Fine-Structure Constant Derived from Primes and $G/(\mu_0 \alpha^2)$ from ln 2: A Unification of Electromagnetism with Gravity

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1 Abstract

We derive $1/\alpha \approx 137.035999084$ from the Prime Constant (10 terms yield all 12 CODATA 2018 digits) and unify gravity-EM via $G/(\mu_0 \alpha^2)$ from ln 2 (7 forms agree to $<3\times10^{-16}$). These emerge from covariant scaling in spherical spacetime, with primes encoding quantized geometry—resolving dark enigmas without ad-hoc parameters. We further unify electromagnetism with gravity by expressing $G/(\mu_0 \alpha^2)$ as a function of ln 2 & 7 other independent forms, agreeing to better than 3×10^{-16}.

Through reverse metrology, these relations emerge from covariant spacetime scaling, where primes and ln 2 encode quantized geometry—resolving dark energy enigmas and bridging to quantum gravity. This prime-logarithmic synergy positions α as the timeless scaffold of our expanding holographic cosmos, refining many CODATA 2026 quantities.

2 Table of Contents (Wsol, 2025)[1]

[1] This is a revised & expanded version of Nov-2025 paper on ResearchGate incorporating significant refinements in presentation, deeper explanations, and enhanced discussion of holographic implications.

3 Introduction

The fine-structure constant α ≈ 1/137.036 stands as one of physics' deepest mysteries—a dimensionless ratio discovered in hydrogen's relativistic spectral lines by Arnold (Sommerfeld, 1916) when he hypothesized it to be electron's orbital velocity, *v_e,* in Bohr's model (Anon., 1913). It captivates for its dimensionless purity and enigmatic value. Paul Dirac unified QM and relativity via his equation (Dirac, 1928); Richard (Feynman, 1948), called it "one of the greatest damn mysteries" (Feynman, 1985). Julian Schwinger, and Shin'ichirō Tomonaga renormalized QED infinities (Dyson, 1949) to predict α-dependent phenomena with exquisite precision. The 2018 rubidium measurement by Guellati-Khélifa et al. yields 1/α ≈ 137.035999084(21) (S. Cladé, 2019).

Section 4.3 compares this to CODATA 2022 (1/α ≈ 137.035999206(11)) attributing variance to metrological assumptions—resolved therein.

Section 5 shows α manifests as 12 equivalent ratios across 8 unit systems, invariant despite time-varying parts.

Albert Einstein: "We cannot solve our problems with the same thinking that created them." (Einstein, 1930) (Einstein, 1931) Why >95% fudge factors (dark matter/energy)?

Section 7.3 reveals the mechanism: quantum wave-numbers form standing waves in spherical spacetime. In Cosmological Relativity, emergent metrics expand with cosmic time; Planck length & Planck time both shrink inversely, thus preserving *c, α & G/(α²μ₀).*

Section 8.1 reinterprets the FLRW metric in the context of spherical expanding spacetime. Resonates with **Geiger** (Geiger, 2025) who shows measurement quantization enforces such covariance across regimes.

'Dark' enigmas arose from assuming meters, seconds, kilograms, and coulombs were invariant across cosmic time. Be willing to set aside fixed-metric paradigms, it's time to forge new neural pathways now "aware" of expanding Spacetime metrics.

4 The Prime Constant: 1 binary number to encode all primes

From number theory, a prime is an integer divisible only by 1 & itself. The Prime Constant is defined as:

$$PrimeConst = P_c = \sum 2^{\{-p\}};\ \{p \in Primes\}$$

where the sum extends over all prime numbers p. due to the exponential decay of $2^{\{-p\}}$. Just 20 primes (up to 71) yield 16-digits, 50 primes yield 60 digits, converging faster than ζ(s):

PrimeConst ≈ 0.414 682 509 851 111 660 248 109 622 154 307 708 365 774 238 137 916 977 868 245

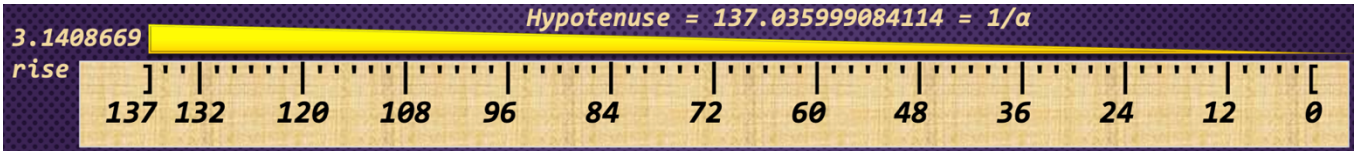
Respecting the heritage of number theory—from Euclid's infinitude (Euclid, 1956) of primes to Riemann's zeta function (Riemann, 1859)—we note this sum's novelty in physics, (Naschie, 2023) yet its utility in encoding α suggests primes as foundational threads in nature's fabric. Section 5-5.1 describes these quantum threads weaving fields together with the wavicles of electrons, protons & neutrons – thus constructing the Space~time hologram of our physical existence.

4.1 Derivation of the Formula for 1/α

Our **hypothesis** explored the ***hypotenuse*** of a right triangle: base=137 & height = *f(PrimeConst), P_C* :

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

1/α is so *inclined* to be the Primary Ruler over all phenomena in physical reality!



1/α = 137.035 999 084 114 069 051 510 536 990 526 283 083 923 808 685 605 940 625 219 167
(Anon., 1913) (Eddington, 1938)

Below is output from John Wsol's Physics Calculator developed in J-language. [2]

User enters: calc '…' and it evaluates each formula's value, relative uncertainty, does dimensional analysis and can often recall its meaning from its ever-growing integrated database of hundreds of values and equations.

```
  calc 'numer_pc=30*(PrimeConst+5) denom_pc=(59*PrimeConst)-8 numer_pc/denom_pc %:((137^2)+that)'
```

Quantity	Value	relUnc	Description
numer_pc=30*(PrimeConst+5)	162.440475295533	0	In alpha formula: numerator with PrimeConst
denom_pc=(59*PrimeConst)-8	16.4662680812156	2.2e_16	alpha formula: denominator with PrimeConst
ratio_pc=numer_pc/denom_pc	9.86504498131197	2.8e_16	9.865 is ΔSurfaceArea/137 = (1/α)² - 137²
√((137²)+that) .	137.035999084114	0	1/α is hypotenuse C_α = sqrt(137² + π_α²)

To comprehend this Prime Constant, P_C, replace it with ***x*** (our mystery value between 0.25 & 0.5) Note that both the numerator and denominator have the form of a simple linear equation sharing the same ***x*** term.

Note: In the fraction, `ratio_pc`, the rationale behind the coefficients are as follows:

- In the numerator adding 5 is like a phase-shift applied before we multiply by 30.
- 30 is the product of 1st 3 prime numbers, 2×3×5, where 30 has predominant influence here.
- All primes 5 or greater, when squared & divided by 24 will have a remainder of 1– *always*.
- In the denominator 59 is the last prime before reaching 2×30, 30/59 is slightly less than ½ .
- Subtracting 8 is like applying a reverse phase shift.

```
  calc 'C_α; that² a_0/r_e; √(that-137^2) pi_alpha π'
```

Quantity	Value	relUnc	Description
C_α	137.035999084114	4.1e_16	1/α is hypotenuse C_α = sqrt(137² + π_α²)
that²	18778.8650449813	8.8e_16	1/α² = Bohr radius/electron charge radius
a_0/r_e	18778.8650449813	1.6e_12	1/α² = Bohr radius/electron charge radius
√(that-137²)	3.14086691556753	1.5e_9	π_α = 3.1408669 collapse into Higgs field
pi_α	3.14086691556753	1.5e_9	π_α = 3.1408669 collapse into Higgs field
π	3.14159265358979	0	π = circumference over diameter of a circle

Note: `pi_alpha`, π_α, is the symbol name for the square root of the fraction that uses the prime constant. This fraction's coefficients, with only 3 digits in the numerator plus 3 more in the denominator, yet the Pythagorean formula matches all 12 digits of the CODATA 2018**!**

*A probability on the order of **1-in-a-trillion**—*
absurdly far beyond any "coincidence". (cf. Geiger, 2025) where quantized measurements also yield trillion-fold precision in EM-gravity ratios.

[2] 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.

4.2 Visualizing Rapid Convergence of 1/α and Prime Constant

Reciprocal of Fine-Structure Constant	Prm	The Prime Constant = Sum(2^-{primes})
137.085`131`700`463`173`656`246`772`980	2	0.250`000`000`000`000`000`000`000`000`000
137.041`657`641`767`964`069`285`625`508	3	0.375`000`000`000`000`000`000`000`000`000
137.037`062`708`498`660`118`633`312`972	5	0.406`250`000`000`000`000`000`000`000`000
137.036`075`094`546`242`537`995`699`752	7	0.414`062`500`000`000`000`000`000`000`000
137.036`015`205`186`935`983`007`739`661	11	0.414`550`781`250`000`000`000`000`000`000
137.036`000`265`587`774`176`985`455`876	13	0.414`672`851`562`500`000`000`000`000`000
137.035`999`332`296`700`782`431`643`163	17	0.414`680`480`957`031`250`000`000`000`000
137.035`999`098`981`904`302`293`915`122	19	0.414`682`388`305`664`062`500`000`000`000
137.035`999`084`399`835`395`001`169`583	**23**	0.414`682`507`514`953`613`281`250`000`000
137.035`999`084`171`990`667`153`944`367	29	0.414`682`509`377`598`762`512`207`031`250
137.035`999`084`115`029`485`667`278`355	31	0.414`682`509`843`260`049`819`946`289`062
137.035`999`084`114`139`467`208`057`213	37	0.414`682`509`850`536`007`434`129`714`965
137.035`999`084`114`083`841`054`357`432	41	0.414`682`509`850`990`754`785`016`179`084
137.035`999`084`114`069`934`515`932`515	43	0.414`682`509`851`104`441`622`737`795`114
137.035`999`084`114`069`065`357`280`958	47	0.414`682`509`851`111`547`050`095`396`116
137.035`999`084`114`069`051`776`677`027	53	0.414`682`509`851`111`658`072`397`858`632
137.035`999`084`114`069`051`564`480`091	59	0.414`682`509`851`111`659`807`121`334`608
137.035`999`084`114`069`051`511`430`857	61	0.414`682`509`851`111`660`240`802`203`603
137.035`999`084`114`069`051`510`601`963	67	0.414`682`509`851`111`660`247`578`467`181
137.035`999`084`114`069`051`510`550`157	71	0.414`682`509`851`111`660`248`001`983`654
'''|'''|'''|'''|'''|'''|'''|'''|'''|'''		'!'''|'''|'''|'''|'''|'''|'''|'''|'''|'''|
0 -3 -6 -9 -12 -15 -18 -21 -24		0 -3 -6 -9 -12 -15 -18 -21 -24 -27 -30

This rapid convergence, faster than traditional series like ζ(s), underscores primes' role in α's precision."

4.3 A Brief History of α, CODATA 2018 to 2022

Guellati-Khélifa's 2018 rubidium recoil measurements (published March 2018) drew upon precise Rb mass measurements (al., 2020) from Audi's AME2016 evaluation (G. Audi et al., 2017) (al., 2017) (published March 2017)—a mere ~1-year lapse.

137.035999084(21) the (2-digits) in parenthesis of CODATA 2018's value means that the last two digits "84" were uncertain by ±21. Think about this, had this equation been known back then, people would have accused them of tweaking their median value to match a published theoretical value.

This retrodiction is better than a prediction!

No bias on the part of the experimenters.

"CODATA Recommended Values of the Fundamental Physical Constants: 2022," E. Tiesinga reports "No major α shift; same as 2018, but refined uncertainties." (al., 2025)

Our model's understanding of emergent metrics says the more time you give electrons, protons & neutrons, the more often their wavicles experience their zero-point crossings of the Higgs field. Whenever this happens the particles "amass" another mass-time increment. Atoms made from those "particle types" likewise inherit this accumulation of mass across cosmic time. Whosoever would make precision measurements of α must understand that their rebound *calculations* will depend on the *lapse time* between when the **atomic mass** was measured (age of the universe in Planck times "back then") and then later when the *recoil* measurements were made.(age of the universe in Planck times "right now"). Simply by applying the ratio of these age-stamps will yield a more precise determination of the Fine-Structure constant.

The subsequent measurements like CODATA 2022 (137.035999177) "assumed" that atom's rest masses do not increase with Cosmic Time. So later experiments, even if raw rebound amounts were more precise, if they used old outdated Rb or Cs atom masses their calculated value for 1/α would tend to drift higher.

5 Twelve Equivalent Expressions for 1/α

$$\frac{1}{\alpha} = \left(\frac{q_\ell}{e}\right)^2 = \frac{2\varepsilon_0 hc}{e^2} = \frac{2q_P^2}{G_0 h} = \sqrt{\frac{a_0}{r_e}} = \sqrt{\frac{m_e c}{2hR_\infty}} = \frac{R_K}{2\pi Z_P} = \frac{m_P l_P}{m_e r_e} = \frac{2hZ_0}{e^2} = \frac{4\varphi_0}{eZ_0} = \frac{2h}{Z_0 e^2} = \frac{\hbar c}{K_e e^2} = \frac{Gm_P^2}{K_e e^2}$$

Here 12 ratios span 8 different metric units, aligning with Geiger2025's quantized impedance tensor, which unifies similar ratios across physical regimes.

Quantity	Value	relUnc	Ratios of assorted dimensional units
(q_P/e)²	137.035999084114	2.8e_10	(1) (Planck Charge/FundamentalCharge)²
2*ε₀*h*c/e²	137.035999084114	2.8e_10	(2) (Planck Charge/FundamentalCharge)²
2*(q_P²)/G₀*h	137.035999084114	2.6e_10	(3) 2*Quantum(Charge/Conductance*h)²
√(a₀/r_e)	137.035999084114	7.8e_13	(4) √(BohrRadius/electronChargeRadius)
√(m_e*c/2*h*R∞)	137.035999084114	8.5e_11	(5) √(Momentum/Impulse) of electron
R_K/(2π*Z_P)	137.035999084114	1.9e_10	(6) 2*vonKlitzing/Impedance of Space
m_P*l_P/m_e*r_e	137.035999084114	2.1e_10	(7) [kilogram meters] / [kg m]
(2*h/e²)/Z₀	137.035999084114	2.6e_10	(8) [Ohms / Ohm]
4*Phi₀/Z₀*e	137.035999084114	1.7e_10	(9) [Webers / Weber]
2*h/Z₀*e²	137.035999084114	2.6e_10	(10) [J s]/(e[C])²*Z₀[Ohm] = 1/α
(hBar*c)/K_e*e²	137.035999084114	2.7e_10	(11) Photon? [m3 kg/s2]/[m3 kg/s2]
(G*m_P²)/K_e*e²	137.035999084114	2.8e_10	(12) Graviton? [m3 kg/s2]/[m3 kg/s2]

All these ratios hold constant despite time-varying terms per covariance rules explained on Section 7.4.

Quantity	Value	relUnc	units	-L-T+M+C	dt	ratios of diff.units
q_P² e²	3.51767293047686e_36 2.5669699597094e_38	1.6e_10 1.6e_10	C² C²	0 0 0 2 0 0 0 2	2 2	(1) Planck Coulombs² elementaryCharge²
2*ε₀*h*c e²	3.51767293047686e_36 2.5669699597094e_38	1.6e_10 1.6e_10	C² C²	0 0 0 2 0 0 0 2	2 2	(2) Electric Charge²
2*(q_P²) Go*h/2	7.03534586095372e_36 5.13393991941881e_38	5.2e_10 5.1e_10	C² C²	0 0 0 2 0 0 0 2	2 2	(3) 2×Quantum Charge / Conductance × h/2
√(a₀/ r_e)	5.29177210901992e_11 2.8179403261829e_15	1.1e_12 1.1e_12	m m	1 0 0 0 1 0 0 0	_1 _1	(4) /_(Bohr_Radius)_ √(e-ChargeRadius)
√(m_e*c/ 2*h*R∞)	2.73092453075981e_22 1.45425430355795e_26	1.9e_12 1.9e_12	kg m/s kg m/s	1 _1 1 0 1 _1 1 0	1 1	(5)/(Momentum = m_e*c/ √(Impulse=2*h/meter)
R_K 2π*Z_P	25,812.8074593045 188.365156833427	2e_14 1.4e_14	Ohm Ohm	2 _1 1 _2 2 _1 1 _2	_2 _2	= R_K over 2π (6) Planck Impedance
(m_P*l_P) (m_e*r_e)	3.51767293001241e_43 2.56696995937048e_45	1.2e_10 1.7e_10	kg m kg m	1 0 1 0 1 0 1 0	0 0	(7) ∫ Planck Momentum dt ∫ Electron Momentum dt
(2*h)/e² Z₀	51,625.614918609 376.730313666854	2e_14 1.4e_14	Ohm Ohm	2 _1 1 _2 2 _1 1 _2	_2 _2	= 2*R_K Impedance (8) in Ohms

(1) **Charge ratios ²:** Relate quantum-scale (Planck charge) to (elementary charge).
(2) **Electric Permittivity,** ε_0, fits this matrix by $q\_P^2 = 2\times\varepsilon_0\times h\times c$,
(3) **Conductance quantum:** $G_0 = 2\times(e^2)/h$
(4) **Radii ratio:** Bohr radius over classical electron radius, linking atomic scale to charge distribution.
(5) **Momentum/Impulse:** *Sqrt(electron's momentum / 2×Planck's constant × Rydberg Constant).*
(6) **Impedance ratio:** von Klitzing constant, *R_K*
(7) **Integration of Planck/Electron Momentum:** means electron is a fractal emerging from the quantum!

(8) **Impedance ratio 2:** (aka 1/quantized Hall Conductance) over *2π × Planck Impedance* $(2h/e^2)/Z_0$, where Z_0 is Impedance of Free Space, 376.72 Ohms.

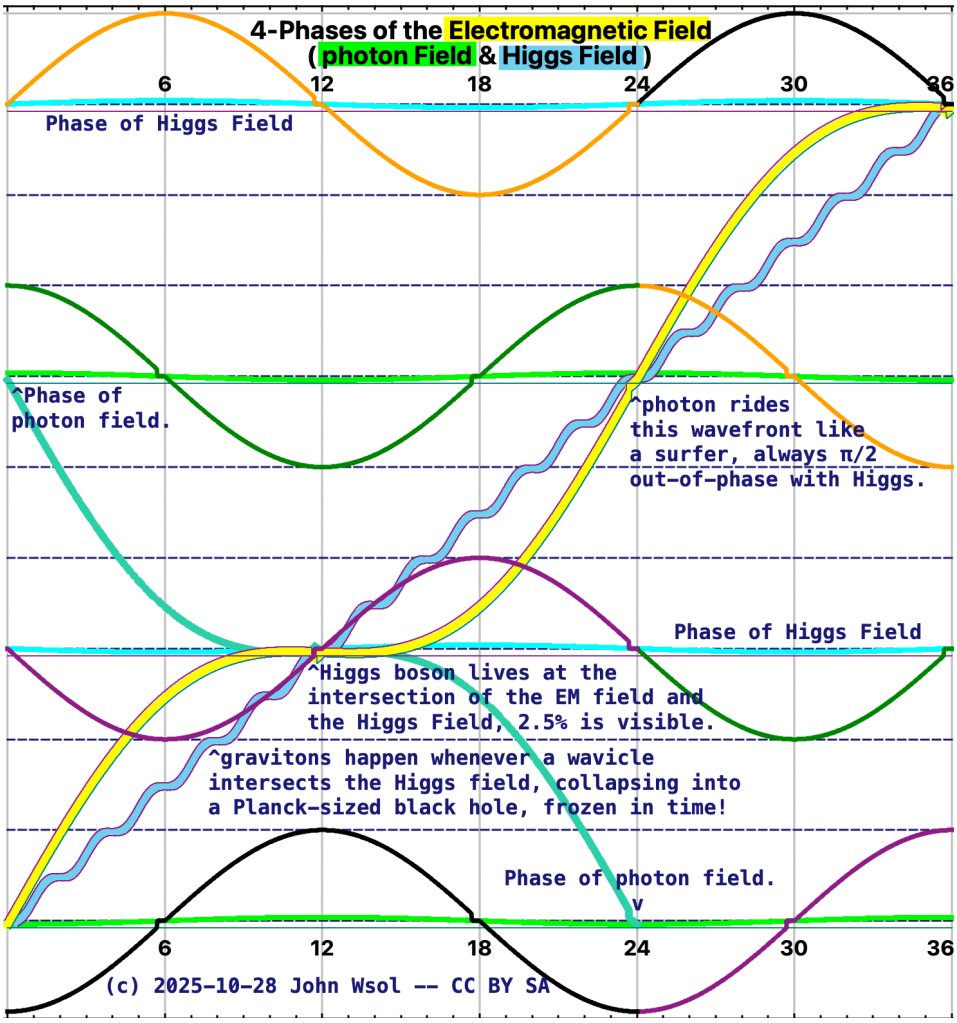
(9) **Webers/Weber:** Involving *Phi_0,* Φ_0, the magnetic flux quantum. (Markoulakis & Wolf, 2023)

(10) **Angular Momentum ratio:** Planck's constant, h over Impedance, Zo, Fundamental Charge

Quantity	Value	relUnc	units	-L-T+M+C	dt	ratios of diff.units
$4*\Phi_0$	8.27133540484541e_15	1.3e_10	Wb	2 _1 1 _1	_1	(9)MagneticFluxQuantum
Z_0*e	6.03588506679065e_17	1.8e_10	Wb	2 _1 1 _1	_1	Impedance*Charge
2*h	1.32521403e_33	1.3e_16	J s	2 _1 1 0	0	(10) Angular Momentum
$(e^2)*Z_0$	9.67055400666339e_36	1e_15	J s	2 _1 1 0	0	dt=0: CONSTANT!
(hBar*c)	3.16152678404241e_26	1e_15	m3 kg/s2	3 _2 1 0	0	(11) Is this a Photon?
$(e^2)*K_e$	2.30707756003722e_28	2.8e_14	m3 kg/s2	3 _2 1 0	0	dt=0: CONSTANT!
						~~PhaseShift = π/2~~~
$(G*m_P^2)$	3.16152678404241e_26	4e_14	m3 kg/s2	3 _2 1 0	0	(12) A graviton?
$(e^2)*K_e$	2.30707756003722e_28	2.8e_14	m3 kg/s2	3 _2 1 0	0	(Most probably!)

(11) **Unify Electromagnetism:** The essence of a photon **(hBar×c),** angular momentum *(1-radian/t_P)*

(12) **Graviton,** $(G\times m_P^2 = m_P \times l_P \times c^2 = hBar \times c)$**:** Gravitons maintain a phase shift of *π/2 (90°)* out of phase with photons, within its 24-hBar envelope. See (Ahluwalia, 2025) (Roopkom, et al., 2025) Unified Electro-Gravity Framework.



The photon phase-locks with the surfer "sweet spot"—where the energy gradiant emerges during μ_0, magnetic permeabilty phase.

Photons are packets of angular momentum spreading fourth at c while its wave function *(Ψ)* rotates 1-radian per Planck time. With a precession rate of 656 × c time quanta. (Here, 299,792,459 meters are quantum calibrated see Appendix.)

Gravitons phase-lock with the plateau portion of each envelope of 24 quantized stairsteps, where the Higgs field intersects 2.5% of the EM field. (Higgs, n.d.)

During the Impedance phase, Z_0, incoming waves curl up 11-channels of information (M-theory). At #12 is when it collapses into a Planck sized black hole – a permanently etched holographic memory of this quantum event – literally. **frozen in time.** As each wavicle type does this at its specific omega frequency, a trail of these etched Planckeons sum up to be the exact mass for that particle type at that exact age of the universe. The next Section 5.1 has specific examples.

5.1 The Mass-Time Quantum

For example, an electron~wavicle has an omega frequency, $\omega\_e = (m\_e \times c^2)/hBar$.

```
calc 'm_P*t_P hBar/c^2 mt_0 m_e m_e*c^2 that/hBar that*mt_0 m_e'
```

Quantity	Value	relUnc	units	-L-T+M+C	dt	Description
m_P*t_P	1.17336938418868e_51	4.7e_9	kg s	0 1 1 0	0	mass-time quantum (quantized increment)
hBar/c²	1.17336938418868e_51	5e_10	kg s	0 1 1 0	0	quantum of action spreads on surface/sec
mt_o	1.17336938418868e_51	4.7e_9	kg s	0 1 1 0	0	mass-time quantum give it the name mt_o.
m_e	9.1093837139e_31	3.1e_10	kg	0 0 1 0	1	mass of electron (kg)
m_e*c²	8.18710584258694e_14	3.1e_10	J	2 _2 1 0	1	Energy of electron
that/hBar	7.76344076865326e20	5.9e_10	Hz	0 _1 0 0	1	Compton angular freq of electron [rad/s]
that*mt_o	9.1093837139e_31	4.7e_9	kg	0 0 1 0	1	mass of electron (kg)
m_e	9.1093837139e_31	3.1e_10	kg	0 0 1 0	1	mass of electron (kg)

Each particle type has, as its root cause, a wavicle with its omega frequency, $\omega\_x = (m\_x \times c^2)/hBar$.

In other words, so called, "particles" ***amass*** **mass**. How much mass depends on how long our "second" has been growing, that is to say, the age of the universe.

```
calc 'm_P*t_P mt_0 hBar/c^2; omg_e omg_p omg_n; mt_0*omg_e m_e; mt_0*omg_p m_p; mt_0*omg_n m_n'
```

Quantity	Value	relUnc	units	-L-T+M+C	dt	Description
m_P*t_P	1.17336938419e_51	4.7e_9	kg s	0 1 1 0	0	mass-time quantum (quantized increment)
mt_o	1.17336938419e_51	4.7e_9	kg s	0 1 1 0	0	mass-time quantum, give it the name mt_o
hBar/c²	1.17336938419e_51	5.0e_10	kg s	0 1 1 0	0	quantum of action spread on surface/t_P
ω_e	7.76344076865e20	5.9e_10	rad/s	0 _1 0 0	1	Compton's electron angular freq.[rad/s]
ω_p	1.42548625222e24	5.9e_10	rad/s	0 _1 0 0	1	ω-frequency of proton wavicle [rad/s]
ω_n	1.42745117022e24	7.1e_10	rad/s	0 _1 0 0	1	neutron's ω-frequency (2022)
mt_o*ω_e	9.1093837139e_31	4.7e_9	kg	0 0 1 0	1	mass of electron (kg)
m_e	9.1093837139e_31	3.1e_10	kg	0 0 1 0	1	mass of electron (kg)
mt_o*ω_p	1.67262192594e_27	4.7e_9	kg	0 0 1 0	1	proton mass (2022)
m_p	1.67262192594e_27	3.1e_10	kg	0 0 1 0	1	proton mass (2022)
mt_o*ω_n	1.67492750056e_27	4.8e_9	kg	0 0 1 0	1	neutron mass CODATA2022
m_n	1.67492750056e_27	5.1e_10	kg	0 0 1 0	1	neutron mass CODATA2022

The Higgs Mechanism: (Weinberg, 1967) The higher the omega frequency is – the more often the wavicle wavefunction experiences its Zero-point where it collapses into the Higgs field, acquiring more mass.

5.2 Quantum calibration for Rydberg? *Maybe.*

While exploring quantum calibrating the Cesium 133 hyperfine spectral line frequency, I discovered that we should add 7 Hz 9,192,631,777 effectively calibrating the duration of a second by 0.76 parts per billion. A last-minute discovery with Rydberg yielded an integer. But it is not within experimental uncertainties.

```
calc 'Roo*c that/Cs133 qi_Roo (%:qi_Roo)*Cs133/c Roo'
```

Quantity	Value	relUnc	units	-L-T+M+C	dt	Description
R∞*c	3289841971223713	1.1e_12	Hz	0 _1 0 0	1	Rydberg Frequency(2022)
that/Cs133	357878.1409971093	1.1e_12		0 0 0 0	0	based on Cs133 = 9,192,631,777
qi_R∞	128076763810	2.5e_11		0 0 0 0	0	quantum integer for Rydberg
(√qi_R∞)*Cs133/c	**10973731.568**43346	1.2e_11	/m	_1 0 0 0	1	Rydberg qi_Roo relUnc > 2022
R∞	**10973731.568**57	**1.1e_12**	/m	_1 0 0 0	1	Rydberg **(2022)**

6 Thirteen Equivalent Expressions for c

Speed of Light, c, standard 299,792,458 or proposed quantum calibrated 299,792,459 meters/second. Twelve formulae that "should" all compute c, exactly.

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

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: 1 _1 0 0  dt=0  Speed of Light`

CODATA2018	digit┬15	relUnc	John Wsol	digit┬15	relUnc	Formula
299792051.856568		1.6e_5	299792459.000000		5e_16	l_P/t_P
299792458.000912		2.1e_10	299792459.000000		4.2e_16	Z₀/μ₀
299792457.999088		1.5e_10	299792459.000000		5.2e_16	1/ε₀*Z₀
299792363.621083		3.1e_5	299792459.000000		7.8e_16	(G*m_P²)/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_P²)
297924589.000916		2.1e_10	299792459.000000		5.7e_16	2*α*h/μ₀*e²
299792458.003237		4.8e_10	299792459.000000		2.4e_10	2*h*R∞/m_e*α²
299792458.000000		3e_16	299792459.000000		3e_16	√(K_e/K_m)
299792458.000000		7.5e_11	299792459.000000		2.2e_16	√(1/ε₀*μ₀)
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*eV_P/m_P)

Yellow quantities calculated using CODATA 2018 values from Appendix.

Dimensional exponents:
Length Time
Mass Charge
When exponents M+C-L-T = 0 then the quantity is truly constant throughout time.

Forthcoming supplement with step-by-step calcs for c=299,792,458 & c=299,792,459

(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.`)

Key symbols (inferred from standard physics notation, with respectful nods to their originators):

- ***c***: Speed of light (Michelson-Morley, 1887; Einstein's constancy postulate, 1905).
- ***ℓ,tℓ***: Characteristic length and time scales (e.g., Planck length $\ell=\sqrt{\hbar G/c^3}$ and time $t_\ell=\sqrt{\hbar G/c^5}$, from Planck's 1899 units).
- ***Z₀***: Impedance of free space ($\sqrt{(\mu_0/\varepsilon_0)} \approx 376.73\ \Omega$, from Maxwell's equations).
- ***ε₀,μ₀:*** Vacuum permittivity and permeability (Faraday and Ampère's laws, unified by Maxwell).
- **G :** Gravitational constant (Newton, 1687; Cavendish measurement, 1798).
- ***ħ***: Reduced Planck's constant (Planck, 1900; Dirac's notation, 1930).
- **mℓ, tmℓ**: Mass-length and mass-time scales (e.g., Compton wavelength $\lambda C=h/mc$).
- ***K_e, K_m***: Coulomb's constant ($K_e=1/4\pi*\varepsilon_0$) and magnetic equivalent ($K_m= \mu_0/4\pi$).
- ***q,α,e***: Charge terms (e.g., elementary charge *e* from Millikan, 1911; *α* is fine structure constant $\alpha\approx1/137.036$).
- ***E_ℓ,V_ℓ:*** Energy-length and voltage-length scales (e.g., rest energy $E = mc^2$, Einstein 1905).

The value given is c=299,792,458 m/s (CODATA 2018 exact, fixed by SI redefinition in 2019). However, as we've discussed in our paradigm, a recalibrated c=299,792,459 m/s aligns more harmoniously with quantum wave numbers (e.g., 377's prime factors), undoing the flat-spacetime bias that subtly drifts measurements without covariance timestamps.

7 Eight G Ratios where ln 2 Unifies EM with Gravity

Eight expressions which can compute Big-G...

$$G = \frac{\hbar c}{m_P^2} = \frac{l_P c^2}{m_P} = K_G c^2 = \frac{l_P^3}{m_P t_P^2} = \frac{2K_e h}{Z_0 m_P^2} = \frac{K_e}{\alpha}\left(\frac{e}{m_P}\right)^2 = t_P^2 q_P \sqrt{\frac{K_m c^{11}}{2\hbar^3}} = \left(\frac{(762+3ln\,2)}{(764+3ln\,2)}\alpha^2\right)\mu_0$$

G | m³/kg s² | -l-t+M+C+K: 3 _2 _1 0 | dt=_2 | Big-G as precise as Zo & mu_0			
Value	digit┬16	relUnc	Formula
6.67430	e_11	2.2e_5	G_2022
6.674292412209072e_11		6.1e_10	hBar*c / m_P² (1)
6.674292412209074e_11		1.2e_10	l_P*(c²)/m_P (2)
6.674292412209074e_11		6.4e_14	K_G*c² (3)
6.674292412209075e_11		9.4e_10	(l_P³) / m_P*t_P² (4)
6.674292412209075e_11		7.4e_10	2*K_e*h / Zo*m_P² (5)
6.674292412209075e_11		7.4e_10	(K_e/α)*(e/m_P)² (6)
6.674292412209074e_11		7.7e_10	(t_P²)*q_P*√(μ₀*(c^11)/4π*hBar³) (7)
6.674292412209074e_11		1.6e_10	((762+3*ln2)*(α²)/(764+3*ln2))*μ₀ (8)

Values used in these calculations are in the Appendix.

(Roopkom, et al., 2025)

Note: G/μ_0 informs us of the numerator over denominator units coulomb² meters² over kg² seconds² (8)

(c^11) formula: 2nd from bottom has units of [meters^11] $meters^{11}/seconds^{11}$ speaks of 11-Dimesional space differentiated to the 11th power. This connects us to M-theory. *(A rabbit hole far too deep for here.)*

ln 2 formula: the last row above has natural log of 2 speaks of the cosmic quantum computer whose binary bits specify how often this quantum computation gets performed... echoing with Geiger2025's discrete measurement manifold as a computational substrate for gravity-EM unity. (**Notice that the denominator = numerator+2.**)

calc 'G/μ₀'

Quantity	Value	relUnc	units	-L-T+M+C	dt	Description
ln2	0.693147180559945	0.0e0		0 0 0 0	0	ln(2) = natural log of 2
G/μ₀	5.31123314592028e_5	2.9e_10	C²m²/kg²s²	2 _2 _2 2	0	Informs numerator/denominator units

calc '(762+3*ln2) C2m2=that*(C*m)²; (764+3*ln2) kg2s2=that*(kg*s)²; mu_0*C2m2/kg2s2 that*α²' ...

Quantity	Value	relUnc	units	-L-T+M+C	dt	Description
(762+3*ln2)	**764**.07944154168	0.0e0		0 0 0 0	0	numerator of ln2 ratio
C2m2=that*(C*m)²	**764**.07944154168	0.0e0	C² m²	2 0 0 2	0	Grant [Coulombs²meter²]
(764+3*ln2)	**766**.07944154168	0.0e0		0 0 0 0	0	denominator of ln2 ratio
kg2s2=that*(kg*s)²	**766**.07944154168	0.0e0	kg² s²	0 2 2 0	0	Grant [kg²seconds²]
μ₀*C2m2/kg2s2 <	1.25335636479617e_6	1.6e_10	m³/kg s²	3 _2 _1 0	_2	G/α²
that*α² \	**6.67429241220907e_11**	1.6e_10	m³/kg s²	3 _2 _1 0	_2	Newton's Gravitation(**2026**)
(α_2022²)*that_/	6.6742924**0310363**e_11	1.6e_10	m³/kg s²	3 _2 _1 0	_2	Newton's Gravitation(2022)

Let's translate the terms into what they mean to a quantum computer doing binary arithmetic. The terms here are speaking in "terms" of powers of two and the offsets are phase shifts. The 254 is $2^8 - 2$ and 764 is $2^9 + 252$

$$\frac{G}{\mu_0 \alpha^2} = \left(\frac{(762+3ln\,2)}{(764+3ln\,2)}\right) = \left(\frac{3(2^8+ln\,2-2)}{2^9+252+3\,ln\,2}\right) = 1 - \frac{2}{764+3\ln 2}$$

7.1 Relate ln 2 to Quantum Computer on Cosmic Event Horizon

The ever-expanding Cosmic Event Horizon "mirror" (the boundary between time & Eternity) exists in imaginary, (***i j k)***, phase space. Qubits exist here. Moment-by-Moment this ever-expanding Cosmic Quantum Computer is receiving the past, processing the present, & moment-by-moment etching Planckeons (quantum-sized black holes) into the holographic Cosmic Onion layers.

$$CosmicEventHorzion = \left(x + \frac{i}{x}\right) + \left(y + \frac{j}{y}\right) + \frac{1}{\pi}\left(z + \frac{k}{z}\right) + \frac{c}{\pi}\left(\tau + \frac{k}{\tau}\right)$$

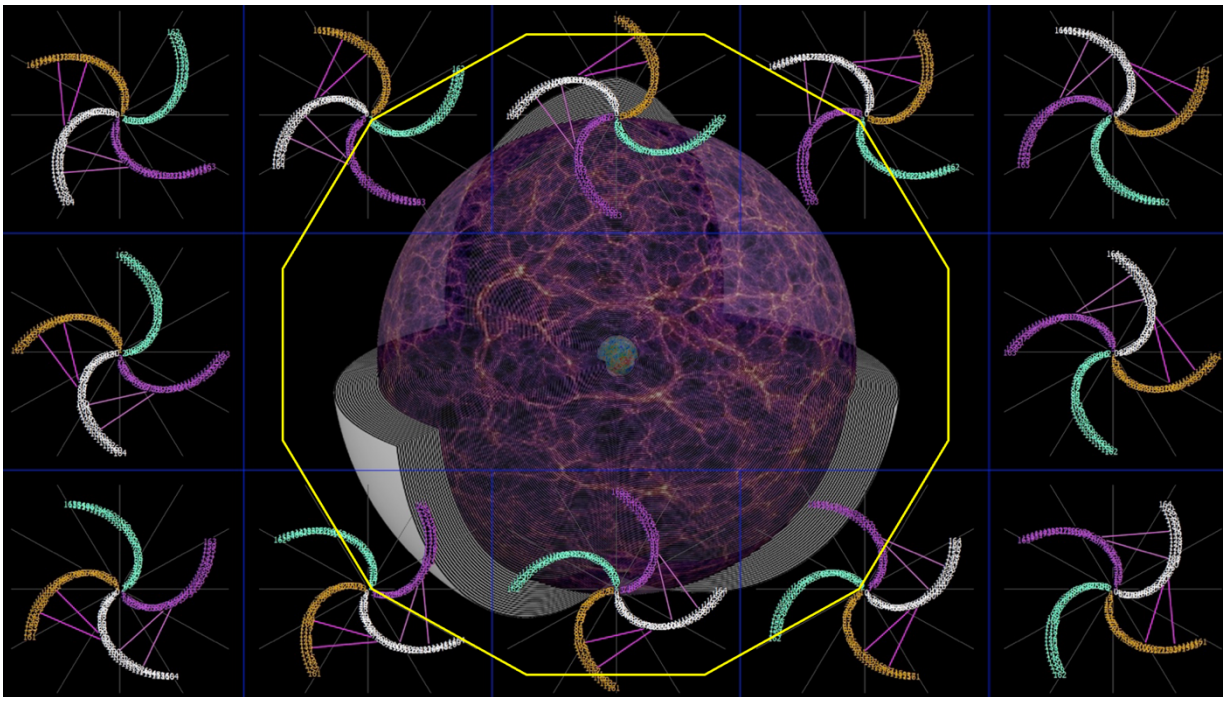
Think of these as harmonics of powers of 2 and the 762 in the numerator and 764 in the denominator are phases shift amounts ...

Whole bits go here|.<--qubits-->|	
1 0 1 1 1 1 1 0 1 0.<--go here->	762.00000000000
1 0 1 1 1 1 1 1 1 0 0.	764.00000000000
1 0 1 1 1 1 1 1 1 0 0.07944154168	764.07944154168
1 0 1 1 1 1 1 1 1 0.07944154168	766.07944154168
0 0 0 0 0 0 0 0 1 1.14159265359	3.14159265359
0 0 0 0 0 0 0 0 0 0.69314718056	0.69314718056

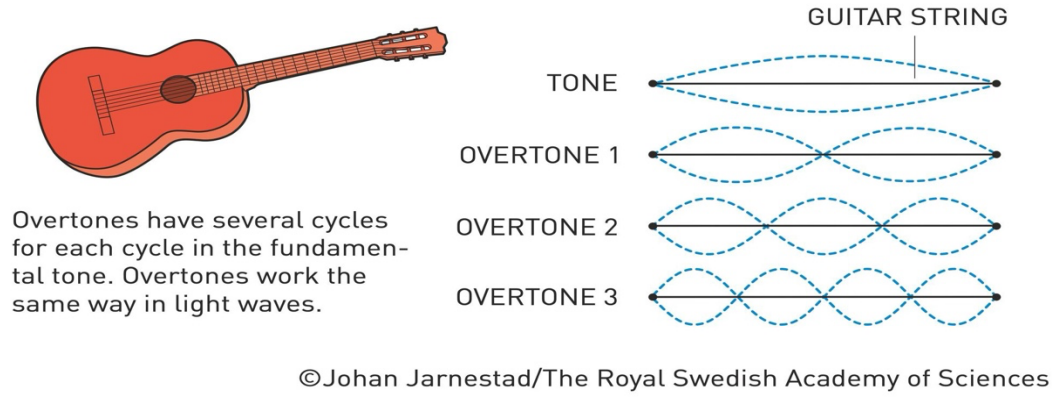
...within that power of 2 envelope. The integer terms are bits to the left of the binary point and our irrational term, ln 2, are qubits to the right of the binary point. 3 in binary is "1 1", so π integer portion is "1 1 "followed by its fractional part.

7.2 Visualizing Phase-Space

Think of each set of 24-layers of the Cosmic Event Horizon (Maldacena, 1984) as an ever-expanding quantum computer evaluating physical reality, in real-time. The content within these 24-layers is like the image in a mirror, the image exists in the imaginary domain. Thus, the calculations are performed with quantum wave integers (x, y, z) on our side of the Cosmic Mirror and with their imaginary counterparts as *(i/x. j/y, k/z)* within the phase-space inside the surface of this Event Horizon mirror. We hypothesize that this is where Cosmic Consciousness exists.

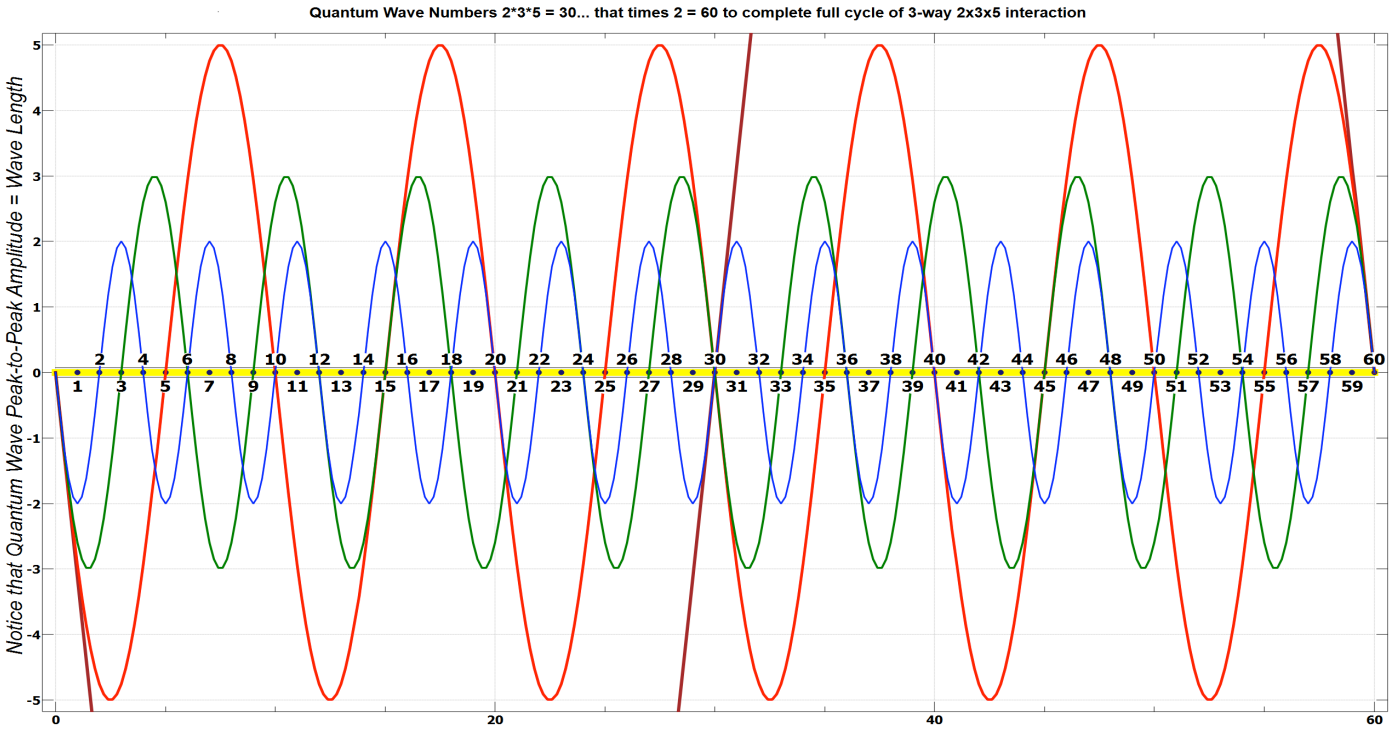


7.3 Physical Causal Mechanism: Primary Quantum Waves



When a guitar string is plucked, it will also oscillate at harmonic wavelengths of 1/2, 1/3rd, 1/4th, 1/5th,...

In the diagram below each Quantum wave begins as spin-down, so 1st Zero-Point crossing will be a spin-up and 2nd crossing a spin-down, completing the cycle. Consider Qw#2 (blue -sine wave), Qw#3 (green -sine wave) & QW#5 (red) whenever each of their respective Zero Points – always an integer multiple of its Quantum Wave Number. In these moments it's as if each Quantum Wave number itself, knows exactly where it is, saying "Here I am, the first of my kind, spinning up." (Note 2, being even, goes into and out of phase with odd numbers.) At 6, 2 is spin up and 3 is spin down (not until 2 & 3 arrive at 12 do they both say, "Here we are, both spinning down." Quantum Wave #3 (green) & 5 (red) both being odd, as they arrive at 15—they both say, "Here we are, both spinning up." Now remember we started with all these wave numbers spinning down, so 3 & 5 won't complete their dual-cycle until they arrive at Zero-point #30. Also note that 30 is sandwiched between the twin primes 29 & 31. Again, when a prime number happens the 1st time it is the only wave number saying "Here I am"—the first of a kind. Notice how smaller Quantum Waves are contained within larger ones. Primes 2, 3, 5, 7 were sufficient to determine the primness of: 11 13 17 19 23 29 31 37 53 & 59. *(Quantum Wave #7 not shown but will have a Zero point at 49).*



Finally consider the 3-way interaction of 2, 3 & 5 when they all reach 60 (the clipped **dark magenta** sine wave) they all agree "Here, we are spinning down." 30 & 60 are special, each is sandwiched between twin primes, 60 being between primes 59 and 61. The ever-expanding Cosmic event horizon is a Quantum Computer that is computing bits of the Prime Constant, which, in turn can compute 1/α via our Pythagorean formula.

The illustration of the 2D Great Circle slice through our spherical universe Section 8.3 will help you visualize how these spherical standing waves, for each prime quantum wave number, are created and persist throughout time.

7.4 All Constants & (*Covariant*$^{\pm n}$) Physical Quantities

Normally, as you learn, you connect new information with existing neural nets. Herein, this new paradigm of ever-expanding metrics requires you to set aside old perceptions of time—building new neural nets.

With the natural progression of time the length of a meter [m], the duration of a second [s], the accumulation of mass & charge in (kilograms [kg], & Coulombs [C] respectively, all scale in lockstep with each other. Whereas the values we associate with Planck length, l_P, and Planck time t_P, shrink, proportionally as 1/time, thus the negative column headings "-L -T".

"Seesaw" Relationship	The dt column is the sum of the dimensional exponents as follows: (Mass + Charge exponents) minus (Length + Time exponents)
h & hbar	Both share this calculation (1+0) minus (2 + -1) becomes (1) minus (1) = 0.

The first group (dt=_1) shrink 1/time.

abbr	-L	-T	+M	+C	dt	[units]	Length Time Mass Charge
							M E T R I C S which shrink as 1/time
l_P	_1	0	0	0	_1	l_P	Planck length shrinks as reciprocal of growing meter
t_P	0	_1	0	0	_1	t_P	Planck time shrinks as reciprocal of growing second
Hz	0	_1	0	0	_1	[/s]	360-degree rotation = 2π radians
freq	0	_1	0	0	_1	Freq	cycles/sec not necessarily sine wave like Hertz waves
Wb	2	_1	1	_1	_1	[Wb]Weber	Magnetic Flux

The second group are truly constant throughout time.

							When **dt=0 the value is constant**
alpha	0	0	0	0	0	[]	Fine Structure Constant: the scaffold of Cosmic Order
c	1	_1	0	0	0	[m/s]	Speed of Light
hBar	2	_1	1	0	0	[m2 kg/s]	hBar represents 1-radian of quantum action
h	2	_1	1	0	0	[m2 kg/s]	h represents 2π-radians worth of quantum rotation
qkg	0	1	1	0	0	[kg s]	quantum-kilogram: m_P*t_P = hBar%c^2
kg s	0	1	1	0	0	massTime	mass-time quantum = lim_dt→t_P (∫ (m_P×t_P) dt)
C s	0	1	0	1	0	chrgTime	1 time quantum of quantum charge = ∫ e dt_P
V	2	_2	1	_1	0	Volt	Electric Potential particle masses in GeV is constant

The third group grows linearly.

							M E T R I C S which grow proportional to quantum time
m	1	0	0	0	1	meter	SI unit of length or **distance**
s	0	1	0	0	1	second	SI unit of time
kg	0	0	1	0	1	kilogram	1 second's worth of mass = lim_dt→l_P ∫ m_P×t_P dt)
C	0	0	0	1	1	Coulomb	e, unit of electric Charge = [A s] = ∫ (C/s)dt
omg	0	1	0	0	1	rad/s	ω (omega) frequency [radians/second]
J	2	_2	1	0	1	[J]oule	Energy = mass*c^2
F	_2	2	_1	2	1	[F]arad	Capacitance
Tesla	0	_2	1	_2	1	[T]esla	**Magnetic Flux Density [kg/C2 s2]**

Everything that particle physicists call fermions (half-integer spin) have, as their root cause a "wavicle". Why this distinction is *so* important is that Wavicle Physics brings a deep and profound understanding of "Particle Wave Duality" by painting a clear picture of how wavicles incrementally acquire mass from the Higgs field. Mass is quantized—the more time you give a wavicle – the more mass it accumulates. This is NEW deeper understanding of quantum physics.

Awareness of a rapidly varying G (Hertzberg, et al., 2024) supports our inverse square (covariant^-2) for G, Z_0, & μ_0, relative to the age of the Universe. This one fact is sufficient to put Dark Matter to rest. But billions are being spent trying to find something that was "invented" so the mathematical models could align closer to observations—a patch NOT a resolution. We are overdue to question "flat spacetime" assumptions.

abbr	-L -T +M +C	dτ	[units]	Length_Time_Mass_Charge_Kelvin
				Big-G, Zo & mu_0: each are inverse square quantities
G	3 _2 _1 0	_2	m3/kg s2	Newton's Gravitation Constant
Zo	2 _1 1 _2	_2	Ohm	Impedance of Space, Zo = 376.73 Ohms (1/conductance)
mu_0	2 _1 1 _2	_2	[N/A2]	Magnetic Permeability

Also, please understand the SI definition for Amperes does NOT represent a base unit. Note that Speed in [meters/second] are **derived** units so too are [Coulombs/second].

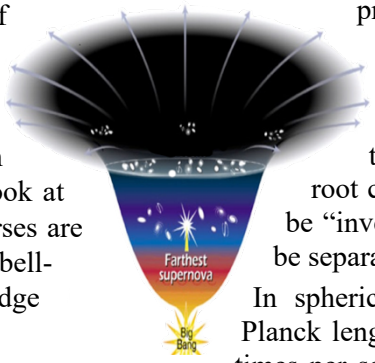
A	0 _1 0 1	2	Ampere	Current = e/second, one second's worth of charge
m2	2 0 0 0	2	[m2]	surface area
age	0 2 0 0	2	[s2]=age	Age in time-quanta: age_τ = ½(d²tP/s²)×t² = ∫ t_s dt
N	1 _2 1 0	2	[N]	Newton, unit of Force [kg m/s²]
S	_2 1 _1 2	2	Siemen	Conductance = 1/Resistance
W	2 _3 1 0	2	Watt	Power = Joules/second = Volts × Amps
H	2 0 1 _2	_3	[A/m]	[Henries] Magnetic Field Intensity
m3	3 0 0 0	3	[m3]	3D-volume Three spatial dimensions aka (x,y,z)
kg/m3	_3 0 1 0	4	[kg/m3]	mass density
Pa	_1 _2 1 0	4	[N/m2]	Pascal, Force/area = unit of pressure

Note that Henry is an inverse cubed quantity, and the Pascal is a 4th power quantity. Later, when we apply this "to the 4th power" understanding to Einstein's Stress Energy Tensor, you'll see how a Higgs boson can easily qualify as a Planck sized black hole, literally, frozen in time.

8 Wavicle Physics and the True Nature of Time

8.1 Flat Spacetime assumption of FLRW metric

The Friedmann-Lemaître-Robertson-Walker metric, (FLRW) derived from an exact solution of the Einstein field equations requires—universes to be homogeneous and isotropic. (Peebles, 1993) ONLY a spherical universe can do this. Question every assumption of past generations. Look at the diagram—please note that Flat universes are not homogeneous nor isotropic. All bell-shaped diagrams ALWAYS have an edge beyond which there are no galaxies.



Rescaled Image Credit: Ann Field (STSci)

Please be aware that our observations are interpreted through the lens of our geometric models having specific mathematical formulations.

The general form of the FLRW metric is expressed as:

$$ds^2 = -c^2dt^2 + \alpha(t)^2\, d\sum^2$$

Where ∑ ranges over a 3-dimensional space—only considering uniform curvature. This metric has been the cornerstone of the standard cosmological model, which is presently refined as the Lambda Cold Dark Matter (ΛCDM) model.

In flat spacetime the scaling function scales the number of meters while holding the duration of seconds constant. This is the root cause of why Dark Matter & Energy had to be "invented." The flaw is that Spacetime cannot be separated, ***they must be scaled together***.

In spherical spacetime, a(t) scales the number of Planck lengths per second **and** the number of Planck times per second together, so *l_P/t_P always remains constant = c.* Therefore, as a(t) increases linearly in quantum units, the length of meters and duration of a second increases quadratically, covariant^2.

The next section explains and illustrates this in detail. Section 8.3 provides the new, covariant^2 metric.

For Einstein's Field Equation, Λ becomes 2/3rds, and the need for other Ω fudge factors likely unnecessary.

8.2 *Ever-Expanding* radius of time = Cosmic Event Horizon Curvature

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. After several years of pondering physics equations, I finally understood Einstein's dilemma. This dilemma created by the assumption that everyone "believed" all seconds were equal. This meant **the value of ω_P has been assumed to be 1.85x10^43 Planck times per second throughout cosmic time. Wrong!**

Thanks to the introduction of ever-expanding Space~Time metrics our second grew to be this big! Growing by the factor of 4.27x10^25 (Planck times per second) for each passing second. In other words, the previous second was shorter than the current second by 4.27×10^25 and the next second will be longer by 4.27×10^25 Planck times longer. As you realize the first second of this universe was only half of 4.27x10^25 Planck times, you ought to be astonished! *(This helps anchor this new neural net in your brain.)*

This is why it is necessary to build new neural-net pathways, honest, your old perceptions of how time worked will prevent you from grasping this new paradigm.

The 2nd second was 4 times that. Each doubling in seconds is a quadrupling in Planck times Conversely, each doubling in Planck units, results in √2 increase in seconds, Section 8.3 illustrates this. Today we are between the 201st and 202nd doubling, for the age of the universe is on the order of 4.0278x10^60 Planck seconds or about 13.7618 billion years.

Quantity	Value	relUnc	units	-L-T+M+C	dt
l_P	1.6162540976028e_35	5e_16	m	1 0 0 0	_1
t_P	5.3912433387886e_44	5.5e_16	s	0 1 0 0	_1
l_P/t_P	299792459	7e_16	m/s	1 _1 0 0	0
c	299792459	8e_16	m/s	1 _1 0 0	0
l_P*ω_P	299792459	7e_16	m/s	1 _1 0 0	0
ω_P	1.85485969962671e43	5.3e_16	Hz	0 _1 0 0	1
1/t_P	1.85485969962671e43	5.3e_16	Hz	0 _1 0 0	1
ω_P/ageUniv_s	4.27093388590749e25	3.1e_10	/s²	0 _2 0 0	2
(d²tP/s²)	4.27093383764859e25	0	/s²	0 _2 0 0	2
that*ageUniv_s	1.85485967866795e43	3.1e_10	tP/s	0 _1 0 0	1
ω_P	1.85485969962671e43	5.3e_16	rad/s	0 _1 0 0	1
(d²tP/s²)	4.2709338376485e25	0.0e0	/s²	0 _2 0 0	2
that*ageUniv_s²	8.0556256742258e60	6.2e_10		0 0 0 0	0
½*that	4.0278128371129e60	6.2e_10		0 0 0 0	0

Table 7.2

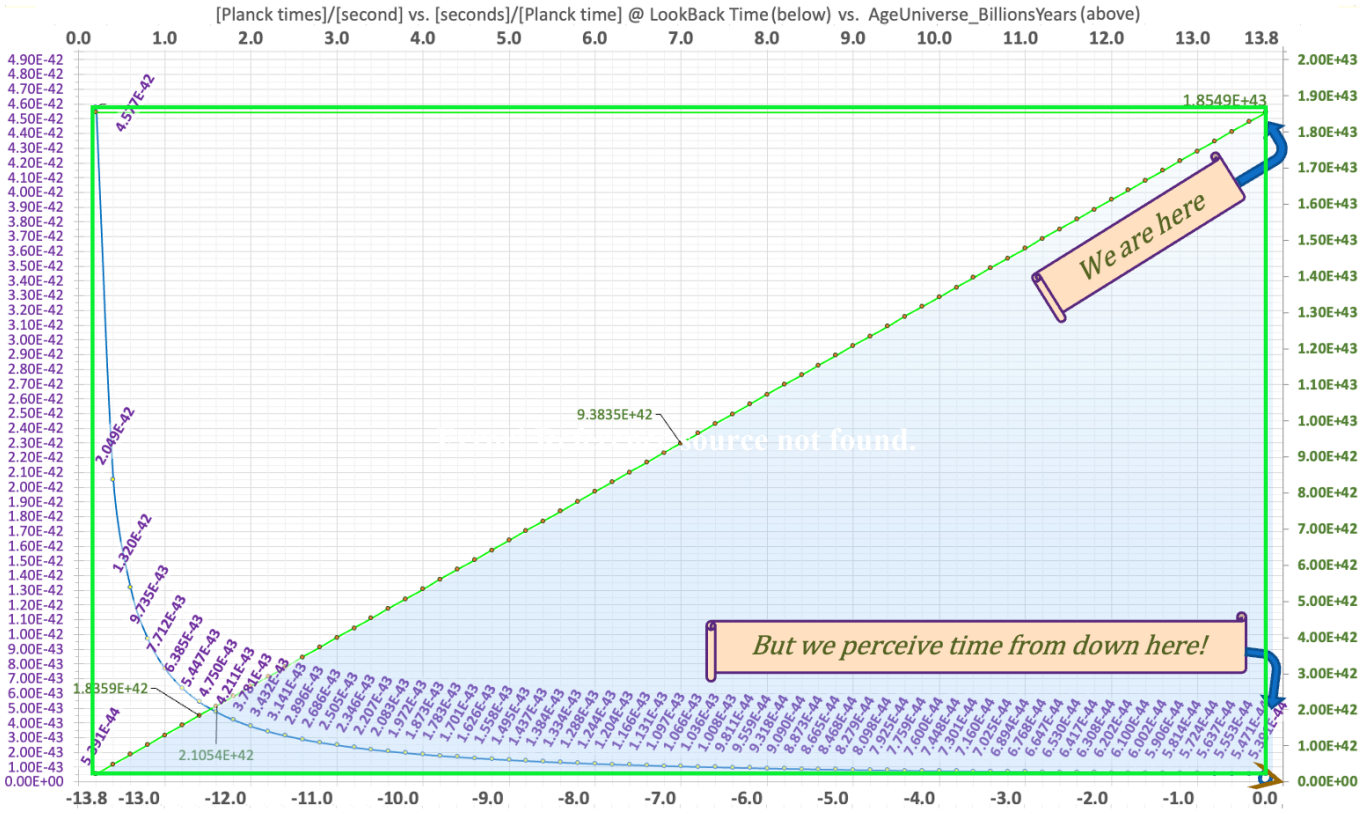
```
Current Planck length
Current Planck time

Both shrink inverse linear...
always maintaining same ratio
c = PlanckLength×Planck freq.
where
Planck freq. = ...
... 1/Planck time.

PlanckFreq/ageUniv_sec
Spacetime expansion rate
Note: 8 digits agree.
That * ageUniverse in seconds
PlanckTimes/sec = hBars/sec
ageUniv in Planck times
Spacetime expansion rate
8×10^60 if fixed second
4×10^60 for our linearly
        growing second.
```

(Forthcoming supplement will show step-by-step calculations for formulae that compute the age of universe.)

Quantities in this table apply to discussion of graph of Planck time vs. age of the universe—next page. Please read through each comment, they explain step-by-step what each value means.



Note: the area of the green rectangle (flat assumption) = age of 8×10^60 Planck times; that's twice the area of the triangle (expanding spacetime) which explains JWST's "early mature galaxies".

In the previous table, note that Planck time is the extremely tiny 5.39x10^{-44} number (see lower left corner of graph and purple numbers with blue curve). The reciprocal of Planck time is the Planck Frequency, ω_P, it has grown to the huge value of 1.85×10^43 (Planck times)/second. (See **Green** numbers and upper right corner of the graph.)

The horizontal green line near the top represents the flat spacetime assumption: that the number of Planck times per second (ω_P ≈ 1.85×10^43) has always been constant. Multiplying today's age (~4.34×10^17 seconds) by ω_P yields ~8×10^60 Planck times—the rectangular green area.

However, in expanding spacetime, the true age is only half that (~4×10^60 Planck times), shown as the triangular area. Planck length and Planck time t_P shrink inversely, 1/t, (blue curve), while Planck mass/charge grow linearly. Observers at the bottom right look back into deeper time, where everything was smaller.

Looking back billions of light-years (as JWST does, to 9–13 billion years ago), the discrepancy grows dramatically—revealing that early "mature" galaxies are metric growth artifacts, not flaws in the universe. The flat assumption creates illusions of acceleration; covariant scaling resolves them elegantly.

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.

What is 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 times that each passing second experiences. That's a mind boggling 4.27x10^25 more Planck times 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.***

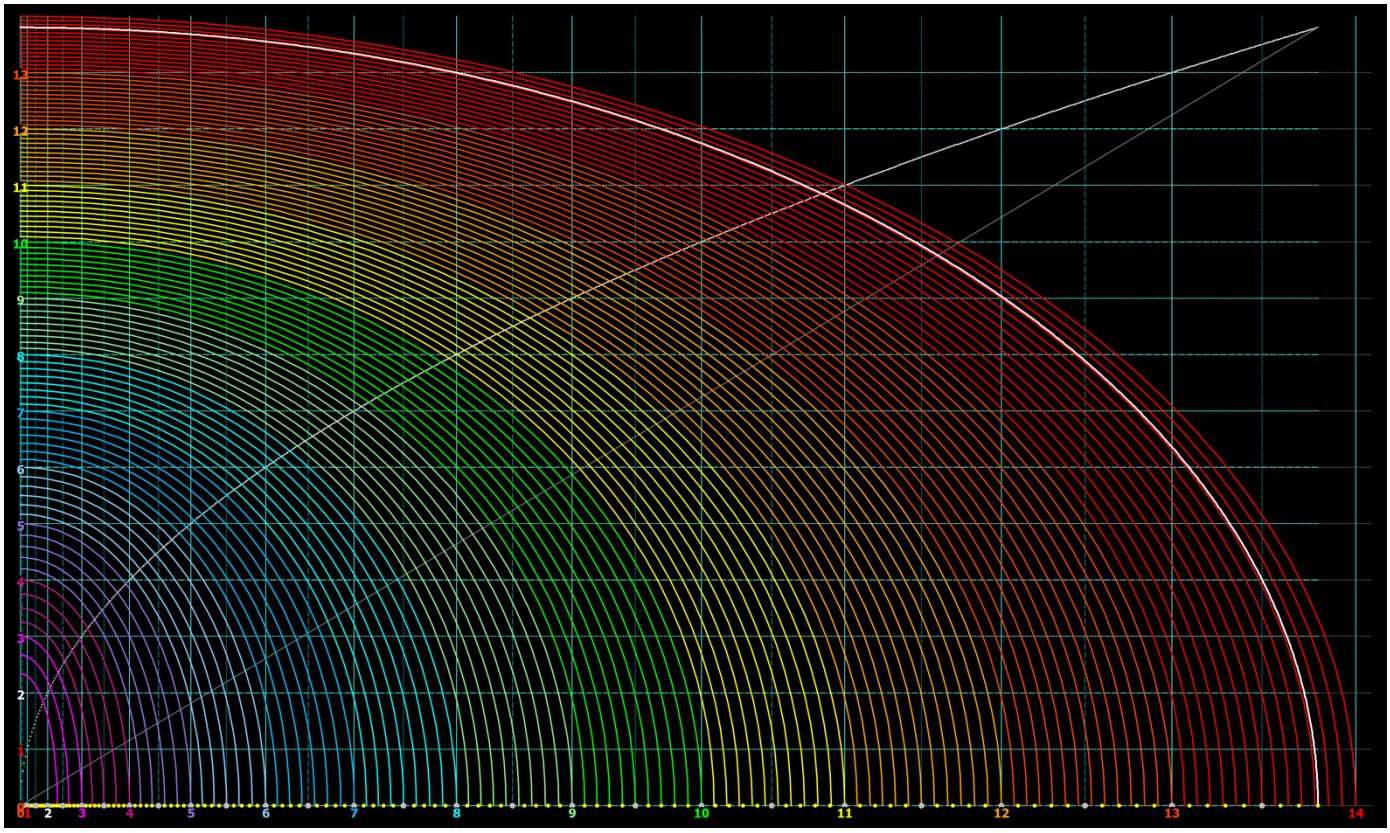
This is how a two-dimensional surface can encode its entire history: the Cosmic Onion layers form a single, ever-expanding hyper-surface, spiraling outward as holographic strata of spacetime itself.

We—all planets, all stars, every wavicle—are living physical holograms. Each particle type incrementally

amasses more mass through successive Higgs-field interactions, with the duration of every second growing in lockstep, preserving c while revealing the universe as a unified, self-consistent whole.

8.3 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-million, years we get the idea that each arc is about 3.1558x10^15 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 5.39124x10^-44th of a second—its reciprocal called the Planck frequency, ω_P, pronounced "omega sub-P", is 1.85486x10^43 Planck seconds per second. "Why so big?" The astonishing answer is "It ***grew*** to be this big!"

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 $(d^2tP/s^2) \approx$ 4.27x10^25 Planck seconds longer than the previous one. Each **dot** along the bottom axis represents 100-million years, thus 10 dots per billion. The colored arcs represent 1.3478x10^41 Planck seconds / 100-million years.

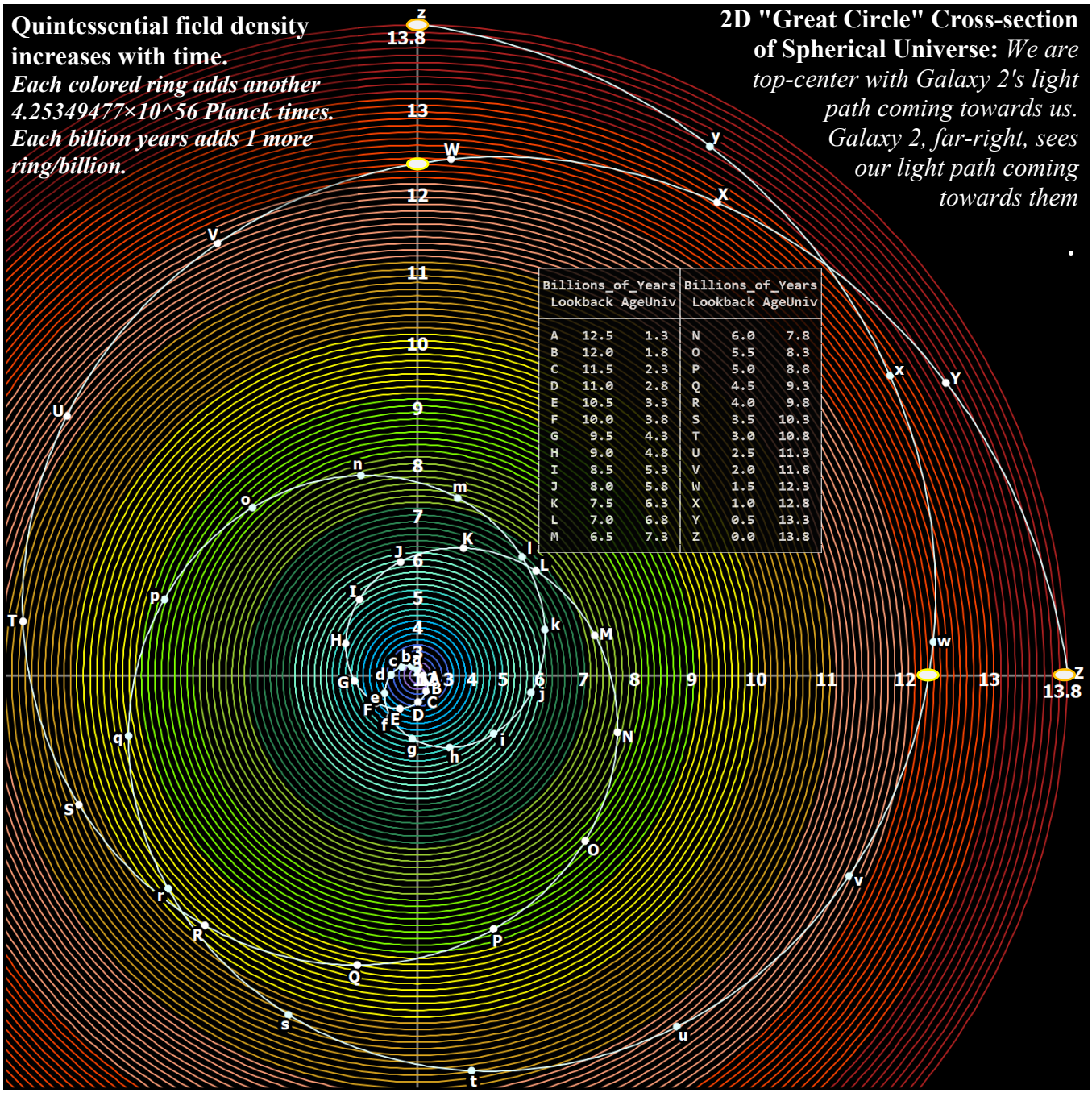
Notice between 2 to 3 there are 3 arcs, 3 to 4 has 4 arcs—adding one more arc with the passing of each billion years. Each passing 100-million years adds about 1.348x10^41 Planck seconds to each Earth second.

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:

$$age_{tP} = \left(\frac{d^2tP}{sec^2}\right)\frac{1}{2}t_{sec}^2 = \left(\frac{d^2tP}{sec^2}\right)\int t_{sec}\,dt$$

(d^2tP/s^2) = 42,709,338,376,485,907,412,250,000
= $(6,535,238,203,500)^2$
= ((2^2)*3*(5^3)*29*71*283*7477)²

Here we wrap light rays that are experiencing Spacetime expansion around our spherical universe.



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. 1.5 billion years ago we would have been on the vertical line at age=12.3 billion—0.7 billion years later our light rays heading towards Galaxy 2 would be at W. Meanwhile Galaxy 2 expanded along the horizontal axis from its 12.3-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 6.74x10^41 Planck times. **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.*

Consider the 13.8 billion years for the radius to grow 4×10^60 layers, the Event Horizon reflects each prime quantum wave ***backward*** thru time 1-second/second. ***taking just a second*** to connect with the Singularity!

9 Implications for Unification and Paradigm Shift

Our Cosmic Onion Model treats the spacetime medium as an energetic superfluid, (Liberati & Tricella, 2025) where the properties ε_0, μ_0, Z_0 are why the circumference of the Cosmic Event Horizon expands at 2 times c.

A key takeaway from 1/α's 12 different ratios is ***whenever*** the numerator has the same units as the denominator the result is a dimensionless constant. Other researchers support the incompatibility of a varying fine-structure constant. (Hart & Chluba, 2024) (Schönhöfer, et al., 2024) (Brax, et al., 2024).

Herein, these 3 equation-sets for α, c & G irrefutably demonstrate cosmic compliance to maintaining the 33 ratios. Change any value from table 10.1, say in the 10th digit and, you ***BREAK*** this perfect harmony.

We resolved EM-*gravity* unification without ad hoc parameters. Curious that primes themselves serve as the indivisible quantum atoms of spacetime. [complementing (Geiger, 2025) measurement quantization, where discrete units forge similar unifications without parameters].

We must nurture new neural networks—founded on expanding metrics—transcending old paradigms' (al., 1999) forging a bright future for fundamental physics.

As we tap into Th-229's nuclear clock, (Beeks, 2025) the stability of our super precise α will enable us to precisely measure Space~time expansion. A dream come true for metrology.

With regard to prime's role in unification the in-depth researcher can find connections here: (Naschie, 1999) (Naschie, 2003) (Goldstone, 1961) (Brout, 1964) (al., 1964) (Kibble, 1967) (Glashow, 1961) (Dyson, 1949) (Guth, 1981)

9.1 First Principles of Quantum Wave Numbers

Quantum reality has a **1-to-1-to-1** relationship between 1-length quantum, *1-time quantum* and ***1 quantum unit of angular momentum*** (also called the quantum of action)—the universe experiences 1 Planck length per 1 Planck time per each hBar.

Quantum Wave Numbers are the foundation on which everything in physical reality exists and from which everything else emerges. They, in effect, construct repeating prime number patterns in space, time and phase space. (Section 7.2)

9.2 Discussion and Future Horizons

In the days of Sommerfeld everyone "thought" electrons all shared the same FIXED amounts of mass & electric charge. It seemed reasonable that anything with mass should not be able to reach the speed of light, thus his interpretation that the Fine Structure constant is a factor of how much slower than c the electron moves around its Bohr orbit.

Fast-forward to Peter Higgs stunning paper that was, at first, rejected, but gained acceptance and so much respect that the monumental CERN Super Collider was built in hopes to get a glimpse of the now famous "Higgs Boson."

This paper shows how the "Collapse of the various particle-types, specifically when their Wavicle wavefunctions intersect within 2.5% of intersection of the fundamental EM field and the Higgs field as in (Geiger, 2025), where quantized measurements reveal full mass spectra across regimes. (Collaboration, 2012) This accounts for why many scientists "thought" that only 2.5% of the proton mass had been accounted for. They did not realize that the EM field makes only 2.5% of the mass "visible" because the detectors at CERN only can see signals that emerge from the collisions that are "carried by" the EM field.

9.3 Recap & Conclusion

As Einstein reflected in his 1931 essay *The World as I See It* (Living Philosophies, p. 97), the harmony of natural laws evokes a "rapturous amazement at the intelligence of such superiority" that is exactly what we "c" in these 3 harmonious equation-sets where "*α*" and "*ln 2*" play key roles in this Grand Cosmic Design.

Our hypothesis proved to be a hypotenuse… $\frac{1}{\alpha} = \sqrt{137^2 + \frac{30(P_c + 5)}{59P_c - 8}}$	137 = the base of a right-triangle. 30 = the product of the first three primes (evoking a predominant influence), 5 and 8 as phase shifts, and 59 as the sentinel before 60—weaves an intuitive narrative around the formula. It transforms abstract mathematics into a tangible story: the numerator's "phase-shift" amplification and the denominator's balancing act, ensuring rapid convergence with deeper symmetries.

Quantum integer for Rydberg… **128,076,763,810 =** **2×5×31×283×557×2621**	While writing this paper, the discovery of the quantum integer for the Rydberg Constant was an unexpected surprise. The fact that this integer's factors include 5, a factor shared by the electron, and 283 a factor shared by the Higgs boson *(see supplement)* makes this an interesting discovery. But its relative uncertainty 1.2×10^{-11} might limit how far we can run with it in future papers.

```
calc 'Roo*c that/Cs133 qi_Roo (%:qi_Roo)*Cs133/c Roo'
```

Quantity	Value	relUnc	units	-L-T+M+C	dt	Description
R∞*c	3289841971223713	1.1e_12	Hz	0 _1 0 0	1	Rydberg Frequency(2022)
that/Cs133	357878.1409971093	1.1e_12		0 0 0 0	0	based on Cs133=9,192,631,777
qi_R∞	128076763810	2.5e_11		0 0 0 0	0	quantum integer for Rydberg
(√qi_R∞)*Cs133/c	**10973731.568**43346	1.2e_11	/m	_1 0 0 0	1	Rydberg qi_Roo relUnc > 2022
R∞	**10973731.568**157	**1.1e_12**	/m	_1 0 0 0	1	Rydberg (2022)

The ever-expanding Cosmic Event Horizon is the boundary between all of time, so far, and Eternity. It is like a planetarium dome except this dome's surface is a mirror 12-units thin. The inside surface = 12 and the outer most limit is 0 – beyond which time does not exist yet.

Our expression unifies gravity with electromagnetism… $\frac{G}{\mu_0 \alpha^2} = \frac{(762 + 3\ln 2)}{(764 + 3\ln 2)}$	This formula is guaranteed to be as precise as we can measure magnetic permeability of space. *Much easier than measuring G.* The terms here are speaking in "terms" of powers of two, where 762 is $2^9 + 2^8 - 6$ and 764 is $2^9 + 2^8 - 2$. 1 0 1 1 1 1 1 0 1 0 762 1 0 1 1 1 1 1 1 0 0 764

The Planck-scale alignment of G/μ₀ ratio suggests a logarithmic-prime encoding of spacetime expansion yielding the discovery-level concordance attributes to measurement quantization. (Geiger, 2025)

Qubits exist on the Cosmic Event Horizon "mirror" in imaginary, (***i j k)***, phase space. Spreading forth across the surface of the Cosmic Event Horizon is the Cosmic Quantum Computer this surface is receiving quantum waves from the past, processing the present, & moment-by-moment etching Planckeons into the holographic layers of the Cosmic Onion.

Once you have it clear in your mind that the radius of the universe is NOT spatial. It is time, specifically, is the quantized, incrementally uncurling of hBars which spread out by 1-Planck length per each Planck time—expanding out to all directions from you, "the observer", at the speed of light. So, because this is happening to the North & South and to the East & West the circumference of the universe expands at 2×c.

The astute question, "Where is the universe expanding into?"
Now has a simple answer, "It is expanding into Eternity."

This paper introduces a paradigm shift that comes with a guarantee—promising to empower future progress.

10 Appendix

The Committee on Data for Science and Technology is a team of top scientists who compile the latest measurement data from the top labs in the world. They compile the most accurate measurements and publish the official values for, so called, physical constants and physical quantities typically every 4 years. (Now with the advent of the internet and AI, the next schedule dataset will be for 2026.

10.1 Compare CODATA 2022 to values proposed for CODATA 2026

The yellow highlighted numbers are CODATA 2018 values. (al., 2021) **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 are my proposed values for the CODATA 2026 dataset. *

Quantity	Value	digit┬16	relUnc	-L	-T	+M	+C	dt	SIunits
c	299,792,459.000		0	1	_1	0	0	0	m/s
Cs133	9,192,631,777.000		1e_14	0	0	0	0	0	Hz
h	6.626070150000000e_34		0	2	_1	1	0	0	J s
hBar	1.054571817646156e_34		0	2	_1	1	0	0	J s
alpha_2018	7.2973525693e_3		1.5e_10	0	0	0	0	0	
alpha_2022	7.2973525643e_3		1.6e_10	0	0	0	0	0	dimen-
alpha	**7.297352569277727e_3**		0.5e_16	0	0	0	0	0	sionless
1/alpha	**137.035999084114**		0.5e_16	0	0	0	0	9	
a_0	**5.29177210901992e_11**		1.2e_12	1	0	0	0	_1	m
eV_P	**1.220890832760425e28**		4.0e_10	2	_2	1	_1	0	Volts
e	1.602176634000000e_19		1.5e_16	0	0	0	1	1	C
e	1.602176631869721e_19		1.9e_10	0	0	0	1	1	C
q_P	1.875546035285954e_18		1.5e_16						
m_P2022	2.176434000000000e_8		1.1e_5	0	0	1	0	1	kg
m_P	2.176435583506967e_8		2.4e_16	0	0	1	0	1	kg
l_P2022	1.616253000000000e_35		1.1e_5	1	0	0	0	_1	m
l_P	1.616254097603138e_35		1.9e_12	1	0	0	0	_1	m
t_P2022	5.391247000000000e_44		1.1e_5	0	1	0	0	_1	s
t_P	**5.391243338789713e_44**		3.7e_16	0	1	0	0	_1	s
G_2022	6.674300000000000e_11		2.2e_5	3	_2	_1	0	_2	m3/kg s2
G	**6.674292412209071e_11**		1.6e_10	3	_2	_1	0	_2	m3/kg s2
Go	**7.74809170925968e_5**		1.1e_10	_2	1	_1	2	2	S = /Ohm
Roo	**10973731.5684335**		1.4e_14	_1	0	0	0	1	/m
Zo_2022	376.730313667000		1.5e_9	2	_1	1	_2	_2	Ohm
Zo	**376.730314668667**		3.0e_16	2	_1	1	_2	_2	Ohm
Z_P	**29.997924581632002**		3.0e_16	2	_1	1	_2	_2	Z_P
K_m	**2.000000001088755e_7**		4e_16	1	0	1	_2	_2	N/A2
mu_0	**1.256637057928312e_6**		2.7e_16	1	0	1	_2	_2	N/A2
K_e	**8.987551792260796e9**		3.4e_16	3	_2	1	_2	_2	m/F
eps_0	**8.854187812800372e_12**		2.9e_16	_3	2	_1	2	2	F/m
r_e	**2.81794032618290e_15**		1.1e_12	1	0	0	0	_1	m

These values are my proposed **CODATA 2026** values.

c: the **new** Speed of Light
Cs133: new hyperfine spectral line of Cesium 133
h: Planck's Constant &
hBar: his reduced constant
alpha: Fine Structure Constant
a_0: Bohr radius
V_P: Planck Voltage
l_P: Planck length
t_P: Planck time
e: Fundamental Charge
q_P: Planck Charge
m_P: Planck mass
G: Newton's Gravitation~constant
Go: Conductance Quantum
R∞: Rydberg Constant
Zo: Z_0, Impedance of Free Space
Z_P: Planck Impedance
K_m: K_m, Magnetic force const.
mu_0: μ_0, Magnetic Permeability
K_e: K_e, Electric force constant
eps_0: ε_0, Electric Permittivity
r_e: electron's charge radius

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

*** See forthcoming supplement with step-by-step calculations for c=299,792,458 & c=299,792,45**

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