597e43 lengths/second	1.8548597e43 times/second	1.956e9 [Watts] [Joules/second]	2.17643559e-8 [kg/second]		6.241509e18 [Coulomb/s]	

Note: Planck Charge, herein, plays a key role yet curiously missing from `NIST.gov` website.   ^Equations (1.5a-h)

The key takeaways from this table are that Planck length and time represent one quantum of length and one quantum of time, but our definitions for meters and seconds are emergent quantities. The huge 10^43 values in bottom row are the reciprocals of Plank time. Why so BIG? These grew over the last 13.762 billion years. The first [second] of this universe took only 4.2709338x10^25 time quanta.   Each subsequent second took 4.2709338x10^25 more time quanta than the previous second. The age of the universe from Earth's perspective is 4.2329839x10^17 seconds.

Planck's Constant is a constant throughout time -- explanation in Section 1.1. The numeric values of Planck mass and charge, as well as fundamental charge, are not purely quantum scale quantities -- they are scaled by the current duration of a second. A kilogram has a per second within its definition. Section 4.19 more fully explains these ideas.

1.7   Software Tools created ensuring consistency

It is said that you cannot really know a subject matter well until you have taught it to someone else. I needed to understand every detail in the process of teaching (programming) the computer how to do basic physics calculations. Over the years, I gathered a database of physics equations while creating a physics calculator using the J-Language. This was ideal for exploring problems that I did not clearly understand. It calculates numeric values, dimensional units, and relative uncertainties.   Calculating the same values and uncertainties found at NIST.gov using the fundamental CODATA 2018 values and their relative uncertainties. Given the new calibrated quantities most calculations have a precision of 15 digits, with a relative uncertainty close to 1.0x10^-15.

Regarding radians, the important "take away" is we should continually be aware equation-by-equation of when a value involves a photon, being a ray of light in a particular direction vs. radiation or gravitation dispersing in all directions. For explanation see Section 4.13 "A Photon vs. a Graviton".

I submit to the authority of the Math Itself, which is validated by exact numerical confirmations for each equation-set within this document, and adherence to a set-of-rules for conceptualizing and computing dimensional units.

 Can there be a higher Authority than the math itself?

1.8   Newton's Gravitation (not exactly) Constant

On 2020-October-07 I discovered that "Planck Charge" can be computed exactly given Planck's constant and the Impedance of Free Space, Z_0. This enabled me to compute more accurate values for the Fine Structure Constant and then to cross-check Planck mass calculations and finally arrive at a precise G. Later, on August 3rd, 2022 I discovered the exact formula for the Fine Structure constant -- see section 3.1

As much as I would like to declare **G** to 30-digits of precision:

G = 6.674 292 323 1573(14) x 10^-11 [m^3/kg s^2] relative uncertainty of 2.8e-12

I honestly cannot, until we can measure the age of the universe to 30-digits of precision.   Section 3.3 explains the calibration constraints – why the current limit is about 11.5 digits.

The novel description of Time, herein, says that length metrics and time metrics are covariant thus -- as the universe expands -- our meter and second scales linearly with the circumference of the universe while our values for Planck length & Planck time scale by its reciprocal -- covariant^-1.

The ratio between a quantity that is growing linearly, covariant^1st and another that is shrinking covariant^-1st is a ratio changing covariant^2nd. *(Think this through with you own brain -- own it -- we will be using this understanding a lot.)*

The surprising thesis of this paper is the realization that, as time progresses, pendulums, clocks, and Cesium atoms slow (covariant^-1) as an indication of the *deceleration* of time itself – while the accumulation of cosmic-time grows covariant^2. (Section 4.18) This represents a true understanding of quantum time vs. emergent time metrics and resolves the Dark Energy enigma.   Rather than the expansion of the universe "thought to be accelerating" – the duration of a second grows -- in our local Space~Time reference-frame -- time itself keeps slowing down.   This is the essence of Cosmological Relativity. The calculations say that the next second takes 4.27x10^25 Planck times longer than the previous.   It has been doing this for 13.762 billion years.

The following sections provide the geometric reasoning and the physics math that explains the certainty of these bold assertions.

1.9   Grasping Light Speed

For humans, it's difficult to imagine a 300,000-kilometer-long ruler, so let's bring this down to Earthly terms that humans can more easily grasp. Taking the square root of the speed of light we get about 17,314.5 meters or about **10 ³/₄th miles**.

$$c = \frac{299,792,458 \, [meters]}{1 \, [second]} = \frac{17,314.51581766 \, [meters]}{1/17,314.51581766 \, [second]} = \frac{\ell}{t_\ell} = \frac{Z_0[Ohms]}{\mu_0[N/A^2]} = \frac{1}{\varepsilon_0[F/m]Z_0[Ohms]} \quad (1.9)$$

Imagine two towers with lasers aimed at each other. One with a red laser & corner reflector. The other with a green laser and corner reflector. They are spaced at a distance exactly = square root of c.   The reflected **round-trip** pulse would take about **¹/8,657**th of a second. A speaker vibrating at this frequency would enable us to relate <u>that</u> distance to an *audible frequency* within the grasp of human hearing.   Imagine your eardrum oscillating out-n-in with laser pulse from us to the far tower and back again.

<mark>This round-trip distance at 8,657 Hz is the same ratio as 2 Planck lengths per 2 Planck times.</mark>

10.759 miles
17,314 meters in
1/17,314th second
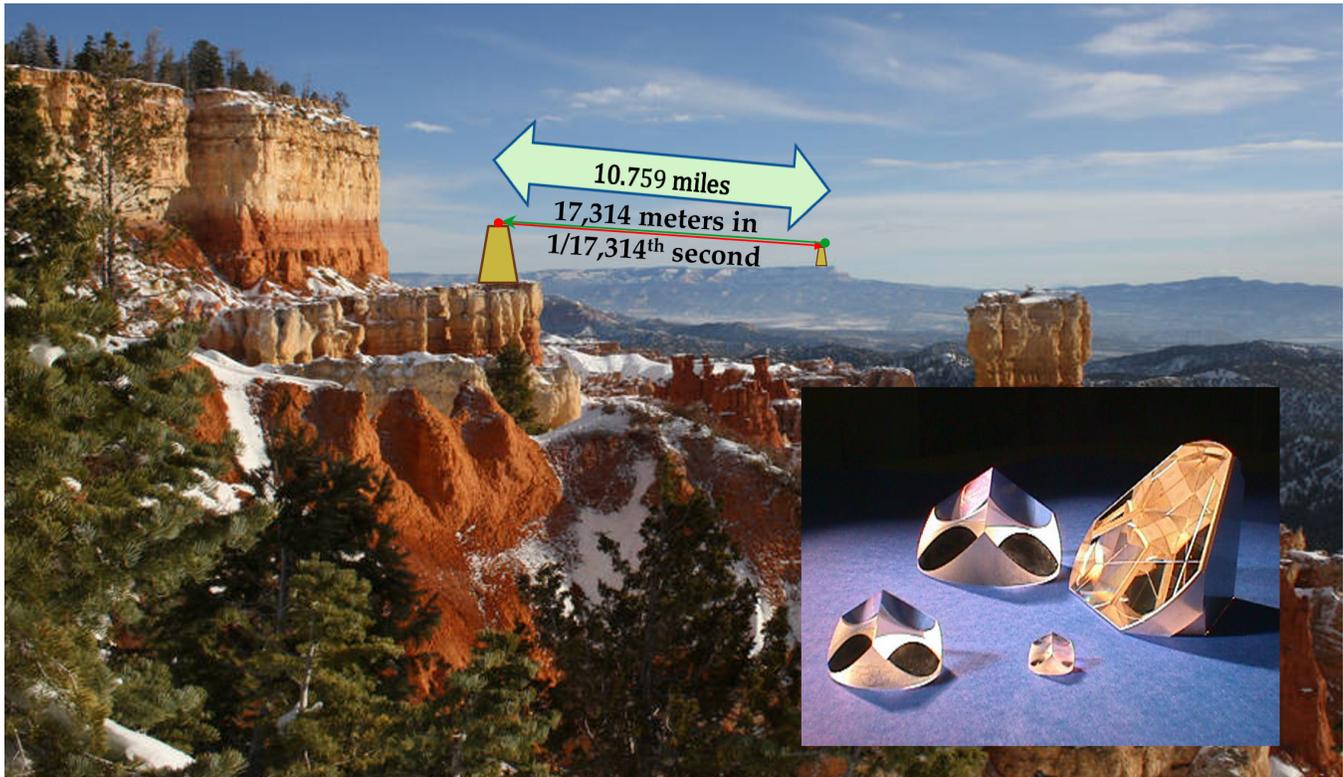
<mark>At the current age of the universe, 17,314 meters is 1.07x10^39 times the current Planck Length.
Likewise, 1/17,314th of a second is 1.07x10^39 times the Planck time.</mark>

In section 4.16 Goes into implications of spacetime expansion and Einstein's "Equivalence Principle:"

2 Procedure: calculating fundamentals

Question: Just how precisely can our metrics be defined? Namely, the duration of a "second", the length of a meter, the mass of a kilogram, the charge of a Coulomb, and the absolute Kelvin temperature scale?

Answer: The speed of light establishes the length of a ruler 299,792,458 meters long, and CODATA Committee "defined" 9,192,631,770 oscillations of Cesium-133's hyperfine transition spectral line to establish the duration of a scone. So, a ruler 1 light second long with tick 9,10 Since the length of a meter, the duration of a second and size of atoms are all emergent [m/s] is constant and [Hertz]*[seconds] is [dimensionless]. These tw

In table 2.1 quantities where the dimensional exponents for (mass+charge) *minus* (length+time)=an integer. When that integer=0 the value is truly constant throughout time. When that value is 1 -- its value grows linearly. When the value is -1 then it shrinks by 1/time. 3 Fundamental properties of the Space~Time medium, (aka, "the Vacuum") are Impedance, Permeability and Permittivity. Impedance of Free Space, Z_0, Magnetic Permeability, μ_0, have **dt = -2** -- shrinking as inverse-square, whereas Electric Permittivity, ε_0, eps_0 is **dt=2** -- its growth with respect to time is parabolic.

2.1 Physical quantities: arranged by dependencies & relative uncertainty

Throughout the rest of this document when a value is highlighted: The yellow highlighted numbers are non-exact CODATA 2018 values. Green values are defined by CODATA 2019 as exact and are the basis to calibrate [meters], [seconds], [kilograms] and [Coulombs].

Note that [kg], [C] are Coveriant^1st so these values will slowly grow with time.

Quantity	Value digit┐16	relUnc	-L	-T	+M	+C	+K	dt	SIunits
c	299,792,458.00000	0	1	_1	0	0	0	0	m/s
Cs133	9.192631770000000e9	1e_14	0	0	0	0	0	0	Hz
e	1.602176634000000e_19	1.5e_16	0	0	0	1	0	1	C
h	6.626070150000000e_34	0	2	_1	1	0	0	0	J s
hBar	1.054571817646156e_34	0	2	_1	1	0	0	0	J s
l_P2018	1.616253000000000e_35	1.1e_5	1	0	0	0	0	_1	m
l_P	1.616254094907563e_35	3.3e_16	1	0	0	0	0	_1	m
t_P2018	5.391247000000000e_44	1.1e_5	0	1	0	0	0	_1	s
t_P	5.391243347781494e_44	3.7e_16	0	1	0	0	0	_1	s
m_P2018	2.176434000000000e_8	1.1e_5	0	0	1	0	0	1	kg
m_P	2.176435594396617e_8	3e_16	0	0	1	0	0	1	kg
G_2018	6.674300000000000e_11	2.2e_5	3	_2	_1	0	0	_2	m3/kg s2
G	6.674292323157284e_11	5.8e_16	3	_2	_1	0	0	_2	m3/kg s2
alpha_2018	7.297352569300000e_3	1.5e_10	0	0	0	0	0	0	dimen-sionless
alpha	7.297352569277727e_3	0.5e_16	0	0	0	0	0	0	
1/alpha	137.035999084114	0.5e_16	0	0	0	0	0		
Zo_2018	376.730313668000	1.5e_10	2	_1	1	_2	0	_2	Ohm
Zo	376.7303136666854	3.0e_16	2	_1	1	_2	0	_2	Ohm
Z_P	29.997924581632002	3.0e_16	2	_1	1	_2	0	_2	Z_P
K_m	2.000000001088755e_7	4e_16	1	0	1	_2	0	_2	N/A2
mu_0	1.256637062120002e_6	3.4e_16	1	0	1	_2	0	_2	N/A2
K_e	8.987551792260796e9	3.4e_16	3	_2	1	_2	0	_2	m/F
eps_0	8.854187812800372e_12	2.9e_16	_3	2	_1	2	0	2	F/m
q_P	1.875546037779709e_18	1.5e_16	0	0	0	1	0	1	C
V_P	1.22089083072416e28	3.4e_16	2	_2	1	_1	0	0	Volts

The 16-digit values are my proposed CODATA 2022 values.

c: the Speed of Light
Cs133: Hyperfine spectral line of Cesium 133
e: Fundamental Charge
h: Planck's Constant &
hBar: his reduced constant
l_P: Planck length
t_P: Planck time
m_P: Planck mass
G: Newton's Gravitation Constant
alpha: Fine Structure Constant
Zo: Z_0, Impedance of Free Space
Z_P: Planck Impedance
K_m: K_m, Magnetic force const.
mu_0: μ_0, Magnetic Permeability
K_e: Ke, Electric force constant
eps_0: ε_0, Electric Permittivity
q_P: Planck Charge
V_P: Planck Voltage

Cyan highlighted quantities, throughout this document, are my proposed values for the CODATA 2022 dataset –. *Here I ascribed alpha with uncertainty of 0.5e_16 to account for standard double precision floating point.*

2.2 Arbitration of Planck length & time

Below I use these averaging formulae to arbitrate 1st pass candidate values for Planck length & time. The ratio of CODATA 2018 Planck length/Planck time yields only 6 digits of c.

$$\ell = \frac{1}{2}(\ell_{2018} + t_{2018}c)$$	$$t_\ell = \frac{1}{2}\left(t_{2018} + \frac{\ell_{2018}}{c}\right)$$	(0) (a,b)

Quantity	Value	digit$_\top$16	relUnc	L__T_M__C_K	dt	SIunits	
l_P2018	1.61625	3000000000e_35	1.1e_5	1 0 0 0 0	_1	m	
l_P	1.616254094907563e_35		1.7e_16	1 0 0 0 0	_1	m	2018 values get adjusted
t_P2018	5.39124	7000000000e_44	1.1e_5	0 1 0 0 0	_1	s	by these factors…
t_P	5.391243347781495e_44		1.8e_16	0 1 0 0 0	_1	s	
l_P%l_P2018	1.000000677556750		1.1e_5	0 0 0 0 0	0		←l_P2018 times this
t_P2018%t_P	1.000000677435291		1.1e_5	0 0 0 0 0	0		←t_P2018 divided by this

Note this multiply factor for Planck length & divide factor for Planck time are not the same. This simple averaging formula "arbitrates" this tug-a-war between the ratios of 2018 values – ensuring an exact ratio of **299,792,458**. This averaging technique only slightly improves the 1.1e-5 relative uncertainty down to 0.8e-5.

Pass 2 arbitration will tell us much more accurately how far off these Planck length & Planck times values are…

It's not until I cross-calculated the Planck mass using its relationship to Planck charge (Section 3.7) that I was able to determine that Planck length was off by exactly 1.2e-10 relative uncertainty. So, I plugged 1.2e_10 in as the relative uncertainty for both Planck length and Planck time.

3 Findings: CODATA 2018 vs. 2022 calcs

Speed of Light, c, 299,792,458 meters/second. Ten formulae that "should" all compute c, exactly.

$$c = \frac{\ell}{t_\ell} = \frac{Z_0}{\mu_0} = \frac{1}{\varepsilon_0 Z_0} = G\frac{m_\ell^2}{\hbar} = \frac{\hbar}{\ell m_\ell} = \frac{2\hbar}{K_m q_\ell^2} = \frac{2\alpha}{\mu_0}\frac{h}{e^2} = \sqrt{\frac{K_e}{K_m}} = \sqrt{\frac{1}{\varepsilon_0\mu_0}} = \sqrt{\frac{G}{K_\Theta}} = \sqrt{\frac{E_\ell}{m_\ell}} = \sqrt{\frac{eV_\ell}{m_\ell}}$$

(3) a-l

Each equation-set in this document lists formulae in the same order as the rows in the table that follows. Each row recalculates each formula -- effectively crosschecking values & validating formulae.

c	m/s	-L-T+M+C+K: 1 _1 0 0 0	dt=0	Speed of Light	**Dimensional**

CODATA2018 digit$_\top$15	relUnc	JohnWsol digit$_\top$15	relUnc	Formula
299792051.856568	1.6e_5	299792458.000000	5e_16	l_P/t_P
299792458.000912	2.1e_10	299792458.000000	4.2e_16	Z₀/μ₀
299792457.999088	1.5e_10	299792458.000000	5.2e_16	1/ε₀*Z₀
299792363.621083	3.1e_5	299792458.000000	7.8e_16	G*(m_P²)/hBar
299792880.782664	1.6e_5	299792458.000000	5.1e_16	hBar/l_P*m_P
299792458.000912	1.5e_10	299792458.000000	5.6e_16	2*hBar/K_m*(q_P²)
297924589.000916	2.1e_10	299792458.000000	5.7e_16	2*α*h/μ₀*e²
299792458.000000	3e_16	299792458.000000	3e_16	√(K_e/K_m)
299792458.000000	7.5e_11	299792458.000000	2.2e_16	√(1/ε₀*μ₀)
299792458.036275	7.8e_6	299792458.000000	3.6e_16	√(G/K_Theta)
299792458.009069	1.6e_5	299792458.000000	2.4e_16	√(E_P/m_P)
299792567.823274	5.5e_6	299792458.000000	2.3e_16	√(e*V_P/m_P)

Yellow quantities calculated using CODATA 2018 values from Section 2.1 above.

exponents:
Length Time Mass Charge Kelvin

When exponents M+C+K-L-T = 0 then the quantity is truly constant throughout time.

(Calculations use the very concise & powerful J-programming language, the brainchild of Kenneth Iverson – 1970's IBM Fellow, inventor of APL & math super genius. J; ▮ for negative sign(distinct from - for subtract). Note J evaluates expressions right-to-left with no operator precedence. The () are necessary in 4th formula above G*(m_P^2)/hBar.)

3.1   α = Fine Structure, defines Electromagnetic Field

[The Fine Structure Constant] "the most fundamental unsolved problem of physics." -- *Paul Dirac*

There is a most profound and beautiful question associated with the observed coupling constant, e, the amplitude for a real electron to emit or absorb a real photon. Nobody knows. It's one of the greatest ~~damn~~ mysteries of physics: a magic number that comes to us with no understanding by man.

You might say "the hand of God" wrote that number, and we don't know how He pushed his pencil." -- *Richard P. Feynman*

On the historic day of 2022-August-03 I discovered an exact formula for the Fine Structure Constant, Equation 3.1a where the Prime Constant plays a central role. The Prime Constant is a binary fraction where each bit position corresponds to an integer where primes get a 1 -- non-primes 0. Note each bit is worth 1/2 the previous bit:

	1	2	3	4	5	6	7	8	9	10	11	12	13
•	0	1	1	0	1	0	1	0	0	0	1	0	1
	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{32}$	$\frac{1}{64}$	$\frac{1}{128}$	$\frac{1}{256}$	$\frac{1}{512}$	$\frac{1}{2^{10}}$	$\frac{1}{2^{11}}$	$\frac{1}{2^{12}}$	$\frac{1}{2^{13}}$

With just the 1st 13 bits this number quickly converges to: 0.4146728515625. Today the age of the universe in Planck times is about 4x10^60 or about a 202-bit number. The 45th prime is 199, the 46th is 211. Calculated here is 63 digits worth of the Prime Constant: *(See Appendix for convergence rate.)*

```
  0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`238`137`916`977`868`245
  '!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!
  0    3    6    9   12   15   18   21   24   27   30   33   36   39   42   45   48   51   54   57  60
The Fine Structure Constant and its reciprocal / Stergios Pellis's 1/α:
  0.007`297`352`569`277`726`665`783`313`402`330`653`912`423`078`499`989`495`271`648`995`938
137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`605`940`625`219`167`076
137.035`999`164`765`639`345
  '''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!'''!|
  0    3    6    9   12   15   18   21   24   27   30   33   36   39   42   45   48   51   54   57   60   63
```

$$\alpha = \left(137^2 + \frac{30(PrimeConst + 5)}{59 PrimeConst - 8}\right)^{-\frac{1}{2}}$$

(3.1)(a)

$$\alpha = \frac{\mu_0 e^2 c}{2h} = \left(\frac{e}{q_\ell}\right)^2 = \frac{K_{\mathrm{m}} c e^2}{2\hbar} = \frac{K_e e^2}{\hbar c} = \frac{e^2}{2hc\varepsilon_0} = \frac{e^2 Z_0}{2h} = \frac{Z_0}{4G_0} = \sqrt{\frac{2R_\infty}{cm_e}}$$

(3.1)(b-i)

```
| alpha    | dimensionless |  -l-t+M+C+K: 0 0 0 0 0  |  dt=0  | Fine Structure Constant |
```

CODATA2018 digit_T15	relUnc	JohnWsol digit_T15	relUnc	Formula
7.29735256930000e_3	1.5e_10	7.29735256930000e_3	1.5e_10	α_2018
7.29735256927773e_3	0	7.29735256927773e_3	0	1/√((137²)+(30*(PrimeConst+5))/ (_8+59*PrimeConst))
7.29735256927772e_3	1.5e_10	7.29735256927773e_3	4.6e_16	μ₀*(e²)*c/2*h
7.29735256929992e_3	1.5e_10	7.29735256927773e_3	6.0e_16	(e/q_P)²
7.29735256927773e_3	4.7e_16	7.29735256927773e_3	4.7e_16	K_m*c*(e²)/2*hBar
7.29735256927773e_3	5.6e_16	7.29735256927773e_3	5.6e_16	(e²)*K_e / hBar*c
7.29735256927773e_3	4.7e_16	7.29735256927773e_3	4.7e_16	(e²) / 2*ε₀*h*c
7.29735256927773e_3	5.1e_16	7.29735256927773e_3	5.1e_16	(e²) / 4π*ε₀*hBar*c
7.29735256929992e_3	1.5e_10	7.29735256927773e_3	4.6e_16	(e²)*Z₀ / 2*h
7.29735256930710e_3	1.5e_10	7.29735256927773e_3	1.3e_12	√(2*R∞*h / c*m_e)

From France, Bureau International des Poids et Mesures, we have Equation (3.1b) defining α in terms of μ₀. [G]

From Greece, Stergios Pellis's excellent research[H] & efforts gives us a candidate value worthy of consideration:

| $a^{-1} \ = \ 360\varphi^{-2} - 2\varphi^{-3} + (3\varphi)^{-5} \ = \ 137.035999164...$ | (3.1j) |

Below I cross-checked Stergio Pellis' Fine-Structure value, α_SP, across several equation sets -- the results diverge around the 10th digit. What makes these equation-sets so powerful is when we see a given quantity **raised to different powers,** if the base value is off, we will see greater divergence in the target value when that quantity is raised to higher powers. This is especially noticeable where α_SP is raised to the 2nd or 3rd powers below:

Value	relUnc	units	Quantity / Formula	Description
299,792,458.000000	0	m/s	c	Speed of
299,792,457.823559	5.9e_10	m/s	2*α_SP*h / μₒ*e^2	Light
1.60217663400000e_19	1.5e_16	C	e	
1.60217663352853e_19	2.9e_10	C	q_P*√α_SP	Elementary
1.60217663352852e_19	3e_10	C	√(2*α_SP*hBar / K_m*c)	Charge
1.60217663352853e_19	2.9e_10	C	√(α_SP* 2*h / μₒ*c)	
9.10938370157333e_31	1.9e_12	kg	m_e	mass of
9.10938370693460e_31	5.9e_10	kg	hBar / c*α_SP*aₒ	electron
9.10938371229586e_31	1.2e_9	kg	2*R∞*h / c*α_SP²	
5.29177210901847e_11	1.9e_12	m	aₒ	Bohr radius
5.29177211213291e_11	5.9e_10	m	l_P*m_P / α_SP*m_e	
2.81794032618213e_15	1.9e_12	m	r_e	
2.81794032452365e_15	5.9e_10	m	α_SP*hBar / m_e*c	electron
2.81794032452365e_15	5.9e_10	m	α_SP*l_P*(m_P/m_e)	charge radius
2.81794032120669e_15	1.8e_9	m	(α_SP³) / 4π*R∞	
10,973,731.5681600	1.9e_12	/m	R∞	Rydberg
10,973,731.5552430	1.2e_9	/m	((α_SP²)/4π)*(m_e / m_P*l_P)	Constant
8.85418781280037e_12	3.6e_16	F/m	εₒ	
8.85418781801144e_12	5.9e_10	F/m	(e²)/2*c*h*α_SP	Electric
8.85418781801144e_12	5.9e_10	F/m	(e²)/4π*c*α_SP*hBar	Permittivity

Recent precise measurements of the Fine-Structure Constant [I], compared here are its reciprocal values:

Measurement Value	when	Source
137.035999046(27)	2010-Dec-16	New determination of the fine structure constant and test of QED [J]
137.035999084(21)	2019-May-20	CODATA 2018 NIST Reference on Constants, Units and Uncertainty
137.035999174(35)	2012	Parker, Yu, et al. "10th-order QED contribution to electron g-2 and improved value fine-structure." [K]
137.035999206(11)	2020-Dec	New determination of the fine structure constant and test of the QED [L]

You might notice that the 1st 12-digits of CODATA 2018 exactly match the 1st 12-digits of my 63-digit value. But the more recent and, believed to be, more accurate measurement is higher starting in the 10th digit. Why?

> *" Guellati-Khélifa has been improving her experiment for the past 22 years. She gauges the fine-*
> *structure constant by measuring how strongly rubidium atoms recoil when they absorb a*
> *photon. (Miiller does the same with cesium atoms.) The recoil velocity reveals how heavy*
> *rubidium atoms are — the hardest factor to gauge in a simple formula for the fine-structure*
> *constant. "It's always the least accurate measurement that's the bottleneck, so any improvement*
> *in that leads to an improvement in the fine-structure constant," Miiller explained." [M]*

Cosmological Relativity says both mass and charge values increase covariant^1st. So, as the years pass by, if scientists use an atomic mass value from 2-3 years ago, we will likely see a drift around the 11th-digit of the Fine-Structure Constant calculations.

3.2   Invisible Geometry of α

A fundamental understanding of the Fine Structure starts with a 4x11x√137 right triangle: $4^2 + 11^2 = 137$. There are 4 Electromagnetic Polarities: Positive Electric, North-to-South dipole, Negative Electric & South-to-North dipole. The frequency combinations of 4 cross-product with 11 spreads the 4 polarities across the 11-time quanta. But 4 & 11 have no common factors. So, the least common multiple is 44. Twice 44 gives us 88 - - a key frequency harmonic. This brings us to another right triangle of keen interest: $88^2 + 105^2 = 137^2$. This brings us close to the ratio of the Bohr radius to the electron charge radius. Compare $137^2 = 18769$ to $\alpha^{-2} = 18,778.8650449813$.   What about this difference? This calls our attention to Equation 3.1a.

$$\alpha = \left(137^2 + \frac{30(PrimeConst + 5)}{59 PrimeConst - 8} \right)^{-\frac{1}{2}}$$

The fraction involving the Prime Constant accounts for this difference.   The Prime Constant correlates an exponential relationship to the distribution of prime numbers. If we could do a Fourier Transform across the span of all time quanta from the Beginning till Now the Prime Constant assigns a power-level to each prime-spike in the power vs. frequency graph.

 Planck Charge's "omega frequency" = 1 Planck second which corresponds to 1-hBar worth of rotation.   The Greek letter ω denotes "radians per second" rather that full rotations as Hertz would imply.   However, "fundamental" charge occurs 11.706... times slower. (11.706... is the reciprocal of the square root of alpha.).

Wavicles couple to the Electromagnetic Field at this ***extremely high frequency*** 1.5845054210677e42 radians/second. (This is the square root of the Fine Structure Constant over the Planck time.)

Frequency of Elementary Charge: $= \omega_{eC} = \sqrt{\alpha}/t_\ell \approx 1.584505421 \times 10^{42} \left[\frac{radians}{second} \right]$	(3.1i)

Everything we know about electrons directly relates to the **Fine-Structure Constant**. The thin red quarter circle with dark blue dots represents the Bohr Radius -- the "lowest" energy state of an electron. Traditionally, with a proton inside, this is thought of as a hydrogen atom.

IF an electron were a "classical particle", meaning it continuously "has" rest mass, then it would have to slow its orbital velocity to αc= 2187691 [m/s] -- Somerfield's original interpretation. [N]

However, with Peter Higg's realization "particles" do not have mass in and of themselves, but he asserts the Higgs field "gives" particles their mass. My interpretation says most of the time electrons are wavicles where all their beingness is ***momentum*** in the form of charge energy propagating at the speed of light.

Like clockwork, 7.7334x10^20 times per second the electron wavicle collapses -- for just 1-time quantum -- it manifests 1.173369x10^-51 of a [kilogram second]. The actual charge radius of electrons would make the red line less than 0.9% of a pixel -- so I multiplied its charge radius by 137.036. Three small red circles reveal that the gaps between when the electron manifests mass are spaced by this 137.036 factor. After doing this 137 times the electron moves 1-radian of its orbit, about 57.3-degrees. A complete orbit of 2π-radians consists of 861.02 of these = $2\pi/\alpha = R_k/Z_P$ (see 3.18).

In between each of the electron's mass-manifestations, I illustrate Δt for the electron as 1.28809x10^-21 of a second. The proton does this dance inside at an ω-frequency 1,836.15 times more frequent. The 3-interwoven green-red-green (up-down-up) sine waves are made up of 1,836 dots. Again, each dot represents 1.173369x10^-51 [kg s]. Thus, the proton to electron mass ratio is exactly = the ω_proton to ω_electron frequency ratio.

Bohr Radius
a_0 = 5.2917721090e_11 [meter]
(electron~wavicle's mass confinement radius)

1-radian of orbit
137.036th mass manifestation-^

Δt = 1.28809e_21 [sec]

>------<2,000x proton~wavicle mass confinement
[mass time] increments occur 1,836.15 times/electron [mass time]
Once every 4 radians (229.183°)

Like clockwork, the electron does this 861.02 times per orbit, but the proton does this **once** every 4.00 radians. In both cases the ratio between the charge radius and mass confinement for each particle type -- these are reciprocals of each other -- a kind of symmetry.

Granted the illustration is a 2D simplification. Yet, this idea of incremental moments of [mass] [time] can be easily projected into spherical & p-orbital shapes.

Electron's charge radius is 18,779 times *smaller* than its mass confinement radius. Compare this to proton's charge radius being 16-times **larger** than its mass confinement radius. *(Protons manifest mass about 7 times per 9 orbits.)*

electron~wavicle Charge radius x 137.036
<------(electron~wavicle's mass confinement radius)------------------------>
<---2000x proton charge radius--->

Schrödinger's equation gives ***shape*** to the Bohr radius. s-orbitals spread the electron-shell into spherical geometry. For higher atomic numbers the p-orbitals twist these into a figure-8 spun along each of (x, y, z)-axis. Yet higher shell orbitals d & f appear to be higher dimensional projections into 3D-space . These ideas need much more research & refinement.

3.3   Can an Electron Know the Age of the Universe?

Consider a slinky toy spring and imagine a tiny spring like the ones in retractable pens -- only imagine one that is, say, 2 meters long.   Now thread the slinky through the center of the long retractable pen spring. This is how I envision the electron~wavicle where the slinky spring's radius corresponds to the electron's orbital radius and retractable pen spring represents the charge radius of the electron.   Then shrink these proportions to those described on the previous page.

I imagined a primordial electron~wavicle expanding with Space~Time in its Bohr radius orbital path spreading forth like a spiral staircase ascending from the depths of times past on up to our here & now reference frame.

How long has the length of a [meter] been expanding to become what it is today?   Calculations revealed 4.34298x10^17 [seconds/meter] or about **13.762 billion years** that the [meter] has been expanding.

$$age_{meter}[seconds/meter] = \frac{4\pi^2(1+\alpha)a_0}{c \times l_P}$$

(3.3)

```
    calc 'a_0 2p1*a_0 2p1*(1+alpha) c*l_P'
```

Quantity	Value	relUnc	units	-L-T+M+C+K	dt	
a_0	5.29177210901847e_11	1.9e_12	m	1 0 0 0 0	_1	Bohr radius
$2\pi \ast a_0$	3.32491847643276e_10	1.9e_12	m	1 0 0 0 0	_1	Orbital path length
$2\pi \ast (1+\alpha)$	6.32903592562418	0		0 0 0 0 0	0	Curvature/time dilation
$c \ast l\_P$	4.84540787864904e_27	1.4e_12	m2/s	2 _1 0 0 0	_1	rate space spreads forth

Note during each Bohr-bit ($2\pi \ast a_0$) the universe expands the path integral by ($2\pi \ast (1+\alpha)$)

Quantity	Value digit14	relUnc	units	-L-T+M+C+K	dt	
secs_p_yr	31.557600000000e6	0		0 0 0 0 0	0	24*60*60*365.25 approx. year
siderealYr	31.558149540000e6	3.2e_11	s	0 1 0 0 0	_1	accurate Earth orbital period
ageUniv_s/secs_p_yr	13.762085572920e9	1.9e_12	s	0 1 0 0 0	_1	Age of Universe - approx.years
ageUniv_s	**4.3429839167599e17**	1.9e_12	s	0 1 0 0 0	_1	- 434 quadrillion seconds
ageUniv_s/siderealYr	13.761845925900e9	3.2e_11		0 0 0 0 0	0	- 13.76 billion sidereal years
omg_P/ageUniv_s	4.2709338373892e25	1.9e_12	/s2	0 _2 0 0 0	2	[Planck seconds]/[second^2]
ageUniv_tP	4.0278129149439e60	1.9e_12		0 0 0 0 0	0	- # Quanta in Expanding Time

"If you want to find the secrets of the universe,
think in terms of energy, frequency and vibration." -- Nikola Tesla

3.4   Think "Quantum Harmonic Resonance"

With the unfoldment of "degrees of freedom" comes an explanation of the unfoldment of dimensions.   1D gives us lengths & distances.   1D time we think of time durations. Each of these have reciprocals. The ideas of 12 inches per foot or 24 hours per day emerge.   From these we construct the idea of speed as being distance/unit of time.

At two dimensions we grasp concepts like surface area: square inches, square meters. As for 2D time we have the idea of acceleration like meters/second/second. We can gain clarity by contrasting two different units of measure for time. For example, when we create precise clocks, we can quote that a certain clock only gains or loses only half-second per month or per year.

Given that hBar represents the smallest increment of angular momentum -- I realized it = 1-radian of rotation. So, I plotted integer multiples of radian rotations and noticed unmistakable patterns. Note 4, 11, 12 & 71 give us clues. 4 splits into 11-strands.   Might these be where the 11-dimensions of M-theory live? Seemed reasonable that these span & curl up in groups of 12 or 24 time quanta. Notice at 11 these reveal the 4 Electromagnetic polarities: Positive electric potential, North-to-South dipole, negative electric, and then South-to-North – repeat forever. I've postulated and explored the idea that at 11.7 these potentials drop to zero and hold at zero though the count of 12 -- I believe, this is the "Zero Point" of Zero Point Energy fame.
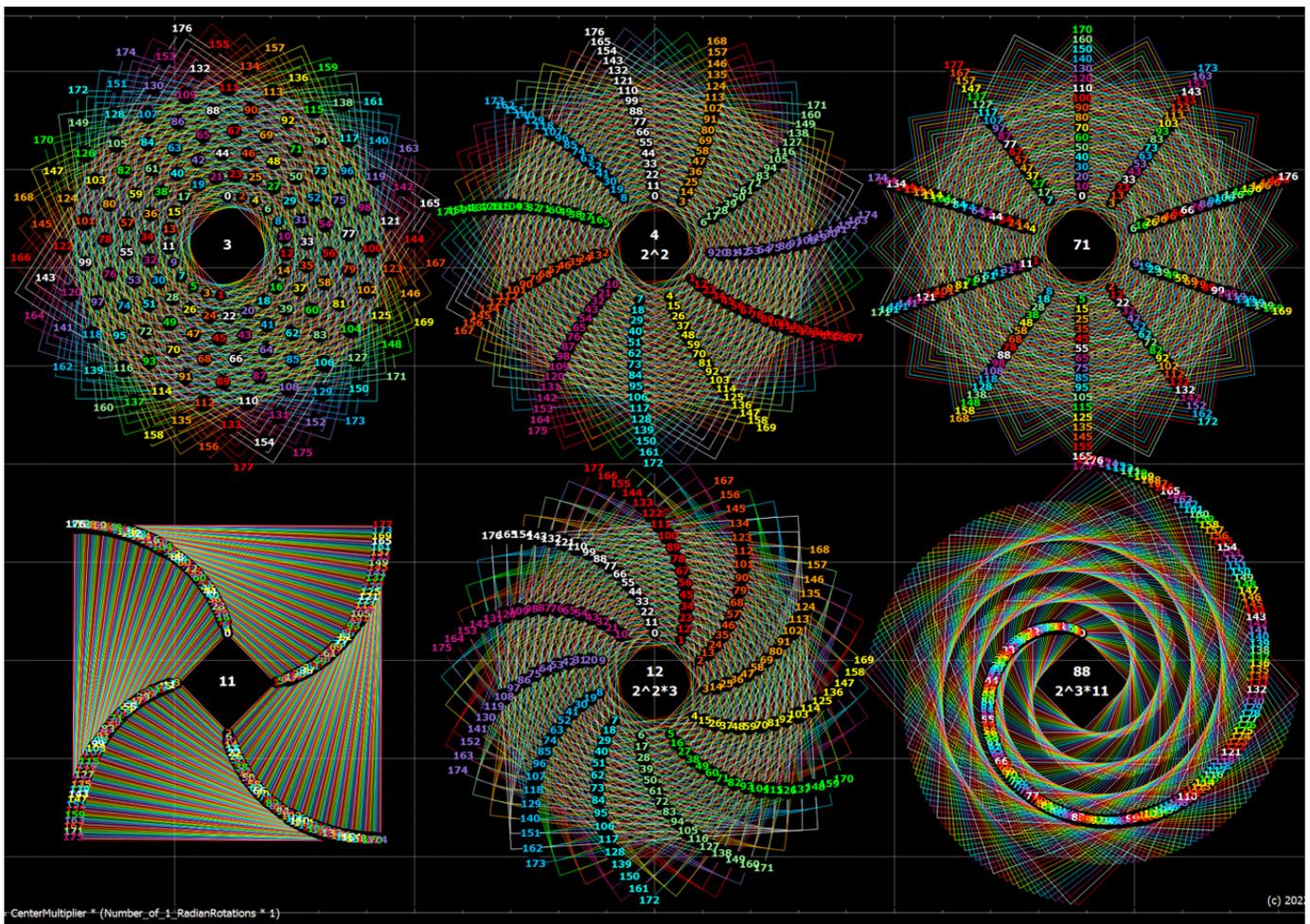
These reflect the pattern of quantized rotations that occur at various integer multiples of the Planck time. The number inside each set spiral is such a multiplier. The GoldenRatio[2] is synthesized by gaps in the Fibonacci sequence -- taking the ratio between every 2nd number (2.618034) of this famous series: 1 1 2 3 5 8 13 21 34 55 89... Note 12 strands in lower right. The depth of this analysis will fill dozens of pages of a subsequent paper.

Each spiral number = CenterMultiplier * (Number_of_1_RadianRotations * 1)   (c) 2022 John Wsol - CC BY SA
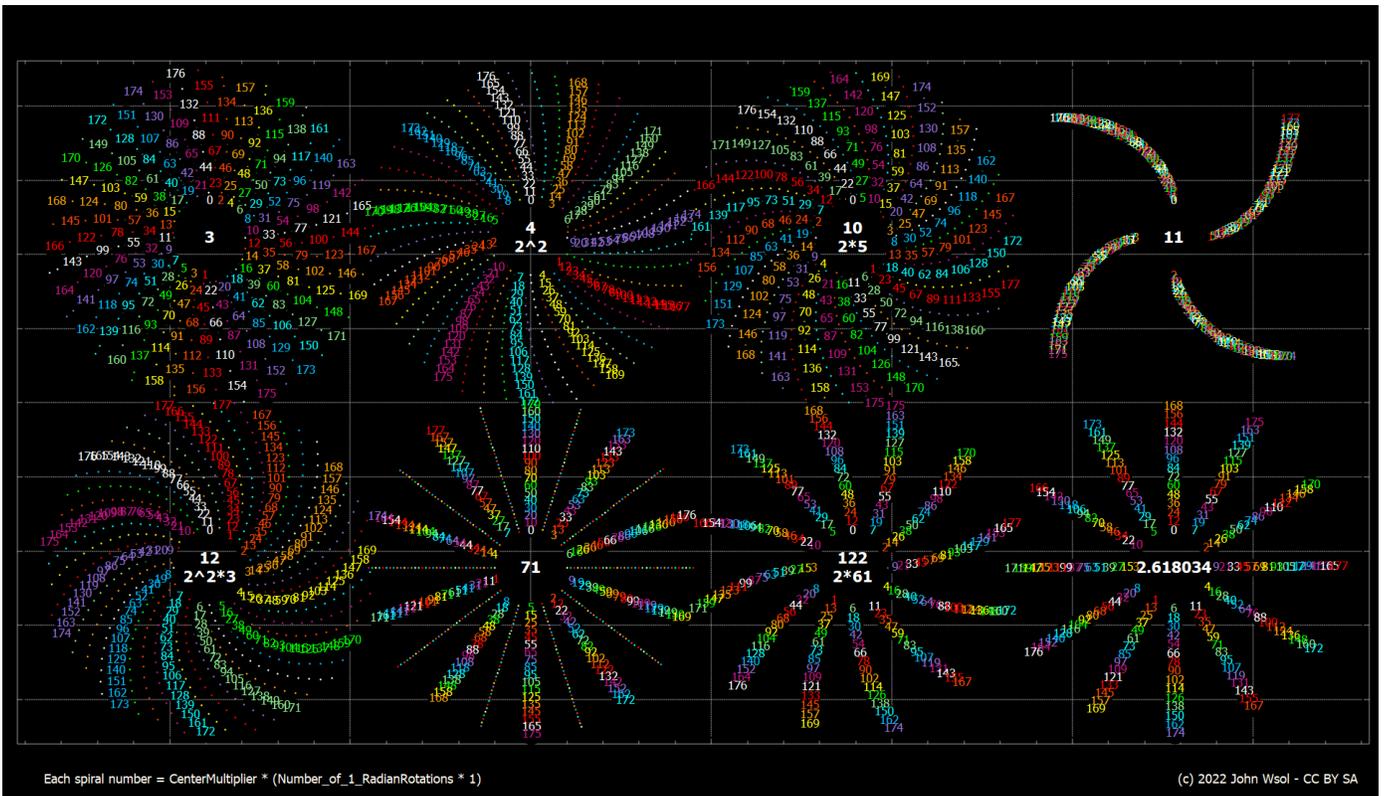
3.5   e = Elementary charge, covariant^1

$$e = q_\ell \sqrt{\alpha} = \sqrt{\frac{2\alpha\hbar}{K_m c}} = \sqrt{\frac{2\alpha h}{\mu_0 c}} = \sqrt[4]{\frac{R_\infty}{m_e \mu_0^2}\left(\frac{2h}{c}\right)^3} \qquad (3.5)$$

```
e  C  -L-T+M+C+K: 0 0 0 1 0  dt=1  elementary charge     Covariant^1
```

CODATA2018 digit⌐15	relUnc	JohnWsol digit⌐15	relUnc	Formula
1.60217663400000e_19	1.5e_16	1.60217663400000e_19	1.5e_16	e_2018
no 2018 PlanckCharge	1.1e_10	1.60217663400000e_19	1e_12	q_P * √α
1.60217663400245e_19	7.5e_11	1.60217663400000e_19	1e_12	√(2*α*hBar / K_m*c)
1.60217663400245e_19	1.1e_10	1.60217663400000e_19	1e_12	√(α*2*h / μ₀*c)
1.60217663400323e_19	1.1e_10	1.60217663400000e_19	1.2e_12	⁴√((R∞/m_e*μ₀²)*(2*h/c)³)

These calculations here cross check the values in Section 2.1-- verifying that those values used in these formulae do indeed compute to the CODATA 2018 "calibration standard" for Fundamental charge. For the current age of the universe, this ensures that the other values in these formulae are <u>self-consistent</u> with all equation-sets that involve electric charge. Please understand that we can use this CODATA 2018 value as a calibration standard for a specific point in time (age of universe), however, we NEED to get use to the newly discovered fact that this value IS EXPANDING with time.

3.6   q_P = Planck Charge = sqrt(2h/Z₀); covariant^1

Value	relUnc	units	-L -T +M +C +K	dt	Quantity
1.602176634e_19	1.5e_16	C	0 0 0 1 0	1	e
1.87554603777971e_18	2.1e_16	C	0 0 0 1 0	1	q_P
8987551792.2608	4.2e_16	m/F	3 _2 1 _2 0	_2	K_e
6.62607015e_34	0	J s	2 _1 1 0 0	0	h
1.05457181764616e_34	0	J s	2 _1 1 0 0	0	hBar
8.85418781280037e_12	3.6e_16	F/m	_3 2 _1 2 0	2	ε₀
376.730313666854	3e_16	Ohm	2 _1 1 _2 0	_2	Z₀
29.97924581632	3.6e_16	Ohm	2 _1 1 _2 0	_2	Z_P

These values are used to compute the Planck Charge & Planck Mass in the next equation-sets...

ε_0: Electric Permittivity

Zo: Impedance of Free Space

Z_P: Planck Impedance

$$q_\ell = \frac{e}{\sqrt{\alpha}} = \sqrt{\frac{2\hbar}{Z_\ell}} = \sqrt{\frac{2h}{Z_0}} = \sqrt{2hc\varepsilon_0}$$

(3.6)
(a-d)

q_P	C	-l-t+M+C+K: 0 0 0 1 0	dt=1	Planck Charge

Value digit15	relUnc	Formula	3.3
1.87554603777971e_18	1.5e_16	e / √α	(a)
1.87554603777971e_18	1.5e_16	√(2*hBar/Z_P)	(b)
1.87554603777971e_18	1.5e_16	√(2*h/Z₀)	(b)
1.87554603777971e_18	2.1e_16	√(2*h*c*ε₀)	(c)
1.87554603777971e_18	4.2e_16	(m_P/c) * √(G/K_m)	(d)

Curious, Planck Charge has long been missing from NIST.gov – this and the assumptions that Space is flat, and SI values for Planck units -- are absolute values throughout time have contributed to perpetuating the mysteries of Dark Matter, Dark Energy and Quantum Gravity.

3.7   m_P = Planck Mass; covariant^1

Planck Mass	$$m_\ell = \frac{K_m q_\ell^2}{2\ell} = \frac{\hbar}{c\ell} = \frac{K_m\hbar}{2\ell Z_\ell} = q_\ell\sqrt{\frac{K_m}{2K_\Theta}} = \sqrt{\frac{\hbar c}{G}}$$	(3.7) (a-e)

m_P	kg	-L-T+M+C+K: 0 0 1 0 0	dt=1	Planck mass

CODATA2018 digit 15	relUnc	JohnWsol digit 15	relUnc	Formula
2.17643400000000e_8	1.1e_5	2.17643400000000e_8	1.1e_5	m_P2018
2.17643706904862e_8	1.1e_5	2.17643559439662e_8	6.2e_16	(K_m*q_P²)/2*l_P
2.17643706905524e_8	1.1e_5	2.17643559439662e_8	3e_16	hBar / l_P*c
2.17643706905524e_8	1.1e_5	2.17643559439662e_8	6.8e_16	K_m*hBar / 2*l_P*Z_P
2.17643434310961e_8	1.1e_5	2.17643559439662e_8	3.6e_16	q_P * √(K_m / 2*K_Theta)
2.17643434311292e_8	1.1e_5	2.17643559439662e_8	2.4e_16	√(hBar*c / G)

Given CODATA committee declaration that Planck's constant, h, the exact value 6.6207017e-34 [Joule seconds] ($hBar = 2\pi h$ is as exact as π) we can use these to calculate a precise value of the Planck Mass for Now.

Equation (3.7) is Maxwell's discovery that's cited in most physics books. (3.2a) Is more direct but did not give us the best uncertainty. (3.2e) yields the best uncertainty of 2.4e-16. Again, all values round perfectly to 15-digits, thus, these are my proposed values for CODATA 2022 consideration.

3.8   von Klitzing Constantly covariant^-2

$$R_K = \frac{h}{e^2} = \frac{2\pi\hbar}{e^2} = \frac{Z_0}{2\alpha}$$

(3.8)

```
R_K Ohm -L-T+M+C+K: 2 _1 1 _2 0 dt=_2 von Klitzing constant
```

CODATA2018 digit⌐15	relUnc	JohnWsol digit⌐15	relUnc	Formula
25812.8074555000	2.3e_10	25812.8074555000	2.3e_10	R_K2018
25812.8074593045	2e_12	25812.8074593045	2e_12	h / e²
25812.8074593045	2e_12	25812.8074593045	2e_12	2π*hBar / e²
25812.8074593042	2.1e_10	25812.8074593045	1.4e_12	Z₀ / 2*α

3.9 R_{oo} = Rydberg Constantly covariant^1

Rydberg Constant

$$R_\infty = \frac{e^4 m_e}{8\epsilon_0^2 h^3 c} = e^4 m_e \mu_0^2 \left(\frac{c}{2h}\right)^3 = \frac{\alpha^2 m_e}{4\pi\ell m_\ell}$$

(3.9)

```
Roo /m -L-T+M+C+K: _1 0 0 0 0 dt=1 Rydberg constant
```

CODATA2018 digit⌐15	relUnc	JohnWsol digit⌐15	relUnc	Formula
10973731.5681600	1.9e_12	10973731.5681600	1.9e_12	R∞_2018
10973731.5680717	3e_10	10973731.5681600	6e_12	(e⁴)*m_e / 8*(ε₀²)*(h³)*c
10973731.5680716	4.2e_10	10973731.5681600	6e_12	(e⁴)*m_e*(μ₀²)*((c/2*h)³)
10973747.0438564	1.6e_5	10973731.5681600	2.7e_12	((α²)/4π)*(m_e/m_P*l_P)

3.10 m_e = Electron mass, covariant^1

The mass of the electron in CODATA 2018 was believed to have a relative uncertainty of `3e-10`, actual value is `1.0e-9 too low`. Here these new calculations naturally inherit the relative uncertainty of Rydberg's constant – *now being the least certain participant in these new calculations.*

$$m_e = \frac{\hbar}{c\alpha a_0} = \frac{2R_\infty h}{c\alpha^2} = \frac{4\pi\hbar R_\infty}{c\alpha^2} = \frac{R_\infty(2h/c)^3}{e^4\alpha^2} = \frac{e\hbar}{2\mu_B} = \frac{\hbar^2}{E_h\alpha^2}$$

(3.10)

(a-f)

```
m_e kg -L-T+M+C+K: 0 0 1 0 0 dt=1 electron mass   2018 uncertainty too low by 1.0x10^-9
```

CODATA2018 digit⌐15	relUnc	JohnWsol digit⌐15	relUnc	Formula
9.10938370150000e_31	3e_10	9.10938370150000e_31	-1e_9	m_e2018
9.10938370152569e_31	1.5e_9	9.10938370157334e_31	1.9e_12	hBar / c*α*a₀
9.10938370151773e_31	3e_10	9.10938370157333e_31	1.9e_12	2*R∞*h / c*α²
9.10938370157337e_31	3e_10	9.10938370157334e_31	6e_12	R∞*((2*h/c)³)/(e⁴)*(μ₀²)
9.10938370151773e_31	3e_10	9.10938370157334e_31	1.9e_12	4π*hBar*R∞ / c*α²
9.10938370157333e_31	2.3e_12	9.10938370157333e_31	2.3e_12	e*hBar / 2*mu_B
9.10938370153365e_31	3e_9	9.10938370157334e_31	4.2e_12	(hBar²) / E_h*a₀²

3.11 r_e = Electron charge radius, covariant^1

$$r_e = \frac{\alpha\hbar}{m_e c} = \alpha\ell\frac{m_\ell}{m_e} = \frac{\alpha^3}{4\pi R_\infty} = \frac{e^2}{4\pi\varepsilon_0 m_e c^2} = \frac{K_e e^2}{m_e c^2}$$

(3.11)
(a-e)

```
r_e m -L-T+M+C+K: 1 0 0 0 0 dt=+1 electron radius (classic)
```

CODATA2018 digit⌐15	relUnc	JohnWsol digit⌐15	relUnc	Formula
2.81794032620000e_15	**4.5e_10**	2.81794032620000e_15	**1.6e_9**	r_e2018
2.81794032621341e_15	3.4e_10	2.81794032618213e_15	1.9e_12	α*hBar/m_e*c
2.81793635289732e_15	1.6e_5	2.81794032618213e_15	2.7e_12	α*l_P*(m_P/m_e)
2.81794032620793e_15	4.5e_10	2.81794032618213e_15	1.9e_12	(α³) / 4π*R∞
2.81794032620481e_15	3e_10	2.81794032618213e_15	3.4e_12	(e²) / 4π*ε_0*m_e*c²
2.81794032620481e_15	3e_10	2.81794032618212e_15	3.4e_12	(K_e*e²) / m_e*c²

3.12 a_0 = Bohr radius, covariant^1

Likewise, the values for the Bohr radius "believed" relative uncertainty of 1.5e-10 the CODATA 2018 is too high by 5.5e-10. The Bohr radius represents the extent to which the electron spreads forth its mass.

$$a_0 = \frac{4\pi\varepsilon_0\hbar^2}{m_e e^2} = \frac{\hbar}{m_e\alpha c} = \frac{\ell m_\ell}{\alpha m_e} = \frac{r_e}{\alpha^2}$$

(3.12)
(a-d)

```
a_0 m -L-T+M+C+K: 1 0 0 0 0 dt=+1 Bohr radius
```

CODATA2018 digit⌐15	relUnc	JohnWsol digit⌐15	relUnc	Formula
5.29177210903000e_11	**1.5e_10**	5.29177210903000e_11	**5.5e_10**	a_0_2018
5.29177210906108e_11	3e_10	5.29177210901848e_11	3.4e_12	4π*ε_0*(hBar²) / m_e*e²
5.29177210904492e_11	3.4e_10	5.29177210901847e_11	1.9e_12	hBar / m_e*α*c
5.29176464760825e_11	1.6e_5	5.29177210901847e_11	2.7e_12	l_P*m_P / α*m_e
5.29177210901974e_11	5.4e_10	5.29177210901847e_11	1.9e_12	r_e/α²

Notice the formulae define what I prefer to call the "mass confinement radius" for electrons. It is a function of the electron wavicles frequency and the properties of the Space~Time medium **-- *nothing else*.** *(Note: no reference to a proton anywhere in these equations.)* In case you don't "get it" -- this means electrons do this Bohr radius thing *all the time*. No proton needed. Even an electron shot from an electron gun -- as it heads towards the 2-slits, thinking "I wonder which slit I should go thru this time?"   And it gets closer. And then thinks, "I wonder if anyone is watching?" and the whole time it is doing this Bohr radius thing.   *Let these thoughts boggle your physics professor's mind!*

3.13 Proton/electron mass ratio

September 2020 "Science" publication of a paper from Vrije Universiteit Amsterdam by Patra, Sayan, et.al, "Proton-electron-mass ratio from laser spectroscopy of HD+ at the part-per-trillion level"[o] their proton-to-electron mass ratio with 2.1e-11 relative uncertainty.– *(3 times improvement vs. CODATA2018).*

$$\left(\frac{m_p}{m_e}\right) = 1836.152673406 \text{ relative uncertainty } 2.1 \times 10^{-11} \tag{3.13}$$

```
Value                 relUnc  units -L-T+M+C+K dt Quantity

 1.83615267343000e3      6e_11       0 0 0 0 0  0  MpMe_2018
 1.836152673406 00e3   2.1e_11       0 0 0 0 0  0  MpMe_2020
 1.83615267340600e3    2.1e_11       0 0 0 0 0  0  MpMe
 1.83615267340600e3    2.1e_11       0 0 0 0 0  0  m_p*c*(α²)/2*R∞*h
 1.83615267340600e3    2.1e_11       0 0 0 0 0  0  m_p*c*α*a₀/hBar
```

3.14 m_p = Proton mass, covariant^1

I calculated the proton mass via the mass of the electron. Albeit, expressed in 2 other equation forms.

$$m_p = \left(\frac{m_p}{m_e}\right)m_e = \left(\frac{m_p}{m_e}\right)\frac{2R_\infty h}{c\alpha^2} = \left(\frac{m_p}{m_e}\right)\frac{\hbar}{c\alpha a_0} \tag{3.14 (a-c)}$$

The expression $\left(\frac{m_p}{m_e}\right)$, above, and `MpMe,` below, represent the numeric quantity for the proton-to-electron mass ratio -- relative uncertainty of 2.1e-11, *inherited from the best measurements by the Amsterdam team.*

```
m_p kg -L-T+M+C+K: 0 0 1 0 0 dt=+1 proton mass

CODATA2018 digit┬15    relUnc  JohnWsol    digit┬15   relUnc  Formula

 1.6726219236 9000e_27 3.1e_10  1.67262192369000e_27  3.1e_10 m_p2018
 1.67262192368089e_27  3.1e_10  1.6726219236 7249e_27 2.1e_11 m_e*MpMe
 1.67262192368414e_27  3.1e_10  1.67262192367249e_27  2.1e_11 MpMe*2*R∞*h / c*α²
 1.67262192368561e_27  1.5e_9   1.67262192367249e_27  2.1e_11 MpMe*hBar / c*α*a₀
```

3.15 r_p = Proton charge radius, covariant^1

$$r_p = 4\ell\frac{m_\ell}{m_p} = 4a_0\alpha\left(\frac{m_p}{m_e}\right)^{-1} = \frac{4\ell\hbar}{m_p c^2 t_\ell} \tag{3.15 (a-b)}$$

Equation (3.15a) is from equation (30) of Nassim Haramein's "Quantum Gravity and the Holographic Mass"[p] paper.

```
r_p m -L-T+M+C+K: 1 0 0 0 0 dt=+1 proton charge radius

CODATA2018 digit┬15    relUnc  JohnWsol    digit┬15   relUnc  Formula

 8.41400000000000e_16  0.0022  8.41400000000000e_16   0.0022 r_p2018
 8.41234455198524e_16  1.6e_5  8.41235641351043e_16  2.1e_11 4*l_P*(m_P/m_p)
 8.41235641344447e_16  1.5e_9  8.41235641351043e_16  2.1e_11 4*a₀*α / MpMe
 8.41234501683958e_16  1.6e_5  8.41235641351043e_16  2.1e_11 4*l_P*hBar/(m_p*c²)*t_P
```

3.16 a_p = Proton "mass confinement radius"

This is normally known as the Yukawa confinement. This, a_p, plus the proton charge radius (16 times smaller than r_p) together these define the bounds of the nucleus.

 In the nucleus a precession of double pairs of proton-neutron wavicles (alpha particle) twist together along the time dimension. These twisted wave constructs are what hold the nucleus together -- the neutron~wavicles twist in-between the proton~wavicles so the proton~wavicles stay 180-degrees out-of-phase with each other. Not really a force, but twisted wave constructs. That's why the "believed" force suddenly disappears just beyond the nuclear mass confinement of these entangled wave functions.

$$a_p = \frac{\hbar}{4m_p c} = \frac{\hbar}{4m_e c}\left(\frac{m_e}{m_p}\right)$$

(3.16)

(a-b)

```
a_p|m|-L-T+M+C+K: 1 0 0 0 0|dt=+1|proton mass confinement radius
```

CODATA2018 digit⌐15	relUnc	JohnWsol digit⌐15	relUnc	Formula
5.25772275841762e_17	3.1e_10	5.25772275844402e_17	2.1e_11	hBar / 4*m_p*c
5.25772275841762e_17	3.1e_10	5.25772275844401e_17	2.1e_11	hBar / 4*(m_e*MpMe)*c
5.25771563552474e_17	1.6e_5	5.25772275844402e_17	2.1e_11	l_P*hBar/4*(m_p*c²)*t_P

3.17 G = Newton's Gravitation, covariant^-2

$$G = \frac{\hbar c}{m_\ell^2} = K_\Theta c^2 = \frac{\ell^3}{m_\ell t_\ell^2} = \sqrt{\frac{K_m}{2K_\Theta}} = \frac{K_m}{2}\left(\frac{q_\ell c}{m_\ell}\right)^2 = t_\ell^2 q_\ell \sqrt{\frac{K_m c^{11}}{2\hbar^3}}$$

(3.17)

Given the values from Table 2.1 these new calculations all round off to 15-digits of agreement. Change any of those values anywhere before the 14th digit -- these calcs will show disagreement. The last formula is an original discovery by the author. I suspect the c^11 term will be helpful to 11-Dimensional M-Theorists.

```
G | m3/kg s2 | LTMCK: 3 _2 _1 0 0 | dt=-2 | Newton's Gravitation (thought to be) Constant
```

CODATA2018 digit⌐15	relUnc	JohnWsol digit⌐15	relUnc	Formula
6.67430000000000e_11	2.2e_5	6.67430000000000e_11	2.2e_5	G_2018
6.67430210439531e_11	2.2e_5	6.67429232315728e_11	4.9e_16	hBar*c / m_P²
6.67430000000000e_11	2.2e_5	6.67429232315728e_11	4.9e_16	K_Theta * c²
6.67427461123062e_11	4.1e_5	6.67429232315728e_11	1.3e_15	(l_P³) / m_P*t_P²
6.67430210437501e_11	2.2e_5	6.67429232315728e_11	8.8e_16	½*K_m*(q_P*c/m_P)²
6.67430136676011e_11	2.2e_5	6.67429232315728e_11	8.2e_16	(t_P²)*q_P*√(K_m*(c^11)/2*hBar³)

In natural quantum units G=1 [length³ mass⁻¹ time⁻²] however, contrary to popular belief, G in emergent units, varies as the inverse square of the size of the universe.

A central tenant of Cosmological Relativity is that whenever you see a physical quantity like c^2 it has units of [meters^2/second^2]. It's like a surface area spreading forth while time decelerates! To understand this simply replace [/second^2] with [Planck seconds / second] increasing every second. Now we can grasp what happens in a gravitational field. The number of Planck seconds per second is more at higher altitudes by 4.27e25 Planck seconds per 9.8 meters (or 32' 2") of elevation. A whole new way to understand General Relativity.

Cosmological Relativity also brings an awareness that the number of Planck times per second continually grows with time. Clocks at higher altitudes tick faster because they are already further ahead in time -- yet at each altitude the duration of each passing second keeps getting longer because everything is expanding.

3.18 R_K = von Klitzing resistance

$$R_K = \frac{h}{e^2} = \frac{2\pi\hbar}{e^2} = \frac{\mu_0 c}{2\alpha} = \frac{Z_0}{2\alpha} = \frac{2\pi Z_\ell}{\alpha}$$

(3.18)
(a-e)

```
R_K│Ohm│-L-T+M+C+K: 2 _1 1 _2 0│dt=_2│von Klitzing constant

CODATA2018 digit┬15│relUnc │JohnWsol  digit┬15│relUnc │Formula
                                                                     (3.17)
   25812.8074555000│2.3e_10│25812.8074555000│2.3e_10│R_K2018         (CODATA2018)
   25812.8074593045│  2e_12│25812.8074593045│  2e_12│h / e²          (a)
   25812.8074593045│  2e_12│25812.8074593045│  2e_12│2π*hBar / e²    (b)
   25812.8074592257│2.1e_10│25812.8074593045│  2e_12│μₒ*c / 2*α      (c)
   25812.8074593042│2.1e_10│25812.8074593045│1.4e_12│Zₒ/2*α          (d)
   noPlanckImpedance│      │25812.8074593045│1.4e_12│2π*Z_P/α        (e)
```

3.19 G_0 = Conductance quantum

$$G_0 = \frac{2}{R_K} = \frac{2e^2}{h} = \frac{q_\ell^2 \alpha}{\pi m_\ell c \ell}$$

(3.19)
(a-c)

```
Go│/Ohm│-L-T+M+C+K: _2 1 _1 2 0│dt=2│Conductance Quantum

CODATA2018 digit┬15  │relUnc │JohnWsol  digit┬15  │relUnc │Formula

 7.74809173100563e_5 │2.3e_10│7.74809173100563e_5 │2.3e_10│2/R_K2018
 7.74809172986365e_5 │  2e_12│7.74809172986365e_5 │  2e_12│2*(e²)/h
 7.74810265661915e_5 │ 1.6e_5│7.74809172986365e_5 │2.8e_12│(q_P²)*α/pi*m_P*c*l_P
```

4 Discussion: Understanding Fundamental Constants & Covariant Metrics

John Wsol presents at Orange County Astrophysics SIG 2022-Sep-16
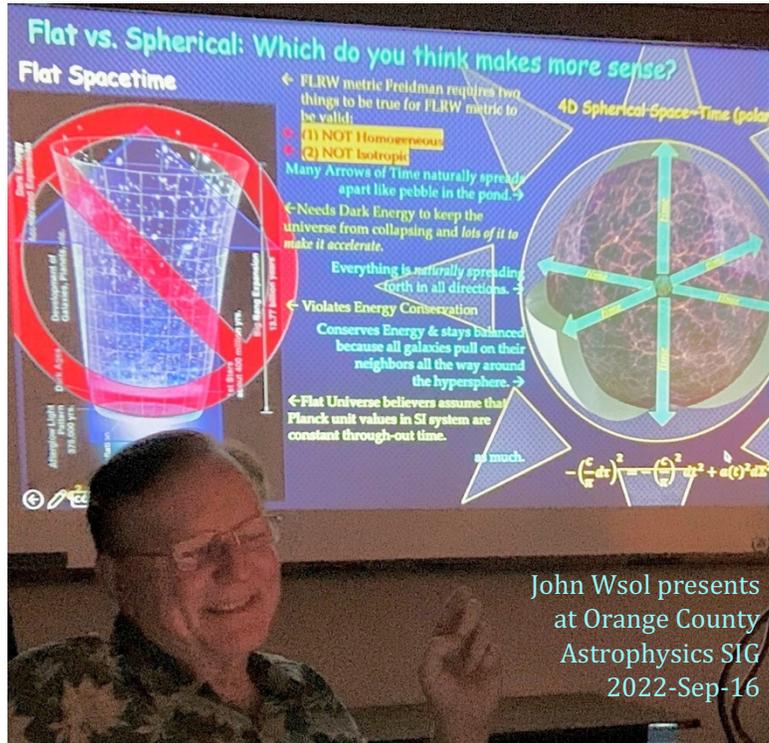
"Here & Now" everything that can be measured we measure relative to ourselves -- our current size and perceived flow rate of time. Essentially, we perceive the universe around us from the perspective of our avatar bodies.   Wherever we are – light/radio waves are coming towards us from all directions – while light from us radiates outward in all directions.

4.1   Old School – Flat Spacetime

Until now, the predominate paradigm has been the belief in "Flat Spacetime". Flat Spacetime was founded on the **"Assumption"** of Euclidean geometry extended to 4 dimensions where all seconds are the same duration throughout time. The unspoken assumptions are: (1) just one arrow of time for the entire universe, (2) the duration of a second has always been 1.85e43 Planck times/second, this is the reciprocal of "today's" Planck time value (5.39e-44 second). These are the reasons Dark Energy *had to be invented* -- the existing Flat Spacetime "models" needs it (through which redshift & luminosity data are interpreted). But does our universe need it? So, we've been stuck with this Dark Energy & Dark Matter enigmas. *This idea took root with the FLRW-metric* Q *which applies scaling function a(t) to Space , but not to time.*

Friedmann-Lemaitre-Robertson-Walker metric	$-c^2 d\tau^2 = -c^2 dt^2 + a(t)^2 d\Sigma^2$ where $d\Sigma^2 = \frac{dr^2}{1-kr^2} + r^2 d\Omega^2$	(4.1) (a, b)

"Flat time" -- a mindset that's hard to break free of.

   Why? It has been ingrained into our neural nets. It's not going to be easy. For years I've struggled getting clarity of this distinction between quantum vs. emergent time metrics. Now, let's forge ahead, building afresh, our neural nets that will focus on clarifying this idea of "Expanding Space~Time".

   Physics equations are the mathematical puzzle pieces which we will fit together into a clear geometric understanding of quantum vs. emergent metrics. With this precise understanding – many Dark Mysteries just fade away. I promise, your patience & perseverance will payoff *BIG Time*. Because this "Yellow Brick Road" paradigm is "The Road" that leads to the resolution of the enigma of Dark Energy and to the redefinition of Dark Matter (Section 4.14) while paving the way to explain Quantum Gravity.

4.2   Cosmological Crisis vs. Opportunity

Each generation of physicists pass along to the next generation the predominate cosmological paradigm of their time. Flat spacetime is responsible for the current Crisis in Cosmology.   It's up to the next generation to seize the opportunity -- to **question** basic assumptions surrounding ideas like "the aether", particle wave duality, Dark Matter, Dark Energy, Dark Flow and Cosmic Geometry. Could it be just a few misperceptions

IS what gave rise to the scientific paradigm in which only 4% of our universe is understood and, **undeniably**, <u>96% not understood?</u>   *This should compel the next generation to identify the "unspoken assumptions" -- the root-cause of this cosmic-sized problem!*

Any theoretical framework which hypothesizes 10^500 multi-verses will likely take 10^499 lifetimes to solve.

A far more productive use of our mental energies would be to confront the fundamentals of the One Universe we live in. Please compare this Cosmic Onion Model -- Space~Time paradigm -- side-by-side with any Flat Universe theoretical framework. Just by being willing to let go of (1) One Arrow of time, (2) "flatness" (3)

assumption that values of Planck units are constant throughout time. Suddenly the of Mystery Dark Energy goes away. As for Dark Matter the explanation is more involved and the math computations much more difficult.

4.3   Particle Physics vs. Wavicle Physics

"Particle Physics, as a field, is kind'a badly named, in a way. Because 'particles' are not the fundamental building blocks of the universe -- they are not fundamental at all. So the things that we believe are the real building blocks of the universe are objects, invisible, fluid-like objects called quantum fields." [R]

-- Harry Cliff, "Particle" Physicist, University of Cambridge (Fridman, 2020)

I would call the invisible fluid-like objects the elastic superfluid Space~Time medium. Space~Time is filled by this medium from past to present. Physical reality is given substance by it. The energetic structure of this medium is due to its persistent rotational oscillations, which construct the holographic Onion-layers of time. Wavicles exist within this energetic Space~Time context. An electron-wavicle is the manifestation of an electron. The root cause of protons, neutrons, muons, etc. is their corresponding wavicle-type. There are three properties of each wavicle-type: a "curvature factor", a charge radius amplitude, and a mass confinement amplitude. For electrons, this "confinement" is called the "Bohr" radius, and for protons and neutrons, this is essentially the Yukawa confinement. Ultimately this

medium is where seekers of Dark Matter should be looking. I suspect, $d(G)/dt$ will play a key role in resolving the Dark Matter enigma.

CERN Super Collider can be thought of as a gigantic microscope. Accelerating bundles of protons effectively stretches the root-cause wavicles, magnifying their interactions with the Higgs Field (the structure of the vacuum). Exploring these mathematical/geometric relationships will ultimately help us arrive at an understanding of a Unified Field Theory. Cosmological Relativity connects these quantum understandings with Relativity theories -- the destination being Grand Unification.

4.4   Quantum Time vs. Emergent Time

Here is my gift to you, the diligent reader/thinker. Here's your *Fastrack to* comprehending **why** "space expansion" *must* include "time expansion", because our emergent metrics grow in lockstep with each other.

Before Einstein, measuring time was easy; just count clock tick-tocks. But how can we hope to comprehend expanding Space~Time? We need distinct definitions for: [S]

<u>Now</u>: defines the local inertial reference-frame it expands with the flow rate of time. The Universe distributes galaxies across a filamentary neural net like structure. "Now" expands quickest in the large voids between galaxies and slowest around supermassive black holes and quasars.

<u>Duration</u>: how long an event takes or time-lapse between 2 events. It is expressed in emergent units of time like seconds, days, or years. All emergent metrics scale together, however, quantum-metrics are absolute.
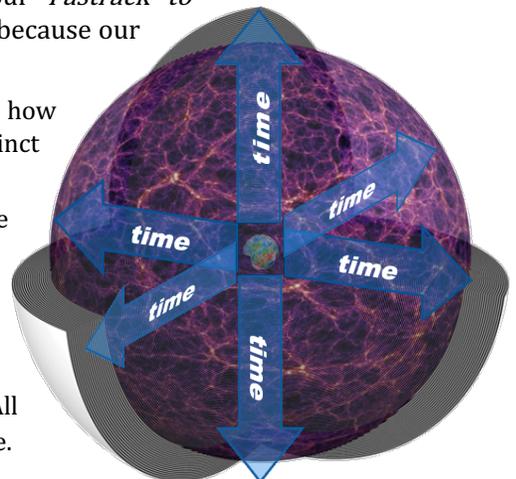
Plank-time: represents 1 time quantum, however, as expressed in SI units, the duration of the Planck time shrinks as the reciprocal of the size of the universe. Planck time, in SI units, is covariant^-1. But relative to the age of the universe Planck time, as expressed in SI units, is covariant^-2. Explained more fully in Section 4.6 Cosmological Relativity

Absolute Age: count of the number Planck time thin Onion-layers from the beginning of time till now.

Apparent Age: $13.8e9 \ years \ \frac{31,557,660 \ seconds}{year} = ageUniv_{secs} = $4.355e17 [seconds] *(round terms)*

The duration of each second expands in lockstep with the Expansion of Space.

Planck times/second = Planck lengths/second = 1 l_P/ 1 t_P = c *(the speed of light)*

Clock Rates: wait a second! <mark>What, exactly, do clocks do?</mark> Any clock you pick, be it a pendulum, a quartz crystal or Cesium 133 – these clocks exist within Space~Time each in its own inertial reference frame. If a clock slows, is it because it is faulty or is it actually measuring the flow rate of time? Sure Einstein, (et. al.) understood **two** reasons why these clocks. Reason one, Special Relativity: the faster a clock is moving, especially approaching light speed, the clock slows because part of its forward momentum rotates the spatial momentum towards the the direction time if flowing from thus countering the flow rate of time. Reason two, General Relativity: clocks in a "gravity well" tick slower than clocks at higher altitudes. This is where the Cosmological Relativity Section 4.2-4.8 explains out emergent second vs. quantum Time and further develop the ideas of Covariance^n relationships as it explains Space~*Time* e x p a n s i o n .

4.5   One vs. integers>1 and their reciprocals

The product of number & its reciprocal is always 1. The Grand Symmetry of all Symmetries is expressed by this "Universal Unity" equation (left). "Square any number by dividing by its reciprocal" equation (right):

$0^0 = x^1 x^{-1} = \dfrac{x}{1} \times \dfrac{1}{x} = x^0 = x^{-1}x^1 = 1$	$\dfrac{x}{1/x} = x^2; \ \dfrac{\sqrt{x}}{1/\sqrt{x}} = x$	(4.5) (a,b)

These are my two basic axioms that we will apply to the dimensional units involving [length^3] [time] [mass][charge]. Starting with the 1:1 ratio of `l_P/t_P = c`:

$1 = \dfrac{c}{1}\left[\dfrac{m}{s}\right] \times \dfrac{1}{c}\left[\dfrac{s}{m}\right] = c^0 = 1$	$\dfrac{c}{1/c} = c^2; \ \dfrac{\sqrt{c}}{1/\sqrt{c}} = c$	(4.5) (a,b)

Let x measure distances & let t measure time. Become aware of dimensional exponents. Starting with the horizontal lines represent x^0 or t^0. The diagonal sloping upward represented by x^1st or t^1st. The reciprocal curve by x^-1 or t^-1. Later we will explore higher integer exponents.

Coulombs and kilograms both are gauged by how many Planck seconds/second in our local reference frame. So that means, mass and charge increase linearly with the age of the universe.

In the equation below let (x,y) be your <u>current</u> (longitude, latitude), let z be the distance from Earth's center, let nt_ℓ be the number of Planck times since the Beginning -- 13.8 billion years is about 4.038x10^60 Planck-times. *(This value accounts for ever-expanding seconds – flat spacetime "believers" think it is twice this number.)*

4.6 Cosmological Relativity: Expanding Space~Time

The first 4 fundamental quantum units are 1 quantum of length, 1 quantum of time, per 1 quantum of mass and per 1 quantum unit of charge. *(We'll save Energy~Temperature for a future paper.)* Length has 3-spatial dimensions often denoted as (x, y, z). These fundamental fixed units correspond to the emergent units of [meter], [second], [kilogram], and [Coulomb]. (The official SI unit is Ampere = 1 [Coulomb]/[second] so Coulomb is more fundamental than Ampere just as [meter] is more fundamental than [meters/second]. Time is the common denominator. That's why so many physics equations involve "dt". "dt" is a tiny differential of time. All of quantum physics is built around this 1 quantum increment of time. At current age of universe there are 1.85e43 (Plank seconds) per second.
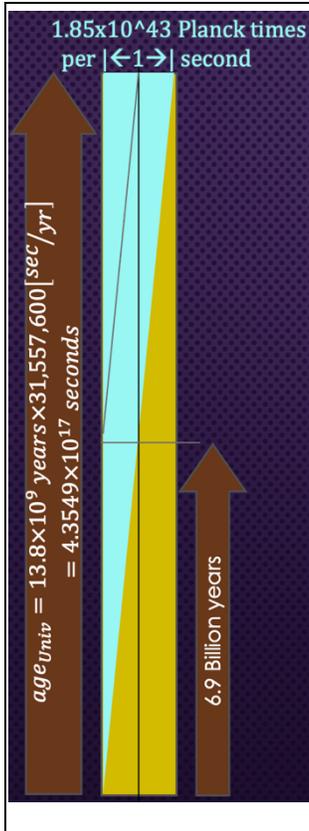
1.85x10^43 Planck times per |←1→| second $age_{Univ} = 13.8 \times 10^9\ years \times 31{,}557{,}600\left[\frac{sec}{yr}\right] = 4.3549 \times 10^{17}\ seconds$ 6.9 Billion years	In Flat & Expanding cosmology the "**number" of seconds** since the beginning of time are the same in both paradigms. Illustrated to the left, the vertical side of the cyan triangle represents the age of the universe in seconds. Speaking in round numbers 13.8 billion years, both space & our time metric have been expanding for about 4.350e17 seconds.

$$13.8\mathrm{e}9[years] \times 365.25\left[\tfrac{days}{year}\right] \times 24\left[\tfrac{hrs}{day}\right] \times 3600\left[\tfrac{sec}{hr}\right] \approx 4.350\mathrm{e}17\ [seconds] \tag{4.6a}$$

If the duration of a second had been the same number of Planck times/second as it is today, we would simply multiply the number of seconds since the beginning of time by number Planck times/second is today = (**rectangular** area).

$$\frac{4.35\mathrm{e}17\left[\frac{seconds}{ageUniv}\right]}{5.39124\mathrm{e}44\left[\frac{t_P}{second}\right]} = 8.070e60\left[\frac{t_P}{age\text{\textit{FlatSpaceTime}}}\right]$$
$$= 4.035e60\left[\frac{t\_P}{age\text{\textit{ExpandingSpaceTime}}}\right] \tag{4.6b}$$

However, in Expanding Space~Time the age of the universe **expressed in Planck times** is the area of the yellow *triangle* – **half that of the rectangle area**. Next consider the bottom half of the yellow triangle. It represents half the age, 6.9 billion years, the area of the bottom yellow triangle is 1/4th the number of Planck times in the 1st half of time. Where 3/4th of "Planck times" are on the 2nd half of time!

==Understanding of this "true nature of time" will change cosmology forever==.

Honest, it's NOT going to be easy. Many Old School scientists will struggle to overcome deep-rooted neural pathways of their life-long "fixed second" Flat spacetime thinking.

This means that as time progresses the circumference of the Universe grows at twice the speed of light. While the "numeric values" of Planck length & time shrink -- covariant^-1 -- "because" our ever-expanding meter sticks and our ever-expanding "seconds" grow linearly -- covariant^1st.

However, the "accumulation of **quantum time**", let's call this the "**age**" of the Universe scales covariant^2 – along with the period of ever-expanding pendulums and all clocks. Why? Contrary to predominate teachings of the past generations when everyone "thought" forces prevented atoms from expanding with 3D space. ==The truth is that all atoms are constructed from proton~wavicles, neutron~wavicles & electron~wavicles.== **All these waveform constructs "exist within" and "expand along with" ever-expanding Space~Time.** Thus, all pendulums, clocks, and Cesium 133 atoms **slow** (covariant^-2) ==because that's what clocks do – they measure the deceleration of the flow rate of time.== In other words, time is continually slowing, while everything is expanding, so all pendulums, clocks, spinning planets & physical processes slow in lockstep with time deceleration.

4.7 Planck time vs. Age of Universe

Our time domain is bounded by two limits. Beginning with the 1st quantum of time up through the current Age of the Universe -- express this age as an integer count of Planck seconds. Today 1 Planck time is the tiny value about

5.39e-44 of a second. The reciprocal being 1.85e43 Planck times per second. It took about 13.762 ± 0.0008 billion years[T] for the number of Planck times per second to grow to this 1.85e43 number. The yellow table show the calcs:

calc 't_P 1%t_P omg_P secs_p_yr ageUniv_yr ageUniv_sec 1r2*ageU_sec%t_P ans%ageU_sec'							
Quantity	Value	relUnc	L_T_M_C_K	dt	Units	
t_P	5.39124334778149e_44	1.8e_16	0 1 0 0 0	_1	s	Planck time
1/t_P	1.85485969653271e43	1.3e_16	0 _1 0 0 0	1	Hz	Planck
omg_P	1.85485969653271e43	2.7e_16	0 _1 0 0 0	1	rad/s	frequency
secs_p_yr	31557600	0	0 0 0 0 0	0	sec/yr	365.25*24*3600
ageU_yr	13.787e9	0.00145	0 1 0 0 0	1	yr	per Planck2018
ageUniv_sec	4.3508463120000e17	0.00145	0 1 0 0 0	1	sec	approx.
ageUniv_sec	4.3429839167599e17	1.9e_12	0 1 0 0 0	1	sec	Equation 3.3
1r2*ageUniv_sec/t_P	4.0351047349684e60	1.9e_12	0 2 0 0 0	1	[tP s]	ageUniv_tP
omg_P/ageUniv_sec	4.2709338373892e25	1.9e_12	0 0 0 0 0	0	[tP/s]	2Qs? 1 answer
ageUniv_sec/sidereal	13.761845925900e9	3.2e_11	0 0 0 0 0	1	yrs	sidereal years

[tP s] is abbreviation for [Planck time][seconds]

$$\int_0^{4.350846312e17 \text{ seconds}} t\_P \, dt$$

The Wolfram Alpha webpage snapshot to the left integrates the Planck time value across the time span of the Age of the Universe in seconds.

Yes! Even Wolfram Alpha can confirm this surprising realization: The accumulation of time, as expressed as the integral of time has units of [time^2].
More specifically **[Planck seconds][seconds]** units abbreviation: **[tP s].**

Definite integral

$$\int_0^{4.350846312 \times 10^{17} \text{ seconds}} t_P \text{ (Planck time)} \, dt =$$
$$(t_P \text{ (Planck time)}) \, 4.350846312 \times 10^{17} \text{ seconds}$$

Indefinite integral

$$\int t_P \text{ (Planck time)} \, dt = t \, (t_P \text{ (Planck time)}) + \text{constant}$$

This integral equation reveals the true nature of time. For it illustrates that the accumulation of time, let's call this **"age",** has units of [time^2].

Two questions, 1 answer:

(1) How many Planck times were there in the 1st second of the universe?

(2) On average, how much longer has each subsequent second slowed?

Interpretations

time squared

Basic unit dimensions

$[time]^2$

4.270933837x10^25 [Planck secs/second]

4.8   Dark Energy Enigma Resolved.

Cosmological Relativity's understanding of the deceleration of the flow rate of time due to each passing second taking longer and longer replaces the belief in some mysterious Energy needed to accelerate expansion.

The math above resolves Dark Energy – once-and-for-all! *-- John Wsol 2022-Feb-08*

4.9 What's "Planck length", l_P ?

```
 15 calc 'l_P l_P%t_P c  1%c t_P%l_P 1%l_P 3*meters%c 1r2*l_P^2'

 Quantity │ Value              │ relUnc │ L_T_M_C_K  │ dt │ SIunits

 l_P       │ 1.61625409490756e_35 │ 1.7e_16 │ 1  0 0 0 0 │ _1 │ m
 l_P/t_P   │ 2.99792458000000e8   │ 2.8e_16 │ 1 _1 0 0 0 │  0 │ m/s
 c         │ 2.99792458000000e8   │       0 │ 1 _1 0 0 0 │  0 │ m/s
 1/c       │ 3.33564095198152e_9  │       0 │ _1  1 0 0 0 │  0 │ s/m
 t_P%l_P   │ 3.33564095198152e_9  │ 2.6e_16 │ _1  1 0 0 0 │  0 │ s/m
 1/l_P     │ 6.18714596393454e34  │ 1.5e_16 │ _1  0 0 0 0 │  1 │ /m
 3*meters%c │ 10.0069228559446e_9 │       0 │  0  1 0 0 0 │  1 │ s
 1r2*l_P^2 │ 1.30613864965273e_70 │ 3.1e_16 │  2  0 0 0 0 │ _2 │ m2
```

Here we see the ratio of Planck length over Planck time is exactly the speed of light. The reciprocal of c says it takes a light ray 3.33564e-9 of a second or 3.33564 nanoseconds to propagate 1 meter. 3 meters takes **10ns** (nanoseconds).

4.10 0^0 = 1 Cosmic Egg + "Let there be light…"

Understand that the limit as x approaches 0 of x^x is 1:

$$\lim_{x \to 0} x^x = 1 \tag{4.10a}$$

In the Beginning, emerging from the "Cosmic Egg" Singularity, an ever-expanding 3D surface spreading forth is the tapestry on which all physical reality exists. Each time-quantum brings another quantum-thin 3D surface layer, thus grows this 4D Space~Time volume. Here's my attempt to formalize this Cosmic Singularity Equation.

$$1 = \left(\hat{x} + \frac{i}{\hat{x}}\right) + \left(\hat{y} + \frac{j}{\hat{y}}\right) + \frac{1}{\pi}\left(\left(\hat{z} + \frac{k}{\hat{z}}\right) + \left(t_\ell + \frac{k}{nt_\ell}\right)c\right) \tag{4.10b}$$

Here, $\hat{x}, \hat{y}, \hat{z}$, (with the hats) represent "unity" for each of three spatial dimensions. The First quantum increment along the x, y, z directions. In the next equation we multiply everything by an integer, n. "n" being the number of quantum times increments since the Beginning. One quantum increment along each respective direction. Today, we call this 1-unit of time the "Planck time." The more I study this and the next equations the clearer I can visualize the 1st, and perhaps only, true **Singularity** in our universe.

The flow rate of time slows towards zero as anything approaches the event horizon. But does time reverse inside the event horizon?

Cosmic Quaternion for Here & Now:

$$\text{Here\&Now} = \left(\pm n\hat{x} \pm \frac{i}{n\hat{x}}\right) + \left(\pm n\hat{y} \pm \frac{j}{n\hat{y}}\right) + \frac{1}{\pi}\left(\left(n\hat{z} + \frac{k}{n\hat{z}}\right) + \left(nt_\ell + \frac{k}{nt_\ell}\right)c\right) \tag{4.10c}$$

Expansion happens in both positive and negative directions at the same time. So, think of $\pm n\hat{x}$ as being your longitude, except converted to the number of Planck lengths going West ←negative ---o--- positive → East – so length wraps around the circumference of your latitude line. That is to say $+n\hat{y}$ are the positive North latitude values whereas. $-n\hat{y}$ the negative value are South latitude positions. Here we your North-Sound degrees°

minutes' seconds" position to the number of Planck lengths we are from the equator.

In the Beginning, in the equation above, "n" starts at 1, this defines THE Singularity. It is the origin point of Space~Time. Each time "n" increments by 1 – time itself unfolds each full (x,y) layer is a surface spreading forth in all directions . *Think about that.*

John Wsol's Cosmic Quaternion Equation:

$$Space\sim Time^2 = \left(x + \frac{i}{x}\right)^2 + \left(y + \frac{j}{y}\right)^2 + \left(\frac{1}{\pi}\left(z + \frac{k}{z}\right)\right)^2 + \left(\frac{c}{\pi}\left(t + \frac{k}{t}\right)\right)^2 \qquad (4.10c)$$

Here (x,y) corresponds to your local reference frame (longitude, latitude), z to your elevation above Earth's center – z bends and scales by $1/\pi$ to align with time expansion. Time, t, scales by the factor of c/π, the speed of light/π.
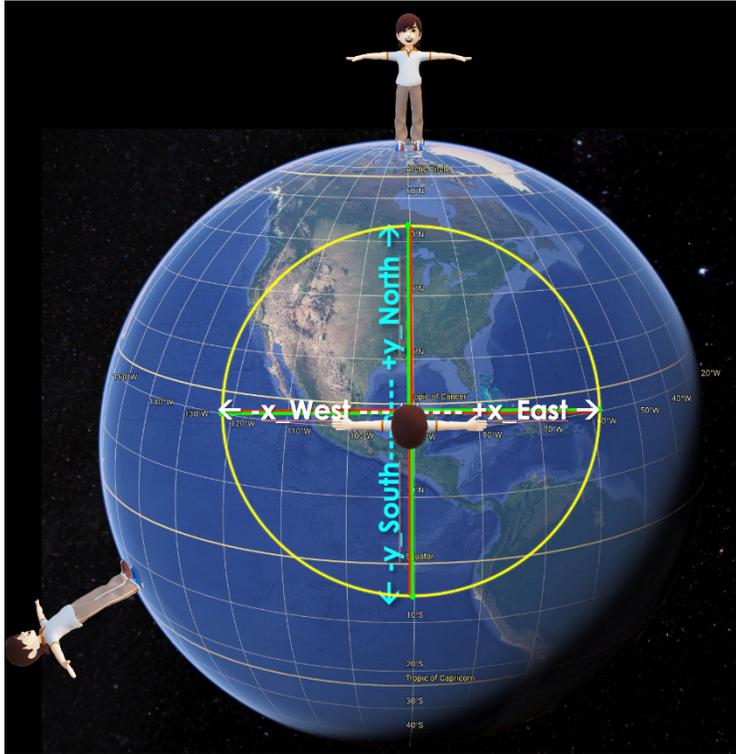
North-South axis. It is like your latitude position, but it is specified the terms of the number of Planck lengths you are North of the equator (positive y-values for positive latitudes)   Or y-values are like South "latitude" values.   This time specifying negative number of Planck lengths from the equator towards the South Pole.

(x, y, z) above, are what we perceive as spatial dimensions, whereas (i, j, k) are their imaginary counter parts -- which exists in the *"other"* half of each time quantum.   Let's call Equation (8) the "Cosmic Quaternion".   On the scale of the solar system x is the planet's position in its orbit around the Sun and y is the tilt of its orbit, z is its distance from the Sun. For our Solar system's position in the galaxy x is where around the galactic rotation we are, and y is the position above/below the galactic plane.   Again, the rule is that negative z is the direction we are falling.   Not towards the galactic center, but we are falling (towards Vega) which is along the curvature of the galactic spiral arm.   That spiral curves inward so that the stars near the center are falling towards the supermassive black hole. So positive z direction is outward.

Substituting this ratio in Equations 4 we get:

$$c = \frac{1\ quantum\ length}{1\ quantum\ time} = \frac{Z_0[Ohms]}{\mu_0[N/A^2]} = c \qquad \begin{matrix}(4.10)\\(d, e)\end{matrix}$$

All pasts leading up to now – each second before was a shorter, 4.2632x10^25 [Planck seconds/second]

and so on till we reach back to the 1st second of
4.2632x10^25 [Planck seconds]

 Right Now! Looking backward through time, I see ourselves as being holographic projections being projected onto the inside surface of an ever-expanding planetarium dome. The dome continually grows the entire duration of the planetarium show. For our universe everything is growing all the time.

Take two examples. First the speed of light 299,792,458 meters/second on our scale a value much greater than 1.

The speed of light, c, 299,792,458 [m/s] divided by its reciprocal, 1/c yields c^2 .

Amperes is NOT a true "fundamental" dimensional metric because it is a ratio of to fundament metrics: 1 [Coulomb/second], and like the speed of light, having units of [meters/second], it should be considered a "derived" metric. Electric charge is the base dimension measured in units of Coulombs.   Charge is more fundamental than Current.   Even though elementary charge is less than quantum charge it is because it happens a slower frequency than $1/t_P$.

Each quantum-level "thing" happens at a certain frequency.   Speed of Light, c =Planck Length/Planck

Time. Understand this clearly, "/Planck Time" is the Planck Frequency – this is the heartbeat of the universe.

$$\frac{1}{x} = \frac{\left(1/\sqrt{x}\right)}{\sqrt{x}}; \quad x = \frac{\sqrt{x}}{\left(1/\sqrt{x}\right)}; \quad x^2 = \frac{x}{1/x}; \quad t^2 = \frac{t}{1/t}$$

(4.10)
(e-d)

Think of Planck's constant as representing a quantum-sized flywheel with a 1 Planck-times worth of mass with a surface area of π(Planck-length)^2 spinning at a frequency of 1-radian/Planck-time. But it's more like a spiral staircase where each step is 1-radian so 6-steps is 0.28 short of a full rotation.

4.11 Properties of the 4D Space~Time Medium

The speed of light, c, is constant throughout all time. $c =$ 1 Planck length/1 Planck time. Deeper understanding comes from replacing the long-standing 3D misconception, known as the "Aether". I propose that the medium of physical existence is has properties (Electric Permittivity, Impedance & magnetic permeability). The ratio $\frac{Z_0[Ohms]}{\mu_0[N/A^2]}$ is what determines the speed of light. I perceive this Space~Time medium to be a plasma superfluid. This Plasma has a balance of positive & negative charge -- positive charge is forward time -- negative charge is its reflection backward in time -- this creates a spherical standing-wave. It is a super-fluid[U] in that is has zero viscosity, zero-friction – no-ether drag along the (x,y) dimensions. It does, however, experience Impedance along the time-dimension, t -- *the z-axis aligns with time.* This Impedance regulates time expansion. While the Magnetic Permeability regulates space expansion. This represents a profound realization which substantiates the assertion that the circumference of the universe expands at 2c while its radius (time dimension) expands at c/π.

4.12 Quantum increment of mass-time

Whether scientists have realized this or not, ever since Newton gave us F=ma, our science has **gauged** mass quantities by the *duration of a second*. I discovered that the magnitude of the value we call Planck mass, as represented in SI units, is scaled by the duration of our "second". In other words, it is NOT a true quantum-scale quantity, rather **it represents one seconds worth** of this tiny 1.173369x10^-51 [kilogram][seconds]. This is the quantum increment that all particles (and objects made from particles) manifest [mass][time]. A 1-kilogram calibration weight takes 1-second to manifest 1-kilogram.

Planck Mass:	$2.175686189\text{e-}8 \text{ kg} = \int_0^{1\,second}[1.173369392 \text{x} 10^{-51}[kg \cdot sec]]\,dt_\ell$	(1.1)

Here I'm **not** performing infinitesimal summation, but rather place a specific limit for delta-t = quantum unity of Planck-time. Essentially the wavicle wavefunction of the particle "collapses" for 1 Planck second -- which represents 1-radian of rotation -- at an ω-frequency (Equation 1.1b) specific for each particle-type. That means that the unit we call a "kilogram" has implied within it a "radians/per second". This tiny 10^-51 quantity **is** the source of the Planck Density -AND- whenever *ANY* wavicle manifests mass – **this** is the tiny increment that all particles manifest [mass][time]. Mass manifestations are particularly interesting. Herein, I define the quantum-level source of mass and will explain how it causes a quantum-sized dent in time, thereby, spreading forth as a temporal dent that fractalizes at the sub-quantum level this effectively describes the mechanism of mass manifestation and of "Quantum Gravity". (See Section 4.13 Photon vs. Graviton -- Quantum Gravity)

Each particle type has a specific angular frequency that it manifests the precise value of [kilogram-seconds] in equation (3). Arthur Compton gave us formulae for wavelengths and angular frequencies for electrons, protons, and any other particle types, denoted by x, defined by:

| Wavicle wavelength: $\lambda_x = \frac{h}{m_x c}$	Wavicle radians/sec frequency: $\omega_x = \frac{m_x c^2}{\hbar}$	(1.1) (a, b)

Dividing the energy of the particle by h-bar gives us its angular frequency (radians/second). Solving for mass:

$$m_x = \frac{h}{\lambda_x c} = \frac{\hbar \omega_x}{c^2}$$

(1.1)
(c, d)

Quantity	Value digit15	relUnc	units	-L	-T	+M	+C	+K	dt	Our kilogram is scaled by the duration of our ever-expanding second...
m_P	2.17643559439662e_8	1.4e_12	kg	0	0	1	0	0	1	MASS: Planck mass
m_n	1.67492748667124e_27	2.8e_12	kg	0	0	1	0	0	1	- neutron
m_p	1.67262192367249e_27	2.1e_11	kg	0	0	1	0	0	1	- proton
m_m	1.88353162700000e_28	2.2e_8	kg	0	0	1	0	0	1	- muon
m_e	9.10938370157334e_31	1.9e_12	kg	0	0	1	0	0	1	- electron
omg_P	1.85485969653271e43	1.4e_12	Hz	0	_1	0	0	0	1	ω, omega frequency: Planck
omg_n	1.42745114886004e24	2.8e_12	Hz	0	_1	0	0	0	1	- neutron wavicle
omg_p	1.42548624078042e24	2.1e_11	Hz	0	_1	0	0	0	1	- proton wavicle
omg_m	1.60523330488700e23	2.2e_8	Hz	0	_1	0	0	0	1	- muon wavicle
omg_e	7.76344070635580e20	1.9e_12	Hz	0	_1	0	0	0	1	- electron wavicle
lam_P	1.01552239817920e_34	1.4e_12	m	1	0	0	0	0	_1	λ, lambda wavelength
lam_n	1.31959091476660e_15	2.8e_12	m	1	0	0	0	0	_1	- neutron wavicle
lam_p	1.32140985540317e_15	2.1e_11	m	1	0	0	0	0	_1	- proton wavicle
lam_m	1.17344411031981e_14	2.2e_8	m	1	0	0	0	0	_1	- muon wavicle
lam_e	2.42631023866356e_12	1.9e_12	m	1	0	0	0	0	_1	- electron wavicle

Each particle has a corresponding wavicle-type; thus, an electron is the manifestation of an electron-wavicle. Likewise, protons, neutrons, muons, etcetera are all manifestations of their corresponding wavicle-type. Wavicles have a curvature factor, a charge radius and a mass confinement radius these radii are reciprocals of each other.

4.13 A Photon vs. a Graviton -- Quantum Gravity
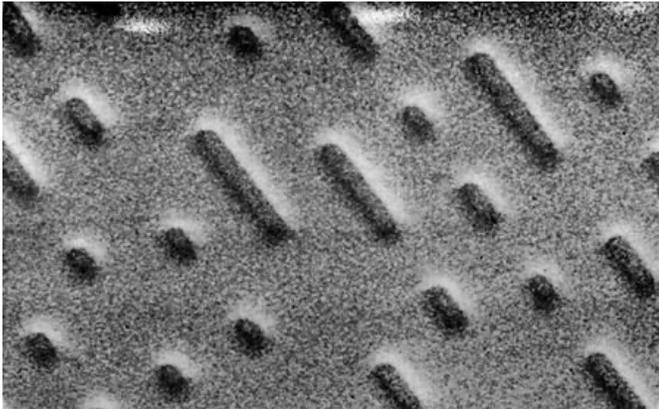
Much like these tiny dots laser etched into this magnified Compact Disk, (CD). The neutron, proton & electron wavicles in atoms of massive objects incrementally create tiny temporal dents. These temporal dents are "etched into" the surface of the Event Horizon of the Now Manifold. While "spreading forth" in all directions -- they split in half as the imaginary part -- these halving's happen for each doubling in distance from each Planck

particle left behind by mass manifestations of all other wavicle types. These sub-quantum "etchings" spreading forth are "gravitons" which merge with neighboring gravitons to sum together resulting in a local time differential. This curvature in time is at right angles to the relaxing curvature of space.   **All the while, everything expands (even atoms) along with Space & emergent "time".**

Planck's constant has units [m² kg/s] are angular momentum or [Joule seconds]. We have to pay attention to hBar = h/2π vs. h = 2π×hBar.   *(Perhaps I over emphasize hBar, but if you **can't** see the tiny bar on the ℏ, you miss the important distinctions I'm highlighting in this paragraph.)* hBar is always used regarding mass & gravity, because its 1-radian increments spread out in all directions. However, "h" says that each ray of light is series of photons, front-to-back, propagating at the speed of light, thus photon = hc.   The propagation direction as defined by a full 360° transverse rotation defining the Poynting Vector.[V]

$$photon = h \left[\frac{m^2 kg}{s}\right] c \left[\frac{m}{s}\right] = hc \left[kg \frac{m^3}{s^2}\right] = 2\pi \ell m_\ell c^2$$

(4.13)

(a-b)

But a photon, "$h \times c$", has units of [m3 kg/s2] which factors to be [Planck Energy][distance].   [m3] (meters^3rd) is a 3D-volume. That volume has mass [kg] that fractalizes time every second.   [/s2] units of [/time][/time]. What does that mean? Simply consider this as [delta Planck-seconds] per [second].   This is the differential of the number of Planck times per second between the reference frame of the source vs. the reference frame of the observer.   Observer can be an eye, or a photosensitive CCD array, or a blade of grass. Any electron whose state can be bumped by this incoming phase-aligned photon. The rule is so simple -- If the wavelength of the incoming light is in phase with the outer-shell (valance) electron of the atom.   This happens at the magic time-slot between the 11.706 time-quanta and the 12th. Time slows down to almost still indicated by the 2.725 Kelvin temperature. Then during the next time quantum, the universe expands 2-quanta to make up for having slowed down during the previous time quantum. This is the Electromagnetic cycle, an oscillation between, the Impedance of Space, Zo and the Magnetic Permeability, mu_0.   During the Magnetic Permeability phase, in the imaginary "counterspace", the temperature spikes to the Planck temperature -- for only about a half-time quantum. Then the temperature drops to the 2.725 Kelvin. This cycle repeats forever. This effects the rate of expansion along the time dimension, yet the Space~Time medium is a superfluid with this energetic structure of 12-layers of Planck time per each half cycle of the Electromagnetic Field. It's as if the universe squeezes 12-time quanta into Space~Time of 11.706 (1/sqrt(α)).

The product of 1 full revolution of angular momentum moving at the speed of light is defines the light-speed & defines the photon.   *They define each other!* Every kilogram of mass throughout the universe manifests 1 kilogram of mass – each-and-every second.   When we integrate mass over time we get the units of kilogram-seconds [kg s] .

So, we are going to make [kilogram][second] a predominant idea in our new neural networks.

As time progresses, every massive object – every atom – each individual neutron, proton & electron – leaves in its wake a tiny dent in time which spreads forth thinner and thinner at the sub-quantum level.   This "dark photon" – is etched into the surface (imaginary plane) of the Cosmic Event Horizon of the Now Manifold.   I've just described the essence of Quantum Gravity.   Much more in a future paper.

4.14 What's the matter with Dark Matter?

Dark Matter is not what everyone "thinks" it is. It is just the residual effect of ordinary matter remanifesting its rest mass every second. Massive objects create around themselves a dent in time second-by-second continually, spreading out in all directions at the speed of light. The light from stars AND their gravitational effect, is **time-delayed** and diminishes in intensity in accord with the inverse-square law. We need to account for the time-delay because stars "feel" the tug of their closest neighbors' and then our local group of stars "feel" more distant star collections in accord with inverse-square law.

 Surprisingly, there are 59,722 stars within 100 light years of Earth. Only 471 of these stars have a magnitude 6 or brighter, making them bright enough to see with the naked eye. Few people are aware that every object remanifests their ever-increasing mass every second. (Remember the duration of each passing second keeps getting longer and our kilogram is gauged by the duration of a second.) No one notices because all masses are doing this. The Sun currently has a mass of 1.988 billion kilograms. Our Sun, like neighboring stars in our spiral arm, each orbiting are loosely bound star groups, each leaving a dent in time. The dents in time spread forth in all directions. Collectively the resulting wakes spread forth merging with their neighbors' temporal wakes.   As the curvature of these temporal dents decreases, so does the curvature of space around the planet, star/star group. Each star causes gravitational lensing while groups of stars, galaxies and galactic clusters also do this at their respective scales.

4.15 Time Covariant^n, where n= -2, -1, 0, 1, 2

Raising Planck time to various powers reveals the huge span of values produced.

Quantity	Value digit_T15	L__T__M__C_K	dt	Units	Description
t_P^2	2.90655048349982e_87	0 2 0 0 0	_2	s2	**t_P^2 = t_P%omg_P = t_ℓ/ω_ℓ**
t_P^1	5.39124334778149e_44	0 1 0 0 0	_1	s	t_ℓ = "tiny^44th fraction" of a second
t_P^0	1	0 0 0 0 0	0		1 [dimensionless]
t_P^_1	1.85485969653271e43	0 _1 0 0 0	1	**t_P/s**	ω_ℓ = 1.85x10^43 Planck times/second
t_P^_2	3.44050449382143e86	0 _2 0 0 0	2	**t_P/s2**	deceleration of time

4.16 Length Covariant^n, where n= -2, -1, 0, 1, 2, 3

Likewise raising Planck Length to different powers note which values get smaller, becomes a constant=1, OR increase by linear covariant^1 or Corvariant^2.

Quantity	Value digit_T15	L__T__M__C_K	dt	SIunits	Description
l_P^3	4.22210388203653e_105	3 0 0 0 0	_3	m3	3D Volume
l_P^2	5.39124334778149e_44	2 0 0 0 0	_2	m2	2D Surface
l_P^1	1.61625409490756e_35	1 0 0 0 0	_1	m	1D Length or distance
l_P^0	1	0 0 0 0 0	0		1 [dimensionless]
l_P^_1	3.44050449382143e86	_1 0 0 0 0	1	/m	per distance; unit of Rydberg constant
l_P^_2	3.82807751790314e69	_2 0 0 0 0	2	/m2	per surface area; pressure = Force/area

The differential between present time vs. the depths of times past makes it "seem" as if the expansion of Space is accelerating.   The truth is: our perception of time slows down at the same rate the "second" grows longer.   The universe and everything in it including ourselves -- our base metrics [meter] [second] [kilogram] [Coulomb] -- these all scale linearly with the "circumference" of the universe.

Here's a rule of Cosmological Relativity: Whenever you see a term in an equation that involves [time^-2], such as c^2 [m2/s2] or acceleration [m/s2], The term [time^-2] is telling us that for each second that goes by, there is a differential of the number of Planck seconds per second.
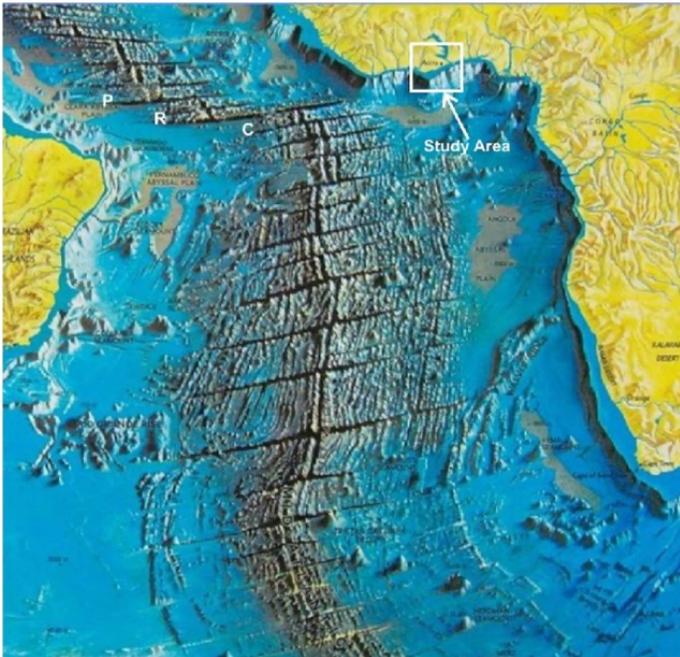
Believe it or not this universal expansion is the root-cause of the whole Earth expanding from within. The atoms nearer Earth's center expand slightly faster than the atoms near the crust tend to expand upward. Therefore, magma underneath mid-Atlantic rife is emerging[W] and creating new crust.

 Another example is Newton's apple. Before it fell the stem of the apple was exerting a force that accelerated the apple upward -- maintaining its height above the ground. When the stem let go of the tree the surface of the Earth, which had been and always is expanding upward at a rate of 9.81 [m/s2] - until the ground hit the bottom of the apple. Then the bruised apple continued its acceleration along with the surface of the ground at this point. The down-to-up z-axis aligning with expanding time represents a time differential vs. the local reference frame's x-y plane of the tangent to the surface of the Earth. While quantum time accumulates square of these values. *(Explained in sections 4.5 - 4.8)*

4.17 Covariant^0th Quantities

Covariant^0: This grey highlighted group have exponents -L-T+M+C+K = 0 . These ratios are constant throughout time. Speed of Light and its value squared are always constant.   Force, in Newtons [kg m/s2] is the ratio of (Mass^1 × Length^1) per Time^2 again, exponents sum to 0. *Surprised, most electric terms fall into this category.*

abbr	-L-T\+M+C+K	dt	units	Length_Time_Mass_Charge_Kelvin
				Most electric quantities are constants
alpha	0 0 0 0 0	0	[]	Fine Structure Constant defines the Dielectric Field
c	1 _1 0 0 0	0	[m/s]	Speed of Light
qkg	0 1 1 0 0	0	[kg s]	quantum-kilogram: m_P*t_P = hBar%c^2
kg s	0 1 1 0 0	0	massTime	1 time quantum of mass = ∫ m_P dt_P
C s	0 1 0 1 0	0	chrgTime	1 time quantum of quantum charge = ∫ e dt_P
momtm	2 _1 1 0 0	0	[J s]	hBar: angular momentum, h: linear momentum
V	2 _2 1 _1 0	0	Volt	Electric Potential

4.18 Covariant^±1st Quantities

The dimensional exponents of various physical quantities are in the column -L-T_M_C_K.   The first 2 rows show dt equals -1 meaning the "values" for Planck Length & Time shrink relative to our metrics for [second] & [meter]. Please understand it is NOT because quantum length and time change -- it is 100% due to the duration of a second & length of a meter growing linearly.

SI units measure length or distances in [meters], time in [seconds], mass in [kilograms], electric charge in [Coulombs], and temperature in absolute [Kelvin]. Note the diagonal of 1s. These 1's say each metric is linear (a 1st order relationship), meaning they ALWAYS scale together, *linearly*. Covariant^1 with the circumference of the universe.

abbr	-L	-T	+M	+C	+K	dt	units	Length_Time_Mass_Charge_Kelvin
								B A S E D I M E N S I O N A L M E T R I C S
l_P	_1	0	0	0	0	_1	meter/l_P	Planck length shrinks as reciprocal of growing meter
t_P	0	_1	0	0	0	_1	sec/t_P	Planck time shrinks as reciprocal of growing second
m	1	0	0	0	0	1	meter	SI unit of length or **distance [l_P/m]**
s	0	1	0	0	0	1	second	SI unit of time
omg	0	1	0	0	0	1	rad/s	ω (omega) frequency [radians/second]
kg	0	0	1	0	0	1	kilogram	m_P, 1 implied second's worth of mass = [(kg s)/s]
C	0	0	0	1	0	1	Coulomb	e, unit of electric Charge = [A s] = [(C/s)*s]
K	0	0	0	0	1	1	Kelvin	T_P Planck Temperature
J	2	_2	1	0	0	1	[J]oule	Energy = mass*c^2
T	0	_2	1	_2	0	1	[T]esla	**Magnetic Flux Density [kg/C2 c2]**
F	_2	2	_1	2	0	1	[F]arad	Capacitance

Covariant^1: When the **sum** of the exponents adds to 1, as in the yellow groups above – all these are linearly covariant with each other.   Meaning that the ratio between our SI unit and the Planck-scale value increases linearly with the circumference of the Universe also growing "linearly" at 2c.   **But what about the "accelerated expansion"?**   Here's where Cosmological Relativity states that the scale factor we apply to space (FLRW equations) should be applied to (the duration of a second/π). As time progresses, we expand out to the next moment of existence wherein time-slows-down as Space~Time 4D-volume increases by a factor^2. The number of particles remain constant because the underlying root-cause "wavicles" and their charge radii and mass confinement radii grow linearly as well.   So, we don't notice the planet beneath our feet and ourselves are growing.

So, Coulombs is awkwardly defined as [Amp][seconds] which expands out to [Coulombs/second] times [seconds].

/kg	0	0	1	0	0	_1	kilogram	m_P, 1 implied second's worth of mass = [(kg s)/s]
Hz	0	_1	0	0	0	_1	[/s]	360 degree rotation = 2π radians
freq	0	_1	0	0	0	_1	Freq	cycles/sec not necessarily sine wave like Hertz waves
Wb	2	_1	1	_1	0	_1	[Wb]Weber	Magnetic Flux

Covariant^-1: The next group (pale green) exponents sum to -1.   Technically, Hz applies to Hertzian "sine" waves, whereas [/s] aka [cycles/second] is more generic (applies to other shaped waveforms & cyclic events).   The important distinction with omega frequency is because, at the quantum-scale, rotations happen in increments of 1-radian (about 57.3°). This is a difficult concept to wrap our heads around. Many quantum-phenomena involve ratios of 2π or 1/2π. On a case-by-case basis it takes time to resolve if this 2π ratio is the ratio of a circumference to radius -OR- it is because a 1-radian rotations vs. a full 360° rotation.

All Constants (Covariant^0) and ($Covariant^{\pm n}$) Physical Quantities

abbr	-L	-T	+M	+C	+K	dt	[units]	Length_Time_Mass_Charge_Kelvin
								B A S E D I M E N S I O N A L M E T R I C S
l_P	_1	0	0	0	0	_1	meter/l_P	Planck length shrinks as reciprocal of growing meter
t_P	0	_1	0	0	0	_1	t_P/sec	Planck time shrinks as reciprocal of growing second
Hz	0	_1	0	0	0	1	[/s]	360-degree rotation = 2π radians
freq	0	_1	0	0	0	_1	Freq	cycles/sec not necessarily sine wave like Hertz waves
Wb	2	_1	1	_1	0	_1	[Wb]Weber	Magnetic Flux
								B A S E D I M E N S I O N A L M E T R I C S
m	1	0	0	0	0	1	meter	SI unit of length or **distance [l_P/m]**
s	0	1	0	0	0	1	second	SI unit of time
omg	0	1	0	0	0	1	rad/s	ω (omega) frequency [radians/second]
kg	0	0	1	0	0	1	kilogram	m_P, 1 implied second's worth of mass = [(kg s)/s]
C	0	0	0	1	0	1	Coulomb	e, unit of electric Charge = [A s] = [(C/s)*s]
K	0	0	0	0	1	1	Kelvin	T_P Planck Temperature
J	2	_2	1	0	0	1	[J]oule	Energy = mass*c^2
Tesla	0	_2	1	_2	0	1	[T]	**Magnetic Flux Density [kg/C2 c2]**
F	_2	2	_1	2	0	1	[F]arad	Capacitance
A	0	_1	0	1	0	2	Ampere	Current = e/second, one second's worth of charge
m2	2	0	0	0	0	2	[m2]	surface area
age	0	2	0	0	0	2	[s2]=age	[age] = accumulation of time = ∫ t_P dt = (1/2)*t^2
N	1	_2	1	0	0	2	[N]	Newton, unit of Force [kg m/s2]
C2	0	0	0	2	0	2	Charge^2	= ∫e dt = 2
S	_2	1	_1	2	0	2	Siemen	Conductance = 1/Resistance
W	2	_3	1	0	0	2	Watt	Power = Joules/second

abbr	-L	-T	+M	+C	+K	dt	[units]	Most electric quantities are constants
								Most electric quantities are constants
alpha	0	0	0	0	0	0	[]	Fine Structure Constant defines quadra-polar EM Field
c	1	_1	0	0	0	0	[m/s]	Speed of Light
qkg	0	1	1	0	0	0	[kg s]	quantum-kilogram: m_P*t_P = hBar%c^2
kg s	0	1	1	0	0	0	massTime	1 time quantum of mass = ∫ m_P dt_P
C s	0	1	0	1	0	0	chrgTime	1 time quantum of quantum charge = ∫ m_P dt_P
momtm	2	_1	1	0	0	0	[J s]	hBar: angular momentum, h: linear momentum
V	2	_2	1	_1	0	0	Volt	Electric Potential
G	3	_2	_1	0	0	_2	[m3/kg s2]	Newton's Gravitation Constant
mu_0	2	_1	1	_2	0	_2	[N/A2]	Resistance = 1/Conductance, i
Ohm	2	_1	1	_2	0	_2	Ohm	Resistance = 1/Conductance, ie. Zo=376.73 Ohms

abbr	-L	-T	+M	+C	+K	dt	[units]	
H	2	0	1	_2	0	_3	[A/m]	[Henries] Magnetic Field Intensity
m3	3	0	0	0	0	_3	[m3]	3D-volume Three spatial dimensions aka (x,y,z)
kg/m3	_3	0	1	0	0	4	[kg/m3]	mass density
Pa	_1	_2	1	0	0	4	[N/m2]	Pascal, unit of pressure

4.19 Covariant^±2nd

Covariant^2: Next, consider this (orange) group below, all having exponents that add to 2. Meaning, that just as pendulums twice as long swing 4-times slower. And ones 3-times longer swing 9 times slower. Pendulums, clocks & Cesium atoms all have oscillations that are "covariant squared". In other words, all clocks slow in lockstep with accumulation of "seconds", the progression of time, herein, "age". Age is the "accumulation of time" Sections 4.3-4.8 explains why it has units of [seconds^2].

Second Order covariant ($Covariant^{\pm 2}$) Physical Quantities

abbr	-L-T +M +C+K	dt	[units]	Length_Time_Mass_Charge_Kelvin
A	0 _1 0 1 0	2	Ampere	Current = e/second, one second's worth of charge
m2	2 0 0 0 0	2	[m2]	surface area
age	0 2 0 0 0	2	[s2]=age	[age] = accumulation of time = ∫ t_P dt = (1/2)*t^2
N	1 _2 1 0 0	2	[N]	Newton, unit of Force [kg m/s2]
C2	0 0 0 1 0	2	Charge^2	= ∫e dt = 2
S	_2 1 _1 2 0	2	Siemen	Conductance = 1/Resistance
W	2 _3 1 0 0	2	Watt	Power = Joules/second

Meters-squared is most easily understood as a surface area. As for momentum, I like to express "Linear Momentum" in equations using **Planck's constant**, h, and express "angular momentum" by **Planck's reduced constant**, hBar.   The full revolution of "h" accommodates the idea of a Poynting vector being the direction of propagation of a ray of light. A light ray is a string of photons = h*c, where angular momentum converts to linear momentum at the speed of light. I use hBar in equations involving mass and its temporal dent spreading out scattered in all directions -- a crude description of quantum gravity.

Values Squared (avoids square root & fractional exponents)

Planck length^2	Planck time^2	Planck mass^2	Planck's 2 constants	elementary Charge^2	Planck Charge^2
$\ell^2 = \dfrac{\hbar G}{c^3}$	$t_\ell^2 = \dfrac{\hbar G}{c^5}$	$m_\ell^2 = \dfrac{hc}{G}$	$h = 2\pi\ell m_\ell c$	$e^2 = \alpha q_\ell^2$	$q_\ell^2 = \dfrac{2h}{Z_o} = \dfrac{m_\ell^2}{c^2}\dfrac{2G}{K_m}$

Note that c, h & hBar have exponents with dt=0 even as the universe expands the ratios that these values represent remain constant. Remember quantum units always = 1. The numeric values we associate with Planck length & Planck time are in emergent units of [meters] & [seconds] it is these metrics which grow with time There is this interplay between [length][time] vs. [mass][Charge]

Quantity	Value digit_T15	relUnc	-L-T +M+C+K	dt	SIunits
G	6.67429232315728e_11	1.9e_16	3 _2 1 0 0	_2	m3/kg s2
K_m	2.00000000108875e_7	0	1 0 1 _2 0	_2	N/A2
l_P	1.61625409490756e_35	1.7e_16	1 0 0 0 0	_1	m
t_P	5.39124334778149e_44	1.8e_16	0 1 0 0 0	_1	s
c	2.99792458000000e8	0	1 _1 0 0 0	0	m/s
h	6.62607015000000e_34	0	2 _1 1 0 0	0	[tP s]
hBar	1.05457181764616e_34	0	2 _1 1 0 0	0	[tP s]
m_P	2.17643559439662e_8	1.5e_16	0 0 1 0 0	1	kg
e	1.60217663400000e_19	0	0 0 0 1 0	1	C
q_P	1.87554603829021e_18	0	0 0 0 1 0	1	C

Covariant^-2: The cyan group, is inverse-square covariance.

abbr	-l-t+M+C+K	dt	[units]	**Length_Time_Mass_Charge_Kelvin**
G	3 _2 _1 0 0	_2	[m3/kg s2]	Newton's Gravitation Constant
mu_0	2 _1 1 _2 0	_2	[N/A2]	Resistance = 1/Conductance, i
Ohm	2 _1 1 _2 0	_2	Ohm	Resistance = 1/Conductance, ie. Zo=376.73 Ohms

What! But conservation of mass is foundational to al of physics.   It still is, but we, herein, are becoming aware that before Newton's apple fell, the stem held the apple to the tree branch. The entire time the upward force on the stem was accelerating the apple upward at the same rate that the whole Earth was expanding -- maintaining its height above the ground.

In the table below the tiny numeric values in the top of each row are "Planck values" expressed in SI units. The bottom number in each row is its reciprocal: 1.616x10^34 [Planck lengths/meter], 1.85x10^43 [Planck times/second]. Turns out Planck mass & Planck Charge are exceptions: ([kg] [second])/[second] 5.33x10^17 ([Coulombs]/[seconds]*[second]) for Planck Charge. As the duration of a "second" grows so do these reciprocal values.   At the current age of the universe the base metric quantities are these values:

do 'l_P 1%l_P t_P 1%t_P degrees=180p_1 hBar e q_P%t_P m_P*t_P hBar%c^2 T_P E_P%k_B'							
Quantity	Value	L_T_M_C_K	dt	SIunits			1 quantum of…
l_P 1%l_P	1.61625409490756e_35 6.18714596393454e34	1 0 0 0 0 _1 0 0 0 0	_1 1	m /m	$l_P = \dfrac{z_0}{c\mu_0} = \sqrt{\hbar G / c^3}$		length
t_P 1%t_P	5.39124334778149e_44 1.85485969653271e43	0 1 0 0 0 0 _1 0 0 0	_1 1	s/rad rad/s	$t_P = \sqrt{\hbar G / c^5}$		time
m_P	2.17643559439662e_8	0 0 1 0 0	1	kg	$m_\ell = \sqrt{\hbar c / G}$		One second's worth of Mass
q_P 1%q_P	1.87554603829021e_18 5.33178060993705e17	0 0 0 1 0 0 1 0 1 0	1 0	C C s	$q_\ell = \dfrac{e}{\sqrt{\alpha}} = \sqrt{2h / Z_0}$		charge
m_P*t_P hBar%c^2	1.17336939201656e_51 1.17336939201656e_51	0 1 1 0 0 0 1 1 0 0	0 0	kg s kg s	$m_\ell t_\ell = \dfrac{\hbar}{c^2} = \sqrt{\hbar c / G}$		1 quantum of Mass-time
deg=180p_1 hBar	57.2957795130823° 1.05457181764616e_34	0 0 0 0 0 2 _1 1 0 0	0 0	1 rad J s	$1\,radian$ $= 360°/2\pi$ $\hbar = h/2\pi = E_\ell t_\ell$		rotation angular mom.
T_P E_P%k_B	1.41678497695729e32 1.41678497695729e32	0 0 0 0 1 0 0 0 0 1	1 1	K K	$T_P = \dfrac{m_\ell c^2}{k_B}$		Temperature

4.20 Covariant^±3rd

Covariant^3: Next Distances can have 3-spatial dimensions, commonly (x,y,z) –accommodating 3D **volume**.

abbr	L__T__M__C_K	dt	units	Length_Time_Mass_Charge_Kelvin
m3	3 0 0 0 0	_3	[m3]	3D-volume Three spatial dimensions aka (x,y,z)

Covariant^-3: The next group (lavender) exponents sum to -3.   The SI unit called [Tesla], [T] is a measure of Magnetic Flux Density.   *This is an advanced subject to be discussed in papers months from now.*

Tesla	0 _2 1 _2 0	1	[T]	Magnetic Flux Density [kg/C2 s2]

Pressure is force per area, making it a natural inverse square. You might think that mass per 3D-volume may be an inverse cube relationship until you come to understand that our ever-expanding "second" means every object has more time to manifest [kg seconds].

For those who study New Age stuff, I suspect that these might map to the 7-Chakkaras.   And, collectively, these might map to 11-dimensions encoding Akashic records.

5   Conclusions

1) What if Newton's Gravitation constant were found to change with the age of the Universe?

   a) In natural units, G = 1 [length^3 mass^-1 time^2] where l-quantum of length, 1-quantum of mass and 1-quantum of time are constantly equal to one.   Here the ONLY thing that matters IS the dimensional exponents.

   b) Contrast THAT with emergent units which expand with time.   The number of Planck seconds/second is always equal to the number of Planck lengths per second, thus ensuring these key ratios $c = l_P/t_P = Z_o/mu_0$.

2) How would that affect our understanding of:

   c) **Cosmic Geometry?** Instead of flat spacetime the cosmos is ever-expanding spherical geometry.

   d) **Dark Energy?** Instead of expansion accelerating -- time (local reference frame) is decelerating. The further OUT we "think" we are looking -- the further back into the depths of times past we are seeing, when everything, relative to "Now", was smaller: atoms, meter sticks, pendulums & planets.   NEW Physics!

   e) **Dark Matter?** The value of G is covariant^-2 & distances are covariant^1st -- flat spacetime does not accounted for this. Dark Matter may be the residual effect of ordinary matter spreading forth as quantum gravity. Much more math and explanations need in a future paper.

3) Which of the so-called Physical Constants are truly constant verses which constantly-change?

   a) 1, e (2.71828), π are constant. Also, ratios of any two quantities that with the same covariance are constant.

   b) Linear expanding metrics (covariant^1st): [meter] and [second] so when we use [meter] to express 1-quantum of length or [second] these values shrink with time (1/time)-- covariant^-1.

   c) [kilograms] & [Coulombs] are gauged by the duration of a [second] they grow covariant with the [second].

   d) All other derived units follow fall into two classes: **quantum-based** and **emergent**.

   Quantum-based: dimensional exponents sum this way: [mass^m]+[Charge^C]-[length^l]-[time^t]

   Emergent: sum this way: [kg^mass] + [Coulombs^C] +[meters^len] + [seconds^time]. (Includes electron~wavicles, other~wavicles, and objects made from atoms . For all these objects expand with time.

6 Acknowledgements

7 Appendix

How quickly does the Prime Constant and Fine-Structure Constant converge? The number n in the left column is an integer count of number of primes the 2nd column is the time quanta since The Beginning.

```
              After just 199 time-quanta since the beginning of time we arrive at
              the 46th prime number yielding 63-digits of precision for the Prime  Constant.
     __n__ 1st, 2nd, 3rd,... Ordinal position of each prime number.
    /      _____
   |   /       n'th prime                      ((+&1,. p:) i.50); <fmtDec PrimeConst_f 50
 ┌─────────────────────────────────────────────────────────────────────────────────────────────┐
  1     2│ 0.250`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`0
  2     3│ 0.375`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`0
  3     5│ 0.406`250`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`0
  4     7│ 0.414`062`500`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`0
  5    11│ 0.414`550`781`250`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`0
  6    13│ 0.414`672`851`562`500`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`0
  7    17│ 0.414`680`480`957`031`250`000`000`000`000`000`000`000`000`000`000`000`000`000`000`000`0
  8    19│ 0.414`682`388`305`664`062`500`000`000`000`000`000`000`000`000`000`000`000`000`000`000`0
  9    23│ 0.414`682`507`514`953`613`281`250`000`000`000`000`000`000`000`000`000`000`000`000`000`0
 10    29│ 0.414`682`509`377`598`762`512`207`031`250`000`000`000`000`000`000`000`000`000`000`000`0
 11    31│ 0.414`682`509`843`260`049`819`946`289`062`500`000`000`000`000`000`000`000`000`000`000`0
 12    37│ 0.414`682`509`850`536`007`434`129`714`965`820`312`500`000`000`000`000`000`000`000`000`0
 13    41│ 0.414`682`509`850`990`754`785`016`179`084`777`832`031`250`000`000`000`000`000`000`000`0
 14    43│ 0.414`682`509`851`104`441`622`737`795`114`517`211`914`062`500`000`000`000`000`000`000`0
 15    47│ 0.414`682`509`851`111`547`050`095`396`116`375`923`156`738`281`250`000`000`000`000`000`0
 16    53│ 0.414`682`509`851`111`658`072`397`858`632`029`965`519`905`090`332`031`250`000`000`000`0
 17    59│ 0.414`682`509`851`111`659`807`121`334`608`837`059`931`829`571`723`937`988`281`250`0
 18    61│ 0.414`682`509`851`111`660`240`802`203`603`038`833`534`810`692`071`914`672`851`562`5
 19    67│ 0.414`682`509`851`111`660`247`578`467`181`073`236`247`357`272`077`351`808`547`973`6
 20    71│ 0.414`682`509`851`111`660`248`001`983`654`700`386`416`891`433`327`691`629`528`999`3
 21    73│ 0.414`682`509`851`111`660`248`107`862`773`107`173`959`274`973`640`276`584`774`255`7
 22    79│ 0.414`682`509`851`111`660`248`109`517`134`332`280`014`624`716`457`660`724`699`962`8
 23    83│ 0.414`682`509`851`111`660`248`109`620`531`908`849`143`084`075`383`747`233`445`319`5
 24    89│ 0.414`682`509`851`111`660`248`109`622`147`495`983`035`716`252`866`967`335`144`465`7
 25    97│ 0.414`682`509`851`111`660`248`109`622`153`806`870`277`484`347`310`261`163`666`728`0
 26   101│ 0.414`682`509`851`111`660`248`109`622`154`201`300`730`094`853`212`967`027`949`369`4
 27   103│ 0.414`682`509`851`111`660`248`109`622`154`299`908`343`247`479`688`643`494`020`029`8
 28   107│ 0.414`682`509`851`111`660`248`109`622`154`306`071`319`069`518`843`373`273`149`446`0
 29   109│ 0.414`682`509`851`111`660`248`109`622`154`307`612`063`025`028`632`055`717`931`800`1
 30   113│ 0.414`682`509`851`111`660`248`109`622`154`307`708`359`522`247`993`848`370`730`697`2
 31   127│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`399`719`747`959`808`270`540`9
 32   131│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`767`061`732`591`773`116`781`1
 33   137│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`772`801`451`101`647`567`503`6
 34   139│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`236`380`729`116`180`184`3
 35   149│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`237`782`027`580`505`001`3
 36   151│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`238`132`352`196`586`205`6
 37   157│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`238`137`826`018`712`474`4
 38   163│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`238`137`911`547`183`197`4
 39   167│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`238`137`916`892`712`617`6
 40   173│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`238`137`916`976`236`514`8
 41   179│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`238`137`916`977`541`575`6
 42   181│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`238`137`916`977`867`840`9
 43   191│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`238`137`916`977`868`159`5
 44   193│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`238`137`916`977`868`239`1
 45   197│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`238`137`916`977`868`244`1
 46   199│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`238`137`916`977`868`245`4
 47   211│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`238`137`916`977`868`245`4
 48   223│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`238`137`916`977`868`245`4
 49   227│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`238`137`916`977`868`245`4
 50   229│ 0.414`682`509`851`111`660`248`109`622`154`307`708`365`774`238`137`916`977`868`245`4
  ^     ^│ '''!'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|
  |     |│     0   -3   -6   -9  -12 -15 -18 -21 -24 -27 -30 -33 -36 -39 -42 -45 -48 -51 -54 -57 -60
 └──│──┘
    |     \_The_n'th_prime_number___
    \_n__
```

This table shows it took 199 time-quantum for 1/alpha to converge to 63-digits of precision...

```
((+&1,. p:) i.50); fmtDec precSqrt ((137x^2)+(30x*(5+PrimeConst_f 50))%(_8+59x*PrimeConst_f 50))
```

```
 1    2| 137.085`131`700`463`173`656`246`772`980`623`296`616`455`735`649`718`660`049`694`915`1
 2    3| 137.041`657`641`767`964`069`285`625`508`330`792`640`331`896`197`988`342`747`989`250`3
 3    5| 137.037`062`708`498`660`118`633`312`972`872`510`991`364`823`025`608`581`622`937`793`6
 4    7| 137.036`075`094`546`242`537`995`699`752`068`348`100`199`376`895`469`200`062`012`350`8
 5   11| 137.036`015`205`186`935`983`007`739`661`458`143`346`258`132`998`501`088`316`297`478`2
 6   13| 137.036`000`265`587`774`176`985`455`876`815`369`966`717`795`602`962`394`296`156`004`6
 7   17| 137.035`999`332`296`700`782`431`643`163`098`359`620`983`928`062`378`838`163`765`143`4
 8   19| 137.035`999`098`981`904`302`293`915`122`471`696`744`372`086`421`417`060`353`095`433`0
 9   23| 137.035`999`084`399`835`395`001`169`583`023`595`427`514`333`816`436`656`510`742`180`0
10   29| 137.035`999`084`171`990`667`153`944`367`083`251`615`582`306`706`547`158`816`328`883`1
11   31| 137.035`999`084`115`029`485`667`278`355`888`535`587`364`925`500`151`829`170`778`133`9
12   37| 137.035`999`084`114`139`467`208`057`213`075`578`592`055`360`388`321`716`747`328`732`9
13   41| 137.035`999`084`114`083`841`054`357`432`288`672`616`909`626`694`071`338`558`602`477`7
14   43| 137.035`999`084`114`069`934`515`932`515`412`514`207`567`377`256`310`050`169`589`160`8
15   47| 137.035`999`084`114`069`065`357`280`958`483`886`851`854`235`418`815`446`765`990`685`3
16   53| 137.035`999`084`114`069`051`776`677`027`907`228`161`200`522`898`131`425`529`026`128`5
17   59| 137.035`999`084`114`069`051`564`480`091`491`967`954`879`707`884`456`540`196`122`701`5
18   61| 137.035`999`084`114`069`051`511`430`857`388`152`903`711`622`637`020`803`323`172`748`6
19   67| 137.035`999`084`114`069`051`510`601`963`105`280`793`538`429`298`334`741`711`374`174`2
20   71| 137.035`999`084`114`069`051`510`550`157`212`601`286`652`606`050`958`100`064`375`120`6
21   73| 137.035`999`084`114`069`051`510`537`205`739`431`409`931`150`263`678`116`807`105`841`8
22   79| 137.035`999`084`114`069`051`510`537`003`372`663`130`607`377`517`079`829`545`031`381`9
23   83| 137.035`999`084`114`069`051`510`536`990`724`740`113`149`641`720`417`516`240`316`238`2
24   89| 137.035`999`084`114`069`051`510`536`990`527`116`316`001`864`598`594`667`669`280`875`4
25   97| 137.035`999`084`114`069`051`510`536`990`526`344`348`044`256`094`212`547`167`054`754`1
26  101| 137.035`999`084`114`069`051`510`536`990`526`296`100`046`905`562`688`664`635`665`622`7
27  103| 137.035`999`084`114`069`051`510`536`990`526`284`038`047`567`929`807`694`002`818`339`9
28  107| 137.035`999`084`114`069`051`510`536`990`526`283`284`172`609`327`752`633`338`265`384`7
29  109| 137.035`999`084`114`069`051`510`536`990`526`283`095`703`869`677`238`868`172`127`145`9
30  113| 137.035`999`084`114`069`051`510`536`990`526`283`083`924`573`449`081`757`849`243`506`0
31  127| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`854`497`895`957`244`365`400`3
32  131| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`809`563`446`844`706`560`518`7
33  137| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`861`346`077`323`157`317`4
34  139| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`820`885`477`306`517`1
35  149| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`649`474`157`144`553`4
36  151| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`606`621`327`104`062`5
37  157| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`605`951`751`634`679`8
38  163| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`605`941`289`517`970`7
39  167| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`605`940`635`635`676`4
40  173| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`605`940`625`418`765`5
41  179| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`605`940`625`259`126`3
42  181| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`605`940`625`219`216`5
43  191| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`605`940`625`219`177`5
44  193| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`605`940`625`219`167`8
45  197| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`605`940`625`219`167`2
46  199| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`605`940`625`219`167`0
47  211| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`605`940`625`219`167`0
48  223| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`605`940`625`219`167`0
49  227| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`605`940`625`219`167`0
50  229| 137.035`999`084`114`069`051`510`536`990`526`283`083`923`808`685`605`940`625`219`167`0
^    ^ |'''!'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|''
|    |      0  -3  -6  -9 -12 -15 -18 -21 -24 -27 -30 -33 -36 -39 -42 -45 -48 -51 -54 -57 -60
|____|
|    \_The_n'th_prime_number___
\_n_
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