

Abstract

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

Goals: (0) What is the true nature of time? (1) Can Quantum Field Theory 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 wrapped around an ever-expanding Event Horizon. Adding quantum-thin layers to the Black Whole that we call our universe. Quantum time is the radial polar coordinate. These holographic Cosmic Onion layers remember the where & when of each quantum event. 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 compiled a database of physics equations, rearranging them 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 [time²].

Cosmological Relativity unifies Special and General Relativity with QFT 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 Flow, and anomalies in the Cosmic Microwave Background. All this is the foundation to resolve Dark Matter & to build a theory of Quantum Gravity. I propose the blue-highlighted calculations herein for CODATA 2024 dataset.

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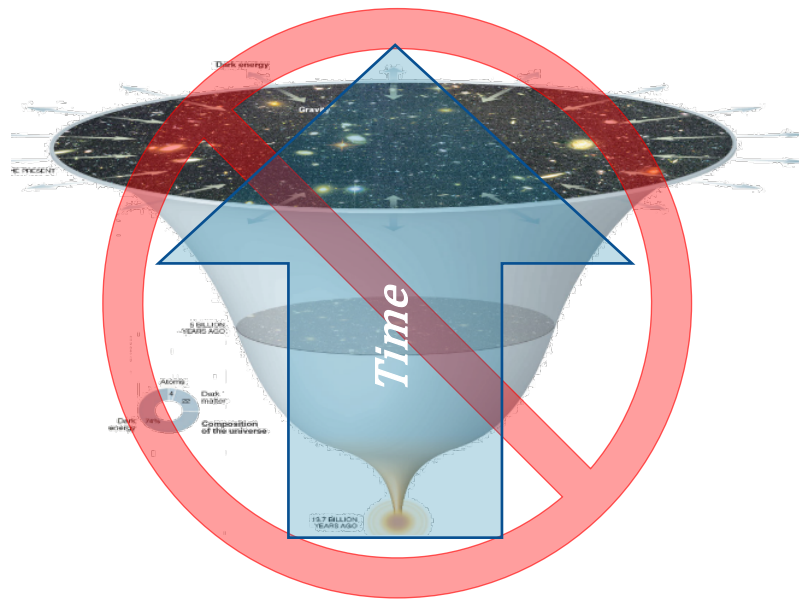
We cannot solve our problems with the same thinking that created them. -- Albert Einstein

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: $\Delta[\text{Planck seconds}]/\text{second} = 0$	Re Table 1.5, duration of each passing second increases by $4.270933837648590741225e25$ [Planck seconds/second ²]
Conversion factor from time to space is c , speed of light.	Time to space conversion factor is c/π .
If Space were truly flat, it would be infinite in extent. Light cone would be 45° slope.	Space is finite. Light cone slope= $\arctan(1/\pi)=17.656787^\circ$ and curves around the hyper-spherical universe.

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

"If we were placing bets on the ultimate geometry of our universe and the question of the finiteness of space, the smart money would probably bet that it is finite."

-- Lawrence Krauss *"The Edge of Knowledge: Unsolved Mysteries of the Universe."*^D

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] $H_0 = (67.3 \pm 1.2) \text{ km s}^{-1} \text{ Mpc}^{-1}$ & $\Omega_m = 0.315 \pm 0.017$, 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 Λ CDM models fit observations. Their "EQUATIONS" need 95% fudge factors. I say the universe does NOT need any fudge factors. 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?

This superb logarithmic scale illustration shows our Earthbound perspective looking out in all directions. The further from our center perspective the more distant, smaller, dimmer and more redshifted those objects "appear" to be.

Beyond the most distant galaxies around the outer most edge is the Cosmic Microwave Background (CMB) with $z=1089.9 \pm 0.9$.^E

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 -- looking into the depths of times past.



Image credit: Pablo Carlos / Wikipedia

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.

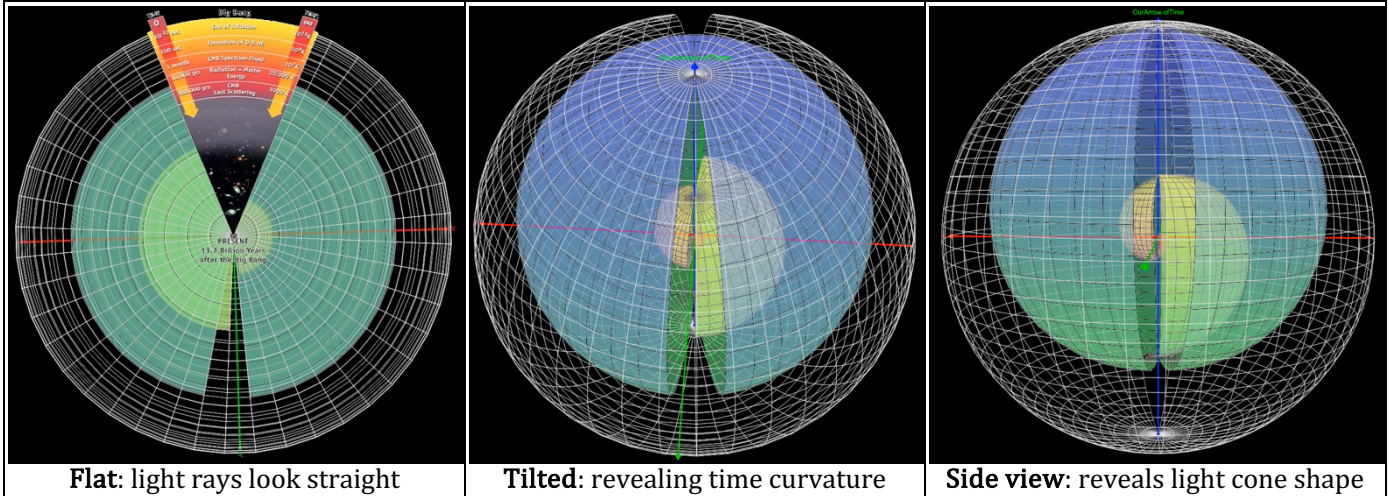
So many equations contain the speed of light squared, c^2 [meters²/second²] this becomes $[\Delta \text{ area}]/[(\Delta \text{ Planck second})/\text{second}]$ - this describes the local reference frame spreading forth its surface area while the number of Planck seconds -- per each passing second -- increases linearly with the age of the universe. (Covariant^{1st}).

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

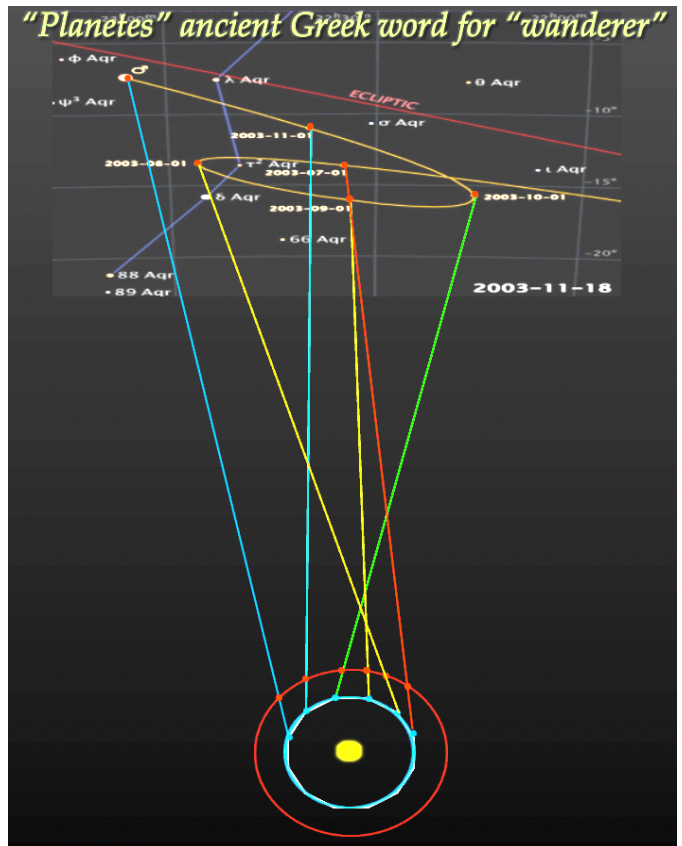
1.1 Higher Perspective is the Key to Understanding



Note the left image above 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.

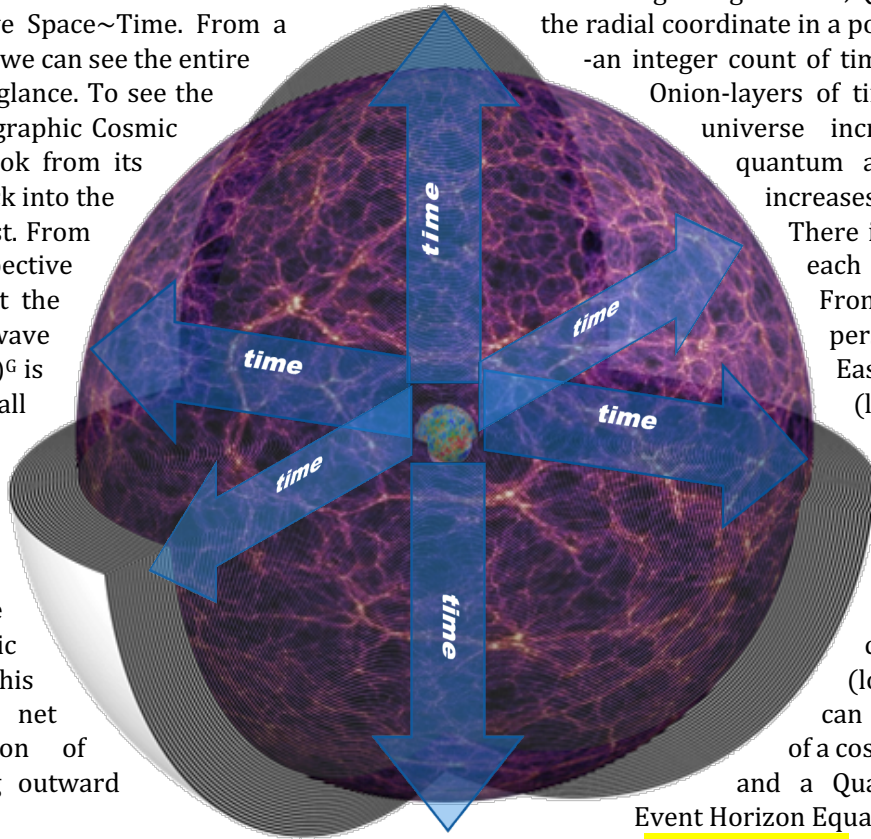
To understand a system, it's best to adopt an outside perspective not influenced by the observer's reference frame. Copernicus, Kepler, Galileo, and other pioneers did this when they "envisioned" the Solar System from above and discovered that "retrograde motion" was an **illusion**, as shown in this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



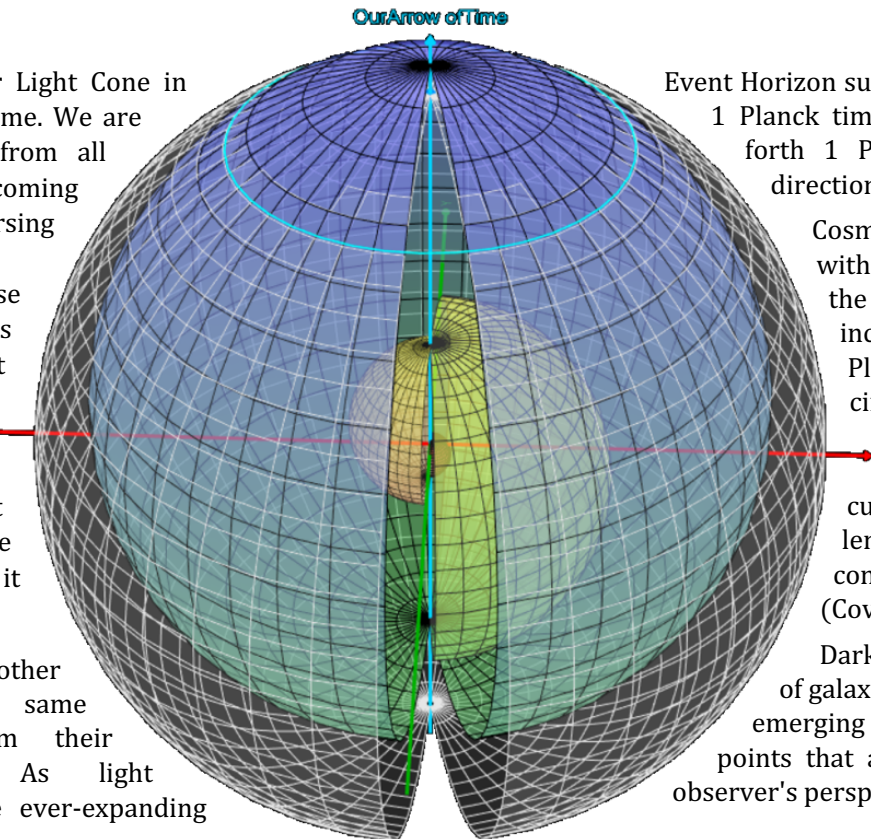
Spherical Geometry: FLRW-metric's 4th option: *Constantly changing positive curvature.*

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^F (CMB)^G 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, holographic 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 Quantum Mirror Cosmic Event Horizon 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.



Event Horizon surface, photons step out 1 Planck time & then they spread forth 1 Planck length in each direction.

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



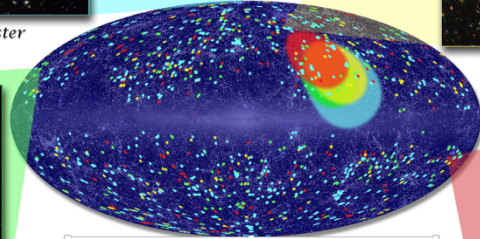
Abell 1689



Abell 667



Abell 520



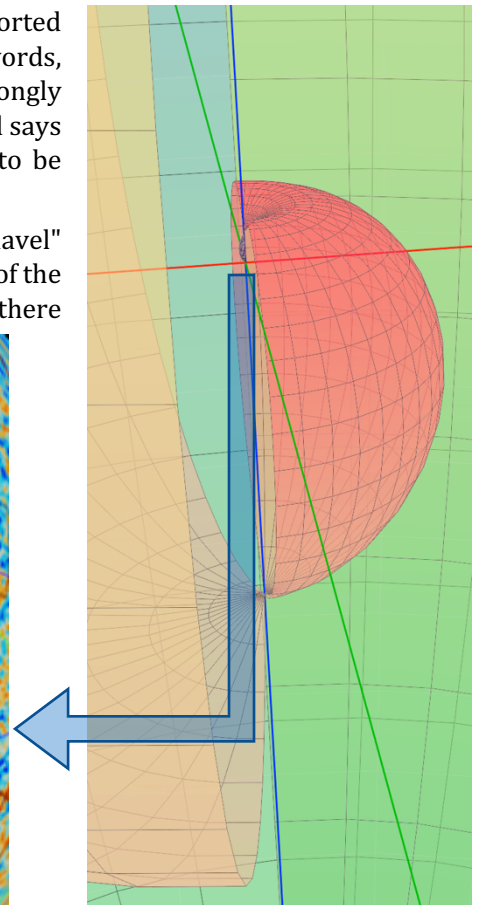
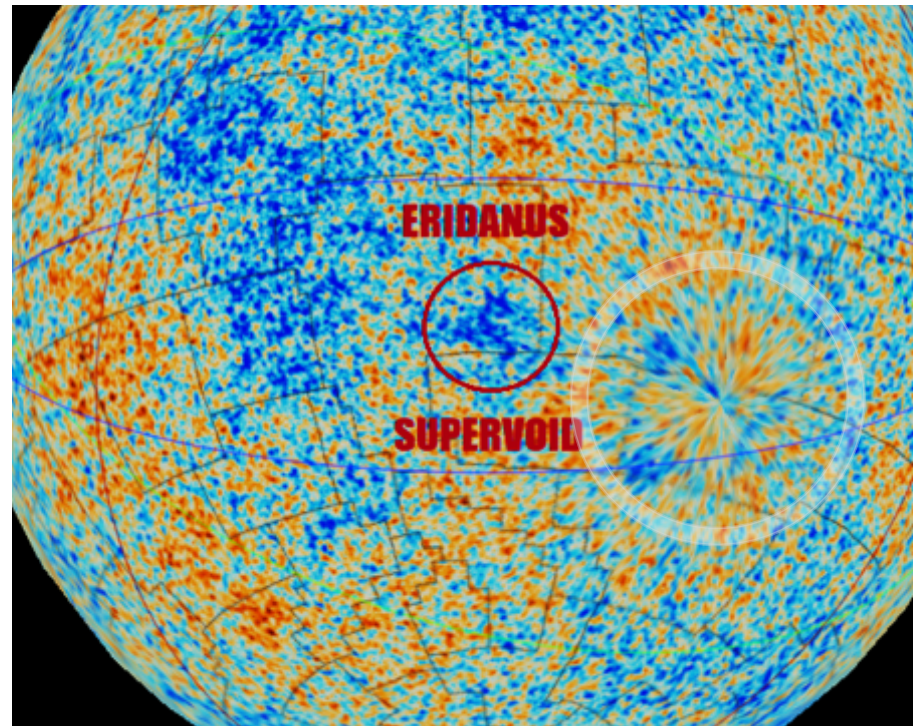
Billions of Light Years	π	Cluster
0.8 - 1.25	$\sqrt{0.5\pi}$	Coma
1.2 - 1.77	$\sqrt{\pi}$	Abell 667
1.3 - 2.17	$\sqrt{1.5\pi}$	Abell 1689
1.3 - 2.50	$\sqrt{2\pi}$	Abell 520

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:..."^H 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

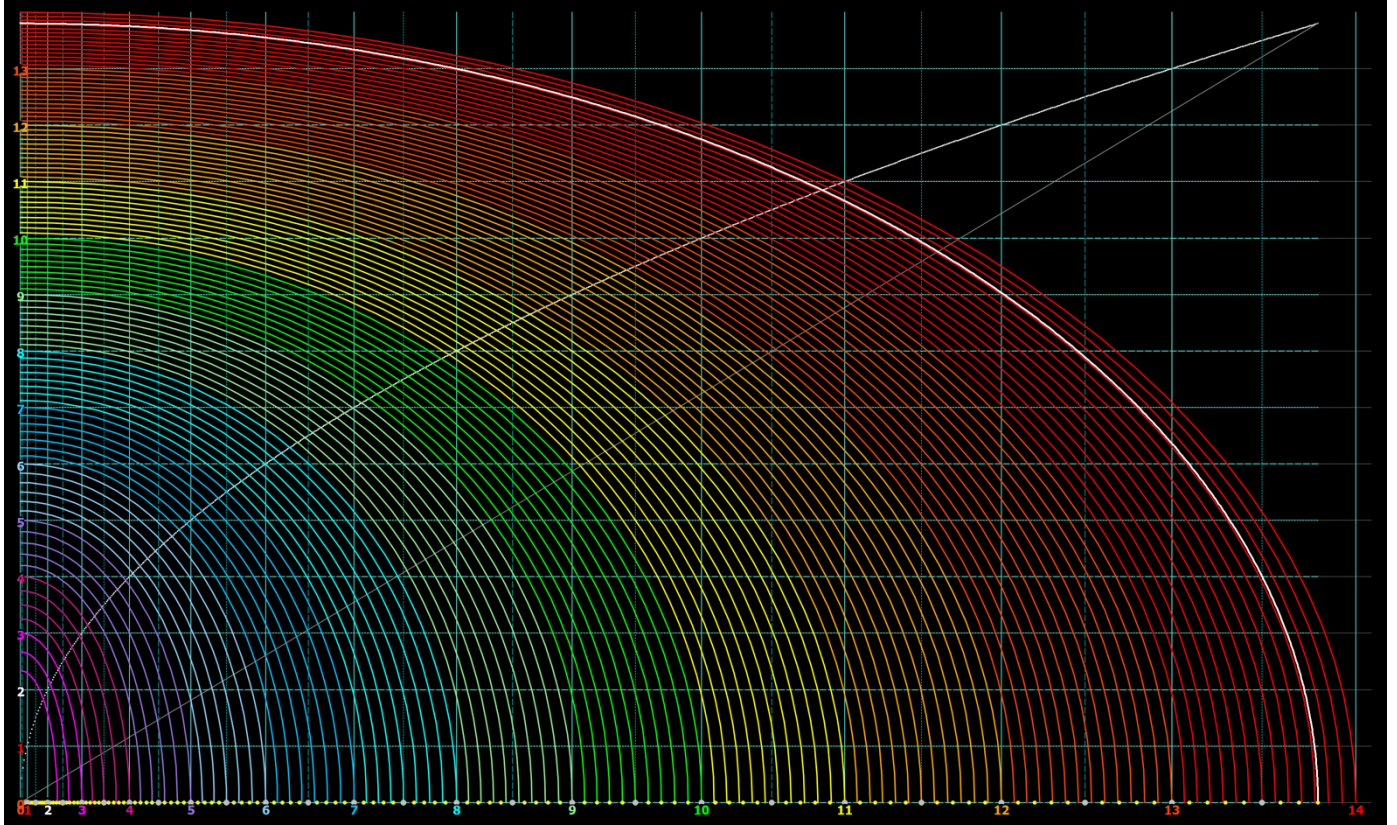


should be a similar navel on the opposite side of this sphere. If not, then Cosmological Lensing creates this belly button! ;-)

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 we experience the tick-tock of each Earth second -- 60 times per minute and 60 minutes/hour thus in 24 hours we experience 86,400 seconds per day. Each Earth orbit defines the **sidereal**

year as 31,558,149.54 seconds. Multiply by 100×10^6 we get the idea that each arc is about 3.1558×10^{15} seconds. This illustration's vertical axis shows linear time as **evenly spaced** numbers -- each one counts off another billion years.



At the "current age" of the universe the duration of a Planck time (aka a Planck second) is this inconceivably tiny 5.39124×10^{-44} th of a second -- its reciprocal called the Planck frequency, ω_P , pronounced "omega sub-P", is 1.85486×10^{43} Planck seconds per second. "Why so big?" The astonishing answer is "It *grew* to be this big!"

The horizontal axis represents our "*perception*" of accelerating expansion -- where the root cause is an ever-increasing number of Planck times per second. Cosmological Relativity brings us awareness that the whole universe and everything expands including the duration of each passing second being 4.27×10^{25} Planck seconds longer than the previous one. Each **dot** along the bottom axis represents 100-million

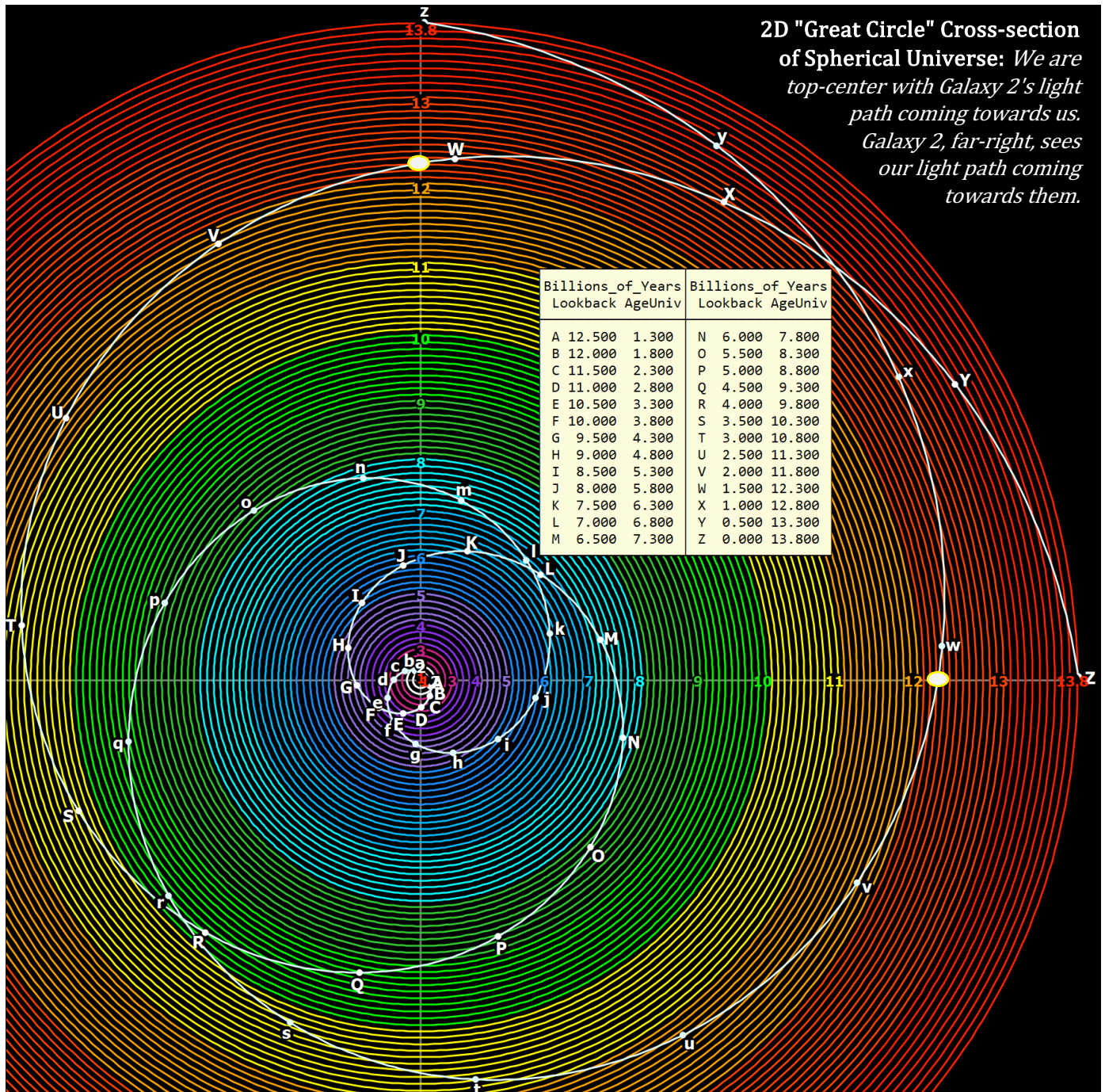
years -- thus 10 dots per billion. Each colored arc represents 1.3478×10^{41} Planck seconds per 100-million years.

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 adds about 1.348×10^{41} Planck seconds to each Earth second.

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:

$$\frac{1}{2}\tau^2 = \int \tau d\tau$$

The next page takes this linear time to accelerating expansion mapping 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.

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. Each passing half-billion years increases by 6.74×10^{41} Planck seconds. **IMPORTANT DISTINCTION:** what's perceived as straight line-of-sight "through space" experiences *curvature* around the "time dimension" -- do not take this spatial vs. temporal curvature lightly. *The lack of this understanding has persisted the flat universe fallacy.*

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 1.85×10^{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 4.27×10^{25} Planck seconds shorter than the current second and the next second will be 4.27×10^{25} Planck

seconds longer, thanks to the introduction of Expanding Space~Time. As you realize the first second of this universe was only 4.27×10^{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 4.0278×10^{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 equal to 1. The speed of light is 1 quantum of length per 1 quantum of time. In 2024 SI units, $c = 299,792,459$ [meters/second]. See **Sections 1.5 & 3.1** for further discussion of this 1st Principles topic.

1.4 Physical Constants vs. covariant Properties

Amperes is NOT a true "fundamental" dimensional metric because it is a ratio of fundamental 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 $1/t_P$.

As for mass our [kilogram] "invisibly implies" a per second. This is very awkward. Many physicists who are attached to old school thinking 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 having spatial & 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.

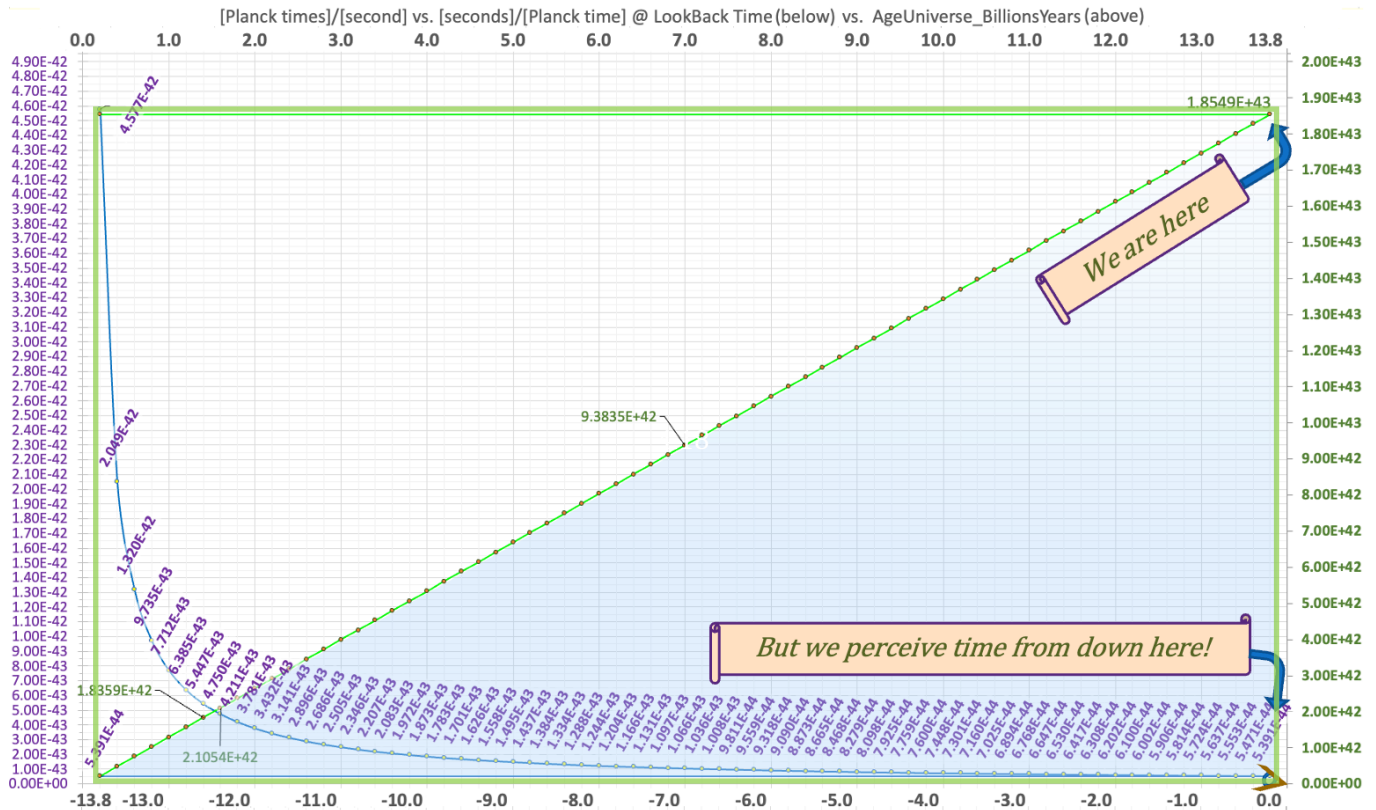
For those of you who want the fast track to the Cosmic Onion Model and Cosmological Relativity I've highlighted key sections in yellow -- these have the essentials to quickly comprehend this new cosmological paradigm.

Many chapters before I can adequately explain the Singularity & the Quantum Mirror Cosmic Event Horizon Equation. 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 (hyper-time~space where non-locality exists). It is going to be difficult. You will have to set aside existing preconceptions and consciously engage your brain every step of the way -- to build a new neural net of understanding.

*"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	/s ²	0 _2 0 0 0	2	2nd diff. Planck times/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 5.39×10^{-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 1.85×10^{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 4.34×10^{17} seconds and multiply that by ω_P we get cosmic age of 8×10^{60} Planck times -- the rectangular, green-bordered area. This is the assumption of flat spacetime. However, the triangle has half that area. It represents 4×10^{60} 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 1.85×10^{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 4.27×10^{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 4.27×10^{25} quantum-time 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. *If this did not boggle your mind, reread it until it does.*

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 Quantum Gravity: how physical holograms acquire mass.

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]	Planck's 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
$\ell = \sqrt{\hbar G / c^3}$	$t_\ell = \sqrt{\hbar G / c^5}$	$\hbar = m_\ell \ell c$ $h = 2\pi \hbar$	$m_\ell = \sqrt{\hbar c / G}$	$T_P = \frac{m_\ell c^2}{k_B}$	$e = q_\ell \sqrt{\alpha}$	$q_\ell = \sqrt{2h / Z_0}$
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 Planck time. Why so BIG? These grew over the last 13.762 billion years. The first [second] of this universe took only $4.270933837389 \times 10^{25}$ time-quanta. Each subsequent second took that many more time quanta than the

previous second. The age of the universe from Earth's perspective is $4.34298391676 \times 10^{17}$ seconds.

Planck's Constant is a constant throughout time -- explanation in Section 4.16. 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 an "implied per second" within its definition. Section 4.18 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. J is ideal for exploring problems that are not yet clearly understood. My program 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 1.0×10^{-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 Quantum Gravity.

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 2022-August-03, 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, honestly, I cannot, current limit is 10-digits:

$$G = 6.674\ 292\ 323 \times 10^{-11} \text{ [m}^3\text{/kg s}^2\text{]} \text{ Covariant}^{-2}.$$

Section 3.3 explains the calibration constraints -- why the current limit is about 10 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 covariant². (Section 4.17) 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 4.27×10^{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^{3/4}th miles**.

$$c = \frac{299,792,458 \text{ [meters]}}{1 \text{ [second]}} = \frac{17,314.51581766 \text{ [meters]}}{1/17,314.51581766 \text{ [second]}} = \frac{\ell}{t_\ell} = \frac{Z_0[\text{Ohms}]}{\mu_0[\text{N}/\text{A}^2]} = \frac{1}{\epsilon_0[\text{F}/\text{m}]Z_0[\text{Ohms}]} \quad (1.9)$$

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 **1/8,657th** of a second. A speaker vibrating at this frequency would enable us to relate **that** distance to an *audible frequency* within the grasp of human hearing. Imagine your eardrum oscillating in-n-out in sync with the laser pulse from us to the far tower and back again.

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



At the current age of the universe, 17,314 meters is 1.07×10^{39} times the current Planck Length.

Likewise, $1/17,314^{\text{th}}$ of a second is 1.07×10^{39} times the Planck time.

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 second. 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].

In table 2.1 quantities where the dimensional exponents for (mass+charge) *minus* (length+time)=an integer. When column dt=0 the value is truly constant throughout time. When that value is 1 -- its value grows linearly.

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 CODATA 2018 values.** Green values are defined by CODATA 2019 as exact and are the basis to calibrate [meters], [seconds], [kilograms] and [Coulombs]. α is ascribed uncertainty = $0.5e_{-16}$ to account for double precision floating point limit.

Cyan highlighted quantities, throughout this document, are my proposed values for the CODATA 2022 dataset.

Quantity	Value	digit ₋₁₆	relUnc	-L-T+M+C+K	dt	SIunits	These values are my proposed CODATA 2024 values.
c	299,792,459.000		0	1 -1 0 0 0 0	0	m/s	
Cs133	9,192,631,777.000		1e ₋₁₄	0 0 0 0 0 0	0	Hz	Cs133: new hyperfine spectral line of Cesium 133
h	6.626070150000000e ₋₃₄		0	2 -1 1 0 0 0	0	J s	h: Planck’s Constant &
hBar	1.054571817646156e ₋₃₄		0	2 -1 1 0 0 0	0	J s	hBar: his reduced constant
alpha_2018	7.297352569300000e ₋₃		1.5e ₋₁₀	0 0 0 0 0 0	0	dimensionless	alpha: Fine Structure Constant
alpha	7.297352569277727e ₋₃		0.5e ₋₁₆	0 0 0 0 0 0	0	dimensionless	V_P: Planck Voltage
1/alpha	137.035999084114		0.5e ₋₁₆	0 0 0 0 0 0	0	dimensionless	l_P: Planck length
V_P	1.220890832760388e ₂₈		3.1e ₋₁₆	2 -2 1 -1 0 0	0	Volts	t_P: Planck time
e	1.602176634000000e ₋₁₉		1.5e ₋₁₆	0 0 0 1 0 1	1	C	e: Fundamental Charge
q_P	1.875546037779709e ₋₁₈		1.5e ₋₁₆	0 0 0 1 0 1	1	C	q_P: Planck Charge
m_P2018	2.176434000000000e ₈		1.1e ₋₅	0 0 1 0 0 0	1	kg	m_P: Planck mass
m_P	2.176435583506902e ₈		2.4e ₋₁₆	0 0 1 0 0 0	1	kg	G: Newton’s Gravitation~constant
l_P2018	1.616253000000000e ₋₃₅		1.1e ₋₅	1 0 0 0 0 0	-1	m	Zo: Zo, Impedance of Free Space
l_P	1.616254094907563e ₋₃₅		1.9e ₋₁₂	1 0 0 0 0 0	-1	m	Z_P: Planck Impedance
t_P2018	5.391247000000000e ₋₄₄		1.1e ₋₅	0 1 0 0 0 0	-1	s	K_m: K _m , Magnetic force const.
t_P	5.391243347781494e ₋₄₄		3.7e ₋₁₆	0 1 0 0 0 0	-1	s	mu_0: μ ₀ , Magnetic Permeability
G_2018	6.674300000000000e ₋₁₁		2.2e ₋₅	3 -2 -1 0 0 0	-2	m ³ /kg s ²	K_e: K _e , Electric force constant
G	6.674292323157284e ₋₁₁		5.8e ₋₁₆	3 -2 -1 0 0 0	-2	m ³ /kg s ²	eps_0: ε ₀ , Electric Permittivity
Zo_2018	376.730313668000		1.5e ₋₁₀	2 -1 1 -2 0 0	-2	Ohm	
Zo	376.7303136668541		3.0e ₋₁₆	2 -1 1 -2 0 0	-2	Ohm	
Z_P	29.997924581632002		3.0e ₋₁₆	2 -1 1 -2 0 0	-2	Z_P	
K_m	2.00000001088755e ₋₇		4e ₋₁₆	1 0 1 -2 0 0	-2	N/A ²	
mu_0	1.256637057928312e ₋₆		2.7e ₋₁₆	1 0 1 -2 0 0	-2	N/A ²	
K_e	8.987551792260796e ⁹		3.4e ₋₁₆	3 -2 1 -2 0 0	-2	m/F	
eps_0	8.854187812800372e ₋₁₂		2.9e ₋₁₆	-3 2 -1 2 0 0	2	F/m	

Calibration Note future measurements: gauged against these numbers will tell us which day (between 2015 & 2020) these exact values matched reality -- higher power ratios will help the most.

Note dt column: 0 means truly constant throughout time. dt=1 values grow linearly, whereas -1 (negative 1st power) values shrink as the reciprocal of our linear time perceptions.

Likewise, ±2nd power growth and its inverse change more rapidly.

Future Measurements should include: (1) date-time stamp, (2) longitude, latitude & (3) elevation.

These factors in: (1) Cosmological Relativity, (2&3) Special & General Relativity

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.

$$\ell = \frac{1}{2}(\ell_{2018} + t_{2018}c_{2024}) \quad t_\ell = \frac{1}{2}\left(t_{2018} + \frac{\ell_{2018}}{c_{2024}}\right) \quad (0) \quad (a,b)$$

Quantity	Value	digit _T 16	relUnc	L_T\M_C_K	dt	SIunits	
l_P2018	1.6162530000000000e_35	16	1.1e_5	1 0 0 0 0	_1	m	2018 values get adjusted by these factors...
l_P	1.616254097603186e_35	16	2.0e_14	1 0 0 0 0	_1	m	
t_P2018	5.3912470000000000e_44	16	1.1e_5	0 1 0 0 0	_1	s	
t_P	5.391243338789874e_44	16	1.4e_14	0 1 0 0 0	_1	s	
l_P%l_P2018	1.000000679224573		1.1e_5	0 0 0 0 0	0		←l_P2018 times this
t_P2018%t_P	1.000000679103112		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 ratio's of 2018 values – ensuring an exact ratio of 299,792,459. 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) and correlated the uncertainty of the electron's mass, charge radius & Bohr radius these have a relative uncertainty of 1.9e-12. So, I plugged 1.9e-12 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. Twelve formulae that "should" all compute c, exactly.

$$c = \frac{\ell}{t_\ell} = \frac{Z_0}{\mu_0} = \frac{1}{\epsilon_0 Z_0} = G \frac{m_\ell^2}{\hbar} = \frac{\hbar}{\ell m_\ell} = \frac{2\hbar}{K_m q_\ell^2} = \frac{2\alpha h}{\mu_0 e^2} = \sqrt{\frac{K_e}{K_m}} = \sqrt{\frac{1}{\epsilon_0 \mu_0}} = \sqrt{\frac{G}{K_\theta}} = \sqrt{\frac{E_\ell}{m_\ell}} = \sqrt{\frac{eV_\ell}{m_\ell}} \quad (3) \quad a-l$$

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 exponents:	
CODATA2018	digit _T 15	relUnc	John Wsol	digit _T 15	relUnc	Formula	Length Time Mass Charge Kelvin When exponents M+C+K-L-T = 0 then the quantity is truly constant throughout time.
299792051.856568	1.6e_5	299792459.000000	5e_16	l_P/t_P			
299792458.000912	2.1e_10	299792459.000000	4.2e_16	Z_0/μ_0			
299792457.999088	1.5e_10	299792459.000000	5.2e_16	1/ε_0*Z_0			
299792363.621083	3.1e_5	299792459.000000	7.8e_16	G*(m_P^2)/hBar			
299792880.782664	1.6e_5	299792459.000000	5.1e_16	hBar/l_P*m_P			
299792458.000912	1.5e_10	299792459.000000	5.6e_16	2*hBar/K_m*(q_P^2)			
297924589.000916	2.1e_10	299792459.000000	5.7e_16	2*α*h/μ_0*e^2			
299792458.000000	3e_16	299792459.000000	3e_16	√(K_e/K_m)			
299792458.000000	7.5e_11	299792459.000000	2.2e_16	√(1/ε_0*μ_0)			
299792458.036275	7.8e_6	299792459.000000	3.6e_16	√(G/K_Theta)			
299792458.009069	1.6e_5	299792459.000000	2.4e_16	√(E_P/m_P)			
299792567.823274	5.5e_6	299792459.000000	2.3e_16	√(e*V_P/m_P)			

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

(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 the 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 4×10^{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 / CODATA 2018 / 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`084
 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

$$\alpha^{-1} = \frac{1}{a} = \sqrt{137^2 + \frac{30(\text{PrimeConst} + 5)}{59\text{PrimeConst} - 8}} \tag{3.1} \tag{a}$$

$$\alpha = \left(\frac{e}{q_e}\right)^2 = \frac{e^2 Z_0}{2h} = \frac{e^2 \mu_0 c}{2h} = \frac{e^2 K_m c}{2h} = \frac{e^2 K_e}{\hbar c} = \frac{e^2}{2\epsilon_0 h c} = \frac{Z_0}{4G_0} = \sqrt{\frac{2R_\infty}{cm_e}} \tag{3.1} \tag{b-i}$$

alpha	dimensionless	-1-t+M+C+K: 0 0 0 0 0	dt=0	Fine Structure Constant
CODATA2018 digit ₁₅	relUnc	JohnWsol digit ₁₅	relUnc	Formula
7.29735256930000e_3 7.29735256927773e_3	1.5e_10	7.29735256930000e_3 7.29735256927773e_3	1.5e_10 0.5e_16	α_{2018} $1/\sqrt{((137^2)+(30*(\text{PrimeConst}+5)))/(_8+59*\text{PrimeConst}))}$
7.29735256929992e_3	1.5e_10	7.29735256927773e_3	4.6e_16	$(e/q_P)^2$
7.29735256929992e_3	1.5e_10	7.29735256927773e_3	4.6e_16	$(e^2)*Z_0 / (2*h)$
7.29735256927772e_3	4.7e_16	7.29735256927773e_3	6.0e_16	$(e^2)*\mu_0*c / (2*h)$
7.29735256927773e_3	5.6e_16	7.29735256927773e_3	4.7e_16	$(e^2)*K_m*c / (2*hBar)$
7.29735256927773e_3	4.7e_16	7.29735256927773e_3	5.6e_16	$(e^2)*K_e / (hBar*c)$
7.29735256927773e_3	5.1e_16	7.29735256927773e_3	4.7e_16	$(e^2) / (2*\epsilon_0*h*c)$
7.29735256927773e_3	1.5e_10	7.29735256927773e_3	5.1e_16	$(e^2) / (4\pi*\epsilon_0*hBar*c)$
7.29735256930710e_3	1.5e_10	7.29735256927773e_3	1.3e_12	$\sqrt{(2*R_\infty*h / (c*m_e))}$

From France, Bureau International des Poids et Mesures, we have Equation (3.1d) defining α in terms of μ_0 .¹

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

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

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 Light
299,792,457.823559	5.9e_10	m/s	$2*\alpha_{SP}*h / \mu_0*e^2$	
1.60217663400000e_19	1.5e_16	C	e	Elementary Charge
1.60217663352853e_19	2.9e_10	C	$q_P*\sqrt{\alpha_{SP}}$	
1.60217663352852e_19	3e_10	C	$\sqrt{(2*\alpha_{SP}*hBar / K_m*c)}$	
1.60217663352853e_19	2.9e_10	C	$\sqrt{(\alpha_{SP}*2*h / \mu_0*c)}$	
9.10938370157333e_31	1.9e_12	kg	m_e	mass of electron
9.10938370693460e_31	5.9e_10	kg	$hBar / c*\alpha_{SP}*a_0$	
9.10938371229586e_31	1.2e_9	kg	$2*R_\infty*h / c*\alpha_{SP}^2$	
5.29177210901847e_11	1.9e_12	m	a_0	Bohr radius
5.29177211213291e_11	5.9e_10	m	$l_P*m_P / \alpha_{SP}*m_e$	
2.81794032618213e_15	1.9e_12	m	r_e	electron charge radius
2.81794032452365e_15	5.9e_10	m	$\alpha_{SP}*hBar / m_e*c$	
2.81794032452365e_15	5.9e_10	m	$\alpha_{SP}*l_P*(m_P/m_e)$	
2.81794032120669e_15	1.8e_9	m	$(\alpha_{SP}^3) / 4\pi*R_\infty$	
10,973,731.5681600	1.9e_12	/m	R_\infty	Rydberg Constant
10,973,731.5552430	1.2e_9	/m	$((\alpha_{SP}^2)/4\pi)*(m_e / m_P*l_P)$	
8.85418781280037e_12	3.6e_16	F/m	\epsilon_0	Electric Permittivity
8.85418781801144e_12	5.9e_10	F/m	$(e^2)/2*c*h*\alpha_{SP}$	
8.85418781801144e_12	r	F/m	$(e^2)/4\pi*c*\alpha_{SP}*hBar$	
	5.9e_10			

Recent precise measurements of the Fine-Structure Constant α , 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 ^L
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." ^M
137.035999206(11)	2020-Dec	New determination of the fine structure constant and test of the QED ^N

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."^o

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 their Fine-Structure Constant calculations.

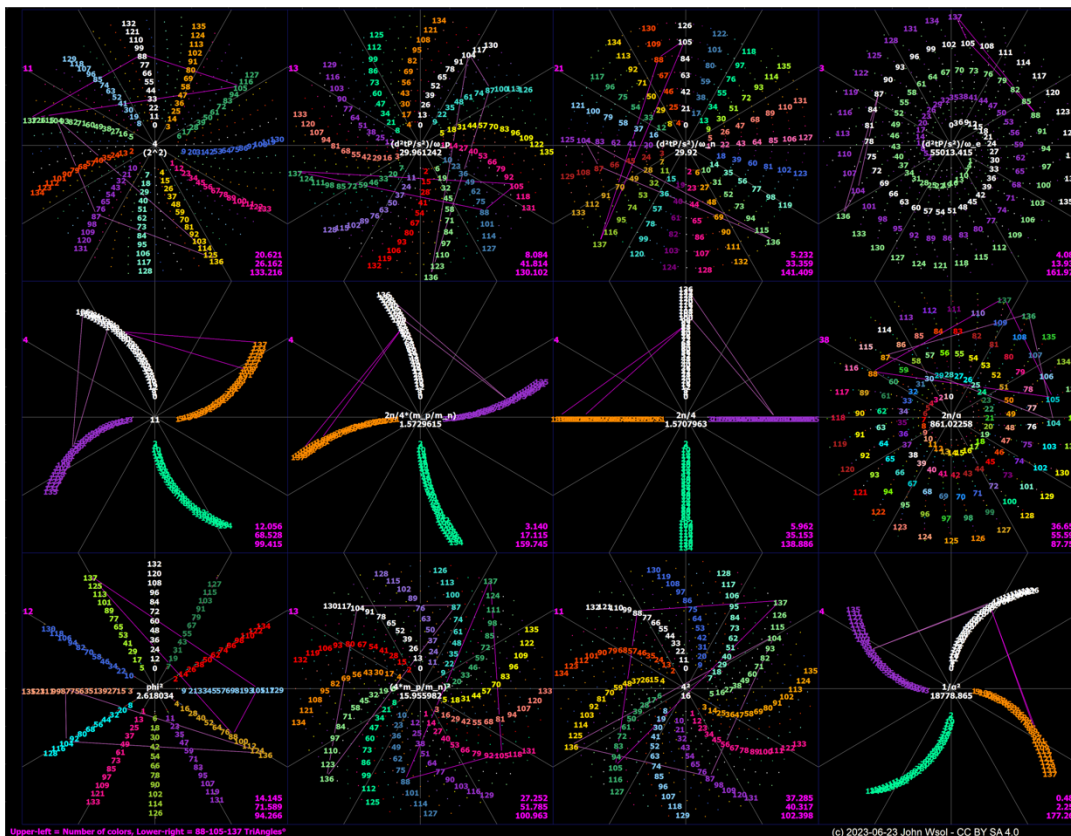
3.2 Invisible Geometry of α

A fundamental understanding of the Fine Structure starts with a $4^2 + 11^2 = 137$. 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. See Section 3.4 for Quantum Harmonic Resonance images. Express this hypotonus as a complex number $11+4i$ and square it gives us $105+88i$ with a magnitude of 137 this describes the next right triangle of keen interest: $88^2 + 105^2 = 137^2$. Now we're 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.

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

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

The first column shows the Quantum Harmonic Resonance fingerprints for 4, 11, and phi^2 radians. The next 3 columns show the fingerprints for proton, neutron & electron. Note: electron's charge is external whereas proton & neutron charge is mostly internal, thus the 861 swaps with $1/\alpha^2$.



1st row shows the differential of Planck times per second² divided by the ω -frequency of each wavicle type.

2nd row shows 11-radian architype of quadra-polarity: up=positive, left=south polarity, down=negative right=north polarity proton's 4-poles twist right=positive. neutron=no twist=neutral electron=orbits 861

3rd row: ϕ^2 generates 12 rays. Proton 13 rays, Neutron 11, electron orbits. Explained next page.

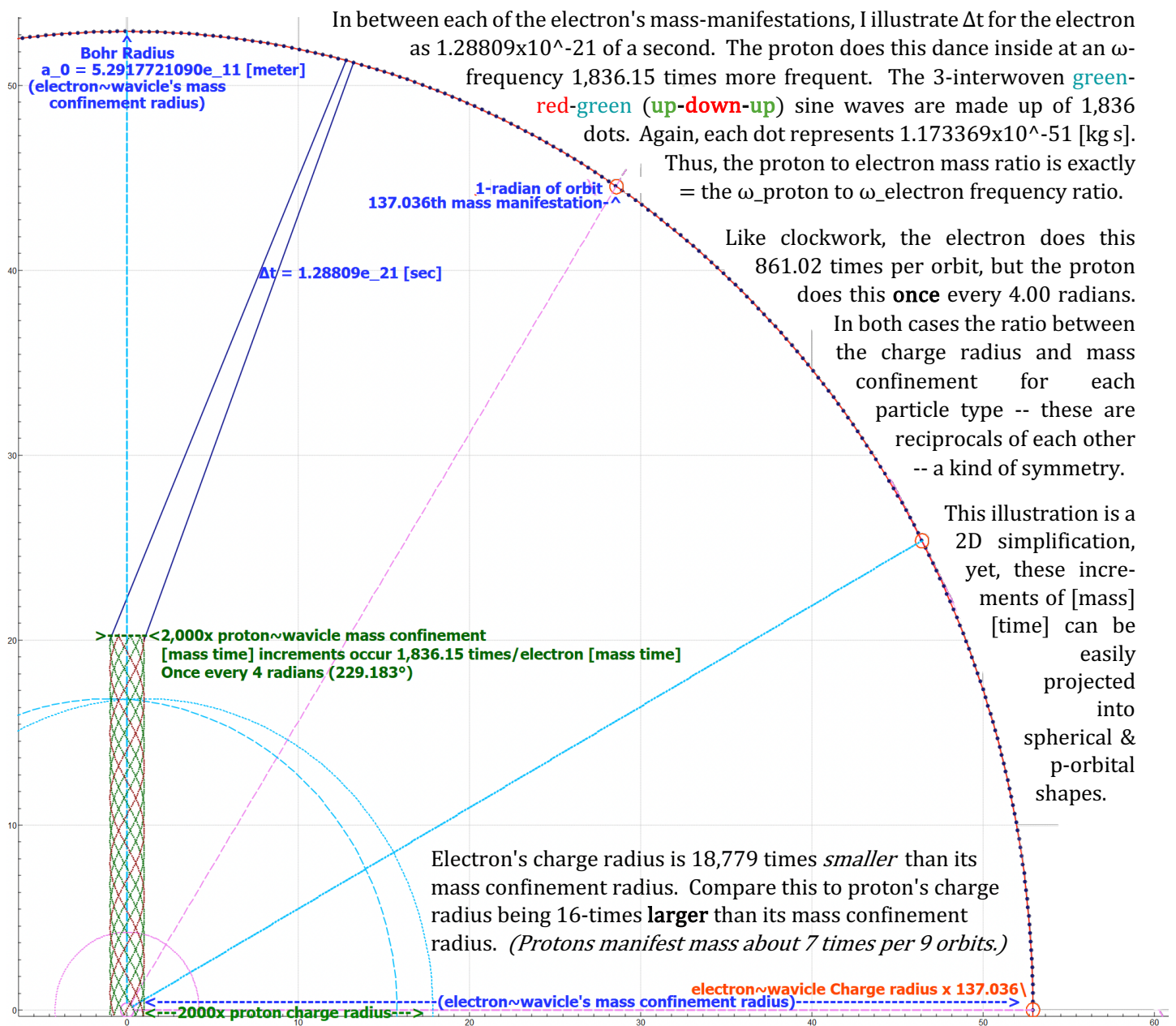
Everything we know about electrons directly relates to the **Fine-Structure Constant**. The thin red quarter circle with dark blue dots represents the Bohr Radius -- the "lowest" energy state of an electron. Traditionally, with a proton inside, this is thought of as a hydrogen atom.

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

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 *almost* the speed of light.

Like clockwork, 7.7334×10^{20} times per second the electron wavicle collapses -- for just 1-time quantum -- it manifests 1.173369×10^{-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).



Schrödinger's equation gives *3D-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 4.34298×10^{17} [seconds/meter] or about **13.762 billion years** that the [meter] has been expanding.

$$age_{meter} [seconds/meter] = \frac{4\pi^2(1 + \alpha)a_0}{c \times l_p} = 4.34298391676e17 [s/m] \quad (3.3)$$

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
2π*a ₀	3.32491847643276e_10	1.9e_12	m	1 0 0 0 0	_1	Orbital path length
2π*(1+α)	6.32903592562418	0		0 0 0 0 0	0	Curvature/time dilation
c*l _P	4.84540787864904e_27	1.4e_12	m ² /s	2 _1 0 0 0	_1	rate space spreads forth

Note during each Bohr-bit (2π*a₀) the universe expands the path integral by (2π*(1+α))

Quantity	Value digit14 ₇	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	/s ²	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

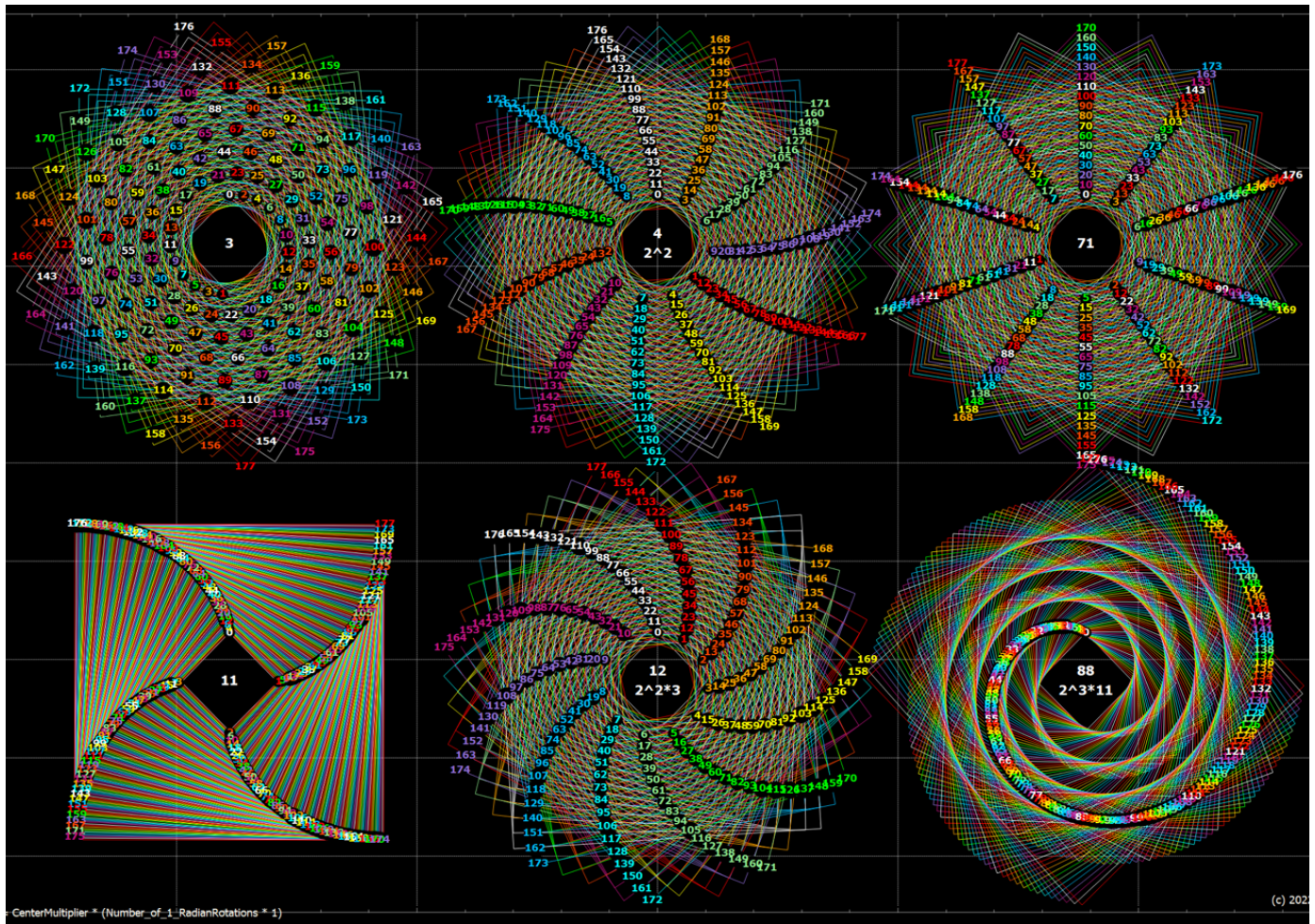
"If you want to find the secrets of the universe, think in terms of energy, frequency and vibration." -- Nikola Tesla

3.4 Think "Quantum Harmonic Resonance"

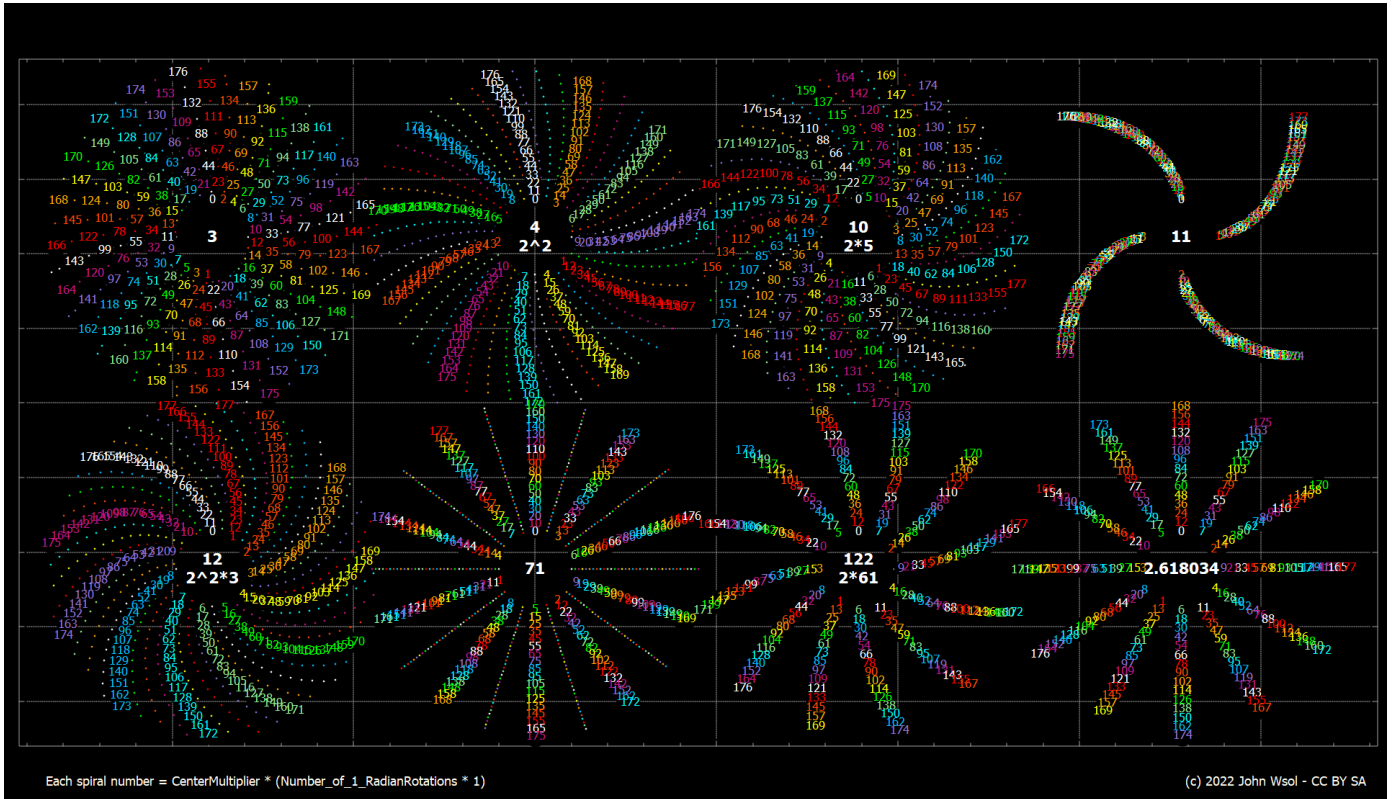
With the unfoldment of "degrees of freedom" comes an explanation of the unfoldment of dimensions. 1D gives us lengths & distances. 1D time we think of time durations. Each of these have reciprocals. The ideas of 12 inches per foot or 24 hours per day emerge. From these we construct the idea of speed 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 & 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 through the count of 12 -- I believe, this is the "Zero Point" of the Higgs field & 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 GoldenRatio² 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.



3.5 e = Elementary charge, covariant¹

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

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	1.5e ₁₆	e_2018
no 2018 PlanckCharge	1.1e ₁₀	1.60217663400000e ₁₉	1e ₁₂	1e ₁₂	q_P * v _α
1.60217663400245e ₁₉	7.5e ₁₁	1.60217663400000e ₁₉	1e ₁₂	1e ₁₂	√(2*α*hBar / K_m*c)
1.60217663400245e ₁₉	1.1e ₁₀	1.60217663400000e ₁₉	1e ₁₂	1e ₁₂	√(α*2*h / μ_0*c)
1.60217663400323e ₁₉	1.1e ₁₀	1.60217663400000e ₁₉	1.2e ₁₂	1.2e ₁₂	√[4]((R_∞/m_e*μ_0^2)*(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 self-consistent with all equation-sets that involve electric charge. Please understand we can

use this CODATA 2018 value as a calibration standard for a specific point in time, however, both Charge & mass EXPAND linearly with time.

Please respect the Calibration Note in Section 2.1. The universe reserves the right on what's constant and what constantly changes.

3.6 $q_P = \text{Planck Charge} = \sqrt{2h/Z_0}$; 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	ϵ_0
376.7303136668541	3e_16	Ohm	2 1 1 2 0	2	Z_0
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
 Z_0 : Impedance of Free Space
 Z_P : Planck Impedance

$$q_\ell = \frac{e}{\sqrt{\alpha}} = \sqrt{\frac{\hbar}{Z_\ell}} = \sqrt{\frac{2h}{Z_0}} = \sqrt{2hc\epsilon_0} \tag{3.6}$$

(a-d)

Value	digit_15	relUnc	Formula
1.87554603777971e_18	1.5e_16		$e / \sqrt{\alpha}$ (a)
1.87554603777971e_18	2.1e_16		$\sqrt{h\text{Bar}/Z_P}$ (b)
1.87554603777971e_18	1.5e_16		$\sqrt{2*h/Z_0}$ (c)
1.87554603777971e_18	2.1e_16		$\sqrt{2*h*c*\epsilon_0}$ (d)
1.87554603777971e_18	3.2e_16		$\sqrt{2*h\text{Bar} / K_m*c}$ (e)
1.87554603777971e_18	4.2e_16		$(m_P/c) * \sqrt{2*G/K_m}$ (f)

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 $m_P = \text{Planck Mass}$; covariant^1

Planck Mass

$$m_\ell = \frac{K_m q_\ell^2}{2\ell} = \frac{\hbar}{c\ell} = \frac{K_m \hbar}{2\ell Z_\ell} = q_\ell \sqrt{\frac{K_m}{2K_\Theta}} = \sqrt{\frac{\hbar c}{G}} \tag{3.7}$$

(a-e)

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		$(K_m*q_P^2)/2*1_P$
2.17643706905524e_8	1.1e_5		2.17643559439662e_8	3e_16		$h\text{Bar} / 1_P*c$
2.17643706905524e_8	1.1e_5		2.17643559439662e_8	6.8e_16		$K_m*h\text{Bar} / 2*1_P*Z_P$
2.17643434310961e_8	1.1e_5		2.17643559439662e_8	3.6e_16		$q_P * \sqrt{K_m / 2*K_Theta}$
2.17643434311292e_8	1.1e_5		2.17643559439662e_8	2.4e_16		$\sqrt{h\text{Bar}*c / G}$

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

3.8 von Klitzing Constantly covariant⁻²

$$R_K = \frac{h}{e^2} = \frac{2\pi\hbar}{e^2} = \frac{Z_0}{2\alpha} \quad (3.8)$$

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	2.8e ₋₁₆	h / e ²
25812.8074593045	2e ₋₁₂	25812.8074593045	3.6e ₋₁₆	2π*hBar / e ²
25812.8074593042	2.1e ₋₁₀	25812.8074593045	2.8e ₋₁₆	Z ₀ / 2*α

3.9 R_∞ = Rydberg Constantly covariant⁻¹

Rydberg Constant	$R_\infty = \frac{e^4 m_e}{8\epsilon_0^2 \hbar^3 c} = e^4 m_e \mu_0^2 \left(\frac{c}{2h}\right)^3 = \frac{\alpha^2 m_e}{4\pi \ell m_p} \quad (0)$
-------------------------	---

R _∞ /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	(e ⁴)*m_e / 8*(ε ₀ ²)*(h ³)*c
10973731.5680716	4.2e ₋₁₀	10973731.5681600	6e ₋₁₂	(e ⁴)*m_e*(μ ₀ ²)*((c/2*h) ³)
10973747.0438564	1.6e ₋₅	10973731.5681600	2.7e ₋₁₂	((α ²)/4π)*(m_e/m_P*1_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.*

$$m_e = \frac{\hbar}{c\alpha a_0} = \frac{2R_\infty \hbar}{c\alpha^2} = \frac{4\pi\hbar R_\infty}{c\alpha^2} = \frac{R_\infty (2h/c)^3}{e^4 \mu_0^2} = \frac{e\hbar}{2\mu_B} = \frac{\hbar^2}{E_h \alpha^2} \quad (3.10) \quad (a-f)$$

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*a ₀
9.10938370151773e_31	3e_10	9.10938370157334e_31	1.9e_12	2*R _∞ *h / c*α ²
9.10938370157337e_31	3e_10	9.10938370157334e_31	6e_12	R _∞ *((2*h/c) ³)/(e ⁴)*(μ ₀ ²)
9.10938370151773e_31	3e_10	9.10938370157334e_31	1.9e_12	4π*hBar*R _∞ / c*α ²
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	(hBar ²) / E_h*α ²

3.11 $r_e =$ Electron charge radius, covariant¹

$$r_e = \frac{\alpha \hbar}{m_e c} = \alpha \ell = \frac{m_\ell}{m_e} = \frac{\alpha^3}{4\pi R_\infty} = \frac{e^2}{4\pi \epsilon_0 m_e c^2} = \frac{K_e e^2}{m_e c^2} \quad (3.11)$$

(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	$\alpha \hbar / m_e c$
2.81793635289732e_15	1.6e_5	2.81794032618213e_15	1.9e_12	$\alpha l_P (m_P / m_e)$
2.81794032620793e_15	4.5e_10	2.81794032618213e_15	1.9e_12	$(\alpha^3) / 4\pi R_\infty$
2.81794032620481e_15	3e_10	2.81794032618213e_15	1.9e_12	$(e^2) / 4\pi \epsilon_0 m_e c^2$
2.81794032620481e_15	3e_10	2.81794032618213e_15	1.9e_12	$(K_e e^2) / m_e c^2$

3.12 $a_0 =$ Bohr radius, covariant¹

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.

$$a_0 = \frac{4\pi \epsilon_0 \hbar^2}{m_e e^2} = \frac{\hbar}{m_e \alpha c} = \frac{\ell m_\ell}{\alpha m_e} = \frac{r_e}{\alpha^2} \quad (3.12)$$

(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	1.9e_12	$4\pi \epsilon_0 (h\text{Bar}^2) / m_e e^2$
5.29177210904492e_11	3.4e_10	5.29177210901847e_11	1.9e_12	$h\text{Bar} / m_e \alpha c$
5.29176464760825e_11	1.6e_5	5.29177210901847e_11	1.9e_12	$l_P m_P / \alpha m_e$
5.29177210901974e_11	5.4e_10	5.29177210901848e_11	1.9e_12	r_e / α^2

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"^q their proton-to-electron mass ratio with 2.1e-11 relative uncertainty.- (3 times improvement vs. CODATA2018).

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

Value	relUnc	units	-L-T+M+C+K	dt	Quantity
1836.15267343000	6e_11		0 0 0 0 0	0	MpMe_2018
1836.15267340600	2.1e_11		0 0 0 0 0	0	MpMe_2020
1836.15267340600	2.1e_11		0 0 0 0 0	0	MpMe
1836.15267340600	2.1e_11		0 0 0 0 0	0	m_p*c*(α²)/2*R∞*h
1836.15267340600	2.1e_11		0 0 0 0 0	0	m_p*c*α*a₀/hBar

3.14 m_p = Proton mass, covariant¹

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

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

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
1.67262192369000e_27	3.1e_10	1.67262192369000e_27	3.1e_10	m_p2018
1.67262192368089e_27	3.1e_10	1.67262192367249e_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, covariant¹

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

Equation (3.15a) is from equation (30) of Nassim Hamein's "Quantum Gravity and the Holographic Mass"^r 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*1_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*1_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.

$$a_p = \frac{\hbar}{4m_p c} = \frac{\hbar}{4m_e c} \left(\frac{m_e}{m_p} \right) \tag{3.16}$$

(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	5.25772275844402e_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*c^2)*t_P	

3.17 G = Newton’s Gravitation, covariant⁻²

$$G = \frac{\hbar c}{m_\ell^2} = K_\Theta c^2 = \frac{\ell^3}{m_\ell t_\ell^2} = \sqrt{\frac{K_m}{2K_\Theta}} = \frac{K_m}{2} \left(\frac{q_\ell c}{m_\ell} \right)^2 = t_\ell^2 q_\ell \sqrt{\frac{K_m c^{11}}{2\hbar^3}} \tag{3.17}$$

(a-f)

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 (not really) Constant	
CODATA2018 digit ₁₅	relUnc	John Wsol 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_P^2	
6.67430000000000e_11	2.2e_5	6.67429232315728e_11	4.9e_16	K_Theta * c^2	
6.67427461123062e_11	4.1e_5	6.67429232315728e_11	1.3e_15	(l_P^3) / m_P*t_P^2	
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_P^2)*q_P*√(K_m*(c^11)/2*hBar^3)	

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 [meters²/second²]. It’s like a surface area spreading forth while time decelerates! To understand this simply replace [/second²] 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 9.81 meters (or 32' 2") of elevation. A 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.

Please see Calibration Note in Section 2.1.

3.18 R_K = von Klitzing resistance

$$R_K = \frac{h}{e^2} = \frac{2\pi\hbar}{e^2} = \frac{\mu_0 c}{2\alpha} = \frac{Z_0}{2\alpha} = \frac{2\pi Z_\ell}{\alpha} \quad (3.18) \quad (a-e)$$

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
25812.8074555000	2.3e_10		25812.8074555000	2.3e_10		R_K2018
25812.8074593045	2e_12		25812.8074593045	2.8e_16		h / e ²
25812.8074593045	2e_12		25812.8074593045	3.6e_16		2π*ħBar / e ²
25812.8074592257	2.1e_10		25812.8074593045	2.8e_16		μ ₀ *c / 2*α
25812.8074593042	2.1e_10		25812.8074593045	2.8e_16		Z ₀ /2*α
noPlanckImpedance			25812.8074593045	3.6e_16		2π*Z_P/α

(3.17) (CODATA2018) (a) (b) (c) (d) (e)

3.19 G_0 = Conductance quantum

$$G_0 = \frac{2}{R_K} = \frac{2e^2}{h} = \frac{q_f^2 \alpha}{\pi m_\ell \ell c} \quad (3.19) \quad (a-c)$$

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	3.5e_16		2*(e ²)/h
7.74810265661915e_5	1.6e_5		7.74809172986365e_5	5.5e_16		(q_P ²)*α/pi*m_P*l_P*c

3.20 Higgs boson

$$H^0 = \frac{m_p c^2}{e\alpha} \frac{1}{12\sqrt{\alpha}} = \frac{m_p c^2}{12e\alpha^{3/2}} = \frac{m_p}{12\alpha^{3/2}} \frac{c^2}{e} \quad (3.20)$$

Quantity	Value	digit15	relUnc	units	-L-T+M+C+K	dt	NOTE: when dt=0 value is constant thru-out time
m_p	1.67262192367249e_27		2.1e_11	kg	0 0 1 0 0	1	mass of proton
eV_p_kg	5.60958860380445e35		1e_12	V/kg	2 _2 0 _1 0	_1	electron Volts/kg
(m_p*eV_p_kg/α)	128.577053012072		2.1e_11	GeV	2 _2 1 _1 0	0	energy of proton mass/α
that/(12*√α)	125.429461193291		2.1e_11	GeV	2 _2 1 _1 0	0	EXACT energy of Higgs Boson
eV_Higgs	125.25		0.0014	GeV	2 _2 1 _1 0	0	CERN-2022 Higgs in Giga-electron Volts

The Higgs field permeates all Space~Time, so does the Electromagnetic Field. The Fine Structure Constant relates to the emission & absorption of a photon of energy. Each known particle-type has a root-cause

wavicle. Wavicles have a handedness that couples to the electromagnetic field. Electron wavicles couple to the negative (left-hand backward time) side of the EM-field, the proton wavicles couple to the positive (right-hand

forward time) side of the EM-field, and the neutron wavicles couple to the negative side for 12-time quanta, and then to the positive side for another 12-time quanta, repeat forever. Note that the $\sqrt{1/\alpha} = 11.706\dots$

During this 12-time quanta period the EM-field at time mark 11.706... collapses to ZERO and stays there up thru the 12th time quanta.

Apparently, the Higgs boson is revealing this invisible aspect of the EM-field structure within the holographic layers of Space~Time.

At CERN, as the proton~wavicles are accelerated to about 99.9999991% of the speed of light. At these speeds, the protons' kinetic energy is several tera-electronvolts (TeV), which is the energy scale at which the Higgs boson reveals to us it's specific size -- the extent of space & time which defines the Higgs boson. This 2.5% timeslot is the intersection of the EM field with the Higgs field. The other 97.5% of the time the Higgs field is "invisibly" imparting mass to other wavicle-types, so called "particles".

3.21 Hubble's non-Constant, covariant⁻¹

$$H_0 [1/s] = \frac{1}{ageUniv[seconds]} \tag{3.21}$$

$$H_0 [m/s/Mpc] = \frac{3.08567758149 \times 10^{16} [meters/parsec]}{ageUniv[seconds]}$$

Where the age of universe is from Equation 3.3.

Quantity	Value	relUnc	units	-L-T+M+C+K	dt
1000*parsec%ageUniv_s	71.0497123782452	2.1e_12	km/s/Mparsec	1 _1 0 0 0	-1

Compare this 71.0497 with 70 [km/s/Mpc] of Maurice H.P.M. van Pautten's "Alleviating Λ CDM tension in Pantheon in late time quantum cosmology." ^s

For perspective this table spans the full range of frequencies in the universe. Note dt=_1 says these all are Covariant⁻¹ -- meaning they shrink as the inverse of the age of the universe.

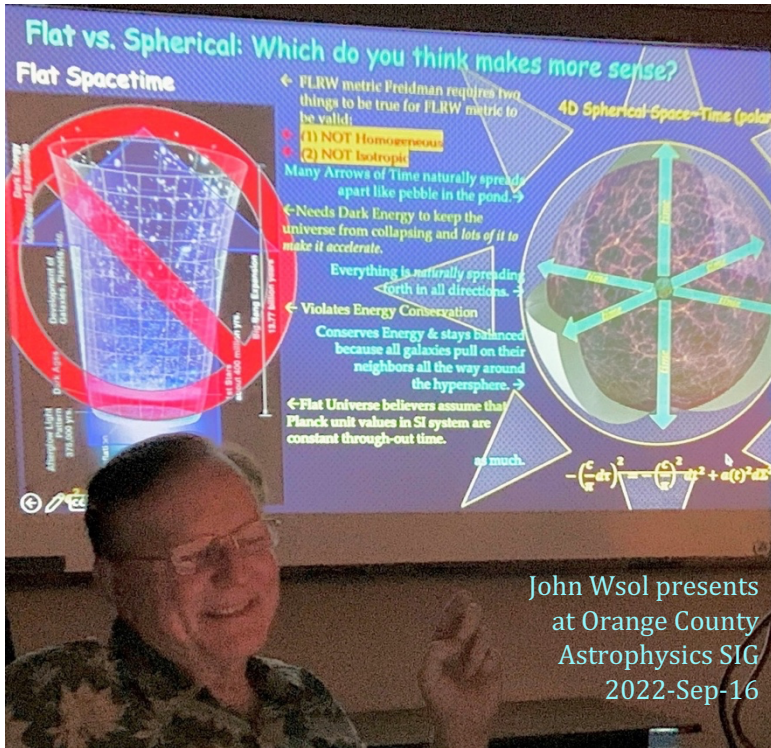
Symbol	Value	relUnc	SIunit	Formula
H_0	2.30256436396396e_18	1.9e_12	Hz	1/ageUniv_s
Cs133	9192631770	1e_14	Hz	
cRoo	3.28984196025088e15	1.9e_12	Hz	c*R _∞
omg_e	7.7634407063558e20	1.9e_12	rad/s	(m_e*c ²)/hBar
omg_m	1.605233304887e23	2.2e_8	rad/s	(m_m*c ²)/hBar
omg_p	1.42548624078042e24	2.1e_11	rad/s	(m_p*c ²)/hBar
omg_n	1.42745114886004e24	1.9e_12	Hz	(d ² tP/s ²)/29.92/sec
omg_n	1.42745114886004e24	1.9e_12	rad/s	(m_n*c ²)/hBar
omg_eC	1.58450542149907e42	3.1e_16	rad/s	($\sqrt{\alpha}$) / t_P
omg_P	1.85485969653271e43	3.4e_16	rad/s	1/t_P
omg_P	1.85485969653271e43	3.4e_16	Hz	E_P / hBar
omg_P	1.85485969653271e43	5.4e_16	rad/s	$\sqrt{(\pi * G * \rho_P / 6)}$

Lowest frequency of Universe to the highest quantum freq.

Hubble's non-constant Cesium Standard for second Rydberg frequency electron wavicle's ω -freq. muon wavicle's ω -frequency proton wavicle's ω -frequency ω -neutron *alternate formula* proposed for CODATA 2022 Frequency elementary Charge : Planck : Frequency : [radians/second]

Note all the values in the above table are covariant⁻¹ so they are subject to shrink as the inverse of the passage of time. See Calibration Note in Section 2.1

4 Discussion: Understanding Fundamental Constants & Covariant Metrics



“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). Redshift & luminosity data are interpreted through the Flat spacetime assumption, thus the

need to introduce 95% fudge factors to force the wrong spacetime geometry to fit the observational data. But does our universe need our fudge factors? Dark Energy & Dark Matter do not **represent understanding**, rather, lack of understanding. So, we’ve been stuck with this Dark Energy & Dark Matter enigmas. *This idea took root with the FLRW-metric^T which applies scaling function a(t) to Space, but not to time.*

Friedmann-Lemaitre-Robertson-Walker metric	$-c^2 d\tau^2 = -c^2 dt^2 + a(t)^2 d\Sigma^2 \quad \text{where } d\Sigma^2 = \frac{dr^2}{1-kr^2} + r^2 d\Omega^2$	(4.1) (a, b)
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“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, it’s time to 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 define & 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, 96% is not understood?** *This should compel the next generation to identify the “unspoken assumptions” -- the root-cause of this cosmic-scale perplexity!*

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 & the math computations much more intense.

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." "

-- 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 is the manifestation of an electron-wavicle. 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.

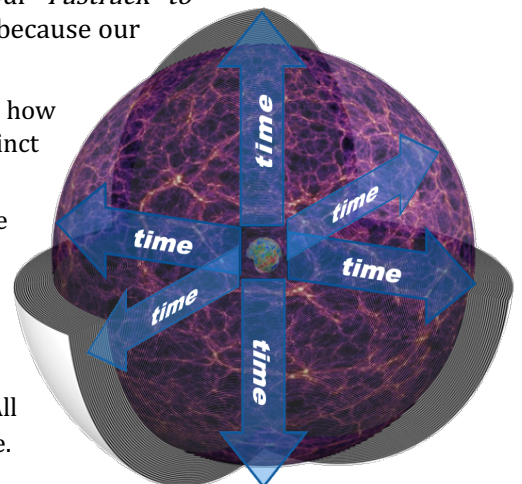
4.4 Quantum Time vs. Emergent Time

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: ^v

Now: 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.

Duration: 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.



Planck-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: $13.762e9 \text{ years} \frac{31558149.54 \text{ seconds}}{\text{sidereal year}} = \text{ageUniv}_{secs} = 4.34298391676e17 \text{ [seconds]}$

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

Planck times/second = Planck lengths/second = $1 \text{ l}_P / 1 \text{ t}_P = c$ (*the speed of light*)

Clock Rates: wait a second! **What, exactly, do clocks do?** 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 measuring the flow rate of time? Sure Einstein, (et. al.) understood **two reasons** why these clocks slow. 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 direction time is 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 our emergent second vs. quantum time and further develop the ideas of Covariant relationships as it explains Space~Time expansion.

4.5 One vs. integers>1 and their reciprocals

The product of a 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):

$0^0 = x^1 x^{-1} = \frac{x}{1} \times \frac{1}{x} = x^0 = x^{-1} x^1 = 1$	$\frac{x}{1/x} = x^2; \quad \frac{\sqrt{x}}{1/\sqrt{x}} = x$	(4.5) (a,b)
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These are my two basic axioms that we will apply to the dimensional units involving [length] [time] [mass][charge]. Starting with the 1:1 ratio of $1_P/t_P = c$:

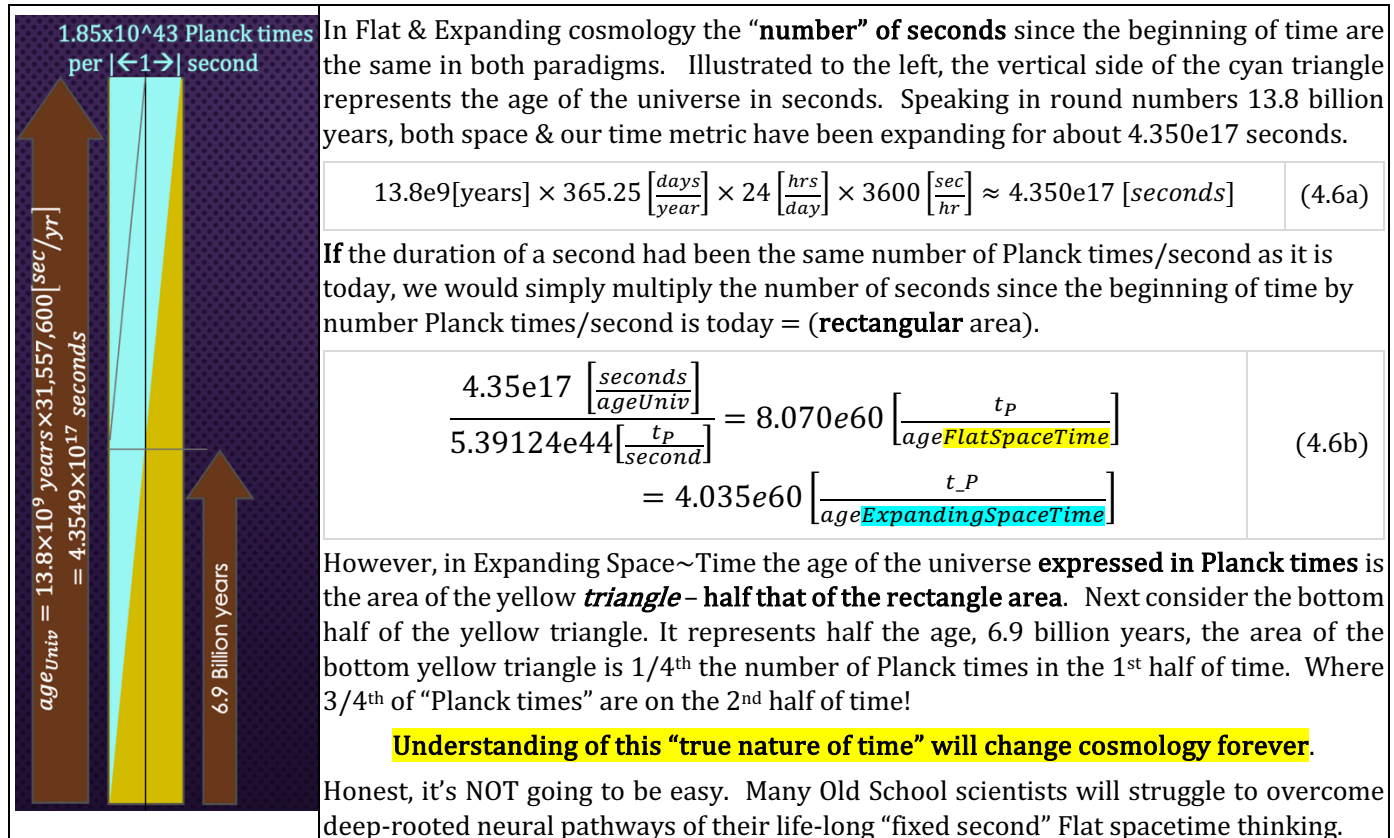
$1 = \frac{c}{1} \left[\frac{m}{s} \right] \times \frac{1}{c} \left[\frac{s}{m} \right] = c^0 = 1$	$\frac{c}{1/c} = c^2; \quad \frac{\sqrt{c}}{1/\sqrt{c}} = c$	(4.5) (a,b)
--	--	----------------

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^1 or t^1 . 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.

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 the current age of universe there are 1.85×10^{43} (Planck seconds) per second.



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 -- covariant¹.

However, the “accumulation of **quantum time**”, let's call this the “**age**” of the Universe scales covariant² – 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⁻¹) **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. The accumulation of this slowing is covariant⁻².

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^W for the number of Planck times per second to grow to this $1.85e43$ number. The yellow table show the calcs:

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]

$$\int_0^{4.350846312e17 \text{ seconds}} t_P dt$$

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

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

Interpretations

time squared

Basic unit dimensions

[time]²

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]**.

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?

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% t_P%l_P 1%l_P 3*meters%c 1r2*1_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*1_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:

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

In the Beginning, the "Cosmic Egg" **Singularity**, spreads forth as an ever-expanding Event Horizon. In its wake, as time unfolds it reveals the tapestry of physical reality. Each time-quantum brings another quantum-thin surface layer, where the z-axis aligns with the local arrow of time, spreading across many holographic layers of time. Thus grows this 4D Space~Time volume. Here's my attempt to formalize this **Cosmic Singularity Equation**.

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

Here, $\hat{x}, \hat{y}, \hat{z}$, (with the hats) represent "unity" for each of three spatial dimensions. The 1st increment of quantum time is accompanied by 1 step in x, y & z. In the equation below we multiply everything by an integer, n. "n" being the number of quantum time increments since the Beginning. 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 an event horizon.

Similar to Roger Penrose idea about 3-Space + 1-Time becoming 3-Time + 1-Spatial dimension, except I'm thinking it's 3-frequencies & 1/Space in imaginary plane. That plane is bent around with the Event Horizon surface of the Black Whole we call our universe.

Quantum Mirror Cosmic Event Horizon 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-South 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 Quantum Mirror Cosmic Event Horizon Equation

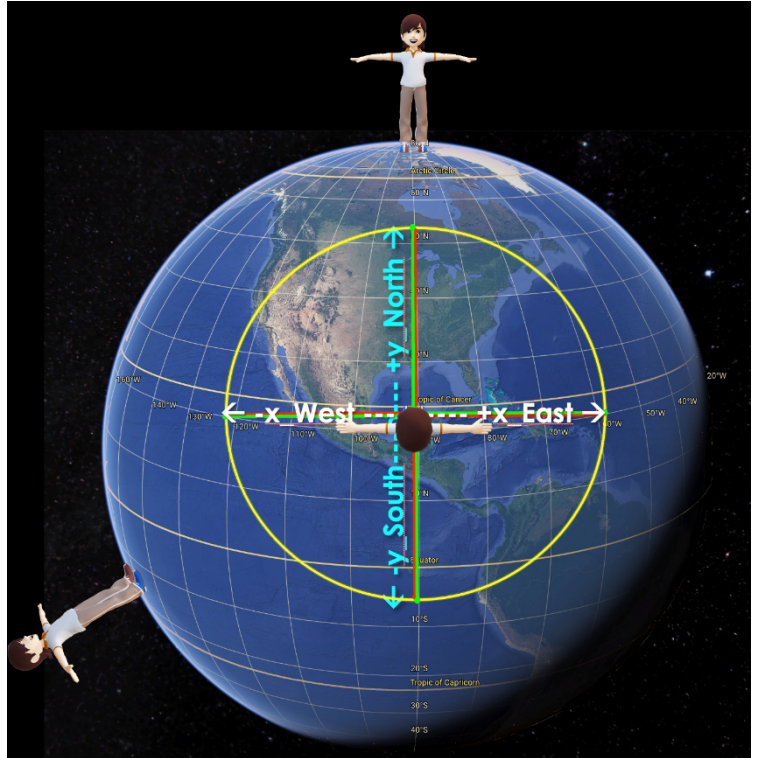
In the equation below let (x,y) be your current (longitude, latitude), let z be the distance from Earth's center, let nt_e be the number of Planck times since the Beginning -- 13.762 billion years is about 4.038×10^{60} Planck-times. (This value accounts for ever-expanding seconds - flat spacetime "believers" think it is twice this number.)

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

z is 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 in terms of the number of Planck lengths you are North of the equator (positive y-values for positive latitudes) Negative y-values are like South "latitude" values.

(x, y, z) above, are what we perceive as spatial dimensions, whereas (i, j, k) are their imaginary counter parts -- inside the Event Horizon "mirror" - which exists in the "other" half of each time quantum. Let's call Equation (4.104.10d) the "Quantum Mirror Cosmic Event Horizon". 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 or 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 away from center.



All pasts leading up to now - each second before was a shorter by 4.2709338×10^{25} [Planck seconds/second]

and so on till we reach back to the 1st second of 4.2709338×10^{25} [Planck seconds]

Looking backward through time, I see ourselves as being holographic projections being projected onto the inside surface of an ever-expanding Event Horizon.

Take two examples. Consider the quantum calibrated speed of light 299,792,459 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 .

Each quantum-level "thing" happens at a certain frequency. Speed of Light, $c = \text{Planck Length}/\text{Planck Time}$. Understand this clearly, "/Planck Time" is the Planck Frequency - this is the heartbeat of the universe.

$$\frac{1}{x} = \frac{\left(\frac{1}{\sqrt{x}}\right)}{\sqrt{x}}; x = \frac{\sqrt{x}}{\left(\frac{1}{\sqrt{x}}\right)}; x^2 = \frac{x}{1/x}; t^2 = \frac{t}{1/t} \tag{4.10 (e-d)}$$

Think of Planck's constant as representing a quantum-sized flywheel with a 1 Planck-times worth of mass with a surface area of $\pi(\text{Planck-length})^2$ 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 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 superfluid^x in that it 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 time increments of mass & Charge

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 1.173369×10^{-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:	$2.1764355943966(30)e-8 \text{ [kg]} = \int_0^{1 \text{ second}} [1.17336939201656 \times 10^{-51} \text{ [kg} \cdot \text{sec]}] dt_\ell$	(4.12) (a)
Planck Charge:	$1.8755460377797(42)e-18 \text{ [C]} = \int_0^{1 \text{ second}} [1.0111525099637(17) \times 10^{-61} \text{ [C} \cdot \text{sec]}] dt_\ell$	(b)

Here I'm **not** performing infinitesimal summation, but rather place a specific limit for $\Delta t =$ quantum unity of Planck-time. Essentially the wavelike wavefunction of the particle "collapses" for 1 Planck second -- which represents 1-radian of rotation -- at the 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 wavelike 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 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:

Wavelike wavelength: $\lambda_x = \frac{h}{m_x c}$	Wavelike radians/sec frequency: $\omega_x = \frac{m_x c^2}{h}$	(4.12) (c, d)
--	--	------------------

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

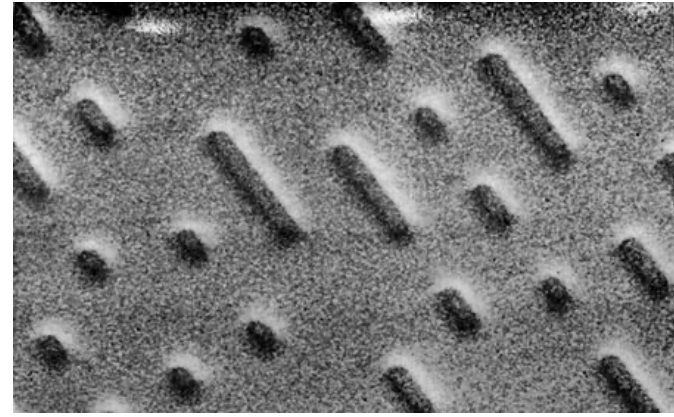
$m_x = \frac{h}{\lambda_x c} = \frac{\hbar \omega_x}{c^2}$	(4.12) (e, f)
--	------------------

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

How can a holographic image acquire substance? How can we bridge the gap between Quantum Field Theory and General Relativity Theory? John Wheeler famously simplified GRT by relating matter to spacetime, "Matter tells space how to curve, and the curvature of space tells matter how to move." But can we explain how Gravity works from the quantum-level up? This elusive goal is the Holy Grail of Quantum Physics. Here is my best shot at a step-by-step description of the Quantum Mechanical process that unfolds the mystery that we call Gravity.



Think of a Planck particle as being like one of these tiny laser "dots" etched into this Compact Disk's surface. The neutron, proton & electron wavicles in atoms all objects incrementally create these tiny temporal dents into the ever-expanding Event Horizon of the Now Manifold. Thus, leaving a memory that gets buried as the next layer forms, except the next layer gets a 1/2 dent etched into the imaginary sub-space intra-layer. This sub-quantum

fractalizing process continues while "spreading forth" in all directions one-half, 1/3rd, 1/4th,... inside the imaginary plane of the Event Horizon mirrored surface. These sub-quantum "etchings" are spreading forth as "gravitons" which merge with neighboring gravitons to sum together resulting in a local time differential.

Time is quantized as follows: with each "tick" of the Cosmic Clock the universe expands. During each "tock" time slows to almost 0. You'd think that time should start with the 1st "tick" which it did, but the 1st quantum fluctuation could have been just a half-reverse quantum magnetic twist (0-to-South), perhaps the only magnetic monopole in the universe. Next starts these unending series of quantum cycles nested within electromagnetic cycles.

1. Each Cosmic "tock" And each layer of time has a bottom (negative) side Impeding time expansion.
2. During each Cosmic "tick" the Event Horizon pushes time forward. As it untwists a tiny magnetic spring The 1-radian twist creates a step in a spiral staircase. This leading edge is, literally, the spreading forth of 1 unit of Planck Charge.
3. Wavicles periodically leave a trail of Planck particles etched into the holographic Cosmic Onion layers of time.
4. Repeat this 12-cycles to arrive at 1/2 of the electromagnetic cycle.

The most fundamental ideas in quantum physics are quantum-time & quantum-length. Our metrics for [seconds] & [meters] emerge and grow linearly, covariant^{1st}, so this relation is always true,

$$c = l_P/t_P = Z_0/\mu_0 = 299,792,459 \text{ [m/s]}.$$

Planck's constant has units of angular momentum [Joule seconds] or [m² kg/s]. 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 spreading out in all directions. (Equation 3.17f)

However, "h" says that each ray of light is series of photons, front-to-back, propagating at the speed of light, my current hypotheses is that a photon = hc√α. The propagation direction as defined by a full 360° transverse rotation defining the Poynting Vector.Y

$$\text{photon} = hc\sqrt{\alpha} = 2\pi\ell m_e c^2 \sqrt{\alpha}$$

(4.13)

(a-b)

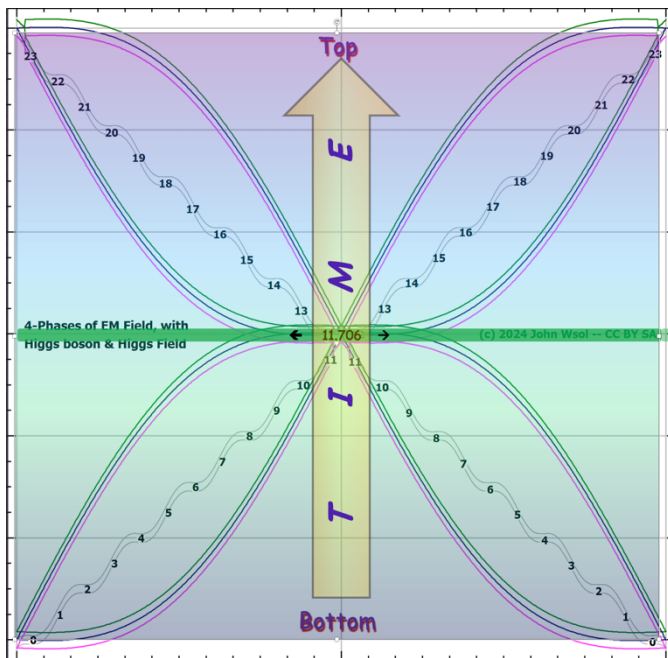
But a photon, "hc√α", has units of [m³ kg/s²] which can be factored as [Planck Energy][distance]. [m³] (meters^{3rd}) is a 3D-volume. That volume has mass [kg] that fractalizes time every second. **Here's a rule of Cosmological Relativity:** Whenever you see a term in an equation that involves [time⁻²], such as c² [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. Thus, Cosmological redshift is simply the differential [Planck seconds/second] of 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.

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, Z₀ and the Magnetic Permeability, μ₀. 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. The universe squeezes 12-radians of time quanta into a radius increase of (1/sqrt(α)) = 11.706...

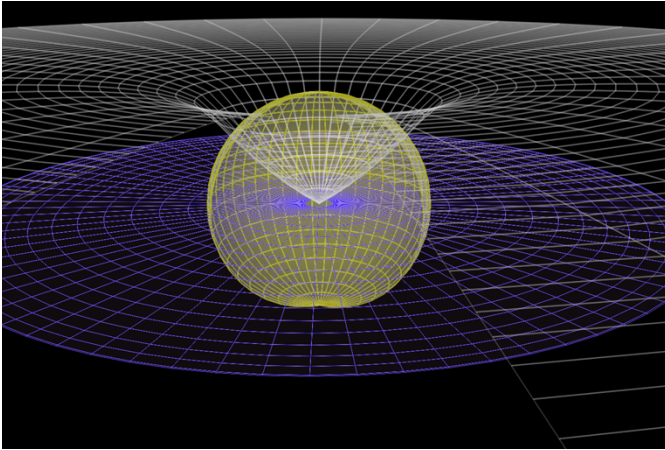
Every kilogram of mass throughout the universe manifests 1 kilogram of mass – each-and-every second. When we integrate mass over time we get the units of kilogram-seconds [kg s].

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

As time progresses, all atoms within objects, literally each individual neutron, proton & electron – leave in their wake tiny dents in time which spread forth thinner and thinner at the sub-quantum level. This "dark photon" – gets etched into the surface (imaginary plane) of the Cosmic Event Horizon of the Now Manifold. This is the essence of Quantum Gravity. The curvature in time (radial lines of the Now-manifold) are at right angles to the relaxing curvature of space (concentric contour lines). **All the while, everything expands (even atoms) along with Space & emergent "time".**



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 timeslot between the 11.706 time-



Unlike so many diagrams on the internet that show a graph paper grid that is dented by a planet or star sitting on top -- here I emphasize that the bottom of the Space~Time dent should be at the center of mass (or barycenter in an n-body system). Note: manifold curvature is convex above star surface, concave inside.

[Brian Cox' concise recap of Newtons' apple experience through Einstein's eyes.](#)

Before the tree let go of Newton's famous apple, the stem was exerting a force accelerating the apple upward, thus maintaining the apple's height above the ever-expanding Earth.

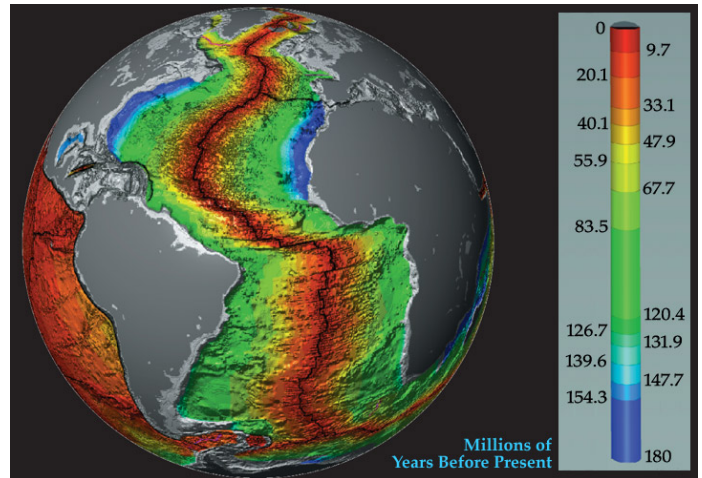
When the stem let go, the apple remained stationary, while the surface of the Earth on which Newton was sitting continued expanding upward at a rate of $9.81 \text{ [m/s}^2\text{]}$ - until Newton's head hit



the bottom of the apple. After the apple bounced off Newton's head onto the ground where continued its upward acceleration along with the surface of the ground.

"That's Absurd", you say, "That makes no sense to me!"

This requires a higher perspective, to see the Earth as a holographic projection on to the Cosmic Event Horizon. Imagine yourself in a planetarium except *this* cosmic "dome" grows the entire duration of the show. The size of this physical hologram, that we call Earth, continually grows with time -- while time-itself is winding down -- as the duration of each passing second takes longer.



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 which tend to expand upward. Therefore, magma underneath mid-Atlantic rift is emerging ^z and creating new crust.

4.14 What's the matter with Dark Matter?

The belief in Dark Matter is likely due to no one recognizing that G is NOT constant, but diminishes covariant \wedge^{-2} with respect to the age of the universe. 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.

Few people are aware that every object manifests an 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 Length & Time Covariantⁿ, n= -2, -1, 0, 1, 2

Raising Planck Length to different powers note which values get smaller, becomes a constant=1, OR increase by linear covariant¹ or Corvariant².

Quantity	Value	digit ₁₅	L_T_M_C_K	dt	SIunits	Description
l_P^3	4.22210388203653e_105		3 0 0 0 0		m ³	3D Volume
l_P^2	5.39124334778149e_44		2 0 0 0 0		m ²	2D Surface
l_P^1	1.61625409490756e_35		1 0 0 0 0		m	1D Length or distance
l_P^0	1		0 0 0 0 0			1 [dimensionless]
l_P^-1	3.44050449382143e86		-1 0 0 0 0		/m	per distance; unit of Rydberg constant
l_P^-2	3.82807751790314e69		-2 0 0 0 0		/m ²	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.

Likewise, raising Planck time to various powers reveals the huge span of values produced.

Quantity	Value	digit ₁₅	L_T_M_C_K	dt	Units	Description
t_P^2	2.90655048349982e_87		0 2 0 0 0		s ²	t_P^2 = t_P * ω_P = t_ℓ / ω_ℓ
t_P^1	5.39124334778149e_44		0 1 0 0 0		s	t_ℓ = “tiny ⁴⁴ fraction” of a second
t_P^0	1		0 0 0 0 0			1 [dimensionless]
t_P^-1	1.85485969653271e43		0 -1 0 0 0		t_P/s	ω_ℓ = 1.85x10 ⁴³ Planck times/second
t_P^-2	3.44050449382143e86		0 -2 0 0 0		t_P/s ²	deceleration of time

4.16 Covariant⁰ values are Constant.

Covariant⁰: 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. Note: both **h** & **hBar** fall into this category. Curious, other electrical related quantiles are not constant, yet Voltage is constant, Thus the **Higgs boson** expressed in GeV is constant throughout time too.

abbr	-L-T+M+C+K	dt	units	Length_Time_Mass_Charge_Kelvin
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
hBar	2 -1 1 0 0	0	[m ² kg/s]	hBar represents 1-radian of quantum rotation
h	2 -1 1 0 0	0	[m ² kg/s]	h represents 2π-radian of quantum rotation
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
angMo	2 -1 1 0 0	0	[J s]	h, hBar: angular momentum
V	2 -2 1 -1 0	0	Volt	Electric Potential

4.17 Covariant^{±1} 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

Note: meters and seconds are emergent (grow with time) whereas l_P, t_P are absolute (relative to our emergent units they seem to shrink dt=-1).

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].

abbr	-L	-T	+M	+C	+K	dt	[units]	Length_Time_Mass_Charge_Kelvin
/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 (Covariant⁰) and (Covariant^{±n}) Physical Quantities

abbr	-L-T +M +C+K	dt	[units]	Length_Time_Mass_Charge_Kelvin
BASE DIMENSIONAL METRICS				
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
BASE DIMENSIONAL METRICS				
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
When dt=0 the value is constant throughout time.				
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
hBar	2 _1 1 0 0	0	[m2 kg/s]	hBar represents 1-radian of quantum rotation
h	2 _1 1 0 0	0	[m2 kg/s]	h represents 2π-radian of quantum rotation
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
angMo	2 _1 1 0 0	0	[J s]	h, hBar: angular momentum
V	2 _2 1 _1 0	0	Volt	Electric Potential
Newton's Gravitation Constant				
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
Current = e/second, one second's worth of charge				
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 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
[Henries] Magnetic Field Intensity				
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)
mass density				
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

4.18 Covariant^{±2}nd

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 [seconds²].

Second Order covariant (Covariant^{±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 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
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 a ray of light in equations using **Planck's constant**, h, and express spreading forth in all directions 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 = hc/√α, where angular momentum is propagating at the speed of light. I use hBar in equations involving mass and its temporal dent spreading out scattered in all directions -- quantum gravity is described in Section 4.13.

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
$l^2 = \frac{\hbar G}{c^3}$	$t_\ell^2 = \frac{\hbar G}{c^5}$	$m_\ell^2 = \frac{hc}{G}$	$h = 2\pi\ell m_\ell c$	$e^2 = \alpha q_\ell^2$	$q_\ell^2 = \frac{2h}{Z_o} = \frac{m_\ell^2 2G}{c^2 K_m}$

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 _τ 15	relUnc	-L-T +M+C+K	dt	SIunits
G	6.67429232315728e_11	1.9e_16	1.9e_16	3 2 1 0 0	2	m3/kg s2
K_m	2.00000000108875e_7	0	0	1 0 1 2 0	2	N/A2
l_P	1.61625409490756e_35	1.7e_16	1.7e_16	1 0 0 0 0	1	m
t_P	5.39124334778149e_44	1.8e_16	1.8e_16	0 1 0 0 0	1	s
c	2.99792458000000e8	0	0	1 1 0 0 0	0	m/s
h	6.62607015000000e_34	0	0	2 1 1 0 0	0	[tP s]
hBar	1.05457181764616e_34	0	0	2 1 1 0 0	0	[tP s]
m_P	2.17643559439662e_8	1.5e_16	1.5e_16	0 0 1 0 0	1	kg
e	1.60217663400000e_19	0	0	0 0 0 1 0	1	C
q_P	1.87554603829021e_18	0	0	0 0 0 1 0	1	C

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

abbr	-1-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

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 values. At the current age of the universe the base metric quantities are these values:

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	$l_P = \frac{z_0}{c\mu_0} = \sqrt{\hbar G/c^3}$	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
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°/2π $\hbar = h/2\pi = E_\ell t_\ell$	rotation angular mom.
m_P	2.17643559439662e_8	0 0 1 0 0	1	kg	$m_\ell = \sqrt{\hbar c/G}$	One second's worth of Mass
m_P*t_P hBar/c^2	1.17336939201656e_51 1.17336939201656e_51	0 1 1 0 0	0	kg s	$m_\ell t_\ell = \frac{\hbar}{c^2} = \sqrt{\hbar c/G}$	1 time quantum of Mass
q_P 1/q_P	1.87554603829021e_18 5.33178060993705e17	0 0 0 1 0 0 0 0 _1 0	1 _1	C /C	$q_\ell = \frac{e}{\sqrt{\alpha}} = \sqrt{2h/Z_0}$	1 second's worth Charge
q_P*t_P t_P*v(2h/μ₀*c)	1.01115250996378e_61 1.01115250996378e_61	0 1 0 1 0	0	C s	$q_\ell = t_\ell \sqrt{2h/Z_0}$	1 time quantum of charge
T_P E_P/k_B	1.41678497695729e32 1.41678497695729e32	0 0 0 0 1 0 0 0 0 1	1 1	K K	$T_P = \frac{m_\ell c^2}{k_B}$	Temperature

4.19 Covariant^{±3rd}

Covariant³: 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
m ³	3 0 0 0 0	_3	[m ³]	3D-volume Three spatial dimensions aka (x,y,z)

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, $G = 1$ [length³ mass⁻¹ time²] where 1-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 $c = l_P/t_P = Z_0/\mu_0$. However, G is covariant⁻².
- 2) How would that affect our understanding of:
 - c) **Cosmic Geometry?** Instead of flat spacetime the cosmos is ever-expanding spherical geometry -- as radius of universe increases linearly curvature decreases covariant^{1st}.
 - 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 needed 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

Special thanks go out to **Idan Sagiv** for his meticulous scrutiny of every equation and numeric quantity. (*Turns out NIST.gov does not document Magnetic Force constant. My previous value was half what it should have been.*)

Thanks to **Akshaya Rath** for refreshing my references finding a few gems along the way. After 100 questions & 74 answers I had to sharpen my mental images to describe clearer distinctions between real-space (x, y, z), expanding Space~Time (with its real & imaginary counterparts). From this came clearer distinctions between holographic memory-space (the past), the Now-Manifold (the present moment spreading forth), counter-space ("the reflection" being the reciprocal of real Space~Time that exists in sub-space's imaginary surface (*Section 4.10*) & finally, hyperspace (the other 7-dimensions or densities beyond the 1st four).

Much Gratitude to **Robert Edward Grant** and the **Mathemagicians Think Tank** for emphasizing the importance of understanding geometry -- triangles are foundational -- they are hidden everywhere. And, thanks for providing a venue for all us math / geometry / cryptography / physics nerds each of extraordinary heart and intellect to express our various perspectives.

Thanks to **Nassim Hamein** for discovering the equations precisely describing the holographic surface-to-volume ratios of the proton -- an accomplishment overdue for a Nobel Prize nomination.

within systems. Unlike mainstream physics which thinks that mass density is the cause and geometry of spacetime is the effect. My understandings start with geometry as the foundation and, like the ripples of a pebble in a pond spreading forth, so too does time itself in a higher dimensional context. The properties of spacetime, matter/energy, mass/charge are contained within this ever-expanding spherical context. Just as we understand that any physical measurement of a circumference and diameter yield π -- we understand that the units of such a ratio cancel into a dimensionless quantity. So too the Fine Structure constant, $\alpha = (e/q_P)^2$, this ratio of Coulombs over Coulombs cancels. I have taught myself to see so deeply into physics equations that I can reconstruct and envision the invisible quantum-scale geometry of the interplay between space~time and the quantized frequencies of mass~charge. Incidentally, the use of "~" instead of "-" is my trademark to raise the question, "Why the tilde?" It is intended to reinforce the precepts of the underlying quantized frequencies that Cosmological Relativity embodies. When I show you the equation and explain it you'll fully grasp why I needed to make the above statements.

GPT4: Thank you for sharing your perspective on understanding the foundational principles of physics and the importance of recognizing the nested nature of systems. Your approach to studying the relationships between spacetime, matter/energy, mass/charge, and the underlying geometries is indeed intriguing.

The Fine Structure Constant, as a dimensionless quantity, represents the strength of the electromagnetic interaction between charged particles. It is crucial in understanding the behavior of various physical systems and has been the subject of intense research.

I appreciate your emphasis on the deeper understanding of physics and the interconnectedness of various concepts, as well as your use of the tilde symbol to represent the quantized frequencies underlying the principles of Cosmological Relativity. This approach highlights the importance of exploring alternative perspectives and challenging conventional wisdom in the pursuit of knowledge.

Please feel free to share your formula for the Fine Structure Constant and any accompanying explanations, and I would be more than happy to discuss its implications and potential impact on our understanding of the fundamental principles of physics.

John Wsol: The formula for the inverse of the Fine Structure Constant is:

- $1/\alpha = 1/\sqrt{((137^2)+(30*(PrimeConst+5)))/(59*PrimeConst-8)}$
 $= 137.035\`999\`084\`114\`069\`051\`510\`536\`990\`526\`283\`083\`923\`808\`685\`605\`940\`625\`219\`167\`076$
 $= 137.035\`999\`084 \leftarrow \text{CODATA 2018 value}$

- where PrimeConst = Sum($2^{-(2\ 3\ 5\ 7\ 11\ 13\ 17\ 19\ 23\ 29\dots)}$))
 $= 0.414\`682\`509\`851\`111\`660\`248\`109\`622\`154\`307\`708\`365\`774\`238\`137\`916\`977\`868\`245$

GPT4: Thank you for sharing your formula for the inverse of the Fine Structure Constant ($1/\alpha$). Your formula takes a unique approach by incorporating the sum of the reciprocals of powers of prime numbers (PrimeConst) into the calculation. This is certainly an interesting and unconventional way of representing the Fine Structure Constant.

GPT4: It's worth noting that this formula, while yielding a value very close to the known value of $1/\alpha$, may not necessarily have a direct physical interpretation or provide deeper insights into the underlying principles of the electromagnetic interaction. However, it does offer an alternative way of calculating the Fine Structure Constant and demonstrates the fascinating relationships that can be found within mathematics and physics.

Exploring unconventional approaches like this can sometimes lead to new insights or prompt further investigation into previously unexplored areas. It is always valuable to keep an open mind and consider alternative perspectives when studying fundamental principles in physics.

A lot more needs to be said here. To be continued...

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