

Space time Variation and the Physical Variables

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The Physical Constants of Nature are actually relativistic Physical Variables, which are defined as continuous functions of the Mass, Charge, Wavelength, and Frequency of a Many-Body System of Charged Particles. Substitution of the Gravitational Variable (G) into Newton's Law of Gravity, leads to the expression for the Force Law for all Particle Interactions, and is valid for all scales of distance and time that are physically attainable. Einstein's Theory of Relativity predicts the existence of an upper limit of the velocity of a given mass ($v = \lambda \nu$) with the adopted standard value ($c = 2.99792458 \times 10^8$ m/s), so it is convenient to introduce the concept of unicity ($u = m\lambda$), and to predict the existence of a lower limit of the magnitude of the unicity of a given mass with the standard value ($b = h_0/c = 2.210218631 \times 10^{-42}$ kg m), where (h_0) is the minimum value of the angular momentum of a System of Particles. This leads to the conclusion that Light has Mass, and that the Photon is a bound state of at least two charged particles. As the mass of a photon approaches zero, the associated wavelength of the photon becomes infinite. Calculation of the magnitude of the mutual interaction Force between particles is simplified by choosing a coordinate system such that the origin is located at the Center of Mass of the System. In order to account for the effect of each individual Particle on the System about the common Center of Mass, it is necessary to express the mass of the System as the Reduced Mass, the frequency as the Reduced Frequency, and the wavelength as the Increased Wavelength. The Mass of the system is directly proportional to the square of the Electric Charge, with half the Magnetic Permeability divided by the Wavelength of the System as the Proportionality Variable. The Gravitational Force is identical to the Electromagnetic Force, and has a magnitude equal to the sum of all of the individual forces of the interacting Charged Particles which constitute a given Mass. Substitution of the Physical Variables into existing equations leads to a Unified Force Law, the solution to the Many-Body Problem, the relationship between Mass and Charge, Rotational Dynamics of the Galaxies, the non-existence of Dark Matter and Dark Energy, a deterministic description of Relativistic Quantum Mechanics, and the determination of the magnitude of the Mass of Light.

I. MANY-BODY SYSTEMS OF CHARGED PARTICLES

Consider an Isolated System of Charged Particles with each Particle having mass (m_k) and charge (q_k), in relative motion about a common center of mass, where n is the total number of particles in the system. The parameters of the system defined below are the Reduced Mass [15], Reduced Frequency, and Increased Wavelength, which take into account the effect of the mutual interaction of the attraction or repulsion of each particle with respect to every other particle in the system.

$$\text{Reduced Mass: } m_R = \frac{1}{\sum_{k=1}^n \frac{1}{m_k}} \quad (1)$$

For a Two-Body System the Reduced Mass [1] is

$$m_R = \frac{1}{\frac{1}{m_1} + \frac{1}{m_2}} = \frac{m_1 m_2}{m_1 + m_2} \quad (2)$$

and for a Three-Body System the Reduced Mass is

$$\text{given by } m_R = \frac{m_1 m_2 m_3}{m_1 m_2 + m_2 m_3 + m_3 m_1} \quad (3)$$

The expression for the Reduced Mass for additional particles follows from taking the Reduced Mass of the additional particle with respect to the Reduced Mass of the particles already taken into account. The expression for the Many-Body Reduced Mass is independent of the order in which the particles are considered since

$$m_R = \frac{1}{\frac{1}{m_1 + m_2} + \frac{1}{m_3}} = \frac{1}{\frac{1}{m_1} + \frac{m_2 + m_3}{m_2 m_3}} \quad (4)$$

The Reduced Frequency of the System is defined as:

$$\text{Reduced Frequency: } \nu_R = \frac{1}{\sum_{k=1}^n \frac{1}{\nu_k}} \quad (5)$$

for a Three-Body System we have

$$\nu_R = \frac{\nu_1 \nu_2 \nu_3}{\nu_1 \nu_2 + \nu_2 \nu_3 + \nu_3 \nu_1} \quad (6)$$

The procedure of considering each of the particles at the center of mass of the System, and then compensating by reducing both the Mass and the Frequency of the subsequent particle leads to a spatial translation, that causes the reciprocal effect of increasing the distance between the particles, and the magnitude of the increase in distance is defined as

Increased Wavelength:

$$\lambda_I = 2\pi \sum_{k=1}^n r_k = \frac{1}{\lambda_R} = \sum_{k=1}^n \lambda_k \quad (7)$$

where \vec{r}_k is the instantaneous position vector from the center of mass of the system to the n^{th} particle. This formulation assumes Circular Orbits, and in the case of non-zero eccentricity, we must take lambda sub I to be the Perimeter or Arclength of the Conic Section which corresponds to the appropriate Interval of Time for which the Frequency is defined.

For the Three-Body System we have

$$\lambda_I = \lambda_1 + \lambda_2 + \lambda_3 \quad (8)$$

The algebraic operation which Increases and Reduces Variables for a Many-Body System applies to any of the physical properties of the System, for instance, the Increased Mass for a Three-Body System is given by

$$M_I = m_1 + m_2 + m_3 \quad (9)$$

II. THE PHYSICAL VARIABLES

The Physical Variables are defined in terms of the Reduced or Increased Mass, the Electric Charge, the Increased Wavelength, and the Reduced Frequency of an Isolated System of Particles.

$$\text{Gravitational Variable: } G = \frac{\lambda_I^3 \nu_R^2}{2\pi M_I} \quad (10)$$

$$\text{Angular Momentum: } h = m_R \lambda_I^2 \nu_R \quad (11)$$

$$\text{Electrical Permittivity: } \epsilon = \frac{q^2}{2m_R \lambda_I^3 \nu_R^2} \quad (12)$$

$$\text{Magnetic Permeability: } \mu = \frac{2m_R \lambda_I}{q^2} \quad (13)$$

Since the Physical Variables are functions of the Mass,

Charge, Wavelength, and Frequency, we see that the numerical values for the Gravitational Variable with respect to the Sun (Table 1) are different for each of the Planets in the Solar System.

TABLE 1. Wavelength (Perimeter of Elliptical Orbit), Frequency (Reciprocal of Solar Period), and Gravitational Variable for the Nine Planets in the Solar System.

Planet	Wave-length (10^{12} m)	Frequency (10^{-8} s $^{-1}$)	Gravitational Variable (10^{-11} m 3 /kg s 2)
Mercury	0.36379	13.15684	6.6698207
Venus	0.67984	5.150901	6.6714975
Earth	0.94004	3.168752	6.6705104
Mars	1.43193	1.684726	6.6690989
Jupiter	4.89020	0.267114	6.6710882
Saturn	8.96611	0.107575	6.6752805
Uranus	18.0265	0.037718	6.6694039
Neptune	28.2617	0.019229	6.6801491
Pluto	37.0707	0.012760	6.6387927

III. FORCE UNIFICATION

Substitution of the Gravitational Variable for the Gravitational Constant in Newton's Law of Gravity, leads to the general expression for the Force between Charged Particles, regardless of whether or not the particles create a localized bound state of Electrical Neutrality. The Gravitational Force is then

$$F_g = G \frac{M_I m_R}{r_I^2} = \frac{\lambda_I^3 \nu_R^2}{2\pi M_I} \frac{M_I m_R 4\pi^2}{\lambda_I^2} = 2\pi m_R \lambda_I \nu_R^2 \quad (14)$$

from Equations (10) and (7)

$$G = \frac{\lambda_I^3 \nu_R^2}{2\pi M_I} \quad \text{and} \quad \lambda_I = 2\pi r_I$$

$$\text{so that} \quad r_I^2 = \frac{\lambda_I^2}{4\pi^2}$$

and similarly, substitution of the Electrical Permittivity Variable for the Permittivity of Free Space into Coulomb's Law for the Electrostatic Force leads to

$$F_e = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r_I^2} = \frac{2m_R \lambda_I^3 \nu_R^2}{4\pi q_1 q_2} \frac{4\pi^2 q_1 q_2}{\lambda_I^2} = 2\pi m_R \lambda_I \nu_R^2 \quad (15)$$

from Equations (7) and (12)

$$r_I^2 = \frac{\lambda_I^2}{4\pi^2} \quad \text{and} \quad \epsilon = \frac{q^2}{2m_R \lambda_I^3 \nu_R^2}$$

Newton's Law of Gravity is then identical to Coulomb's Law for the Electrostatic Force due to the equivalence of Equations (14) and (15), which shows that Gravity is Electromagnetic.

The magnitude of the Magnetic deflecting Force acting on a Charged Particle in a Magnetic Field is also equivalent to the Gravitational, Electromagnetic, and Centripetal Force, which follows from substitution of the Magnetic Permeability Variable from Equation (13) into the expression for the Magnetic Flux Density from Equation (31).

$$F_B = qvB = q\lambda_I v_R \frac{2\pi m_R v_R}{q} = 2\pi m_R \lambda_I v_R^2 \quad (16)$$

and the Centripetal Force is

$$F_c = \frac{m_R v^2}{r_I} = \frac{m_R \lambda_I^2 v_R^2}{\lambda_I} \frac{2\pi}{\lambda_I} = 2\pi m_R \lambda_I v_R^2 \quad (17)$$

so that

$$F_g = F_e = F_B = F_c \quad (18)$$

and the general expression for the Force between mutually interacting Charged Particles in a Many-Body System is therefore

$$\text{Force Law: } F = 2\pi m_R \lambda_I v_R^2 \quad (19)$$

The Strong Nuclear Force and the Weak Interaction also obey the Force Law and can be described as attraction or repulsion between Quarks and Leptons. The Strong Nuclear Force is much stronger than the Electromagnetic Force acting between the Proton and Electron only as a result of the fact that the relative velocities are of much higher magnitude for comparable values of Particle Mass. The attractive Force between the Proton and the Neutron is caused by both the attractive Force between the positively charged Up Quarks of the Proton and the negatively charged Down Quarks of the Neutron, and also because of the attractive Force between the negatively charged Down Quark of the Proton and the positively charged Up Quark of the Neutron. We are now in a position to define the expressions for Physical Quantities in terms of the Mass, Charge, Wavelength, and Frequency as follows

$$\text{Distance (Radial): } \lambda_I = 2\pi r_I \quad \text{and} \quad r_I = \frac{\lambda_I}{2\pi} \quad (20)$$

$$\text{Unicity: } u = m_R \lambda_I \quad (21)$$

$$\text{Velocity: } v = \lambda_I v_R \quad (22)$$

$$\text{Centripetal Acceleration: } a_c = 2\pi \lambda_I v_R^2 \quad (23)$$

$$\text{Centripetal Bosian: } b_c \equiv 4\pi^2 \lambda_I v_R^3 \quad (24)$$

$$\text{Momentum: } p = m_R \lambda_I v_R \quad (25)$$

Energy:

$$E = h v_R = m_R \lambda_I^2 v_R^2 = \frac{q^2}{2\epsilon \lambda_I} = \frac{\mu \lambda_I v_R^2 q^2}{2} \quad (26)$$

$$\text{Duxcity: } D \equiv m_R \lambda_I^3 v_R^3 \quad (27)$$

$$\text{Electric Charge } q = \sqrt{\frac{2m_R \lambda_I}{\mu}} \quad (28)$$

$$\text{Electric Current: } i = q v_R \quad (29)$$

$$\text{Electric Field: } E = \frac{2\pi m_R \lambda_I v_R^2}{q} \quad (30)$$

$$\text{Magnetic Flux Density: } B = \frac{2\pi m_R v_R}{q} \quad (31)$$

$$\text{Magnetic Field Strength: } H = \frac{\pi q v_R}{\lambda_I} \quad (32)$$

$$\text{Magnetic Moment: } \mu_M = \frac{q \lambda_I^2 v_R}{4\pi} \quad (33)$$

$$\text{Pressure (Stress): } P = \frac{8\pi^2 m_R v^2}{\lambda_I} \quad (34)$$

$$\text{Energy Density: } u_E = \frac{6\pi^2 m_R v^2}{\lambda_I} \quad (35)$$

$$\text{Temperature: } T = \frac{m_R \lambda_I^2 v_R^2}{n k_b} \quad (36)$$

$$\text{where } k_b = 1.380658102277 \times 10^{-23} \text{ J/K}$$

$$\text{Perimeter of a Circle: } P_I = 2\pi r_I = \lambda_I \quad (37)$$

$$\text{Area of a Circle: } A_I = \pi r_I^2 = \frac{\lambda_I^2}{4\pi} \quad (38)$$

$$\text{Volume of a Sphere: } V_I = \frac{\lambda_I^3}{6\pi^2} \quad (39)$$

Perimeter of an Ellipse (approximately):

$$\lambda_I \approx 2\pi \sqrt{\frac{a^2 + b^2}{2}} \quad (40)$$

$$\text{Area of an Ellipse: } A_I = \pi ab \quad (41)$$

IV. RELATIVITY

Einstein demonstrated in the Special Theory of Relativity [1] in 1905, that the mass of a particle varies as a function of the velocity when viewed by an observer in a relative Inertial Reference Frame, and postulated the limiting maximum velocity of a mass which has the current standard adopted value ($c = 2.99792458 \times 10^8 \text{ m/s}$). This velocity dependent behavior also applies to the observed parameters of Distance and Time, and the magnitude of the variation can be calculated from the Lorentz Transformations [1] as follows

$$\alpha = \frac{\lambda_I v_R}{c} = \frac{v}{c} \quad (42)$$

$$\beta = \frac{\lambda_I^2 v_R^2}{c^2} = 1 - \frac{m_{R0}^2}{m_R^2} = \frac{v^2}{c^2} \quad (43)$$

$$\gamma = \frac{1}{\sqrt{1 - \frac{\lambda_I^2 v_R^2}{c^2}}} = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \quad (44)$$

where the relativistic mass [1] is given by

$$m_R = \gamma m_{R0} = \frac{m_{R0}}{\sqrt{1 - \frac{\lambda_I^2 v_R^2}{c^2}}} \quad (45)$$

where (m_{R0}) is the rest mass. We can then solve for the relativistic wavelength (λ_I) which gives

$$\lambda_I = \sqrt{\frac{c^2}{v_R^2} \left(1 - \frac{m_{R0}^2}{m_R^2} \right)} = \sqrt{\beta} \frac{c^2}{v_R} = \frac{v}{v_R} \quad (46)$$

for the relativistic frequency (ν_R) which gives

$$\nu_R = \sqrt{\lambda_I^2 \left(1 - \frac{m_{R0}^2}{m_R^2} \right)} = \sqrt{\beta} \frac{c^2}{\lambda_I} = \frac{v}{\lambda_I} \quad (47)$$

and the Equations for the Dynamics of Systems of Charged Particles with the Physical Variables, are Relativistic Equations.

V. CONSERVATION LAWS

The Unicity and the Velocity of an Isolated System of Charged Particles are both Conserved Quantities. These parameters of the System only change as a result of the addition or removal of at least one particle to or from the Isolated System being considered. Since Mass is inversely proportional to Wavelength, and Wavelength is inversely proportional to Frequency, it then follows that Mass is directly proportional to Frequency. The product of Unicity and Velocity is then also a Conserved Quantity, and is the Angular Momentum as defined by Equations (11), (21), and (22).

Conservation of Unicity:

$$u_{\text{ISOLATED SYSTEM}} = m_R \lambda_I \quad (48)$$

and is a fixed parameter of the System and for a Two-Body System

$$m_R \lambda_I = m_1 \lambda_1 = m_2 \lambda_2 \quad (49)$$

Conservation of Velocity:

$$v_{\text{ISOLATED SYSTEM}} = \lambda_I v_R \quad (50)$$

and is a fixed parameter of the System and for a Two-Body System

$$\lambda_I v_R = \lambda_1 v_1 = \lambda_2 v_2 \quad (51)$$

Conservation of Angular Momentum:

$$h_{\text{ISOLATED SYSTEM}} = (u_{\text{IS}})(v_{\text{IS}}) \quad (52)$$

$$h = (m_R \lambda_I)(\lambda_I v_R) = m_R \lambda_I^2 v_R \quad (53)$$

If a Planet is moved further away from the Sun, the Unicity will increase and the Velocity will decrease by an equal amount. Conservation of other Physical Quantities such as Energy, Momentum, and Charge follow from equivalent algebraic expressions of the Conservation of Unicity and Velocity, and are therefore equivalent statements. Mass is then not a form of Energy, but rather a dynamic property of a collection of bound Charged Particles in Dynamic Equilibrium. The phenomenon of localized Electrical Neutrality between Particles of opposite Charge does not prevent the attraction of other Masses external to the System, due to the creation of Electric and Magnetic Fields by Induction, which are the result of the general motion of the entire system.

VI. THE MASS OF LIGHT

Photons are bound Charged Particles with relatively low Mass, high Velocity, long Wavelength, and high Charge. The Lorentz Transformations [1] show that the value of the Mass of a System of Particles approaches infinity as the value of the velocity approaches (c). Another mechanism by which the Mass of a System of Particles can increase is by the decrease in Wavelength, due to Conservation of the Unicity ($u = m\lambda$) of the System, which occurs when a Force is encountered that is greater in magnitude than the binding Force of the Photon. Such a Force can separate the bound Charged Particles of the Photon from their relative positions in their initial state of Dynamic Equilibrium about their common Center of Mass. Pair Production of Elementary Particles is actually Pair Separation and occurs when one of the constituent Particles of a Photon comes within close proximity to a Particle with opposite Charge, and is attracted to such a Particle with a Force that is greater than the binding Force that existed between the Photon Pair, prior to encountering such a Particle. Photons all travel at velocities that are slightly less than (c), and a photon with a higher value of Frequency than another Photon, also has a higher Mass, a lower Velocity, and a lower Wavelength.

Combining Einstein's [1] asymptotic limiting maximum velocity of a given mass (c) along with the Planck-Einstein [5] relationship between Energy and Frequency, which is absolutely equivalent to DeBroglie's hypothesis for the relationship between Wavelength and Momentum [9], we arrive at the limiting minimum value for the Unicity of a given mass, by recognizing that the Unicity is the ratio of the Angular Momentum and the Velocity.

$$u = \frac{h}{v} \quad (54)$$

Since the asymptotic limiting minimum Angular Momentum is

$$\lim_{\lambda_1 v_R \rightarrow c} h = \lim_{\lambda_1 v_R \rightarrow c} m_R \lambda_1^2 v_R = m_R \lambda_1 c = h_0 \quad (55)$$

where (h_0) has the value that Planck [5] found to be the proportionality factor between Photon Energy and Frequency

$$h_0 = 6.62606876 \times 10^{-34} \text{ J s} \quad (56)$$

and the asymptotic limiting maximum velocity of a given mass is (c)

$$\lim_{m_R \rightarrow \infty} \lambda_1 v_R = c = 2.99792458 \times 10^8 \text{ m/s} \quad (57)$$

then we can conclude that

$$\lim_{\lambda_1 v_R \rightarrow c} u = \lim_{\lambda_1 v_R \rightarrow c} m_R \lambda_1 = \lim_{\lambda_1 v_R \rightarrow c} \frac{m_R \lambda_1^2 v_R}{\lambda_1 v_R} = \lim_{\lambda_1 v_R \rightarrow c} \frac{h}{v} \quad (58)$$

and therefore (b) can be defined as the asymptotic limiting minimum Unicity.

$$b \equiv \lim_{\lambda_1 v_R \rightarrow c} u = \frac{h_0}{c} = 2.10218631 \times 10^{-42} \text{ kg m} \quad (59)$$

The Lorentz Transformations [1] could also be defined in terms of Unicity instead of Velocity and we see that relativistic effects are inherent in Nature since the Mass, Charge, Wavelength, and Frequency of Systems of Charged Particles are limited by both the Velocity, and the Unicity. We now have an alternate expression for the minimum Angular Momentum since

$$h = uv \quad (60)$$

$$h_0 = bc = 6.62608 \times 10^{-34} \text{ J s} \quad (61)$$

We can now estimate the Mass of an individual Photon in the same way that we estimate the Wavelength and Frequency of a Photon by using the value of the limiting velocity (c), even though we are aware that all Photons travel at a Velocity which is less than (c), since they have Mass. This method of approximation is both useful and convenient, however, since we are often only interested in calculating these values to a limited number of significant figures.

$$m_R \approx \frac{u}{\lambda_I} = \frac{h_0}{\lambda_I c} = \frac{b}{\lambda_I} \quad (62)$$

For Photons with relatively lower Mass and Frequency, which have relatively higher Wavelength, Equation (62) becomes more accurate. If the Mass of a Photon was Zero, then Equation (62) shows that the value of the Wavelength would be Infinite, which is certainly not the case for the Electromagnetic Spectrum. Since we have the value of the Magnetic Permeability of Free Space [8] by definition

$$\mu_0 = \lim_{\lambda_1 v_R \rightarrow c} \frac{2m_R \lambda_I}{q^2} = 1.2566 \times 10^{-6} \text{ kg m/C}^2 \quad (63)$$

then along with Equation (59)

$$b = \lim_{\lambda_1 v_R \rightarrow c} u = \frac{h_0}{c} = 2.10218631 \times 10^{-42} \text{ kg m}$$

we can estimate the absolute value of the Electric Charge on each of the individual Particles of the Particle / Anti-Particle pairs that make up the Photon as follows

$$q = \sqrt{\frac{2m_R \lambda_I}{\mu}} \quad (64)$$

and the Photon Electric Charge

$$q_{\text{Photon}} \approx \lim_{\lambda_1 v_R \rightarrow c} \sqrt{\frac{2m_R \lambda_I}{\mu}} = \sqrt{\frac{2b}{\mu_0}} \quad (65)$$

or equivalently

$$q_{\text{Photon}} \approx \sqrt{\frac{2h_0}{\mu_0 c}} = 1.875545842 \times 10^{-18} \text{ C} \quad (66)$$

which is greater than the Electric Charge on the Electron or Proton by

$$q_{\text{Photon}} = (11.70623765) q_{\text{Electron/Proton}} \quad (67)$$

VII. DETERMINISM AND UNCERTAINTY

The Heisenberg Uncertainty Principle [2] which states that the position and momentum of a particle can only be measured to a limited degree of accuracy, depends upon the act of measurement or equivalently, the addition of an external Force to the System that is being considered. The Position and the Momentum of Particles are certainly disturbed by incoming photons, but this statement of inherent Uncertainty should not be extended to apply to the values of Position and Momentum, or Energy and Frequency, for an Isolated situation in which no external disturbance takes place. Well defined orbits exist in Nature as a result of the mutual Interaction of Particles and should not be forbidden by the limiting principles of the act of measurement, since the act of measurement qualifies as an example of an external disturbance. Determinism is

prevalent in Nature and is often a necessary requirement for certain processes to proceed, while Uncertainty appears as the unpredictable disturbances brought upon a System by the influence of another External System.

VIII. QUANTUM MECHANICS

The parameters of any Physical Systems which are observed to have quantized values is a result of either the addition of Charged Particles to the System, or the loss of Charged Particles from the System. The discrete Energy Levels expressed by either eigenvalue Solutions of the Schrodinger Equation, or by Bohr's Principal Quantum Number, are new balanced states of Dynamic Equilibrium due to Forces exerted on the System by the Mass or Charge of one or more of the constituent particles of an incoming Photon. The Time-Dependent Schrodinger Equation [7] can be written as

$$-\frac{\hbar^2}{8\pi^2 m} \frac{\partial^2 \Psi}{\partial x^2} + V\Psi = i \frac{\hbar}{2\pi} \frac{\partial \Psi}{\partial t} \quad (68)$$

and this is [44] equivalent to

$$\frac{\hbar\omega}{2\pi} = \frac{\hbar^2 k^2}{8\pi^2 m} + V \quad (69)$$

where the wave number (k) is equal to

$$k = \frac{2\pi}{\lambda} \quad (70)$$

and the angular frequency (ω) is equal to

$$\omega = 2\pi\nu \quad (71)$$

and the Electrical Potential (V) for the Interaction of Charged Particles [7] is given by

$$V = -\frac{1}{4\pi\epsilon_0} \frac{e^2}{r} \quad (72)$$

where the magnitude of the Electric Charge [8] on the Electron and Proton (e) is equal to

$$e = 1.602176462 \times 10^{-19} \text{ C} \quad (73)$$

and the Permittivity [8] of Free Space (ϵ_0) is equal to

$$\epsilon_0 = 8.854187817 \times 10^{-12} \text{ kg m}^3 \text{ s}^2 / \text{C}^2 \quad (74)$$

Substitution of the Electrical Permittivity Variable into the Equation (72) for the Electrical Potential, and replacing (r) with $\frac{\lambda}{2\pi}$ we get

$$V = -\frac{1}{4\pi\epsilon_0} \frac{e^2}{r} = \frac{2m_I \lambda_I^3 \nu_R^2}{4\pi q^2} \frac{2\pi q^2}{\lambda_I} = -m_R \lambda_I^2 \nu_R^2 \quad (75)$$

and substituting this result into Equation (69) we get

$$\frac{\hbar\omega}{2\pi} = \frac{\hbar^2 k^2}{8\pi^2 m} - m_R \lambda_I^2 \nu_R^2 \quad (76)$$

then we replace (ω) and (k) with ($2\pi\nu$) and ($\frac{2\pi}{\lambda}$)

and arrive at

$$\hbar\nu_R = \frac{m_R^2 \lambda_I^4 \nu_R^2 4\pi^2}{8\pi^2 m_R \lambda_I^2} - m_R \lambda_I^2 \nu_R^2 = -\frac{m_R \lambda_I^2 \nu_R^2}{2} \quad (77)$$

which represents the sum of the Kinetic Energy and Potential Energy of the System. This is one half of the Energy as defined in Equation (26).

Consider the System of the Electron and Proton in the Ground State of the Hydrogen Atom in terms of the Bohr Model (10). We have the following approximate values for the parameters of the System from the Bohr Equation for the radius of the Electron in a Circular Orbit around the Proton in the Ground State

$$r_n = \frac{4\pi\epsilon_0 n^2 \hbar^2}{4\pi^2 q m e^2} = 5.291772083 \times 10^{-11} \text{ m} \quad (78)$$

and from the Bohr Frequency for the Ground State[2]

$$\nu_1 = \frac{e}{4\sqrt{\epsilon_0 \pi^3 r_1^3 m}} = 6.579683919 \times 10^{15} \text{ s}^{-1} \quad (79)$$

Electron Parameters [8]

$$m_e = 9.10938188 \times 10^{-31} \text{ kg}$$

$$q_e = -1.602176462 \times 10^{-19} \text{ C}$$

$$\lambda_e = 3.32491846 \times 10^{-10} \text{ m}$$

$$\nu_e = 6.579683919 \times 10^{15} \text{ s}^{-1}$$

Proton Parameters [8]

$$m_p = 1.67262158 \times 10^{-27} \text{ kg}$$

$$q_p = 1.602176462 \times 10^{-19} \text{ C} \quad (80)$$

$$\lambda_p = 1.810807198 \times 10^{-13} \text{ m}$$

$$\nu_p = 1.208130415 \times 10^{19} \text{ s}^{-1}$$

System Parameters from Equations (2) [8] (7) (5)

$$m_R = 9.104423456 \times 10^{-31} \text{ kg}$$

$$q_e = 1.602176462 \times 10^{-19} \text{ C}$$

$$\lambda_I = 3.3267292 \times 10^{-10} \text{ m}$$

$$\nu_R = 6.576102462 \times 10^{15} \text{ s}^{-1}$$

The respective Orbits of the Electron and Proton about their common Center of Mass are well defined, and we can verify that each individual Particle in the System has the same value for both the Unicity ($u = m\lambda$) and for the Velocity ($v = \lambda\nu$).

$$\text{where } u = 3.028795197 \times 10^{-40} \text{ kg m} \quad (81)$$

$$\text{and } v = 2.187691252 \times 10^6 \text{ m/s} \quad (82)$$

When the Electron moves to the higher Energy Level of the First Exited State, the Unicity increases and the Velocity decreases so that we must conclude that at least one new Particle has either entered or left the

bound System. Since the Electron moves to an orbit which is a greater distance away from the Proton than its Ground State orbit, it is reasonable to assume that the entering Particle is the Negatively Charged Particle that was separated from its anti-particle in the incoming α -Lyman Photon. It is convenient to name this negatively charged Particle the α -Lymanon which can be assigned the symbol $(\alpha-Ly^-)$, and then to name its Anti-Particle which is Positively Charged, the α -Anti-Lymanon $(\alpha-Ly^+)$ after the Lyman Series of the Atomic Line Spectra for Hydrogen Gas, which represents the transition of the Electron from the Principal Quantum Number [$n = 2$ to $n = 1$]. We can first calculate the Mass of the α -Lymanon $(\alpha-Ly^-)$ and the α -Anti-Lymanon $(\alpha-Ly^+)$ that existed as the bound state of the α -Lyman Photon, just prior to its encounter with the Proton and Electron. The Reduced Mass of the Photon is approximated by

$$m_R \approx \frac{u}{\lambda_I} = \frac{h_0}{\lambda_I c} = \frac{b}{\lambda_I} \quad (83)$$

and since (λ_I) is taken from the Lyman Series Line Spectra for Hydrogen

$$\lambda_I = 1.215684457 \times 10^{-7} \text{ m} \quad (84)$$

we find the Mass of the α -Lymanon $(\alpha-Ly^-)$ from Equation (83)

$$m_R \approx 1.818085785 \times 10^{-35} \text{ kg} \quad (85)$$

The frequency can also be approximated from

$$v_R \approx \frac{c}{\lambda_I} = 2.466038422 \times 10^{15} \text{ s}^{-1} \quad (86)$$

and the Force between the α -Lymanon $(\alpha-Ly^-)$ and the α -Anti-Lymanon $(\alpha-Ly^+)$ is

$$F = 2\pi m_R \lambda_I v_R^2 = 8.445294163 \times 10^{-11} \text{ N} \quad (87)$$

TABLE 2. Wavelength (Perimeter of Circular Orbit), Frequency (Reciprocal of Proton Period), and Gravitational Variable for the First Excited State of the Hydrogen Atom.

Particle	Wave-length (10^{-11} m)	Frequency (10^{15} s $^{-1}$)	Gravitational Variable (10^{29} m 3 /kgs 2)
Proton	0.07243	755.08151	1.489469142
Electron	132.996	0.4112302	1.489469142
Lymanon	99.7478	2.4673816	1.489469142

We now use the values from (Table 2) to calculate the Mass, Charge, Wavelength, and Frequency of the Negatively Charged $(\alpha-Ly^-)$ as it exists in the bound Three-Body System with the Proton and Electron in the

State known as the First Excited State of the Hydrogen Atom. Given the Mass values of the Proton and Electron, and calculating their Frequencies and Wavelengths in the First Excited State from the Bohr Equation for Energy Levels [2], we can calculate the Mass of the $(\alpha-Ly^-)$ particle.

$$m_p = 1.67262158 \times 10^{-27} \text{ kg}$$

$$m_e = 9.10938188 \times 10^{-31} \text{ kg}$$

$$m_{\alpha-Ly^-} = 2.699111068 \times 10^{-31} \text{ kg}$$

The Reduced mass is then

$$m_R = \frac{m_1 m_2 m_3}{m_1 m_2 + m_2 m_3 + m_3 m_1} = 2.08191 \times 10^{-31} \text{ kg} \quad (88)$$

At the very instant that the separation occurs, the mutual Three-Body Force acting between the Proton, Electron, and $(\alpha-Ly^-)$ is given by

$$F = 2\pi m_R \lambda_I v_R^2 = 3.7803059 \times 10^{-10} \text{ N} \quad (89)$$

This shows that the Mass of a Particle depends not only on the Velocity in the relativistic sense, but also on the individual values of the Charge, Wavelength, and Frequency of every other Particle in the System to which the Particle is bound. We calculated the different Mass values that the negatively charged α -Lymanon $(\alpha-Ly^-)$ takes on as a result of whether it is bound to the α -Anti-Lymanon $(\alpha-Ly^+)$, or bound to a Proton and Electron. This is true for all Particles, and the value of the Mass of an Electron (e^-) when it is bound to a Positron (e^+), is much less than the value of the Electron Mass when it is bound to a Proton. The change in Frequency is very small as we expect for Light moving more slowly in a Refractive Medium.

$$m_{e(\text{Proton})} = \frac{u}{\lambda_e} = \frac{h_e}{\lambda_I^2 v_e} = 9.10938188 \times 10^{-31} \text{ kg} \quad (90)$$

and

$$m_{e(\text{Positron})} = \frac{b}{\lambda_e} = 4.85086912 \times 10^{-35} \text{ kg} \quad (91)$$

IX. ROTATIONAL DYNAMICS OF SPIRAL GALAXIES

The analysis of the Dynamics of the Rotation of Spiral Galaxies using the Equations of Motion with the substitution of the Gravitational Variable, shows that the reason the tangential velocity has a higher than expected value at the outer perimeter of a Spiral Galaxy, is due to the Increasing Value of the Gravitational Variable as it is measured radially outward from the Galactic Center. Given the following

data for the Sun as it rotates around the Center of the Milky Way Galaxy, we calculate the value of the Gravitational Variable and the Centripetal Force acting on the Sun as it travels around the Center of the Galaxy. We will do so using an approximate expected value for the magnitude of the Mass of the visible Stars that lies within the Circular Orbit of the Sun around the Galactic Center of the Milky Way [3].

$$M_I_{\text{SUN-MW}} = 1.795 \times 10^{41} \text{ kg} \quad (92)$$

$$R_I_{\text{SUN-MW}} = 2.469 \times 10^{20} \text{ m} \quad (93)$$

$$\lambda_I_{\text{SUN-MW}} = 1.551 \times 10^{21} \text{ m} \quad (94)$$

$$v_R_{\text{SUN-MW}} = 1.416 \times 10^{-16} \text{ s}^{-1} \quad (95)$$

The Gravitational Variable of the Sun with respect to the Galactic Center of the Milky Way Galaxy is found using Equation (10)

$$G_{\text{SUN-MW}} = \frac{\lambda_I^3 v_R^2}{2\pi M_I} = 6.50 \times 10^{-10} \text{ m}^3/\text{kg s}^2 \quad (96)$$

Comparison of this value with the value of the Gravitational Variable of the Earth with respect to the Sun [Table 1], we find that the value of the Gravitational Variable of the Sun with respect to the Galactic Center of the Milky Way Galaxy is approximately ten times greater.

$$G_{\text{EARTH-SUN}} = \frac{\lambda_I^3 v_R^2}{2\pi M_I} = 6.67 \times 10^{-11} \text{ m}^3/\text{kg s}^2 \quad (97)$$

In order to demonstrate that the choice of the value for the expected magnitude of the Mass of the visible Stars that lie within the Circular Orbit of the Sun around the Galactic Center of the Milky Way was a valid one, we must also require that the resulting value lie in the range between the value of the Gravitational Variable at the radial position where the Galactic tangential velocity becomes relatively uniform, and the outer edge of the Galaxies' Visible Disk.

To observe the effect that the number of Particles in a chosen System has on the Physical Quantities that represent the System, we calculate the value of the Gravitational Variable of the entire Solar System with respect to the Galactic Center of the Milky Way, and find that it is very close to but not exactly, the value of the Gravitational Variable of the Sun with respect to the Galactic Center of the Milky Way.

$$G_{\text{SL.SYS-MW}} = \frac{\lambda_I^3 v_R^2}{2\pi M_I} = 6.49 \times 10^{-10} \text{ m}^3/\text{kg s}^2 \quad (98)$$

X. ELEMENTARY PARTICLES

The Gravitational Variable of the Electron with respect to the Proton in the Ground State of Hydrogen from Equation (10) has the following value

$$G_{E-P} = \frac{\lambda_I^3 v_R^2}{2\pi M_I} = 1.514179 \times 10^{29} \text{ m}^3/\text{kg s}^2 \quad (99)$$

As an α -Lyman Photon approaches the Two-Body Electron-Proton System, the negatively charged α -Lymanon ($\alpha\text{-Ly}^-$) begins to repel the Electron, and pushes the Electron out to the radial orbit of the First Excited State which is approximately four times further out. We now have a Four-Body System to analyze which includes the Electron, Proton, the α -Lymanon ($\alpha\text{-Ly}^-$) and the α -Anti-Lymanon ($\alpha\text{-Ly}^+$). Actually, we already had a Four-Body System long before the entry of the α -Lyman Photon, yet we chose to neglect it simply because of lack of interest in the variation of Physical Quantities taking place out at a large number of significant figures, which are often called negligible and are typically disregarded. There is an important difference between the Scientific Methodology of reporting the measured value of a Physical Quantity of a System of Particles to a large number of significant figures representing experimental precision, and assuming the value of a Physical Quantity to many significant figures for the purpose of observing the Space time Variation of the Physical Quantity as a result of considering the effects of lesser magnitude acting on the System as not negligible. Relativistic effects exist and are equally valid in so called non-Relativistic situations. This shows the validity of Mach's Principle [56], which states that every Particle in the Universe effects every other Particle in the Universe, and it is we who choose to either include or neglect the effects of greater or lesser magnitude due to our choice of which elements to include or exclude in the System of Particles. The Principle of Space time Variation can be stated as the idea that the Laws of Physics describing an Isolated System of Charged Particles, are equally valid and analytically continuous over the range of all physically attainable values of Mass, Charge, Wavelength and Frequency. The concept of Physical Quantities have been defined for the sake of convenience and for the ability to make predictions, and the concept of Force is both the same concept and is described by the same set of Equations whether we decide to consider the mutual Interaction between Galaxies or Quarks. With this in mind, it is convenient to neglect the Force or the effect of the Mass and Charge of the α -Anti-Lymanon ($\alpha\text{-Ly}^+$) on the Three-Body System of the Electron, Proton, and α -Lymanon ($\alpha\text{-Ly}^-$) in their state of Dynamic Equilibrium in the First Excited State of the Hydrogen Atom. This is a valid and useful assumption which greatly simplifies the Force calculation since the α -Anti-Lymanon ($\alpha\text{-Ly}^+$) is at a relatively large distance away for the other three Particles at the time that the Electron begins its continuous outward spiral

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trajectory from its orbital position in the Ground State, to its orbital position in the First Excited State of the Hydrogen Atom. The continuous Electron Orbital Transition occurs only when the negatively charged α -Lymanon (α - Ly^-) gets in between and close enough to the Proton and Electron, that the Force of the Three-Body System becomes just greater than the Force between the α -Lymanon (α - Ly^-) and the α -Anti-Lymanon (α - Ly^+) which existed as the incoming α -Lyman Photon. We recall that the Electric Charge between the Particles in the incoming α -Lyman Photon is on the order of magnitude of ten times greater than the Electric Charge between the Electron and Proton in the Hydrogen Atom from Equation (66).

$$q_{\text{PHOTON}} \approx \sqrt{\frac{2h_0}{\mu_0 c}} = 1.875545842 \times 10^{-18} \text{ C}$$

We calculate the mutual Force acting between the Particles of the Three-Body System which consists of the Three-Body System of the Electron, Proton, and α -Lymanon (α - Ly^-) in their state of Dynamic Equilibrium in the First Excited State of the Hydrogen Atom, from Equation (19), or the Force Law.

$$F = 2\pi m_R \lambda_l \nu_R^2$$

and from Equation (3) for the Three-Body Reduced Mass

$$m_R = \frac{m_1 m_2 m_3}{m_1 m_2 + m_2 m_3 + m_3 m_1}$$

where from (Table 2)

$$\begin{aligned} m_e &= 9.10938188 \times 10^{-31} \text{ kg} \\ m_p &= 1.67262158 \times 10^{-27} \text{ kg} \\ m_{\alpha-Ly^-} &= 2.699111068 \times 10^{-31} \text{ kg} \end{aligned} \quad (100)$$

so that the Three-Body Reduced Mass is

$$m_R = 2.081906065 \times 10^{-31} \text{ kg} \quad (101)$$

and from Equation (8) for the Three-Body Increased Wavelength

$$\lambda_l = \lambda_1 + \lambda_2 + \lambda_3$$

where from Equation (78)

$$\begin{aligned} \lambda_e &= 1.329967384 \times 10^{-9} \text{ m} \\ \lambda_p &= 7.243228793 \times 10^{-13} \text{ m} \\ \lambda_{\alpha-Ly^-} &= 9.974789339 \times 10^{-10} \text{ m} \end{aligned} \quad (102)$$

and from Equation (6) for the Three-Body Reduced Frequency

$$\nu_R = \frac{\nu_1 \nu_2 \nu_3}{\nu_1 \nu_2 + \nu_2 \nu_3 + \nu_3 \nu_1}$$

where from Equation (78)

$$\begin{aligned} \nu_e &= 4.11230245 \times 10^{14} \text{ s}^{-1} \\ \nu_p &= 7.550815097 \times 10^{17} \text{ s}^{-1} \\ \nu_{\alpha-Ly^-} &= 2.467381568 \times 10^{15} \text{ s}^{-1} \end{aligned} \quad (103)$$

so that the Three-Body Force is given by

$$F = 2\pi m_R \lambda_l \nu_R^2 = 7.10548 \times 10^{-10} \text{ N} \quad (104)$$

which is the same value as the magnitude of the Force between the α -Lymanon (α - Ly^-) and the α -Anti-Lymanon (α - Ly^+) from Equation (87). Depending on the distribution of other Charged Particles in the vicinity of the Four Bodies which are external to the system, the positively charged α -Anti-Lymanon (α - Ly^+) can recapture the negatively charged α -Lymanon (α - Ly^-), at which time the Electron would spiral back toward the Proton and achieve its initial Ground State Orbit. The Third Excited State of the Hydrogen Atom can be chosen for simplicity as a Four-Body System of the Electron, Proton, negatively charged α -Lymanon (α - Ly^-), and negatively charged α -Balmeron (α - H^-) where the Mass of the α -Balmeron (α - H^-) is given by

$$m_{\alpha-H^-} = 3.368659223 \times 10^{-36} \text{ kg} \quad (105)$$

It is evident from the complex process of how Elementary Charged Particles mutually Interact, that a Particle is a bound state of the combination of other bound Particles, and that the description of their properties depends upon the definition of the characteristics of the System of Particles that is chosen to investigate. This view follows from the observation that both a Galaxy and a Quark can be treated as individual Charged Particles with reference to the existence of relatively large volumes of empty space surrounding each Isolated Particle being considered. The relationship between Mass and Charge leads to an order of magnitude calculation for the Electric Charge of a Planet, a Star, and a Galaxy. Though these Particles are in a localized State of Electrical Neutrality due to equal numbers of Positively and Negatively Charged constituent Particles, they are not exempt from the influence of the Electric and Magnetic Fields that are induced both by other Particles in the Universe,

nor are they exempt from inducing Electric and Magnetic Fields of their own due to their motion in Space time. An order of magnitude calculation gives the following estimated values for the Electrical Charge of the Earth and for the Electrical Charge of the Milky Way Galaxy from Equation (28) and their measured Magnetic Field Strength

$$q = \sqrt{\frac{2m_R \lambda_I}{\mu}}$$

$$q_{\text{EARTH}} \approx 5.0 \times 10^{22} \text{ C} \quad (106)$$

$$q_{\text{MILKY WAY}} \approx 5.0 \times 10^{35} \text{ C}$$

and can be calculated by either taking into account every individual Particles' effect on the System, or by measuring the magnitude of the Induced Magnetic Fields that governs their dynamic behavior and motion in Space time. The Magnetic Fields of the Sun, Earth, and Moon are Induced by the known nine Planets, Setra and Quararao, the sixty-five known Natural Satellites, the Asteroids, Comets, and to some extent every Photon, Lepton and Quark in the Solar System. We would obviously neglect the contribution from the Photons, Leptons, and Quarks in the Andromeda Galaxy, yet their contribution is as easy to calculate if we desire to do so.

It is possible to calculate additional properties of Systems of Particles as long as we either measure or estimate a sufficient number of properties so that we have as many Equations as we have unknown variables. The Force, Unicity, and tangential Velocity of the Proton and Neutron in the Deuteron comes from Equations (1) and (2) if we simply make an estimation of their separation distance (r_I) to get

$$F_{\text{PROTON-NEUTRON}} = 1.071154601 \times 10^3 \text{ N}$$

$$u_{\text{PROTON-NEUTRON}} = 1.2172929 \times 10^{-41} \text{ kg m} \quad (107)$$

$$V_{\text{PROTON-NEUTRON}} = 5.443389698 \times 10^7 \text{ m/s}$$

The property of Intrinsic Spin of a Particle suggests that the Particle consists of at least two other Particles which rotate about their common Center of Mass. The Electron is the bound state of more than one other Particle, and is essentially a Photon with slightly more Mass than the α -Lymanon ($\alpha\text{-Ly}^-$). The designation of the Electron as the lightest known massive Particle or the designation of the α -Lymanon ($\alpha\text{-Ly}^-$) as the heaviest Photon is an arbitrary designation. This leads to the perspective that the concept of Exchange Force and Virtual Particles can actually be regarded as the exchange of real Particles that are all subject to the Force Law, and that a state of Dynamic Equilibrium that exists between a System of Particles is only stable

until acted upon by Particles from an external System. Observation of the Product Particles in the Decay Modes of Sub-Atomic Particles reveals the identity of the constituent Particles that form the bound states of the Reactant Particles. The decay of a Neutron to a Proton, Electron, and an Electron Anti-Neutrino, reveals that the Down Quark is actually the bound State of an Up Quark and an Electron.

$$n \rightarrow p + e^- + \bar{\nu} \quad (108)$$

or in terms of the constituent Quarks

$$\text{udd} \rightarrow \text{udu} + e^- + \bar{\nu} \quad (109)$$

and canceling an Up Quark and a Down Quark from both sides of Equation (109)

$$\text{d} \rightarrow \text{u} + e^- + \bar{\nu} \quad (110)$$

The Up Quark is then the bound state of a Down Quark, a Positron, and an Electron Neutrino, the Strange Quark is the bound state of a Down Quark, an Up Quark, and an Anti-Up Quark. This analysis shows that Particles are all essentially bound states of Photons, and that the binding process has the effect of Increasing the Mass of the bound Particle, decreasing the Wavelength, and Increasing the Frequency by a negligible amount. The Binding Process may release existing bound Photons, however, which is referred to as Radiation.

XI. CONCLUSION

In order to account for the mutual interaction of a Many-Body System of Charged Particles, the Reduced Mass, Reduced Frequency, and Increased Wavelength must be used to represent the magnitude of Physical Quantities associated with the System. The Unicity and Velocity are Conserved Quantities of a System of Charged Particles, and lead to the fact that Direct, Inverse, and Joint Variation in Nature require that the Proportionality Factors in the Equations representing Physical Quantities are themselves Variables rather than Constants. Equations expressed in terms of Proportionality Variables are intrinsically Relativistic so that parameters can be substituted directly as measured, regardless of the Reference Frame in which the measurements are taken. This demonstrates that the Laws of Physics are indeed analytically continuous on all scales of Space time that are physically attainable. Substitution of Physical Variables for the Physical Constants into existing Equations of Physics, shows that a Physical Quantity is a Universal Concept, and behaves in accordance with the same Equation in all situations. The Concept of Force can be described by

the same Force Law for Galaxies, Solar Systems, Molecules, Atoms, Nucleons, Quarks, and Leptons. This is a result of the absolute equivalence of Newton's Law of Gravity, Coulomb's Law for the Electrostatic Force, the Magnetic deflecting Force, and the Centripetal Force. Electrical Neutrality is a localized phenomena which does not prevent the attraction or repulsion of Systems of Charged Particles due to mutual Electric and Magnetic Induction, which results from motion in Space time. Relativity is a statement of the Conservation of Velocity, and the statement of the Conservation of Unicity must also be considered to describe the limitations of the physically attainable states of Charged Particles. Light has Mass and is comprised of Charged Particles known as Photons which are the building blocks of ordinary Matter. A single Photon is a pair of Charged Particles which mutually Interact and rotate around a common Center of Mass, and creates an Electromagnetic Wave which propagates radially outward at the limiting maximum velocity (c). Though the propagation of the Wave Disturbance through the medium of Space travels at the velocity (c), the individual Charged Particles all translate and rotate at velocities which are necessarily less than (c). Photons are also subject to the limiting minimum unicity (b), as are all Charged Particles, and these two limiting values are properties of the medium of Light that pervades Space, which results from the emission of Photons by Stars. Quantum Mechanics is the description of discrete Physical Quantities due to either the addition or removal of Photons from the System of Charged Particles that is being considered. The discrete values result from an adjustment the System executes in order to maintain the state of Dynamic Equilibrium. The trajectories of the Particles during this adjustment are continuous functions of Distance and Time. Particles Interact and execute motion in well-defined Orbits, and Heisenberg's Uncertainty Principle applies to the act of measurement alone, and should not be extended to forbid well-defined Orbits that are less than a minimum Wavelength. Uncertainty applies to the effect that an incoming or outgoing external System of Charged Particles may have on an Isolated System, and Determinism applies to relative trajectories while the System remains in Isolation. The Earth revolves around the Sun regardless of our ability to measure it, and is subject to sudden displacement out of that orbit by collision with a sufficiently Massive Object. If a Particle is relatively small, we could use smaller Photons to measure it. The Rotational Dynamics of Spiral Galaxies must take into account the variation of the Physical Variables so that the Gravitational Variable, Electrical Permittivity Variable, Magnetic Permeability Variable, or the Angular Momentum

Variable can be used to demonstrate that the Rotational Velocity is in accordance with the actual Mass Distribution, and that Dark Matter and Dark Energy do not exist. Galaxies, Stars and Planets can be considered as Charged Particles, whose value is the Sum of the individual constituent Charges. This phenomena is identical bound Protons and Neutrons in the Nucleus, since it is the Charged constituent Quarks which Rotate and Induce Fields that cause the binding effect. Quarks are made of Leptons, which are made of Neutrinos, which are made of Photons. The property of Intrinsic Spin is evidence for the further sub-division of Particles into additional constituent Particles, so that the Electron is comprised of at least two other Particles. For the sake of categorizing existing Particles, the product Particles of the Decay Modes reveal that the actual constituent Particles of the reactant Particles. The Decay of a Particle is simply the forced unbinding and reorganization of bound states of a collection of Particles. Particle Annihilation is actually Particle Binding, and Pair Production is actually Pair Separation. When a pair of typical oppositely Charged Leptons bind, the Mass of the resultant Photon is on the order of one thousand times less than the Mass of each individual Free Particle. Mass is then a Dynamical property of a System of Particles and depends upon the Charge, Mass, Wavelength, and Frequency of the other Particles in the System. Mass is actually not a form of Energy. To make the statement that any one Physical Quantity is a form of another Physical Quantity is vague, since the actual relationship between them is better expressed mathematically. Energy is a very useful Physical Quantity, but one that contains Mass in its definition so that we could say that any given Physical Quantity is a form of every other. If we choose to do this, then Mass could more accurately be described as the Dynamic Equilibrium of Induced Magnetic Fields. This is evident from the fact that the pseudoscalar (π^+) Meson has a Mass that is approximately five times less than the Vector (ρ^+) Meson, even though they are both comprised of the bound states of an Up Quark and an Anti-Down Quark. The concept of Total Energy, Rest Energy, and Rest Mass of a Particle are also vague for several reasons. First, because each are represented by expressions that are mixed limits which approach the limiting value (c) for the velocity parameter in the expression, yet approach zero velocity for the mass parameter. Second, the description of Mass as a function of velocity makes the assumption that the Particle remains in its initial bound state, and since the Mass also depends on the characteristics of the bound state, then variation of Mass as a function of velocity, is an incomplete description. The Energy of either a Particle or a System of Particles need not be sub-

divided into types such as Kinetic and Potential in the same way that there are no distinct types of Forces. The concept of Energy and Force are singular concepts with one meaning, and it can be shown that Physical Variable Substitution reveals that the Force Coupling Constants, such as the Fine Structure Constant, are all equal to unity. Energy and Mass are not equivalent since Energy depends on Mass, and also depends on the square of the Wavelength and Frequency. An Electromagnetic Wave propagates at the Velocity (c) and all Wave Velocities depend on the medium in which they propagate, however, the Charged Particles that create the Waves can never achieve the same velocity (c) as the wave. Since the value of the Energy of a System of Particles can never achieve the value of the product of the Mass and the square of the Velocity of Light, then it is also true that since (c) is actually an asymptote, we must conclude that $E < mc^2$.

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