Self-Consistent Structure for the Electron / Positron

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Efforts to find physical structure in the electron/positron have been at an impasse, as with the atom before Rutherford. The particles must have spin gyration bodies of charged mass for their quantum radiation effects; this contradicts both their empirical collisions like ideal points and theories of unconfinable self-repulsion in such electric bodies. The broadest prior analysis resolved the conflict with point-like impacts of idealized rigid spheres rotating point charges at the relativistic limit on quantized equators of near classical size. Thus, herein, a spheric structure functions as if a linked set of 6 conic vortices, with outer rigidity from the fast inner reactions of close entanglement, were each spinning in the same conic sense with points inward and were, in 3 separate coaxial pairs, synchronously orbiting orthogonally to their spins and to each other pair in 3 perpendicular planes. The set maintains over the spheric orbit cycles an average interior balance between all 6 gyres of the self and mutual forces scaled by equations for empirical measurements between immersed conic vortices. The conic bases of the 6 gyres act as if only outwardly spreading evenly around the sphere in a cycle average the left or right axial spinning of the gyres' + or − "electric charge" force toward other particles, while projecting at *c* their 6 components of a unit charge rotation sum to the equator of a sum axis. This axis is at the spheric octant centroid that is at the quantum mechanics summation angle of arccos $1/\sqrt{3}$ from each of the 3 major poles of the rotation axes of the gyre pairs. That composite electron/positrons must have exactly 6 microquanta of mass and 1/6 negative or positive charge in 3 pairs to exhibit the charged mass of these leptons was independently defined by general charge and mass composite equations derived from Particle Data Group (PDG) empirical data on Standard Model (SM) interactively enlarged quark masses and conserved 1/3 or 2/3 charge in composite hadrons.

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The present status of the electron is like that of the atom when it was studied by Rutherford early in the last century. He found a definite internal structure that had atom-like properties, as if the atom were built as he described, to a correctable approximation. The ensuing corrections (by Bohr, Einstein, de Broglie, Schrödinger, Dirac, etc.) created the more complete atomic structure of today. As Feynman indicated (*1*), it became non-productive to stick too closely to Rutherford's original atom. Yet, that structure was a necessary step from which the very productive corrections of the present atomic understanding were discovered. Similarly, a productively Rutherfordian baseline of self-consistent physical structure for the electron is long overdue.

Inconclusive mathematical and mechanical concepts of electron structure have arisen over the last century (e. g., *2, 3, 4*), including theories of infinitesimal vibrating strings, vacuum effects, and preons (e. g., *5, 6*). Main stream physics "structure functions" (e. g., *7, 8*) are empiricly devised calculations as if electron/positrons (and photons) have otherwise undefined structural shapes analogous to the prior apparent "partons" of inelastic scattering in the quarks of nuclear hadrons. All agree that any electron or positron structure must necessarily have a spinning electric charge with a symmetricly all-directional electrostatic force. Whether the spinning is the unknown generator of the static "charge" force is not usually discussed, though one paper (*9*) proposed a sphericly wrapped electromagnetic field "vorton bound to a point dipole." Recently, evidence has also accumulated on "entanglement" of particles and photons (e.g., *10*, *11*) with unstated implications to electron structures. Einstein's often cited comment (e. g., *12*), that it would be enough to understand the electron, still applies.

Departure point. The most definitely structural and structurally broadest of the prior efforts was a monograph by Mac Gregor (*12*) summarizing both his many refereed electron structure publications and a thorough list of references, including relevant electron structural factors for quantum mechanics generally and quantum electrodynamics (QED) particularly. This book analyzed the conflicting requirements for electron structure, from the necessity for a spin gyration radius of a unit-charged electron body providing the quantum mechanical basis for the line splittings of light spectra, to the empirical collision data indicating a dimensionless point with unit charge rather than a body, and to the theoretically destructive self-repulsion of the electron's charge dispersed in any conceptual body. That analysis determined that only an idealized, rigid sphere of "mass", with a radius corrected to slightly more than √3 larger than the classical Compton radius, rotating a point unit charge (or perhaps a few fractional point charges) at exactly the relativistic limit on the equator, would meet all the point collision, quantum electrodynamic, gyromagnetic, spectroscopic, spin, electrostatic, and internal strength necessities for any general physical structure in the electron and its mirror twin, the positron.

Overall structural form and functions. A more finitely rigid sphere body with a deterministic yield strength and mass herein approximates Mac Gregor's ideal description of the electron/positron, as if such a body were composed of a closely spaced set of 6 mutually interactive, and very rapidly rotating conicly shaped vortices in a necessarily fluidic vacuum state. [A set of 6 is the minimum for any three dimensional (3D) spheric symmetry of conic vortices.] The 6 gyres are both individually spinning at a high angular rate, in the base-referenced sense of spin for the specific particle, and also jointly revolving in relatively slower, symmetricly synchronized orbits around their common center, with their conic points inward (PI, as opposed to bases inward BI) in relative axial angles between any two gyres of $(+\pi/3) \leq \alpha \leq +\pi$ (schematic Figs. 1 and 2A). The individual vortex spinning creates a fast-acting mutual interlinkage of entangled pressure and shear waves and currents between the points and sides of conic gyres (Fig. 2B) within a particle, and between the outwardly faced bases of the gyres of two separate particles, with a consequent inherent capability of exhibiting several different types and strengths of mutual and self forces, while supporting a less abstract or less purely symbolic particle-wave duality than the prior physics understandings summarized by Mac Gregor (12).

Except for the inertial equivalent to centrifugal force in the orbital revolutions of gyres within a particle, these vortical forces, and the vortex formations which generate them, are scaled down to subatomic particle size herein by prior empirical Eqs. 5 to 17 for 3D force and current measurements in the lab between members of symmetric pairs of fully immersed (as well as certain surface) conic vortices in water (*13, 14*). These lab vortices (Figs. 2 and 3) were viscously driven, by axial right circular cones of 1/6 or 1/9 π (30° or 20°) whole cone angles β, to high spiral wave turbulence in the gyre centers, with completely developed secondary vortical flow formations, including multiple internal smaller vortices, peripheral toroid rings, and eddies. Such vortices are energeticly active at their centers, not passive, as if exhibiting in the spinning currents and waves of their turbulence the existence of power sources for the forces of particles.

As displayed later, the 6 scaled component gyres are also described in broader terms (*15, 16*, *17*) by recent independently derived Eqs. 2 and 3, which show that the electron functions among the other massive particles (in a new classification of the particles) as if it is one of a systematic series of composites and that as a composite the electron or positron must have exactly 6 generalized microquanta, each with a rounded 10.9525 electron-Volts (eV) of mass and 1/6 negative or positive charge, from which the interactively enlarged empirical particle mass (0.511 MeV rounded) develops by a power law, with 1 conserved unit of total charge. The general charge and mass composite law Eqs. 2 and 3, which generated this definition, was found (*15, 16*, *17*) to apply to all the empirical subatomic massive particles (possibly excepting bosons), and was derived initially from Particle Data

Group (PDG) empirical data (*18*) on the interactively enlarged quark masses and their conserved 1/3 or 2/3 fractional charges in the composite Standard Model (SM) hadrons (mesons and baryons.) Thus, this independently derived confirmation of the number of electron components with their charge distribution also redefines the mass for the down-scaled particle structures and forces which can approach Mac Gregor's quantum mechanical requirements for the electron (*12*), and constrains these structural characteristics within a systematic correlation to the other subatomic particles.

The scaled forces of the six gyres maintain the net relative spacings of the gyre orbits within this structure for the electron by balancing the stronger (*14*) $+\alpha$ PI (Figs. 2A, B, and 3B) types of mutual forces, from the interacting pressure waves and sheared currents (*13*) between the points and sides of the drive cones and gyres, averaged over the orbital cycles, with the self force and revolving inertial equivalents to centrifugal force [as will be quantitatively demonstrated. Since the net outward repellent mutual forces (Eqs. 8 to 16) and the pseudo-centrifugal outward effects vary at different non-linear rates with size of gyre orbits as well as various velocities, the system seeks and settles on the diameter in each similar orbit at which the net average outward radial force balances the constant inward self force (Eq. 7) at a scaled spinning velocity. (Similarly, since the repellent average mutual forces on each gyre tend to push each orbit and each orbiting gyre in each orbit as far as possible on average away from the other gyres and orbits, the system also necessarily settles on the equally spaced orbits and relative phases of gyre locations in orbit at which the average forces during an orbit cycle balance on each side of the orbit for each gyre.)]

Under the scaled balance of these iteratively defined (*14*) forces, velocities, and dimensions (Eqs. 5 to 16), the entire spheric electron assemblage of six gyres then functions as if it is kept internally strain-free from relative movement between its cycling gyre orbit locations up to a yield and brittle breaking strength based on the cohesively directed vortex self force and is consequently externally rigid (*12*) to impacting stresses below that level (as required by Mac Gregor's analysis.)

The force of particle charge. For the six vortex assemblage the electron/positron's minus or plus "electric" (electrostatic) charge forces toward other charged particles (per Eqs. 5, 6, and 8 to 17) arise:

(i) As if charge polarization originates through the two opposite senses (with respect to the conic base axis) of conic vortex spinning currents, and as if charge forces are scaled primarily from the generally weaker mutual forces of repulsion (+) or attraction (−) for gyres of the same or opposite spins (*14*) between the <u>outward</u> looking bases of the average number of the 1 to 6 members of each particle's set of 6 revolving gyres which can momentarily face another particle's set at negative relative axial angles $-\pi \leq \alpha \leq 0$ of the gyres, similarly to two isolated lab gyres with bases inward (BI) toward each other (Fig. 2A), not points inward. [These weaker mutual forces between gyre bases come from the vibratorily varying spin currents of the much smaller, more tightly curled and impulsively spinning, multiple spiral wave vortices nested together within each main gyre diameter (*GD*) disk of heavy central turbulence driven viscously by the boundary layer fluids near the conic bases (Figs. 3A and B) (*13, 14*). The currents of the more distant base toroid of elliptical cross section, impulsively circulating under the influence of the turbulent spiral waves, are often neglected since they are much weaker, and appear to have far less influence in gyre forces, than the multiple spiral wave vortices and the steadier, stronger, more laminar, and more circularly helical currents (Fig. 3B) of the point toroid.]

(ii) As if those turbulently unique spinning forces from the gyre bases within the GD arise from the axial volume centroid of each spiral wave *GD* disk just above the cone base (Fig. 3A and B) (*13*) and are dispersed only <u>outwardly</u> around the entire electron/positron across solid angles slightly $>\pi$ (180°) in arc width centered on each gyre axis (Fig. 3C), so that these forces (*14*) (Eqs. 5, 6, and 8 to 17 below) do not interact inwardly with the base *GD* disks of other gyres in the same electron structure [even at their closest spherical approach of $\alpha = +\pi/3$ ($+60^\circ$)], but, aided by diffusion at each current shear zone, do spread the electric force effect approximately evenly outside the structural sphere over the rotation cycle average (Fig. 3D).

(iii) As if such turbulently generated types of more tightly curled spinning force from the base spiral waves can not appear within an electron/positron assemblage between the much larger and more laminarly flowing sides, points, and side toroid circulations of the six gyres (Fig. 3A and B) (*13*, 14, *19)*.

Consequently, the 6 conic vortex components of this electron structure function as if there is no present cause for last century's "Poincare' " problem (e. g., *12, 9)* of theoretically quasi-infinite repulsive electrostatic forces internally between all parts of any suitably small electron body with diffused charge (or between all parts of any alternative hollow spherical shell body with surface charge), requiring ideally rigid, almost infinite tensile strength throughout the electron body to avoid instant self destruction on first assembly.

Synchronized structural processes. In another aspect of overall structure, the two simplest generalized microquanta of + and − 1/6 charged mass cited earlier (*15, 16, 17*) were found necessary in the various particles primarily as bound pairs of 1/3 net charge where both paired microquanta must be of the same charge, as in the electron or positron, or in some proportion of neutral pairs of two opposite 1/6 charges in many other massive particles listed by the PDG (*18*). In correlation with this charge-related pairing of components, it was found independently in the lab (*14*) that in adjacent point-toward-point $+\alpha$ conditions such as those inside this electron structure, two conic gyres of similar scale can force each other into locked coaxial alignment as a pair at $+\pi\alpha$, even during many conditions (to be further discussed) of mutual repulsion from spinning in the same sense (Fig. 3E).

Accordingly, the electron/positron functions (Fig. 1 schematic) as if six PI vortices, each spinning in the same base-referenced, co-rotating sense [shown counterclockwise (CCW) on the bases] were also, in interphased synchrony, orbiting at a single lower angular rate about the common center as three coaxial pairs in separate orthogonal planes intersecting at that center as origin, each pair with its orbital axis on an orthogonal axis of that origin, on which the sense of orbital rotation that matches the gyre spins determines the primary reference pole of the pair orbits (Fig. 4A). In these orbits each gyre is always at a relative axial angle α from its paired gyre of $+\pi$, and from each other gyre of $(+\pi/3) \leq \alpha \leq (+2\pi/3)$ or (60° to 120°). Since the two CCW gyres shown in each pair have their conic base references facing in opposite directions on the ends of each spin co-axis, each pair has no net spin, nor net gyroscopic momentum, from the internal spin of the two vortices; those effects would ensue from the orbital rotation as a pair. [This would not be true if there were a pair that was neutral in charge with two contra-rotating gyres (with CCW and clockwise, CW, bases outward) on a pair co-axis, which is not the case in this electron/positron structure.]

The first column (Fig. 1) shows a half revolution (between five step positions) of the 1/8 cycle ($\pi/4$, 45°) stepped sequence of transitory positions of gyre pair A. In the same way, columns B and C show the non-interfering phased positions of the other two pairs at the 1/8 cycle times. Column ABC indicates the combined positions of the gyres of all three pairs at each transitory step. The positions repeat every half cycle.

The quantum summation axis. In the first three rows (Fig. 1), three of the gyres on the front view of the sphere are shown moving between each other pair's primary rotation poles in CCW progression around the surface octant (Fig. 4A) which the 3 primary poles define, here the upper right front octant for the viewer. The rotational summation axis (S) for all three orbital revolutions of the pairs is through the unique location of the surface centroid of that octant of the sphere (Fig. 4B), where the primary CCW summation pole (like the rotation sense of the gyres again) is equally distant at $\theta = \arccos 1/\sqrt{3}$ (54.73561..°) from each of the three summed primary poles of the three gyre pairs (Fig 4C), as if this structure of 6 vortices were the inherent structural cause of that quantum mechanical summation angle (*12*) (which is necessarily relied on in Mac Gregor's analysis for the properties of the ideal electron sphere.)

If one, two, or all three of the pair rotations as orbital pairs (or even the "charge" rotation sense of all six vortex spins together) are randomly reversed as variations of a thought experiment, then at some sequential step (Fig. 1) determined by the specific change, the primary summation pole results in the same way exactly at the centroid of some similarly defined octant, all 8 of which can be reached in this way and can be rotated into any viewing attitude in the figures. The quantized primary summation pole configuration itself, at $\theta = \arccos 1/\sqrt{3}$ from each of the three primary poles of the gyre pairs in a distinctive octant, is invariant and always present in this structure. [In the opposite octant of the sphere the paired gyres move clockwise (CW) around the octant, opposite to the CCW gyre spins, identifying the secondary summation pole at that octant centroid (Fig. 4B).]

Zitterbewegung. At 3/8 of the selected cycle (in the fourth row, Fig. 1), each of the 6 gyres crosses the quantal summation equator at the $\theta = \arccos 1/\sqrt{3}$ angle and in the same projected circular direction on that equator (Fig. 4D) with $\pi/3$ equatorial arcs between the crossings [though half the gyres alternately around the S equator are crossing between summation hemispheres in the opposite direction to the other half. Note also that while the summation axis and its S equator are tilted at θ from the gyre orbital axes and orbits, neither the S axis nor the peak displacement of the S equator from the C orbit is on any gyre orbit. The S equator crosses each gyre orbit at an $\varepsilon = \pi/4$ (45°) angular point equally distant between the other two orthogonal orbital planes.]

The simultaneous crossings of the S equator by all 6 gyres repeats a half cycle later. Such an equatorial contraction of the loci of the gyres followed by an axial expansion away from the summation equator toward the summation poles twice per orbit could be taken as if it were a classical (e. g., *12, 20, 6*) "zitterbewegung"-like (trembling or oscillatory movement) action of the entire particle [at twice the subsequent iteratively derived orbital frequency below (here $\sim\sqrt{3}\times 10^{21}$ from force iterations below.) Thus, all six gyres simultaneously exhibit (twice in each orbital cycle) the exact summation of the angle cosine components of their common 1/6 charge rotational velocities projected to a charge of 1 (one *q*) at a single velocity on the summation equator.

The pervasive electron structural necessity. To provide such a projected velocity of the 1/6 charge centers of the gyres, as if they sum to the charge of $q = 1$ moving at the speed of exactly *c* [required per Mac Gregor's analysis (*12*)] on the summation equator from their relative orbit angles of $\theta = \arccos 1/\sqrt{3}$, each of the 6 effective charge centers in the *GD* disks of the 3 pairs of gyres in such an electron/positron structure must orbit in its plane orthogonal to that of each other pair at the peripheral velocity $|\mathbf{V_G}| = c\sqrt{3}$, as if it is possible to do so:

$$\sum_{0}^{6} \frac{n\,q}{6}\, c\,\sqrt{3}\;\cos\arccos\frac{1}{\sqrt{3}} \;=\; c\,q \qquad (1a)$$

Such a question of classical impossibilities might be approached morphologically by rotating the three orbits into the summation equatorial plane to obtain zero crossing angles and cosines of 1 in an effective single orbit with the charge centers of all six gyres at $|\mathbf{V_G}| = c$. Then the question only changes to whether a real item of massive structure with charge could physically move the charge at *c* without any part of the 3D mass reaching that classically forbidden speed for any mass, even if the charge itself is ideally reduced to a mathematical point. Actually, the same crux of what can be real exists, not only for a six part electron structure, but even for Mac Gregor's analytic single part sphere (12) with an equatorial point charge being moved at *c* in ideal tangency on a circular one dimensional line in which no 3D part of the sphere participates, or for dimensionally similar current-constrained closed helices as electron structures (*21, 22*), and also for any electron structural system summed from two or more separately rotating components, as well as any concept of a point electron. The true problem then becomes that classical physics defined the electron out of any form of real existence under the *c* definition. In other words, the electron cannot exist as a real body unless some part of that body can with internal reference equal or exceed the classical limit on velocity, which also is not permitted. Much modernized quantum physics has avoided the issue, though numbers of individual physicists (e.g., *1-6, 9, 12, 21-39*), particularly Barut (*22*), Hestenes (2), and Mac Gregor (*12*), have tried over long careers to bring the two disciplines together on electron structure within the classical *c* limitation.

If the electron is "real" rather than a collection of ideal abstractions, and if Mac Gregor's long-extended, thorough, and repeatedly peer-reviewed analysis of the requirements for electron body and unit charge rotational velocity at exactly the relativistic limit *c* at the spheric equator is correct (*12 and its author's own journal references therein*), then there is here a necessity to take this long-lasting problem situation as evidence that nature may function as if actual charged masses, or any form of electric current carrying structure, at least within the electron/positron, do not in the mass feature (as they do not in the charge feature) have any unreal infinite singularity at *c* as the asymptoticly unachievable limit for real mass velocities. Rather, there is the positive necessity that just below and at the speed of light nature may work as if an accumulation of radiated wave effects builds up in a charged mass's vicinity to a high relative peak (such as an order or a few orders of magnitude increase in apparent mass) which requires excessive energy to break through to a higher range of real velocities and is empiricly excluded as an unstable operating condition for all natural effects except for those particular radiation waves. (For these waves, if they have mass, it is small enough to be considered subliminal in present physics practice even after augmentation at *c*.) This is a single, simplest, minimal proviso necessary for bringing the numerous interrelated electron phenomena into a unified "real" structure of any type.

Adaptive necessities. Equation coefficients of mass, momentum, or energy effects with velocity would then be stated as if they must necessarily be in the form of having an additive term, such as f(*v/c*), which steeply approaches a peak limit at *c* and drops back immediately above *c* to a continuation of a subluminal (subphotic) velocity function, of the form:

$$C_{mv} = C_{m0} [f(v) + f(v/c)], \quad (1b)$$

where f(*v*) ≅ f(*υ*) ≈ 1 very closely in the vicinity of and below *c* in Eq. 5e, and f(*v/c*) is constrained to vanish at about *c* +1 (in m/s or cm/s) and above.

Otherwise it will probably continue indefinitely to be impossible or unfeasible (e.g., *1-6, 9, 21-39*) to construct a widely acceptable and generally applicable structure for the electron as a lepton member of the structured real particles. (And the electron must continue to be a self-contradictory assortment of mathematical abstractions rather than a real physical body.) Further necessity for such a determination of some form of electron structure may be considered to be present now in the findings of non-structural electron "structure functions" in particle scattering (e. g., *7, 8, 40, etc.*) and in the real and rapidly advancing findings of entanglement (e. g., *10, 11, 41, 42, 43, etc.*) which are all electron/charge-related, such as between electron-radiated photons, "holes", qbits, etc. There are eloquent statements in the physics literature of the importance of the physical basis of the electron's behavior (e. g., *2, 20, 21, 22, 44*), among which is a cogent recent finding (*45*) of the necessity for composite structure in the light leptons, which include the electron.

Such a quantitative process at speeds above *c* as is indicated would be analogous to breaking through the speed of sound in the fluids of air and water with peak resistance coefficients arising when there is a peak in opposing force from the accumulation of energy and pressure propagating as a standing wave at the leading surface of a body (*46*).

In that sense, scaling the effects of laboratory conic gyres (if not also other types of structures) to Mac Gregor's specifications (*12*) for an electron body requires only that the electric effect waves from the gyre bases (or other constructs) occur as if their propagation, here as shear waves outside the particle, with inseparable mass effects shear waves at a different wave length, were the phenomena spreading at *c* and inhibiting by wave accumulation the more rapid passage of "matter", due here alternatively to interactions of the generalized microquantal (*15, 16*) charged mass components of the particles of matter. That type of activity should be correctably compatible at or below *c* with Newtonian mechanics, Maxwell's equations, Einsteinian relativity, and QED, since they work first (and in final predictions) from observables at $\leq c$ of long known forces and bodies whose most individually conserved feature is not so much interactively variable and apparent masses, nor entropicly dissipatible forms of energy, as it is constantly conserved electric "charge" phenomena carried with constant minimal rest masses at lowest quantal energy levels including the energy equivalent of mass (with conveniently derived empirical "magnetics" occurring only during movement and acceleration of charge.)

Thus, for a valid thought experiment on electron/positron spheric structure composed of vortices, the active charge part of each vortex must move in orbit well above *c* in internal reference, and the only structural parts permitted to move at that velocity (at a necessary smaller radius) must be protected within the overall superphotic structure where they cannot accumulate an energetic exterior standing wave of any kind. Consequently, if no exposed parts of the structure are operating at or near *c*, it is not necessary to know the incomplete term in Equ. 1b.

Operating as if moving at √3 times *c* as vortical collections of turbulent shearing currents within electrons would unavoidably include a pressure wave component with its own speed of entanglement communication above *c* (e. g., *10, 11, 41, 42, 43*) in spreading wave force effects that, because of their speed of passage, are otherwise undetectable directly in present everyday science (*47*). (Herein, the shear and pressure wave forces are included later in the scalable net mutual force between gyres.)

Such a potentially correctable structure of vortical waves and currents could also clarify and provide testable features, not only for entanglement reactions, but also in relation to particle "structure functions", double slit particle interference experiments, and other characterizations of particles as waves, among the dilemmas of the present view of nature (e. g*., 2, 3, 4-9, 20-39, etc.)* with many divergent and fragmentary concepts of the possible structure and compositeness of the electron and its family of leptons.

Interactively enlarged mass of particles. Empirical increase of mass by interaction of components within the hadron class of largest particles is well known in the PDG (*l8*) tables of data on the nominal current or running masses of the various quarks/antiquarks m_q and the orders-of-magnitude greater composite masses of the typical hadronic particles m_p that two or three N_q quarks/antiquarks compose. This is especially clear when these composite hadron masses are analyzed by inverting an empiricly derived exponential equation (Eq. 1 in *15*) as:

$$m_p = N_q^y \sum m_q \, , \qquad (2)$$

where y asymptoticly approaches 5 (from $<<1$) with decreasing $\sum m_q$ due to combinations of 2 or 3 of the very lightest mass quarks/antiquarks in their wide range of masses. This is still more informative (*15, 16*) when this basic equation (with a minimal new empirical correction factor for the net charge of pairs of components) is applied to the number N_c of the many-orders-of-magnitude lighter and uniformly standardized, microquantally 1/6 charged components m_u (10.9525 eV mass) as if they interactively compose increased composite masses m_p of the leptonic (electron, etc.) and quark (LQ) particles (which consequently become very regular and systematic (*15, 16*)). For this further application, $\sum m_q$ of variable quark component masses becomes the equivalent sum of the variable number of fixed mass components ($N_c\, m_u$), and y is quantized exactly at the low mass asymptote of 5, in what thus becomes a further derived power law [from Eqs. 2 and 3 in (*15*) which lead by collection of terms to the reference's less explanatory, but simpler Eq. 6 (*17*)]:

$$m_p = N_c^5 \left(N_c m_u\right) \left[(n_\pm/n) + (n_0/na)\right] , \qquad (3a)$$

or per Eq. 1, $$m_p = N_c^5 \left(N_c m_u\right) \left[(n_\pm/n) + (n_0/na)\right] C_{mv}, \qquad (3b)$$

where $n_\pm$ is the number of + or − charged pairs of components (as with the 3 negatively charged pairs of gyres in the electron), n_0 is the number of neutral pairs of components (zero in the electron/positron, so that the new factor in brackets equals 1 here), $n = N_c/2 = n_\pm + n_0$ is the total number of pairs of components, and $a = 3^x$, where the exponent x is 1 in the usual range of LQ particles (*15*) (or 2... for extreme cases such as astrophysical neutrinos, etc.) This independently derived equation predicts that the mass contribution of a pair of components (vortices herein) to the interactive mass increase within a usual LQ particle, such as an electron/positron or a quark/antiquark, depends by a factor of 3 on whether the gyre components in the pair are of the same charge and thus co-rotating, as in all three pairs of the electron, or of self-neutralizing opposite charges and thus contra-rotating, as they would necessarily be (*15, 16*) in many pairs of heavier but less charged quarks (when such structures are extended to those particles.)

Thus, the general factor of 3 greater contribution of increased mass from a charged pair of components in a particle arose independently, and acts in the present paired vortices as if it takes effect through the large viscous shear interaction between opposing toroidal ring components of the common inward currents at the center of a pair of co-rotating PI gyres on a co-axis (Fig. 3E), versus the lower shear between more closely co-directional currents at the pair center with two contra-rotating PI gyres on a co-axis. This added viscous shear between the co-rotating pair would generate eddies in addition to those observed (*13*) circulating in isolated vortices from the turbulently sheared spiral wave disks within the *GD*. Eddies and shear currents thus appear to be parts of the gyre that act as if contributing to creating mass, evidently by a quantized factor of 3 more for the co-rotating pair with the large adjacent areas of higher shear, opposed toroid currents than for the contra-rotating pair. In the presence of 4 or more other vortices in LQ particles, this same quantized level of the one pair's shear factor would evidently appear from the general LQ mass/charge Eq. 3 as if that level of shear is redistributed in accordance with other shear conditions among any additional current contacts with other pairs (Fig. 4E) (which in any cohesively compact particle would intrude around and partially within the axial volume between the two members of a pair.)

Since the first generation of observed eddies *E* created and distributed by the spiral wave disk shear processes S_i at the base of an isolated conic vortex (*13*) (Figs. 3A and B) are seen to circulate around the gyre in the outer toroidal currents to be disrupted and disappear in the main axial inflow processes *D* (largely at the conic point), the concentration of eddies C_E present within a vortex for mass generation is a vortex equilibrium function analogous to a chemical reaction equilibrium in reaction kinetics with characteristic rates of first generation k_S and absorption k_D, so that $S\ k_S \rightarrow C_E \rightarrow D\ k_D$. Insertion of the isolated vortex into a set of six (Fig. 4E) adds a shear source of eddies between multiple toroidal flows with a different input rate in the volume of each vortex as:

$$(S_1\ k_{S1} + S_2\ k_{S2}) \rightarrow C_E \rightarrow D\ k_D\ , \qquad (4)$$

and a higher equilibrium concentration of first generation eddies results.

But first generation eddies disappear by disruption k_D in the central axial inflow currents of each vortex (*13*) so that they cannot appear in a large part of the volume of each gyre or of the whole particle; and according to Mac Gregor's analysis, mass must be evenly distributed throughout the electron. Further, the estimated number of first generation eddy currents can fit only the linear one of three mass factors in the equation (Eq. 3). Thus eddies alone could not reasonably be more than a fractional factor in LQ mass increase over the mass of the number of components in the general Eq. 3, where that mass is multiplied by the term N_c^5, which by collection of terms (*17*) becomes N_c^6 times the mass of one component vortex, or up by 4 orders of magnitude in the electron. This requires an element in each component (or "as if" vortex) that interacts completely throughout all the components in the electron's set of 6. (Since the exponent does not increase with larger N_c, the quantized exponent of 6 describes the effective distributed completeness of interaction with larger numbers of components.)

The element in the vortex structural formation which would meet this penetration specification for a mass factor is the observed (*13*) vibratory component of the turbulent spinning current (that acts as if it generates the electric force) from the spiral waves within the base *GD* (which is also the observed source of the few eddies in an isolated vortex.) At each separate phase of the multiply interfering vibration cycles from each small area in the spiral wave disk, the mixed pressure and shear waves of the vibratory component of the turbulent spinning force dispersed outward in charge effects over a wide angle from the *GD* in a turbulent vortex necessarily has a reactive equal and opposite vibratory force that is expressed in penetrating waves inward throughout the vortex and anything immediately surrounding it, such as the rest of the electron (Fig. 4E).

From the multiplying of the two factors in the independently derived LQ mass Eq. 3, and from the relatively similar scales of each small vibration area in the spiral wave turbulence and the core circulations of the low velocity eddies in a typical vortex, the inward vibratory forces from the spiral wave disk must function as if they are resonantly absorbed by the initial eddies, which are then turbulently disturbed by the absorbed energy into a large resultant number of very small or fractal additional eddy shear circulations that would have a different resonance due to their smaller wavelength scale. Such eddies are small enough and evidently intense enough (from their dual energy inputs) that they would be carried along by the main vortex intake currents rather than being disrupted, so that the smallest chaotic eddies necessarily permeate the entire vortex system. Such a widely distributed disturbed body of small circulations at different individual velocities from the larger eddies would then necessarily generate irregularly shaped waves, with harmonic components that penetrate, and are swept along to a degree by, all currents and other larger scale waves within the electron structure at cross-penetrating velocities. (Such shorter wavelength waves might also increase by resonant non-linear triggering of marginally unstable small volumes of sheared currents throughout the particle in a maser-like process.) These smaller waves would also tend fractionally to sweep the larger waves and currents along, very much like the cross-coupling of capillary wind waves into larger waves in water. This aspect of the waves must also necessarily have the effect of coupling each overall vortex and particle more closely to its surroundings and medium [a possible element of Machian inertia (6).]

It is such a concentration of smallest penetrating shear waves (arising in accordance with the non-linear product of the two Eq. 3 factors and beyond the scope of their larger sources in flow currents) which can act as if it constitutes the internal composite "mass" energy of the particle in accordance with Eq. 3, as if the smaller mass of the initial isolated vortex must consist of a similar small set of waves. Such waves could also generate (within the particle boundary with the exterior medium) and propagate outward from the particle, at a very low level and narrowly limited velocity (such as *c*), a separate class of interpenetrating circulatory shear waves such as would transmit the effects of the initial spinning and vibratory currents when the wave interacts with other waves. These waves would be capable of forcibly interacting through resonance with other similar smallest eddy circulations wherever they are located. This would include any eddies generated by spinning shears of electric scale waves compressed immediately around the particle due to particle velocity approaching *c*. Such very low level force coupling mechanisms, similar at small scale to those observed in the lab (*13, 14*) only at higher levels and larger scales equivalent to electric (and stronger) forces within symmetric pairs of vortices, would comply with predictive Eq. 3 (*15, 16*) for a single inertial and gravitational mass further generated by interactions of numbers of components which are closely bound into LQ sets, such as the basic electron (and subsequently into hadronic groups of sets), as if by a stronger range of wave and current coupling forces of vortices. Mass effectively becomes the least organized or lowest level reservoir of rotational energy within a particle at an isolated short resonant wave length of relatively broad band (low Q). Orbiting turbulent vortical shearing currents and waves at $\sqrt{3} \times c$ within electrons unavoidably, wherever current stagnations occur, causes pressure wave components (*47*) with a yet higher speed of entangling propagation in effects (e. g., *10, 11, 41, 42, 43*) that are not directly observable. (Shear and pressure wave and current forces herein combine in scalable net local mutual forces between gyres.)

General sub-summary. With this, the essential features of the discrete electron particle act as if they become fundamentally an organized set of circulatory currents and waves (amenable to many prior flow and wave equations) as generated by forcefully driven currents in turbulent conic vortices (*47*), of which initial empirical characterization has been carried out separately (*13, 14*) and is applied quantitatively here in Eqs. 5-17 on scaled particle size and forces. However, Eqs. 2 and 3, including their various related forms (*15, 16*), remain the quantitative statement of particle mass as just described.

These general features, then, as if some of them were not presently considered forbidden, characterize the spheric structure to be scaled, quantified, and balanced in its forces within the electron/positron to approximate Mac Gregor's analysis (*12*) of requirements for the particles' empirical and quantum mechanical functions. Such a structure of vortical wave and current forces would be (and has been) testable for its presence, not only in types of entanglements and electron "structure functions", but also in double slit particle-wave interference, and related dilemmas (e. g.*, 2, 3, 4-9, 20-39).* The more specific gyre factors of size, spacing, internal velocities, and forces are recursively interlinked, and their subject order of discussion herein after convergent iterations is not entirely sequential.

Scaling specific vortex velocities. If the velocity of each gyre in its orbit $|\mathbf{V_g}|$ is necessarily as if greater than c, then too the velocity of currents and waves in the gyre must be enough greater than $\mathbf{V_g}$ for the vortex to maintain its integrity in its major vortical parts as if $\mathbf{V_g}$ is relatively standing still. This will insure that the side of the gyre which is spinning in the $\mathbf{V_g}$ direction will be moving only negligibly faster than the opposite side, so that the gyre will not be unbalanced by its orbital movement. In addition, the mutual forces between gyres and the self force that provides the centripetal force to balance the inertially effective centrifugal tendencies in the orbits are functions of spinning velocity in the gyre, specificly the peripheral velocity $\mathbf{V_p}$ for the scaled vortex internal velocity contour equivalent to the fluid boundary layer at the edge of the base of the lab drive cone with the $\beta = \pi/6$ (30°) whole cone angle. As will be seen later in force scaling, an iterated convergent balance of forces is found as if the scaled velocity $|\mathbf{V_p}|$ is at $c^{1.5}$. The other scaled velocities in the gyre then maintain the same ratio to $\mathbf{V_p}$ as measured in the lab (*13, 14*). [This does not apply strictly to the much smaller froth-like eddies fragmentarily observed in the lab, as generated by vibratory disturbances of the first generation gyre eddies and other shears, and correlated at scale herein with mass effects. The shear waves of these tiniest frothy eddies are estimated to scale in the electron particle as if acting at $\approx c$ (with shear wave radiations from the sphere at c) and are therefore just beyond direct observation in particles generally.] A higher necessary velocity range also arises later.

Structural size scaling. While the original equation (Eq. 5) for the size reference length *GD* in the lab vortex data was directly applicable over the 10^6 larger macroscopic scaling to correlated observables of tornado, storm supercell, and hurricane vortices (*13, 14*), it requires broader generalization to scale the lab data in convergent iterations to some prior unknowns as if vortices do occur at the 10^{-12} smaller scale in subatomic particles. Most lab data was taken at *GD* = 20.3 cm (Fig. 5), around which it varied as (from Fig. 1a and Eq. 1 in *14*):

$$GD = d_c \left[1 + e \left(\frac{\rho}{\eta} \right)^{0.6667} V^{A\sqrt{V}} \right], \qquad (5)$$

where d_c is the drive cone base diameter in cm, $V = |\mathbf{V_p}|/1000$ with the peripheral velocity of the drive cone base $\mathbf{V_p}$ measured in cm s^{-1}, the coefficient *e* is the base of natural logarithms, and $A = (2\,A_b + A_s)/100$ with the two drive cone surface areas in cm^2. (Kilometer scale units are used for *A* and d_c, but not for $\mathbf{V_p}$, in scaling large storms.) The area of the cone base A_b in cm^2 is given twice the weight of the area A_s of the sides because of the higher turbulence and peak velocity in the spiral wave disk of centrifugal flow off the base which is the principal turbulent determinant of *GD*. (Note *V*, as a square root, in its own exponent at the lab scale; this is a recurrent empirical equation form for these gyres.)

Except when briefly varied in the lab over a range of 4 to 1 to find its exponent, the kinematic viscosity ratio of fluid density ρ in gm cm^{-3} to viscosity η in centipoise cp was very close to 1 for vortex data in the lowest molecular weight and simplest experimental liquid, cool water (*13, 14*). From that trend with fluid simplicity, and in scaling to a vacuum state within particles as if with a simplest implied nominal vacuum fluid, the fluid must also be defined for scaling with a balanced mean ratio of $\rho / \eta \cong 1$.

For the range from the lab data through the subatomic particles, as noted above, the exponent of V in Eq. 5 is generalized to:

$$C_{AV} \ A^{QA} \ V^{QV} = A\sqrt{V} \text{ (at lab to weather scale, } GD \geq 5 \text{ cm)} , \qquad (5a)$$

where: $$C_{AV} = 1+ \left[\{\log (Q_A)^3/(f(\upsilon))^{0.00889}\} - 0.097315715\right]^3, \qquad (5b)$$

$$QA = Q_A = \left[1 - [(\log V) / \{1.4002\ \pi^3\ (f(\upsilon))^{0.015}\}]\ \right]^2, \qquad (5c)$$

$$QV = Q_v = \left[0.5 - [(\log A)/\{2e^3(|\log||\log V|)^{1.3366}\}]\right]\left[2 - \{f(\upsilon)\}^{0.0122}\right]^{1.0001}, \qquad (5d)$$

and: $$f(\upsilon) = \exp (\chi^{\psi}), \qquad (5e)$$

where $\psi = \pi^{\pi}$, $\chi = \upsilon/e$, and υ is the exponent in $|\mathbf{V_p}| = c^{\upsilon}$ ($0 < \upsilon \rightarrow 3.3+$). The effect of the last factor in Eq. 5d vanishes toward 1 at $|\mathbf{V_p}| << c^{2.5}$, but is active above that. The net effect of Eqs. 5c and 5d at $|\mathbf{V_p}| = c^{1.5}$ is that the base factors A and V (in the exponent of V in Eq. 5) exchange their exponents over the 10^{-12} interval from the lab scale, but Eq. 5c at Q_A = 0.500008921 determines 5b at $c^{1.5}$. At $>c^2$, Eqs. 5a-d are active.

Initial force balance and scale estimate. There is an estimated range of effectively non-dimensional ratios between gyre size and particle size (in generalized *GD* units) for which the scalable mutual and self gyre forces (Figs. 7 to 9) (*13, 14*) should neither implode nor explode the particle, but instead can adjust a balance of the larger self force against the inertial equivalent of centrifugal force in gyre orbits at $\mathbf{V_g}$. Since (Figs. 1 and 4) the 6 vortices pass through symmetric relative axial angles $\alpha = \pi/2$ (90°) with each other every quarter cycle, approach and recede from the symmetric α limits of $\geq\pi/3$ (60°) and $\leq 2\pi/3$ (120°) every alternate eighth cycle, and are constantly at coaxial π (180°) from their pair partners, the ratios of lab vortex repulsive mutual forces ($\mathbf{F_M}$) in co-rotation at these four symmetric relative angles (Fig. 9) can be used to estimate the feasible ranges of gyre *GD* to particle size ratios for further study. For this the force is summed as approximate averages for each of the two repeated arc octant states of relative angles in a cycle and averaged, as projected outward on the radius [$C_{FM} = \cos(\pi\text{-}\alpha)/2$], at the various *GD* distances (*R*) in the sphere ($\mathbf{F}_{MRGD}$) between vortex cone centroids of volume (CV) for a *GD* scaled particle radius. The averaged sum is also weighted by the number (M_{ovo}= 1, 2, or 4) of other-vortex-octants with which the force is generated at each angle per repeated quarter cycle, and is then compared as an $\mathbf{F_M}_{\text{ave}}$ with the scalably constant (at fixed $\mathbf{V_P}$) axial self force (Fig.7) of point thrust (**PT**) inward on the radius (*13, 14*). This will estimate whether the average total mutual forces of a configuration can be in a feasible range of between 0.2 and 0.7 |**PT**| for fine adjustment of its balance with the inertial equivalent of centrifugal force in the gyre orbits:

$$\frac{\sum_{1}^{2}{}_{\text{arc octants}}\sum_{1}^{4}{}_{\alpha\text{ states}} |\mathbf{F}_{MRGD}| C_{FM}\ M_{ovo}}{2} = |\mathbf{F}_{\mathbf{M}\text{ave}}| \qquad (6a)$$

$$[|\mathbf{F}_{\mathbf{M}\text{ave}}| \ / \ |\mathbf{PT}|] \cong 0.45 \pm 0.25 \ . \qquad (6b)$$

This criterion indicates that a 1.375/1 ratio to the uniform vortex *GD* for the particle radius at the equivalent 30 degree drive cone CV (from which mutual forces are measured) (*14*) is in the feasible range and is also the smallest and most compact feasible size ratio (Fig.6) that permits gyre core circulations to clear each other sufficiently at the $\alpha = \pi/3$ (60°) closest angular approach. This estimate survives the subsequent iterations. [The more flexible outer portions of the side toroids will be about 40% distorted in the cross section of this closest angular approach, at which the tips of the outer smoothed spiral waves will just touch at the 2*GD* diameter where they are observed in the lab (*13*) to finish subsiding from the turbulence boundary at the *GD* and merge to circularly spreading ripples (Fig. 3A).]

One quadrant of the scaled (*13*) particle cross section in the Fig. 1, step 1 position, at a radius of 1.375 GD units to the equivalent cone CV (Fig. 6), shows the centroid of the turbulent GD disk which functions as if it is generating the electric charge (and is the initial source of mass effects in the individual vortex) at a 1.6875 *GD* radius (calculated empiricly from the smoothed mean lab data geometry.) This particle ratio radius then equates to the Mac Gregor electron radius (*12*) of 6.6962×10^{-11} cm. Thus, a scaled

$GD = 3.9681185 \times 10^{-11}$ cm is established as an initial scaling iteration reference for determining balanced unknowns. From these constraints the scaling iterations are convergently finalized to find a force balance at $|\mathbf{V_p}| = c^{1.5}$. The scaled equivalent cone base diameter (Eq. 5) evolves to $d_c = 1.5872474 \times 10^{-11}$ cm, which determines the scaled components of $A = (2 A_b + A_s)/100$ in the $\pi/6$ (30°) β (whole cone angle) right circular cone in that equation. This enables scaling of balanced forces between the 6 vortices proportioned at 1.375 *GD* (radius to gyre drive cone CVs) of the electron particle at the Mac Gregor radius size (Fig.6).

Scaling self force. The empirical Eq. 7 derived to express the lab data in general form defines the axial self force (Fig. 7) of a conic vortex as point thrust **PT** in grams (from Eq. 2 and Fig. 3 of Ref. 14):

$$|\mathbf{PT}| = \frac{\sin\beta}{10\,\pi}\left(\frac{\rho}{\eta}\right)^{0.25} |\mathbf{V_p}|^{1.525}\,\frac{A_s}{9.807\times 10^2}, \quad (7)$$

where β is the whole cone angle, ρ and η are fluid density in gm cc^{-1} and viscosity in cp respectively, $\mathbf{V_p}$ is the peripheral velocity of the cone base in cm s^{-1}, and A_s is the area of the sides of the cone in cm^2. The number 9.807×10^2 is the conversion factor from dynes force to grams force (for lab convenience.) In immersed vortices **|PT|** is much larger than other forces generated by the vortices in the lab (*13, 14*) at the scaled vortex separations maintained by the force balances in the electron (not at some other minimal separations); and in scaling, the cohesive inward orientation of **PT** in the electron/positron continues to dominate individual forces within the particle. This conic vortex self propelling force is a jet reaction force toward the cone point from axial intakes of fluid at low velocity and peripheral ejection of the fluid at a factor ~10 higher velocity with baseward angle components (Fig. 3B) between arctan 1/4 (14°) and $\pi/6$ (30°) from the perpendicular to the axis (*13, 14*). The original equation for this force needs no further generalization.

Duplicating gyres and forces with different drive cones. The Eq. 7 and its graph (Fig. 7) effectively show that the viscous boundary layer of a 30 degree cone (*14*) may exactly model generation of the axial **PT** force exhibited by a 20 degree cone (that will nest within the 30 cone) rotating at a much higher peripheral velocity, and that the larger cone does so at the peripheral velocity at which it also exhibits the *GD* (Fig. 5) (Eqs. 5 and 5a) of the smaller, faster rotating cone, as well as matching the other gyre forces produced by that cone (*13, 14*). Thus the sum of all forces $\sum \mathbf{F}_{30} = \sum \mathbf{F}_{20}$ at these relative conditions. The overall fluid vortex is then effectively the same for both drive cone conditions, and matching a single force or the *GD* is sufficient for equivalence. (This is a general reciprocal modeling relation to be further applied in the electron after the scaling of other forces.)

Scaling mutual forces between symmetric conic vortices. The two curves of Fig. 8 for co- and contra-rotating gyre pairs are produced by subsequent Eq. 12, which is the general lab mean of a variable f(*R*) coefficient to be determined (TBD) for Eq. 8. This coefficient thus provides an approximate mean dual curve shape for Eq. 8 by controlling a sliding scale of adjusted *GD* shift (*GDS*) units for radial (R) distance between CVs of any two symmetric gyres in quantifying lab scale mutual force with many variables at any vortex scale (Figs. 9 and 10 from Figs. 7 and 8 in Ref. *14*). (The electron or positron uses internally only the central portion of the upper co-rotation curve. All of both curves may be used as an electron interacts with other particles, or inside other particles composed of similar vortical components in accordance with general Eq. 3.) But the coefficient that generates the curves is used only with modifying factors, and it is but one of two variable coefficients affecting radial mutual force $\mathbf{F_M}$ in grams for the lab data in both the original and the now generalized Eq. 8 (from Eq. 4 in Ref. *14*):

$$|\mathbf{F_M}| = \frac{1}{2}\ \frac{\rho}{\eta}\ \frac{A_s\ \sin\beta}{9.807\times10^2}\ |\mathbf{V_p}|\left[\frac{|\mathbf{V_p}|^{0.525}}{\pi^{\pi}}\right]^{ut} f(\alpha)_{TBD}\ \ f(R)_{TBD}\ , \quad (8)$$

where $u=(1-1/z^8)$, $t=1+[(6/z^{0.45})(ev/e^v)]$, $v=(z-1)/(z^{0.667}-0.6)$, $z=|\mathbf{V_p}|/800$, and $z'=[3/(0.5z+1/z+1/1.5z+5.703/z^{16})^{-0.5}]+\log\log z$, with the last term being the effective value at high z as z is generalized to z' in scaling the following functional coefficient equations for f(α) and f(R) down to the electron size. These coefficients are to be chosen from the necessary equations below by known rules (Table 1 of Ref. *14*), which are much simplified in the electron/positron by its unique (among all particles) lack of any oppositely charged (here contra-rotating) components (*15, 16*). The other variables and coefficients have been defined previously. The now generalized forms yield the lab equations closely at z=1, an average reference lab condition for most immersed vortex data, where the exponent ut = 0 (Eq. 8).

A basic f(α) functional coefficient (from Eq. 7 of Ref. *14*), which effectively changes the vertical scale of Fig. 8, approximates the empirical data for immersed vortices in same rotation, at relative axial angle α between $+\pi$ and $-\pi$, and has further adaptations for the effects of $\mathbf{V_p}$ in later Eqs. 10a-b, etc., for different zones of relative angle variation:

$$f_H(\alpha) = 1 - \frac{1}{17} \tan \frac{4}{9}\alpha \ . \qquad (9)$$

This equation applies fully only to the range of $+5\pi/6$ to $+\pi$ (+150 to +180°) of PI relative axial angles. For $+\pi/2$ (+90°) it must be adapted for $\mathbf{V_p}$ effects, as (from Eq. 9 in Ref. *14*) with z' for scaling here:

$$f_{HV1}(\alpha) = f_H(\alpha) \frac{1}{\left(\frac{3z' - 0.75}{2} + 1 \right)} \ . \qquad (10a)$$

That equation should be slightly modified for most remaining gaps in the range of α, as (from Eq. 9b in Ref. *14*):

$$f_{HV2}(\alpha) = f_H(\alpha) \frac{1}{\left(\frac{3z' - 0.75}{6} + 1 \right)} \ . \qquad (10b)$$

However, near $+\pi/3$ (+60°) α and below that angle a different coefficient must be applied as (from Eq. 13 in Ref. *14*):

$$f_B(\alpha) = 1 + [2ye/(e^y)] - 2.5 \sin (|\alpha|/9) \qquad (11)$$

where y = $|\alpha|/(\pi/6)$, and e is the base of natural logarithms.

The general Eq. 12, for variation of effects (Fig. 8) on mutual force from separation in *GD* units of CVs of two symmetric gyres, f(R) in Eq. 8 must account for the lab reversal of mutual force directions in co-rotation as R approaches zero in the upper curve (which does not occur inside the electron) as well as the continuing attraction from contra-rotation (as if between the gyres of electrons and positrons) in the lower curve (from Eq. 15a/b in Ref. *14*):

$$f_R(R) = \left(\frac{1}{2} + \frac{H}{2} - \frac{16}{(1+3R)^2}\right) \left(\frac{1}{(1+R)^{R-1}}\right) + \left(\frac{H}{(1+R^2)}\right), \qquad (12)$$

wherein $H = +1$ for same rotation (co-rotation) on the upper curve as if within either the electron or positron. This general coefficient equation must also be computed with additional internal factors to modify R adaptively, as $R_{i,j,k,l} = RC_i\, C_j\, C_k\, C_l$, where the basic real R is read in the actual *GD* units for the measured data or for a selected real value before *GD* shift in this equation. Here C_i, C_j, etc., are each equal either to 1 (one) or to any coefficient equation listed later as applicable to the case in question, where they have the GDS effect of either shrinking or stretching the scale of R (Fig. 8) horizontally in *GD* units from the actual case for a corrected calculation of $|\mathbf{F_M}|$.

The first of these adaptation coefficients for use in Eq. 12 is an additional variable factor for $\mathbf{V_p}$ for all cases, generalized (from Eq. 16 in Ref. *14*) as:

$$C_V = z'^{\,z'} \quad . \qquad (13)$$

For +π (+180°) α in same rotation of immersed vortices in scaling the electron, the adaptation for $\mathbf{V_P}$ includes the z' velocity ratio as (Eq. 21 in Ref. *14*):

$$C_{3l1} = 1\,/(3\sin\beta)^{3\log z'} \quad . \qquad (14)$$

A small change of that z' exponent is needed from − 5π/6 to +5π/6 (−to + 150°) (Eq. 22 in Ref. *14*):

$$C_{3l3} = 1\,/(3\sin\beta)^{3\log 3z'}, \qquad (15)$$

which is used by itself only for − π (−180°), but combines for the broader range of angles with (Eq. 23 in Ref. *14*):

$$C_T = \frac{1}{1 - \dfrac{2}{3\,\pi^2}\,\tan^2 0.485\,\alpha} \quad . \qquad (16)$$

For a more accurately scaled balance of forces in the electron than first forecast in Eq. 6, the same two summations of $\mathbf{F_M}$ are employed as there with the following α state inputs to Eq. 8, (from Table 1, Ref.14) :

For an α octant arc around +π/3 (+60°), Eqs. 10b, 11, 12, 13, and 16.

For the α octant arc around +π/2 (+90°), Eqs. 10a, 12, 13, 15, and 16.

For the α arc around +2π/3 (+120°), Eqs. 10b, 12, 13, 15, and 16.

For the +π (+180°) point, Eqs. 9, 12, 13, and 14.

Then for any gyre, $+\mathbf{F_{M}}_{ave}$ is an approximate average (at δα steps) of iterated summed repulsive mutual force (Eq. 6a), to which the + pseudo-centrifugal force $\mathbf{F_{cf}}$ at $\mathbf{V_g}$ below is added for balance (Eq. 6b) with the radial inward −**PT** at |$\mathbf{V_P}$| for the gyre. At the feasible particle radius to gyre *GD* ratio, d_c, |$\mathbf{V_P}$|, |$\mathbf{F_M}$|, |**PT**|, and *GD* are iterated in this way, starting with trial d_c and |$\mathbf{V_P}$|. As before in Eq. 6, the π (180°) point occurs with one other vortex (once) in each of the two repeating octant states; π/2 (90°) occurs four times per orbit cycle in one octant; and both π/3 (60°) and 2π/3 (120°) occur twice each per orbit cycle together in the other repeating octant (*46*). After dividing by 2 for the approximate average summed repulsive mutual force $\mathbf{F_M}_{\text{ave}}$ projected outward (+) as in Eq. 6 discussion on the internal particle radius of each vortex, the individual gyre's inertial equivalent to + centrifugal force $\mathbf{F_{cf}}$ at $\mathbf{V_g}$ is added for comparative balance with the constant radial inward (−) oriented **PT** at |$\mathbf{V_P}$| = $c^{1.5}$ for each gyre. [Since the gyre current speeds and forces function as if they travel internally at ≥|$\mathbf{V_P}$|, four orders of magnitude higher speed than |$\mathbf{V_g}$|, questions of relativistic and wave doppler effects on internal forces are neglectable.]

Mass considerations. The mass of a single gyre is involved in the pseudo-centrifugal force $\mathbf{F_{cf}}$ at |$\mathbf{V_g}$| = $c\sqrt{3}$. Per Eq. 1, even at $c^{1.5}$, f(υ) (Eq. 5e) is only 1.00000004; it is clearly negligible at |$\mathbf{V_g}$|. With a single gyre, only the definition of m_u of Eq. 3 applies. Thus, since "mass" waves act as if largely passing through other waves and currents, only the 10.9525 eV mass (converted to grams) of each isolated vortex is rotating for $\mathbf{F_{cf}}$ at $\mathbf{V_g}$ at a mean radius (Fig. 6) between the gyre's circulation equivalent to the lab drive cone CV and the prior (*12*) particle radius at the CV of the spiral *GD* disk, or 1.53125 *GD*.

Iteratively convergent balances of internal forces and size. Iterations were cut off with forces balanced (Eqs. 6a, 8, etc.) within 1.2% of either side and slowly converging to: $\mathbf{F}_{\mathbf{M}\text{ave}} + \mathbf{F}_{\mathbf{cf}} = -\,\mathbf{PT}$. These strongest available individual gyre forces (Figs. 7 and 9) and lateral projections of mutual forces are those which hold the orthogonal orbits of the vortices in rigidly steady relative positions similarly to the general action of the strong force (*49*) in holding together the similarly exceptionally stable proton (*18*). At this point, 77% of **PT** of −1.126206 dynes force due to $\mathbf{V}_\mathbf{p}$ (Eq. 7) in each vortex supplies centripetal force to hold the original uniform mass of the isolated gyre in its orbit at $\mathbf{V}_\mathbf{g}$, while the remaining 23% balances with the summed $+\mathbf{F}_{\mathbf{M}\text{ave}}$ repulsive radial components of $+\alpha$ PI mutual forces on that gyre. Since "mass" waves were noted earlier to act as if largely passing through other waves and currents, only the isolated 10.9525 eV mass (converted to grams) of each separate component vortex is rotating at $\mathbf{V}_\mathbf{g}$ at a radius for that mass of each single vortex at the mean between the location (Fig. 6) of the gyre's circulating current equivalent to the lab drive cone CV and the Mac Gregor radius of the particle at the centroid of the turbulent spiral wave disk. For the same reason of interpenetration of "mass" waves, the N_c^6 enlarged mass of the entire electron over that of one vortex acts as if it is evenly dispersed throughout the entire radiused volume of the particle and is fractionally swept along by the gyres into rotation around the summation axis as if it were on average equivalent to the cylindric integration rotational velocities of Mac Gregor's sphere (*12*), asymptoticly reaching the relativistic limit at the massless one dimensional circular line of the equator. As distinct from the shielded internal body of each vortex moving at a fraction of $\mathbf{V_g}$ within the particle, when the entire particle is accelerated to near *c* by external forces, this total interactively enlarged mass of the whole particle does participate in the further relativisticly enlarged accumulation of wave energy as equivalent mass in standing waves around the particle. This internal mass of concentrated shear waves at a very short wavelength acts as if it is held within the rigid sphere of stabilized orbits of the GD disks of the vortices, since that is where the wave mass is continuously created from other concentrated higher speed actions, while in a smoothed cycle average for the particle a portion of the wave energy propagates outward beyond the particle perimeter at a naturally much reduced speed for viscous shear waves which are not directly driven by faster parts of the gyre. The total, as if observably photic in speed, mass wave energy in the particle is that portion of the unobservable superluminal eddy and other shear current energies in the vortex which acts as if it is triggered nonlinearly into the lower speed observable dispersions of mass effects by the vibratory wave interaction. The unobservable, superphoticly spinning energy reservoir in the core of each individual gyre functions as if continuing inexhaustibly.

At the final iteratively computed $|\mathbf{V_P}| = c^{1.5}$ cut-off conditions of this slowly converging internal electron force balance, as if it were structured from 6 of the vortices described by Eqs. 1 to 17, the uniform computed (Eq. 5) vortex *GD* = 3.968625094 × 10^{-11} cm, with a scaling deviation of 0.0128% above the exact *GD* equation error reference for the set of 6 gyres (spaced at 1.375 *GD* radius to CVs) to form a sphere (Fig. 6) with charge centers at the Mac Gregor electron radius (*12*) of 6.6962 × 10^{-11} cm to yield electron properties at *c* on a spin equator. Each gyre has its $|\mathbf{V_P}|$ current contour at d_c = 1.5872474 × 10^{-11} cm.

Balance of lateral forces. There is an additional balance of mutual force components between the gyres, adding lateral forces $\mathbf{F_L}$ perpendicular to $\mathbf{F_M}$ in the plane of the axes of two symmetric gyres, and similar perpendicular forces $\mathbf{F_P}$ out of that plane (Fig. 11). The two additional forces were of the same range as $\mathbf{F_M}$, but were not sufficiently constrained within the scope of the lab data to derive a separate series of Eq. 8 coefficients, and could only be estimated by data curve extrapolations for scaling. However, due to the symmetries of the gyre revolutions, the estimate error components of these three forces cancel out over a cycle, so that within the octant-by-octant average coarse summation (as in Eq. 6) (neglecting any internal relativistic and doppler effects), mutual forces projected perpendicular to orbits balance to maintain orbit relative spacings and mutual forces tangentially projected in aid of gyre rotation balance those opposing rotation. By this estimate the gyres appear to revolve in their orbits as if from an original source of angular momentum. Evidently any losses in orbital momentum are relatively low. Maintaining charge, mass, and entanglement radiations, including the charge generation of magnetics, must be driven largely as if from the primary vortex spinning.

Scaling mutual forces between two electrons. The averaged summation of scaled mutual forces between individual vortices during cycle arc octants within the electron (as in Eq. 6a) can be repeated in the geometry between the gyres of two separate electron/positron particles with some relative orbital phasing assignments. The relevant "electric" forces, while generated on the same scaled basis between every two gyres with opposed bases, only propagate outside each electron boundary as if in naturally reduced velocity shear waves at *c*, and relativistic effects of relative particle velocity are necessary unless the forces between two electrons are averaged at successive static rests with respect to each other, as if at the instants of removing an ideal electrostatic screen from between them. The scaling and summing will necessarily result in lower mutual forces $\mathbf{F_M}$ per gyre-to-gyre interaction at the same separations due to the lower $-\alpha$ BI (Fig. 2A) average forces (Fig. 10) at various $-\alpha$ which occur than at the equivalent $+\alpha$ (Fig. 9) conditions. However, average external force summations on a entire particle may be in the same range as internal forces on a single gyre or higher due to the larger average number of external gyre interactions involved and/or to the fact that gyres may come into very short separations R or actual contact due to the attraction of opposite charge or due to being accelerated together with sufficient energy to overcome repulsion. In those two cases the extremely strong attraction forces (Fig. 10) at very short range must result in contact, in overcoming **PT** (Fig. 7), and in disruption (or "annihilation") of both particles (to be separately reported in connection with extension of vortices to other particles.)

Possibly the simplest arrangement for summing the gyre-to-gyre forces between two electrons by scaling from the empirical equations (8 to 17) is to bring into mirror symmetry the instantaneous gyre locations over a repeating half cycle of orbits (equivalent to the two symmetric gyres of the lab data with their axes in a plane without offsets.) This will occur with the two particles coaxially aligned along their summation axes, with the major summation pole of one facing the secondary summation pole of the other, and with starting at step 2 (line 2, column 4, Fig. 1) where three gyres are clustered at $\pi/3$ (60°) separations evenly around the axial pole (Fig. 4C) and may be opposed to a similar cluster of three on the other particle. If one particle is then rotated around this axis by $\pi/3$ (60°) in either direction, the opposed gyre clusters are in mirror image same phase to each other throughout their $|\mathbf{V}_g|$ speed half cycle (which repeats) while the particles are considered static for simplest force summation averaging. For comparison with the individual gyre's $|\mathbf{PT}|$ force above, the particle centers are set per the classical F = e^2/r^2 (*12*) at 1 dyne repulsion at 4.80286 10^{-10} cm radial separation (equal to the charge value e), which is within 1% of 12 *GD* for these gyres as above. This is also far enough that the various subtended angles are small enough to neglect angle corrections which sum to about 1%. For each gyre during the first step the mirror image gyre opposing is fully symmetric (as in the lab data) at a relative axial angle within the range of the lab −120 degree case, permitting use of that set of equations (from Table 1 of Ref. 14) at a geometricly corrected GD separation scale. The other two opposing gyres with reference to each gyre in each particle are offset from symmetry at other angles with no lab correction measurement. It is estimated for first order calculation that the two deviations would be less than 10% if they were known and opposite to each other, and furthermore that the summation axes are summing the interactable effects projected from each particle as a cooperative circulation between gyres in a plane perpendicular to the summation axis in such an approximation. The contribution to repeating half cycle average force for the octant centered at this cluster configuration is then estimated at 3 gyres interaction on 3 gyres in each particle = 9 × $\mathbf{F_M}$ repulsion between two mirror image gyres at full radial projection parallel to the line of separation between particle centers for the first step. Similarly, in the next (2nd) step (3rd in Fig. 1) when the gyres in each particle are in the internal $+\pi/2$ ($+90^\circ$) positions, the relative axial angles for the mirror twin of each gyre are in the range of the lab $-\pi/3$

(-60°) angle equation set (per Table 1 of Ref. *14*), permitting those equations to be used at a geometricly corrected *GD* separation, and then summed for the octant at 3 on 3 = 9 $\times$ $\mathbf{F_M}$ repulsion between two mirror gyres. However, this is doubled in average weighting to 18, since the 4th step of the half cycle to be summed and averaged is also in this configuration. At the 3rd step, the gyres are all at the summation equators, and the mirror image of each gyre is at zero relative angle with the full 12 *GD* separation. (This attitude also exposes the sides of the gyres between electrons so that the side forces and the internal mass generating vibratory forces add briefly to the total average force.) The five other interactions of each gyre are at large angle offsets for which no lab correction is available. Again the assumption of projected interactive summing of the equivalent 6 on 6 = 36 times the force interaction of a single symmetric pair is applied for first order estimation; this step is the largest contributor to the average force. [Adequate empirical data on non-symmetric offset variations from the more analyzable symmetric experiments (*13, 14*) would have required a state-of-the-art automated test tank facility and very large increases in experimental scope.]

The computation equations for summations of $+\mathbf{F_{M}}_{ave}$ in the three mirror symmetric gyre octant configurations between electrons employ the following four α state inputs to Eq. 8, with $|\mathbf{V_P}| = c^{1.5}$ (from Table 1 Ref.14):

For the octant arcs near $-2\pi/3$ (-120°), Eqs. 10b, 12, 13, 15, and 16.

For the two $-\pi/3$ (-60°) arcs, Eqs. 10b, 12, 13, 15, and 16.

For the zero relative (0°) arcs, Eqs. 9, 11, 12, 13, 16, and 17. (At exactly zero angle average Eqs. 11 and 16 may be omitted, since each is then a multiplier by 1.)

The additional Eq. 17 required is a further modification of Eq. 9 (from Eq. 8 of Ref. 14):

$$f_{HV0}(\alpha) = f_H(\alpha)\ [0.5 + \{(1.5/0.34)\ (z' - 1)\}] \qquad (17)$$

The resulting coarse-grained, first-order summation (similar to the $\mathbf{F}_{\mathbf{M}ave}$ factor of Eq. 6a) at the designated separation distance for average electrostatic force equivalent between two static electrons over a repeating half cycle of vortex $\mathbf{V}_g$ orbits within the particles, as if the gyres are at $|\mathbf{V}_p|$ of $c^{1.5}$, is equal to 1.1195062 dynes force compared to the 1.0 dyne of classic theory. This shows a deviation of 12% high for the presently uncorrectable extrapolations over non-symmetric offsets from the symmetric dual vortex data base and its empirical equations as scaled down 12 orders of magnitude in size. (The approximate summation of offset gyre effects appears confirmed as usable in first order estimates.)

Sub-summary of specific factors. This potentially correctable result joins the other factors above that function as if they correlate structurally with characteristics of the most basic electron particle. These results of iteratively convergent solutions of scaled equations from lab data are sufficient to demonstrate a systematic structural method as if a set of vortex components might operate within Mac Gregor's analysis of electron requirements (*12*) to support the particle's analyzed essential properties. Broader investigations of the structure of LQ particles from such vortex components under initial guidelines of the references (*13, 14, 15*, *16, and 12*) thus show promise of fitting the empirical PDG Standard Model (SM) data (*18*) for the overall spectrum of subatomic massive particles. This constitutes a prediction that further refinement and extension of the empirical data on turbulent conic vortices and its application to particle structure will substantiate the approach by multiple correlations and offer a more complete structural resolution of large uncertainties in PDG empirical data such as the masses of quarks, or of a physical source for the strong force in hadrons, and finally may be corrected closely enough to yield perfected structure for the LQ subatomic massive particles and, through them, for all other particles. The experimental proof will be further improvement and continuation of the trend (since the 1980s) of closer correlation and reduced deviations from the PDG empirical data tables of the references (*15, 16*), especially with the uncertain masses of the quarks, the proliferation of hadron nucleons, and the future phenomena of particle entanglement.

Entanglement. Within such structures there is a direct mechanism for the phenomena of entanglement (e. g., *10, 11, 41, 42, 43*) in the superphotic coupling of precisely tuned orbits of gyres within a particle by means of closely interlocked juxtaposition. This has aspects of resonance, which is empiricly never infinitely sharp nor of infinite Q, but has a bandwidth of feasible frequencies within which actual frequencies may be shifted by linked interaction with a source of a slightly different frequency. Close association of two similar particles interacting with each other would then bring about such a narrower tuning of gyre orbits extending to a synchronized phase lock or full entanglement, which could remain constant over a separation until retuned by a new juxtaposition. Similarly, the spinning frequencies of the individual gyres at the equivalent d_c for the nominal *GD* could be tuned by coupling at the highest speed of interaction. In this there is not such a stringent constraint to a phase lock. (In fact the doppler effects of relative motion may make that impossible, and slightly different frequencies in a blurred resonance may result.) Such tuning (as with radio frequency resonances) can be highly sensitive to extremely faintly distant signals arriving at the usual coupling velocity, which here functions as if it is $\geq c^{1.5}$. If that occurs, this higher frequency band would necessarily be modulated in a phased medley of the gyres by the doppler frequencies resulting from their orbital approaches and recessions. The two particles would then be sensitized to a highly individualized signal set of multiple frequencies, for which the probability of a random duplication by another two particles would be reduced by the product of the number of frequencies (including the sidebands) and the values of the frequencies themselves (in a possibly long reference time period) and functions of the various Qs or response band selectivities (which may be related to quantized uncertainties.) When the factor is added that the stated gyres can only function as if there were a real internal driver which must be smaller than the 30 degree cone boundary layer used for scaling, and must necessarily have its own much higher $\mathbf{V_P}$ and frequency on which these frequency modulated signals would be further modulated, the opportunity for entanglement signal uniqueness between two particles and the speed $\geq|\mathbf{V_P}|$ with which it must be transportable begin to match the scope of the presently observed empirical characteristics of entanglement (e.g., *10, 11, 41, 42, 43*). The probability of failure of an actual entanglement of such electron structures with a unique medley of resonance frequency links between electrons in the same shell of an atom of helium at low K, for instance, should then approach:

$P_F \cong 1/\ [\omega_O\ \omega_d^2\ f(Q_O)\ \omega_{P1}\ \omega_{sb1}^6\ f(Q_1)\ \omega_{p2}\ \omega_{sb2}^{14}\ f(Q_2)\ N_{\omega 25}\ ]$, (18?) **now (20)**

in which the number of effective sidebands may be understated, and the order of multiplication may not be commutative. The probability of detecting an actual entanglement, on the other hand, would be sensitive to time schedule, instrumentation, method of separation of entangled particles, etc.

The scaled vortex driver. A further requirement for the drivers of any vortex components for electron particles is that such drivers must obviously perform as if able to maintain spinning in each gyre for the PDG

(*18*) >4.6 × 10^{26} year lifetime of the electron or at least for most of the computed 13.7 Ga present age of the universe (*18*). Even assuming the usual physics simplification that charge is always conserved, therefore it takes no energy to maintain a charge field or its interactions with other charges, there is the mass enlargement phenomenon (Eqs. 2 and 3) which necessitates a further assumption [that the energy stored in such mass enlargement is always supplied by relative velocity of quark (or any other) components before their merger into the larger hadron (or other LQ) particles] in order to avoid that mass energy drain on the internal energy of the components. Such a velocity could be supplied as if from acceleration of single conic gyres by **PT** (Eq. 7), but that must come from internal gyre energy again. This would apply until the gyre is locally static and its point thrust is opposed by an equal and opposite force in its pair mate in an electron. At that point it can be superficially assumed that **PT**, like the charge maintenance simplification, has all its energy conserved in the point secondary toroidal vortex, which returns the energy/momentum without loss at the axial inflow to the main vortex, and thus that the vortex is lossless for the life of the electron. If the component vortex is still constrained (as in *15* and *16*) by uniform equivalence to a similar component in any LQ particle, such as a top quark, where the observable mass/energy enlargement ratio may be 3.9295 × 10^4 greater (*15*) than the 7776 (6^5) ratio (Eq. 3) in the electron/positron, then the vortex driver must function as if capable of a very wide range of energy conversions to mass in particle formation without apparent variation of uniform component spinning velocity, within its resonant Q allowance for frequency bandwidth. Therefore, the rotational energy of the driver must be at least $>10^4$ greater than the mass energy of its greatest designated load, without providing for any of the additional lifetime losses listed:

$E_D \ >10^4 \times 3.9295\times10^4 \times 7776\times10.9525$ eV = $>3 \times 10^4$ GeV, (19?) **now (18)**

where such a number has similarities to the indefiniteness of the long-sought Higgs and heavier particles (*18*).

As a step toward defining the possibility of ultimate conic drivers which could function as if providing the primal and long-continuing energy sources in the vacuum medium for the two simplest and most basic types of 1/6 charged conic vortex components that would be required (*15, 16*) to compose the structures of the electron/positrons (and other particles) of nature out of that energy, it is necessary to demonstrate that the generalized size scaling equations (5 to 5e) for a *GD* and conic fluid velocity contour (as if of a largest drive cone boundary layer for an electron's vortices to enable Mac Gregor's structural specifications (*12*) for that specific particle) do also provide for scaling to a more nearly ultimate energy source.

Such a scaling demonstration would rest on the original lab finding (*14*) (Fig. 5) that Eq. 5 describes the lab data in which a smaller $\pi/9$ (20°) β drive cone, with dimensions that would nest inside those of a larger $\pi/6$

(30°) drive cone, can generate a vortex with the same size *GD* and exterior forces, such as **PT** (Fig. 7) (per Eq. 7), as the vortex from the larger cone when the smaller cone is driven at the same energy or power level (Fig. 2 of Ref. *14*) to a suitably higher $\mathbf{V_P}$. [The lab data, of course, did not demonstrate vortices that are without power/energy losses such as were listed above (as if there are entropy losses to an unspecified general vacuum energy, especially in the vicinity of galactic accumulations of particles) and then were specificly disregarded in estimating a non-conservatively lowest minimum E_D limit (Eq. 18) that can be only one component of the limit.]

Simultaneously with the 0.0128% cut-off deviation of slow convergence toward the specified electron vortex *GD* at the basic $c^{1.5}$ noted earlier, Eqs. 5 to 5e also interatively converged before cut-off to a deviation of 2% higher than the same exactly specified electron vortex *GD* dimension of $3.9681185 \times 10^{-11}$ cm at $|\mathbf{V_P}| = c^3$. This occurs with base diameter $d_c = 1 \times 10^{-15}$ cm on a $\beta = \pi/60$ (3°) drive cone, provided that the reasonably assumed kinematic viscosity ratio of density ρ to viscosity η continues very close to 1 over this range of flow velocities (*47*).

However, even with the reasonableness of numerical equality to viscosity, it is obvious that with the density of the vacuum ρ_0 at classical velocities necessarily less than the average density of the universe (*18*) and thus $< 10^{-30}$ gm cm^{-3}, it is unlikely that continuation of such a density will permit sufficient energy storage at any scaled spinning velocity and scaled cone size to drive the vortices. Therefore, it is necessary to describe the scaled vortical kinematic density and viscosity at a wave or current velocity |**v**| in terms of the vortex size scaling necessities of Eq. 5e as:

$\rho_V = \rho_0$ f(υ), and $\eta_V = \eta_0$ f(υ), (20?) **now (19)**

where the f(υ) factor (Eq. 5e) is greater than 1 but less (usually far less) than 1.05 below |**VP**| = $c^{2.5}$, equals e at c^{e}, is slightly less than 6.7×10^{15} at c^3 (and still indicating a very low effective vacuum density and viscosity), but reaches 1.3×10^{51} at $c^{3.3}$, indicating an effective vacuum density $< 2.64 \times 10^{21}$ gm cm^{-3} at that velocity and an equivalent viscosity limit in cp. It is clear that such a medium might at some correctable point below c^4 approach an otherwise undetectable rigidity and density that would prevent further velocity increase for scaling, but might store very large amounts of rotational energy in a very small volume.

Nature of a vacuum state. It is possible to hypothesize the general nature of a simplest ultimate medium that might support such density/viscosity states in all classes of particles as consisting of ball-like knots of a single type of ultimate string-like phenomenon that cannot break, stretch, or compress itself, but wriggles incessantly in random directions at random angles up to π radians within a Planck-like length. This relation also defines an effective diameter and an effective length-to-diameter ratio of about e^3, such that there would be a probability peak of three to five of such worm-like strings per knot with an average approaching about $1/\pi$ of each string length at each end protruding at nominally "random", but consequentially constrained, locations from the knot ball to make and release "random" entangled connections from knot to knot at a rate controlled by a Planck-like frequency of the random wriggling movements in each half-a-diameter length segment. At such short resultant spacings each rigid ball would have a very short individual mean free path. Thus planar-fronted pressure components of complex waves generated at any initial impact speed would have the natural almost rigid pressure wave velocity of the medium of the order of $c^{3 \text{ to } 4}$ for entanglement communication and pressure forces. The medium might be highly efficient at transmitting entanglement information at such very high speeds. Exterior forces driving relative movement shear currents between layers of knot balls (like those in molecular fluids) would meet almost no viscous frictional or inertial resistance at ball-past-ball time intervals well beyond the probable periods of connect/disconnect between knot balls. Thus shear waves such as those for the electric and mass effects waves would have the natural shear wave velocity of the medium of the order of *c.* At more forcefully driven equality of periods there would be transition levels of viscous and inertial resistance. With relative forces which would accelerate free knot balls to shorter relative passage intervals than the most probable make/break periods, the viscous resistance to relative movement and effective cross-coupling into all the mass influence waves present in all directions from the impact point of application of force would escalate at superexponential rates (with potential velocity relative to local rest) like those expressed by Eqs. 5e and 20.

The necessary potential approach to a suitable driving energy source for vortical spinning as if in the vicinity of c^3 to drive the basic particle vortices at $c^{1.5}$ is sufficient to demonstrate a systematic structural method as if a set of vortex components operate within Mac Gregor's analysis of electron structural requirements (12) to generate a correctable approximation of the essential characteristics of the electron and its positron mirror twin. [The residual prior deviations in vortex GD and forces at iteration cut-off might be benefited by an extended scope of lab experiments (including using H_2, He, CH_4, and N_2 fluids at various pressures) to refine the equations.]

Conclusions. A correctable and extendable electron/positron structure is composed of 6 systematicly interactive vortices as scaled microquanta which function as if physically generating cohesive mass, conserved charge force, and organized spin effects in the particle. This correlates with an extended and well documented independent analysis (*12*) of the quantum mechanical requirements for electron structure, and with an independent derivation (*15, 16*) from PDG particle data tables (*18*) of a generalized composite structure definition and resultant re-classification of the massive subatomic particles ranging from neutrinos to hadrons. The detailed structure, including the forces of charge, scales by quantitative convergent iterations from prior lab data and empirical force equations (*13, 14*) on highly turbulent conic vortices. Thus the overall scaled structure consists of local currents and waves (in a preliminarily characterized and quantified vacuum medium) that are potentially consistent with wave radiations and experiments in electron wave packet interference. Since this electron structure functions as if approximately and correctably exhibiting the simple shape, size, mass, charge, and charge force, and the exact net rotation rate and quantal summation angle defined by Mac Gregor's thorough analysis (*12*) of electron structure requirements, the remaining much more complex properties of the particle must consequently result consistently with the electron's quantum mechanical performance and PDG empirical data (18) as already demonstrated by Mac Gregor (*12*, *q. v.*). Necessary (and sufficient) mechanisms of this electron structure, which are also found necessary to any real electron structure, may justify relaxation of the relativistic limit on physical reality in consistency with the current proliferations of entanglement. (*53, 54*)

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$$m_p = (2m_u/3)\, N_c^6\, [0.5 + (n_\pm/n)], \qquad (21)$$

where, as in the text with Eq. 3, m_p is the mass of an "elementary" particle such as the electron, m_u is the rounded 10.9525 eV mass of each of the two universal plus or minus 1/6 charged microquantal components, N_c is the number of such components (in the particle) which act in bound pairs n, and $n_\pm$ is the number of such pairs which are charged in either polarity rather than neutral. (As a baseline relation in the electron, with a small deviation from rounding m_u, $m_p = 6^6 m_u$, since all the pairs are charged.) That Eq. 6 therein was derived in reference *15* from another Eq. 1 therein (Eq. 2 herein) which was derived initially directly from Particle Data Group (PDG) 2004 empirical particle data on Standard Model (SM) quark components of conserved 2/3 charge and interactively enlarged mass in the composite baryons.]

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47. Here it appears as if all macroscopic fluid effects were only the result of fluidic subatomic processes between the vortical components of particles in the inter- and intra-particle vacuum, which may thus be described in the usual fluid terms.

48. Re average summations of mutual gyre forces within the electron, throughout the pair rotation cycle (Fig. 1) each $\pi/2$ (90°) arc

segment of all three orthogonally planar rotation circles is necessarily occupied by a moving gyre for half the cycle time. Each sphere surface octant formed by those arc segments then has six arc occupancies by a gyre during the four quarters of the cycle time. In the same force averaging interval, only the two summation pole octants have three gyres present for a quarter cycle, and no gyres are present for the next quarter cycle; but there are at that time overlaps of these two octants by forces from gyres in other nearby octants.

49. The relatively very strong **PT** centripetal force (Fig. 7), as balanced with the orbital equivalent to centrifugal force and the strongest repulsive $+\alpha$ or PI vortical mutual forces (Fig. 9) between the components of the very stable (*18*) electron/positron, is directly equivalent to the well known strong force (e. g., *50, 51, 52*) between the quark components of the very stable proton (*18*) and other hadrons [an implication to be separately demonstrated in those particles by similar methods applied next to light quark structures with their combination in hadrons, and then to neutrinos (per *15, 16*).]

50. S. Treiman, *The Odd Quantum* (Princeton Univ. Press, Princeton, NJ, 1999).

51. F. Close, M. Marten, C. Sutton, The Particle Explosion (Oxford Univ. Press, Oxford, UK, 1987).

52. L. Lederman, D. Teresi, The God Particle (Houghton Mifflin Co.,

Boston, MA, 1993).

53. It is not expected that this skeleton electron structure should be considered complete or final, rather that useful fleshing out of this limited extension of Mac Gregor's idealized electron body into scalings from real structures will require correction and further extension similar to that which occurred over the last century with Rutherford's long forgotten atom.

In the event that the critical experiments Mac Gregor specifies (*12*) are ever run and they prove the Mac Gregor electron radius to be too large by a significant factor, while correcting the present departure point, such a result can only increase the necessity for velocities within the electron above the speed of light by some formulation broadly similar to that found necessary here. The present scaling method from lab vortex data (*13, 14*) under the composite power law (*15, 16*) for finding the necessary balance points for internal electron forces should then constrain the combined feasible range of departure point dimensions and necessary vacuum propagation properties for the various types of particle forces. The existence of electron force balances should still be determinable within such a structure.

54. Particular appreciation is due to Matthew Clark, who had his students in woodworking at the Okaloosa County Vocational and Technical School (in Fort Walton, Florida) turn the large 30 degree cones out of maple wood for the exploratory experiments (*13, 14*) which then became crucially

important to this research. Again I thank Fred E. Howard, III for critical and constructive comments on the physics, and H. Blevins Howard for special support on computer equipment and software. I continue to owe much special appreciation to Cheryl Mack, senior librarian, and Christi Rountree of the US Air Force Armament Laboratory Technical Library, and likewise now to their new librarians, Eleanor Baudouin and Michael Jackson, for excellent and patient assistance of long standing in obtaining documents of the background literature.

Self-consistent structure for the electron-positron

Fred E. Howard, Jr.

FIGURE CAPTIONS

(NOTE: Several of the figures are mentioned briefly very early in the general phase of the discussion, but they are not discussed in specific detail until later. For best reader convenience, Fig. 1 should accompany the paragraphs entitled "**Synchronized structural processes"** herein on page 9 and thereafter. The other figures should then follow rapidly.)

Fig. 1. Three schematic coaxial pairs (columns A, B, and C) of rapidly spinning, conicly shaped vortices (from prior symmetric pair force experiments under water) all have the same base-referenced outward sense of vortex spin (shown counterclockwise, CCW) with points inward (PI). The three pairs of vortices also more slowly orbit separately in three orthogonal planes around three orthogonal axes (marked in the first row). The five rows of one eighth orbit steps show a repeating half cycle of each paired vortex orbit. The three orbits are phased together from their starting points (row 1) as if they interlock symmetricly around a common axial center of the six gyres in the combined sphere of the ABC column to demonstrate a vortex thought experiment. Together the orbiting vortices make up a correctable, scaled model structure of six uniform, but now specific, micro-quanta

(previously derived only in the broadest generic terms) as if they develop through mutual interaction the appropriate spin, mass correlates, forces micro-scaled from lab data, and other essential physical characteristics matching those previously defined for the electron/positron by independent empirical data and quantum mechanical analysis.

Fig. 2. The prior experimental data for forces between two axially driven immersed conic vortices are scaled herein through quantitative equations based on symmetries of vortex size, spinning rotational velocity, form, and relative axial angles. (**A**) For micro-scaling of measured mutual forces between two otherwise uniform conic vortices of either spin sense symmetricly located in the plane of their co-planar axes, positive relative angles of the axes ($+\alpha$) indicate that the conic points are inward (PI), as in Fig. 1, where all angular relations between any two gyres in the assemblage are always symmetricly coplanar and positive, as if within an electron or positron. The force equations also apply between two symmetric vortices with cone bases oriented toward each other (BI) at negative relative axial angles ($-\alpha$), as between two particular gyres located with coplanar symmetry in two separate Fig. 1 assemblages. This can occur throughout repeating half orbital cycles as if two electron/positrons were arbitrarily constrained for ready force calculation to orientations with mirror symmetry between the two internal orbital structures. (**B**) Symmetries of measured

form in the scaled cross-sectional outlines of the cores of stronger vortical currents also become important when two conic gyres are viscously driven in the lab to high centrifugal turbulence in the central spiral waves of the disk at the cone base. Other secondary current formations become significant, such as the relatively weak toroidal flow with an elliptical cross section at the base end of each gyre and the more forcefully important strong toroidal currents around the point and sides of the drive cone. Changing relative axial angles cause significant changes in vortex flow interferences and viscous shears, with consequent changes in mutual forces described by the scaling equations. The variation of mutual force effects with radial separation of symmetric gyres is thus strongly dependent on relative axial angle α. The axial asymmetry of strongly driven vortical currents also creates a measured self force of the individual gyre which scales as if forcing the PI gyres of Fig. 1 symmetricly inward in the balanced pairs of their thought-experimental orbits.

Fig. 3. In a scaled schematic summary for immersed, centrally driven vortices, the measured vortex fluid velocities and parcel trajectories within a single turbulent conic gyre differentiate more clearly than the mutual force equations for two gyres between the radically different natures of force variations with relative axial angles $-\pi \leq \alpha \leq 0$, or $0 \leq \alpha \leq +\pi$ (Fig. 2A) and the ways in which the vortex forces in the two angle ranges can take effect. (**A**)

The common intuitive figure of a generalized smoothly flowing conic vortex is that of a disk-like surface spiral wave planform whether the net flow is radially inward or outward. Similarly, the repeatable scaled planform (shown in the alternative clockwise rotation sense, CW) of fully immersed, centrally driven turbulent conic gyres of arbitrary orientation with respect to a liquid surface also has a measured, organized spiral wave core structure within its apparently chaotic flow parcel trajectories. There are strong local rotary and centrifugal components of corkscrew flow trajectories within the core circulation of each of six to twelve single complete spiral waves or interstitial partial waves. The spirals shear strongly against each other. The spiral wave formation as a whole rotates comparatively slowly. In addition, each organized spiral wave has chaoticly turbulent and impulsively vibratory fragments of yet smaller, fractal spiral waves (not shown) on its upper surface (opposite the drive cone base) and in the fluid between the displayed wave cores. (See text for details and consequences that correlate with force effects associated with "charge.") The characteristic dimension is the gyre diameter (GD) boundary, at which the central turbulently driven spiral waves subside abruptly into smooth outward turning spiral waves, due to dissipation of mixed shear and pressure wave momentum into the surrounding fluid. At two GD these spirals convert into near circular ripples. Between the spiral waves near the GD, numbers of eddies are also generated in shear zones to move outward in the overall centrifugal spinning flow. (**B**) The elevation cross section outline of core current flows shows an almost spherical flow structure surrounding the spiral wave disk. In contrast to the centrifugal turbulence in the disk, the more massive vortical currents up around the sides of the drive cone (and in the lower toroid) are almost laminar as they gradually gain circular momentum from lower levels of viscous shear at the drive cone surface until they depart centrifugally just below the turbulent disk. The boundary between these distinctive flows is at arctan 1/4 (14°) above the cone base. Above that subplanar sheet of shear, the upper surface of the more rapidly accelerated spiral wave turbulence from the cone base increases at an angle of $\pi/6$ (30°) to its maximum disk thickness at the GD where the disk growth reverses. The numerous smaller and impulsively turbulent spiral wave vortices in the disk generate relatively weak, chaoticly non-coherent force interactions of mixed shear and pressure waves and currents which are dispersed over a wide angle outside the electron sphere to interact with other particles at bases inward (BI) $-\alpha$ relative axial angles. The single large smooth vortex and secondary toroid around the sides and point of the drive cone generate stronger coherent current and wave forces, that are concentrated at PI $+\alpha$ relative axial angles within the electron-matching spheric structure of Fig. 1. (**C**) In cross section outline, the symmetrical relative BI force contour around the spiral wave disk, transposed from the laboratory volume centroid (CV) of the drive cone to the CV of the turbulent disk within the GD. This contour is computed at microscale from the mutual force equations for empirical lab measurements between two symmetric immersed vortices over the angle range $-\pi \leq \alpha \leq 0 + \pi/12$ (15°) for a half-power cut-off. (**D**) Three orthogonal views of the solid angle coverage of far field BI forces from each individual vortex in the structure of six orbiting vortices in Fig. 1. Thus every vortex pair functions together as if constantly illuminating the entire surrounding sphere outside the electron with base derived "charge force". Any individual vortex in the illuminated hemisphere of a separate assemblage of vortices at far-field separation would be constantly illuminated at a level in the Fig. 3C pattern by each of at least three vortices from the Fig. 1 structure. (Resulting charge force fluctuations would be as if at a constant 6 times the orbital frequency of $\sqrt{3} \times 10^{21}$, or beyond γ ray photon frequencies and probably not directly detectable in the average force.) (**E**) Within each pair of vortices of the Fig. 1 structure (with separation here not to scale for illustration of the mechanism) two co-rotating vortices (shown CCW) near PI $+\pi$ α in relative axial angle experience a turning mutual force from the strong shear of the extensive opposed toroid currents beyond the core outlines, which tends to rotate the two gyres into coaxial alignment and prevent any departure from it.

Fig. 4. The gyre orbits of Fig. 1 have special consequences that are clearer in scaled three dimensional (3D) views at distant perspective of the orbital

tracks without the outlines of the gyres being shown in every case. (**A**) The orbital tracks of the vortex pairs in Fig. 1 denote the primary pole of each orbit axis as that end of the axis around which its pair of gyres orbits in the same CCW (or alternate CW) sense as the spin of all six vortices. (If one vortex of the six, or one pair of vortices, or other combination, is not in the same CW or CCW spin sense as all the others, the structure is quantally not relatable to the electron/positron. There is no non-quantized gray scale in this.) In Fig. 1 the three gyres in row 1 on the vertices of the upper right front octant are on each others primary orbital poles and advance in the next two steps around that octant toward each remaining primary pole of an orbital axis for each of these gyres to pass through. That sequence marks this octant with special emphasis. (**B**) The primary pole of the summation axis of all three uniformly equal orbital rotations of the pairs passes through the spherical surface centroid of the octant between the primary poles of the three orbital axes. (There is always such a configuration in one of the eight octants.) The secondary pole of the summation axis passes through the centroid of the symmetricly opposite octant, around which the orbiting gyres pass in the opposite rotational sense to their spins. (**C**) The centroid of the octant and the primary pole of the summation axis are necessarily equally distant from each of the primary orthogonal poles of the orbits. The precise spherical angle of this distance $\theta = \arccos 1/\sqrt{3}$ (54.7...°), the angle of quantum electrodynamics (QED) summation. When the three noted vortices are half way along the sides of this octant, at step two of Fig. 1, they are at their closest approach in the orbital cycle to each other of $\alpha = \pi/3$ (60°) in symmetric relative angle between their spin axes, and each gyre is at its most distant separation from the two other vortices of the other pairs on the far sides of the sphere at $\alpha = 2\pi/3$ (120°). Each gyre is constantly at $\alpha = \pi$ (180°) from its coaxial pair mate. (**C** alternate) Completion of the spheric orbits around the octant while observing along the primary pole of the summation axis brings in the summation equator in the plane of the image and perpendicular to the summation axis. This view puts the three arcs of θ in a more complete background and also indicates with additional orbital direction arrows where the three orbits cross the plane of that equator at six equal separations of $\pi/3$ (60°) and in the same rotational CCW sense as all the rotations in the structure. (**D**) This view along the radius to the crossing of the summation (S) equator by the C orbit demonstrates that the S equator crossings by the orbits are at six equal separations of $\pi/3$ (60°) along the equator and are also at the distinctive S axis spherical angle of θ = arccos $1/\sqrt{3}$ (54.7...°). (Direction arrows are shown for the three orbits only where they cross the S equator.) The portion of the A orbit that is in view overlays the portion of the B orbit on the far side of the sphere, and vice versa. The primary pole of the A orbit lies along the C orbit plane and overlays the primary pole of the B axis on the far side of the sphere. In this view it can be seen that the nearest point of the S equator to the C primary axis is at an angle of $(\pi/2) - \theta$ on the vertical centerline of an octant rather than at an orbital crossing. The summation equator crosses every orbit at $\varepsilon = \pi/4$ (45°) from both the orbital pole and the orbital plane. (**D** alternate) The overall external symmetry of the structural sphere may be intuitively clearer with the view rotated twice to bring the A orbital axis in line with the summation axis at vertical and make the summation equator horizontal. (**E**) Inside the vortex electron structure, a sketch of 5 of the 6 core circulations of the conflicting vortical shear current systems. The sketch is for the instants when the gyre pairs in the structure are at $\pi/2$ (90°) to each other (Fig. 1, rows 1, 3, and 5). The micro-scaled view along one axis, with the nearest vortex removed, shows the $\pi/2$ (90°) crossing shear angles of the current trajectories in the lower toroid circulations which create very large numbers of eddies (not shown). This shear action is increased when the flexible toroidal flows are distorted at the times of closer gyre approach to each other, as at step 2 of Fig. 1 and in Fig. 4C when three gyres are $\pi/3$ (60°) apart. (See text for details and consequences in eddy force effects that correlate with "mass".)

Fig. 5. Lab measurements of the significant GD dimension of individual turbulent conic vortices (Fig. 3A) versus peripheral velocity of the base of the drive cone under varied drive gear ratios, as also described by equations (Eqs. 5 to 5e) in the text accounting for whole cone angles β (where the

smaller cone could nest within the outline of the larger), other cone dimensions, fluid density, and the viscosity of the lab water which was varied over a range of 4 to 1 by changes of temperature and sugar solution. The data and equations support scaling to electron dimensions derived by independent analyis (12). (Taken from Ref. 14 with permission.)

Fig. 6. The GD scaled cross section outline of one structural quadrant of Figs. 1, step 1, and 4E, showing the relative electron radius derived independently (12), for which balanced internal vortex forces and charge equivalent external forces are scaled herein from the empirical equations for lab force data (14) measured through the smaller cross marked volume centroid (CV) of the equivalent viscous drive cone boundary of the scaled vortex. The electron radius circle passes through the CV of the turbulent spiral wave disk (Figs. 3A and B) as the center of generation of scaled forces found equivalent to the forces of "charge".

Fig. 7. Lab measurements of the self point thrust (**PT**) of individual turbulent conic vortices due to the axial intake of fluid and its accelerated centrifugal expulsion at significant angles toward the drive cone base (Fig. 3B). PT (Eq. 7) is shown versus peripheral velocity of the base of the drive cone under varied other conditions similar to those of Fig. 5. The data and equations support scaling to electron dimensions derived by independent

analyis (12). (Taken from Ref. 14 with permission.)

Fig. 8. Graph of a general force coefficient equation (Eq. 12) derived from GD scaled lab measurements of the mutual forces between two symmetric turbulent conic vortices (Fig. 2A) versus peripheral velocity of the base of the drive cone under varied other conditions similar to those of Fig. 5. This coefficient is a factor in Eq. 8, as varied by other Eqs. 13 to 17. The data and equations support scaling to electron dimensions derived by independent analyis (12). (Taken from Ref. 14 with permission.)

Fig. 9. Lab measurements and graphs of derived Eq. 8 for the mutual radial forces $\mathbf{F_M}$ between two symmetric turbulent conic vortices (Figs. 2A and B) over the $+\alpha$ PI range, versus peripheral velocity of the base of the drive cone under varied other conditions similar to those of Fig. 5. Eq. 8 is varied by other coefficient Eqs. 9 through 12. The data and equations support scaling of forces within the particle to electron dimensions derived by independent analyis (12). (Taken from Ref. 14 with permission.)

Fig. 10. Lab measurements and graphs of derived Eq. 8 for the mutual radial forces $\mathbf{F_M}$ between two symmetric turbulent conic vortices (Figs. 2A and B) over the $-\alpha$ BI range, versus peripheral velocity of the base of the drive cone under varied other conditions similar to those of Fig. 5. Eq. 8 is

varied by other coefficient Eqs. 9 through 12 with added Eq. 17. The reversed double arrows indicate strong instability and spontaneous reversal of forces causing changes of relative gyre separations in either direction. The data and equations support scaling of estimates of forces between electrons to electron dimensions derived by independent analyis (12). (Taken from Ref. 14 with permission.)

Fig. 11. Lab measurements of the mutual lateral force $\mathbf{F_P}$ between two symmetric turbulent conic vortices (Figs. 2A and B) at the maximum BI and PI angles, versus peripheral velocity of the base of the drive cone under varied other conditions similar to those of Fig. 5. When cross checked for GD scaling from Fig. 5, the data show, especially in the baseline data at 1X gear ratio at which the body of the data were obtained, that the briefly extrapolated PI lateral force on co-rotating gyres at the 2.75 GD scale separation of cone CVs (55 cm for 1X data), otherwise required within each orbital pair of micro-scaled gyres for force balance in the electron structure, is directed toward coaxial alignment of the gyre pairs. Other gyres in the structure at the GD scaled separations that occur in the orbits would not experience forces toward coaxial alignment. (Taken from Ref. 14 with permission.)