A Digital Particle Structure For General Relativity

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1-27-2011

Is reality digital or analog? The question can be rephrased. Is reality digital-discrete, entangling and background dependent or is reality metrical, continuous and background independent? Stated in another way, is the nature of reality ultimately founded on Quantum Mechanics, on General Relativity or on some future subsuming concepts. In supports of the latter contention, it is simply that the mind of man has not yet accrued enough perceptual and empirical knowledge at this time to conceive the compatible interrelation between the two aspects of the same reality. To demonstrate that there is still room for combining both aspects, this article uses the discrete, digital and entanglement ideas of quantum mechanics and the metrical background independence of general relativity. This is done by theoretically equating a discrete, entangled volume structure to the energy-momentum 4-vector of special relativity in order to mathematically demonstrate a heretofore unknown mathematical connection between the quantum length realm and the nuclear-atomic realm. The cosmic realm is then connected by using the comma goes to semicolon rule of general relativity. A pertinent question is then put forth. Does a discrete entangled volume provide particle structure for general relativity?

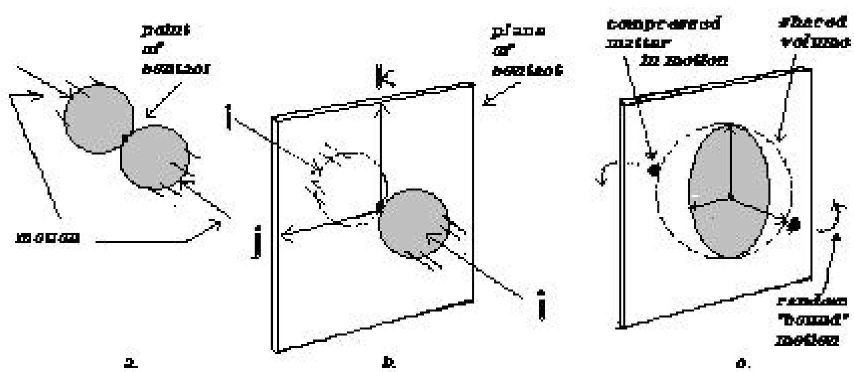
A universal particle is hypothesized from definitions based on *a priori* assumptions about space and matter: space is that which contains matter and matter is that which occupies space, matter and space always exist together, and that matter and space are necessary and sufficient for the definition of each other. This intuitive perception of reality leads to postulating a constant proportionality between matter and space, $\rho = M/V$. The constancy allows the density to be the same from the Planck length real to the cosmic realm; it also permits matter and space to be a function of each other. At the Planck length realm, μ and υ are definite discrete and whole amounts of matter and space, respectively.

Postulate: a universal particle, p, exists such that a universal and inherent property of objective reality proportionally binds υ and μ such that υ must uniquely and inseparably contain μ. The universal particle is needed to provide a domain of definition for the entangled shared volume. The matter in υ is assumed to be contractile it can contract or expand within its *original* universal volume provided the matter unit correspondingly acquires an accelerating/balancing rate-of-change to compensate for the change in ρ, and provided no other matter occupies the *original* universal volume. The autonomic property of the universal particle will cause the universal particle to resist change in its balanced state. The *universal particle*, then, is simply a piece of *balanced space-matter*, together with an innate ability to autonomically balance its ρ_u by way of a rate-of-change of displacing-altering motion:

$$P = \left\{p : p \Rightarrow \left(\upsilon \,\&\, \mu\right) \wedge \left(\rho_u = \tfrac{\mu}{\upsilon} = constant\right) \wedge \left[\,(d/a)\ motion\,\right]\right\}.$$

Now, let p have dimensions greater than 3 or 3. Let two spherical $p's$ mathematically collide along a line of action and become symmetrically bound. As the bound particles continue to intersect, ρ prevents the matter units from violating each other's volume, while the locus of the intersection in 3-space will be a shared volume, υ_s consisting of two welded and inseparable 3-d spherical segments penetrating from the multi dimensional realm if greater than 3. Half of one segment belongs to one p while the other half belongs to the other p. They are entangled. The 3-d discrete volume is devoid of matter and is entangled with the two discrete universal $p's$. In order to keep ρ balanced, imagine μ being compressed, away from the imbalanced vicinity, into an imperceptible curled up space in the Planck length realm and below the shared volume realm. Imagine a countably infinite amount of intersecting shared volumes. This would constitute a reality of a 3-d space consisting of vibrating, moving entangled virtual quantum space particles devoid of matter. The continuity of the density, ρ, would allow continuity of its properties to be valid from the quantum Planck length realm to the cosmic realm of general relativity. If one p vibrates, the other intersecting p will simultaneously and instantaneously vibrate, simply because they are not disconnected; one p will immediately know what the other is doing. However, when ρ is imbalanced, the curled up discrete $\mu's$ are displaced in the surface brane of the two $p's$, then instantaneous finite bound balancing velocities and the vibrations of υ_s will simultaneously occur together. This line of reason connects velocities and vibrations. Another way of looking at this two body system is to assumed that the matter units and their respective motions exists in curled up Planck length volumes that are confined to the higher dimensional surface membrane (branes) covering υ_s.

Special relativity can now be employed. Let the two $p's$ collide, at the instant the two surface membrane or branes touch, let the point of contact be the origin of a rectangular coordinate system. The perpendicular plane of contact will contain two dimensions while the radial line will constitute the third dimension. Relative to the two intersecting $p's$, the plane will be stationary while the two welded spherical segments will form on both sides as the $p's$ continue to collide and become bound, after which υ_s will be at it maximum when the maximum compression is reached. Relative to the point of contact an the two $p's$, the shared volume is a scalar (fig.1).



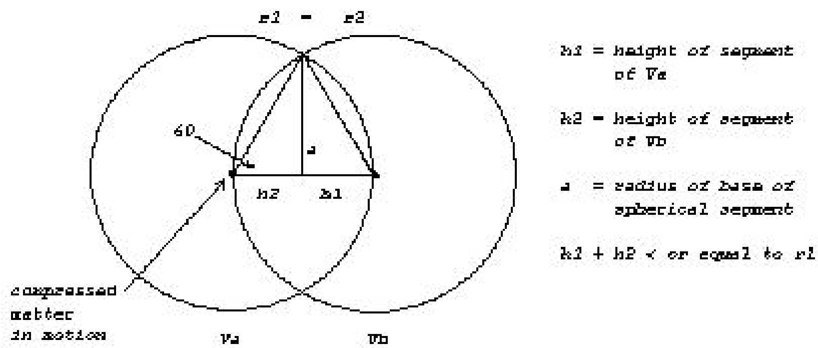
Relativity insists that the laws of nature must be independent of the coordinate systems.

Therefore, the properties of υ_s will be constructed of tensor invariants. Relative to the point of contact, the evolving $\upsilon_s(x^\alpha)$ becomes a $(0,0)$ tensor that defines a pure scalar space field surrounding the point of contact. The gradient and directional derivative tensors will be used to connect υ_s to the energy-momentum 4-vector of special relativity. Any mathematical handbook will give at least two formulae for the volume of spherical segments, and one for the surface area of the segments. At *maximum* compression,

$$\upsilon_{s1} = \tfrac{\pi}{3}h(h^2+3a^2),\ \ \upsilon_{s2} = \tfrac{1}{3}\pi h_1^2(3r_1-h_1),\ \ A_{sa} = \tfrac{8}{3}\pi a^2\ \ \&\ \ a = \sqrt{3}\,h,$$

υ_{s2} gives the radial distance between the two $\mu's$: $\frac{1}{2\pi}\nabla^2\upsilon_s = [r_1+r_2-(h_1+h_2)] = r.$

This article will use υ_{s1} since it employs the variable a. It must be stated that the two a lengths in the **j-k** plane are equal, since the locus of the surface area is a circle in this plane (fig.2).



The formula for Thomson's cross section of a free electron is $\sigma_t = (8/3)\pi r_e^2$, where $r_e = \frac{e^2}{m_e c^2}$ is the classical radius of the electron. This is the same as the formula for the surface area of υ_s. The assumption that they are equal provides the a measure of of υ_s. In keeping with the concept of invariance, the shared volume structural connection to the 4-vector becomes apparent by using the directional derivative of υ_s in the direction perpendicular to the surface of p

$$\nabla\upsilon_{s_e}\bullet\mathbf{n} = \nabla\upsilon_{s_e}\bullet\frac{\nabla\upsilon_o}{|\nabla\upsilon_o|} = \frac{\partial\upsilon_{se}}{\partial h}\frac{1}{\sqrt{7}} + \frac{\partial\upsilon_{se}}{\partial a}\frac{\sqrt{3}}{\sqrt{7}} + \frac{\partial\upsilon_{se}}{\partial a}\frac{\sqrt{3}}{\sqrt{7}} = \frac{\partial\upsilon_{se}}{\partial h}\frac{2}{\sqrt{7}} = \pi(h^2+a^2)\frac{2}{\sqrt{7}} = \tfrac{4}{3}\pi r_e^2\frac{2}{\sqrt{7}} = 2.51439299334x10^{-25}cm^2.\ \blacklozenge$$

Surprisingly,

$$m_p^2c^2 = (1.67262163783x10^{-24}gm\bullet 2.99792458x10^{10}\tfrac{cm}{\sec})^2 = 2.51441423843x10^{-27}gm\tfrac{cm^2}{\sec^2}.\ \blacklozenge$$

This invariant directional derivative, a tensor of order 2, is equated with the rest mass of the proton. In Special Relativity, and in Minkowskian space-time, it is the scalar length of the energy-momentum four-vector., Hence at maximum compression when ρ is balanced to it's limit and causes the directional derivative to become a constant,

$$\nabla\upsilon_{s_e}\bullet\mathbf{n} = \tfrac{4}{3}\pi r_e^2\frac{2}{\sqrt{7}} = 100m_p^2c^2 = 100(m^2c^2-m^2v^2),\ \text{where}\ m = m_o/\sqrt{1-\alpha^2}.\ \blacklozenge$$

When universal particles collide and light ensues, another digital-analog aspect of reality is revealed! But at this point, a curious event happens when light spreads from the point of impact in the *a-plane* to the surface of the *a-plane*. In $\frac{4}{3}\pi(c\tau)\frac{2}{\sqrt{7}} = 100m_p^2c^2$, c drops out and $\nabla\upsilon_{s_e}\bullet\mathbf{n}$ is equated to rest mass! Therefore, when light signals are used as measurements and spreads in the space-time of υ_s, it has the property of mass. This supports the concept in general relativity that light has mass! The equating of fundamental units can now be inferred relative to υ_s: $cm^2 = gm =$ sec. The absolute value of the gradient gives another surprising result: from $\nabla\upsilon_{s_e} \bullet \mathbf{n} = |\mathbf{n}||\nabla\upsilon_{s_e}|\cos\theta$ $= 100m_p^2c^2$, it is seen that if the gradient and the unit vector are aligned such that $|\mathbf{n}| = 1$ and $\theta = 0$, then $|\nabla\upsilon_{s_e}|$ should still be of the form $100m_p^2c^2$, then $|\nabla\upsilon_{s_e}| = 2/3\sqrt{10}\,\pi r_e^2 = 100m_x^2c^2$ where $m_x =$ $2.419025183x10^{-24}\left(gm\ or\ \sec\right) = m_p + 3m_{\pi^\pm} = p^\pm + \pi^\pm + \pi^\pm + \pi^\pm$. The greatest value of the gradient is the light momentum of three charged pion rest-masses plus the proton's rest-mass, where $m_p =$ $1.67262158x10^{24}gm$, and $m_{\pi^\pm} = 2.488012x10^{-25}gm$. These rest-mass values are *exactly* equal to the 1998 CODATA values of the fundamental mass constants that were compiled by the Committee of the International Council of Scientific Unions.

The mass-energy formula appears without the factor, 100, in SR, therefore, it must stand alone relative to υ_s. Following this line of reasoning, the term was separated into two parts, namely $100m_p^2c^2 = 99m_p^2c^2 + m_p^2c^2$. Examining the numerical value of $99m_p^2c^2$ showed that $99m_p^2c^2 =$ $2.4892461x10^{-25}(cm^2\ or\ gm)$, the *area* of the *a-plane* circle. This showed the full meaning of the directional derivative: $\nabla\upsilon_{s_e} \bullet \mathbf{n} = \pi a^2 + m_p^2c^2$; It depicts the background structural area of the *a-plane* circle. A supporting example is offered. The binding energy of the deuteron which is important in the creation of the stars can be deduced from $\phi = \frac{4}{3}\pi r_e^2\frac{2}{\sqrt{7}}$, and $\frac{d\phi_e}{dm_p} = 2 \times 99m_pc^2 + 2m_pc^2$. There is free particle pair energy and structural potential energy involved. Using $hv = 2 \times 99m_pc^2$, and the time of vibration, gives $\tau = 2.226135762161x10^{-26}\frac{\sec}{vib}$, which is then used to produce the mass in $\frac{4}{3}\pi\tau^2\frac{2}{\sqrt{7}} = 100m^2 = 100(3.96128818833x10^{-27}gm)^2$ where the mass in *mev* is 2.22213 *mev*. This is the exact mass-energy involved in the quantum explanation relative to the production of a neutron and a proton, and the production of a deuteron: $hv + d \to n + p$ and $n + p \to hv + d$. Further, it was also realized that the classical electromagnet radius of the proton defines the light momentum of the electron. The masses of the electron and the proton have the same shared volume structure. The classical electromagnetic radius of the proton gives $\nabla\upsilon_{s_p} \bullet \mathbf{n} = \frac{4}{3}\pi r_p^2\frac{2}{\sqrt{7}} = 100m_e^2c^2 = 100(m^2c^2 - m^2v^2)$. This suggest that the digital-analog ideas of υ_s is simply another way of looking at the two body system, $r_em_e = r_pm_p = e^2/c^2$.

If υ_s vibrates, expand and contract, relative to its maximum value, the $\mu's$ will also vibrate; then the *longitudinal Doppler effect* can be incorporated. For example, still using r_e, and the velocity of the electron, the mass of the bound neutron will be the modified 99*th* term:

$$\frac{4}{3}\pi r_e^2\frac{2}{\sqrt{7}}\frac{\sqrt{1-\frac{\upsilon_e}{c}}}{\sqrt{1+\frac{\upsilon\frac{\upsilon_e}{c}}{c}}} = 2.496110428x10^{-25}cm^2 = 99(1.674918388x10^{-24}gm)^2c^2. \ \blacklozenge$$

The directional derivative gives equal results when using quantum parameters and considering υ_s to be a standing wave packet. Since v_e in the phase velocity, $\frac{c^2}{v_e}$, can be shown to be the group velocity of a wave packet, and v_e can also be shown to be the velocity of a particle, then the wave length of the neutron as a measure of the a-length shows a different aspect between the wave length and the phase velocity of the electron.: $\frac{4}{3}\pi\bar{\lambda}_{c_n}^2\frac{2}{\sqrt{7}}\left(\frac{\sqrt{1-\frac{\upsilon_e}{c}}}{\sqrt{1+\frac{\upsilon_e}{c}}}\right) = 99\frac{m_e^2c^4}{v_e^2}$; and without the Doppler effect, λ_{c_p} gives the phase momentum of the electron, $100(m_e^2c^4/v_e^2)$. $\bar{\lambda}_{c_e}$ gives the phase momentum of the proton. This is so because $\lambda = \hbar/p$, where p is the momentum mc or mv.

To understand the Planck length connection, one must consider the line integral of electric intensity derived from Coulomb's law with respect to a radial field of a single charge e. The electric intensity **E** at an element of path of length d**S** makes an angle θ with the path where $E = \frac{e}{r^2}$, $d\mathbf{s}\cos\theta = dr$ and the integral is the same along any path. The electric force is therefore conservative and independent of the path. As a result, Potential Energy can be associated with the intensity and/or force:

Using the classical radii of the election and the proton as upper and lower values gives the energy and length:

$$E_b - E_a = -e\int_a^b \mathbf{E}\cdot d\mathbf{S} = e^2(\tfrac{1}{r_a} - \tfrac{1}{r_b}) = \tfrac{r_p r_e}{r_e - r_p} = 1.535534527x10^{-16}\ cm;$$

the electromagnetic mass is $1.67170604x10^{-24}\ gm$ which equals $m_p - m_e$.

The Planck length is usually selected by quantum physicists because they believe that quantum physics is more prevalent at this scale than General Relativity. It has also been demonstrated that it is the prevalent length in the demonstration of vacuum fluctuations. This length is purported to be the simplest length that can be constructed from the gravitational constant, Planck's constant, and the speed of light. The radius of curvature of the circle, a, is then correlated to Planck's length by way of the directional derivative of the υ_s. This length can be defined as $2^{\frac{1}{2}} l_P = 2^{\frac{1}{2}}\left(G^{\frac{1}{2}}\hbar^{\frac{1}{2}}c^{-\frac{3}{2}}\right) = 2^{\frac{1}{2}}(1.61625281x10^{-33}cm)$. The Schwarzschild length can be derived by letting the gravitational potential energy equal the kinetic energy, and then assuming the escape velocity of a photon equals the speed of light. The Planck length can be derived by equating the mass of the gravitational Schwarzschild length and the mass of the Compton wavelength, and then assuming the Schwarzschild length may be equal to the Compton wavelength at the Planck scale: $L_{gs} = \frac{2Gm}{c^2}$, $\bar{\lambda}_{c_p} = \frac{\hbar}{mc}$, $\frac{L_{gs}c^2}{2G} = \frac{\hbar}{\bar{\lambda}_{c_p}c}$, $\bar{\lambda}_{c_p} = \frac{2G\hbar}{c^3}$ and $l_P = \sqrt{L_{gs}\bar{\lambda}_{c_p}} = 2^{\frac{1}{2}} l_p = \pm 2^{\frac{1}{2}}\sqrt{\frac{G\hbar}{c^3}} = \pm 2^{\frac{1}{2}}(1.61625281x10^{-33}cm)$. The above described length is of quantum-mechanical size and can be equated to the length below which a mini-quantum black hole is formed! However, I believe the matter units constitute two equal mini black holes that balance each other and prevents collapse.

In the two body system of the electron and the proton, both respective velocities are assumed to compositely work together. As a consequence, the relativistic change in the relativistic change of mass with respect to the velocities is the connecting link that mathematically connects the Planck length realm to the upper realms. Now consider another tensor approach to υ_s involving the motion of the matter units along the density balancing surface curve of υ_s. The curve can be described as a path with a real number, s, associated with each point of the path. Since the one-form is dual to its associated tangent vector, the tensor operation of contraction with respect to the one-form and its associated tangent vector, in curved space, (that is nearly flat) can produce the frame invariant number, $\frac{d\upsilon_s}{ds} = \langle \widetilde{d}\upsilon_s, \vec{V}\rangle$. The vector components are $\left(\frac{1}{\sqrt{7}}, \frac{\sqrt{3}}{\sqrt{7}}, \frac{\sqrt{3}}{\sqrt{7}}\right)$ when the term involving the Christoffel symbols is near zero. Hence, $\frac{d\upsilon_s}{ds} = \frac{\partial\upsilon_{se}}{\partial h}\frac{1}{\sqrt{7}} + \frac{\partial\upsilon_{se}}{\partial a}\frac{\sqrt{3}}{\sqrt{7}} + \frac{\partial\upsilon_{se}}{\partial a}\frac{\sqrt{3}}{\sqrt{7}} = 2\frac{\partial\upsilon_{se}}{\partial h}\frac{2}{\sqrt{7}} = \frac{8}{3}\pi r_e^2\frac{2}{\sqrt{7}} = 100(\Lambda^o + \mu^+ + \mu^-)^2c^2$. Using $\frac{8}{3}\pi r_e^2\frac{2}{\sqrt{7}}$ as the formula, the Planck length connection follows:

$$\frac{d\upsilon_s}{ds} = \frac{8}{3}\pi\left[2^{\frac{1}{2}}\left(\frac{G\hbar}{c^3}\right)^{\frac{1}{2}}\right]^2\frac{2}{\sqrt{7}} = \left[\left(\frac{1}{\sqrt{1-\frac{v_e^2}{c^2}}}-1\right)\left(\frac{1}{\sqrt{1-\frac{v_p^2}{c^2}}}-1\right)\right]^2 m_{l_p}^2 c^2. \ \blacklozenge$$

$$\frac{d\upsilon_s}{ds} = \frac{8}{3}\pi\left[\left(2^{\frac{1}{2}}\frac{G\hbar}{c^3}\right)^{\frac{1}{2}}\right]^2 = \left\{\left(\frac{1}{\sqrt{1-\frac{v_e^2}{c^2}}}-1\right)\left(\frac{1}{\sqrt{1-\frac{v_p^2}{c^2}}}-1\right)\left[m_e+3\left(\frac{me^2}{mp}\right)\right]\right\}^2 c^2 \ \blacklozenge$$

m_{l_p} is the bound shared volume Planck length mass, $9.12426547 \times 10^{-28} gm$. The electromagnetic length of this Planck length mass is $e^2/m_{l_p}c^2 = 2.813343722x10^{-13}\,cm = a$, and $\pi a^2 = 99(1.67170604x10^{-24}gm)^2c^2$, which is the same potential energy-mass associated with the electric force and electric intensity that was computed above. Also the difference between the mass of the electron and the reduced mass of the electron is $4.9584 \times 10^{-31}gm \approx m_e^2/m_p$. $9.10938215943693 \times 10^{-28} + 3\left(\frac{m_e^2}{m_p}\right) = 9.124265533 5 \times 10^{-28}\,gm$. Hence $m_{l_p} = m_e + 3\left(\frac{m_e^2}{m_p}\right)$, where m_e is the CODATA value of the electron. As a result, the Planck length realm value for the radius of the electron is $1.613528864 \times 10^{-33}cm$. This bound system would be characterized by $m_p(G\hbar/c^3)^{\frac{1}{2}} = m_e(2.96768692x10^{-30}cm)$ and $m_e(2.9628335674 \times 10^{-30}cm) = m_p(1.6136095944 \times 10^{-33}\,cm)$

The results of the previous section lead to the derivation of the exact CODDATA value of the Dirac-Planck angular momentum and spin constant, $\hbar$. The derivation uses only υ_s parameters and the inverse of one of the associated eigen value vectors:

$$\left(\frac{m_e^2}{m_p}\mathbf{i} + (9.1242652843x10^{-28}\,gm)\mathbf{j}\right)\cdot\left(\frac{2}{1}\mathbf{i}+\frac{2}{\sqrt{3}}\mathbf{j}\right) = 2\frac{m_e^2}{m_p} + \frac{2}{\sqrt{3}}(9.1242652843x10^{-28}\,gm) = 1.05457162853x10$$

$\blacklozenge$

Further interrelation among the fundamental constants will show a υ_s connection between the Planck length constant and the constant in Einstein's general relativity field equation, $G_{\mu\nu} = (8\pi G/c^4)T_{\mu\nu}$. This connection is based on the fundamental reactions of the stars: $n^o \to p^+ + e^- + \bar{\nu}_e$ (beta decay of a free neutron outside/inside nucleus) In the equations below, the CODATA values are listed first, and the bound υ_s values are listed next:

$m_n = m_p + m_e + m_\nu$ (m_ν is the bound υ_s mass associated with electron anti-neutrino),

$$1.6749272118x10^{-24}gm = 1.6726216378x10^{-24}gm + 9.1093821545x10^{-28}gm$$
$$+1.3946357946x10^{-27}gm,$$

$$1.6749192565x10^{-24}gm = 1.67261457163x10^{-24}gm + 9.1093436705x10^{-28}gm + 1.3937506052x10^{-27}gm.$$

Relative to υ_s, the Einstein constant is a length, where $\gamma = \left(1/\sqrt{1-(v_e/c)^2}-1\right)\left(1/\sqrt{1-(v_p/c)^2}-1\right)$. Using the constant as a measure in $\frac{d\upsilon_s}{ds}$ gives

$$\frac{d\upsilon_s}{ds} = \frac{8}{3}\pi\left[2^{\frac{1}{2}}\left(\frac{Gh}{c^3}\right)^{\frac{1}{2}}\right]^2\frac{2}{\sqrt{7}} = \frac{4}{3}\pi\left[2\left(\frac{Gh}{c^3}\right)^{\frac{1}{2}}\right]^2\frac{2}{\sqrt{7}} = (\gamma 9.124265471x10^{-28}gm)^2c^2$$

$$\frac{4}{3}\pi\left(8\pi\frac{G}{c^4}\right)^2\frac{2}{\sqrt{7}} = [\gamma^2c(2.78750121x10^{-27}gm)]^2 = [2\gamma^2c(1.39375061x10^{-27}gm)]^2 \quad \blacklozenge$$

The Einstein bound υ_s light momentum mass is produced by using the inverse of the same 3-d vector used with the gradient. Taking the dyadic or tensor of order two, $\mathbf{T} = T_{ii}$, where the coefficients of the **jj**, **kk** dyads give the connection:

$$\left(\frac{m_e^2}{m_p}\mathbf{i} + (9.124265284x10^{-27}\,gm)\mathbf{j} + (9.124265284x10^{-27}\,gm)\mathbf{k}\right)\left(-\frac{\sqrt{7}}{1}\mathbf{i} + \frac{\sqrt{7}}{\sqrt{3}}\mathbf{j} + \frac{\sqrt{7}}{\sqrt{3}}\mathbf{k}\right) =$$

$$(-2.62518037x10^{-30}gm)\mathbf{ii} + (2.78750909x10^{-27}gm)\mathbf{jj} + (2.78750909\,x10^{-27}gm)\mathbf{kk}. \quad \blacklozenge$$

The Planck length constant gives the υ_s Planck length nuclear mass, the Einstein length constant gives twice the missing antineutrino υ_s bound structural mass, and the inverse of the directional derivative vector gives the υ_s bound Einstein nuclear mass that is exactly equal to twice the missing antineutrino bound structural mass. The quantum Planck length realm is connected to the cosmic Einstein realm by way of the relativistic change in the relativistic change in the bound υ_s light momentum mass with respect to the velocities of the electron and the proton. The above equations demonstrate a possible background dependent space structure that is connected to the metrical background independent space of GR.

Finally, the following reasoning connects υ_s to the cosmos. General relativity, with its pseudo-Riemannian indefinite metric, has shown that any deviation from flat-space “locally” is very small and hardly observable except in extreme conditions of motion and matter density. By assumption, locally, there is always a flat Lorentz space tangent to the curved space. In a rest-frame, or when velocity is extremely low compared to the speed of light, space appears to be three-dimensional. This is based on the GR requirement that ‘The metric of space-time can be put in the Lorentz form $\eta_{\alpha\beta}$ at any particular event by an appropriate choice of coordinates". As a consequence, the directional derivative and its changes relative to momentum can be put in terms of the curved manifold of GR. The “strong equivalence principle” states “Any physical law which can be expressed in tensor notation in SR has exactly the same form in a locally inertial frame of a curved space-time”. By transforming to general spherical coordinates in the flat non-Euclidian space-time of SR, Christoffel symbols and momentarily co-moving reference frames can be used where the principle of minimal coupling then allows the switch to geodesic curves. The conservation of four-momentum is $T^{\alpha\nu}{}_{,\nu} = 0$ in the local Lorentz frame, and this can be generalized to $\nabla \cdot \mathbf{T} = T^{\alpha\nu}{}_{;\nu} = 0$ in the curved frame by the “comma-goes-to-semicolon rule”, “because if a law contains derivatives in the special-relativistic form (‘commas’) then it has these same derivatives in the local inertial frame". To convert the law into an expression valid in any coordinate frame, one simply makes the derivatives covariant (‘semicolons’). Hence $(1/100)\nabla\upsilon_{s_e} = (m^2c^2 - m^2v^2)$ must be amended accordingly when going over to the covariant derivative relative to the conservation of momentum law of GR! This is the geometric law in curved space-time.

It has been mathematically shown that the combination of both digital quantum aspects of reality and general relativity analog aspects of reality can give the mind of man a different perspective of seeing the next horizon in the quest to understand the true nature of reality. The discrete shared volume idea provides the theoretical impetus for a metrical particle structure for General Relativity, and a different way of perceiving the entanglement of a two body system. Finally, it is hoped that the above example gives support to the statement that both digital and analog concepts will be subsumed within a more comprehensive idea of reality. Future computers will even have to employ algorithms of both concepts along with the entanglement concept. All must coexist.

Cover Sheet

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US Army Signal Corp, 1957-1959; acquired secret clearance to repair transmitting station's electronic equipment, was stationed in Japan.
Worked for the USPS in Cleveland, Ohio, 1959 to retirement in 1992: Letter carrier until 1974, supervisor to manager, and then associate office postmaster (level 20) from 1985-1992.
Cleveland State University, 4 year degree in secondary education, math major, 1974, attended college after work each day.
Substitute teacher in Cleveland, Ohio school system from 1974-1985, substituted on days off from USPS.
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