Self-Consistent Structure for the Electron / Positron

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Abstract

The 100 year search for physical electron structure is resolved, like Rutherford's initial atom, by correctable real structure which fits prior requirements analysis. Scaling with new data equations of turbulent vortex forces correlated with mass/charge equations of a recent classification of particles, iterations converge to 6 closely entangled conic vortices (in a constrained vacuum state) with the external charge force, impact rigidity, mass, and analyticly specified spheric spin radius of dual wave/particle electron/positrons with inherent summation of 3 orthogonal vortex pair rotations at the quantum mechanical spin quantization angle arccos($1/\sqrt{3}$). This is supported by present empiricly demonstrated superphotic entanglement, and provides mechanisms for that through subparticulate coupling structures (previous prohibition of which defeated other electron structure efforts.)

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Electrons today are like the indeterminate atom before Rutherford a century ago. He shaped real structure to his firmest data, as if this defined nucleated atoms, to a correctable approximation. As Feynman indicated (*1*), Rutherford's original structure became non-productive. Yet, it was the necessary step from which corrections creating today's atom were discovered. A correctable, real baseline structure for electron/positron mirror-twins is overdue.

Last century's inconclusive electrons (e.g., *2, 3, 4*), included vibrating strings and preons (e.g., *5, 6*). "Structure functions" are devised (e.g., *7, 8*) as if electrons have undefined "partons". One concept (*9*) wrapped electromagnetic field "vortons" around point dipoles. “Entanglement” of particles and photons (e.g., *10*, *11*) has implications to electron structure. Yet, Einstein's often cited comment (e.g., *12*), that it would be enough to understand the electron, still applies.

Departure point. The structurally broadest prior effort was Mac Gregor's monograph (*12*) summarizing his refereed electron papers, thorough references, and related quantum electrodynamics (QED). He analyzed conflicting requirements, from charged body spin radii for QED line-splittings of light spectra, to empirical point-collisions, and theoreticly destructive self-repulsion. This analysis determined that only an ideally rigid sphere (not ellipsoid) of "mass", corrected to slightly $>\sqrt{3}$ times the Compton radius, spinning a point unit charge (or perhaps fractional point charges) equatorially at exactly the relativistic limit, meets all point collision, spin, QED, gyromagnetic, etc., necessities.

Overall structural form and functions. A sphere, with defined strength and mass, approximates that ideal electron (*12*) as if it comprises 6 cone-shaped vortices in a fluidic vacuum state. [Six is minimum for three-dimensional (3D) symmetry.] Base-referenced, high-spin gyres revolve orbitally, with points-inward (PI) $+\alpha$ relative axial angles between any two (Fig. 1 and 2A). Spinning creates fast, entangled shear/pressure waves and currents between points and sides of gyres (Fig. 2B) inside particles, and between gyre bases [at $-\alpha$ (BI)] in separate electron/positrons, with distinctively appropriate mutual/self forces, and inherent particle-wave duality.

Excepting pseudo-centrifugal force in gyre orbits, vortex forces and mass scale to electron size through general Eqs. 1 to 4 plus 18 to 21 below and Eqs. 5 to 17 for lab 3D measurements between symmetric underwater vortices (*13, 14*). These gyres (Fig. 2, 3A, and 3B) were viscously driven, by right circular cones of π/6 or π/9 (30° or 20°) whole-cone angles β, to high spiral-wave turbulence, with vibratory centrifugal vortex cores in the spirals, peripheral toroid rings, and eddies.

The 6 gyres in each particle are also described by separately derived Eqs. 2 and 3 in a classification of the massive particles as composites of generalized microquanta with small mass and 1/6 negative or positive charge, wherein electron/positrons necessarily have 6 quanta with 1 conserved unit charge. Since that classification of particles was derived initially (*15, 16*, *17*) from Particle Data Group (PDG) (*18*) quark/anti-quark masses and 1/3 fractional charges in composite Standard Model (SM) hadrons (supporting online text), its separate derivation of 6 electron components both defines mass and charge for scaled vortices (discussed below) and systematicly correlates this particle structure with the other massive particles.

The size and relative spacing of gyre orbits are balanced (supporting online text) over orbital cycles by PI repellant mutual forces between co-rotating gyres [Eqs. 8 to 16 below (*14*)], against each gyre's stronger, inward-directed, self point-thrust (**PT**) (Eqs. 6 and 7), less its orbital pseudo-centrifugal force ($\mathbf{F_{cf}}$), at convergently determined tangential spin velocities and other dimensions (Eqs. 5 to 5e). Under this iteratively scaled internal balance, the electron assemblage of gyres functions as if its mutually entangled, fast spin couplings of forces keep it internally strain-free from relative movement between gyre orbit locations up to an effective yield strength scaled by cohesive |**PT**|−|$\mathbf{F_{cf}}$|, and the particle is consequently externally rigid [as required (*12*)] to stresses below that level.

The forces of particle charge. Between two separate 6-vortex particles, mutual forces from minus or plus "electric" charge occur:

(i) As if charge polarity represents the two senses of vortex spin.

(ii) As if charge forces are primarily between outer bases of gyres at BI angles $-\pi \leq \alpha \leq 0$ (Fig. 2A), scaled (Eqs. 8 to 17) as mutual repulsion (+) at longer ranges with gyres of like spins, or attraction (−) with unlike spins. [These usually weaker base forces (supporting online text fig. 10) arise from smaller, vibratory spiral wave vortices (Fig. 3A and B) within each turbulent gyre diameter (*GD*) disk, not from the main gyre's larger, more laminar point and side toroid currents (*13, 14*).]

(iii) As if those turbulently unique spinning forces disperse only outwardly from the volume centroid (CV) of each base *GD* disk across solid angles slightly >π(180°) wide (Fig. 3C and D), can not interact inwardly with other *GD* disks in the same particle (supporting online text), but spread evenly outside the structure on average.

Thus, 6 vortex electrons operate as if there is no cause for last century's "Poincare'" problem (e.g., *12, 9)* of theoretical, quasi-infinite repulsive electrostatic force within small charged bodies requiring point charges, quasi-infinite rigidity, or both (*12*) to avoid self-destruction of every electron/positron on assembly.

Synchronized structural processes. Microquanta of +/−1/6 charged mass above (*15, 16*) were usually bound in same-charge pairs of 1/3 net charge (in electron/positrons) or in neutral pairs of opposite charges in many other particles.

Similarly, two PI conic lab gyres at high $+\alpha$ (*14*) usually force each other to $\alpha=+\pi$ coaxial alignment (Fig. 3E), even during co-rotating mutual repulsion (supporting online text.)

Accordingly, (Fig. 1) 6 quantized PI vortices [shown counterclockwise (CCW)] balance forces and orbits as three spin-coaxial pairs in separate orthogonal planes, with each gyre at $\alpha=+\pi(+180°)$ from its pair-mate, and from each other gyre $(+\pi/3)\leq\alpha\leq(+2\pi/3)$ or (+60° to +120°). The orbits are exactly synchronized in forcefully entangled resonance. Since gyre spins on co-axes are opposed, each pair has no net spin, nor gyroscopic momentum, from vortex spins. Pair orbital rotations drive required particle spin (*12*).

The spin summation axis. Three gyres at their closest approach (Fig. 1, rows 1 to 3), between primary orbital poles matching the specific spins (Fig. 4A), move around the octant (here upper-right-front) wherein the unique centroid (Fig. 4B) is the primary orbital summation pole (S) (here also CCW). Thus S is equally distant at $\theta=\arccos(1/\sqrt{3})$ (54.73561...°) from each pair's primary orbital pole (Fig 4C), as if this structure of 6 vortices were the inherent cause of that quantum mechanical quantization axis angle (*12*), which is necessarily relied on in Mac Gregor's analysis for the QED properties of the electron/positron.

This quantized summation angle configuration is invariant and always present in this vortex structure (supporting online text.)

Zitterbewegung and charge summation at velocity. At 3/8 cycle (Fig. 1, 4th row), each gyre crosses the S equator at $\theta=\arccos(1/\sqrt{3})$ in the same (here CCW) projected direction (Fig. 4D), with π/3(60°) between crossings. Half the gyres cross to within (π/2)−arccos(1/√3) or (35.3°) of the primary S pole (Fig. 4C); half similarly approach the opposite secondary pole; and after a half cycle all cross the equator again. This S equatorial contraction of gyres, expansion near the S poles, and contraction to the equator [fig. S4D(alternate)], acts as if this were the classical electron "zitterbewegung" trembling action (e.g.*, 6, 12, 20*), here at twice the orbital frequency ($\sim\sqrt{3}\times10^{21}$ below.)

Also, twice per orbit, the 1/6 charged gyres clearly sum to charge 1 on the S equator at the projected velocity.

The pervasive electron/positron structural necessity. For the projections to match *c* exactly (*12*), the charge CVs of *GD* disks must orbit at peripheral velocity $|\mathbf{V_G}|=c\sqrt{3}$ cm s^{-1}, as if that is possible.

This dilemma of classical impossibility leads (supporting online text) to concluding that, since early last century, attempted electron structures were forced into self-defeating compromise with the same issue, the impossible classical infinite singularity of mass at an ultimate speed limit of *c*. (Charge escapes singularity!) Elaborate stratagems (e.g. *9, 12, 22*) to elude mass singularity are not generally accepted. Most present physics avoids the issue. But many physicists (e.g., *2-6, 21-39*), especially Barut (*22*), Hestenes (2), and Mac Gregor (*12*), have searched at length for reality-related structure within singularity limits.

New necessity for real electron structure arises in "structure functions" of particle scattering (e.g., *7, 8, 40*). Many discuss the importance of a physical basis for electron properties (e.g., *2, 20, 21, 22, 41*), with another recent finding (*42*) of necessity for composite structure in light leptons, including electrons.

Finally, empirical proof of real existence for superphotic action is now established in entanglement (e.g., *10, 11, 43, 44, 45*) between electron-radiated photons, "holes", qbits, etc., but without any definite physical mechanism. These proofs also demonstrate extended range for entangled coupling. This empirical evidence clearly removes the classical impossibility above c for subparticulate actions, including $\mathbf{V_G}$, by and between components in single or separate particles. Herein, interpenetrating pressure wave components of vortical currents/waves inherently provide such higher speed, resonantly coupled entanglement mechanisms.

Adaptive necessities in mass at *c*. There is still an orders-of-magnitude increase in apparent mass of particles at speeds just below c which require exceptional energy and are thus severely inhibited (as is direct observation at $>c$.) For this, general equation coefficients of mass with speed would include an additive term, $\mathrm{f}(v/c)$, which steeply approaches a peak limit at c, following the empiricly confirmed (quasi-classical) values, and vanishes shortly above c, with a continuing sub-/superluminal velocity function, $\mathrm{f}(v)$, in the general form:

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

where $\mathrm{f}(v) \cong \mathrm{f}(\upsilon) \approx 1$ very closely near and below c (Eq. 5e below).

Transonic rockets are partial analogs, with peak resistance from accumulated sound waves propagating on body surfaces in shear/pressure standing waves until broken through with shock waves (*46, 47*). Scaling lab vortices to electrons (*12*) requires only that electric-force shear waves from surface *GD*s (Fig. 3C), mixed with mass-effect shear waves from inside a particle, occur as if they propagate at *c* and accumulate around particles near *c*, over-inhibiting their speed, but not that of unobservable subparticles (supporting online text.) This is compatible with Newtonian mechanics, magnetics, Maxwell's equations, Einsteinian relativity, and QED, since they accommodate particle speed limitation and work primarily with observables at $\leq c$.

Then *GD* disks of "charge" would (Eq. 1) orbit well above *c* ($c\sqrt{3}$), meeting analytic requirements (*12*) as if vortices compose electrons.

Interactively enlarged mass between vortices. That correlation with classical particle observables is equivalent near *c* to interactive enlargement of intrinsic rest mass (*15, 16*). Order-of-magnitude increases of 2-3 N_q PDG (*l8*) light quark masses m_q occur in composite hadron masses m_p at rest. This long-known SM interactive increase was re-analyzed empiricly (Eq. 1 in *15*):

$$m_p = N_q^y \sum m_q \,, \tag{2}$$

where *y* asymptoticly approaches 5 (from <<1) with decreasing $\sum m_q$ sums of the lowest mass quarks/antiquarks. This enabled derivation (*15*) of more fundamental N_c (Eq. 3a) of uniform microquanta of 1/6 charge with 10.9525 eV mass m_u increased interactively (*15, 16*) to empirical masses m_p of lepton (e.g., electron at 0.511 MeV mass) and quark (LQ) particles [which are systematicly regular in the new classification of massive particles by these equations (*15, 16, 17*)]. Here $\sum m_q$ (Eq. 2) of ≤ 3 variable quark masses becomes $(N_c\, m_u)$ of ≥ 2 lower uniform masses, and *y* is quantized at the low mass asymptote of 5, in LQ power law (*15*, *16*, *17*):

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

or for whole particles (Eq. 1), $m_p = N_c^{5} \left(N_c m_u\right)\left[(n_{\pm}/n) + (n_0/na)\right]\mathrm{C}_{mv}$, (3b)

where $n_{\pm}$ is the number of + or − charged pairs of microquantal components (as 3 negative pairs of electron gyres), n_0 is the number of neutral pairs of components [zero in electron/positrons, so the bracketed charged-pair factor (B_F)=1 here], $n=N_c/2=n_{\pm}+n_0=$ total number of pairs, $a=3^x$, and x=1 in usual LQ particles (*15*) or 2.... in extreme neutrinos.

Vortical correlations with enlarged intrinsic mass. B_F (Eq. 3a/b) reduces by 3^1 the interactively increased mass from a usual LQ component pair with unlike 1/6 charges [neutral (contra-rotating) pairs found in quarks/neutrinos (*15, 16*)], versus like charges [charged (co-rotating) pairs of full mass, in electron/positrons.] Higher co-spinning mass correlates (Fig. 3E) to large viscous shear between opposed toroidal ring currents versus little shear with opposite PI spins but parallel toroid currents (supporting online text.) Fluid shear causes eddies (Fig. 3A and B) (*13*), which thus apparently scale as if embodying interactive intrinsic "mass" (Eq. 3a/b).

However, initial lab eddies E_i from GD spiral shears S_i drift toroidally to cone point inflows D, which disrupt them. Eddy concentration C_E is in kinetic equilibrium with rates of supply k_S and disruption k_D, as $S_i k_S \rightarrow C_E \rightarrow D\, k_D$. Adding 5 gyres (Fig. 4E) adds intergyre shear for higher C_{E2}:

$$(S_1 k_{S1} + S_2 k_{S2}) \rightarrow C_{E2} \rightarrow D k_{D2}\,. \tag{4}$$

Additive C_{E2} is insufficient (supporting online text) for empirical power factor N_c^5 (Eq. 3a/b), almost 4 orders of magnitude in electrons. This identifies exponentially compounded random shear interactions throughout 6 gyres between inward reaction force waves from continuing chaoticly vibratory turbulence of multiple spiral waves in each gyre *GD*, times multiplicative interactions $(N_c m_u)B_F$ with initial eddies, creating large mass numbers (Eq. 3a/b) of noncoherent shear wave eddies small enough to recirculate at *D* without disruption (k_D=0). Conserved C_{Ec} permeates the structure with evenly packed, low shear speed, intrinsic mass correlate, which summed cross-penetrating waves of pair orbits drive to the required (*12*) equatorial *c* equivalent.

Such eddy waves cross-penetrate outward from the particle at shear velocity (a steadily replaced small loss) for eventual forcible interaction through broad, low quality (Q) resonance coupling with similar eddy circulations wherever located, as if of gravitational mass with spherical radiant back-pressure. Since eddies are randomly spin-sensed and may present outward randomly, there is no net polarization of particles or waves. Random wave-receiving eddies on average act as if coaxially aligning least energeticly with those incoming noncoherent waves that are of opposite spin sense and wave phase which cancel back-pressure, leaving a net attractive reduction of back-pressure toward another radiant source. [Waves also cross-couple slightly by a function of the change in Eq. 5e with absolute relative velocity versus averaged individual speed. By summing wave speeds, the net local cross-coupling between outgoing/incoming waves overall acts (Eq. 5e) as if creating Machian "inertial" resistance to change of movement status in the medium as if there were a slight but quasi-infinite drag wave from mass wave-cross-coupling to the medium.]

General sub-summary. These features of electron/positron structure act as if they are, at speeds near and above c, only co-organized circulatory currents and waves which interpenetrate and cross-couple like currents/waves in water. Such wave actions have already tested positive for existence in entanglements, double-slit particle-wave (or eventually entanglement-wave) interference, etc., (e.g*., 2, 3, 4-9, 22-40, 43-45).* The following consequent quantitatively testable factors, linked recursively in convergent iterations, are not in fully sequential order.

Scaling specific vortex velocities. Gyre currents/waves must spin fast enough to maintain vortex integrity while orbiting at $\mathbf{V_g}$, as if that velocity is negligible. Orbital centrifugal inertia must balance each gyre's centripetal self force minus repellant mutual forces, which are both functions (Eqs. 7, 8, etc.) of gyre spinning velocity $\mathbf{V_p}$ at the scaled velocity contour equivalent to the peripheral base boundary layer on the baseline lab drive cone (with whole cone angle β=π/6(30°), diameter d_c=7.9375cm, at 1X drive gear ratio.) Stable iterated convergent balance occurs below at $|\mathbf{V_p}|=|c|^{1.5}$ (**V** and c always in cm s^{-1}.) Other internal gyre velocities scale at lab ratios to $\mathbf{V_p}$ (*13, 14*). [Due to their size, lab $\mathbf{V_p}$ of frothy smallest eddies (observable only as much less than the lowest measured velocity) scales as if $\approx c$.]

Structural size scaling. The principal lab *GD* reference length of 20.3 cm (Fig. 5) (Eq. 5) scaled up 10^6 in hurricanes (*13, 14*), but is generalized further (supporting online text) for scaling down 10^{-12} by Eqs. 5a to e (from Fig. 1 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 $V = |\mathbf{V_p}|/1000$, e is the base of natural logarithms, and $A = (2\,A_b + A_s)/100$ with drive cone surface areas in cm^2 (or km^2 in weather.) Except for lab variation 4:1, fluid viscosity η in cp, and also density ρ in gm cm^{-3}, stayed very close to 1 in the simplest fluid, lab water (*13, 14*). Thus, as if scaling to a simplest vacuum state, $(\rho/\eta) \cong 1$. The exponent of V (Eq. 5) generalizes iteratively to:

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

where:

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

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

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

and:

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

where $\psi = \pi^{\pi}$, $\chi = (\upsilon/e)$, and υ is the exponent in $|\mathbf{V_p}| = c^{\upsilon}$ ($0 < \upsilon \rightarrow 3.3+$). The last factor in Eq. 5d vanishes toward 1 at $|\mathbf{V_p}| << c^{2.5}$. Per Eqs. 5c and 5d, first exponent factors A and V (Eq. 5) effectively exchange exponents from lab to $|c|^{1.5}$ scale.

Initial force balance and size ratios estimate. Since (Fig. 1 and 4) vortices orbit at $\alpha = +\pi(180°)$ from pair-mates, and between $+\pi/3\ (60°) \leq +\pi/2 (90°) \leq +2\pi/3\ (120°)$ from other gyres, the ratio of the average lab (*13, 14*) repellant mutual forces $|\mathbf{F}_{\mathbf{M}ave}|$ (Eq. 6a) at these angles (fig. s9 in supporting online text)) to $|\mathbf{PT}|$ (Eq. 7) can estimate (Eq. 6b) feasible gyre GD to particle radius ratios for stable particles. At trial ratios, the lab mutual force ($|\mathbf{F}_{MRGD}|$) average for 2 alternating arc octants at 4 angle states per cycle, projected on a radius [C_{FM} =cos(π-α)/2], at each *GD* unit distance (*R*) between cone CVs, is weighted by number (M_{ovo}=1, 2, or 4) of other gyres in each angular relation per repeated quarter cycle, summed overall (|$\mathbf{F}_{\mathbf{M}\text{ave}}$|, Eq. 6a), and checked (Eq. 6b) against |**PT**| for estimated pseudo-centrifugal force comparison:

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

(arc octants; α states)

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

Particle radius at cone CV (*14*) of 1.375 *GD* is the most compact feasible ratio for acceptable distortion of toroids at α =π/3(60°) closest approach. (This survives iterations.) The quadrant cross section at α = π/2 (90°) (Fig. 6 and 4E), shows the resulting *GD* CVs at 1.6875 *GD* radius, which equates to the analytic electron radius (*12*) of 6.6962×10^{-11} cm, setting a scaled *GD* = $3.9681185 \times 10^{-11}$ cm reference target for loop iterations (Eqs. 5 to 16). From these constraints and β=π/6(30°), iterations slowly converged to cut-off force balance with (Eqs. 5 to 5e) $|\mathbf{V_p}| = |c|^{1.5}$, which determines f($\upsilon$), and d_c = $1.5872474 \times 10^{-11}$ cm, which determines *A*.

Scaling self force. Self force is jet reaction axial thrust toward a cone point, **PT** (Fig. 7), from axial fluid intake at low velocity and radial ejection ~10× faster angled toward the base (Fig. 3B) between arctan 1/4 (14°) and π/6 (30°). (From lab Eq. 2 and Fig. 3 of *14*):

$$|\mathbf{PT}| = \frac{\sin\beta}{10\,\pi}\left(\frac{\rho}{\eta}\right)^{0.25} |\mathbf{V_p}|^{1.525}\,\frac{A_s}{9.807\times10^{2}}\ , \quad (7)$$

where A_s is the cone side area in cm^2, 9.807×10^2 is the conversion factor from dynes to grams force, and other terms were defined.

Scaling with different drive cones. Eq. 7 and Fig. 7 show that the viscous boundary layer of a $\beta=\pi/6$ (30°) cone (*14*) at low $\mathbf{V_P}$ models **PT** of a smaller $\pi/9$ (20°) cone at higher $\mathbf{V_P}$. Fig. 5 (Eq. 5) likewise shows reciprocal modeling of *GD* at the same $\mathbf{V_P}$s [where mutual forces also match (*13, 14*).] The two fluid vortices are then equivalent; and matching either property is sufficient for equivalence (applied during scaling.)

Scaling radial mutual force between symmetric conic vortices. At any $\mathbf{V_P}$, the mutual force $|\mathbf{F_M}|$ (Eq. 8) in grams, along a radius of separation R in GD scaling units between two co-/contra-spinning symmetric drive cone CVs, is controlled (supporting online text.) by two variable coefficients to be determined, vertically by $f(\alpha)_{TBD}$ (Eqs. 9 to 11), but predominantly by $f(R)_{TBD}$ (Eq. 12) (Fig.8), with further variables (Eqs. 13 to 17) (from Eqs. 5 to 24 in *14*). [The electron/positron uses only the central negative slope of the upper curve (Fig 8) internally, but uses all of both curves in external interactions, as below.] (Generalized from Eq. 4 in *14*):

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

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 $z'=[3/(0.5z+1/z+1/1.5z+5.703/z^{16})^{0.5}]+\log\log z$, the last term being the effective value at electron scale. Other terms were defined previously. This yields the lab equations at $z=1$, where $ut = 0$.

These equations apply by electron/positron rules (simplified from Table 1 of *14*) due to unique (among all particles) lack of internal oppositely charged (contra-rotating) components (*15, 16*). In same rotation at $+5\pi/6 \leq \alpha \leq +\pi$ (+150° to +180°):

$$f_H(\alpha) = 1 - (1/17)\tan[(4\alpha)/9] \quad . \tag{9}$$

For $\alpha = +\pi/2$ (+90°):

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

For most remaining ranges of $+\alpha$:

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

But for α near $+\pi/3$ (+60°) and lower:

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

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

$H=+1$ for co-rotating $\mathbf{F_M}$ (Fig. 8) with its reversal as $R \to 0$ (only between particles here):

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

Here, $R=R_{i,j,kl} = R_r C_i C_j C_k C_l$, where real R_r is in actual *GD* units before shrinking/stretching the *GD* scale for other variables with $C_i C_j$...that are each equal either to 1 or to any coefficient (Eqs. 13 to 17) listed later for the case. For $\mathbf{V_p}$ effects in all cases:

$$C_V = z'^{z'} \quad . \tag{13}$$

For $\alpha = +\pi$ (+180°) in co-rotating immersed gyres:

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

For $\alpha = -\pi$ (−180°), and $= -5\pi/6$ to $+5\pi/6$ (−150° to +150°):

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

which for the broader range of angles is used with (from Eq. 23 in *14*):

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

For iteratively scaled balancing electron forces (Eq. 6a), $+\mathbf{F}_{\mathbf{M}\mathrm{ave}}$ at $|\mathbf{V_P}|$ uses α states from Eq. 8 (Table 1, *14*) for $|\mathbf{F}_{MRGD}|$ with δ inputs in:

For the α octant arc near $+\pi/3$ (+60°), Eqs. 10b, 11, 12, 13, and 16.

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

For the α arc near $+2\pi/3$ (+120°), Eqs. 10b, 12, 13, 15, and 16.

For the α point at $+\pi$ (+180°), Eqs. 9, 12, 13, and 14.

Then for any gyre, the projected force along the particle radius $+\mathbf{F}_{\mathbf{M}\mathrm{ave}}$ (Eq. 6a), the pseudo-centrifugal force $+\mathbf{F_{cf}}$ at $\mathbf{V_g}$ below, and the radial inward $-\mathbf{PT}$ at $|\mathbf{V_P}|$ (Eq. 7) must converge iteratively from trial inputs of $|\mathbf{V_P}|$, d_c, radius ratio, and generalization factors, to a force balance with *GD* error null for particle size. [Since gyres function (Eqs. 1 and 5e) as if currents/waves travel internally at the lab ratio to

$|\mathbf{V_P}|$, $|\mathbf{V_g}|$ doppler/relativity effects are neglectable.]

Mass effect in internal forces. The mass of one gyre m_u appears in the pseudo-centrifugal force $\mathbf{F_{cf}}$ at $|\mathbf{V_g}|=c\sqrt{3}$. At $c^{1.5}$, f(υ) (Eqs. 1 and 5e) is 1.00000004; it is negligible at $|\mathbf{V_g}|$. The 10.9525 eV (*15, 16*) interpenetrating mass waves of the gyre are estimated (supporting online text) at mean radius (Fig. 6) between the ratio dependent equivalent cone CV and the spiral *GD* disk CV, or 1.53125 *GD*.

Iteratively convergent balance of internal forces and size. Iterations were cut off with forces balanced (Eqs. 6a, 8, etc.) within 1.2% and slowly converging to: $\mathbf{F_{Mave}}+\mathbf{F_{cf}} = -\mathbf{PT}$. At this point, 77% of **PT** of −1.126206 dynes (Eq. 7) centripetal force holds each gyre mass in orbit and 23% balances average mutual forces from other gyres (supporting online text). Each gyre has its $|\mathbf{V_P}|=|c|^{1.5}$ current contour at $d_c=1.5872474\times10^{-11}$cm. The computed (Eqs. 5 to 5e) $GD = 3.968625094\times10^{-11}$cm, with a scaling deviation of 0.0128% above the *GD* error reference, as if forming a sphere (Figs. 6 and 4e) with 6 charge centers at the required electron radius (*12*) of 6.6962×10^{-11}cm to yield electron properties at c on a spin equator.

Exterior forces between two scaled electron structures. Non-iterated average, summed instantaneous forces were computed (Eqs. 6a adjusted and 8 to 17) between the gyres (supporting online text) of S coaxial, fixed particles at classical (*12*) center separation (12 *GD* within 1%) for 1 dyne repulsion. Another equation covers α=0 (from Table 1, *14*):

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

Since for each gyre 2/3 to 5/6 of α positions are balanced in offset from symmetry, and lab data (*13, 14*) are largely symmetric, limited extrapolations with uncertain error estimates yield a first-order repulsion of 1.1195062 dynes, 12% high.

Ultimate vortex driver convergence. The iteratively convergent structural scaling solutions (Eqs. 1-16) above also were required to converge simultaneously (per Eqs. 1, 5 to 5e, and discussion of 7), in the same scaled vortices, on an alternate, more nearly ultimate drive cone (supporting online text.) The single convergence cut-off also exhibited a *GD* deviation of 2% high for $d_c=1\times10^{-15}$ cm on a $\beta=\pi/60(3°)$ drive cone at $|\mathbf{V_P}|=c^3$ (*47*). Such a gyre d_c in each impact could cause the empirical impact electron radius $<10^{-14}$ cm (*12*).

In this structural paradigm the full effective *GD* of each component vortex in the electron (or positron) is maintained in the full effective analytic particle radius (*12*) in the static electron and in the electron in an atomic orbit at the typical orbital velocity of less than 1% of *c*. However, when electrons and positrons are accelerated in experimental particle colliders or in cosmic ray events (etc.) to velocities closely approximating *c*, in this acceleration the individual gyre dimensions are compressed by stripping away in the medium the outer gyre flow circulations down to the dimensions of this scaled ultimate vortex driver without loss of gyre or particle forces, mass, etc., in the continued surrounding conic zone of influence . This holds since this ultimate driver is considered to be always the actual vortex driver nested within the viscous flow contour equivalent to the much larger effective drive cone and particle dimensions in the static and normally lower particle velocity conditions analyzed (*12*) for QM performance requirements. The ultimate drive cone with the standard *GD* then is the universal structural microquantum (*15, 16*) in all LQ particles and thence in the hadrons.

Driver energy minimum. Energy storage E_D required by such a quantal driver for losses only to the mass enlargements for a similar gyre in a large quark (*15, 16*) in a large hadron (Eqs. 2 and 3), without including lifetime entropic losses in charge and mass wave radiation:

$$E_D > 10^4 \times 3.9295 \times 10^4 \times 7776 \times 10.9525 \text{ eV} = >3 \times 10^4 \text{ GeV}. \quad (18)$$

For such energy storage (Eqs. 1 and 5e), at $|\mathbf{v}|=c^3$, $f(\upsilon) \approx 6.7 \times 10^{15}$. Applying this in:

$$\rho_v = \rho_0 \, f(\upsilon), \text{ and } \eta_v = \eta_0 \, f(\upsilon), \quad (19)$$

with vacuum density $\rho_0 < 10^{-30}$gm cm^{-3} of the universe (18), $\rho_v < 10^{-14}$gm cm^{-3}, for gyres. But at $c^{3.3}$ $f(\upsilon) \approx 1.3 \times 10^{51}$, as if $\rho_v < 2.64 \times 10^{21}$gm cm^{-3} and η_v equivalent, creating a limit for pressure waves in the medium c_p described by $f(\upsilon)$, and providing for a yet smaller inner core of the driver d_c as the only impenetrable, undeformable part of the electron's interpenetrating waves/currents. Such a medium class (Appendix I in supporting online text) could at a correctable Planckian limit below c^4 store such large amounts of rotational energy in such a very small volume.

Conclusion. Iteratively convergent solutions of scaled equations from lab data demonstrate a systematic structural scaling method and a scaled electron/positron structure as if a set of 6 conic vortex components correctably function within Mac Gregor's analysis of electron structure requirements (*12*) to support the particle's analyzed essential properties. This correctably resolves a 100 year search for reality-related baseline electron structure. (*48*)

See <u>at this point</u>: Appendix I Other aspects of vortices in electron structure: (Synopsis from supporting online text.) [2 pages of further key material, equations, and full conclusion; a **copy is inserted here, page 30, after Fig. Captions.]**

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$$m_p = (2m_u/3)\, N_c^6\, [0.5 + (n_\pm/n)], \qquad (20)$$

where m_p is the mass of any "usual elementary" particle [e.g., electrons (Eq. 3)], the factor [0.5 + ($n_\pm/n$)]=F ($0.5 \geq F \leq 1.5$) for analytic classification graphs (*16*), and m_u is the mass of either of the two simplest and most basic, oppositely charged but otherwise uniform, universal, paired, microquantal component units (or unicons) of particulate matter (herein turbulently driven vortices). [For the electron, with a small deviation from rounding m_u to 10.9525 eV, $m_p = 6^6 m_u = 0.511$ MeV, since all pairs $n_\pm$ are charged, and ($n_\pm/n$) = 1. {Since this mass includes the partially equivalent Mac Gregor (*12*) relativistic mechanical mass increase of 3/2, this mass (20) must be decreased by a 2/3 factor for use in his electron (*12*), where the rest mass is taken before the relativistic increase. This adjustment does not apply herein (per Eq. 1), since the vortices are not moving at c, but only project their velocities (Fig. 4D) on the S equator at c.}]

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48. This skeleton electron structure is not considered complete or final. Rather, fleshing out this extension of Mac Gregor's idealized electron (*12*) by scaling real vortex structures will require further correction and extension such as Rutherford's long-forgotten atom was given over the last century.

If critical experiments Mac Gregor specifies (*12*) prove his electron radius to be too large, that corrects the present departure point but does not obviate necessity for superphotic speeds by some formulation similar to these. The present scaling method from lab vortex data should still apply.

49. Particular appreciation is due to Matthew Clark, whose woodworking students at the Okaloosa County Vocational and Technical School (Fort Walton, Florida) turned

the maple wood cones for the exploratory experiments (*13, 14*) which later became crucially important. Again I thank Fred E. Howard, III for critical and constructive comments on the physics, and H. Blevins Howard for 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 now to new librarians, Eleanor Baudouin and Michael Jackson, for excellent and patient assistance of long standing in background literature.

Supporting Online Material

Supporting online text. (Expanded text with added clarification on major points in print text, and with more lab data plots versus equation for full data used from references in scaling to electron size.)

Appendix I. (Two page synopsis of significant topics and equations cut from print text but needed to round out the main thesis of functional electron structure with its relation to entanglement, a constrained vacuum state, full conclusions, etc.)

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FIGURE CAPTIONS/LEGENDS

Self-consistent structure for the electron-positron (Howard)

Fig. 1. Vortex schematic movements in electron/positron mirror-twin structure. Three coaxial pairs (columns A, B, and C) of rapidly spinning, conicly shaped vortices (scaled from prior symmetric pair force and current experiments under water) all must 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 new type of correctable, scaled model structure of six uniform micro-quanta (previously derived only in formless generic terms) as if they develop through mutual interaction the appropriate spin, forces micro-scaled from lab data, mass correlates, and other essential physical characteristics matching those previously defined for the electron/positron by independent empirical data and quantum mechanical analysis.

Fig. 2. Relative axial angle conventions for lab vortex drive cones, and schematic vertical cross sections for two complex turbulent conic vortices. Relative angles range to + and $-\pi$ (180°). Scaling equations herein for the prior experimental data on forces between two axially driven, fully immersed conic vortices are organized around symmetries of vortex and drive cone size, spinning rotational velocity, and equal distance along co-planar axes (through a common center.) (**A**) For two otherwise uniform, symmetric conic vortices of either spin sense, positive relative axial angles ($+\alpha$) are for conic points inward (PI), as in Fig. 1, where angles between any two gyres are always symmetricly coplanar. In two separate Fig. 1 assemblies two vortices may briefly be coplanar symmetric with cone/gyre bases inward toward each other (BI) at negative relative axial angles ($-\alpha$). (**B**) The scaled cross-sectional outlines of the cores of stronger vortical currents indicate the flow interferences and viscous shears which cause strong irregularities of mutual forces between two turbulent gyres with change of relative axial angle.

Fig. 3. Scaled schematics of quantitatively measured and analyzed features of

turbulent, centrally driven, underwater conic vortices. (**A**) Vortex fluid velocity core structures and parcel centrifugal trajectories within the apparently chaotic, vibratory turbulence of the central spiral wave planform disk of a conic gyre, here in the alternative clockwise (CW) rotation sense. Each spiral wave core is a bent centrifugal vortex. At the gyre diameter (GD) boundary the turbulence subsides abruptly into smooth, outward turning spiral waves with dissipation of momentum and eddies into surrounding fluid. At two GD spirals fade into circular ripples. See text details correlated with electron "charge" force. (Adapted from *13*.) (**B**) Elevation cross section of core currents by line-weights surrounding the GD disk. Massive lower side and toroid currents are near-laminar. Note radial flow angles at GD. (Adapted from *13*.) (**C**) Base BI isoforce contour around the GD volume centroid (CV). Mutual repellent to gyre bases of same spin sense. (Adapted from *14*.) (**D**) Orthogonal views of instantaneous solid angle coverage of far field BI forces from each of 6 vortices in Fig. 1. (See fig. S3d legend, supporting online text.) (**E**) Mutual force toward coaxial alignment from opposed toroid currents in co-rotating vortices (shown CCW, separation not-to-scale.)

Fig. 4. Scaled orbits with and without gyres. (**A**) For three coaxial gyre pairs the uniform spin sense (shown CCW) (Fig. 1) determines three primary orbital poles, always on a distinctive octant, here the upper right front, around which (rows 1-3, Fig. 1) three gyres advance. (**B**) The primary pole (S) of the orbit spin summation axis is at the surface centroid of that octant. (**C**) The S pole is necessarily equally distant from the primary orbital poles, at the precise spherical angle $\theta = \arccos 1/\sqrt{3}$ (54.7...°) of

quantum electrodynamics (QED) quantization. Halfway around this octant (step two, Fig. 1) three gyres are at their closest $\alpha=\pi/3(60°)$ and each most distant $\alpha=2\pi/3(120°)$ from two other vortices. (**D**) The S equator is crossed at θ by the orbits at equal separations of $\pi/3$ (60°) along the equator and at $\varepsilon=\pi/4(45°)$ from each orbital pole. (**E**) With one gyre removed the conflicting vortical shear currents with axes at $\pi/2(90°)$ to each other (Fig. 1, row 1) create many eddies (not shown) and even more at closer approach (Fig. 1, row 2 and 4C). (See text and supporting online text for details and consequences in eddy effects that correlate with "mass".)

Fig. 5. Lab measurements of the significant gyre diameter (GD) scaling 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 with small changes in density. The data and equations support scaling to electron dimensions specified 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 mutual force data (*14*) versus pair separations measured from the smaller cross marked volume centroid (CV) of the

equivalent viscous drive cone boundary layer of the scaled vortex. The electron radius circle (heavy dashed line) passes through the CV of the turbulent GD spiral wave disk (Figs. 3A and B) as the center of generation of scaled forces found equivalent herein to the forces of "charge" (Figs. 3C and D). (Outer base toroid force contribution is comparatively slight.) Light dashed radial lines show $\pi/6(30°)$ angles for estimate of point toroid distortion when at $\pi/3(60°)$ closest approach of vortices in orbit (Fig. 4C). One 30° cone shows the relative internally nested appearance of a more ultimate vacuum drive cone for the same vortex in a particle (see text) as if that ultimate cone were relatively scaled up by a factor of 1000.

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. (With overloaded drive motors only 5/1 velocity range resulted from 16/1 drive gear ratio range.) The data and equations support scaling to electron dimensions derived by independent analyis (*12*). (Taken from Ref. *14* with permission.) (Other force equations 1 to 17 in text and force data in supporting online text.)

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 and B, 3A and B). This coefficient, as varied by other Eqs. 13 to 17, is a predominant factor in Eq. 8 for variation of mutual force versus peripheral velocity

of the base of the drive cone under varied other conditions similar to those of Fig. 5 and 7 (Eqs. 5 and 7). The data and equations support scaling of lab forces and dimensions to electron particle dimensions derived by independent analyis (*12*). Note that at the smallest scaled intraparticle separations of vortices (which do not occur within the present electron structure due to high gyre orbital velocities but would occur in annihilative particle collisions) the data indicate very high attractive mutual forces which will also be of interest in systematicly extending this type of component structural data to other particles that exhibit the strong force between larger numbers of components (per *15, 16*). (Taken from Ref. *14* with permission.)

APPENDIX 1 (from supporting online text)

Other aspects of vortices in electron structure: (Synopsis from supporting online text.)

Entanglement physical process. Within vortical structures there is a direct mechanism for the phenomena of entanglement (e. g., *10, 11, 41, 42, 43*). Gyre orbits in electron structure are rigidly interlocked in resonance by the direct forces of their entangled superphotic currents and waves. Sensitive resonances of separated force couplings have bandwidths of inverse *Q* in which narrower widths of linked orbit frequencies (ω), harmonics (H), and dopplers (*d*) occur. These are frequency/amplitude modulated (FAMed) with sidebands (SB) by all lower state ω and H, FAMed with SB on similar gyre V_p spinning ω and H, and this is again FAMed on ultimate driver ω and H, and shared at the highest pressure wave velocity near driver $|V_p|$. Thus, uniquely tuned entanglement failure probability for two electrons in a He atom, etc., would approach:

$$P_F \cong 1/ [\omega_O\, \omega_d^2 f(Q_O)\ \omega_{P1}\, \omega_{sb1}^6 f(Q_1)\ \omega_{p2}\, \omega_{sb2}^{14} f(Q_2)\, N_{\omega 25}] \,. \qquad (22)$$

Once outside the electron particle, the higher speed pressure waves of entanglement must act as a true radiation that can maintain entangled resonant coupling between particles, qbits, etc., or (by the cited empirical observations) be repeated as an additional coupling by photons that have been radiated in the entangled state.

Nature of a vacuum state. Eqs. 5b-e and 19 indicate an active (rather than inert) vacuum state and numericly hypothetical medium as if supporting the necessity of not only an ultimate vortex driver for electron energy near order $c^{3\text{-}4}$, but also high speed pressure wave entanglement phenomena, and continuous radiation of electron mass and charge shear wave effects (as an inherent entropic source of some only partially recovered, dispersed energy.) Separated shear and pressure wave velocities here might result from the tieing and untieing and entangling and disentangling of a probability range of hard knots made by the random actions of a single type of uniform worm-like strings at Planck length order. Knots would be packed closely with very short mean free paths for knots in slightly compressing pressure waves. In lateral coupling of pressure waves/shear waves and currents, shear viscosity and density of coupled knots would be dependent on ratio of wave passage period per knot (i. e., velocity) to most probable period of knot-to-knot entanglement change. Broad lateral couplings with high apparent densities would occur with rapidly moving currents and waves. High velocity stress might delay disentanglement in ultimate driver states.

Balance of lateral mutual forces. In addition to the radial mutual force $\mathbf{F_M}$ between gyres, there are two orthogonal mutual force components with balanced effects primarily on accelerating or retarding gyres in orbit. (*15, 16*) As noted below, lab data behind this estimated balance are more limited.

Additional vortex experiments and data errors. Present lab data are more sparse than would be desirable, especially (fig. S9 and S10 in supporting online text) near 0.75 GD gyre CV separation (not present within electrons, but important in high energy particle impacts.) where repulsive forces are unstably reversible to attraction and then become large. It is estimated (*13, 14*) that due to the required level of gyre turbulence, if the prior data at each point were in statistical quantities, 1 sigma errors would be near 10%. With a large state-of-the-art test tank facility and a factor of 10-100 increased scope, automatic data smoothing techniques would reduce the error level somewhat and determine it more accurately. Other refinement possibilities include quantity of data on lateral mutual forces, on fluids with wider variation of density to viscosity ratio than 4/1, on a wider variety of cone sizes and angles as well as higher peripheral velocities, on measurement of vibratory wave pressures and frequencies, on current velocities in the smallest eddies, and most especially on the complexities of non-symmetric relative axial angles and offset locations of gyres that occur between particles, as well as on experimenting with varied 6 gyre orbit angle configurations.

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 and empirical collision 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 quantitatively constrained vacuum medium) that are 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 (*15, 16, 17*), charge, and charge force, and the 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 generally, justify relaxation of the relativistic limit on physical reality among subparticulate structures in consistency with the current empirical data on proliferations of entanglement. (*48*)