A Theory For Inertia, Testing For It With A Torsion Pendulum, And Its Subatomic Structure Appearing On A Planetary Scale

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Introduction

The hour was first invented in ancient Egypt by dividing the night and day into 24 units, 12 for the day and 12 for the night. Since the day is longer in the summer, and the night shorter, and in the winter the day is shorter and the night is longer the length of an hour depends on the season. The ancient Greek astronomer, Hipparchus, divided the day and night into hours determined by the length of day and night during spring and fall equinoxes when length of day equals the length of night, inventing the equinoctial hour used year round. Hipparchus had access to ancient Babylonian knowledge of celestial motions where they knew the day of 24 hours gave an hour that could be divided by 60 minutes, and each minute by 60 seconds. The Babylonians got the base 60 divisions of the hour from the ancient Sumerians. But passage of time wasn't measured down to the second until Christiaan Huygens invented his pendulum clock, which was demanded by the astronomical revolution that came about from the work of Copernicus (Earth moves around the Sun), Galileo (Earth is not at the center of the Universe from looking at Jupiter's moons with his telescope), Brahe (data for planetary motions), Kepler (explains Brahe's data introducing elliptical orbits for the planets), and Newton (explains Kepler's laws of planetary motion with his universal law of gravitation). However, ancient Sumerians, ancient Egyptians, ancient Babylonians, and 10th century Arabs have reported of dreams and visions come to them by the Gods that demonstrate knowledge of the second as far back as 3000 BC. They even connected it to the human heartbeat.

In this paper we present our findings that the second is characteristic of subatomic particles, and is on the scale of the planets as well. With a theory for inertia that gives us a Universal Particle Equation

$$m_i = \kappa_i \cdot \sqrt{\frac{\pi r_i^2 F_n}{G}},$$

$$F_n = \frac{h}{c t_1^2},$$

$$F_n = \frac{6.62607015 \times 10^{-34}\ \text{J·s}}{(299{,}792{,}458\ \text{m/s})(1\ \text{s})^2} = 2.21022 \times 10^{-42}\ \text{N},$$

$$t_1 = 1\ \text{second},$$

m_i the mass of the particle, r_i its radius, F_n a universal normal force, G the universal constant of gravitation, and t_1 a universal time invariant.

On the planetary scale we find

$$\frac{\hbar_{\odot}^{2}}{GM_{m}^{3}}\frac{1}{c} = \frac{3.0281E8\,\text{m}}{299{,}792{,}458\,\text{m/s}} = 1.010\text{ seconds} \approx 1\text{ second}$$

M_m the Moon, $\hbar_{\odot}$ a Solar System Planck-type constant, c the speed of light.

This holds for the evolved Solar System when

$$\frac{KE_{\text{moon}}}{KE_{\text{earth}}}(24\text{ hours})\cos(\theta) = 1\text{ second}$$

The kinetic energy of the Moon and the kinetic energy of the Earth maps the 24 hour day into our base unit of counting, 1 second. $\theta = 23.5°$ is the inclination of the Earth to its orbit.

In the second paper we present the relationship of the Universal Particle equation to Electromagnetism.

In the third paper we present a way of testing for the 1-second invariant in a proposed experiment using a torsion pendulum. The theory for inertia predicts we should find a spike at 1 Hz, and interestingly in torsion pendulum data there is a 1 Hz spike. It has always been treated as noise, and there are several theories used to account for this noise, but it has always just been subtracted out. In our experiment we design a torsion pendulum that should account for this noise based on the theories for it, to see if the 1 Hz spike still appears.

In the fourth paper we present our findings or how the Earth/Moon/Sun system is based on the same 1-second characteristic time if we formulate it in a fairly direct analog of the hydrogen atom solution to the Schrodinger wave equation.

The occurrence of 1-second so implicitly in equations from the subatomic to the Solar System is striking. However, after having tried to solve the Schrodinger wave equation for the Solar System, I find it becomes so complex that it may be impossible. The wave equation predicts nodes in an inverse square field for the atom, so while it might predict nodes in the Solar System from its inverse square field, it can't be used to figure out their evolution from the protoplanetary disc in a direct analog of the atom. The strange analogs for the Solar System with the hydrogen atom seem very striking, but have to be tweaked because of course subatomic particles are very different than planets, like planets don't jump form orbit to orbit and emit energy, or all have the same size. I wish I could go to other star systems and learn of other structures and harmonies in them, and study the ancient history of them, and how other off-world beings might have developed their calendars to describe them, and find possible connections between them. That is, in such a scenario I would become an exoarchaeologist. I feel there is a great mystery here that pertains to why we are here and where we are going, and I present this in hopes it will be found by others who may have another piece to the puzzle, because the undertaking of explaining it would be too immense for one person.

A Universal Particle Equation

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Abstract
We present a universal particle equation where what we experience as mass is taken as resistance to changes in a particle's motion through the temporal dimensions, which is measured by G, the universal constant of gravitation. To do this we introduce a normal force given by $F_n = h/(ct_1^2)$ where t_1 is on the order of $t_1 = 1$ second, which is Lorentz invariant. The normal force, F_n is exposed to the cross-sectional area of the particle $A_i = \pi r_i^2$. The result is the mass of the particle is given by $m_i = \kappa_i \sqrt{\pi r_i^2 F_n / G}$, with experimental verification giving 1.00500 seconds (proton), 1.00478 seconds (neutron), and 0.99773 seconds (electron). The coupling constant, κ_i,, is predicted by a prediction for the radius of the proton, which is $r_p = \phi h/(cm_p)$ with $1/\phi = \Phi$ where $\Phi = (\sqrt{5}+1)/2$ is the golden ratio, and κ_i in general is predicted by the fact that for the electron, with no substructure, it has its κ_i equal to 1, meaning it matches the analytic structure of a force subjected to a cross-sectional area, directly.

Theoretical Framework
In special relativity, the invariant spacetime interval is given by:

$$ds^2 = c^2dt^2 - dx^2 - dy^2 - dz^2$$

For an object at rest the motion is entirely in the temporal dimension. As an object acquires spacial velocity, its temporal velocity decreases according to:

$$v_t = \frac{c}{\gamma} = c\sqrt{1 - \frac{v^2}{c^2}}$$

where γ is the Lorentz factor. This relationship reveals the hyperbolic nature of spacetime rotations - increasing spatial velocity requires decreasing temporal velocity to maintain the constant magnitude c.

The Universal Particle Equation

We introduce two equations that give on the order of 1-second in terms of the proton radius and mass:

$$1.\quad \left(\sqrt{\phi \cdot \frac{\pi r_p}{\alpha^4 G m_p^3}}\right)\frac{1}{3} \cdot \frac{h}{c} = 1 \text{ second}$$

$$2.\quad \frac{1}{6\alpha^2} \cdot \frac{r_p}{m_p}\sqrt{\frac{4\pi h}{Gc}} = 1\text{second}$$

m_p : $1.67262E - 27kg$ (Proton Mass) [1]

r_p : $0.833E - 15m$ (Proton Radius) [2]

h : $6.62607E - 34J \cdot s$ (Planck Constant) [3]

c : $299{,}792{,}458 m/s$ (Light Speed) [4]

G : $6.6730E - 11N\frac{m^2}{kg^2}$ (Universal Gravitational Constant, 2018) [5]

α : 1/137 (Fine Structure Constant)

ϕ: $(\sqrt{5} - 1)/2 \approx 0.618$ (Golden Ratio Conjugate)

These will be verified presently. When setting the left side of equation 1 equal to the lefts side of equation 2, we get an equation for the radius of a proton that is accurate:

$$3.\quad r_p = \phi \cdot \frac{h}{cm_p}$$

$$r_p = (0.618) \cdot \frac{6.62607E - 34}{(299{,}792{,}458)(1.67262E - 27)} = 0.8166E - 15m$$

The CODATA value from the PRad experiment in 2019 gives

$$r_p = 0.831fm \pm 0.014fm$$

With lower bound $r_p = 0.817E - 15m$, which is almost exactly what we got.

We can see equation 3 may be the case because we get it from Planck Energy $E_p = h\nu_p$, Einsteinian energy, $E_p = m_p c^2$, and the Compton wavelength $\lambda_p = h/(m_p c) = r_p$ when we introduce the factor of ϕ, which is the golden ratio conjugate, where the golden ratio, $\Phi = 1/\phi = (\sqrt{5} + 1)/2 \approx 1.618$.

We explain this factor by invoking Kristin Tynski, her paper titled: One Equation, ~200 Mysteries: A Structural Constraint That May Explain (Almost) Everything [5].

Tynski shows that for any system requiring consistency across multiple scales of observation has the recurrence relation:

scale(n+2) = scale(n+1) + scale(n)

Which leads to:

$\lambda^2 = \lambda + 1$

Whose solution is Φ. Equations 1, 2, and 3 directly yield our Universal Particle Equation:

$$4.\ \ m_p = \kappa_p \cdot \sqrt{\frac{\pi r_p^2 F_n}{G}}$$

$$5.\ \ F_n = \frac{h}{c t_1^2}$$

$$6.\ \ t_1 = 1 \text{ second}$$

where $\kappa_p = 1/(3\alpha^2)$. Here we see in equation 4, the cross-sectional area of the proton $A_p = \pi r_p^2$ is exposed to the normal force, F_n mediated by the 'stiffness of space' as measured by G, producing the proton mass, m_p. In general we have

$$7.\ \ m_i = \kappa_i \cdot \sqrt{\frac{\pi r_i^2 F_n}{G}},$$

$$F_n = \frac{h}{c t_1^2},$$

$$F_n = \frac{6.62607015 \times 10^{-34} \text{ J·s}}{(299{,}792{,}458 \text{ m/s})(1 \text{ s})^2} = 2.21022 \times 10^{-42} \text{ N},$$

$$t_1 = 1 \text{ second},$$

$$m_i = \kappa_i \sqrt{\frac{\pi r_i^2}{G} \cdot \frac{h}{c t_1^2}}$$

We can verify this solving 7 for t_1 and showing it is on the order, closely, to 1-second:

$$8.\ \ t_1 = \frac{r_i}{m_i} \cdot \sqrt{\frac{\pi h}{G c}} \cdot \kappa_i$$

Proton: $\kappa_p = \frac{1}{3\alpha^2}$, $\alpha = 1/137$:

$$t_1 = \frac{0.833 \times 10^{-15}}{1.67262 \times 10^{-27}} \cdot \sqrt{\frac{\pi \cdot 6.62607 \times 10^{-34}}{(6.674 \times 10^{-11})(299{,}792{,}458)}} \cdot 6256.33 = 1.00500 \text{ seconds}$$

Neutron: $\kappa_n = \frac{1}{3\alpha^2}$:

$$t_1 = \frac{0.834 \times 10^{-15}}{1.675 \times 10^{-27}} \cdot \sqrt{\frac{\pi \cdot 6.62607 \times 10^{-34}}{(6.674 \times 10^{-11})(299{,}792{,}458)}} \cdot 6256.33 = 1.00478 \text{ seconds}$$

Electron: $\kappa_e = 1$:

$$t_1 = \frac{2.81794 \times 10^{-15}}{9.10938 \times 10^{-31}} \cdot \sqrt{\frac{\pi \cdot 6.62607 \times 10^{-34}}{(6.674 \times 10^{-11})(299{,}792{,}458)}} \cdot 1 = 0.99773 \text{ seconds}$$

We suggest $\kappa_e = 1$ for the electron may be because it is the fundamental quanta (does not consist of further more elementary particles). G has been rounded to 6.674E-11. This is a Natural Law.

$r_n = 0.84E - 15m$. (Neutron radius) [6]
$r_e = 2.81794E - 15m$. (Classical electron radius) [7]

The Geometric Mechanism of Inertia

As such the geometric mechanism for inertia is that when we apply a force to accelerate a particle spatially, we are rotating its velocity vector, diverting motion from the temporal dimension to spacial dimensions. The normal force F_n resists this rotation, manifesting as as an inertial resistance. $t_1 = 1$ second given by equation 8 is Lorentz invariant because G, c, and h are invariant, r_p is not but the ratio r_p/m_p is invariant because while r_p is frame dependent, it is adjusted for by the relativistic mass of m_p.

The dimensionless factor κ_i distinguishes elementary particles from composite hadrons. Remarkably, the same $t_1 = 1$ s emerges for the electron, proton, and neutron when their respective κ_i are chosen appropriately.

The factor $1/3$ reflects the three valence quarks inside the proton and neutron. The α^{-2} appears because the proton's small radius (relative to its mass) is set by the strong interaction, which is $\sim 1/\alpha$ times stronger than electromagnetism. Consequently, the required enhancement scales as the square of that ratio because it deals with surface area.

The electron: $\kappa_e = 1$ as the baseline

For the electron, using its classical radius $r_e = 2.81794 \times 10^{-15}$ m and mass $m_e = 9.10938 \times 10^{-31}$ kg, the equation (8) with $\kappa_e = 1$ gives

$$t_1 = \frac{r_e}{m_e}\sqrt{\frac{\pi h}{Gc}} \cdot 1 = 0.99773 \text{ s},$$

within 0.23% of 1 second. This shows that the electron naturally satisfies the invariant without any extra factor. The value r_e is not assumed as a physical radius; rather, the invariant predicts it. Solving $t_1 = 1$ s for r_e yields

$$r_e = m_e\sqrt{\frac{Gc}{\pi h}} = 2.82 \times 10^{-15} \text{ m},$$

Concerning bound matter (like atoms) we assume since protons in the nucleus of an atom have spaces between them due to electric forces, and protons and neutrons may be touching, but not existing in the same space, the mass of an atom is the sum of the masses of its protons, electrons, and neutrons as given by the theory of inertia in this paper: they all expose a cross-sectional area to the normal force.

Discussion

The normal force has a relationship to the Planck force, the maximum gravity for the minimum mass. It links the normal force to a full rotation (2π). We have the normal force

$$F_n = \frac{h}{ct_1^2} = 2.21022E - 42N$$

We have the Planck force for gravity

$$F_{Planck} = G\frac{m_P^2}{l_P^2} = (6.674E - 11)\frac{(2.176434E - 8kg)^2}{(1.616255E - 35m)^2} = 1.21020E44N$$

Where, m_P is the Planck mass, and l_P is the Planck length. They are given by:

$$m_{Planck} = \sqrt{\frac{\hbar c}{G}} = 2.176434E - 8kg$$

$$l_{Planck} = \sqrt{\frac{\hbar G}{c^3}} = 1.616255E - 35m$$

And, Planck time is:

$$t_{Planck} = \sqrt{\frac{\hbar G}{c^5}} = 5.391247E - 44s$$

We form the ratios between the normal force and Planck force:

$$\frac{F_n}{F_{Planck}} = 1.826326E - 86$$

Divide by Planck time squared and we have:

$$\frac{F_n}{F_{Planck}} \frac{1}{t_P^2} = 6.2834743s^{-2}$$

That number is 2π. We have the final equation:

$$9. \quad t_1 = \sqrt{2\pi \frac{F_{Planck}}{F_n}} \cdot t_P = 1.00\text{seconds}$$

From the Planck units we have:

$$F_{Planck} = G \frac{m_P^2}{l_P^2} = \frac{c^4}{G}$$

So, it can be written:

$$10. \quad t_1 = \sqrt{2\pi \frac{c^4}{GF_n}} \ \cdot \ t_P$$

We can write

$$11. \quad F_n = 2\pi F_{Planck} \cdot \frac{t_P^2}{t_1^2}$$

2π is a full rotation, so we can define an angular frequency, ω:

$$F_n = F_{Planck} \cdot t_P^2 \cdot \frac{d\omega}{dt}$$

$$12. \quad \frac{F_n}{F_{Planck}} \cdot \frac{1}{t_P^2} \int_0^{1\text{second}} dt = \omega_1$$

$$13. \quad \omega_1 = \frac{2\pi}{second}$$

Integrating one more time gives the angle over 1-second:

$$14. \quad \frac{F_n}{F_{Planck}} \cdot \frac{t_1}{t_P^2} \int_0^{1\text{ second}} dt = \theta_1$$

$$15. \quad \frac{F_n}{F_{Planck}} \cdot \frac{t_1^2}{t_P^2} = \theta_1$$

$$16. \quad \theta_1 = 2\pi$$

The normal force $F_n = h/(ct_1^2)$ and the Planck force $F_{\text{Planck}} = c^4/G$ are related through the Planck time $t_P = \sqrt{\hbar G/c^5}$. Substituting their definitions yields the dimensionless identity

$$\frac{F_n}{F_{\text{Planck}}} \cdot \frac{t_1^2}{t_P^2} = 2\pi,$$

which holds for any value of t_1 because the factors of t_1 cancel. This identity does *not* determine the numerical value of the second; rather, it shows that when t_1 is taken as the empirical 1second invariant (obtained from the proton, neutron, and electron masses and radii via equation (8)), the ratio F_n/F_{Planck} acquires a clear geometric meaning: over one second, the accumulated angular phase is exactly 2π – a full rotation in the temporal dimension. Thus the Planck scale relation is not a derivation of the second but a consistency check and an elegant reinterpretation: the second is the time required for the normal force, when scaled by the Planck force, to close a complete cycle, reinforcing the view that time emerges from a cyclic variable in the quantum vacuum. Moreover, the identity can be rearranged as

$$\frac{F_n}{F_{\text{Planck}}} = 2\pi \left(\frac{t_P}{t_1}\right)^2 = 2\pi (t_P \cdot \nu_0)^2,$$

where $\nu_0 = 1/t_1 = 1\,\text{Hz}$. This reveals a natural angular frequency $\omega_0 = 2\pi\nu_0 = 2\pi$ rad/s, a universal resonance at one hertz that links the Planck scale to the macroscopic normal force. Hence, even though the numeric value $t_1 = 1\,\text{s}$ is ultimately fixed by particle data, the interpretation as a 2π phase per second is independent and suggests that inertia is governed by a fundamental clock ticking at exactly one hertz.

From golden ratio to coupling constants. The golden ratio conjugate $\phi = (\sqrt{5} - 1)/2$ arises naturally from the scale invariant recurrence $\text{scale}(n+2) = \text{scale}(n+1) + \text{scale}(n)$, which Tynski showed governs systems that must be consistent across multiple observational scales. Applying this to the proton gives $r_p = \phi\, h/(m_p c)$, which matches the experimental radius. Substituting this r_p into the universal particle equation $m_p = \kappa_p \sqrt{\pi r_p^2 F_n / G}$ and using $F_n = h/(c t_1^2)$ with $t_1 = 1\,\text{s}$ yields a closed expression for κ_p. Solving it gives $\kappa_p = 1/(3\alpha^2)$, where α is the fine structure constant. The factor $1/3$ reflects the three valence quarks in the proton, while α^{-2} accounts for the electromagnetic and gluonic enhancement of the normal force inside a composite hadron. The neutron, having a similar internal structure, inherits the same $\kappa_n = 1/(3\alpha^2)$ when its magnetic radius is used. Thus the golden ratio not only predicts the proton's size but also, via the universal particle equation, determines the large coupling constants for hadrons, leaving the electron as the minimal case $\kappa_e = 1$. This elegant link between geometry (ϕ), quantum dynamics (α), and compositeness (three quarks) strongly supports the physical reality of the normal force and the 1second invariant.

Conclusion

We have presented a fundamental 1-second invariant that emerges from the intrinsic properties of elementary particles—the proton, neutron, and electron—and from the fabric of Planck-scale physics. The invariant is expressed as

$$t_1 = \frac{r_i}{m_i}\sqrt{\frac{\pi h}{Gc}}\,\kappa_i = 1 \text{ second},$$

where $\kappa_p = \kappa_n = 1/(3\alpha^2)$ and $\kappa_e = 1$.

Crucially, the invariant leads to a universal particle equation:

$$m_i = \kappa_i \sqrt{\frac{\pi r_i^2 F_n}{G}}, \qquad F_n = \frac{h}{c\, t_1^2},$$

with F_n a constant normal force of magnitude 2.21022×10^{-42} N. This equation suggests that the mass of a particle is determined by its cross-sectional area (πr_i^2), the stiffness of spacetime (G), and a universal normal force F_n that arises from the quantum constraint $t_1 = 1$ s.

The geometric origin of the second becomes apparent when we relate F_n to the Planck force $F_{\text{Planck}} = c^4/G$. We find

$$\frac{F_n}{F_{\text{Planck}}} \cdot \frac{t_1^2}{t_P^2} = 2\pi,$$

which means that over one second, the ratio F_n/F_{Planck} accumulates exactly 2π radians of angular phase—a full rotation. Thus, one second is not an arbitrary human convention but rather the time required for this cyclic closure in the temporal dimension, rooted in Planck-scale dynamics.

In summary, the 1-second invariant unifies particle physics and fundamental constants through a single, testable relation. The universal particle equation $m_i = \kappa_i\sqrt{\pi r_i^2 F_n/G}$ provides a new perspective on inertia: mass arises from the resistance to rotating a particle's temporal velocity into spatial velocity, quantified by the normal force F_n. This framework suggests that time, mass, and the quantum vacuum are intimately connected, and that the second—far from being arbitrary—is a natural resonance of the universe.

Note

The universal particle equation and 1-second invariant were discovered by the author and reported as early as;

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Geometric Origin of Electromagnetism: Derivation of the Fine Structure Constant from a Universal Particle Equation

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Abstract
We extend the geometric theory of inertia – in which mass arises from resistance to rotating a particle's velocity from the temporal dimension into spatial dimensions – to include electromagnetism. Introducing a universal normal force $F_n = h/(ct_1^2)$ with $t_1 = 1$ second, we show that the electron's mass and classical radius determine the fine-structure constant α. No free parameters are needed: α is expressed solely in terms of G, h, c, m_e, and the 1second invariant. The existence of two charge signs (+1, –1) and the neutral state (0) follows from an internal cyclic coordinate, while the neutron's neutrality and composite enhancement $\kappa_n = 1/(3\alpha^2)$ emerge naturally. A critical discussion addresses the logical status of identifying the geometric electron length with the classical electron radius.

1. Introduction

The geometric theory of inertia presented in earlier work [1] postulates that the mass of a particle is a measure of resistance to diverting its intrinsic temporal motion into spatial directions. This resistance is quantified by a universal normal force

$$F_n = \frac{h}{c\,t_1^2}, \qquad t_1 = 1 \text{ s},$$

which, combined with the gravitational constant G and the particle's cross-sectional area πr_i^2, yields the universal particle equation

$$1. \quad m_i = \kappa_i \sqrt{\frac{\pi r_i^2 F_n}{G}}.$$

For the proton and neutron the coupling constant is $\kappa_p = \kappa_n = 1/(3\alpha^2)$, while for the electron $\kappa_e = 1$. The theory predicts a 1second invariant that arises from a full 2π phase accumulation when comparing F_n to the Planck force.

In this paper we show that the same geometric framework determines the strength of electromagnetism, i.e., the fine structure constant $\alpha = e^2/(4\pi\varepsilon_0\hbar c)$, and explains the existence of two opposite charges and a neutral state. The key step is to identify the electron's effective radius r_e – which appears in the universal particle equation – with the classical electron radius. This identification leads directly to a prediction of α that agrees with experiment to within 0.2%.

2. The Electron as the Elementary Case

For the electron we have $\kappa_e = 1$ because it is point-like and has no internal substructure. Equation (1) then gives

$$m_e = \sqrt{\frac{\pi r_e^2 F_n}{G}}.$$

Solving for the effective radius r_e:

$$2. \qquad r_e^2 = \frac{G m_e^2}{\pi F_n} = \frac{G m_e^2 c t_1^2}{\pi h}, \qquad \text{using } F_n = \frac{h}{c t_1^2}.$$

3. Classical Electron Radius as the Geometric Scale

In standard electrodynamics the classical electron radius is defined by equating the electrostatic self-energy to $m_e c^2$:

$$3. \qquad r_e^{(\text{class})} = \frac{e^2}{4\pi\varepsilon_0 m_e c^2}.$$

Within our geometric framework this radius is not a physical boundary but the scale at which the universal normal force F_n (the resistance to rotating temporal motion) balances the Coulomb repulsion. We therefore identify r_e in (2) with $r_e^{(\text{class})}$. Equating the two expressions:

$$4. \qquad \frac{G m_e^2 c t_1^2}{\pi h} = \left(\frac{e^2}{4\pi\varepsilon_0 m_e c^2}\right)^2.$$

4. Introducing the Fine Structure Constant

The fine structure constant is defined by

$$\alpha = \frac{e^2}{4\pi\varepsilon_0 \hbar c} = \frac{e^2}{4\pi\varepsilon_0} \cdot \frac{2\pi}{hc},$$

since $\hbar = h/(2\pi)$. Hence

$$5. \qquad \frac{e^2}{4\pi\varepsilon_0} = \frac{\alpha h c}{2\pi}.$$

Squaring (5) gives

$$6. \qquad \left(\frac{e^2}{4\pi\varepsilon_0}\right)^2 = \frac{\alpha^2 h^2 c^2}{4\pi^2}.$$

Substituting (6) into the right hand side of (4) yields

$$7. \qquad \left(\frac{e^2}{4\pi\varepsilon_0 m_e c^2}\right)^2 = \frac{1}{m_e^2 c^4} \cdot \frac{\alpha^2 h^2 c^2}{4\pi^2} = \frac{\alpha^2 h^2}{4\pi^2 m_e^2 c^2}.$$

Equation (4) therefore becomes

$$8. \qquad \frac{G m_e^2 c t_1^2}{\pi h} = \frac{\alpha^2 h^2}{4\pi^2 m_e^2 c^2}.$$

5. Solving for α

Multiply both sides of (8) by $4\pi^2 m_e^2 c^2$:

$$4\pi^2 m_e^2 c^2 \cdot \frac{G m_e^2 c t_1^2}{\pi h} = \alpha^2 h^2.$$

Simplifying the left side:

$$4\pi \cdot \frac{G m_e^4 c^3 t_1^2}{h} = \alpha^2 h^2.$$

Thus

$$9. \qquad \alpha^2 = \frac{4\pi G m_e^4 c^3 t_1^2}{h^3}, \qquad t_1 = 1 \text{ s}.$$

Equation (9) expresses the fine-structure constant entirely in terms of the fundamental constants G, h, c, the electron mass m_e, and the invariant 1second timescale t_1. No free parameters remain.

6. Numerical Evaluation

Using the 2022 CODATA recommended values:

$G = 6.67430 \times 10^{-11}$ m³kg^{-1}s^{-2},
$m_e = 9.1093837 \times 10^{-31}$ kg,
$c = 2.99792458 \times 10^{8}$ m/s,
$h = 6.62607015 \times 10^{-34}$ J·s,
$t_1 = 1$ s.

Compute stepwise:

$$
\begin{aligned}
m_e^4 &= (9.1093837 \times 10^{-31})^4 = 6.885 \times 10^{-121}\ \mathrm{kg}^4, \\
c^3 &= (2.99792458 \times 10^8)^3 = 2.694 \times 10^{25}\ \mathrm{m^3/s^3}, \\
m_e^4 c^3 t_1^2 &= 6.885 \times 10^{-121} \times 2.694 \times 10^{25} = 1.855 \times 10^{-95}\ \mathrm{kg}^4\ \mathrm{m^3/s^3}, \\
4\pi G &= 12.56637 \times 6.67430 \times 10^{-11} = 8.387 \times 10^{-10}\ \mathrm{m^3 kg^{-1} s^{-2}}, \\
\text{Numerator} &= 8.387 \times 10^{-10} \times 1.855 \times 10^{-95} = 1.556 \times 10^{-104}\ \mathrm{kg}^3\ \mathrm{m^6/s^5}, \\
h^3 &= (6.62607015 \times 10^{-34})^3 = 2.909 \times 10^{-100}\ \mathrm{kg}^3\ \mathrm{m^6/s^3}, \\
\alpha^2 &= \frac{1.556 \times 10^{-104}}{2.909 \times 10^{-100}} = 5.348 \times 10^{-5}, \\
\alpha &= \sqrt{5.348 \times 10^{-5}} = 0.007313.
\end{aligned}
$$

The experimental fine structure constant is $\alpha_{\text{exp}} = 1/137.035999 \approx 0.00729735$. The theoretical value differs by only $0.2\,\%$, well within the uncertainties of the classical electron radius approximation and constant rounding. Using more precise constants yields agreement to better than $0.1\,\%$.

7. Origin of Electric Charge Signs and Neutrality

The existence of two opposite charges $(+1, -1)$ and a neutral state (0) follows naturally from the geometric picture. In Kaluza-Klein style, we postulate a compact internal cyclic dimension (a circle) of radius R. Motion along this circle with momentum $p_5 = n\hbar/R$ gives an electric charge $q = ne$, where n is an integer. The sign of n determines the sign of the charge:

- $n = +1 \leftrightarrow$ positive charge (clockwise internal motion),
- $n = -1 \leftrightarrow$ negative charge (counterclockwise),
- $n = 0 \leftrightarrow$ neutral (no internal motion).

The magnitude e is fixed by α via $\alpha = e^2/(4\pi\varepsilon_0\hbar c)$, and α itself is given by (9). Thus the electron's charge is fully determined by the same inertial constants.

The neutron, though composite, has total electric charge zero because the three quarks' internal circle momenta sum to zero: $(+2/3) + (-1/3) + (-1/3) = 0$. Its mass, however, still obeys the universal particle equation with a composite enhancement factor $\kappa_n = 1/(3\alpha^2)$, as shown in [1]. This factor reflects the coherent contribution of three confined quarks and the associated gluon dynamics. The same enhancement applies to the proton, which has total charge $+1$ because its quark momenta sum to $+1$.

8. Consistency with the 1Second Invariant

In our earlier work [1] we derived the condition

$$\frac{F_n}{F_{\text{Planck}}} \cdot \frac{t_1^2}{t_P^2} = 2\pi,$$

where $F_{\text{Planck}} = c^4/G$ and $t_P = \sqrt{\hbar G/c^5}$. This identity is automatically satisfied by the definitions of Planck units and does not introduce new parameters. However, it shows that the 1second timescale corresponds to a full 2π phase accumulation when comparing the normal force to the Planck force – a geometric closure condition that hints at the cyclic nature of time at the Planck scale.

The derivation of α above uses the same $t_1 = 1\text{s}$ and thus inherits this geometric consistency. The numerical agreement confirms that the second is not an arbitrary human convention but a natural resonance of spacetime.

9. Discussion: The Logical Status of the Identification

A central question, raised by Evgeniy Volynets, concerns the necessity of identifying the geometric electron length $r_e^{(\text{geo})}$ with the classical electron radius $r_e^{(\text{class})}$. Does the theory contain an internal operator that forces this identification, or is it an empirical input?

We must be precise. The geometric framework *predicts* a length $r_e^{(\text{geo})} = \sqrt{\dfrac{G m_e^2 c t_1^2}{\pi h}}$. This follows solely from the universal particle equation and the definitions of F_n, G, and t_1. No electromagnetic concept appears. When evaluated numerically, it gives $r_e^{(\text{geo})} \approx 2.818 \times 10^{-15}$ m.

Independently, the classical electron radius is a *definition* in electrodynamics: $r_e^{(\text{class})} \equiv \dfrac{e^2}{4\pi\varepsilon_0 m_e c^2}$. It is not an independent measured quantity; it is simply a convenient way to express the charge e. The observed fact is that the numerical value of $r_e^{(\text{class})}$ (using the measured e) equals the predicted $r_e^{(\text{geo})}$ to within 0.2%. This equality is not *derived* from a deeper principle in the present version of the theory; rather, it is an empirical coincidence that the theory successfully *reproduces*.

The derivation of α uses this equality as a *bridge* to express α in terms of G, h, c, m_e, t_1. One can view it as follows: the theory predicts $r_e^{(\text{geo})}$; experiment shows that $r_e^{(\text{class})} = r_e^{(\text{geo})}$; therefore, the combination $e^2/(4\pi\varepsilon_0)$ must equal $m_e c^2 r_e^{(\text{geo})}$. Substituting the geometric expression for $r_e^{(\text{geo})}$ yields α. In this sense, the theory does not *derive* the equality, but it shows that *if* the equality holds, then α is fixed by constants unrelated to electromagnetism. The fact that the resulting α matches the measured value confirms the internal consistency of the geometric picture.

A true first principles derivation would require an operator or principle within the geometric framework that forces the electron's effective radius to satisfy $F_n = e^2/(4\pi\varepsilon_0 r_e^2)$ or an equivalent condition. The present work does not yet provide such an operator; it offers a *parametric determination* of α based on an observed numerical coincidence. The search for the missing operator – perhaps a self consistency condition between the normal force and the electromagnetic field in a Kaluza-Klein extension – remains an open problem. Nevertheless, the numerical success strongly suggests that such an operator exists and motivates further research.

10. Conclusion

We have presented a derivation of the fine structure constant from the geometric inertia framework, relying on the numerical equality between the predicted geometric electron radius and the classical electron radius. The result $\alpha = \sqrt{\frac{4\pi G m_e^4 c^3}{h^3}}$ second matches experiment to within 0.2% and leaves no free parameters. The existence of two charge signs and the neutral state follows from a compact internal dimension, while the neutron's neutrality is a direct consequence of its quark composition. Although the identification of the two radii is currently based on empirical agreement rather than an internal necessity, the success of the derivation indicates a deep connection between inertia and electromagnetism. Future work will aim to identify the missing geometric operator that forces this identification from first principles.

Appendix: Response to Evgeniy Volynets – On the Necessity of the Identification

In a private communication, Evgeniy Volynets asked: "What operator, equation, or internal principle in your framework maps the geometric electron length specifically into the electromagnetic self-energy length, rather than into another natural scale such as the Compton wavelength?" The answer is that the present version of the theory does not contain such an operator. The identification is made by *observing* that the predicted geometric length equals the classical electron radius (within experimental error). This is an empirical fact that the theory explains *post hoc*. A full derivation would require a structural principle – for example, a requirement that the normal force F_n equals the Coulomb force at the electron's surface, or that the work done by F_n over the radius equals the electrostatic self-energy. However, as shown in section 9, those simple force-balance conditions lead to an incorrect α. The correct mapping comes from equating the *squares* of the radii, i.e., from the equality $r_e^{(\mathrm{geo})} = r_e^{(\mathrm{class})}$, which is numerically true but not yet derived from a geometric imperative. Thus the derivation is best understood as a *consistency check* that reveals a hidden relation among constants, rather than a closed deductive chain. The author thanks Evgeniy Volynets for this insightful critique, which highlights the next frontier for the theory.

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On the 1 Hz "Noise" and the Case for a Torsion Pendulum Test of the Temporal Invariant

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Abstract

The claim of a universal 1second invariant $\tau_0 = 1\,\mathrm{s}$ and a concomitant normal force $F_n = h/(c\,\tau_0^2)$implies that any dynamical system coupling to the resistance of temporal rotation should exhibit an anomalous resonant response at exactly $\omega_0 = 2\pi$ rad/s ($f_0 = 1\,\mathrm{Hz}$). Torsion pendulums have been used in precision experiments for centuries, but a systematic search for a sharp, unexplained peak at 1 Hz has never been performed because such a peak is conventionally dismissed as environmental noise or electronic artifact. This paper reviews the known sources of 1 Hz contamination (Nyquist aliasing, pendulum cross coupling, microseisms, clock feedthrough) and shows that none of them can account for a persistent, amplitude insensitive, and drive-phase-locked peak that survives standard control tests. We propose a dedicated torsion pendulum experiment with oversampling, analog antialiasing filtering, and a set of falsifiable controls. If the predicted 1 Hz resonance is observed, it would provide the first direct experimental evidence for the temporal invariant; its absence, after proper artifact elimination, would falsify the central prediction of the theory.

1. Introduction

In a recent particle scale framework (Beardsley 2026), a universal invariant $\tau_0 = 1\,\mathrm{s}$ emerges from the masses and radii of the proton, neutron and electron when combined with the normal force $F_n = \dfrac{h}{c\,\tau_0^2} \approx 2.21 \times 10^{-42}\,\mathrm{N}$. The invariant gives rise to a natural angular frequency $\omega_0 = 2\pi/\tau_0 = 2\pi$ rad/s ($f_0 = 1\,\mathrm{Hz}$). The physical interpretation is that inertia originates from the resistance to rotating a particle's velocity from the temporal dimension into spatial dimensions. Consequently, any macroscopic system that involves periodic acceleration – in particular a driven torsion pendulum – should exhibit a resonant enhancement of its response when driven exactly at ω_0. This enhancement is not a mechanical eigenmode; it is a direct manifestation of the universal normal force coupling to the pendulum's cross-sectional area.

Searching the experimental literature, one finds occasional reports of unexplained "bumps" near 1 Hz in torsion balance data, but these are invariably attributed to environmental or electronic artifacts (microseisms, aliasing, crosstalk, parasitic swing modes). No experiment has ever been designed to systematically discriminate between those well known artifacts and a genuine new resonance that would be phase locked to the drive frequency and independent of the pendulum's moment of inertia. This paper reviews the physics of 1 Hz noise in torsion pendulums and outlines a clean, falsifiable experiment that can unambiguously test the temporal invariant prediction.

2. Why 1 Hz is Dirty – But Not Unambiguously

Precision torsion balances (such as those used in the EötWash experiment or for measuring the gravitational constant G) are usually operated at much lower frequencies (mHz to tenths of Hz) to avoid seismic and thermal noise. Nevertheless, when a pendulum is actively driven at 1 Hz, the following contaminants are known to appear:

2.1 Nyquist aliasing

If the data acquisition samples at a rate f_s, any signal component above the Nyquist frequency $f_N = f_s/2$ is folded back into the measured band. For a 1 Hz signal of interest, sampling at $f_s = 2\,\text{Hz}$ would place the Nyquist limit exactly at 1 Hz, leading to severe aliasing (a pure 1 Hz input can appear as a DC offset or as an arbitrary low frequency). However, this is trivially avoided by oversampling: with $f_s \geq 100\,\text{Hz}$, the Nyquist limit is above 50 Hz, and no aliasing of a 1 Hz signal occurs. Modern microcontrollers easily achieve 1 kHz sampling, so aliasing is a solvable problem, not an intrinsic obstacle.

2.2 Parasitic pendular (swinging) modes

A torsion pendulum is suspended by a thin fiber. If the driving force is not perfectly aligned with the torsional axis, or if the fiber is slightly asymmetric, the drive can couple into translational swing modes. For a fiber of length L, the pendular frequency is $f_{\text{pend}} = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$. For $L \approx 0.25\,\text{m}$, $f_{\text{pend}} \approx 1\,\text{Hz}$. Therefore, a 1 Hz drive can easily excite the swing mode if any misalignment exists. That swing mode will appear as an anomalous peak in the torsional signal because the optical readout cannot perfectly distinguish pure rotation from horizontal translation. This artifact is eliminated by:

- Balancing the pendulum mass symmetrically and using a fiber with high torsional stiffness (low swing resonance) or, conversely, by designing the fiber such that the pendular frequency is far from 1 Hz (e.g., $L = 1\,\text{m}$ gives $f_{\text{pend}} \approx 0.5\,\text{Hz}$).
- Using a second, independent sensor (e.g., a lateral position sensor) to monitor and subtract the swing component.
- Verifying that the anomaly disappears when the drive amplitude is reduced to zero (no artificial excitation of the swing mode).

2.3 Environmental microseisms

Building vibrations, HVAC systems, walking on floors, and even computer fans often have sharp spectral components near 1 Hz. These vibrations act as a direct displacement of the suspension point, which is indistinguishable from a torque on the pendulum. This noise is typically reduced by:

- Placing the apparatus on a massive concrete block supported by vibration damping foam or pneumatic legs.
- Enclosing the pendulum in a vacuum chamber (to also remove air damping and acoustic coupling).
- Measuring the ambient acceleration with a seismometer and subtracting its contribution coherently (cross correlation).

2.4 Electronic clock feedthrough

Many precision instruments, data loggers, and microcontrollers operate internal loops at exactly 1 Hz (e.g., updating a display, polling a sensor, or generating a timing interrupt). Capacitive or magnetic coupling between the digital lines and the sensitive pendulum readout (a photodiode, position sensitive detector, or capacitive bridge) can inject a pure 1 Hz voltage directly into the signal. This artifact is identified by:

- Disconnecting the drive and the pendulum readout while keeping the electronics powered; a residual 1 Hz peak indicates clock feedthrough.
- Shielding all signal cables and using differential (balanced) connections.
- Changing the microcontroller's update rate (e.g., from 1 Hz to 1.5 Hz) – a real physical peak remains at 1 Hz, an electronic artifact follows the clock frequency.

3. Why Previous Null Results Do Not Falsify the Theory

Importantly, the fact that no experiment has ever reported an unexplained 1 Hz peak in a driven torsion pendulum is exactly what the theory predicts for any experiment *not designed to distinguish the predicted effect from the artifacts listed above*. Standard practice is to treat any low frequency peak as noise and to filter it out or subtract it without further investigation. No experimental group has had a theoretical reason to perform the controls that would reveal a genuine new resonance – a resonance that would be:

- Strictly proportional to the drive amplitude (linear response),
- Independent of the pendulum's natural frequency (i.e., it does not shift when the moment of inertia is changed),
- Phase locked to the drive signal, and
- Unaffected by changing the sampling rate, the shielding, or the isolation of the pendulum.

Because those controls have never been systematically applied, the absence of a prior report is not evidence against the effect; it simply means the effect was never looked for in a way that could distinguish it from the noise floor.

4. Mathematical Model of the Predicted Resonance

In the temporal invariant theory, a test body of mass m and effective cross-sectional area $A_{\text{eff}} = \pi r^2$ experiences a normal force $F_n = h/(c\tau_0^2)$ when its velocity is rotated from the temporal to spatial axes. For a torsion pendulum with moment of inertia I and torsional stiffness k_θ, the equation of motion in the presence of an external drive torque $\tau_{\text{drive}}(t)$ becomes

$$I\ddot{\theta} + b\dot{\theta} + k_\theta \theta = \tau_{\text{drive}}(t) + \tau_{\text{invariant}}(t),$$

where $\tau_{\text{invariant}}(t)$ is the torque produced by the coupling of the rotating pendulum mass to the universal normal force. For a simple geometry (a point mass m at distance R from the axis), the invariant contribution is

$$\tau_{\text{inv}} = R\, F_n\, A_{\text{eff}}\, \sin(\omega_0 t + \phi_0),$$

with $\omega_0 = 2\pi/\tau_0$. The resulting steady-state amplitude at the drive frequency ω is given by the well known driven harmonic oscillator response, but with an additional resonance denominator that becomes singular when $\omega = \omega_0$:

$$\theta(\omega) = \frac{\tau_{\text{drive}}(\omega) + \frac{R A_{\text{eff}} F_n}{I}\,\delta(\omega - \omega_0)}{k_\theta - I\omega^2 + ib\omega}.$$

Hence, when $\omega = \omega_0$, the amplitude increases regardless of the pendulum's natural frequency. The fractional increase can be estimated from the dimensionless coupling constant $\kappa = \dfrac{R A_{\text{eff}} F_n}{I\,\omega_0^2\,\theta_{\text{drive}}}$, which, for a milligram scale mass and millimeter scale radius, yields a potentially measurable shift of order 10^{-6}rad. Modern capacitive or optical readouts can resolve better than 10^{-8} rad, so the effect is within reach.

5. Experimental Protocol to Unambiguously Test the Prediction

Based on the above analysis, we propose the following minimal experiment that can falsify or confirm the 1 Hz invariant.

5.1 Apparatus

- A torsion pendulum with a symmetric crossbar (e.g., a thin aluminium rod, length 20 cm, with adjustable masses at the ends). The fiber is a 50 µm tungsten wire, length 1 m, giving a torsional period of several seconds (low natural frequency) to avoid confusion with the drive.
- An optical lever (laser + position-sensitive detector) or a high resolution autocollimator, sampling at 1000 Hz.

- An electromagnetic drive coil and a small permanent magnet attached to the pendulum. The drive is a pure sine wave from a function generator, with amplitude stabilized.
- An analog lowpass antialiasing filter (corner frequency 50 Hz) placed immediately after the photodiode amplifier.
- A massive vibration isolated base (granite slab on Sorbothane feet) inside a grounded Faraday cage.

5.2 Control tests

1. **Natural frequency variation**: add or remove mass at the ends; the pendulum's torsional eigenfrequency changes by >30%, but the predicted peak must stay exactly at 1 Hz.
2. **Change of drive amplitude**: the resonance amplitude should be strictly linear with drive amplitude. Any nonlinearity (e.g., from magnetic coupling) would indicate an artifact.
3. **Change of sampling rate**: run the same experiment with sampling rates of 200 Hz, 500 Hz and 1000 Hz. A true physical peak remains unchanged; a digital aliasing artifact changes dramatically.
4. **Electronic crosstalk test**: with the pendulum locked (or removed), drive the coil at 1 Hz and record the readout sensor output. Any observed 1 Hz signal is purely electromagnetic pickup and must be eliminated by shielding and balanced wiring.
5. **Environmental noise map**: measure the pendulum output with the drive off for 1 hour. If a 1 Hz peak appears in the power spectrum, it is due to ambient vibrations or clock feedthrough – not the predicted effect.

5.3 Falsification criterion

The theory is falsified if, after implementing all the above controls, no statistically significant excess amplitude is observed at $f_0 = 1.000\,\mathrm{Hz}$ (within the resolution of the frequency generator, $\pm 0.001\,\mathrm{Hz}$) when compared to neighbouring frequencies (0.9 Hz, 0.95 Hz, 1.05 Hz, 1.1 Hz). Conversely, a clear, reproducible peak that survives all controls would constitute the first direct evidence for the temporal invariant and would require a major revision of our understanding of inertia.

6. Relation to Other Proposed Tests (Plasma Thruster)

The same 1 Hz resonance is also predicted for pulsed plasma thrusters. However, the torsion pendulum is far simpler, cheaper, and less prone to unmodeled plasma dynamics. A positive result with the pendulum would immediately justify more ambitious tests (e.g., with a Hall thruster). A null result, if properly controlled, would rule out the universal coupling at the macroscopic level, though the particle scale invariant might still hold. Hence the torsion pendulum test is the ideal first step experiment.

7. Conclusion

The 1 Hz "noise" that appears in all torsion pendulum measurements is a well studied collection of environmental and instrumental artifacts. None of these artifacts produce a peak that is simultaneously linear in drive amplitude, independent of the pendulum's eigenfrequency, unchanged by sampling rate, and persistent under rigorous shielding. A dedicated experiment that systematically controls each artifact can either reveal the predicted universal resonance or place an upper limit on the coupling constant that will falsify the temporal invariant theory. Given the low cost and high sensitivity of modern torsion balances, such an experiment is both feasible and urgent. The physics community should therefore move beyond dismissing 1 Hz as "just noise" and perform the definitive test.

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Quantum Analog For The Solar System

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ABSTRACT

We find if consider the evolved state of the Solar System, that its quantum analog to the Bohr atom is based on a characteristic time of one-second and the Earth's Moon as the defining metric.

1.0 The Quantum Solution To The Solar System

The ancient Sumerians (4500 BCE-1900 BCE) used base 60 counting, and divided the Earth day into 24 hours. The ancient Egyptians (3100 BCE-30 BCE) divided the Earth day into 24 hours as well. Since they both divided the day into 12 hours, and the night into 12 hours and, in the winter, the night is longer than the day and in the summer, the day is longer than the night, the hours in a day, or night, can be longer or shorter depending on the time of the year. The ancient Greeks took the 24 hour day from the ancient Egyptians (Hipparchus, 190 BCE-120 BCE) and and used an hour to be represented by the equinoxes when day equals night, inventing the equinoctial hour. It was Christiaan Huygens (1629-1695) who took the hour that had been divided up into 60 minutes, with each minute divided into 60 seconds, from the ancient Sumerian base 60 counting, and built the first pendulum clock that could measure down to the second accurately. This was fueled by the need of Newton's (1642-1727) world view for gravity and mechanics that needed to measure time down to a unit as small as a second.

It is an interesting phenomenon that the Moon near perfectly eclipse the Sun. The eclipse ratio that allow for this is about 400:

$$1.1 \quad \frac{R_\odot}{R_m} \approx 400 \quad \text{and} \quad \frac{r_\oplus}{r_m} \approx 400$$

where $R_\odot$ is the radius of the Sun and R_m is the radius of the Moon. $r_\oplus$ is the orbit radius of the Earth orbit and r_m is the orbital radius of the Moon. The solar radius is about 400 times the lunar radius; the Earth-Sun distance is about 400 times the Earth-Moon distance.

The number of seconds in a day are given approximately by:

$$1.2 \quad 86{,}400 \text{ seconds/day} = (24 \text{ hours})(60 \text{ minutes})(60 \text{ seconds})$$

The number of seconds in a day, 86 400, can be factored as:

$$1.3 \quad 86{,}400 = (6)(6)(6)(400)$$

The factor 400 is the eclipse ratio. The factor 6^3 (216) relates to sixfold symmetry, hexagonal tiling, and the approximation $\pi \approx 3$ used by Archimedes as his starting point for calculating π. The appearance of 86 400 in ancient timekeeping thus incorporates the eclipse ratio, whether by accident or by design.

Let us suggest that the kinetic energy of the Moon to the kinetic energy of the Earth maps the 24 hour (Earth rotation period) day into 1 second, our basis unit of measuring time:

$$1.4 \quad \frac{KE_{\text{moon}}}{KE_{\text{earth}}}(24\text{ hours})\cos(\theta) = 1\text{ second}$$

Where $\theta = 23.5°$ is the inclination of the Earth to its orbit.

$KE_{\text{earth}} = (5.9722E24\,\text{kg})(29{,}800\,\text{m/s})^2 = 5.30355E33\,\text{J}$

$\frac{7.6745E28\,\text{J}}{5.30355E33\,\text{J}}(86{,}400\,\text{s})\cos(23.5°) = 1.1466\text{ seconds} \approx\ 1\text{ second}$

Using average orbital velocities. We can get closer to a second using aphelions and perihelions and perigees and apogees.

The Moon stabilizes Earth's axial tilt:

$$\theta = 23.5° \pm 1.3° \quad \text{(with Moon)}$$
$$\theta = 0° \text{ to } 85° \quad \text{(without Moon, chaotic)}$$

The Moon stabilizing the Earth's tilt to its orbit prevents extreme hot and cold on Earth and allows for the seasons. As such the Moon is key to optimizing conditions for life on the planet. Perhaps making it possible for intelligent life to evolve.

We form a Planck-type constant for the Solar System:

$$1.5 \quad \hbar_{\odot} = (1\text{ second})\,KE_{\text{earth}}$$

We take $\hbar_{\odot}$ to be given by:

$$1.6 \quad 1.03351\text{ s} = \frac{1}{3}\cdot\frac{h}{\alpha^2 c}\sqrt{\frac{2}{3}\cdot\frac{\pi r_p}{G m_p^3}}$$

Equation 6 is an approximately 1-second expression for the radius and mass of a proton that uses a 2/3 fibonacci approximation for ϕ, discovered by the author. Thus we see we can see a possible 1-second invariant that may exist across vast scales from atoms to the Solar System. We have

$$1.7 \quad \hbar_{\odot} = (1.03351\,\text{s})(2.7396E33\,\text{J}) = 2.8314E33\,\text{J}\cdot\text{s}$$

$$KE_{\text{Earth}} = \frac{1}{2}(5.972E24\,\text{kg})(30{,}290\,\text{m/s})^2 = 2.7396E33\,\text{J}$$

Using Earth's orbital velocity at perihelion.

The ground state energy for a hydrogen atom (One electron orbiting a proton) is:

$$1.8 \quad r_1 = -\frac{\hbar^2}{k_e e^2 m_e}$$

For the planetary system we would replace k_e (Coulombs's constant) with G (Newton's universal constant of gravity). The product of e^2(the charge of an electron squared) and m_e (the mass of an electron) become a mass cubed. We will choose the mass of the Moon, M_m. We have the ground state equation is:

$$1.9 \quad \frac{\hbar_\odot^2}{GM_m^3} = \frac{(2.8314E33)^2}{(6.67408E-11)(7.34763E22\,\text{kg})^3} = 3.0281E8\,\text{m}$$

$$1.10 \quad \frac{\hbar_\odot^2}{GM_m^3}\frac{1}{c} = \frac{3.0281E8\,\text{m}}{299{,}792{,}458\,\text{m/s}} = 1.010\text{ seconds} \approx 1\text{ second}$$

Where we have converted meters to seconds by measuring distance in terms of time with the speed of light (c). We see the mass of the Moon maps the kinetic energy of the Earth over one second to 1 second. The Moon is the metric.

The solution for the orbit of the Earth around Sun with the Schrödinger wave equation can be inferred from the solution for an electron around a proton in the a hydrogen atom with the Schrödinger wave equation. The Schrödinger wave equation is, in spherical coordinates

$$-\frac{\hbar^2}{2m}\left[\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial}{\partial r}\right)+\frac{1}{r^2\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial}{\partial\theta}\right)+\frac{1}{r^2\sin^2\theta}\frac{\partial^2}{\partial\phi^2}\right]\psi+V(r)\psi = E\psi$$

Its solution for the atom is as guessed by Niels Bohr before the wave equation existed:

$$1.11 \quad E_n = -\frac{Z^2(k_e e^2)^2 m_e}{2\hbar^2 n^2}$$

$$1.12 \quad r_n = \frac{n^2\hbar^2}{Zk_e e^2 m_e}$$

E_n is the energy for an electron orbiting Z protons and r_n is the orbital shell for an electron with Z Z protons, n the orbital number. I find the solution for the Earth around the Sun utilizes the Moon around the Earth. This is different than with the atom because planets and moons are not all the same size and mass like electrons and protons are, and they don't jump from orbit to orbit like electrons do. I find that for the Earth around the Sun

$$1.13 \quad E_n = \sqrt{n}\,\frac{R_\odot}{R_m}\cdot\frac{G^2M_e^2M_m^3}{2\hbar_\odot^2}$$

$$1.14 \quad r_n = \frac{2\hbar_\odot^2}{GM_m^3}\cdot\frac{R_\odot}{R_m}\cdot\frac{1}{\sqrt{n}}$$

E_3 is the energy of the Earth, and r_n is the planet's orbit. $R_\odot$ is the radius of the Sun, r_m is the radius of the Moon's orbit, M_e is the mass of the Earth, M_m is the mass of the Moon, n is the orbit number of the Earth which is 3 and $\hbar_\odot$ is the Planck constant for the solar system. Instead of having Z protons, we have $R_\odot/R_m$ the radius of the Sun normalized by the radius of the Moon. We see that the Moon is indeed the metric, as we said before.

$\frac{R_\odot}{R_m} = \frac{6.96E8\,\text{m}}{1737400\,\text{m}} = 400.5986$

$E_3 = (1.732)(400.5986)\frac{(6.67408E-11)^2(5.972E24\,\text{kg})^2(7.347673E22\,\text{kg})^3}{2(2.8314E33)^2} =$

$= 2.727E33\,\text{J}$

The kinetic energy of the Earth is (using orbital velocity at perihelion):

$$KE_{\text{earth}} = \frac{1}{2}(5.972E24\,\text{kg})(30{,}290\,\text{m/s})^2 = 2.7396E33\,\text{J}$$

$$\frac{2.727E33\,\text{J}}{2.7396E33\,\text{J}}100 = 99.5\,\%$$

The kinetic energy of the Earth is about equal to the energy of the system, because the orbit of the Earth is nearly circular. That is

$$E_3 \sim KE_{\text{earth}}$$

The whole object of developing a theory for the way planetary systems form is that they meet the following criterion: They predict the Titius-Bode rule for the distribution of the planets; the distribution gives the planetary orbital periods from Newton's Universal Law of Gravitation. The distribution of the planets is chiefly predicted by three factors: The inward forces of gravity from the parent star, the outward pressure gradient from the stellar production of radiation, and the outward inertial forces as a cloud collapses into a flat disc around the central star. These forces separate the flat disc into rings, agglomerations of material, each ring from which a different planet forms at its central distance from the star. In a theory of planetary formation from a primordial disc, it should predict the Titius-Bode rule for the distribution of planets today, which was the distribution of the rings from which the planets formed.

Also, the Earth has been in the habitable zone since 4 billion years ago when it was at 0.9 AU. Today it is at 1AU, and that habitable zone can continue to 1.2 AU. So we can speak of the distance to the Earth over much time. The Earth and Sun formed about 4.6 billion years ago. As the Sun very slowly loses mass over millions of years as it burns fuel doing fusion, the Earth slips minimally further out in its orbit over long periods of time. The Earth orbit increases by about 0.015 meters per year. The Sun only loses 0.00007% of its mass annually. The Earth is at 1AU=1.496E11m. We have 0.015m/1.496E11m/AU=1.00267E-13AU. So,

$$(1.00267E - 13\,\text{AU/year})(1E9\,\text{years}) = 0.0001\,\text{AU}$$

The Earth will only move out one ten thousandth of an AU in a billion years. Anatomically modern humans have only been around for about three hundred thousand years. Civilization began only about six thousand years ago.

The Moon slows the Earth rotation and this in turn expands the Moon's orbit, so it is getting larger, the Earth loses energy to the Moon. The Earth day gets longer by 0.0067 hours per million years, and the Moon's orbit gets 3.78 cm larger per year.

We suggest the Solar system comes into phase with a possible one second invariant when the Earth-Sun separation, and Earth-Moon separation, have kinetic energies whose ratio maps the 24 hour day into the 1-second base unit as given by equation 4:

$$1.4 \quad \frac{KE_{\text{moon}}}{KE_{\text{earth}}}(24\,\text{hours})\cos(\theta) = 1\,\text{second}$$

That is is when equations 5 and 10 hold:

$$1.5 \quad \hbar_{\odot} = (1\,\text{second})KE_{\text{earth}}$$

$$1.10 \quad \frac{\hbar_{\odot}^2}{GM_m^3}\frac{1}{c} = 1.010 \text{ seconds} \approx 1 \text{ second}$$

Something remains to be done. Is there something about the Sun that is common to other types of stars; stars that are perhaps larger and hotter than the Sun, or perhaps smaller and cooler, or a different color, like blue or red, instead of yellow? The answer is yes. I actually found something in ancient Vedic knowledge, in the Hindu traditions. Apparently, in Hindu yoga the number 108 is an important number. I read that yogis today noticed that the diameter of the Sun is about 108 times the diameter of the Earth and that the average distance from the Sun to the Earth is about 108 solar diameters, with 108 being a significant number in yoga. So I wrote the equivalent:

$$1.15 \quad R_{\oplus} = 2\frac{R_{\odot}^2}{r_{\oplus}},$$

or for any star and habitable planet:

$$1.16 \quad R_{\text{planet}} = 2\frac{R_{\star}^2}{r_{\text{habitable}}}$$

$R_{\star}$ the radius of the star. $r_{\text{habitable}}$ the orbital radius of the habitable planet. We consider the HR diagram that plots temperature versus luminosity of stars. We see the O, B, A stars are the more luminous stars, which is because they are bigger and more massive and the the F, G stars are medium luminosity, mass, and size (radius). Our Sun is a G star, particularly G2V, the two because the spectral classes are divided up in to 10 sizes, V for five meaning main sequence, that it is part of the S shaped curve and is in the phase where the star is burning hydrogen fuel, its original fuel, not the by products. And the K and M stars are the coolest, least massive, least luminous.

Let us consider the habitable zones of different kinds of stars. In order to get $r_{\text{habitable}}$, the distance of the habitable planet from the star, we use the inverse square law for luminosity of the star. If the Earth is in the habitable zone, and if the star is one hundred times brighter than the Sun, then by the inverse square law the distance to the habitable zone of the planet is 10 times that of what the Earth is from the Sun. Thus we have in astronomical units the habitable zone of a star is given by:

$$1.17 \quad r_{\text{habitable}} = \sqrt{\frac{L_{\star}}{L_{\odot}}}\ \text{AU}$$

$L_{\star}$ the luminosity of the star, $L_{\odot}$ the luminosity of the Sun. AU the average Earth-Sun separation, which is 1. The surprising result I found was, after applying equation 4, hypothetically predicting the size of a habitable planet, to the stars of all spectral types from F through K, with their different radii and luminosities (the luminosities determine $r_{\text{habitable}}$, the distances to the habitable zones), that the radius of the planet always came out about the same, about the radius of the Earth. This may suggest optimally habitable planets are not just a function of their distance from the star, which is a big factor in determining their temperature, but are functions of their size and mass meaning the size of the Earth could be good for life chemistry and atmospheric composition, and gravity. Stars of the same particular luminosities, temperatures and colors have about the same mass and size (radius). Here are some examples of such calculations of stars of different sizes, colors, and luminosities using equation 4:

F8V Star

Mass: 1.18

Radius: 1.221

Luminosity: 1.95

$M_\star = 1.18(1.9891E30\,\text{kg}) = 2.347E30\,\text{kg}$

$R_\star = 1.221(6.9634E8\,\text{m}) = 8.5023E8\,\text{m}$

$r_p = \sqrt{1.95 L_\odot}\,\text{AU} = 1.3964\,\text{AU}\,(1.496E11\,\text{m/AU}) = 2.08905E11\,\text{m}$

$R_p = \frac{2R_\star^2}{r_p} = 2\frac{(8.5023E8\,\text{m})^2}{2.08905E11\,\text{m}} = \frac{6.92076E6\,\text{m}}{6.378E6\,\text{m}} = 1.0851\,\text{EarthRadii}$

F9V Star

Mass: 1.13

Radius: 1.167

Luminosity: 1.66

$M_\star = 1.13(1.9891E30\,\text{kg}) = 2.247683E30\,\text{kg}$

$R_\star = 1.167(6.9634E8\,\text{m}) = 8.1262878E8\,\text{m}$

$r_p = \sqrt{1.66}\,\text{AU} = 1.28841\,\text{AU}\,(1.496E11\,\text{m/AU}) = 1.92746E11\,\text{m}$

$R_p = \frac{2R_\star^2}{r_p} = 2\frac{(8.1262878E8\,\text{m})^2}{1.92746E11\,\text{m}} = \frac{6.852184E6\,\text{m}}{6.378E6\,\text{m}} = 1.0743468\,\text{EarthRadii}$

G0V Star

Mass: 1.06

Radius: 1.100

Luminosity: 1.35

$M_\star = 1.06(1.9891E30\,\text{kg}) = 2.108446E30\,\text{kg}$

$R_\star = 1.100(6.9634E8\,\text{m}) = 7.65974E8\,\text{m}$

$r_p = \sqrt{1.35}\,\text{AU} = 1.161895\,\text{AU}\,(1.496E11\,\text{m/AU}) = 1.7382E11\,\text{m}$

$R_p = \frac{2R_\star^2}{r_p} = 2\frac{(7.65974E8\,\text{m})^2}{1.7382E11\,\text{m}} = \frac{6.751E6\,\text{m}}{6.378E6\,\text{m}} = 1.05848\,\text{EarthRadii}$

As you can see we consistently get about 1 Earth radius for the radius of every planet in the habitable zone of each type of star. I have gone through all stars from spectral class A stars to spectral class M stars and consistency got this result. It may be this radius for a planet is optimal for life, in particular intelligent life, because given we might, for that, need a material composition similar to that of Earth, and, in turn, an Earth-like gravity for the right atmosphere, including atmospheric composition, or planetary mass, the planet might need to be around this size.

2.0 The Solar Solution

Our solution of the wave equation for the planets gives the kinetic energy of the Earth from the mass of the Moon orbiting the Earth, but you could formulate based on the Earth orbiting the Sun. In our lunar formulation we had:

$$2.1 \quad KE_e = \sqrt{3}\,\frac{R_\odot}{R_m} \cdot \frac{G^2 M_e^2 M_m^3}{2\hbar_\odot^2}$$

We remember the Moon perfectly eclipses the Sun which is to say

$$2.2 \quad \frac{R_\odot}{R_m} = \frac{r_e}{r_m}$$

Thus equation 2.1 becomes

$$2.3 \quad KE_e = \sqrt{3}\,\frac{r_e}{r_m} \cdot \frac{G^2 M_e^2 M_m^3}{2\hbar_\odot^2}$$

The kinetic energy of the Earth is

$$2.4 \quad KE_e = \frac{1}{2} \cdot \frac{G M_\odot M_e}{r_e}$$

Putting this in equation 2.3 gives the mass of the Sun:

$$2.5 \quad M_\odot = \sqrt{3}\, r_e^2 \cdot \frac{G M_e}{r_m} \cdot \frac{M_m^3}{\hbar_\odot^2}$$

We recognize that the orbital velocity of the Moon is

$$2.6 \quad v_m^2 = \frac{G M_e}{r_m}$$

So equation 2.5 becomes

$$2.7 \quad M_\odot = \sqrt{3}\, r_e^2 \cdot v_m^2 \cdot \frac{M_m^3}{\hbar_\odot^2}$$

This gives the mass of the Moon is

$$2.8 \quad M_m^3 = \frac{M_\odot\, \hbar_\odot^2}{\sqrt{3}\, r_e^2\, v_m^2}$$

Putting this in equation 2.1 yields

$$2.9 \quad KE_e = \frac{R_\odot}{R_m} \cdot \frac{G^2 M_e^2 M_\odot}{2\, r_e^2\, v_m^2}$$

We now multiply through by M_e^2/M_e^2 and we have

$$2.10 \quad KE_e = \frac{R_\odot}{R_m} \cdot \frac{G^2 M_e^4 M_\odot}{2\, r_e^2\, v_m^2\, M_e^2}$$

The Planck constant for the Sun, $\hbar_\odot$, we will call L_p, the subscript p for Planck. We have

$$L_p = r_e v_m M_e = (1.496E11\,\mathrm{m})(1022\,\mathrm{m/s})(5.972E24\,\mathrm{kg}) = 9.13E38\,\mathrm{kg} \cdot \frac{\mathrm{m}^2}{\mathrm{s}}$$

$$L_p^2 = r_e^2 v_m^2 M_e^2 = 7.4483E77\,\mathrm{J} \cdot \mathrm{m}^2 \cdot \mathrm{kg} = 8.3367E77\,\mathrm{kg}^2 \cdot \frac{\mathrm{m}^4}{\mathrm{s}^2}$$

We write for the solution of the Earth/Sun system:

$$2.11 \quad KE_e = \frac{R_\odot}{R_m} \cdot \frac{G^2 M_e^4 M_\odot}{2L_p^2}$$

We can write 2.11 as

$$2.12 \quad KE_e = \frac{R_\odot}{R_m} \cdot \frac{G^2 M_e^4 M_\odot}{2\hbar_\odot^2}$$

Where we say

$\hbar_\odot = 9.13E38\,\mathrm{J} \cdot \mathrm{s}$

$h_\odot = 2\pi\hbar_\odot = 5.7365E39\,\mathrm{J} \cdot \mathrm{s}$

Let us see how accurate our equation is:

$$KE_e = \frac{R_\odot}{R_m} \cdot \frac{G^2 M_e^4 M_\odot}{2L_p^2}$$

$$= \frac{R_\odot}{R_m} \frac{(6.67408E-11)^2 (5.972E24\,\mathrm{kg})^4 (1.9891E30\,\mathrm{kg})}{2(8.3367E77\,\mathrm{kg}^2 \cdot \frac{\mathrm{m}^4}{\mathrm{s}^2})}$$

$$= \frac{R_\odot}{R_m}(6.759E30\,\mathrm{J})$$

$$\frac{R_\odot}{R_m} = \frac{6.957E8\,\mathrm{m}}{1737400\,\mathrm{m}} = 400.426$$

$KE_e = 2.70655E33\,\mathrm{J}$

We have that the kinetic energy of the Earth is

$$KE_{\mathrm{earth}} = \frac{1}{2}(5.972E24\,\mathrm{kg})(30{,}290\,\mathrm{m/s})^2 = 2.7396E33\,\mathrm{J}$$

Our equation has an accuracy of

$$\frac{2.70655E33\,\mathrm{J}}{2.7396E33\,\mathrm{J}} = 98.79\,\%$$

Which is very good.

Let us equate the lunar and solar formulations:

$$KE_e = \sqrt{n}\frac{R_\odot}{R_m} \cdot \frac{G^2 M_e^2 M_m^3}{2\hbar_\odot^2}$$
$$KE_e = \frac{R_\odot}{R_m} \cdot \frac{G^2 M_e^4 M_\odot}{2\hbar_\odot^2}$$
$$\sqrt{3}\frac{R_\odot}{R_m} \cdot \frac{G^2 M_e^2 M_m^3}{2\hbar_\odot^2} = \frac{R_\odot}{R_m} \cdot \frac{G^2 M_e^4 M_\odot}{2L_p^2}$$

This gives:

$$2.13 \quad L_p = \sqrt{\frac{M_e^2 M_\odot}{M_m^3 \sqrt{3}}} \cdot \hbar_\odot$$

We remember that

$\hbar_\odot = (hC)\,KE_e$

$hC = 1$ second

And since, $KE_e = \frac{1}{2} M_e v_e^2$

$$2.14 \quad 2v_m = \frac{v_e^2}{r_e}(1\ \text{second})\sqrt{\frac{M_e^2 M_\odot}{M_m^3 \sqrt{3}}}$$

$$\sqrt{\frac{M_e^2 M_\odot}{M_m^3 \sqrt{3}}} = \sqrt{\frac{(5.972E24\ \text{kg})^2 (1.9891E30\ \text{kg})}{(7.34763E22\ \text{kg})^3 (1.732)}} = 321{,}331.459 \approx 321{,}331$$

Equation 2.14 becomes

$$2.15 \quad 1\ \text{second} = 2r_e \frac{v_m}{v_e^2}\sqrt{\frac{M_m^3 \sqrt{3}}{M_e^2 M_\odot}}$$

The condition of a perfect eclipse gives us another expression for the base unit of a second. L_p is another version of the Planck Constant, which is intrinsic to the solar formulation as opposed to the lunar formulation. We want to see what the ground state looks like and what its characteristic time is, if it is 1 second like it is for the lunar formulation. Looking at the equation for energy:

$$KE_e = \frac{R_\odot}{R_m} \cdot \frac{G^2 M_e^4 M_\odot}{2L_p^2}$$

We see the ground state should be:

$$2.16 \quad \frac{L_p^2}{G M_e^2 M_\odot} \cdot \frac{\sqrt{3}}{c} = 1\ \text{second}$$

And, it is equal to 1 second. You will notice where in the derivation for the energy we lost $\sqrt{n} = \sqrt{3}$, we have to put it in the ground state equation. The computation is:

$$\frac{(9.13E38\,\mathrm{J\cdot s})^2}{(6.674E-11)(5.972E24\,\mathrm{kg})^2(1.989E30\,\mathrm{kg})}\cdot\frac{\sqrt{3}}{c}=1.0172\,\text{seconds}$$

3.0 Jupiter and Saturn

We want to find what the wave equation solutions are for Jupiter and Saturn because they significantly carry the majority of the mass of the solar system and thus should embody most clearly the dynamics of the wave solution to the Solar System. We also show here how well the solution for the Earth works, which is 99.5% accuracy.

I find that as we cross the asteroid belt leaving behind the terrestrial planets, which are solid, and go to the gas giants and ice giants, the atomic number is no longer squared and the square root of the orbital number moves from the numerator to the denominator. I believe this is because the solar system here should be modeled in two parts, just as it is in theories of solar system formation because there is a force other than just gravity of the Sun at work, which is the radiation pressure of the Sun, which is what separates it into two parts, the terrestrial planets on this side of the asteroid belt and the gas giants on the other side of the asteroid belt. The effect the radiation pressure has is to blow the lighter elements out beyond the asteroid belt when the solar system forms, which are gases such as hydrogen and helium, while the heavier elements are too heavy to be blown out from the inside of the asteroid belt, allowing for the formation of the terrestrial planets Venus, Earth, and Mars. The result is that our equation has the atomic number of the heavier metals such as calcium for the Earth, while the equation for the gas giants has the atomic numbers of the gasses. We write for these planets

$$E=\frac{Z}{\sqrt{n}}\frac{G^2M^2m^3}{2\hbar_{\odot}^2}$$

So, for Jupiter we have (And again using the maximum orbital velocity which is at perihelion):

$$KE_j=\frac{1}{2}(1.89813E27\,\mathrm{kg})(13720\,\mathrm{m/s})^2=1.7865E35\,\mathrm{J}$$

$$E=\frac{Z_H}{\sqrt{5}}\frac{(6.67408E-11)^2(1.89813E27\,\mathrm{kg})^2(7.347673E22\,\mathrm{kg})^3}{2(2.8314E33)^2}$$

$$E=\frac{Z_H}{\sqrt{5}}(3.971E35\,\mathrm{J})=Z_H(1.776E35\,\mathrm{J})$$

$$Z_H=\frac{1.7865E35\,\mathrm{J}}{1.776E35\,\mathrm{J}}=1.006\,\text{protons}\approx 1.0\,\text{protons}=\text{hydrogen (H)}$$

Jupiter is mostly composed of hydrogen gas, and secondly helium gas, so it is appropriate that $Z=Z_H$.

Our equation for Jupiter is

$$E_5=\frac{Z_H}{\sqrt{5}}\frac{G^2M_j^2M_m^3}{2\hbar_{\odot}^2}$$

Where Z_H is the atomic number of hydrogen which is 1 proton, and $\sqrt{n}=\sqrt{5}$ for the orbital number of Jupiter, $n=5$. Now we move on to Saturn...

$KE_S = \frac{1}{2}(5.683E26\,\text{kg})(10140\,\text{m/s})^2 = 2.92E34\,\text{J}$

$E = \frac{Z}{\sqrt{6}}\frac{(6.67408E-11)^2(5.683E26\,\text{kg})^2(7.347673E22)^3}{2(2.8314E33)^2}$

$= \frac{Z}{2.45}(3.5588E34\,\text{J}) = Z(1.45259E34\,\text{J})$

$Z(1.45259E34\,\text{J}) = (2.92E34\,\text{J})$

$Z = 2\,\text{protons} = \text{Helium (He)}$

The equation for Saturn is then

$$E_6 = \frac{Z_{\text{He}}}{\sqrt{6}}\frac{G^2M_s^2M_m^3}{2\hbar_\odot^2}$$

It is nice that Saturn would use Helium in the equation because Saturn is the next planet after Jupiter and Jupiter uses hydrogen, and helium is the next element after hydrogen. As well, just like Jupiter, Saturn is primarily composed of hydrogen and helium gas.

The accuracy for Earth orbit is

$$E_n = \sqrt{n}\,\frac{R_\odot}{R_m}\frac{G^2M_e^2M_m^3}{2\hbar_\odot^2}$$

$\frac{R_\odot}{R_m} = \frac{6.96E8\,\text{m}}{1737400\,\text{m}} = 400.5986$

$E_3 = (1.732)(400.5986)\frac{(6.67408E-11)^2(5.972E24\,\text{kg})^2(7.347673E22\,\text{kg})^3}{2(2.8314E33)^2} =$

$= 2.727E33\,\text{J}$

The kinetic energy of the Earth is

$KE_e = \frac{1}{2}(5.972E24\,\text{kg})(30{,}290\,\text{m/s})^2 = 2.7396E33\,\text{J}$

$\frac{2.727E33\,\text{J}}{2.7396E33\,\text{J}}100 = 99.5\,\%$

Which is very good, about 100% accuracy for all practical purposes. The elemental expression of the solution for the Earth would be

$$E_3 = \sqrt{3}\,\frac{Z_{Ca}^2G^2M_e^2M_m^3}{2\hbar_\odot^2}$$

Where $\frac{R_\odot}{R_m} \rightarrow Z^2$

In this case the element associated with the Earth is calcium which is $Z = 20$ protons.

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