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PLANCK, MUON, AND FINE STRUCTURE CONSTANT

$$E = h_m f = 1/2\,\pi c_{rms}$$

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Abstract

By representing the Earth as a black body radiation source of photons and muons, Planck's constant and its newly discovered complement, the Muon constant are calculated near the Earth's surface. A new Muon energy equation is presented to complement the Plank-Einstein formula. Using Thompson Cross Section scattering equation and the Lorentz Factor, it is shown that the elusive fine structure constant is a proportionator derived from the Flux Transfer Frequency of the Sun and Mercury. Permittivity and Permeability constants are calculated in the far field of the Earth. By expanding the Earth antenna to cosmic scale, it is shown that electromagnetic waves are constructed in the far field by combining electrostatic near field photons and magnetoquasistatic muons. The traditional electromagnetic wave as defined by James Clerk Maxwell is described in terms of quantum photons and muons. The mathematical relationship between the half-

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life of mass, dark energy and dark matter are explored. The paper concludes that Isaac Newton's view that Mass and Light are transmutable is expressed in a new mass light equivalence equation.

1. History of the Photon and Muon

Max Planck empirically derived a formula for the observed frequency spectrum of black body radiation. At the beginning of the 19th century, he determined that black-body radiation could only change its energy, E, that was proportional to the frequency of its associated electromagnetic wave [1]. Planck was able to calculate the value of h from experimental data on blackbody radiation. His result, 6.55×10^{-34} J.s, was within an error of less than 1.2% of the currently accepted value of $6.62607015 \times 10^{-34}$ $\mathrm{m^2 kg/s}$ as published by 2018 CODATA [2].

In 1905, the value E was associated by Albert Einstein with a "quantum" or minimal element of the energy of the electromagnetic wave itself. The light quantum, or photon, behaved as an electrically neutral particle, as opposed to an electromagnetic wave. Max Planck received the 1918 Nobel Prize in Physics for his discovery of energy quanta and Einstein received his Nobel Prize in 1921 for his discovery of the photo electric effect [3].

A particle with a mass in the meson range had been predicted before the discovery of any mesons, by theorist Hideki Yukawa [4]. Muons were discovered by Carl D. Anderson and Seth Neddermeyer at Caltech in 1936, while studying cosmic radiation [5]. Anderson noticed particles of the same velocity that were negatively charged but turned less sharply than electrons, but more sharply than protons. To account for the difference in curvature, it was supposed that their mass was greater than an electron but smaller than a proton. The existence of the muon was confirmed in 1937 by J. C. Street and E. C. Stevenson's cloud chamber experiment [6]. The first paper to describe the muon's radioactive decay

was published by scientists named Williams and Roberts [7]. In 1941, the muon's half-life was measured by Rasetti and found to be $t_{1/2} = 1.5 \pm 0.3\,\mu s$ [8]. In the same year, muons were used to observe the time dilation predicted by special relativity, for the first time [9].

Muons are the most numerous energetic charged particles at the Earth's surface. A charged particle loses energy by ionization. As it passes through matter the charged particle interacts with electric fields and typically knocks loose some of the loosely bound outer electrons. Muons can travel large distances; however, they lose energy proportional to the amount of matter they pass [10]. Muons lose energy at a rate of about $2\,\text{MeV}$ per g/cm^2. Since the vertical depth of the atmosphere is about $1000\,\text{g}/\text{cm}^2$, muons will lose about $2\,\text{GeV}$ to ionization. The mean energy of muons at the Earth's surface is $4\,\text{GeV}$. Muons have an average flux of about 1 muon per square centimeter per minute. This is about half of the typical total natural radiation background on the surface of the Earth [11].

2. Thompson Cross Section Scattering

At the point when an electromagnetic wave interacts with a charged particle, the electric and magnetic segments of the wave apply a Lorentz power on the particle, setting it into motion. Since the wave is occasional in time, so is the movement of the particle. In this way, the particle is accelerated and, subsequently, discharges radiation. All the more precisely, energy is retained from the electromagnetic wave by the particle, and reproduced as electromagnetic radiation. Such a procedure is known as the Thompson scattering of the electromagnetic wave by the particle [12].

The scattering of a photon by a charged particle is called Compton scattering, and the quantum mechanical version of the Compton

scattering cross-section is known as the Klein-Nishina cross-section [13]. As the photon energy increases, and eventually becomes comparable with the rest mass energy of the particle, the Klein-Nishina formula, which predicts that forward scattering of photons, becomes increasingly favored with respect to backward scattering. The Klein-Nishina cross-section does, in general, depend on the frequency of the incident photons. Furthermore, energy and momentum conservation demand a shift in the frequency of scattered photons with respect to that of the incident photons.

If the charged particle in question is an electron then the well-known Thomson scattering cross-section equation [14, 15] is as follows:

$$\sigma_{\text{Thomson}} = \frac{8\pi}{3}\left(\frac{e^2}{4\pi\varepsilon_0 m_e c^2}\right)^2 = 6.65\times10^{-29}\,\text{m}^2.$$

3. Lorentz Factor and the Fine Structure Constant

The Lorentz factor or Lorentz term is the factor by which time, length and relativistic mass change for an object while that object is moving. The expression appears in several equations in special relativity, and it arises in derivations of the Lorentz transformations. The name originates from its earlier appearance in Lorentzian electrodynamics - named after the Dutch physicist Hendrik Lorentz [16].

The Lorentz factor γ is defined as [17]

$$\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{1}{\sqrt{1-\beta^2}} = \frac{dt}{d\tau},$$

where:

- v is the relative velocity between inertial reference frames,

- c is the *speed of light in vacuum*,

- β is the ratio of v to c,

- t is coordinate time,

- τ is the proper time for an observer (measuring time intervals in the observer's own frame).

To complement the definition, I define the reciprocal

$$\alpha = \frac{1}{\Gamma}.$$

The first postulate of relativity states that the laws of physics are the same in all inertial frames. Einstein showed that the law of conservation of energy is valid relativistically, if we define energy to include a relativistic factor. Total energy E is defined to be:

$$E = \gamma mc^2,$$

where γ is the Lorentz or relativistic factor, m is mass, c is the speed of light, and v is the velocity of the mass relative to an observer.

Relativistic effects on muons

Kinetic Energy

$$K = \alpha mc^2 - mc^2,$$

where

$$\alpha = \frac{1}{\sqrt{1 - \frac{u^2}{c^2}}} \text{ and } u \text{ is relative velocity.}$$

Rearrange

$$\alpha = \frac{K + mc^2}{mc^2} = \frac{(2 + 0.1)\,\text{GeV}}{0.1\,\text{Gev}} = 21.$$

Using time dilation:

$$\Delta t = \alpha \Delta t',$$

$$\Delta t = 21 \times 2.2 \times 10^{-6}\text{s} = 4.6 \times 10^{-5}\text{s}.$$

Range $x = ct$,

$$x = (3.0 \times 10^{8}\ \text{m/s}) \times (4.6 \times 10^{-5}\text{s}) = 13{,}860\ \text{m}.$$

The muons have a half-life of 2.2 microseconds. At the speed of light this would give a range at relativistic speeds of 13,860 meters, given a minimal $2\,\text{GeV}$ muon (rest mass = $0.1\,\text{GeV}$). In Table 1, the left-hand column shows speeds as different fractions of the speed of light (i.e., in units of c). The middle column shows the corresponding Lorentz factor, the final is the reciprocal.

Table 1. Lorentz factor and reciprocal in relation to different fractions of the speed of light

Speed (units of c)	Lorentz factor	Reciprocal
0.000	1.000	1.000
0.050	1.001	0.999
0.100	1.005	0.995
0.150	1.011	0.989
0.200	1.021	0.980
0.250	1.033	0.968
0.300	1.048	0.954
0.400	1.091	0.917
0.500	1.155	0.866
0.600	1.250	0.800
0.700	1.400	0.714
0.750	1.512	0.661
0.800	1.667	0.600
0.866	2.000	0.500
0.900	2.294	0.436
0.990	7.089	0.141
0.999*	**22.366***	0.045
0.99995	100.00	0.010

*Values in bold are exact.

We see from Table 1 that the Muon is traveling at nearly 0.999 the

speed of light. Since our Lorentz factor includes $dt/d\tau$, I will explore this relationship with electromagnetic theory in more detail. The electrical RC time constant, also called tau (τ - units in seconds), is equal to the product of the circuit resistance (in Ω) and the circuit capacitance (in farads- F), i.e.,

$$\tau = RC.$$

The time constant τ is related to the cutoff frequency f_c, an alternative parameter of the RC circuit, by

$$\tau = RC = \frac{1}{2\pi f_c}.$$

Or, equivalently,

$$f_c = \frac{1}{2\pi RC} = \frac{1}{2\pi\tau} \quad [18],$$

where capacitance in F and resistance in Ω yields the time constant in seconds or the frequency in Hz. By convention, the bandwidth of an electrical power system is the frequency where $|V_\infty|^2$ drops to half-value, or where $\omega\tau = 1$. The relationship with frequency is defined by,

$$f_c = \frac{1}{2\pi RC} = \frac{1}{2\pi\tau}.$$

Inserting the relative Lorentz Factor for tau,

$$f_c = \frac{1}{2\pi \times 22.366} = 0.007115 \text{ Hz},$$

$$f_c = \frac{1}{2\pi \times 21.000} = 0.007578 \text{ Hz},$$

$$f_c = \frac{1}{2\pi \times 21.804} = 0.007299 \text{ Hz},$$

$$f_c = 0.007229 = \frac{1}{137} = \text{Fine Structure Constant} \quad [19].$$

I note that $0.007229\,\text{Hz}$ is on the same Hertzian scale as the flux transfer frequency of $0.00265\,\text{Hz}$. Using the Fine Structure Constant as a frequency, I can calculate the wavelength of this frequency,

$$\lambda = \frac{c}{f} = \frac{3\times10^{8}}{0.007229}\,\text{Hz} = 41{,}499{,}515{,}839 \text{ meters.}$$

The astronomical distance of Mercury to the Sun is 57×10^{9} meters [20]. However, Mercury has the most elliptical orbit of all the planets. When Mercury is closest to the Sun, it is only 46 million kilometers distant, but when the planet is at the opposite end of its orbit, it is 70 million kilometers away from the Sun. Mercury's orbit is ten times more eccentric than Earth. Using an increasing Lorentz factor of 22.366 results in a larger wavelength of 42 billion meters. By increasing the Lorentz factor from 21 to 30, and thereby increasing particle speed closer to the full speed of light a result can be achieved that matches the astronomical distance of the Sun to Mercury. I note that from previous work the magnetic impedance for Earth is $60\,\Omega$ with a $60\,\text{s}$ time constant and the results of this paper indicate that Mercury has a magnetic impedance of $30\,\Omega$ and a time constant of $30\,\text{s}$ at 0.159 wavelength. 21.8 is the near surface impedance of Mercury's antenna. $0.007229\,\text{Hz}$ is the flux transfer frequency from the Sun to Mercury. The flux transfer events on Mercury will occur approximately every 137 seconds, which equates to 2.28 minutes.

Table 2 shows the first three flux transfer event results reported by the satellite Messenger in 2010 [21]. The results show a period of 2 minutes between flux transfer events.

Table 2. Mercury flux transfer event modeling results

Event	1	2	3
DOY	014	014	014
Start Time (UTC)	18:32:24	18:34:27	18:36:20
Duration (s)	0.97	3.42	6.00
Q_{χ}	0.101	0.049	0.082
ASF	0.12	0.055	0.202
$H^{\underline{a}}$	L	L	L
$R_0{}^{\underline{b}}(R_M)$	0.078	0.35	0.52
$\mid Y_0/R_0 \mid$	0.53	0.69	0.46
B_0(nT)	20.9	30.3	38.7
θ_A(deg)	–53.9	5.7	69.8
ϕ_A(deg)	254.9	132.3	302.9
Φ(MWb)	0.0011	0.030	

4. Calculate Speed of Light using Quadratic Mean (c_{rms})

In mathematics, the root mean square (abbreviated RMS or rms) is a statistical measure of the magnitude of a varying quantity. It is also known as the quadratic mean. The Root Mean Square (RMS) value of a set of values is the square root of the arithmetic mean (average) of the squares of the original values [22].

In the case of a set of n values x_1, x_2, ..., x_n, the RMS value is given by,

$$x_{rms} = \sqrt{\frac{x_1^2 + x_2^2 + ... + x_n^2}{n}},$$

where

$$x_{rms} = c_{rms}, \quad x_1 = c, \quad x_2 = c^2, \quad x_3 = c^3, \quad x_4 = c^4, \quad n = 4.$$

Inserting the values results in:

$$c_{rms} = 4.05 \times 10^{33}.$$

5. Calculate Planck's Constant from Near Field Time Constant

If we treat the Earth as a black body radiation source of complex light waves created by the near, far and magnetoquasistatic fields, we find c_{rms} to be a composite speed of light that takes into account the three major electromagnetic fields. However, there is a propagation delay associated with the Earth, which we need to account for. This delay, which we know as τ, reflects the RC circuit of the Earth. These two variables, time delay of light combined with the aggregate *rms* speed of light are shown to be mathematically related by,

$$h = \frac{\tau}{c_{rms}},$$

where

$$\tau = 2.73 \text{ s} \quad [23],$$

$$c_{rms} = 4.05 \times 10^{33}.$$

Inserting the values, I calculate 6.74×10^{-34} which is within an error of less than 1.7% of Planck constant of 6.626×10^{-34}.

6. Calculate Muon Constant from Magnetoquasistatic Time Constant

I now calculate muon constant from the magnetoquasistatic time constant.

$$h_m = \frac{\tau}{c_{rms}},$$

where

$$\tau = 60\ \text{s} \quad [22],$$

$$c_{rms} = 4.05 \times 10^{33}.$$

Inserting the values, I calculate $h_m = 1.48 \times 10^{-32}$, (Muon Constant).

For an electron, the Thomson cross-section is numerically given by:

$$\sigma_t = \frac{8\pi}{3}\left(\frac{\alpha\hbar c}{mc^2}\right)^2 = 6.6524587158\ \ldots \times 10^{-29}\,\text{m}^2$$

$$= 66.524587158\ \ldots\ (\text{fm})^2.$$

Dividing the Thomson cross-section by the muon to electron mass ratio of 206

$$\sigma_t = \frac{6.65245 \times 10^{-29}}{206},$$

$$\sigma_t = 3.2293447 \times 10^{-31}.$$

Divide by the Muon relativistic factor of 21, or the time constant ratio $60/2.73$ also equal to 21; inserting the value,

$$\sigma_t = \frac{3.2293447 \times 10^{-31}}{21},$$

$$\sigma_t = 1.469 \times 10^{-32}.$$

Comparing to $h_m = 1.48 \times 10^{-32}$, I find the error to be less than 1%.

A new Muon Constant h_m is thus invented and affirmed. The Muon Constant is the magnetic complement of Planck's photon constant.

7. Calculate Permittivity and Permeability from the Far Field Time Constant

I now calculate permittivity and permeability from the far field time constant.

$$h_f = \frac{\tau}{c_{rms}}.$$

If I use the following values:

$$\tau = 377 \times 86{,}400 = 32{,}572{,}800,$$

$$c_{rms} = 6.36396 \times 10^{16} \ (c \text{ and } c^2 \text{ only in the far field}).$$

Inserting the values, I calculate 5.118×10^{-10},

$$\varepsilon_0 = \frac{5.118 \times 10^{-10}}{60} = 8.53 \times 10^{-12}.$$

According to previous work, electric vacuum permittivity equals $8.854 \times 10^{-12}\ \mathrm{C}^2/\mathrm{Nm}^2$ [24].

$$\mu_0 = 5.118 \times 10^{-10} \times 2370\ \Omega = 1.21 \times 10^{-6}.$$

According to previous work magnetic vacuum permeability equals 1.256×10^{-6} Tm/A [25].

The frequency of vacuum permittivity is calculated to be 18 GHz and the frequency of vacuum permeability is calculated to be 126.7 KHz.

8. Calculate Energy at Electromagnetic Fields

(a) Magnetoquasistatic field

$$E = h_m \times f \qquad \text{(Muon Energy Quanta Equation)},$$

where

$h_m = 1.48 \times 10^{-32}$,

$f = \frac{1}{2\pi\tau} = \frac{1}{2\pi \times 60} = 0.00265$ Hz (magnetic flux transfer event frequency).

Inserting the values, I calculate the energy of a muon at the frequency of the Earth's magnetoquasistatic field as:

$$E = 3.922 \times 10^{-35} \text{J}.$$

(b) Near field

$$E = h \times f,$$

where

$$h = 6.626 \times 10^{-34},$$

$$f = \frac{1}{2\pi\tau} = \frac{1}{2\pi \times 2.73} = 0.0582985 \text{ Hz}.$$

Inserting the values, I calculate the energy of a photon at the frequency of the Earth's electrostatic near field as:

$$E = 3.86 \times 10^{-35} \text{J}.$$

(c) Far field

$$E = h \times f,$$

where

$$h = 6.626 \times 10^{-34} \qquad \text{(Planck Constant)},$$

$$f = \frac{1}{2\pi\tau} = \frac{1}{2\pi \times 32{,}572{,}800} = 4.86 \times 10^{-9} \text{Hz}.$$

Inserting the values, I calculate the energy of a photon at the frequency of the far field as $E = 3.23 \times 10^{-42}$ J.

9. Conclusions

What is known as the fine structure constant is a Lorentz scaling factor derived from the flux transfer frequency of the Sun and Mercury. The Earth has a similar Lorentz scaling factor of 60 at 0.159 wavelength, and 30 at the surface of the Earth, both of which are recognizable time scaling factors. The frequency of 0.007229 Hz permeates space throughout the solar system and acts as a proportionator and scaling factor. The fine structure constant is an electromagnetic frequency that can also be represented as a Lorentz Factor or RC time constant of 137.

The spherical Earth has an impedance made up primarily of resistance and capacitance. This RC circuit can be used to calculate a time constant, or τ. By dividing τ by the quadratic mean speed of light I have shown that Planck's constant is a function of impedance and the speed of the radiated photons, which are emitted from the near, magnetoquasistatic and far field. Earth acts as a black body radiation source emitting a quantum of energy over a time period of 2.73 seconds.

The newly discovered Muon constant h_m is the magnetic equivalent of Planck's Constant. One end of Earth's antenna is radiating photons and the other end is muons. By dividing the numerator of 60 seconds by the quadratic mean speed of light a new constant of the Earth is found. The Muon constant is a function of magnetic impedance and the speed of radiated muons, which are radiated from the magnetoquasistatic and near field. Earth is a black body radiation source emitting quanta of muon energy over a time period of 60 seconds. If the wavelength is given, the energy can be determined by first using the wave equation $(c = \lambda \times \nu)$ to find the frequency, then using the Muon equation to calculate energy. The Planck-Einstein relationship has a twin magnetic equation, $E = h_m \times f$.

The research presents that the far field is where the Permeability and

Permittivity constants meet and formulate. Permeability and Permittivity constants can also be represented as frequency which allows for proportionating action at a distance where magnetic and static conditions are present. It is concluded that all electrically related constants are distinct inverse frequencies that radiate in space. These dominant frequencies act as proportionators in equations and calculations to match physical characteristics that have been altered by the dominant frequency acting on the material elements of the body. Cosmic evolution has a variety of dominant frequency signals that affect all aspects of time, space, gravity and the electromagnetic field. To understand cosmic evolution one must understand wavelengths, frequency and how the factors of relativity affect proportionality or scaling.

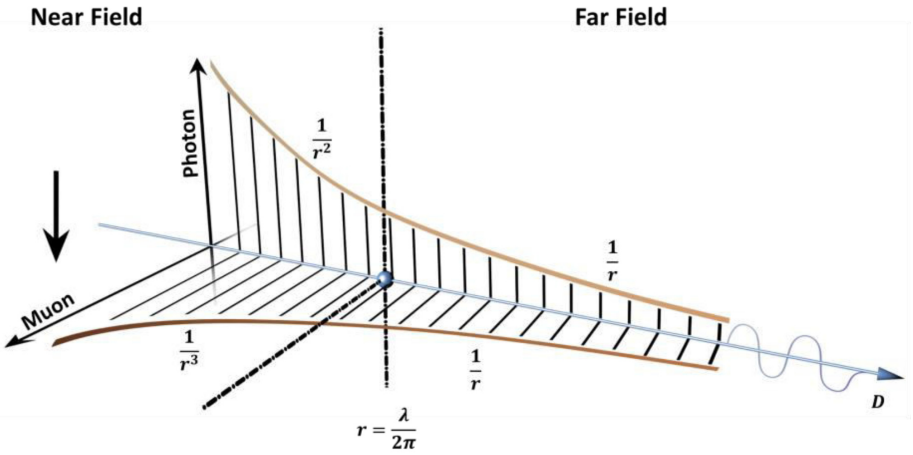

Figure 1. Photon and muon electromagnetic wave.

By looking at the Earth as a macro scale antenna, we can see from Figure 1 that an electromagnetic wave, when exploded to such a large dimension, can be seen as a combination of photons derived from a radiating electrostatic field combined with muons radiating from a radiating magnetic field. Each of these fields has its own time constant, which determines propagation delay and frequency in the near fields. The photons and muons combine in the far field to form what we know as an

electromagnetic wave. The muon decays in a couple of milliseconds to become the electron and a couple of neutrinos, (I ignore neutrinos because they are not really part of my theoretical work, and little of value is known about neutrinos). The muon thus creates the electron, and the photon adds energy to the electron. The added energy quanta of the photon frees-up the electron to give it freedom to move around. The moving electrons are what we call a current waveform.

Figure 1 is meant to represent the combining of muons and photons to make an electromagnetic wave. The muon provides the electron, and the photon provides the energy, which allows it to move along a wave. This is by definition an electrical current. This is how an electromagnetic wave is created on a subatomic particle level. This interpretation of an electromagnetic wave as a combination of photons and muons is thought to exist at all levels from radio waves to power equipment. Photons are known to be a part of the electric field in an electromagnetic wave. Muons are theorized to be the quanta of energy that make up the magnetic component of all electromagnetic waves.

The Plank and muon constants have been expressed in terms of Energy (E) by,

$$E = hf.$$

Substituting $h = \frac{\tau}{c_{rms}}$,

$$E = \frac{\tau f}{c_{rms}}.$$

Substituting $\tau = \frac{1}{2\pi f}$, and the equation reduces to,

$$E = \frac{1}{2\pi c_{rms}} \qquad \text{(Energy Inverse Light Speed Equivalence).}$$

I conclude that energy quanta, in its most basic form, is inversely

proportional to the *rms* speed of light traveling around the circumference of a circle. The slower the *rms* speed of light the higher the energy quanta. This would suggest that at the moment of the Big Bang, light was not moving and then began to move slowly around a circle. Out of infinite energy was born a slow-moving photon crawling in a circle. As, the centrifugal forces began to grow, the radius of the circle became larger and the speed of light increased everywhere until it reached a maximum speed of 3×10^{8} m/s. Since the universe has only three known dimensions (x, y, z), the photon started from a frame of rest as a slow speed of light c, then immediately became c^2 as it began to circle, and then c^3 as it reached upward to fill space with solenoids and finally c^4 which has the shape of spheres. The basic quantum equation of $E = 1/2\,\pi c_{rms}$ set in motion the miniature building blocks or shapes (circles, solenoids and spheres) of the universe.

One can see that $\tau = 1/2\pi f$ and $E = 1/2\pi c_{rms}$ are similar mathematical expressions. I conclude that $E = \tau = \mathrm{RC}$ of the universe. Energy is thus equivalent to the impedance and capacitance of the universe. The universe may also be a very large rotating dipole antenna with gargantuan spherical, solenoidal and circular fields similar to the planet Earth and all other planets. If this is the case then it stands to reason that the fundamental frequency of the universe is equal to c_{rms}, which can be expressed as 4×10^{33}Hz. The fundamental wavelength of the universe is 2.5×10^{-34} meters. This value is likely the smallest length in the universe and approaches a theoretical Planck length of 1.6×10^{-35} meters. Superstrings, singularities, or even grains of the universe could all turn out to be in the range of 2.5×10^{-34} meters. The Planck length is too small for scientists to measure; it is thought to represent the theoretical limit of the shortest measurable length. According to the uncertainty principle, no instrument should ever be able

to measure anything smaller, because at that range, the universe is probabilistic and indeterminate. This scale is also thought to be the demarcating line between relativity and quantum mechanics. Since this is a universal frequency it is reasonable to conclude that the tiny grains of the universe are what we have long dismissed as ether. Light may have a medium to travel through and the material to build the shapes from photons, muons and grains of the universe.

We can see that $E = 1/2\,\pi c_{rms}$ can also be equated to Einstein's Mass Energy Equivalence equation, such that

$$E = mc^2 = 1/2\,\pi c_{rms}.$$

It is not difficult to imagine that light c, c^2, c^3 and c^4 is travelling through the universe and colliding with grains of the universe that are so small they contain little mass. The energy released is almost undetectable. The improved equation brings balance to the universe. Energy is released when light encounters mass, energy is conserved when light is passing through free space where no mass is present. The law of conservation of energy states that the total energy of an isolated system remains constant; it is said to be conserved over time [26]. This law means that energy can neither be created nor destroyed; rather, it can only be transformed or transferred from one form to another. Classically, conservation of energy was distinct from conservation of mass; however, special relativity showed that mass is related to energy and vice versa by $E = mc^2$, and science now takes the view that mass-energy is conserved. A consequence of the law of conservation of energy is that a perpetual motion machine of the first kind cannot exist, that is to say, no system without an external energy supply can deliver an unlimited amount of energy to its surroundings [27]. For systems which do not have time translation symmetry, such as general relativity, it may now be possible to define conservation of energy. Energy increases and decreases based on

the speed of light which rapidly accelerates in the 3rd and 4th dimension where curvature becomes more extreme. Put simply heavy mass creates a huge explosion when combined with speed of light squared, and conversely low or no mass with light turning in ever steeper patterns are equivalent to mass energy. Mass as it vaporizes in a nuclear explosion becomes light. That light is turning and accelerating at faster and faster speeds. Energy is conserved in a nuclear explosion and energy is conserved in the universe. Energy is conserved by the shaping of light. The more light turns the greater its acceleration, and always it is in equilibrium with the stars and the planets. Dark Energy is in fact Light Energy that we have not yet detected. Light Energy, or c_{rms} is everywhere - ever turning, ever accelerating, ever shaping our universe.

Scientist believe the universe is expanding because planets and stars are moving away from each other. Our telescopes tell us this is happening so this must be true. But we cannot see the speed of light with an ordinary telescope. By combining my equation with Einstein's equation, I agree that the universe is expanding but the law of conservation of energy also says that something else is happening. Light is bending and accelerating to offset the release of mass energy. The universe is reshaping itself in the form of spheres, solenoids and loops. The universe is in equilibrium. Mass is pushing the universe outward and light is pushing it inward. The speed of light is the great equalizer of the universes.

Half-life, or radioactive decay can be explained by solving the equation for mass, such that

$$m = 1/2\pi c^2 c_{rms}$$

which reduces to,

$$m = 1/2\pi c_{rms}^{n+3} \qquad \text{(Mass Light Equivalence).}$$

Earnest Rutherford discovered the concept of radioactive half-life of the radioactive elements which was the basis for the Nobel Prize in Chemistry he was awarded in 1908 “for his investigations into the disintegration of the elements, and the chemistry of radioactive substances” [28]. I add to his body of work by showing that mass is inversely proportional to that of a collection of the speed of light. As mass disintegrates, we see that the *rms* value of the speed of light increases by the square of light. Mass converts to photons moving at faster and faster speeds until half of the mass is left. I note the Mass Light Equivalence equation above includes $1/2$ which matches Rutherford’s theory.

As mass breaks down into light it accelerates on itself into higher and higher angular velocity. By turning a photon in ever tighter circles at various multiple speeds of light; it is conjecture but perhaps mass is then reconstituted to minute particles of matter as the photons are compressed at higher and higher dimensions? Dark matter may be compressed mass. 70% of the universe is said to be dark matter. This minute material could be the result of compression caused by tighter and tighter spheres of light crushing photons and any matter trapped in its web. The byproduct of the compression of light may be dark matter.

Mass Light Equivalence equation demonstrates how the universe is expanding as light is compressing. From previous work we know that space is associated with light speed such that c^3/r^2, c^4/r^3 and so on. Space contracts when under compression and expands when compression is inverted as the equation demonstrates. This would suggest that the expansion of the universe will be offset by periods of compression.

Negative mass has been previously modeled to describe dark energy and radiation in a negative-index metamaterial unified way. Negative mass is associated with negative momentum, negative pressure, negative kinetic energy and is faster than the speed of light [29]. I can see a parallel of my work to this revolutionary theory proposed by Z. Y. Wang -

both of us based our theories on an electromagnetic foundation. But I reach a slightly different conclusion in that inverse mass and the *rms* quadratic speed of light are equivalent. In my work, dark energy or phantom energy is shown to be derived from the quadratic speed of light. Dark energy is inversely proportional to multiples of the speed of light.

Collectively the energy stored in the capacitor of the universe is offset by the inverse expended energy of the tiny nuclear reaction going on throughout the universe as light traverses in circles, solenoids and spheres. The energy stored in the spherical capacitor of the universe is equivalent to the inverse energy released on the circumference of the sphere of the universe. This conclusion supports the bubble theory, which can be interpreted as a spherical capacitor, or more aptly a spherical universe [30]. The universe is more than just a bubble or a sphere; it is a sphere, a solenoid and an expanding yet weakening loop. The universe is flat in one dimension and solenoidal in another. I have found three dimensions but there are many more. The universe is expanding in one dimension and contracting in other dimensions. The universe is a dynamic system that obeys the laws of conservation of energy.

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