THE PHYSICAL BASIS OF ZERO-POINT ENERGY?

Planck's Constant from Hubble's Constant:

Cosmological Origin of Terrestrial **ZPF** & ***Zitterbewegung***

by

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Abstract

In a Newtonian model of *e.g.* the Bohr atom, it is physically **incorrect** to omit the aggregate forces from all electrostatic charges (monopole potential [with or without retarded potentials]) in the visible universe. Though the standard hypotheses of cosmic homogeneity/isotropy imply such forces have a *zero-mean*, they also have a **non-zero** *variance!* It is known since Fényes (1952) & Nelson (1967,1985) that Schrödinger's Equation is derivable from Newtonian mechanics, in *Stochastic Mechanics* (**SM**) as a **neo-classical** alternative to the Copenhagen interpretation of QM. In SM, the forces acting are augmented by a zero-mean, non-zero-variance *background-field* process, but (although Nelson remarks that **"no physical system … is truly isolated"**) no plausible candidate for the **source** of **"mutual energy transfer which averages out to zero"** and is thus **"responsible for …quantum fluctuations"** has hitherto been identified. Here it is **proved** that the **cosmic electrostatic forces** from all of the universe's quarks & electrons provide a quantitatively adequate source of Schrödinger's micro-physical *zitterbewegungen*, thereby explaining both the necessity of a statistical treatment of micro-physical "jittering" and rendering mistaken/irrelevant the oft-noted "weirdness" of reality alleged by Copenhagen. For non-relativistic motions, $M \cdot d^2\mathbf{x}/dt^2 = \boldsymbol{F} + h \cdot \boldsymbol{w}(t)$ in SM, where M, $\boldsymbol{x}$, and $\boldsymbol{F}$ have classical Newtonian significance, and where if the mass M carries one electron charge, the force-vector $\boldsymbol{F}$ is the sum of the electrostatic forces of all quarks & electrons in a sphere of radius $R_o = 1$ *Astronomical Unit* (AU), while $\boldsymbol{w}(t)$ is a unit-intensity-matrix stochastic vector-process (having dimensions $1/[m^2\text{-}sec]$) and h is a scale-factor having units of angular momentum. Specifically, if $\mathbb{E}$ is the *expectation* operator and δ the Dirac delta-function, $\mathbb{E}\{\boldsymbol{w}(t)\} \equiv 0$ and $\mathbb{E}\{\boldsymbol{w}(t)\cdot\boldsymbol{w}(\tau)^T\} \equiv \boldsymbol{I}_3\cdot\delta(t-\tau)$, where $\boldsymbol{I}_3$ is an identity 3-matrix with units $1/[m^2\text{-}sec]$. Summing the aggregate cosmic forces from outside said sphere arising from charge-sources of mean number-density $\bar{n}$ *particles*/m^3 it is easy to compute (from a convergent integral) that

$$h = \sqrt{8\pi/3} \cdot \left(\frac{e^2}{4\pi\varepsilon}\right) \cdot \frac{\bar{n}}{R_o^{\,1/2}} \cdot \iota ,$$

where e denotes the electron charge and ε the permittivity of free space and ι a unit-intensity scale-factor of dimensions ($m^{5/2}\cdot sec$). Now $\bar{n} = 5.51 \cdot \Omega \cdot (H_o/70)^2$ per m^3 from standard physical cosmology, where $\Omega \equiv (\rho_o/\rho_c)$ denotes the usual *critical density* ratio, and where H_o denotes the value, at the present epoch, in (*km*/*sec*)/*Mpc*, of ***Hubble's constant***. To test validity of the preceding derivation, note that identifying h with ***Planck's constant*** yields $\cdot\Omega\cdot(H_o/70)^2 = 0.0693$, in relatively excellent agreement with the latest observational data. The result renders the Copenhagen interpretation untenable, vindicates Einstein's surmise that "God does not play dice," and demonstrates the ontological ***reality*** (& physical origin) of **non-virtual** *Zero-Point Fluctuations* (**ZPF**).

Analysis

It has been pointed out by Edward Nelson [1]-[2] and others that the Copenhagen interpretation of Quantum Mechanics (**QM**) would never have gained wide credibility if it had been realized from the beginning that the assumption of a microscopically small and randomly fluctuating "background field" of zero-mean, non-zero-variance, finite-intensity forces would resolve the supposed double-slit paradox (and all other paradoxes requiring a non-Newtonian interpretation of [non-relativistic] dynamics). In fact there is no mystery about where probability enters into mechanics if one models Newtonian mechanics in the form of an initial value problem in the discipline of *stochastic differential equations* [3],[4],[5],[6],[7], namely

$$M \cdot d^2\mathbf{x}/dt^2 = \boldsymbol{F} + h \cdot \boldsymbol{w}(t), \qquad \boldsymbol{x}(0) = \boldsymbol{x}^0, \tag{1}$$

where M denotes the *mass* of a rigid body whose center of mass is located at the *radius vector* $\boldsymbol{x}$, where $\boldsymbol{F}$ denotes the resultant of macroscopic *forces* acting on the body's center of mass, where t denotes time, and where $\boldsymbol{w}(t)$ denotes a zero-mean Gaussian white-noise-like vector-process of unity intensity-matrix:

$$\mathbb{E}\{\boldsymbol{w}(t)\} \equiv 0, \quad \mathbb{E}\{\boldsymbol{w}(t) \cdot \boldsymbol{w}(\tau)^{\mathrm{T}}\} \equiv \boldsymbol{I}_3 \cdot \delta(t-\tau), \tag{2}$$

where $\mathbb{E}$ denotes the mathematical *expectation* operator, where $\boldsymbol{I}_3$ denotes the 3×3 *identity* matrix (with dimensions $1/[m^2\text{-}sec]$), where $^{\mathrm{T}}$ denotes vector-matrix *transposition*, and where $\delta(t)$ denotes the Dirac *delta-function*.

For physicists who regard the formulation (1)-(2) as of dubious utility, it should be noted that today scores of thousand of engineers and thousands of financial analysts wield stochastic differential equations on a daily basis. Indeed, millions of airline passengers rely on the Kalman-Bucy filter [for which Kalman received the Kyoto Prize] to navigate their airplanes safely, while millions of investors rely on the Black-Scholes option-pricing model [for which Scholes received a Nobel Prize in economics] to compute fair values of time-wasting assets.

Strictly speaking, a white-noise-like process, or Wiener process, is differentiable nowhere and (1) must be interpreted as a formal Volterra integral equation wherein $\boldsymbol{w}$ is the formal derivative of a Brownian motion process with normally-distributed independent increments. However, the intricacies of stochastic processes (*e.g.* the Itô calculus) can be avoided heuristically by regarding (1) in the usual sense with $\boldsymbol{w}(t)$ a continuous sample function approximating a white-noise-like process; then (1) will have a well-defined, unique ([8], [9], [10]) "deterministic" solution $\mathbf{x}(t)$ for each such sample function, and a Monte Carlo analysis can be applied numerically to estimate the sample *mean* $\hat{x}(t) = \mathbb{E}\{\boldsymbol{x}(t)\}$, any sample's *deviation* $\tilde{x} = \boldsymbol{x} - \hat{x}$ from the mean, and the *covariance matrix* $\boldsymbol{P}(t) = \mathbb{E}\{\tilde{x}(t) \cdot \tilde{x}(\tau)^{\mathrm{T}}\}$, etc. as usual.

Now the body's position $\boldsymbol{x}(t)$ is a *random process* which tends to the usual Newtonian motion as $h \to 0$. Consequently one can define the *probability density* of the process as a time-varying probability function $\rho = \rho(t;\boldsymbol{x})$ whose first and second moments agree with the mean $\hat{x}$ and covariance $\boldsymbol{P}$ just defined, etc. But since ρ is necessarily *positive-definite*, one can stipulate that $\rho \equiv |\psi|^2 \equiv \psi\cdot\psi^*$ where ψ is a complex number and * denotes complex conjugation. The amazing fact, which would have prevented the counter-intuitive Copenhagen interpretation from gaining widespread credibility if it had been realized at the time, is that the question: *what law governs the evolution in time of the complex scalar* ψ *?* has an <u>UNAMBIGUOUS</u>, <u>UNIQUE</u> solution which coincides with Schrödinger's equation of QM for the *complex* "wave function" ψ in case the force $\boldsymbol{F} = -\,grad(\Phi)$ is derivable from a scalar potential Φ, *i.e.* in the case that the stochastic system goes into a classical Hamiltonian system as $h \rightarrow 0$!

For nearly two decades, Nelson [1]-[2] has been studying the mathematical properties of such stochastic processes, under the assumption that sooner or later some physical process would be identified that provides a reasonable candidate for the *background field* $\boldsymbol{w}(t)$; "no physical system … is truly isolated" [2, p. *viii*; *cf.* p. 132].

The purpose of this paper is to demonstrate that the sought-for background field is merely the aggregate resultant of the classical Coulomb forces of all charged particles in the visible universe! It is surprisingly easy to prove this. For simplicity, instantaneous electrostatic action-at-a-distance will be assumed. (It is left as an exercise for the reader to employ the radial symmetry exploited below, in the present case of a monopole potential, and derive the same result if use is made of a Retarded Potential instead of the classical Coulomb force.) Also, for simplicity, it will be assumed that the visible universe is comprised of an equal number of electrons and protons; as another exercise for the reader, the same result will be obtained if one considers a universe of electrons and quarks.

For simplicity, take $\boldsymbol{x}^0 = 0$, and let (1) govern the time-evolution of the motion of an electron, so that $M = M_e$ denotes the mass of an electron, and let $\boldsymbol{F}$ denote the resultant of all of the Coulomb forces within a large but finite volume V (say, encompassing the earth or some portion of the solar system); and let V_∞ denote the (infinite) exterior volume outside of V. Then

$$h\cdot\boldsymbol{w}(t) = -\iiint_{V_\infty}\left(\frac{e^2}{4\pi\varepsilon}\right)\cdot n_q(t,\vec{r})\cdot\frac{\vec{r}}{r^3}\cdot dV\ , \tag{3}$$

where $n_q \equiv n_+ - n_-$ and where n_+ and n_- are the number-densities of protons and electrons, respectively, in the volume V_∞. These densities are assumed to be random processes; however, basic physical assumptions about the visible universe *constrain* the nature and behavior of *candidates* for such processes. In particular, the assumption that there are as many *baryons* as *leptons* and that the visible universe can be approximated as having a time-invariant local *mean* particle-density $n(\boldsymbol{r})$ requires that:

$$\mathbb{E}\{n_+(t,\boldsymbol{r})\} \equiv \mathbb{E}\{n_-(t,\boldsymbol{r})\} \equiv n(\boldsymbol{r})\ . \tag{4}$$

Here we are **not** assuming that the particle density at a given distance $r = |\boldsymbol{r}|$ from the earth is constant, but simply that at any given cosmic location the local density is independent of time (on the time-scale of the motion being considered in (1)).

It is known that most of the matter in the universe is fully-ionized hydrogenic plasma, in which the protons and electrons move randomly as in the kinetic theory of plasmas. Accordingly there is no correlation between the positions of positive and negative charges along any *fixed* radius-vector $\boldsymbol{r}$ from the earth. Therefore

$$\mathbb{E}\{n_+(t,\boldsymbol{r})\cdot n_-(t,\boldsymbol{r})\} \equiv 0 . \tag{5}$$

Similarly, the hypothesis of random fluctuations of the charged particles in V_∞ requires the assumption that

$$\mathbb{E}\{n_+(t,\boldsymbol{r})\cdot n_+(t',\boldsymbol{r}')\} \equiv \mathbb{E}\{n_-(t,\boldsymbol{r})\cdot n_-(t',\boldsymbol{r}')\} \equiv (\iota_0)^2[dn(\boldsymbol{r})]^2\cdot\delta(\boldsymbol{r}-\boldsymbol{r}')\cdot\delta(t-t'), \tag{6a}$$

$$[n(\vec{r})]^2 = \iiint [dn(\vec{r}\,')]^2\cdot\delta(\vec{r}-\vec{r}\,')\cdot dV(\vec{r}\,'), \tag{6b}$$

where the dimension of the $\delta(t)$ is *per second* while the dimension of the $\delta(\boldsymbol{r})$ is *per cubic meter*, which requires the introduction of $\iota_0 = 1$ as a unity scale-factor having the dimensions of $(m^3\cdot sec)^{1/2}$. Next one finds, as an immediate corollary of (4)-(6), that

$$\mathbb{E}\{n_q(t,\boldsymbol{r})\} \equiv 0, \quad \mathbb{E}\{n_q(t,\boldsymbol{r})\cdot n_q(t',\boldsymbol{r}')\} \equiv 2\cdot(\iota_0)^2\cdot[dn(\boldsymbol{r})]^2\cdot\delta(\boldsymbol{r}-\boldsymbol{r}')\cdot\delta(t-t'). \tag{7a,b}$$

Using (7a) it is easy to prove from (3) that $\mathbb{E}\{h\cdot\boldsymbol{w}(t)\} \equiv 0$. Next, reducing a 6-fold integral to a triple-integral by means of the spatial delta-function $\delta(\boldsymbol{r})$ in (6b), and then removing the factor $[n(\boldsymbol{r})]^2$ from the inside to the outside of the triple-integral by the standard device of replacing it by its appropriately-defined *constant* mean value $\overline{n}^{\,2}$ we find after a trivial calculation that

$$h^2\cdot\mathbb{E}\{\boldsymbol{w}(t)\cdot\boldsymbol{w}(\tau)^T\} \equiv (\iota_0)^2\cdot\Phi\cdot\boldsymbol{J}\cdot\delta(t-\tau) , \tag{8}$$

where the scalar Φ, which has dimensions of (m^2/sec^4), is defined as
and the matrix-valued integral $\boldsymbol{J}$ has dimensions *per meter* and is given by

$$\Phi = 2\cdot\left(\frac{e^2}{4\pi\varepsilon}\right)\cdot\overline{n}^{\,2}, \tag{9a}$$

$$\vec{J} = \iiint_{V_\infty}\left(\frac{\vec{r}\cdot\vec{r}^{\,T}}{r^6}\right)\cdot dV. \tag{9b}$$

Now let us specialize V to denote a sphere of radius $R_o = 1$ AU, because our Sun is the closest large mass of plasma containing randomly moving charges, such as (assuming on-average large-scale isotropy/homogeneity) we have modeled the **exterior** V_∞ of V to be. Then V_∞ may be approximated by the *spherical annulus* having inside radius R_o and outside radius $R_\infty >> R_o$, where ultimately we shall allow $R_\infty \to +\infty$. Let (R,θ,φ) define a spherical coordinate system: $\boldsymbol{r} = R\cdot[\sin(\theta)\cos(\varphi),\sin(\theta)\sin(\varphi),\cos(\theta)]^T$, volume element $dV = R^2 \cdot sin(\theta) d\theta \cdot d\varphi \cdot dR$, and $0 \leq \theta \leq \pi$, $0 \leq \varphi \leq 2\pi$, $R_o \leq R \leq R_\infty$. Then it is a simple exercise in integral calculus to prove that (letting $R_\infty \rightarrow +\infty$)

$$\boldsymbol{J} = (4\pi/3) \cdot (1/R_o) \cdot \mathbb{I}_3 , \qquad (10a)$$

where $\mathbb{I}_3$ is a *dimensionless* 3×3 *identity* matrix [in contrast to $\boldsymbol{I}_3$ in (2) above]. It is essential to note in (2) that $\boldsymbol{I}_3 = (\iota_1)^2 \cdot \mathbb{I}_3$, where $\iota_1 = 1$ is a unity scale-factor having dimensions of $[1/(m \cdot sec^{1/2})]$ Consequently, combining (2) and (8)-(9)-(10a), we have proved that

$$h^2 = (\iota)^2 \cdot \Phi \cdot (4\pi/3) \cdot (1/R_o), \qquad \iota \equiv (\iota_0/\iota_1) , \qquad (10b)$$

in which $\iota = 1$ is a unity scale-factor of dimensions $(m^{5/2} \cdot sec)$. Finally, taking square-roots, it has been proved that

$$h = \sqrt{8\pi/3} \cdot \left(\frac{e^2}{4\pi\varepsilon} \right) \cdot \frac{\overline{n}}{R_o^{1/2}} \cdot \iota , \qquad (11)$$

as claimed in the Abstract above. **Thus the basis of all microphysics, Planck's constant *h*, has a value determined by the large-scale conditions of the entire universe!**

Comparison with Empirical Measurements

In order to test the validity of the previous expression for h, we require an estimate of the mean particle-density of the universe. According to Peebles [11], the mean number-density is related to Hubble's constant as follows. Assume that the universe is composed entirely of protons and neglect the mass of the electrons in comparison to the nearly 2,000 times greater mass of the protons. Then

$$\overline{n} = \rho_0/M_p = \left(9.23 \times 10^{-27} \cdot \Omega \cdot (H_o/70)^2 \, kg/m^3 \right) / (1.67 \times 10^{-27} \, kg) =$$

$$= 5.53 \cdot \Omega \cdot (H_o/70)^2 \text{ per } m^3 , \qquad (12)$$

where H_o denotes the present epoch's value of the *Hubble constant*, measured in *km*/*sec* per *Mpc*. Inserting (12) into (11) and solving for the least well-known factor gives, after use of the well-known values $h = 6.625 \times 10^{-34}$ *J-sec* ; $e = 1.6021 \times 10^{-19}$ *C* ; $\varepsilon = 8.854 \times 10^{-12}$ *F/m*; $R_o = 1.485985 \times 10^{11}$ *m*, the result, consistent with [11], that

$$\Omega \cdot (H_o/70)^2 = 0.0693. \qquad (13)$$

According to recent news reports [*Washington Post*, 5/26/99; *The Economist*, 5/29/99], $H_o \cong 70$ and so the factor $(H_o/70)^2 \cong 1.0$ is of order unity. In a discussion of the product on the left side of (13), Peebles quotes the cosmic background radiation (CBR) results as supporting a value of 0.013 ± 0.005, which means that since the second factor is not certainly well-known, the density ratio Ω could be within an order of magnitude of the range [0.01, 0.02] according to the CBR. Peebles also discusses 5 dynamical approaches to estimation of Ω, arriving at the range [0.004, 0.200] for the 4 shorter-scale methods and [0.01, 1.0] for the more controversial longer-scale method. In conclusion he states that "it seems prudent to bear in mind … that what is securely detected on smaller scales, $\Omega \sim 0.1$, is all there is." If one rounds off (13) to a single decimal place, namely $\Omega\cdot (H_o/70)^2 = 0.1$, and keeps in mind that $(H_o/70)^2 \sim 1$, then in the light of the most **"securely detected"** results, our new formula (11) has predicted that $\Omega \sim 0.1$, *i.e.* empirical **confirmation** of the validity of (11) is as **good as could be hoped for!**

Rebuttal of Possible Criticisms

It may be objected that (1) neglects the transport of energy by radiation; indeed, Davidson [11] has argued that all of the "weirdness" in the Copenhagen interpretation of QM stems from an inherently problematic nature of the Marshall-Braffort *radiation-reaction* term in the classical dynamics of charged particles. (In the Marshall-Braffort Equation, one adds a term $\tau\cdot M\cdot d^3\boldsymbol{x}/dt^3$ to the right-hand side of (1).) Moreover, if one includes the loss of energy by acceleration in (1), then in the Bohr atom one would obtain the familiar spiraling inward of the electron which caused Bohr to introduce the completely *ad hoc* hypothesis of quantization of angular momentum. (Landé [12] has shown that Schrödinger's equation can be derived from just 3 "quantal" postulates, namely quantization of *angular momentum* because of periodicity in angle, quantization of *energy* because of periodicity in time, and quantization of *linear momentum* in a crystal lattice [Duane's Rule] because of periodicity in space; however, all 3 postulates violate classical-dynamics-based intuition, and Duane's Rule specifies instantaneous momentum-transfer at a distance!) But if one includes Maxwell's Equations in the preceding model in the manner pioneered by Dyson (1951) [who according to Marshall 'owed much to Schwinger &Weisskopf'], Braffort (1954), Marshall (1963) [28], Boyer (1975), and de la Peña & Cetto (1977) then one must augment the presently-advocated SM by *Stochastic Electrodynamics* (**SED**), in which the value of Planck's constant *h* is assumed to be an unexplained constant of nature [***but cf. [27]!***], but the cosmic ***dipole radiation*** from all charged particles in the universe is taken to be a zero-mean, non-zero-variance background field added to the right-hand-side of Maxwell's Equations when expressed in homogeneous form. The spectral density of this field is taken to be proportional to the cube of frequency [which is the unique PSD compatible with Lorentz invariance], subject to an *ad hoc* high-frequency cutoff. To a large extent, SED is competitive with Copenhagen/Dirac QED, since it predicts the same results for the Lamb Shift and leads to a derivation of Planck's blackbody radiation law (without the necessity for assumption that photons exist as discrete particles! [28]), although it does NOT predict "spontaneous pair-production" in an "energetic vacuum" and in SED, the ZPF is **real** rather than virtual. Working within SED, Puthoff [13]-[14] has shown that when the electron is close to the proton, the energy which the electron gains from the fluctuations in the SED background field is precisely equal to the energy lost by classical *bremsstrahlung* radiation if and only if the electron is moving in the lowest Bohr orbit! Therefore Puthoff (following Boyer [who according to [28] followed a published idea of

Nernst (1916) which followed the Bohr (1913) atom by only a few years]) has "explained" the stability of the Bohr atom (subject to the qualification that he has to take h as an unexplained given [***but cf. [27]!***], whereas we ***explain*** the cosmic radiation background which determines the quantitative value of h). [The reader who regards the present "physically reasonable" but "quite arbitrary" choice of R_o = 1 A.U. as not truly totally arbitrary, but more or less mandated by the proximity of randomly moving charges in our massive Sun, will note that the monopole-radiation ***explanation*** of Planck's constant h gets within a single order of magnitude of h, whereas the ***complementary*** -- *NOT* competing! -- dipole-radiation ***"estimation"*** of h, dealing with numbers of the order of 10^{39} and 10^{79}, understandably gets consistency with observations only within a numerical factor "of a few orders of magnitude."] Therefore the present result may be described as both a *complement* to, and a *more fundamental* underpinning of, and at the same time the final *perfection* of, the SM/SED program for ***replacing QM*** & ***QED*** by ***SM*** & ***SED***. In this connection it should be mentioned that Puthoff and his collaborators Haisch and Rueda have gone on to use SED to derive a neo-classical TOE: they derive Newton's Equations of Motion, Newton's Law of Gravity (as a shadowing of a Casimir-Effect-like *repulsion* rather than attraction phenomenon), the correct value of the Newton-Cavendish gravitational parameter G, the *identity* of Inertial and Gravitational Mass and a new approach to Mach's Principle, an *explanation* of Dirac's famous microphysical & cosmological numerical "coincidences" [but Puthoff (1989) should be compared with the "simpler and more straightforward" *parallel explanation* of de la Peña & Cetto (1984 & 1997 [27a,b])], and other striking results, including the fact that in principle *extraction of macroscopically useful energy from the ZPF* does not violate any established laws of physics! For a website with more than a score of down-loadable popular and technical/scientific papers on the ZPF aspects of SED, see Haisch [15]. A comprehensive reference to the status and techniques of SED prior to the most recent results of Puthoff, Haisch & Rueda is in de la Peña & Cetto [16], who reference the important papers of Marshall [28].

A second objection to the present theory is that it could be falsified if the present search for the "missing" perhaps non-baryonic *dark matter* is completed in a manner satisfying to the currently-fashionable majority expectation that for some metaphysical reason $\Omega \equiv 1$, which would violate our prediction (13) by an order of magnitude.

The present authors' answer is that in early 1975 Bass submitted a paper [17] to *Nature* which demonstrated that by means of a statistical analysis of every single known astrophysical measurement of the Eddington-Robertson parameter γ, Bass was certain, to a 2-σ confidence level, that $\gamma > 1$, which contradicted the then current Brans-Dicke variable-gravity theory. It seems now that despite unjust, ideologically-motivated rejection of his paper, this conclusion was well-founded: see [18] for recent astronomical **evidence** that $\gamma > 1$. Bass attributed this contradiction to majority expectations of $\gamma \leq 1$ to the accident of the wrong choice of sign on the so-called *Dicke coupling constant* $\omega \equiv -(2\gamma - 1)/(\gamma - 1) \equiv -|\omega| < -2 < 0$ if $\gamma > 1$, *assumed* mistakenly to be positive according to a prejudice of Dirac (while ignoring opposite prejudices published by Einstein, Milne, and Sciama!). Despite unjust rejection of his paper [17] ("the author *should wait* until the resurfaced radio-telescope at Arecibo provides more accurate measurements of γ"), Bass has remained of the opinion that G is increasing with time, as in the supposedly metaphysically/theologically *a priori* cosmology of Milne [21a,b], and a recently published book by a geophysicist [22] gives numerous hard evidences for that fact. Furthermore, it is easy to show that (regarding General Relativity as a phenomenological theory in a Euclidean-Newtonian absolute space & time, as is possible from the Milne-McCrea Theorem to the effect that the Lemaître-Friedmann cosmological equations can be derived from Newtonian gravity, and from the well-known inconsistency with Special Relativity in the choice of an absolute *cosmic time* in standard cosmology), with Mach's Principle incorporated in General Relativity in the manner of Jordan's scalar-tensor theory [17], and the sign of ω reversed from that chosen by Brans & Dicke, there is *no reason* to believe that there is any "missing mass", because the *discrepancy* between galactic rotations as observed kinematically and the corresponding masses *deduced* from the [unwarranted] *assumption* of constant Cavendish parameter *G* and the classical Newtonian-mechanics type of Virial Theorem can be satisfactorily explained *quantitatively!*

Discussion and Conclusions

Until recently, Bass was taken in by the widespread allegation that experimental confirmation of predictions based upon Bell's Inequalities had established the "non-locality of reality" and resolved the EPR Paradox "in the manner that would have least pleased Einstein." But this was because "editors anesthetized by the Copenhagen interpretation" (to quote de la Peña & Hodgson [23]; *cf.* Hodgson [26]) had prevented publication of the important papers by Thomas Brody which *inter alia* prove conclusively the **irrelevance of Bell's Inequalities** (all 5 known derivations include an *overlooked* tacit assumption which when recognized explicitly *contradicts* QM!!! [furthermore, in addition to the *logical/mathematical* arguments of Brody, note the *physical* objections of Marshall [28] to the misinterpretation of supposedly "Bell Inequality"-based Aspect-type experiments allegedly 'proving' the 'non-locality of reality,' on grounds of mistaken *assumptions* that (i) electrons are point-particles rather than extended objects with physical spin, and that (ii) photons can be regarded legitimately as particles whose polarization may be regarded as spin, both of which assumptions are not defended by
advocates of non-locality while ignoring massive counter-evidence -- as well as Marshall's proffered *testable* 3% difference between an optical prediction of ***QED*** vs that of ***SED***]).

With all due respect to his excellence as mathematician, probabilist, and gifted expositor, William Faris had also wandered into the same metaphysical shadows only now at last illuminated by Brody's posthumous masterpiece [23] and the evidence marshaled by Marshall [28], for on the one hand he has intimidated Nelson into relinquishing SM (Nelson says [2] that "I have loved and nurtured Markovian stochastic mechanics for 17 years, and it is painful to abandon it" while at the same time manfully *thanking* Faris for having "insisted that SM violates locality"), and on the other hand, after reading the first draft of David Wick's wonderful survey [24] of "seven decades of heresy in QM," Faris contributed an appendix on QM & probability which apparently confirmed Wick in his *reconsideration* of SM (to which he says he had been leaning during the many years during which he wrote his first draft) as seemingly "fatally compromised” by the discovery by Timothy Wallstrom, a former student of Nelson, that SM cannot explain the Bohr atom without the inclusion of an extraneous *ad hoc* postulate equivalent to the quantization of angular momentum. This topology-based discovery is equivalent to the idea that a function defined by a line integral cannot be made single-valued if the line surrounds a singularity; however, it is hoped that the above references to the work of Puthoff and the SED school ([13]-[16],[23],[27],[28]) will sufficiently enlighten Nelson and Wick that they can return to SM with clear consciences.

While we disagree with Faris that nature is demonstrably non-local, we agree emphatically with his cheerful prediction that the successor to QM will be so clear that **“school children will assimilate it”** [hopefully, as demonstrated above!] and that, together with the Puthoff/Haisch/Rueda neo-classical Theory of Everything (*i.e.* combined SM & SED $\rightarrow$ TOE), this sought-for illumination/debunking of QM/QED “weirdness” [25] will empower a neo-classical Renaissance of the type prophesied by Faris’ expectation that in the near future “fundamental science will have reached its end.”

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