Dynamics of Black Holes and Structure Formation in the Hotson - Westergard Universe Model

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The theory of the object known in general relativity as a Black Hole is not fully worked out and remains a source of various controversies. This paper shows that true black holes do not exist in nature due to forces that prevent the formation of singularities and event horizons. A reconstruction of the derivation of the Einstein field equations of general relativity shows that a force causes a phase-change transition from matter to energy near the Planck scale. This phase-change is the cause of an ejection process from the nuclear region of galaxies and ultimately results in the formation of gas, dust, stars, and other structures throughout the Universe.

Key Words: Angular Momentum, Antimatter, Black Holes, Beta Decay, BEC, Bose-Einstein Condensate, Degenerate matter, Degenerate Hydrogen Well, Dirac's Equation, Galaxy Harmonics, General Relativity, Gravitation, Gravitational Collapse, Hotson/Westergard Universe, Left Handedness, Matter Creation, Plasma Physics, Quantum of Time, Quasar Ejection, Quantum Unification, Singularities, Speed of Gravity, Strong Nuclear Force, Structure Formation, Subatomic Harmonics, Uncertainty Principle.

Introduction

In the theory of general relativity, the entity known as a 'Black Hole' (BH) is a geometrical object, which represents the end point of the gravitational collapse of a massive degenerate object. A BH forms when a body of matter is sufficiently dense and massive that its' internal gravitational attraction is great enough to overcome the repulsive electron and neutron degeneracy pressure. According to the Standard Model (SM), when this occurs a gravitational collapse ensues in which all the mass of the object is ultimately compressed to a point singularity, having a diameter less than the period at the end of this sentence and a minimum mass about four times the mass of the Sun.

The spherical area surrounding the point singularity from which the escape velocity exceeds light speed is called the 'event horizon' of the black hole. However, according to the (SM), all of the mass of the black hole is contained within the point singularity.

The lifetime of a (BH) of two solar masses has been calculated to be 1.2×10^{67} years. The temperature near the singularity is assumed to be near zero degrees K.

The escape velocity from within the event horizon of such an object exceeds the speed of light. In Einstein's theory of relativity, light waves and gravity waves travel at speed c. However, in the case of a star in orbit, one astronomical unit, from the event horizon of a black hole, the gravitational effect or force between the two bodies is not restricted in the least by the event horizon which shows that the speed of gravity must be much greater than light speed. In fact, the well-known astronomer, Tom Van Flandren, who is an expert in the field of celestial mechanics, has shown that gravity travels at least 10^{10} times faster than light. See his paper 'The Speed of Gravity What the Experiments Say' in Physics Letters A 250: 1-11 (1998) or his web site Meta Research (and also check out 'The Top 30 Problems with the BIG BANG'). The SM clams that no information (radiation or gravitation) can escape the event horizon of a black hole. Well, that star one astronomical unit from the event horizon knows exactly what the total mass of the singularity is. If one subatomic particle is added to the singularity, the star's orbit will change ever so slightly.

What follows are quotes from three published papers, by the following authors: Chase, Crothers, and Heaston. The bold text indicates emphasis added by Westergard.

The following quotes are taken from the very excellent article by Walter E. Chase titled **"Observations on the Theory of Gravitational Collapse: An Analysis of the Dynamics of Black Holes"** [1] which inspired me to select the title of the present paper. Quote:

"The discovery that black holes radiate leads to the conclusion that a black hole must have a finite lifetime. Since the radiation is very weak, this lifetime will, of course, be very long. For example, for the case of a black hole of two solar masses, the lifetime has been calculated to be 1.2×10^{67} years.

"**Conclusion # 1:** If a black hole has a finite surface temperature, however small, when viewed by a distant observer, then the surface temperature as measured by an observer who lowers himself deeper and deeper into the potential well of the black hole will approach infinity as the radial location, r, of this observer approaches the radial coordinate of the event horizon $(r \to a)$.

"The conclusion is that the "proper" surface temperature of any black hole must be infinity. What we seem to have is an object of essentially infinite surface temperature located at the bottom of a gravitational potential well so deep that after redshifting its apparent surface temperature approaches zero (or in the above example, 0.03 microKelvins).

"**Conclusion #2:** If we try to generalize the concept of proper lifetime to the case of a radiating black hole (by letting an observer drop deep into the potential well and thus observe the hole ("close up"), we find that a straightforward generalization of the concept of proper time leads to a proper lifetime of zero.

"Obviously, it is very unlikely that an object with truly infinite temperature and truly zero lifetime actually exists. We seem

forced to the conclusion that a black hole is, in actuality, an object of extraordinary short (but still not zero) proper lifetime.

"For example, an observer who jumps off a platform into a black hole will pass smoothly through the event horizon and continue on to the point singularity at the center of the hole. The observer will notice no anomaly as he crosses the event horizon, and if the platform from which he jumps is not too distant from the black hole (say at the distance of the orbit of Mercury for a black hole of two solar masses) then the elapsed proper time, as measured by the falling observer, will be only a few hours until time of impact on the central singularity. This, at any rate, is the standard view (for a point "observer" and no tidal effects). The apparent long lifetime of a black hole appears to be largely an artifact of time dilation.

"Conclusion #1: The "proper" surface temperature of a black hole is infinity.

"Conclusion #2: The "proper" lifetime of a black hole is zero.

"Conclusion #3: The interior of a black hole is not accessible from the exterior.

"As mentioned earlier, it is very unlikely that an object with truly infinite temperature and truly zero lifetime actually exists. We seem forced to the conclusion that a black hole is, in actuality, an object of extraordinarily high (but still finite) proper temperature, and extraordinarily short (but still not zero) proper lifetime.

"This observation suggests the possibility that there is some criterion, quite possibly in the nature of a very hard limit, which prevents space-time from becoming stressed beyond some critical point. When the distortion of space-time reaches this limit the vacuum suddenly breaks down in a gigantic explosion, and the stress is relaxed as massive quantities of stored energy radiate away. Black hole radiation suggests the possibility that the distortion of space-time sufficient to form an event horizon could be approximately the same as the distortion of space-time sufficient to produce breakdown.

"The following view emerges as a potential model of the collape of a massive object to form a black hole. As in-falling matter becomes more and more dense, there eventually develops a point—probably at the very center of the star—at which matter is compressed nearly to within its own event horizon. When this occurs, a massive breakdown of the very substructure of the vacuum ensues and an enormous explosion develops. The matter falling inward near the surface of the star eventually falls into the shock wave of the internal explosion and is sufficiently compressed to explode itself or is simply blown outward. However, by the time the internal explosion has reached the surface, the star has collapsed to the point that it is almost inside its event horizon. Although breakdown of the vacuum prevents the star from actually falling inside its event horizon, the star comes so close to doing so that the redshift and time dilation to a distant observer makes the exploding mass extraordinarily cold and virtually frozen in time.

"Consider the possibility that extreme compression of matter—almost to within its own event horizon—can lead to a breakdown process **(analogous to a sudden phase change)** in which all he mass in some region suddenly converts to a superheated ball of both radiation and elemental particles which are heated nearly to the speed of light. It is possible that such a form of matter might be able to escape from the (potential) black hole just before the event horizon forms. **If this occurs, then the collapse to the true black hole is halted, the singularity at the center never develops, the event horizon never forms, and all the associated conceptual and theoretical problems simply disappear.**

$$dr / dt = c[a(t) - r] / r \tag{2.19}$$

"It is actually fairly easy to show that, $r(t)$, the solution of Equation 2.19 never crosses the event horizon for $a(t)$ a monotonically decreasing function. What this implies is that the interior of a black hole may not be reached by a light pulse which propagates toward the black hole directly down a radial. Since a pulse which propagates directly down a radial will approach the black hole faster than a light pulse launched from the same point at the same time in any other direction, our result also implies that the interior of a black hole may not be reached by any light pulse when the evaporation of the black hole is taken into account. Moreover, since light moves toward the black hole faster than any material particle can, **our result also implies that no material particle can fall through the event horizon and access the interior of an evaporating black hole**. When the finite lifetime of a black hole is taken into account, the interior must be totally inaccessible from the outside (as inaccessible as the outside is from the interior in the theory of the static black hole).

"Consider the formula for the maximum amount of entropy that may be contained within a spherical surface of area A.

$$S_{\max} = (k / 4)(A / a) \tag{4.15}$$

The physical significance of this equation is as follows. If we pump entropy into a spherical region of space, once the entropy in the region becomes equal to $S_{\max}$ x an event horizon forms at the surface, A, bounding the region. Thereafter, if we continue to pump entropy into the region, we find that the event horizon expands with increasing entropy in accordance with Equation 4.15. In this view, the physically significant event described by Equation 4.15 is the formation of the event horizon. We know, however, that the event horizon of a black hole emits black body radiation. We have seen in Section 2 that to a local observer this radiation will be extraordinarily intense. We have also seen that to a local observer dropping deeply into the potential well of a black hole, the temperature of the black hole event horizon must approach infinity. **The development of a surface temperature of infinity is a very significant event, and this event is triggered by the breakdown of space that occurs at the event horizon**. We have also seen that if an event horizon forms it has a proper lifetime of zero, and thus exists only fleetingly. In this monograph we propose a new way of looking at Eq. (4.15). In this view, the physically significant event described by Eq. (4.15) is the breakdown of space at the surface, A.

"This way of looking at Eq. (4.15) puts us in mind of Eq. (4.13), $Q_{\max} = [q / (4)](A / a)$. This equation determines the maximum amount of free electric charge, $Q_{\max}$, which may be contained within a spherical region within a dielectric. When the

charge, $Q_{\max}$, is reached, the dielectric breaks down at the surface, A, of the spherical region. We derived Eq. (4.13) by applying the concept of a hard limit on allowable electric field strength, $E < E_r$, to a spherical region. However, given Eq. (4.13) it would be possible, in principle, to work backward and determine that the validity of (4.13) implies the existence of a limit on allowable electric field strength. We could express this limit as a constraint on the components of the electric field vector. Thus, from Eq. (4.13) we could discover

$$\left[E_x^{\,2} + E_y^{\,2} + E_z^{\,2}\right]^{1/2} < E_c \quad (4.16)$$

"If we view Equation 4.15 in this new light, the Schwarzschild singularity takes on true physical significance for the first time. The Schwarzschild singularity becomes viewed as the marker for a region of spacetime which is so 'stretched' by gravitational forces that it cannot withstand the stress, and consequently breaks down in a process viewed by a local observer as an intense, high temperature explosion. In my opinion, this new view makes Equation 4.15 a little more comprehensible. Equation 4.15 has always been somewhat mysterious. It asserts that a vast quantity of entropy is contained within a black hole. Given the simplicity of the structure of a black hole, **it has never been really clear where all this disorder was being stored. Moreover, the mechanism by which the entropy stored in the black hole ultimately escapes into surrounding space has never been explained in satisfactory fashion**. A black hole evaporates because of the coupling between gravity and vacuum quantum fluctuations at the surface of the hole. This process does not appear to be at all dependent on what is going on inside the hole. **There is thus a complete causal break between activity inside the hole and the way radiation emerges from the hole. This causal break is due, of course, to the existence of the event horizon**.

"This monograph proposes that the breakdown of space that must occur at the event horizon actually occurs just before the event horizon forms. We have argued that an event horizon must (to a local observer) be infinite in temperature and infinitesimal in duration. Truly infinite temperature is probably not physically possible. We have argued instead that just before spacetime becomes so stretched that an event horizon forms, the structure of space breaks down in an intense explosion of extraordinarily high (but not infinite) temperature and very short (but not zero) duration. Immense quantities of energy are radiated out of the breakdown region and the gravitational stress on this region is relaxed. In this view the event horizon never quite forms and the causal break between interior and exterior never occurs. **See 'The Black Hole' by Westergard below.**

"In this monograph we propose the following: **When a full quantum theory of the coupling of the vacuum to gravity is available, it will turn out that the stretching of spacetime represented by the Schwarzschild singularity constitutes a limit on the structure of spacetime which it will be possible to approach, but never reach.**

"The view taken here is that the Einstein field equations cannot be solved for an arbitrary spacetime metric, just as Maxwell's equations within a dielectric cannot be solved for the arbitrary electric field strength. **The contention of this monograph is that there is a limit on the degree to which spacetime may be distorted from the Euclidian, and that if this limit is exceeded, vacuum breakdown will occur and the corresponding spacetime geometry will not be allowed.**

"We have concluded that it is not possible for a light pulse to propagate straight down a radial and cross the event horizon of a black hole. This has been rigorously established within the framework of the quasi-static Schwarzschild metric of Eq. (2.17) $dr/dt = \pm c(r-a)/r$. The conclusion that it is not possible to access the interior of a decaying black hole by any means whatsoever followed from several informal arguments.

"Conclusion 3a: If a black hole has a finite lifetime, it is not possible for a light pulse propagating inward down a radial to pass through the event horizon and reach the interior of the hole. From this finding, we reasoned to the second part of our two part conclusion.

"Conclusion #3b: The interior of a decaying black hole is totally inaccessible from the exterior. Neither light nor falling observers may cross the event horizon.

"The conclusions and speculations of this monograph require no change in the above sequence 1 through 7 (which is the standard view of collapse of a star to become a Black Hole) until step 7 is reached. However, the view taken in this monograph requires that step 7 be modified as follows:

"7: There exists only one force, which can stop this collapse—a massive infusion of heat. This infusion occurs in the last stages of the collapse. At some point in the collapse, a small region at the center of the star will be compressed almost to within its event horizon. A black hole almost forms, but, in accordance with the previous discussion, the space near the almost-formed event horizon instead breaks down in a tremendous explosion. (It may perhaps be regarded as similar to, but much more intense than, the nuclear explosion, which occurs when a ball of fissionable material near the critical mass is sufficiently compressed.) Matter falling in from the outer layers meets this outgoing fireball and is so strongly compressed that any small spherical region within it is compressed almost to within its own event horizon. This highly compressed region also explodes. This process continues as the star continues to collapse. Finally, just as the outer layers of the star are about to collapse through the location where the event horizon would form, the fireball emerges from the interior and halts the collapse. What exits is now a ball of superheated matter of very high entropy and temperature. This process restores the thermal pressure of the star at a high enough level to halt and reverse the collapse. This black hole explodes. (See **'The Black Hole'** by Westergard below for a different nonviolent force that prevents collapse to a singularity).

"The Schwarzschild singularity represents a stretching of space-time to an extreme, which is not allowed. Any attempt to stretch space-time to this extreme will result in a massive breakdown, which will radiate away enormous quantities of energy and relax the distortion. This breakdown will occur just before the Schwarzschild limit is reached." End of quotes.

The following is from an excellent paper "The Schwarzschild Solution and its Implications for Gravitational Waves" by Stephen Crothers [2]

"The so-called 'Schwarzschild solution' is not Schwarzschild's solution, but a corruption, due to David Hilbert (December 1916), of the Schwarzschild/Droste solution, wherein m is allegedly the mass of the source of a gravitational field and the quantity r is alleged to be able to go down to zero (although no valid proof of this claim has ever been advanced), so that there are two alleged 'singularities', one at $r = 2m$ and another at $r = 0$. It is routinely asserted that $r = 2m$ is a 'coordinate' or 'removable' singularity which denotes the so-called 'Schwarzschild radius' (event horizon) and that the 'physical' singularity is at $r = 0$. The quantity r in the so-called 'Schwarzschild solution' has never been rightly identified by the physicists, who, although proposing many and varied concepts for what r therein denotes, effectively treat it as a radial distance from the claimed source of the gravitational field at the origin of coordinates. The consequence of this is that the intrinsic geometry of the metric manifold has been violated. It is easily proven that the said quantity r is in fact the inverse square root of the Gaussian curvature of the spherically symmetric geodesic surface in the spatial section of the 'Schwarzschild solution' and so does not in itself define any distance whatsoever in that manifold. With the correct identification of the associated Gaussian curvature it is also easily proven that there is only one singularity associated with all Schwarzschild metrics, of which there is an infinite number that are equivalent. Thus, the standard removal of the singularity at $r = 2m$ is erroneous, as the alleged singularity at $r = 0$ does not exist, very simply demonstrated herein. This has major implications for the localization of gravitational energy, *i.e.* gravitational waves. **Schwarzschild's actual solution forbids black holes!"**

The following list of derivation steps is quoted from a paper by Robert J. Heaston [3], titled "Derivation of the Einstein Field Equations of General Relativity", all of which is very relevant to the current paper.

"The reconstruction dictates the path that Einstein had to take if he wanted his field equations to converge on the Newton gravitational force. The major lesson learned from this reconstruction is that Einstein probably overlooked, ignored, or bypassed some valid alternative options that radically change the interpretation of the field equations. **The most significant option reveals that singularities are theoretically impossible, an observation that negates inflation theory and modifies the explanations of theories of black holes, the big bang, and strings.**

"Step 1: Newton Force. Newton (1642-1727) published his **Mathematical Principles of Natural Philosophy**, otherwise referred to as **The Principia**, in 1687 [4]. **The Principia** was the pre-eminent theory of gravitation until the general theory. Einstein repeatedly stated [5] that the field equations had to converge on the Newton inverse square law of gravitation at "low masses, large separations and low velocities". **(For steps and end points see Fig. 1).**

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"Five different end-points of the Einstein field equations have been identified as a result of this reconstruction. An end-point indicates a limit or some major threshold. These end-points are indicated in Fig. 1 by large black dots. One of these dots is located over the Newton gravitational force at step 1. **The Newton end-point is not at a specific condition, but we would not exist if it were not for this end-point.** All five end-points will be discussed together after step 18.

"Step 2a: Mass-Energy Equivalence. The record indicates that Einstein had [6] a sudden inspiration on how to begin the derivation of the field equations while writing (October-November 1907) the *Yearbook* article. This inspiration became known as the *equivalence principle*, which explains why Einstein was so adamant that his field equations have to converge on the Newton gravitational force, and why his derivation had to start with step 2a. The equivalence principle essentially states that the mass in Newton's first law (inertial motion) is the same as the mass in Newton's second law (accelerated motion), is the same as the mass in Newton's inverse square law (gravitation), and is the same as the mass in Einstein's $E = mc^2$. No elevators necessary.

"Consequently, the potential energy of the Newton gravitational force is set equal to mc^2 in step 2a. Einstein implied this step at the end of his 1907 *Yearbook* article [7] where he wrote the following. "Any energy, including electromagnetic energy, must, in the gravitational field, have a potential energy ascribed to it, which is equal to that of a mass of magnitude E / c^2. Hence the formula $E = mc^2$ is valid not only for the inertial but also for the gravitational mass, … ." This quote indicates how and where Einstein applied the equivalence principle.

"A later assessment indicates that Einstein may have taken the only step open to him. As Hawking and Israel state [8], "Experiments first carried out by Galileo and subsequently refined by Eötvös, Dicke, Braginsky and Kreuzer indicate that gravity couples only to the energy content of a body. If one introduces no additional geometric structure into spacetime apart from the metric itself and if one requires that the field equations should not involve derivatives higher than the second, one is led uniquely to the Einstein field equations." The conditions stated by this quotation guarantee that step 9 to come can link-up with step 2a.

"As stated above, Einstein's objective was to incorporate gravity within the special theory of relativity. If $E = mc^2$ is considered to be a part of the special theory, then step 2a is an obvious mathematical way to achieve Einstein's objective

"Step 3: Collapse Length. Both steps 2a and 2b give step 3. Einstein had to come through steps 2a or 2b to get to step 3 for two reasons. Notice in Fig. 1 that the collapse length is a template for the field equations except for the multiplier 8π. The field equations cannot converge on the Newton force of gravitation without steps 2a and 2b and step 3. **The way that steps 2a and 2b were defined implies that gravitational collapse occurs until a mass reaches a finite point where it can collapse no more.** Further application of force causes a phase-change transition from matter to energy. This phase-change is an alternative to collapse to a singularity.

"Collapse to a singularity necessarily implies that the laws of physics, particularly the conservation of energy, fail at some point in the collapse process. One way to preserve the laws of physics is to identify a limit in gravitational collapse. ***Six reasons***

will be given in the following **to justify why gravitational collapse reaches a limit instead of continuing to a singularity.**

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"Step 5: Relative Measure. Steps 4 and 5 are quite similar. Both steps are reconfigurations of step 3. Step 4 measures how the gravitation potential of an astrophysical object affects the path of a light beam. Step 5 appears to compare the gravitation potentials of different bodies to each other and some relativistic endpoint. The magnitudes of n are based upon observations of stars. In his article on "The Renaissance of General Relativity:" Will [16] describes results of these observations. "For the most part, the effects of general relativity in stars are very small. The characteristic measure of the size of relativistic effects in bodies is the quantity GM/Rc^2 where M and R are the mass and radius of the body. For the Sun, this factor is 10^{-5}, while for a white-dwarf it is 10^{-3}, both small corrections to the overall structure. … The factor for a neutron star can be as large as 0.3, so that general relativity can introduce sizable corrections to the structure of the body."

"No discussion is presented by Will on the maximum magnitude that n may achieve. In the case of a singularity, n would have to go to infinity. **On the other hand, it is suggested that n approaches unity as the gravitation potential of a body approaches c^2.** In this case $100 \times n$ is the percentage of achieving a relativistic state. For example, a neutron star is $30\,\%$ on the way to being relativistic. Einstein could not consider this option since observations were not possible until the 1970s. **A maximum magnitude of $n = 1$ is the *first reason* why gravitational collapse reaches a limit.**

"Step 6: Heaston-Marquardt Potential of Light. A simple rearrangement of step 3 results in some constant gravitation potential equal to the speed of light-squared. What is the meaning of this constant gravitation potential? A constant $\Phi = c^2$ was separately observed by Heaston [17] and Marquardt [18] at the same meeting. **Heaston attributed the constant potential to be that of light/energy as a consequence of a phase change from mass to energy upon gravitational collapse. Marquardt noticed the ubiquitous occurrence of the potential in phenomena.** There are some hints in a letter to Laub [19] that Einstein had qualms about the role of c^2, but the issue requires much speculation.

"At first glance, c^2 has the units of $\mathrm{m}^2/\mathrm{sec}^2$, but a second look based upon the familiar $E = mc^2$ indicates that c^2 also may have the units of $\mathrm{joules/kg}$, or when inverted as c^{-2} the units are $\mathrm{kg/Joule}$. Could c^2 be the quantum of gravity? **The constant gravitation potential is the *second reason* that a gravitational collapse limit may exist.**

"Step 7: Properties of Free Space. Steps 6 and 7 are related because the gravitational potential c^2 has a role to play in defining the properties of free space. As stated by Tilley [20]: "From Faraday's law of induction, Maxwell inferred that at any point in space, an electric field was associated with a changing magnetic field. Then Maxwell found that in order for relations between the fields to be mathematically consistent, he would have to assume that a magnetic field was associated with the changing electric field. This in turn implied that it would be possible to have a self-sustaining electromagnetic wave, consisting of fluctuating electric and magnetic fields, propagating through space with a wave speed $c = 1/(\mu_0\varepsilon_0)^{1/2}$… It was this discovery that led Maxwell to suggest that light was an electromagnetic wave phenomenon.

"The role of the speed of light in the Maxwell equations and the electromagnetic characteristics of light hinted to me that c^2 could be the constant gravitation potential of light. In addition, since both Klyushin [21, 22] and Wright [23] associate the magnetic permeability μ_0 and the electrical permittivity ε_0 with properties of the ether, it is logical to suggest that the ether is actually represented by c^2. The ubiquitous presence of c^2 in most of the steps in Fig. 1 provides ample justification that c^2 is a universal reference frame."

The speed of light in step 7 in Fig. 1 is expressed as the electromagnetic speed of light c_{em}^2 to differentiate it from the kinematic speed of light. No subscript is used in the rest of the paper. Applications determine the specific form of the speed of light. Wavelength λ and frequency ω are usually defined by the electromagnetic format and may or may not use subscripts.

Einstein gave a talk [24] in 1920 in Leyden, Netherlands on "The Ether and the Relativity Theory" that implies the existence of an ether that could be c^2. "Einstein, who had once dismissed the ether from physics as 'superfluous,' now, to everyone's surprise, declared that in the general theory of relativity 'the ether concept had once more acquired a clear content,' albeit one differing from Lorentz's. 'The ether in the general theory of relativity is a medium which itself is bereft of all mechanical and kinetic properties, but which has a share in determining mechanical (and electromechanical) occurrences.' … This 'medium' was represented by the gravity potentials and was therefore identical with the gravitational field—which makes one wonder what meaning Einstein's new terminology could have had …."

Some of Einstein's friends persuaded [25] him not to bring up the subject of the ether again. And, he didn't. In essence, Einstein by-passed steps 6, 7 and 8.

"Step 8: Critical Collapse Ratio. Step 3 describing the gravitational collapse length can be rearranged one more way to define step 8, the critical collapse ratio.

$$r_S / m = G / c^2 = 7.41 \times 10^{-28}\,\mathrm{m/kg}$$

In words, a mass of one kilogram cannot be contracted to a length less than 7.41×10^{-28} meters and still be a mass. Additional collapse and that kilogram would be converted into energy. Any other mass will have a characteristic collapse limit of r_S based upon the critical collapse ratio. The other combinations in step 8 in Fig. 1 will be explained later.

"Other members of the **Natural Philosophy Alliance** have recognized a need for a collapse of matter to energy. Rydin [26] has referred to the critical collapse ratio in step 8 as the *Heaston limit*, because it fulfills a role in his *Big Wave model* [27]. **Wester-**

gard [28] requires a limit like step 8 in the *Hotson-Westergard universe model*. The critical collapse ratio also provides a mechanism that is consistent with Scarborough's *LB-FLINE model* [29] of energy generation within astrophysical objects.

"The critical collapse ratio is the *third reason* why a gravitational collapse limit exists. The critical collapse ratio suggests a controversial third alternative to fission and fusion to obtain nuclear energy. Contrary to the other two approaches, it may be concluded that all matter, rather than just the mass defect, will transition into energy when subjected to a sufficient force. In addition, the billions of stars that exist do not need to have the rigid compositions now required. The third alternative may or may not be practical, but the theoretical potential exists. This conclusion is more palatable than acceptance of gravitational collapse going to infinity and a singularity. A critical-collapse ratio end-point is located in Fig. 1 next to step 8.

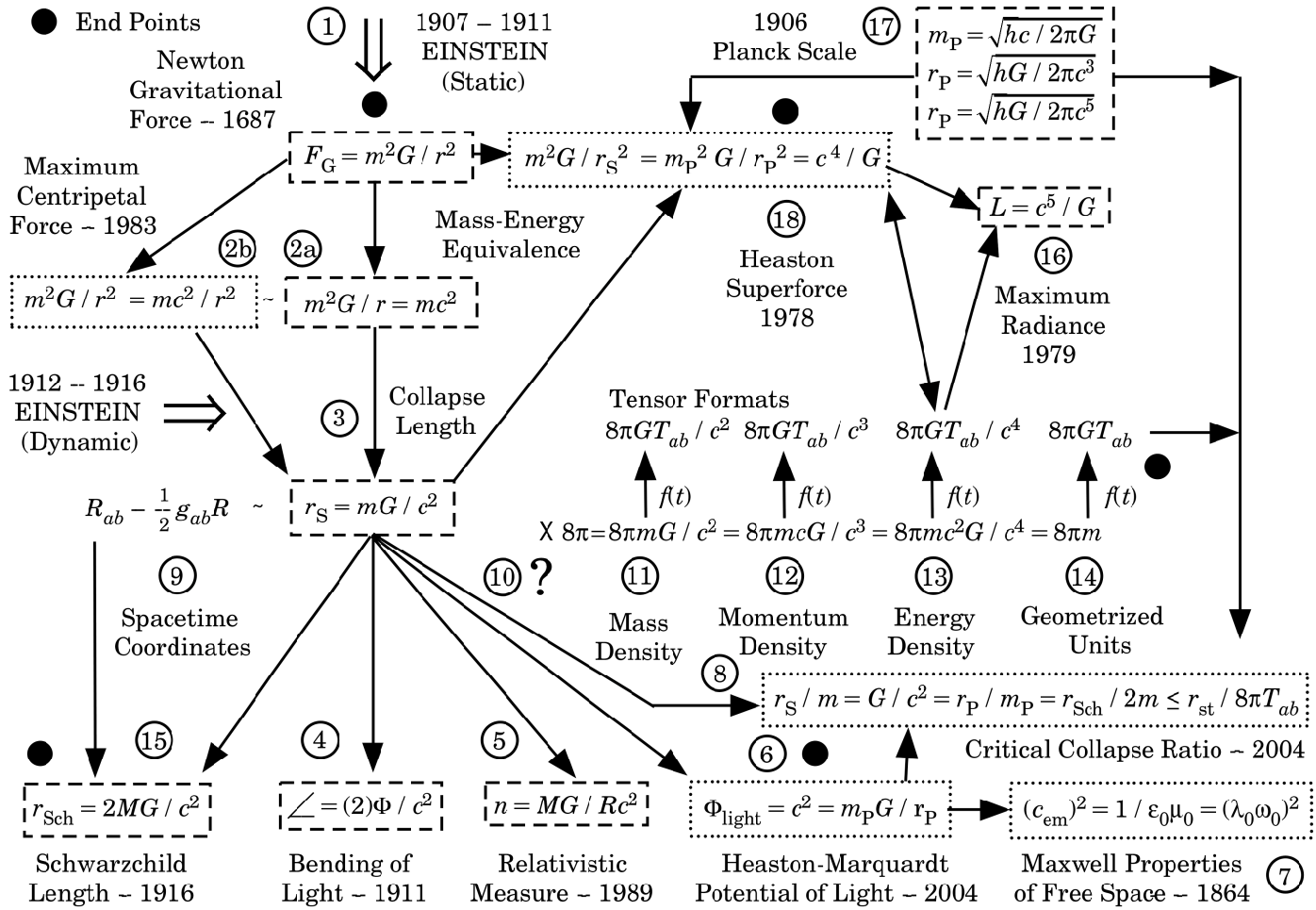

Figure 1. Reconstruction of the derivation of the Einstein field equations of general relativity by relating Einstein's personal correspondence with his technical publications

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"Step 10: The Mysterious 8π. Einstein begins his derivation of the field equations with step 9 in his 1916 paper, not step 1. My explanation of how Einstein eventually couples steps 1 and 9 is as follows. While explaining the mathematics of step 9, Einstein introduces [37] the Greek letter kappa κ into his equations on the left-side as some undefined constant. When step 9 replaces r_S in step 3, κ winds up on the right side of the equation along with an unexplained 8π.

"My explanation for 8π involves three options: a unique geometry for the shape of space that Einstein chose, consequences of manipulating the spacetime tensors and some unexplained manipulation of the Poisson equation [38]. The origin of 8π is on the left side of the field equations and is moved to the right-side to be visible. Misner and others [39] essentially say this. "The equation derived by comparing acceleration in the Newton and Einstein theories and derived directly from the Einstein field equations can only agree if the proportionality constant is 8π." **That is the only way that the Einstein theory can link with the Newton theory. Still, a mystery surrounds the source of 8π, which is the reason for the question mark at Step 10.**

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"Step 14: Geometrized Units Format. Both Einstein and Grossman were students of mathematics taught by Minkowski, who apparently began the use of geometrized units in his 1908 paper [40]. Einstein continued this practice of assuming units where $c = 1$ in those units in a footnote to his 1916 paper [41]. "The unit

of time is to be chosen so that the velocity of light *in vacuo* as measured in the 'local' system of coordinates is to be equal to unity." Misner and others expanded [42] this practice: "Throughout this book, we use 'geometrized units,' in which the speed of light c, Newton's gravitational constant G, and Boltzmann's constant k are all equal to unity." Others [43] have extended geometrization to include the Planck constant. **In my opinion, geometrized units are a big mistake. Much valuable information is hidden from view. Fig. 1 would be even more indecipherable in geometrized units**. It is necessary to be very cautious in interpreting equations when reading articles on cosmology. Most papers on cosmology state somewhere in the text what units are being used.

"The assumption of geometrized units is the reason why the Einstein field equations collapse to a singularity. Dicke and Peebles [44] emphasize the impact of this choice of units, "With the proper choice of units of measure (obtained by setting $G, h/2\pi$ and c equal to 1) the Einstein field equations are satisfied, and the energy density and pressure are positive, so the usual singularity theorems apply." In my opinion the choice of geometrized units is a *reductio ad absurdum*. Nevertheless, a singularity end-point is indicated in Fig. 1 next to step 14.

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"Step 16: Maximum Radiance. Einstein wrote a paper [47] in 1918 on a quadrupole formula solution to the field equations that predicted gravitational waves. It was not until the 1970s and 1980s that there was a major interest in gravitational waves. Douglas and Braginsky [48] showed that "an upper limit on the luminosity of an astronomical source can be estimated." This estimate, which can be derived from the field equations, is indicated in step 16. A flux of energy per second can be obtained by multiplying a velocity times a force. **The existence of a maximum radiance is the *fourth reason* that has been identified which suggests a collapse limit.**

"Step 17: Planck Scale. -----The Einstein field equations have primarily been used in cosmology and theories about black holes, inflation theory, big bang theory and spin-offs to unified field theory and string theory. **Efforts by cosmologists using the field equations with geometrized units result in gravitational collapse to a singularity. Most of the efforts by cosmologists have been concerned with bulk matter.**

"A parallel effort has been on-going since the 1950s to unify the four fundamental forces (gravitational, electromagnetic, weak and strong forces). The Planck constant was introduced through the characterization of the weak and strong forces. Progress in unifying the electromagnetic, weak and strong forces has been referred to as grand-unified theory (GUT). **Efforts to unify gravity with the other forces have evolved under the standard model with the prediction of the convergence of all four forces at the Planck scale and some hypothetical superforce based mostly upon particle interactions rather than a bulk matter approach [52]. The Planck scale is included in Fig. 1 because of these efforts.**

"There is no theory for the Planck scale. This scale was created [53] in 1906 when Planck used dimensional analysis to juggle the speed of light, the gravitational constant, and his own Planck constant to obtain natural units of mass, length and time. It was fortuitous that Planck scale physics had no application until the force unification efforts.

"Since the standard model predicts that the gravitational force, along with other forces converges on the Planck scale, then the field equations should do likewise. It can be shown for the first time that the field equations also converge on the Planck scale as indicated by the following equation.

$$R_{ab} - (1/2)g_{ab}R = 8\pi T_{ab} r_P^{\,2} \big/ m_P^{\,2} G$$

This representation of the field equations is identical with step 13, but it converges on the Planck scale at the superforce c^4 / G described in step 18 that follows. This convergence occurs when geometrized units are not used, because the consequences of the convergence are not visible with geometrized units, which mathematically normalize the equations with their presence. The Planck length divided by the Planck mass also meets the requirements of the critical collapse ratio in step 8.

"The equation above and the characteristics of the Planck scale tend to support the Bekenstein-Hawking formula [54] for the entropy of a black hole,

$$S = 2\pi k A\, c^3 \big/ 4hG$$

where S is entropy, A is the surface area of the event horizon, and the other terms are the same as defined before. Note that the Planck length squared appears inverted in this formula.

Convergence on the Planck scale is the *fifth reason* that the Einstein field equations reach a collapse limit.

"Step 18: Heaston Superforce. In his 1984 book **Superforce**, Davies [55] says, "At the Planck energy, all four forces of nature could be completely merged into a single superforce, …" **Heaston first derived the only known specific superforce in 1976 and has explained its meaning in a number of presentations and papers [56]. Step 18 is the Heaston superforce.**

"Seven reasons may be given for recognizing the existence of the Heaston superforce. (1) The Heaston superforce has the units of a force and has a tremendous magnitude of $c^4 / G = 1.21 \times 10^{44} N$ that fulfills the expectations described by Davies and others. **The magnitude of the superforce is to the strong force between nucleons as the strong force is to the gravitational force.** The relative strength of the superforce as compared with the gravitational force at the Compton length of a particular mass corresponds to the Eddington number [57] derived from the field equations. (2) If the Planck length and the Planck mass from step 17 are directly substituted into the Newton gravitational force in step 1, the result is the superforce in step 18. (3) When the collapse length in step 3 is substituted into the Newton gravitational force in step 1, mass vanishes, and the result is the Heaston superforce in step 18. The superforce is the consequence for any mass, since mass cancels out and apparently vanishes into energy. (4) The speed of light times the superforce in step 18 gives the resulting radiance flux in step 16. (5) The superforce in step 18 shows up in inverted form in step 13 in the field equations. (6) When $c = G = 1$ in step 14, the superforce is equal to unity and the field equations are normalized and can converge on a singularity because of an asymptote. (7) Much of

Fig. 1 is knit together by the superforce because steps 2a, 2b, 3, 4, 5, 6, 8, 11, and 15 when multiplied on both sides by c^2 or c^{-2} will include the superforce.

"The Heaston superforce provides a *sixth reason* for justification of a gravitational collapse limit. In addition, a Planck scale-Heaston superforce end-point is located in Fig. 1 between steps 17 and 18.

"Conclusions [Heaston's]

"The major conclusion resulting from a reconstruction of the derivation of the Einstein field equations is that many limits were identified. Most of these were not known to Einstein.

- The constant speed of light is a maximum in translation and rotation.
- **The transition of mass to energy provides a threshold.**
- Forces converge on a superforce at the Planck scale.
- Matter exhibits a maximum radiance.
- **The event horizon of black holes is a limit.**
- Bending of light is a maximum in black holes.
- Astrophysical bodies tend toward a maximum in relativistic behavior.
- A critical collapse ratio of length to mass exists.
- A constant gravitation potential of light/energy can be defined at c^2.
- The gravitation potential of light is the largest possible gravitation potential. It may be concluded from all of these limits, thresholds, boundaries, and possible asymptotes that the Einstein field equations are bounded. **The primary new consequence of this conclusion is that there is a valid alternative to collapse to a singularity.**

"Another interpretation of the constant gravitation potential of light is that this potential could represent the ether because it is so ubiquitous. The units of c^2 in joules per kilogram also suggest that c^2 could be the quantum of gravity. If c^2 is the constant gravitation potential of energy and is caused by the transition of matter to energy at a critical collapse ratio, then a third alternative to fission and fusion may exist.

"All of the above observations can be related in terms of a spectrum of the mathematical results of the Einstein field equations. The calculated consequence of the field equations is a length-per-unit-volume that represents the curvature of spacetime. Evaluations of the derivations in Fig. 1 indicate that five end-points may be defined. Related steps in Fig. 1 are suggested for each end-point.

"**1.** Collapse of matter into energy with <u>zero</u> curvature of spacetime and a constant gravitation potential of energy/light. Steps 2a, 2b, 3, 6, 7, and 8. **The surprising consequence of this end-point is that the mathematics already exists to explain it; this end-point corresponds to a massless Minkowski spacetime [58].**

"**2.** Collapse on Newtonian conditions at low masses, low velocities, large separations and <u>negligible</u> spacetime curvature. Steps 1, 4, 5, 11, 12 and 13. This is not a sharp end-point, but the universe as we know it would not exist otherwise.

"**3. Collapse of bulk matter on a Schwarzschild black hole event horizon with a <u>very large</u> spacetime curvature. Steps 9, 11, 12, 13 and 15. This bulk consequence of the collapse of matter is to be distinguished from particle collapse in the next end-point.**

"**4. Collapse of particles to the Planck scale at an <u>extremely large</u> curvature of spacetime that acts like a trapped surface below the Schwarzschild event horizon. Steps 8, 17 and 18. An inconsistency exists between end-point 3 for bulk matter and end-point 4 for particle matter although inflation theory ends at the Planck scale and transitions to expansion.**

"**5. Collapse of bulk matter on a singularity with <u>infinite</u> spacetime curvature using geometrized units. Steps 9, 3, 10 and 14. The laws of physics fail only at this end-point.**

....

"The most significant conclusion of the reconstruction of the derivation of the Einstein field equations of general relativity is that his equations remain as a great intellectual achievement, but they must be interpreted in a different manner. Some alternative explanations are possible that will revolutionize our understanding of the universe."

The following is from the Annual Review of Astronomy and Astrophysics By Geoffrey Burbidge, titled "An Accidental Career" [4], which gives a very good understanding of some problems associated with any attempt to change the standard Big Bang Model or even to question the current paradigm. Geoffrey Burbidge served on the initial advisory committee of ARAA in 1960 and served on the editorial committee for five years. In 1973 Burbidge was appointed editor-in-chief, a position he held for more than thirty years. Burbidge was also Director of Kitt Peak National Observatory from 1978–1984. Burbidge and his wife Margaret (who had a Ph.D. in astronomy and was the assistant director of the University of London Observatory) married in 1948. Margaret Burbidge was nominated Director of the Royal Greenwich Observatory from 1979-1982. Both Geoffrey and Margaret are and were two of the greatest astronomers of the 20th century.

"In the late 1940's, some of the greatest physicists of the day, E. Fermi, G. Gamow, E. Teller, Maria Mayer, R. Peierls, and others considered that one of the major unsolved problems was the origin of the chemical elements, **and they concluded that to build them up from hydrogen, a site was needed where there was a large supply of neutrons!!! And, that this site must be the early universe.**

"Penzias and Wilson serendipitously found the background radiation but 24 years prior to that (in 1941) Andrew McKellar, at the Dominion Astrophysical Observatory in Canada, published a paper in which he showed, using the CH and CH^+ lines, that the temperature of this blackbody radiation must lie between 1.8 K and 3.4 K. Although some of us tried to understand this radiation field in terms of large numbers of discrete sources (they did not prevail and it was claimed that the background radiation was predicted by the Big Bang proponents, which is not correct BW).

"It was our discovery of the presence of noncircular motions that first led to the conclusion that matter is pouring out of the center of galaxies. We did a rotation curve study of one of the classical Seyfert galaxies, NGC 1068, which allowed us to set limits to the mass at the center, suggesting that the very large mo-

tions of the gas giving the broad emission lines indicates that matter is pouring out of the center of the galaxies. In the same period Allan Sandage and Roger Lynds had shown that a major outburst was taking place in the nearby irregular galaxy M82. 1959 – 1969.

"It soon became apparent that for Quasars (QSO's), there was no significant correlation between redshifts and apparent magnitudes, as is the case for galaxies. However, it was clear that most astronomers wanted to believe, without proof, that the redshifts were cosmological in origin, and thus the QSO's could be used for cosmological investigations,

"The major argument for this point of view appeared to be, first and foremost, continuity, and second, if they are closer by, there was no theory to explain the large redshifts. The belief that the absence of a theory was evidence against the existence of noncosmologieal redshifts was, and still is, given considerable weight! For me, such an approach is unbelievable, and a bad way to do science. This could only be got around by supposing that the radiating sources are surfaces that were expanding at highly relativistic speeds, an approach that was taken by L. Woltjer and Martin Rees, and a point of view that was immediately accepted by what is already developing into an "establishment" view. Hoyle and I were more skeptical and also in 1966, we wrote a paper making the case that the QSO's might well be comparatively nearby objects, ejected from active galaxies and that the redshifts were intrinsic and had nothing to do with cosmology. The redshifts could not be due to Doppler motions, because if they were, blueshifts would predominate, but there were, and are, no blueshifts.

"Other observational phenomena associated with QSOs and radio sources that bear heavily on our understanding were soon discovered. They include the existence of very rapid radio variations in compact radio sources that are associated with angular motions of the order of 10^{-3} milliarc seconds per year, absorption lines in QSO spectra, and QSOs that appear very close to comparatively nearby galaxies.

"The first of them was found by groups of radio astronomers led by Ken Kellermann, M. Cohen, and others. They showed that if the redshifts of the sources are small, the corresponding motions are less than or only a fraction of the velocity of light. However, for large redshifts the same motions translate into what have come to be known as superluminal motions with values of $\gamma = (1 - v^2 / c^2)^{-1/2}$ often of the order of 5 to 10 or more. I have always considered it likely that superluminal motions as large as this are an artifact and that the belief that the redshifts are measures of distance is wrong. I have shown in two papers published in recent years that if the nearest low redshift galaxies near to the radio sources are the real physical sources, the velocities are reduced to values less than or of order of c. This of course means that the redshifts of those sources (often QSOs) are intrinsic.

"However, once again the establishment point of view is to accept the reality of superluminal motions. I'm still highly skeptical, as I have never been able to convince myself or others that coherent motions corresponding to large values of y can ever be maintained and certainly not over timescales of years, as is required from the observations. In fact, no one has been able to demonstrate this. However, if the QSO's are comparatively nearby, the ejection hypothesis must be correct.

"The third line of evidence concerning the distance of the QSOs was first produced by H.C. (Chip), Arp, a veteran staff astronomer in Pasadena who, in the late 1960's, began to find evidence that appeared to show that high redshift QSOs and radio sources often lie so close to low redshift bright galaxies that he argued they must be physically associated. This work, which went right in the face of the cosmological redshift hypothesis, was extremely unpopular. Chandra, at that time the editor of the Astrophysical Journal, asked Margaret and me to referee some of Arp's early papers because Chandra believed that we would indulge in fair play!

"I became convinced that his evidence could not be ignored. Arp persisted in his observing program until, in the late 1970's, he was forced off the telescopes at Mount Wilson and Palomar by his colleagues and so left to work in Germany. For me this was as far away from fair play as it was possible to go in professional astronomy. As time went on we and a few others became collaborators with Arp, and the evidence for noncosmological redshifts has grown stronger. But for the community that was not prepared to accept these results, the treatment of Arp by his colleagues worked—an example had been made. **Nowadays none of the younger generation is prepared to work on such a radical proposition because they know that if they do, they will get no support from their peers, no funding, and no observing time—the lifeblood of astronomy.**

"Over the years I have concluded that this X-ray emission is associated with QSOs being ejected from centers of active galaxies. It appears to me that as the QSOs are ejected most of the energy comes out in the form of X-rays, later on it will be optical radiation, and finally radio frequency energy. The mechanism of the production of X-ray photons is either due to the synchrotron process or it is inverse Compton radiation.

"Extragalactic energy sources: The results that I have obtained in the 1950s and 1960s, connecting the very powerful extragalactic sources – radio galaxies, Seyfert galaxies, and QSOs – led me to ask what energy sources could possibly be responsible, and also to ask how efficient they must be because a large fraction of what we detect is a huge flux of relativistic electrons with an assumed, but undetected, flux of protons. This was a burning question, and it still is.

"We know that stars do evolve and explode as supernovae. The total amount of energy that is available for release in a supernova per solar mass is about 10^{52} ergs, but most of this comes out in the form of neutrinos. Only 10^{52} ergs or less is left and what we see is 10^{50}-10^{51} ergs as ejected gas and high-energy particles with a rapidly rotating neutron star or black hole left. Most of the energy of the pulsar or neutron star is rotational energy.

"Fred Hoyle and Willy Fowler did not like my supernova chain reaction idea and began to work on the idea that massive stars (10^6 M sun or larger) were releasing gravitational energy as they collapsed. They ignored the question of where the massive starts came from in the first place. It was obvious by this time that the only possibilities were the energy released in gravitation collapse, or the energy was due to creation in the center of galax ies. In 1964, Hoyle, Fowler, Margaret, and I discussed all of this

in a paper published in the Astrophysical Journal. Hoyle and I were quite keen on the creation idea, but it was soft pedaled in that paper. By then, following the publicity generated by the Texas meeting on Relativistic Astrophysics, the field was swamped by theorists working on gravitational collapse, which was generally adopted as the solution, though it is usually stated, incorrectly, that Donald Lynden Bell and Martin Rees, in 1970 were the primary movers. (a) It is not at all obvious why energy will ultimately end up in the form of Gev particles; Note: Perhaps the gravitational energy provides some of the spin ejection energy. (b) No serious suggestions have been made that deal with the problem of the low efficiency. Thus it is argued that matter spiraling into the hole is responsible for the outbursts we see.

"The evidence that is used to conclude that QSOs always lie in galaxies is also flawed, if not plain wrong. This, of course, is a bootstrap argument of the worst kind, but it is generally accepted. It is taken even further by those who feel that a relationship has been established between the size of a galactic bulge and the mass of the central (completely unseen) black hold. By this means it is argued that we can understand the energetic of even the largest redshift QSOs, which are the most luminous if the redshifts are of cosmological origin.

"After 40 years of work I still believe that the large energies in the form of relativistic particles and magnetic flux comprise a major unsolved problem, and that ultimately we shall find that these sources are telling us something new about physics.

"However, when clusters are studied in detail, it appears that the result we found for the Hercules cluster is generally true – the visible kinetic energy dominates over the potential energy; i.e., the virial condition is apparently violated, and this normally would mean that the cluster must either still be forming, or coming apart, or that the galaxies do not make up a single physical system. However, because for many clusters the distribution of the galaxies suggests that the cluster is relaxed and stable, the solution has been to suppose that the clusters in general contain large amounts of dark matter, enough to satisfy the virial relation. This frequently means that 90% or more of the mass must be dark, or else it is in the form of very hot diffuse gas, or something else. This solution has largely been advocated by theorists who have never really looked at clusters.

"However, starting in the 1950's, the Armenian astronomer Victor Ambartsumian, and extremely good theorist, began to make the case that many types of systems, particularly irregular systems, were unbound, and were coming apart. He stressed his argument by simply pointing out that there are many configurations that appear from what we see to be expanding, and so perhaps they just are doing this. He stressed that it was very important just to look at the observations.

"However, other establishment figures, particularly Jan Oort, would not have it – they could not understand what happened to the galaxies after clusters had disintegrated, **and in any case they believed that galaxies were all old and that they must have formed soon after the big bang!** This might mean that some galaxies are young as would be expected if the steady state model was correct. **In other words, Ambartsumian's suggestion was much too radical, as it cast doubt on the general belief in a beginning soon after which galaxies formed.**

"For many people this was the beginning of the idea that the universe must largely be dominated by dark matter, which we could not detect directly. Of course, it is not unreasonable to argue that there is much dark matter around – because the end product of stellar evolution is dead stars (very old white dwarfs, neutron stars, black holes, *etc.*); **but this is very far from accepting the view that whenever it appears necessary, the virial condition can be invoked.**

"We also began to find that there are observations of a number of very small compact groups of galaxies with one member that has an anomalous redshift. We had already found in 1959, that this was true for the fifth galaxy in a famous quintet – Stefan's quintet, which has a smaller redshift than the others. As soon as this discovery was announced there was a flurry of papers; most tried to argue that the small redshift galaxy is much closer than all the others, but this question still remains open.

"In fact, it turns out that out of about 100 very compact groups of galaxies catalogued by Paul Hickson (quartets and quintets) about 40% have one galaxy with a highly discrepant redshift. This either means (a) that one of the galaxies is literally being ejected from the remaining group, which may be expanding, or it might be bound if enough dark matter is present, or (b) that the discrepant redshift or blueshift is not a Doppler shift, or that the discrepant galaxy is either a foreground object or a background object.

"However, for me, as well as for Ambartsumian, statistical arguments and the observed morphology suggest that these systems have positive total energy and are coming apart. Most people believe that the virial argument can be applied in all cases, and that the total mass (luminous and dark) is proportional to the size of the system.

"From the largest scale starting with the universe itself, I believe that expansion, sometime explosive, is an important cosmological feature of the observable cosmos. Expansion is going on in some clusters and groups of galaxies. It is also a common feature going on in the centers of many individual galaxies. **This suggest that galaxy formation is often due to explosive events, and not always, if ever, simply a result of gravitational collapse.**

"It is probable that the general belief, that the formation of all condensed structures is a result of gravitational forces alone, stems from the fact that gravity is a well-established attractive force that works on many scales, **but we have no theory to help us explain expansion. When we see evidence that might suggest that one galaxy is being ejected from another, this possibility is ignored in part because we have no theoretical understanding of how such a process could occur.** Pairs of interacting galaxies are always assumed to be merging. When this is the case we should be able to see tidal tails, as the Toomres pointed out in a brilliant theoretical analysis in 1972.

"This also is one of the reasons why the bandwagon effect, which has reached enormous proportions in some areas of astrophysics, prevails. **Minority views are not given fair weight. And of course, we are all individuals who often find it difficult to control our own feelings of superiority or jealousy when someone else makes a great discovery, particularly when it doesn't fit in with our beliefs.**

"As, I have said many times, in many places, progress in cosmology is entirely dependent on observational discoveries. The most important of these, made in the 1920's, was first that the nebulae (galaxies) are indeed systems similar to our own Milky Way, but much further away, and second, that they followed a tight redshift apparent magnitude relation. Both of these discoveries, largely attributed to Edwin Hubble, led almost immediately in 1929 – 1930 to theorists relating the observations to the Friedmann-Lamaitre solutions to Einstein's equations and hence to the realization that the universe is expanding. Given this situation, the only interpretations that were thought to be possible were that (by reversing the time axis) it was clear that there must have been a beginning, that the expansion would continue, and only observations could determine whether it was slowing down or speeding up, or that the observed expansion continued without changing in any way.

"Of course, there was also the possibility that the redshifts that were measured were not due to expansion at all. Some very well-known physicists – Fitz Zwicky, Edwin MacMillan, Max Born, and others – suggested this, but the known laws of atomic physics suggested that this would not work.

"For about 20 years after the discovery, the only interpretation that had any credibility was that the Friedmann expansion is taking place, and the most interesting aspect of this to most physicists, is to ask what took place at the beginning. However, in 1948, based largely on Tommy Gold seriously proposing that the expansion that we observed might be independent of epoch, he and Hermann Bondi, and independently Fred Hoyle, proposed that the universe has always been expanding in a steady state. This hypothesis requires that creation of mass-energy takes place at a rate determined by the expansion. **Of course, in principle there is no difference between the proposition that creation was a single event in the past, and that creation takes place continuously.**

"In the late 1940's, some of the greatest physicists of the day, E. Fermi, G. Gamow, E. Teller, Maria Mayerk R. Peierls, and others, considered that **one of the major unsolved problems was the origin of the chemical elements, and they concluded that to build them up from hydrogen a site was needed where there was a large supply of neutrons.** George Gamow, Ralph Alpher, R. Herman, and others realized that this must be the early universe (the only place they could think of).

"Earlier Gamow had concluded that the amount of helium in the universe, already known to be about 25% by weight, could not have been made by hydrogen burning in stars because there was not enough time. Thus he made an arbitrary choice to get the right answer (in order to provide the observed elemental abundances) B.W. Thus there is nothing fundamental about the agreement that has been reached between theory and observation, because it depends completely on the belief that Gamow had that there indeed was a Big Bang and that most of the helium was made in the first few minutes.

"But how strongly do the major pillars of belief in the Big Bang based on b and c stand up? As far as (b) is concerned, the fact that Gamow originally chose an initial ratio of baryons to photons that would allow the production of the light elements indicates that making the observed ratios of those isotopes fit the theory is of no fundamental significance as far as testing the Big Bang hypothesis is concerned.

"However, since the early 1960's, the main pillars of belief in the Big Bang have rested on (a) the expansion, which is real, (b) the belief that the light isotopes were made in the Big Bang, and (c) the discovery of the microwave background, always claimed to have been made by Penzias and Wilson in 1965, and predicted by Alpher, Herman, and George Gamow in 1949. Although some of us tried to understand this radiation field in terms of large numbers of discrete sources the solution seemed quite contrived.

"As far as (c) is concerned, it is certainly true that Gamow, Alpher and Herman argued that if there was a beginning there would be a fireball that would expand in a form of a black body.

"In the late 1930's, optical astronomers, particularly Adams and McKellar, had detected absorption lines caused by interstellar molecules in the interstellar gas, and form molecular physics they were able to show that these molecules CH and CH+ are sitting in a low-temperature radiation field. In 1941, more than a decade before the work of Alpher, Herman, and Gamow, Andrew McKellar at the Dominion astrophysical Observatory in Canada, published a paper in which he showed, using the CH and CH+ lines, that the temperature of this blackbody radiation must lie between 1.8 K and 3.4 K. Although there were no direct observations of the radiation field, this was a very accurate prediction, because we now know from the direct observations that $T = 2.726$ K. Although there is some uncertainty in the estimate of the energy density, it should be remembered that the blackbody temperature T is proportional to (energy density) 1/4.

"In the Big Bang theory it is not possible to predict a temperature at all, and when Gamow and his colleagues, and later the Princeton group, speculated on the value of T, they frequently assumed much higher values. These values were wildly wrong. Because the energy density of blackbody radiation is proportional to the fourth power of the temperature, even a value of T of 5 K, suggested by Gamow at one time, leads to an energy density more than ten times the measured value.

"But there is more. Has this discovery really established that the radiation originated in a beginning?

"In the 1950's, I became interested in the origin of helium, and I realized that if it came from hydrogen burning I could calculate directly how much energy had been released. I made this calculation and published the result in 1958, and speculated on the various places where it might have occurred.

"Unknown to me (I don't read literature either) Gold, Bondi, and Hoyle had done similar calculations in 1955 and had speculated that the hydrogen burning takes place in giant K stars.

"Using the known values for the mass density of matter in the universe and a He/H ratio of 0.24, it turns out that the energy density is about 4.5×10^{-13} erg/cm^3. If it is assumed that this has been degraded into blackbody energy, the blackbody temperature is $T = 2.75$ K.

"This is a remarkable result because it agrees so well with the observed temperature. For cosmologists who believe in a big bang, it must be a coincidence!

"Over the years Holyle and I became convinced that it really does suggest that all of the helium has arisen from hydrogen burning in stars somewhere. Accepting this, we have a stellar source for all of the helium, so it is now hard to argue against the view that all of the isotopes including ^{2}D and Li are also produced in stars. The low temperature at which D will burn in a stars interior means that it must be produced in stellar flares, and there is some observational evidence that this does occur in the sun and elsewhere.

"In the papers of 1955 and 1958, Gold, Bondi, Hoyle, and I made one critical omission. In neither paper did we point out that the calculated energy density meant that the blackbody temperature would be about 2.75 K. If we had done this there would have been a direct prediction of the blackbody temperature available (admittedly made by unpopular people) when the first measurements by Penzias and Wilson were made. This might have led to a different chain of argument and belief in the cosmological community. **Most of them believe that there is only one viable cosmological model and no attempt is made to consider origins that do not start with a Big Bang.** The reader can see from this that I believe that the pillars (b) and (c) on which much of Big Bang cosmology rests are not as strong as is generally advertised.

"Some of the classical cosmologists, including W.H. McCrea, showed in the 1940s and 1950s, that forming galaxies by gravitational collapse in an early phase of an expanding universe would not work. In order to construct a scenario in which it is possible to form galaxies, a whole series of assumptions have to be made.

"These start with the idea that there are small density fluctuations present in the original material—possibly with a quantum origin. Then it is necessary, in order to get rid of the horizon and flatness problems and to do away with a high density of magnetic monopoles, to develop the concept of a very rapid, very early expansion phase—inflation. This idea, due to Guth and Linde, is very attractive, but it does not come out of pure theory and can never be directly tested.

"In order to get the gravitational instability argument to work, it is necessary to invoke the presence of large amounts of cold dark matter, and because it is found that the amount required is in conflict with what is indicated from the ^{2}D abundance in primordial nucleosynthesis, it has had to be argued that this is a new kind of matter, nonbaryonic matter, for which there is no direct experimental or observational evidence.

"Given all of these assumptions, extensive numerical studies have been made to attempt to get agreement between what is seen in the large-scale structure of visible galaxies in the universe and the theoretical distribution of matter that must largely be nonbaryonic.

"Also, in the last few years it has been claimed that the universe is accelerating, and this has led to the revival of the idea that there must be a positive cosmological constant and what is called dark energy. (This claim is based on observations of supernovae of Type 1a at large redshifts. Though prizes have been given for this type of work, some very good observers are very skeptical of the results. But this is the basis for all of the excitement about dark energy.) In fact, long ago it was shown by Bondi and by Hoyle and Sandage in 1956, that any steady state universe would be accelerating and not decelerating, essentially because energy is being continuously created as the expansion continues. **Thus, overall, I believe that the current bandwagon view is a much too contrived solution to the puzzle of the origin of galaxies to be correct.**

"What has been entirely left out of this scenario are the many observations, some of which I have mentioned earlier, which show that individual galaxies are ejecting large amounts of energy that we do not really understand. Also, there is much evidence that suggest that the high redshift QSOs are being ejected from the active galaxies. This result is one that the conventional cosmologists have continuously ignored, but by now the evidence that this effect is present is overwhelming. Another huge problem it raises is that the redshifts of the QSOs do not have a cosmological origin.

"The fact that there is no understanding of these redshifts is almost certainly one of the reasons why the data have been ignored. There is some evidence in favor of cosmological redshifts, but we are at one of those times when contradictions are rife; but for me, that is not a good reason to reject good data because we don't understand it.

"All of these data led Fred Hoyle, Jaant Narlikar, and me in the early 1990s, to propose a cosmological model, which is a modified version of the original steady state. We have argued that we live in a cyclic universe that is now in an expansion phase and has a period of about 20 billion years. It is largely driven by the creation processes, which takes place in the nuclei of galaxies where we see all the activity taking place, and where creation is occurring very close to the centers—the theory is that developed by Hoyle and Narlikar in the 1960s. **Basically, galaxies beget galaxies. This can explain nearly all the phenomenon that we observe, though we have not yet been able to understand the anomalous redshifts of the QSOs.** This was all laid out in a monograph we published in 2000.

"Although this is a very unpopular point of view, I believe that it is probably closer to the truth than the standard model. Only time will tell. Unfortunately, though it is generally believed that as science evolves, in time truth will tell, there is such a heavy bias against any minority point of view in cosmology that it may take a very long time for this to occur. This is because anyone who takes a university position will get no research support or time on telescopes, and the young people are well aware of this." End of quote.

M82 is one example of hundreds that show low redshift galaxies which are observed to be physically connected to high redshift QSO's and/or appear to have ejected QSO's. Many of the galaxies show bipolar ejections with one QSO on each side of the ejecting galaxy and across the minor axis at about equal distance from the galaxy.

QSOs Associated with M82 [5]

From E. Margaret Burbidge,[1] Geoffrey Burbidge,[1] Halton C. Arp ,[2] and Stefano Zibetti [2]

"The starburst/AGN galaxy M82 was studied by Dahlem, Weaver, and Heckman using X-ray data from *ROSAT* and *ASCA* as part of their X-ray survey of edge-on starburst galaxies. They found 17 unresolved hard X-ray sources around M82, in addition to its strong nuclear source, and other X-rays within the main body of M82. We have measured optical point sources at these positions and have obtained redshifts of six candidates at the Keck I 10 m telescope, using the low-resolution imaging spectrograph (LRIS). All six are highly compact optical and X-ray objects with redshifts ranging from 0.111 to 1.086. They all show emission lines. The three with the highest redshifts are clearly QSOs. The others with lower redshifts may be either QSOs or compact emission-line galaxies. In addition to these six, there are nine QSOs lying very close to M82 which were discovered many years ago. There is no difference between optical spectra of these latter QSOs, only two of which are known to be X-ray sources, and the X-ray–emitting QSOs. The redshifts of all 15 ranges between 0.111 and 2.05. The large number of QSOs and their apparent association with ejected matter from M82 suggest that they are physically associated with the galaxy and have large intrinsic redshift components. If this is correct, the absolute magnitudes lie in the range $8 < M_v < 10$. Also, we speculate that the luminous variable X-ray source which has been detected by *Chandra* in the main body of M82 some 9″ from the center is another QSO in the process of ejection from the nucleus, and we propose some observational tests of this hypothesis".

The Hotson/Westergard Universe

Commentary on the Work of Don Hotson by Bill Zebuhr

"In 2002, Infinite Energy published a two-part article by Don Hotson, "Dirac's Equation and the Sea of Negative Energy" (Issues 43 and 44). These are available online at:

www.zeitlin.net/OpenSETI/Docs/HotsonPart1.pdf

www.zeitlin.net/OpenSETI/Docs/HotsonPart2.pdf

"As a casual reader of IE at the time the articles first appeared, I did not pay close attention to the depth of the material; however, I was motivated to read them more carefully when Billie Westergard, an astronomer who published an article IE #68, stated that he thought Hotson's work might be the best published in physics. By then, **I was a technical editor for IE and I reread the Hotson articles. First I read them through, realizing I was missing a lot. Then, I studied them, trying to see the justification for each assertion and came to the conclusion that Billie Westergard was probably right and these articles might be the best material written in physics;** I went on to state this in an editorial (IE #69). Don saw my editorial and said that I "smoked him out of his cave." That started a two-year effort that resulted in the third article that is in this issue. Volume 15, issue 86, 2009.

Quotes from Dirac's Equation and the Sea of Negative Energy, Part 1, by D.L. Hotson [6]

"The treatment of Dirac's equation is a lesson in the way modern science works (or rather doesn't). This treatment has more recently been paralleled by the treatment of Reich, Pons and Fleischmann, Halton Arp, and others. But I think if one had to point to a single place where science went profoundly and permanently off the track, it would be 1934 and the emasculation of Dirac's equation. This crisis at the heart of science caused a chronic "hardening of the paradigm" and science thereby lost the ability to self-correct.

"Dirac's wave equation is a relativistic generalization of the Schrödinger wave equation. In 1934 this brilliantly successful equation was shorn of half of its solutions by a questionable bit of mathematical slight-of-hand. Because it was "politically correct," this bit of juggling became the accepted interpretation. However, recent developments have shown the very basis of this mathematical trick to be invalid, in that it would involve massive violations of conservation. A reevaluation is therefore warranted.

"The Schrödinger wave equation has been said to "contain most of physics and all of chemistry." Since Dirac's equation is a relativistic generalization of this already generally applicable wave equation, in formulating it Dirac expected that its solutions would describe "everything that waves." Since all matter and energy evolve as waves, Dirac thought his equation would be a unitary "theory of everything." However, the discovery of several new particles and peer criticism resulting in the truncation of the equation frustrated this expectation, and it is generally known at present as "Dirac's equation of the electron."

"Dirac's complete equation, however, describes a quantum spinor field, which has as solutions four different kinds of electron: electrons and positrons of positive energy, and electrons and positrons of negative energy. Such supposedly "fundamental" entities as quarks and gluons have no comparable wave equations; yet they wave. Therefore they cannot be truly fundamental. Since in principle the Dirac field comprises "everything that waves," the equation therefore predicts that the entire physical universe can be made from these four kinds of electron. This study validates this prediction: all matter and all forces are shown to be necessary combinations and applications of just these four kinds of electron, fulfilling Dirac's unitary expectation.

"In addition, direct applications of Dirac's equation provide simple, logical, and natural models of the electromagnetic field, the "photon," the "strong nuclear" force, the Ψ wave, inertia, and gravitation. It provides direct-contact physical models that agree with experiment, as opposed to the purely mathematical (and unworkable) models so much in vogue. The phase-entanglement feature of quantum mechanics, demonstrated by Bell's Inequality and the proofs thereof, requires that our reality be non-local. This seems to banish causality. However, Dirac's equation provides causal, direct contact models which are nonetheless non-local.

"The universe exhibits very conspicuous economy, even parsimony, of means. The DNA molecule, the basis of life, is arguably the most complex entity known. Yet its code is written using just four components, the four bases whose combinations comprise the genetic code. It can be shown by complexity theory that three bases would not provide sufficient complexity for this code, and five would be redundant. Yet any number of components could have been used. However, only four are necessary, only four are used. Further, all stable matter, including all of the chemical elements and their compounds such as DNA, is built of just three components—electron, proton, and neutron. Again only three components are necessary, only three are used. Consider this as a sequence, from more complex to less complex: four components are both necessary and sufficient to build DNA, three components are both necessary and sufficient to build all stable matter. Does this suggest that to build these three components would require thirty-six "fundamental" components, and nearly one hundred entities? Surely not…

"Going by the above sequence, we should instead consider how many components are necessary to build electron, proton, and neutron. And here the computer shows the way.

"The only physically possible combinations of these three entities result in ninety-two "natural elements," most of them stable. (Note that all possible combinations are actually used.) And the possible (chemical) combinations of these ninety-two "elements" are unlimited. So the numbers of entities in the computer modeling sequence would be 2, 3, 92, unlimited.

"This is the fastest physically possible route to unlimited complexity. It is faster than any arithmetic or geometric progression. These are the necessary numbers of entities; they should be sufficient. It is totally absurd to suppose that the sequence would go 36, 3, 92, unlimited, as the Standard Model (SM) insists.

"In the early 1930s controversy involved the Dirac relativistic wave equation (Dirac, 1928a, 1928b), a relativistic generalization of the Schrödinger equation:

$$\sum_{\beta}\left[\sum_{\mu}(\gamma_{\mu})_{\alpha\beta}\frac{\partial}{\partial x^{\mu}}+\frac{mc}{\hbar}\delta_{\alpha\beta}\right]\psi_{\beta}=0 \quad , \quad x^{\mu}=\vec{x},\, ict$$

"Pais (1994) ranks this spectacularly successful equation "...among the highest achievements of twentieth-century science." It was the first to be Lorentz-invariant, it had electron spin as a necessary consequence, it gave the right magnetic moment, the Thomas factor appeared automatically, and the Sommerfeld fine structure formula was derived with the correct Goudsmit/Uhlenbeck quantum numbers. At low energies, the results of the ordinary Schrödinger wave equation are recovered. It predicted the positron, which was discovered by Anderson soon after. It has since become the very basis of Quantum Electrodynamics (QED) (Pais, 1994).

"Despite these successes, the physics community greeted it with alarm and outrage. This was because the equation gave twice as many states as they thought it should have. They expected a Ψ with two components; but this equation gave four. After the discovery of the positron, it was realized that its four solutions call for electrons and positrons of positive energy, and electrons and positrons of negative energy (Pais, 1994).

"As Dirac pointed out, this is because the energy-momentum-mass relation $E^2 = c^2p^2 + m^2c^4$, always associated with Einstein and Special Relativity has two roots; it calls for both positive and negative energy: $\pm E = \sqrt{c^2p^2 + m^2c^4}$.

"[The mass-energy relationship $E = mc^2$ was first derived and published by Oliver Heaviside (1890) and further refined by Poincare (1900), but Einstein (1905) first furnished the complete expression including momentum.] Dirac wondered what to do with the negative energy solutions. "One gets over the difficulty on the classical theory by arbitrarily excluding those solutions that have a negative E. One cannot do this in the quantum theory, since in general a perturbation will cause transitions from states with E positive to states with E negative." (Dirac, 1928a)

"Since all negative-energy states have lower energy than any positive-energy state, Dirac wondered why there were any filled positive states, since according to Hamilton's law all entities tend to seek the lowest-energy state. He suggested that all of the negative energy states must be filled, like the filled electron shells in the Pauli exclusion scheme. Then, unless a "vacancy" occurred, positive energy particles would "float" on the surface of the negative-energy "sea" and stay positive.

"**Heisenberg's Window.**

"Heisenberg was the most upset by this theory, which outraged his Machian belief system, so it is no surprise that he was the first to work out a way to squirm out of the Dirac equation's and the energy equation's requirements of negative energy states (Heisenberg, 1934b).

"He made use of one of Dirac's own suggestions. After absorbing extended criticism from the Machians, Dirac had concluded that, contrary to his earlier "hole" theory, all the negative-energy states must be filled with negative-energy electrons and positrons. He reasoned that if all the negative states and none of the positive states were filled, the two could have no effect on each other. Thus Dirac made what came to be called the "zeroth order subtraction," removing those parts of the theory which referred to the negative-energy "sea." (The subtraction utilizes a mathematical trick, the Grassman elements, to remove two of the states called for in the Dirac equation, the two negative energy solutions. The Grassman elements are generalizations of Hamilton's "quaternions," elements that satisfy such strange-looking equations as $a \times b = -b \times a$. Grassman's elements look even stranger. In them, $a \times a = 0$. They can be used mathematically to express the exclusion principle, but at the cost of eliminating negative energies. There is no justification for supposing they apply to Dirac's oscillators. Their use is equivalent to saying, "Let black equal white. Now, black doesn't exist!") While Dirac intended the step merely to simplify calculations, Heisenberg seized on it, using it to deny any existence to such states.

"The problem was that such states seemed necessary, both to the theory and to the experimental evidence. Using the theory, Dirac (1930a), Oppenheimer (1930), and Heisenberg (1931) had all shown that every charged particle can give rise to unlimited numbers of electron-positron pairs and their associated photons, pulled up from the "sea" by the charge, making every interaction an infinite-body problem. Moreover, this "polarization of the vacuum," apparent in measurements even then, has since been

rigorously verified (Pais, 1994). The Dirac theory (1934) required every charge to be surrounded by unlimited numbers of the opposite charged ends of electron-positron pairs (henceforth "epos"). Experiment verified that the epos were both present and necessary.

"This "polarization of the vacuum" has since become QED's most celebrated success. Using difficult perturbation calculations involving the charges of an unlimited number of epos and their associated photons surrounding a charged particle, the theory computes the electron's magnetic "g" factor to an agreement with experiment of ten significant figures or more.

"So Heisenberg looked for and finally found what seemed to be an escape hatch. (Furry and Oppenheimer [1934] independently made similar suggestions)

"Since Dirac's "zeroth order subtraction" removes all trace of the negative-energy "sea" from the equations, Heisenberg (1934b) found that he could skirt around the "sea" (mathematically) as if it doesn't exist. The equations call for electron-positron pairs. But since the negative-energy "sea" removed from the equations now doesn't exist, they can't come from there. Therefore the operator that previously called for unlimited numbers of negative energy electron-positron pairs to be raised in state (from negative to positive energy), now magically became a "creation operator" of unlimited numbers of positive energy electron-positron pairs. (Magically, because they apparently appear from nowhere) Since they come from nowhere, yet must be present, this operator creates them on the spot. Similarly, when they disappear again at this same sea level, they can't be returning to the non-existent "sea," they must be annihilating, so the state-lowering operator magically becomes an "annihilation operator." (See Pais [1994] for the details)

"In effect, Heisenberg merely put "horse blinders" on the equations, so they could no longer "see" the negative energy solutions. He reset his gauge to zero at "sea level." Using the "zeroth order subtraction," which forces all results to be positive, an "ocean" no longer exists: there are no negative solutions, so nothing is below "sea level." Those waves out there; oh, they're just vacuum fluctuations around the zero base line. We call them "Zero-Point Fluctuations." **When a dolphin is ill-mannered enough to jump out of this nonexistent ocean, we merely utilize the "creation" operator, and voilà, a dolphin appears. When it dives back into the non-existent ocean, quick, Henry, the "annihilation" operator, and presto! It's gone.**

"At What Cost?

"On one side we have perhaps the two most used and respected relations in modern physics, the energy equation and Dirac's relativistic wave equation. The energy equation calls for negative energy, and Dirac's equation specifically calls for negative-energy electrons and positrons in unlimited numbers. Experiment confirms that electron-positron pairs (epos) in unlimited numbers actually exist, surrounding and being polarized by every charged particle.

"As noted above, the Dirac equation was spectacularly successful. Not only did it explain everything Dirac hoped it would, the above listed accomplishments include several complete surprises, as were the totally unanticipated predictions.

"But if we follow Heisenberg, we are expected to believe that this colossus of equations has feet, or roots, of clay. We are told that it is completely wrong only in this one thing, the sign of the electron-positron pairs verified by experiment. They are not merely "raised in state" from a negative energy "sea" of such pairs. That, we are assured, is impossible: it must be "an accident of the formalism." Instead, these necessary epos must be created on the spot in an operation that violates either conservation or General Relativity, or both.

"The Miracle of "Creation"

"However, for Heisenberg to put physics into the "creation" business is something else entirely. In what form does a "relation" loan out "pure energy"; cash, check, or money order? And since there are unlimited numbers of epos around every charge at all times, it doesn't matter how briefly each individual epo exists, it amounts to a permanent loan of infinite energy. "Creation" is the proper term for it: only God could have that much energy to loan.

"There are further conservation problems with any "creation" process, even one where the mass-equivalent energy is supplied by real, 0.511 MeV photons. For both electron and positron have spin (angular momentum) energy equal to $\hbar/2$. By any assumption as to the size of electron and positron, this is much more energy than that supplied by photons at "creation," or taken away by photons at "annihilation." Somehow the "created" electron has something like sixteen times more energy than the photon that "created" it.

"This spin energy is real energy. It is the angular momentum needed by the electron to set up a stable standing wave around the proton. Thus, it alone is directly responsible for the extension and stability of all matter. Ultimately, it supplies the hv energy acquired by a photon when an electron jumps from one orbit to another. This half-integer energy is the cause of Fermi-Dirac statistics, of the Pauli exclusion principle, and ultimately of the periodic table of elements.

"In mathematics, if you set two things spinning in opposite directions, and take the average, the spins average to zero. But in the physical world, giving two real objects large amounts of angular momentum takes real energy. Instead of honestly facing this gross abandonment of conservation, current theory dubs particle angular momentum an "intrinsic attribute." All that says is, "This energy is there; we don't know where it comes from, so let's not talk about it." Calling it an "intrinsic attribute" is supposed to close the subject, like the Stephen Leacock aphorism: "'Shut up,' he explained." Naming and agreeing to ignore it makes this 1600% violation of conservation go away. In effect, current theory proclaims a miracle every time "creation" or "annihilation" is invoked—perhaps 10^{100} or more times a second. This demonstrates that conservation is merely paid lip service in the present practice of physics—something to be respected if it agrees with the current paradigm, but thrown to the winds if it proves inconvenient.

"Even ignoring these massive violations of conservation, it seems hopelessly naïve to suppose that complex entities such as electrons and positrons, with spin, charge, and a number of other properties, could be "created out of nothing" but "pure energy." This is like supposing that if we put a bunch of electronic components in a box, and shake them hard enough (*i.e.* add "pure energy") the result will be a computer. "Pure energy" can never supply the exact and specific information necessary to make the

highly complex little entities that we call electron and positron. After all, we don't know how to make either electron or positron. What is "electric charge"? We haven't a clue. Why are their spins quantized in half-integer values? No idea. Where do they get their immense, anomalous angular momentum? Beats us. And how on earth do they manage to pack all this into a zero or near zero radius? Yet we baldly suppose that "pure energy" knows how to do all these things we can't do!

"Given all these problems with Heisenberg's "window," wouldn't it have made sense to at least look at what two of the most successful equations in recent scientific history mandate? They say that electron-positron pairs already exist, everywhere. Instead of being "created" in pair production or around every ion, which as we have seen involves massive violations of conservation, **they are merely raised in state from negative to positive energies.**

"When an electron approaches a positron, they don't just rush together and disappear. Instead, they approach until they are a distance apart that is the width of the electronic ground state of hydrogen. At this relatively large distance (some 56,000 times the diameter of a proton) they start to orbit around each other in the configuration called "positronium."

"(This in itself should have told us that something other than "annihilation" was going on.) They never get closer to each other than atomic distances. After orbiting each other in this pseudoatom for a time that depends on whether their spins are parallel or opposed, they emit two or more photons that total all of their positive energy. After that they are no longer detectable, and conventional wisdom says that their charges and spins have "cancelled" and that they have "annihilated" and are no more. But since they never get closer to each other than 56,000 times the diameter of a proton, how can they possibly "cancel and annihilate"? They never get anywhere near each other, and nothing passes between them. For them to "annihilate" would be action at a distance, a direct violation of causality. **Doesn't it make more sense to suppose that they still exist, as the Dirac equation requires, merely lowered in state to negative energies?**

"Another problem: to say that something has charge means that it has potential energy with respect to every other charged particle in the universe, and vice versa. For an electron and positron to "annihilate" while they are a large distance apart means that, according to Maxwell's equations, the potential energies of every charged particle in the universe must change instantaneously, except for those that are exactly equidistant from both of them. This violates conservation not only locally, but universally. It is real action at a distance, violating causality as well. But again the problem would seem to be solved merely by taking seriously what the Dirac equation says: **that the spins and charges still exist, merely lowered in state to negative energies.**

"What the equations call for validates the conservation of charge, which is violated by "creation" and "annihilation." Just as conservation of mass-energy means that mass-energy can neither be created nor destroyed, so conservation of charge means that charge can neither be created nor destroyed. (We will later look at other supposed creations of charge, such as beta decay, and show that in each case the supposed creation was merely the separation of an existing epo.)

"Arp's Axiom

"So we see the choice that scientists of the time had to make: whether to believe what these fabulously successful equations say about negative energy, and try to figure out what negative energy might mean, or to escape through Heisenberg's "window" and save the paradigm. As we know, they saved the paradigm, even though this required wholesale miracles that put science into the "creation" business on a scale rivaling the God of religion. Also incidentally, it required immense violations of causality, of conservation of charge, and of conservation of angular momentum, as well as the mind-numbing violation of conservation of mass/energy. Thus it violated four of science's most basic "laws." **One wonders if there are any lengths to which scientists will not go in order to save the paradigm. In this case, saving the paradigm would seem to involve the virtual abandonment of science itself.**

"Heisenberg's window was chosen and almost immediately the theory was engulfed in infinities. For, of course, if these epos are "created" by the electron's charge, its mass must include them—an infinite-body problem, making the mass of the electron, as Treiman (2000) puts it, "slightly infinite." Moreover, surrounded by this infinity of positive charges, its "bare" charge had to be infinite also, or no charge would "leak out" to be measured. And virtually any electromagnetic process one could name turned out to be infinitely probable.

"These infinities continued to plague the theory, turning up in endless additional cases and making life miserable for everyone until, in exasperation, we fudged the answers we wanted. This only swept under the rug certain classes of infinities, but at least it allowed us to do the theory and extract additional information after some of the infinities were wished away.

"After the Nobel Committee had dignified this fudge with a prize, there was no longer any need to consider changing the paradigm when conflicting data threatened it. Following Heisenberg's lead, one merely crafted unobservable entities with suitably designed properties that made it all right again.

" "But wait," the defenders of the paradigm exclaim. "The electron's magnetic 'g' factor agrees with experiment to better than ten significant figures. This proves that we made the right choice!" Sorry, it doesn't. The Dirac theory also calls for positive-energy epos to surround every charge. (Moreover, as Dirac pointed out, a perturbation such as this will cause transitions from states with E positive to states with E negative.) So this one calculation would be exactly the same, whichever choice was made. But seemingly all of the other calculations come up either infinite, or so imprecise as to call into question the validity of the theory. An example is the magnetic moment of the proton, in which the measured value is 10,000 times more accurate than the theoretical value (Feynman, 1985). Obviously, this is why we hear only about this measurement of the " g " factor, the one total success, not about the numerous total failures and near misses.

"**Therefore it would seem that the accepted paradigm's only instance in which near-perfect agreement is reached between theory and experiment is the one instance in which both choices would give the same result.**

"It is increasingly clear that we made a choice to save the existing paradigm despite the basic laws of physics, the evidence, and the clear meaning of the equations. As a direct result, violations of conservation, entities, infinities, and ever more mathematically intractable theories proliferated without limit, right up to the present. But there is one recent development that calls into question the very basis of that choice.

"The Smoking Gun

"It turns out that, in effect, the equations of QM act as if time is quantized. As Prof. Treiman (2000) explains, "There is another inequality relation in quantum mechanics that is often cited, one involving energy and time. It has the look of an uncertainty principle but it stands on a different footing than the Heisenberg uncertainty relations discussed above." He goes on to show that there is a minimum time, τ, which must elapse before the wave function "changes appreciably." [This minimum time appears to be $2e^2/3mc^3$, or 6.26×10^{-24} seconds. We will discuss this later.] This means that the wave function changes only in increments of the constant, τ. From the time $t=0$ to $t=\tau$ there is no change in the function; then at $t=\tau$, all the change happens at once. He then shows that the modern version of what Heisenberg assumed to be the uncertainty relation $\Delta t\Delta E\geq\hbar$ is really the inequality $t\Delta E\geq\hbar$ (We will examine this apparent quantization of time in more detail later).

"If time is a constant that can only come in increments of τ, as this inequality relation shows, then obviously it cannot be taken in increments approaching zero. Furthermore, in a "perfect quantum measurement" situation, such as the Airy Pattern, (Herbert, 1986), the root mean square energy deviation would equal $\hbar/\tau$. At most, it would be a random amount over this depending on the measurement situation. Therefore Heisenberg's "relation" is a poor "relation": it does not have infinite amounts of energy to lend on every occasion. In a good measurement situation all the energy available is $\hbar/\tau$. There certainly is none to spare to "create" infinite numbers of electron-positron pairs. **This means that Heisenberg's window never existed.**

"To recap: Heisenberg's window was not outrageously in violation of conservation only because Heisenberg's relation was supposed to supply infinite amounts of energy to every interaction. If that is not the case, as the above "smoking gun" emphatically shows, then Heisenberg's window doesn't exist. But the paradigm escaped through that nonexistent window.

"Negative Energy

"It seems we need to go back to 1934 and take another look at Dirac's negative energy solutions. As mentioned above, simply taking these equations at their word eliminates most of these infinities and gross violations of conservation. The equations say that unlimited numbers of epos already exist, everywhere, and that they are merely raised in state, not "created." It is possible, perhaps, that there exists another "window." Certainly defenders of the paradigm will search for one. However, Heisenberg (and other brilliant theorists, such as Pauli, Jordan, Furry, and Oppenheimer) searched for six years, then came up with a window that wasn't. In any case, the above difficulties with the present paradigm indicate very clearly that there were immense problems with the choice they made.

"What might we expect to find down the "road not taken"? As noted in the opening argument, Ockham's razor measures the progress of science in terms of simplicity. If "negative energy" is a correct road, we would expect the number of entities recognized by science, seven in 1932, to decrease further rather than to increase to nearly one hundred, as they have done since then. We would expect a consequent simplification of the mathematics involved. We would certainly expect to clear up the gross violations of conservation implicit in Heisenberg's "creation" window. And this would, as we will show, clear up the infinities that plague current theory without recourse to fudging.

"This is such an ambitious project that we cannot hope to prove all of this in the present work. We merely hope to indicate the directions that future theory might take in following the clear leads of the energy equation and, most particularly, of the complete Dirac equation in the light of subsequent discoveries. And above all we should remain flexible. Clearly, this crisis at the heart of science was the result of a chronic "hardening of the paradigm." With new discoveries being made almost daily, no theory can be expected to be the final answer. In all probability, there is no "final answer."

"Therefore, while we may present a number of probable consequences of following this new road, keep in mind that they are all tentative, subject to revision as well as analytical and experimental falsification. In view of this, the first step is to take a long look at the rejected alternative, the negative energy sea that this most successful of equations calls for. In particular, what could "negative energy" represent?

"Symmetry

"These two equations call for symmetry between positive and negative energy. This only matches the symmetry between the forces recognized by physics. There are two kinds of forces in nature, those that bind matter together, and those that free it; that blast it apart. The binding forces, such as gravitation, the "strong nuclear" force, and the Coulomb force between unlike charges, all have negative signs. The freeing forces, such as the repulsive Coulomb force between like charges, have positive signs. The positive-sign forces act to increase the amount of positive energy; the negative-sign forces all act to decrease it. Logic would indicate that "positive energy" would be the result of positive forces, and "negative energy" the result of negative forces. However, because matter (mass) is positive energy, our reality has a large positive-energy balance. It never seems to venture into negative territory, so we get by with an illogical "single entry" bookkeeping that treats positive energy as the only kind.

"Negative Roots

"Science has ignored the negative energy solutions to these equations as "imaginary," like the square root of a negative number. However, the square root of minus one is not "imaginary"—that is perhaps an unfortunate name. Mathematically, represented as i, it simply designates a number field, or dimension, at right angles to the everyday three. It is necessary to many disciplines, especially electronics. In the Einstein-Minkowski interpretation of special relativity this "imaginary" dimension is time. According to Minkowski (1909), there is "no difference" between x, y, z, and ict, where t is time and c is

the velocity of light. Everyone who takes relativity seriously, therefore, believes in the reality of at least one direction in which one cannot point: a definitely non-Machian belief. However, mathematically there is no limit to the number of dimensions. In electronics, for instance, this "imaginary" dimension is not time. So it would seem that we need at least five dimensions.

"Many of the popular string and superstring theories require, for symmetry, a space of ten dimensions (Sirag, 2000). General Relativity as well calls for ten tensors, or "dimensions of curvature" (Sirag, 1977a). To quote Dirac, (1963), commenting on the ten tensors of curvature of General Relativity, "The gravitational field is a tensor field with ten components. One finds that six of the components are adequate for describing everything of physical importance and the other four can be dropped out of the equation. One cannot, however, pick out the six important components from the complete set of ten in a way that does not destroy the four-dimensional symmetry." Recent studies in astronomy have shown that space on a large scale is not curved, but appears to be Euclidean to the limits of measurement (Arp 1998, Van Flandern 1998). In this case, General Relativity's ten tensors of curvature become merely linear degrees of freedom, or dimensions.

"Dirac (1928a, b) laid the foundations of QED with his relativistic wave equation. In doing so, though, Dirac found that having three dimensions "real" and the fourth "imaginary" didn't work—it violated the symmetry. He took the first derivatives of all four dimensions by introducing i as well into x, y, and z, making them symmetrical by making them all "imaginary." Most physicists have considered this a trick, an "accident of the formalism," and disregarded it. However, when added to Dirac's above statement about the six "necessary" (dimensional) components and the four "unnecessary" ones, this might imply that our entire reality is "imaginary," as eastern mystics have insisted for thousands of years.

"All it need mean, though, is that there exist six other dimensions that are in "imaginary" (orthogonal) directions with respect to our four, while our four are similarly "imaginary" with respect to the other six. This gives us a place to put Dirac's negative-energy "sea." As we will demonstrate, it also gives us a physical explanation of "negative energy."

"The Kinetic Theory of Mass/Energy

"What is mass? Recent thought suggests that the energy equation, instead of saying that two different things can somehow be converted into each other, really means that mass is just another form of energy (Haisch and Rueda, 1997). **At a fundamental level, all matter consists of charged particles in harmonic motion** (Cf. Feynman's "parton" model of the proton/neutron). Mass appears to be the harmonic motion of charged particles "trapped" within an energy well of some kind. This is why the most convenient and most often used unit expresses mass in terms of energy: the eV.

"What then is this stuff, energy? As mentioned above, the SM has no idea what mass is. But as just another form of energy, it appears to be firmly associated with motion: the harmonic vibration of a charge, or linear motion (momentum). Many of the recent theories in Stochastic Electrodynamics (SED) use this kinetic definition (Puthoff, 1989) which is of a piece with the general kinetic definition of mass in the Lorentz relationships (Huang, 1952**). According to Haisch, Rueda, and Puthoff (1994), mass is caused by an action of the Zero-Point Fluctuations (ZPF) of the vacuum electromagnetic field that resists the acceleration of a harmonically vibrating charge. "Mass is the manifestation of energy in the ZPF acting upon [vibrating] charged particles to create forces." (Haisch and Rueda, 1997)**

"By this kinetic definition, an electron-positron pair vibrating in a direction at right angles to our ordinary four, an "imaginary" direction, would have negative energy, the negative root of the Dirac equation. Just as the square root of a negative number merely refers the result to a direction at right angles to our ordinary directions, so the negative root of the energy equation refers to an energy (a vibration of charges) in one of these "imaginary" directions.

"All of the groundbreaking equations of quantum mechanics contain i either explicitly or implicitly. The meaning of this has been staring us in the face for seventy years. These "complex" functions involve vibrations partly in "real" partly in "imaginary" directions. (And some that are "pure imaginary," such as the ±c velocity eigenvalue of the electron/positron.)

We have been like Mr. A. Square from Flatland witnessing the intrusion of a three-dimensional creature into his two-dimensional domain, puzzled over such seemingly impossible events, but unable to comprehend "how it can be like that." Clearly, in both his case and ours, reality comprises more dimensions than those we can directly sense.

"And most conclusively, a perturbation, as Dirac pointed out, must cause transitions from states of positive energy to those of negative energy. Quantum mechanics must be symmetric with respect to energy. **Since our reality has a large positive energy balance, symmetry requires another reality with a large negative-energy balance.** Vibrations of epos in these "imaginary" directions, as called for by the energy equation and Dirac's equation, would seem to meet this requirement.

"**This would also seem to explain the relative unobservability of this negative-energy domain.** It has no inertia, hence no "mass," for reasons we will examine later. This, of course, will explain why "binding energy," above, has no inertial or gravitational mass.

"Since these equations call for negative energy solutions, and since there is in fact a physically possible explanation for negative energy, there seems to be no further excuse for doubting that all four of the Dirac equation's roots have physical meaning.

"The Electron-Positron Pair

"The negative-energy electrons and positrons called for, however, appear to be permanently associated in pairs—epos. What can this mean? In our experience, an electron and a positron form "positronium," then lose all their positive energy and become undetectable. According to Dirac's equation, they drop into the negative energy sea. What configuration do they assume there? For a possible answer, we need to consider what Dirac's equation says about the electron.

"Dirac's equation describes a "spinor field." In such a field, rotation of the wave function through 360° does not get it back to its original state, but to its opposite: the electron has to "turn around twice" to get back to where it was. At 360°, its wave

function Ψ becomes $-\Psi$ and it becomes, in effect, a positron traveling backwards, to arrive at 0° and switch back to an electron. (In QED, a positron is considered to be an electron travelling backwards in time [Feynman, 1985]) So a positron is really only a totally out-of-phase electron.

"However, the equation also says (Huang, 1952) that the electron always travels at velocity c: its velocity eigenvalue is $\pm c$. Thus, in addition to whatever overall (macrocosmic) motion the electron has, which we could call its momentum, the electron has an internal vibration at velocity $\pm c$. Dosen't this mean that this internal vibration is as an electromagnetic wave? That's the only momentum-carrying entity allowed to travel at c. Furthermore, this internal vibration must be in an "imaginary" direction, or, combined with its "momentum" velocity it would at times exceed c, which is not allowed in "real" directions for a "positive energy" particle. **(This is the first explanation ever given for this eigenvalue vibration that doesn't violate the Lorentz relationship.)**

"The only way it could travel at c and not at any other velocity would be for the electron's wave (Ψ) to be reflected at 360 degrees by the spinor "phase change" (positive to negative), thus changing electron to positron. (Since in this state they have no "mass" or inertia, this reflection takes no time or energy.) The analog would be a vibration traveling along a string fixed at each end, therefore reflected at each end. **A spin 1/2 particle is out of phase with this phase change, and so is reflected. A spin 1 particle merely gets sent on its way, this being the fundamental difference between fermion and boson.** This accounts for the fact that the fermion's wave doesn't spread. (The Fourier sums of waves that have amplitude only in a small area ["wave packets"] show that a non-spreading wave is possible, but don't explain why this should happen. Moreover, they do spread with time, as required by the uncertainty relationship. **Also, the waves are still present even in areas where they add to 0 amplitude).**

"**This gives a possible model for a non-annihilating, non-spreading electron-positron pair.** For one thing, they are both fermions, so the probability of them being in the same place at the same time is exactly zero. (Another reason they can't "annihilate.") Therefore they must establish some stable relationship at a non-zero distance from each other. **However, according to the above reciprocation, an electron and a positron could share a very stable relationship, vibrating in an imaginary direction while turning into each other every 360°. On this model, they would be "particles" only at 0°, 360°, and 720°, turning into waves in between ("wave-particle duality"). And if they traveled as electromagnetic waves, they would not interfere with each other as they passed. (See Westergard [11])** Since in the least-energy arrangement their spins and charges would cancel, the epo would appear to all the universe (and to the equations) as a neutral spin-zero boson, vibrating in an "imaginary" direction. (According to the kinetic theory, only charged entities can have energy, so any neutral spin-zero boson would have to be an association of entities whose spins and charges cancelled.)

"**Moreover, the period of this reciprocation would have to be the "quantum of time," τ, equal to $2e^2/3mc^2$, or 6.26 x 10^{-24} seconds.** As shown above, this is the time required for an "appreciable change" in the wave equation, which therefore only changes in increments of τ. This is Γ_e, the Lorentz-Abraham damping constant of the electron, and in classical electrodynamics, it is called the "damping constant" (Jackson, 1975) or the "characteristic time" (Jackson, 1993) of the electron. In particle physics, this is the minimum time taken by any interaction, and interactions that take longer than this seem to require exact multiples of this "quantum of time." Since they travel at c as electromagnetic waves, this would make the "length" of an epo (a one-dimensional string, with a "point particle" at each end) equal to τc, $2e^2/3mc^2$, or 1.87×10^{-15} meters. **This is the measured diameter of the proton, which, as we will see, is not a "mere coincidence."**

"Pair Production

"We can now consider the interaction miscalled "creation." A high-energy photon collides with something, say a lead nucleus, and produces a "pair"—a "real" electron and positron, which separate at high velocity. **Using the "complete" Dirac theory, we would regard this as the capture by a (negative energy) epo of sufficient positive energy to split the epo in half, and to give each half 0.511 MeV of "positive" energy plus sufficient momentum to escape their mutual Coulomb attraction. They each now have a positive energy of m_ec^2 plus momentum energy, pc, in a "real" direction.**

"However, the electron, as part of a negative-energy epo, has a one-dimensional oscillation at $\pm c$ in an "imaginary" direction. It retains this oscillation as a "real" electron— hence its velocity eigenvalue of $\pm c$ (Huang, 1952). (Since this one-dimensional oscillation has no "mass" or inertia, it can't be affected by the capture, and the electron, obeying conservation of angular momentum, retains it.) Therefore the "real" electron's wave function has a circular vibration at c in two "real" directions (giving it mc^2 of positive energy) plus a vibration at $\pm c$ in an "imaginary" direction, which adds no positive energy. This makes its total (spherical) vibration complex—part "real" and part "imaginary." However, a component of the angular momentum of its "imaginary" spin carries over, giving the "real" electron its immense angular momentum of $\hbar/2$. Note that if all three vibrations were all positive energy, the electron's energy would have been mc^3, around 1.5×10^8 MeV. As it is, because of our four "real" dimensions, the component of this complex spin energy in any "real" direction appears to be $4^2(mc^2)$ or around 16 times the electron's positive rest energy.

"This also accounts for the fact that this quantum number is two-valued — "spin up" or "spin down," as any "real" direction can only be at right angles to three "imaginary" directions at a time. And it of course accounts for the fact that the electron's wave function is a complex variable, with "real" and "imaginary" parts.

"This further accounts for the hitherto mysterious fact that the electron's angular momentum is also complex, as the electron's angular momentum vector cannot point in any "real" direction. Consequently, neither can the electron's orbital angular momentum vector in an atom (Treiman, 2000).

"With this understanding, we have at a stroke eliminated the massive violation of energy and angular momentum conserva-

tion involved in "creation. The $\hbar/2$ angular momentum of the electron is compounded from the epo's vibration at $\pm c$ in an "imaginary" direction in the negative energy sea, and returns to that sea when it meets a matching positron. This understanding also eliminates the violation of conservation of charge, as well as the violation of energy conservation involved in the "creation" of two charges, as a charge is energy—potential energy with respect to every other charged particle in the universe. The "creation" and "annihilation" of charges also violates, as we have seen, causality.

"We can further see reasons for some of the properties of the electron, properties totally inexplicable by conventional theory, properties that are just brushed aside with remarks like "Quantum mechanics is odd!" (Treiman, 2000)

"This is only the beginning of the riches to be mined from taking these equations seriously. For as it is well known, every unmeasured quantum entity evolves as a wave, yet every measurement reveals it to be a particle—as accurately as we can measure, a point-particle. (The latest measurements show the electron to be smaller than 10^{-18} m [Lederman, 1993], which is 2000 times smaller than the proton. And these measurements are consistent with a true point-electron.) However, there are severe difficulties with the point-electron model. A true point-electron, for instance, would have infinite density and infinite gravitational and Coulomb self-energy. Current theory is wildly divergent on this issue. The followers of Feynman and QED insist that everything behaves as particles, and QED treats them as point-particles (Feynman, 1985). Quantum field theorists insist that everything is wave or field, that particles are mere epiphenomena (Weinberg, 1977).

"There is, however, a logical way of resolving these views. In order to negotiate the "two slit" experiment and its variants, the quantum object must have total knowledge of "the entire measurement situation"—in theory, the entire physical universe. That a single electron or photon should have such omniscience is of course absurd. However, if the unmeasured quantum object exists as a non-local, multidimensional, phase-entangled analog wave or set of interference patterns, as the equations and experiments insist, then any interaction or measurement would represent a digital slice of this analog wave. **Our "quantum of time" _ would then represent the "reporting cycle" of this process, the minimum time between "reports."** As Gribben (1998a) says, the universe seems to "make the computation and present us with the result." Thus, when a measurement or interaction happens, the analog wave is converted to a digital solution with the result reported to a specific set of coordinates—thus a "mathematical point."

"Thus, every measurement or interaction involves an analog-to-digital conversion—and this involves a minimum quantizing error proportionate to the "quantum of time." This is the minimum time between digital "slices" of the analog wave, and so fixes the minimum "uncertainty" of the conjugate variables. **This is the first explanation ever given for the uncertainty principle—it represents merely the minimum quantizing error.** We can now see that the fundamental relation is that of time and energy, $\tau\Delta E \geq \hbar$. The other conjugate (complementary) properties derive from this.

"Of course, the units of Planck's constant are the products of energy and time, the units of angular momentum, as in the above inequality. It has always simply been assumed that energy is the quantized entity, and you will find this stated as fact in textbooks. But a photon can have any energy (witness the results of a Doppler shift) and the equations of QM would work exactly the same if it is assumed that time, not energy, is the quantized entity.

"It is perhaps unfortunate that QM came to maturity at the same time as Relativity. Einstein convinced everyone that a bastard unit, space-time, was a more accurate designation than either space or time separately. Thus physicists came to accept another bastard unit, the energy-time of Planck's constant, which is not even a true constant, but a constant of proportionality. Heisenberg (1938a, 1938b, 1944) always considered Planck's constant to be shadow or projection of some true constant in some other dimension, a constant that would explain the "size" of the uncertainty principle. The constant he arrived at was τc, $2e^2/3mc^2$, or 1.87 x 10^{-15} m. He attempted to cut the universe into tiny cubes $(\tau c)^3$ in size. This, of course, was a failure. However, one wonders why he never suggested the more natural unit _ as his "pure" constant. Could it be that he realized that if time were quantized, his "window" through which the paradigm had escaped would be nonexistent?

"If we take Dirac's equation seriously, moreover, time must be quantized. As everyone from von Neuman (1928) to Pais (1993) recognizes, the equation describes a spinor field in which electron changes to positron and vice versa every 360°, which as we have seen is the time τ. If this change happened at random times, no charge could ever be measured, as our measuring devices don't work that fast. The result would be zero average charge. **So every electron in the universe must change polarity at the exact same instant. In this case, at every phase angle opposite charges still attract, and like charges repel, no matter whether the lepton is nominally electron or positron at that instant. And since, as we will show, all matter is compounded of electrons and positrons, this means that all matter must change polarity in this same rhythm, the "quantum of time," which is the "clock speed" of "least count" of the universe.**

"In any case, Heisenberg clearly agreed with the above assessment of the "size" of the uncertainty principle. Moreover, our understanding that this "size" is the inescapable uncertainty involved in an analog-to-digital conversion clears up several further problems with the electron, particularly with the infinities involved in the "point-electron" model.

"The Quantum Field

"Assuming the reality of this negative energy epo sea, we can account for many of the hitherto mysterious properties of the electron. But how can we account mathematically for the sea itself? Here quantum field theory comes to the rescue. In his book The Odd Quantum, Sam Treiman (2000) introduces "only for pedagogical purposes" a very simple "model field": a single, scalar field $f(x,y,z,t)$ which classically obeys the linear differential equation

$$\frac{1}{c^2}\frac{\partial^2\phi}{\partial t^2} - \left\{\frac{\partial^2\phi}{\partial x^2} + \frac{\partial^2\phi}{\partial y^2} + \frac{\partial^2\phi}{\partial z^2}\right\} + \rho^2\phi = 0$$

"Treiman then goes on to quantize the field, and solve for the eigenvalues. The results, as he states, are "quite remarkable." Notably:

" . . .The allowed momentum eigenvalues p form a continuum, all magnitudes and directions being allowed. For any given momentum p there is a particular state with energy $E = [(cp)^2 + (mc^2)^2]^{1/2}$, where $m = \hbar p / c$.

"…This is just exactly the relativistic energy-momentum relation that holds for a material particle of mass m. It is natural to interpret this state as in fact describing just that; we may speak of this as a one-particle state. A particle has somehow emerged out of the quantum field. The parameter p that we started with fixes its mass. [Emphasis his]

"It is important to note that, to be accurate, the above expression should read "plus or minus E." The one-particle state can have either positive or negative energy. (Typically, as Dirac noted, the negative root is suppressed: if we pretend it isn't there, maybe it will go away.)

"The remarkable thing is that, starting with a simple field, particles emerge as quanta of the field. Treiman further notes that there are families of one, two, or all possible numbers of particles. **More, in multiparticle states all the particles must be exactly identical.** And finally, this particular "model field," deliberately chosen for its simplicity, describes as its quanta neutral, spin-zero bosons. According to Treiman, ". . .it is easy to construct analogous linear theories for charged as well as neutral particles of various spins. Theories involving charge yield both particles and antiparticles as their quanta." (We have previously noted that the quantum spinor field governed by the Dirac equation has just such properties.)

"We are looking for simplicity here, applying Ockham's Razor. And it turns out that the simplest possible quantum field would necessarily be populated with all possible numbers of strictly identical, neutral, spin-zero bosons. Such particles, as noted above, can have either positive or negative energy. To quote Gribbin (1998b), "In the quantum world a field must give rise to particles." (Emphasis his.) However, no such field of unlimited numbers of neutral, spin-zero positive-energy bosons exists. Why not, if a field must give rise to particles? However, as we have argued above, a "sea" of negative-energy, neutral, spin-zero bosons is a requirement of quantum mechanics itself: of the energy equation, and of the Dirac equation of the electron. Two of its solutions call for negative-energy electron-positron pairs, which would necessarily associate as neutral spin-zero bosons**. Thus the simplest possible form that the Vacuum Electromagnetic Field could take would have as its unique solution exactly the same result as the Dirac spinor field: a "sea" of unlimited numbers of negative-energy electron-positron pairs. We have now approached this from three different directions, and, they all point to the same result.**

"Treiman complains that, in the "model field" described above, there are no interactions. It is what is called a "free field theory," a theory free of interactions. Start with a state in which two particles approach as for a collision, and in fact they won't collide, because the classical field equation on which it is based is linear: the sum of any set of solutions is also a solution. (For this reason, quantum field theory, with its multiple fields, one for each "fundamental" particle, requires non-linear terms in the differential equations that describe them in order for there to be interactions, and this is why none of the theories are exactly soluble.) But as we noted above, this "free field theory" exactly describes our strictly identical, negative-energy boson sea, in which electron and positron approach as if for a collision, but in fact they don't collide, as they are both waves at the time. (We will later show that this lack of interactions between fields is a non-problem, because there is only one field, this simplest Dirac field.)

"The form that this negative-energy boson sea must take can be seen as we approach the absolute zero state of the zero point. In laboratory ultra-cold studies, we remove "positive" energy and achieve lower temperatures to come closer and closer to "zero absolute," which is a state of no positive energy. **That there is still immense energy ($h\nu/2$) at this zero point of no positive energy should immediately have informed us that positive energy is not the only kind of energy.** So what is the alternative to positive energy?

"As we approach the zero-point, some curious things happen. First, centered at about 2.73°K, we find an immense number of photons. Then, at 0°K, the equations of QM tell us that there is unlimited energy. Let's say you are approaching a wall. As you approach, you detect a large amount of energy. And at the wall, you find it is glowing white hot. You ask what is behind the wall, and someone tells you, "Oh, there is nothing behind the wall. The universe ends there." Would you be inclined to believe it? Yet that's what we are told about the zero-point. Energy and activity decline rapidly with temperature, then near the wall, suddenly there are immense numbers of photons, and at the wall, unlimited energy. But nothing is behind it. Believe that, and there are some bridges you might be interested in buying.

"The matter that registers in our measuring devices is positive energy. **But all matter except the electron is composite, and positive energy is pushing-apart or explosive energy. It takes immense negative energy to bind matter together.** If positive energy were the only energy, one would think that at temperatures near absolute zero matter would lose its cohesion and fall apart. Nothing of the kind—in fact matter binds closer and closer together until it becomes all one thing. It takes energy to bind matter together, yet all positive energy has been removed. What is left? Only negative energy is the result of negative forces.

"The Bose-Einstein Condensate

"Various typical changes occur in the physical characteristics of material substances near 0°K. In a conductor, some of the electrons change their phase so that they become, in effect, positrons. An electron and this pseudo-positron then form what are called "Cooper pairs," bosons formed of two fermions, in which the two 1/2 spins add up to spin 1, and both must be in the same state governed by the same wave function. (The members of a Cooper pair are separated by about 10^{-6} m, thousands of times the distance between the ions in the conductor's lattice) **At even**

lower temperatures a true Bose-Einstein Condensate (BEC) may be formed, which acts as a single unit rather than as a collection of molecules. This permits the special states in which superconductivity and superfluidity occur. These are very energetic states, as their behavior demonstrates. They are states in which negative (binding) energy has overcome the tiny residual positive (freeing) energy, so that they are all governed by the same wave function.

"All this happens as we approach the zero-point. Order increases, everything is bound closer together. Negative (binding) energy becomes predominant. Everything seems to settle in toward a BEC. (Here we might note a further difficulty with the Standard Model and its Grand Unified Theories [GUTs]. **These assume that at higher and higher energies the forces and particles lose their identity and unify. However, the experimental evidence points exactly the other way. Higher positive energies allow entities more degrees of freedom to resonate in more and different modes, whereas at lower energies they approach the BEC, in which the binding (negative) energy is so strong that the parts lose every bit of identity and must all be in the same state." [Note: This low energy state at 0 degrees K is very similar to the low energy state at the center of a degenerate gravitational well where all forces are unified near 0 degrees K and maximum density. See Unification below.]** "This is emphasized by the failure of the prediction made by every GUT that the proton must be unstable. So far, no proton has ever been observed to decay. Result: no GUTs.)

"A BEC can only result from the total dominance of negative (binding) energy over positive. Looked at that way, the interface between negative and positive is not 0°K, but a few degrees higher, perhaps around 2.7°K. In any case it is different for different substances, and certain BEC characteristics manifest themselves at much higher temperatures.

"And at the zero-point, instead of no energy, there is suddenly a flood of it. (Zero-Point [ZP] energy—hv /2 for each mode of the vacuum electromagnetic field.) Why would this be, if there is "nothing" beyond it? What generates this energy, where does it come from, if it isn't another "miracle"? [Big Bang theory insists that the microwave background comes from the exact other end of the energy spectrum, from a state of infinitely high energy and temperature, created out of nothing: by a "miracle." We suggest that this is a violation of causality: infinite temperatures can not be a "proximate cause" of an energy field near 0°K. We suggest that the source of this energy should be sought nearer at hand, at the adjacent "zero-point" with its unlimited energy, and beyond, in negative territory. We will later look at this in more detail.] Again, this is real energy, with many measurable effects.

"What becomes clear from all this is that the negative energy sea of bosons (epos) called for by the equations must exist in the form of a BEC. **According to the equations and everything we know, our reality is surrounded by and immersed in a vast, all pervasive Bose-Einstein Condensate.**

"This is a rather startling conclusion. However, it is supported not only by the equations of quantum mechanics, but by a large and growing body of clear experimental evidence.

"Bell's Inequality and the now numerous proofs thereof (Clauser and Shimony, 1978, Aspect *et al.*, 1982) demonstrate that our reality must be non-local, connected faster than light. As Nick Herbert (1985) puts it, "A universe that displays local phenomena built upon a non-local reality is the only sort of world consistent with known facts and Bell's proof." (Emphasis his.) **Phase-entangled quantum objects share information apparently instantaneously, no matter how great their spatial separation.**

"Non-local or faster than light action also must be a property of the electromagnetic field, according to a whole series of experimental results starting with the Sherwin-Rawcliffe experiment (1960) and continuing with those of the Graneaus (1982, 1983, 1985, 1987, 1993) and Pappas (1983, 1990A, 1990B). These experiments all show that changes in the electromagnetic field must propagate much faster than light, apparently instantaneously, so that a moving charge has no "left-behind potential hill." Thus, changes in electromagnetic potential must propagate apparently instantaneously over any distance.

"The same is true of gravitation, as was shown in the classical Laplace demonstration based on the absence of any change in the angular momentum of the earth's orbit (Laplace, 1966), and as has been repeatedly demonstrated by Van Flandern (1993, 1996, 1998). **He shows that even in a static field, if gravitation propagated merely at light speed, it would result in a "couple," which would measurably increase the earth's angular momentum.** This, of course, does not happen. He further shows that General Relativity, supposed to be a local theory, nonetheless assumes and requires instantaneous changes in the "curvature of empty space," and so is non-local.

"Therefore, both electromagnetism and gravitation act non-locally. They also must be representative of the non-local reality that Bell's proof shows must contain the local effects we normally experience.

"**However, there is one and apparently only one extended structure that exhibits non-locality: the BEC.** If you insert an electron into one end of a BEC, however large, an electron emerges from the other end faster than light can travel that distance—this is the phenomenon of superconductivity. This non-local action results from the fact that every constituent of a BEC must be governed by the same wave function and every part must be in the same state and therefore act as one.

"**Bell's proof and the experimental facts of electromagnetism and gravitation require a non-local reality.** Dirac's equation, in requiring a universal BEC, provides just that. Therefore all these proofs of non-locality amount to proofs of a universal BEC, our one non-local extended structure. We will later demonstrate that these non-local actions are not literally instantaneous, but take the finite time τ. This results in clear, intuitive non-local models of electromagnetism and gravitation which nonetheless act by direct contact, and thus demonstrate causality.

"We will show that this ends the centuries-long debate between those who accept the evident action-at-a-distance of gravitation and electromagnetism as unmediated and acausal and those who insist on causality despite the appearances. Accepting that we are imbedded in a universal BEC gives the best possible answer to both. As we will see, it provides physical but non-

local models which nonetheless demonstrate direct contact causality.

"From what we know of BECs from those we have managed to create in the laboratory, this BEC would be the daddy of them all. It is composed all of negative-energy, one-dimensional epos, all with identical negative energy (but no "mass"). Each epo is charge condensed so that each charge "sees" only its oppositely charged "pair" (as in the Cooper pair). No unbalanced charges allowed, no positive energy allowed, and the entire BEC described by a single wave function.

"How many times must nature describe this to us, before we get the picture? We have looked at three equations, the energy equation, Dirac's equation, and this very simplest quantum field, which we might call the "Zeroth Quantum Field" (ZQF). Each of them seem to be describing this same object, a universal BEC composed of unlimited numbers of spin 0 neutral negative-energy bosons, which have to be one-dimensional electron-positron pairs.

"Of course, the BEC wasn't well described in 1934, so it is no mystery why Dirac didn't see that this is what his equation calls for. Only in the light of more recent findings is it evident that Dirac's "sea" must be a BEC. For, of course, it fills the crucial needs of Dirac's sea—it is "full," so that no positive energy particle can "fall in" unless it first loses all its positive energy, and then only if a balancing antiparticle similarly divests itself. **Further, it has no "mass," hence no inertia or gravitational interaction, so it is virtually undetectable. [Haisch and Rueda (1997) insist that negative "mass" is impossible, since "mass" is a result of the action of the ZPF on polarizable entities. Since this would not include negative-energy epos in a BEC, they are quite correct. They don't have "mass." Negative energy is quite a different thing.] And as we will see, it is the source of the unlimited polarized electron-positron pairs that the Dirac equation requires, and experiment shows, to be surrounding every "bare" charge.**

"Physics Through the Looking-glass

"Let's step back a moment and look at what the full Dirac equation and the simplest quantum field, the ZQF, seem to call for. As Gribbin (1998a) remarks, "In the quantum world a field must give rise to particles." Unlimited numbers of them, the quanta of the field. This is the famous "second quantization." According to QFT, there is nothing in the universe but quantized fields. We here invoke the simplest possible quantum field which "must" supply the unlimited numbers of epos called for by the full Dirac equation. The question might then be "Why would this ZQF supply negative energy epos? One would think that the first 'category' to be filled would have positive energy." Here we might recall that we call positive energy "positive" only because of Ben Franklin's mistaken choice. It would be much more logical to call the electron, the very unit of electricity, positive in sign, in which case what we call "negative energy" would be positive energy, and would be the first "category."

"That there is a negative-energy "sea" balancing the positive energy of our reality restores the symmetry between negative and positive energy called for by the energy equation and Dirac's equation. **Moreover, there are indications that negative energy is primary. This has profound implications.**

"For one thing, we can now follow the process miscalled "creation," and see where the energies come from. If the negative energy BEC is a completely filled sea of epos, under every mode of the vacuum electromagnetic field would be either an electron or a positron, one end of an epo—hence "half a boson." In terms of energy, "half a boson" is $h\nu/2$. This is exactly the zero-point energy called for by the equations. The electron and positron in the BEC have no positive energy, only charge. But together they make a neutral spin-zero boson whose energy is $h\nu$. In this case $\nu = 1/\tau$, around 1.6×10^{23} Hz. This would give the epo an energy ($E = h\nu$) of around 660 MeV, and give each "mode" of the vacuum electromagnetic field an energy of half that, 330 MeV. Thus the "Zero-Point Energy" (ZPE) and the jitter-motion (Zitterbewegung) caused by it both emerge as direct consequences of Dirac's equation. As we will see later, "half an epo" is also "half a photon."

The Electromagnetic Field: (See Part 1 of Hotson's Infinite Energy Paper page 16, 17, & 18)

"Conservation of Angular Momentum (a.k.a. "The Photon")

"If the epo is the quantum of the electromagnetic field, as shown above, this would seem to leave the "photon" in limbo. Let's look at a single electron of hydrogen, orbiting the proton at some energy level above its ground state. After a few thousandths of a second, it will jump to its ground state. To do so, it must lose angular momentum—spin—in the amount of $h\nu$. In the conventional view, the electron "emits"—instantly creates—a "particle" called the "photon," which is an electromagnetic "wavicle" traveling at velocity c and which delivers the angular momentum intact to some other electron, whereupon it is no more. Since Einstein banished the aether, however, the question has been "what is waving?" The photon has no rest mass, and contains no charges—so it violates our kinetic definition of energy.

"However, in every situation in the macrocosm (and according to Newton's laws) in order for a "real" object to get rid of spin angular momentum, that real object must set some other real object spinning. Can the photon be the only exception? As we will see, it isn't. For while an electron in its ground state is "charge condensed," in that it only "sees" its proton, and its proton only "sees" it, an electron in a higher orbit has a slight unbalanced charge which must cause the BEC to surround it with epos, as above. **And if an electron needs to lose spin, what more natural than that it set spinning those objects closest to it, the polarized epos that surround it? They have charges, and are pointing in "real" directions, so they can absorb the "real" (positive) spin energy that the electron has to get rid of.**

"So the electron gives a tiny sidewise "push" to certain positrons in the sphere surrounding it, and then it is "gone"— it is in its ground state. The epos are left "holding the spin," some more than others, because the lost spin is a vector quantity, and its energy will go primarily to epos that are pointing in the vector direction. Since the electron is gone, the epos are no longer in chains, and the spin energy will travel up the epo "string" (at velocity c) exactly the way a sidewise impulse will travel up a

plucked guitar string. (Note that a sidewise impulse given to a charged particle [an "electric wave"] will, by Maxwell's equations, generate a magnetic wave at right angles.)

"By the time the energy has reached the electron end, the electron has become a positron, again with a sidewise impulse, so to conserve angular momentum it must select and polarize some electron in exactly the right direction at the right distance. It thus initiates a vector line of epos, each carrying the spin energy "bucket-brigade" style at velocity c. Therefore the "photon" at this point would be a wave, carried by epos, spreading at velocity c in every direction, but with most of the energy carried by lines of epos pointing in the vector direction.

"An epo carrying "real" angular momentum would change from a spin-0 boson to a spin-1 intermediate vector boson—vector because any amount of energy less than $2m_e c^2$ is unstable, and can only be carried for one-half cycle. Since it is unstable, it must dump the energy, polarizing the next epo in line. And since it is an "epo carrying a photon," we suggest the name "epho."

"At this point the "photon" amounts to a wavefront traveling at c, a coherent bunch of intermediate vector bosons, each carrying a portion of the angular momentum. They take all possible paths, following the Feynman "path integral" or "sum-over-histories" version of QM, with most of the paths being cancelled by destructive interference. **The remaining paths, summed, make up the amplitude, the Ψ wave.** (Again, a "mathematical abstraction" takes on a certain physical form.)

"Note how exactly the Feynman sum-over-histories method mirrors the actual process. Like Feynman's version, the "ephos" take all possible paths. Feynman breaks down each path into a series of short arrows or vectors, the directions of which, summed, keep track of the path's phase. We have seen that each epho is a vector, rather shorter than Feynman's, each epho being only 1.87×10^{-15} m long. Feynman could not explain why a "path" should have phase, he merely asserted that it did. We can now see that it has phase because each epho on each "path" is itself an electromagnetic wave with phase. Together they form a coherent wavefront. Ephos on the "least action" path will reinforce each other, and any epho that takes a "wild" path gets out of phase with the wavefront, suffers destructive interference, its angular momentum is cancelled, and it drops back into the epo "sea." Thus the only ephos that continue to carry energy are those that are close to the (least action) "classical" trajectory.

"In the famous "two slit" experiment, many of the paths comprising the epho "wave" which represents the "single photon" go through each slit, and interfere with each other, forming the well-known Ψ wave "interference pattern." At the screen, one of them is randomly selected from this densité de présence according to $|\Psi|^2$, the probability, to deliver all of the wave's angular momentum to a single electron in the screen.

"Again, the "collapse of the wave function" into a single result has never been given a satisfactory explanation. However, it seems likely that the first epho positron to select a "real" electron as its "other end" causes the collapse. Those who favor the "many universes" version of QM might say that all of the vector bosons deliver the full amount of angular momentum to different electrons, but in different universes. It is a good thing that angular momentum is conserved in this manner, one electron's discarded spin all being delivered to another single electron, as otherwise we would never see the stars. **(The wavefront of a single "photon" from a distant star can be bigger than a continent—if this energy was not delivered to a single electron, the energy would be so diffuse that we probably would never have become aware that stars other than our own sun existed.)**

"Considering the properties of the BEC, however, we can make a certain amount of sense of the process. The "rules of the game" seem to be that if the "photon" is generated by the jump of a single electron, the BEC must find a single electron, somewhere, to accept that angular momentum. (We may assume that the spreading Ψ wave carries as information a certain "memory" of how it was generated.) This amounts to an analog-to-digital conversion, with the sum of the angular momentum of the entire wave being delivered to a single electron, a "point event." As Gribbin noted, above, the universe "makes the computation" and presents us with the result. If, however, the signal was generated by the movement of many electrons as in a plasma or conductor, the resulting radio wave's angular momentum can set multiple electrons moving, as in an antenna.

"So, again, another unexpected bonus: a model of the "photon" that doesn't violate the kinetic theory of energy. Note that the model gives physical meaning both to Feynman's path integral version of QM and to the Ψ wave.

"Further, it should be noted that since each epho wave individually travels at c, the velocity of light would be independent of the velocity of the source, and the same in any frame of reference. It would in fact be Lorentz's electromagnetic aether (Lorentz, 1909). The transmission of light would agree with Lorentzian relativity, which meets all the tests devised for Special Relativity (Ives, 1946, 1949, 1950, 1951), including those that SR fails, such as the Sagnac effect (Sagnac, 1913) and the Silvertooth effect (Silvertooth, 1987, 1989, Silvertooth and Whitney, 1992). One of the tragedies of science is Lorentz's death in 1928, just as Dirac's equation was formulated, as **Lorentz surely would have recognized the negative-energy sea as responsible for his electromagnetic aether."**

Quotes from Dirac's Equation and the Sea of Negative Energy, Part 2, by D.L. Hotson [7]

"Summary of Part 1

"We show that the Standard Model (SM) of particle physics is totally inadequate by any reasonable criteria, violating the basic scientific rules of simplicity, mathematical consistency, causality, and conservation. All these violations stem from the 1930s, when by a mathematical trick the Dirac wave equation was truncated to eliminate its negative energy solutions. Recent developments, however, have shown that time is quantized (Treiman, 2000), thereby eliminating the very basis of that mathematical trick, as it would involve massive violations of conservation of mass/energy.

The energy equation and Dirac's equation call for both positive and negative energy. Thus they are symmetrical with respect to energy, as are the forces of physics. We show that positive (repulsive) forces increase positive energy, while negative (attractive) forces, such as gravitation, the strong nuclear force, and the Coulomb force between unlike charges, all increase negative energy. According to the modern kinetic theory of mass-energy, negative energy would merely be a vibration of charges at right angles to our ordinary dimensions, in an "imaginary" direction. The equations of QM, which all include "i", therefore indicate that these functions are complex, including vibrations in "imaginary" directions. This understanding explains several anomalies with the electron, such as its velocity eigenvalue of $\pm c$, which can only be in an "imaginary" direction. It also explains the electron's anomalous spin of $\hbar/2$.

"The solutions to Dirac's equation describe a "spinor" field in which electron changes to positron every τ, the quantum of time, ($2e^2/3mc^3$, equal to 6.26×10^{-24} seconds). An electron-positron pair ("epo") therefore must form a neutral spin-zero boson with electron and positron alternating every τ. A quantum field such as the Dirac spinor field must give rise to particles, unlimited numbers of them (Gribbin, 1998b). Therefore, the Dirac field must give rise to a "sea" of negative-energy bosons which, since they are "below zero," must form a universal Bose-Einstein Condensate (BEC).

"This universal BEC cannot exist in the presence of unbalanced charges, so every unbalanced charge must instantly be surrounded by epos raised from negative to positive energy. They connect and neutralize every unbalanced charge, forming the "electromagnetic field," which is composed of chains of one-dimensional epos connecting and balancing every unbalanced charge. They carry charge "by proxy."

"The universal BEC can't abide positive energy either. When an electron jumps from a higher energy level to a lower one, thereby losing (positive energy) angular momentum, this momentum is absorbed and carried by the epos that surround it, forming a wave of epos carrying angular momentum, which carry the "photon" according to the Feynman "path integral" version of QM. The pattern of these epos form the photon's Ψ wave.

"A "Theory of Everything"?

"We have seen the power of Dirac's equation, when all of it is taken seriously. In a sense, though, Dirac took it even more seriously. It is not an equation of the electron, as it is popularly called. It is a relativistic generalization of the Schrödinger wave equation, which is said to "contain most of physics and all of chemistry." Dirac thought of it as a Theory of Everything—he thought that its solutions should include "everything that waves," *i.e.* every possible particle. As he was deriving it, he hoped it would have only one solution—the one, unitary particle out of which everything could be made (Dirac, 1933). So, powerful though this equation is, it did not live up to its discoverer's expectations. It was not unitary, and failing that, it was not even a Theory of Everything.

"The annoying thing is, it should be. It generalizes a very generally applicable equation—the Schrödinger wave equation—and makes it covariant. We have seen that every one of its requirements and predictions, including the negative-energy epo, has withstood every test. It is as valid and widely applicable an equation as has ever been discovered. It is as general as the whole universe. It should describe "everything that waves." Yet as solutions, instead of general ones, it has particular ones: just the positive energy electron and positron, and their negative energy counterparts. **In a sense, though, that is unitary: two of the four are just different energy states of the same particles, and electron and positron turn into each other every half cycle—they are really the same particle, merely out-of-phase with each other (Huang, 1952). So one could say that the four solutions to Dirac's equation are unitary—they describe four kinds of electron, differentiated by *state* and *phase*.**

"Where Do You Take Out The Garbage?

"The BEC is completely ordered, covered by a single wave function. But in detail, it is a hive of activity, full of charges going at the speed of light. **Its frantically gyrating epos fill every cranny in every dimension of the negative energy realm. However, the close quarters and random configurations must frequently put electron adjacent to electron in positions that generate considerable amounts of positive energy. (Like charges repel, which is positive energy.) The BEC can't stand positive energy. It must get rid of it. (The BEC can't tolerate positive energy spin and must get rid of it also.)**

"The BECs we can generate (in a lab), at temperatures near 0°K, need fierce refrigeration to maintain their integrity. The (universal) BEC is somewhere below zero. How is it refrigerated? Where do its waste products go? Where does the BEC take out the garbage, and where is its garbage pile? I suggest that we are sitting in it. We seem to be, to put it bluntly, BEC excrement.

"The BEC must generate positive energy in great quantities. All of its dimensions are full, even if it could accommodate the stuff. It has to get rid of it. **So it is no coincidence that "our reality" has a large positive energy balance. We are the BEC's dump. (Literally, it's "heat dump.")**

"We have seen that the effective boundary between the positive and negative energy realms is several degrees above absolute, as BECs, superconductivity, and superfluidity all begin to happen there. Mercury becomes a superconductor at 4.1°K. An "ideal gas" will form a condensate at 3.1°K. However, for real substances, because of interactions between the molecules, the figure is somewhat lower. (The critical temperature for helium liquid is 2.2°K.) **This would seem to put the boundary right around 2.7°K, or at least too close to this figure to be coincidence.** We would expect the number of photons "dumped" from the BEC to peak there, falling off randomly on either side of this peak to form a "black body" spectrum peaking at this temperature. **This would seem to be the most probable explanation for some or all of the 'microwave background.'** In any case, this vast number of photons seems much more likely to come from the negative territory adjacent to it, than from a Bang at the complete other end of the spectrum. (The infinite temperatures of a Bang cannot be the "proximate cause" of an energy field near absolute zero.)

"Why would the numbers of photons peak at this temperature, instead of increasing all the way down to zero? This is because, if the boundary between positive and negative is 2.7K,

photons with less energy than this would randomly drop back into the condensate and out of 'our reality'—the less positive energy, the faster they would drop, forming the lower curve of the black body.

"If our positive energy reality is indeed made of 'exhaust' from the BEC, then everything must be made of electrons and positrons, as that is all the BEC has to offer. However, 'pair production,' one epo at a time splitting into electron and positron, leaves no net positive energy balance, as equal numbers of them must sink back into the sea. The BEC must have some other means of permanently expelling the large amounts of positive energy that make up our reality". **See 'Structure Formation' and 'The Black Hole' below.**

β-decay

"There is a major, unnoted anomaly in the relative abundances of the three entities out of which all stable matter is made. The numbers of electrons and protons appear to be exactly equal. (By charge conjugation [C] and charge conservation as outlined above, they must be exactly equal.) And while the most common element, hydrogen, contains no neutrons, there is an excess of neutrons in the more complex elements. If you count the unknown but probably large number of neutron stars, there seem to be nearly as many neutrons as protons. Thus there appear to be *nearly twice as many nucleons as electrons*.

"However, unlike the simple electron, which seems to have no parts, there is abundant evidence that nucleons are not fundamental. They do have parts, almost certainly not just a few parts, but swarms of them (Krisch, 1987; Pais, 1994; Rith and Schäfer, 1999). Somehow those parts must have been assembled to make the nucleon. Modern theory dismisses this as just another miracle. However, if nucleons came together in the same kind of way as the chemical elements, with compound units being compounded of simple ones, we would expect electrons to be much more numerous than nucleons. How can a *compound* entity be more abundant than a *simple* one? Simple hydrogen is about 10^{12} times more abundant than compound uranium, which masses about 238 times as much. The compound nucleon masses nearly 2000 times as much as the simple electron, so by this comparison we would expect electrons to be at least 10^{13} times more abundant.

"Instead, in a total and massive reversal of our expectations, the compound nucleon appears to be nearly twice as abundant as the simple electron. This immense anomaly cries out for an explanation. It is the clearest kind of indication that the production of nucleons themselves and the process of nucleosynthesis follow entirely different kinds of laws for some unknown reason. Nucleosynthesis takes place in stars, and involves an additive process: individual nucleons, or at most alpha particles, are added one by one to produce the heavier elements. This explains the relative rarity of these heavier elements, as much more energy, special conditions, and quite a bit of luck (or "fine tuning") are necessary to produce them.

"However, because of their anomalous abundances, compound nucleons must be produced in some entirely different manner than the additive process that produces the heavy elements. This is a major indicator of what that process might be—and what it is not. (It virtually rules out, for instance, the production of these abundances in a "Bang," big or little, as production in a "Bang" would mimic the additive processes of solar nucleosynthesis, and produce orders of magnitude more leptons than nucleons.)

"If there were some one known subatomic process whose end products were neutrons, protons, and electrons in their very anomalous observed abundances, with almost equal numbers of each, we could be virtually certain—to a vanishingly small uncertainty—that this is the process by which the universe came about. Is there such a known process? As it turns out, there is exactly one such known process: it is called: β-decay.

"Outside a nucleus, the neutron is unstable, but with an extraordinarily long mean lifetime. Whereas all of the other known unstable particles decay in nanoseconds or less, often much less, the neutron hangs around for 14.8 minutes on average. After this uniquely long lifetime, a lone neutron will break down, emitting an electron and an antineutrino, and turning into a proton. The antineutrino is almost never seen again—it could go through light-years of lead without interacting. But this process produces electrons and protons in exactly equal numbers. (They of course form hydrogen, the most abundant atom.) Moreover, the neutron itself, if it happens to be absorbed into a nucleus during its 15-minute mean lifetime, is again completely stable. (Except in certain radioactive nuclei.) And in stars, where nucleons are combined into nuclei, there is abundant energy available to fuse electrons and protons back into neutrons, where needed (Conte, 1999). This, of course, happens wholesale, in degenerate stars.

"So *given enough neutrons*, the process of beta decay, alone and unaided, would produce exactly the very strange abundances of the universe we observe. Moreover, we know of no other process whose end products would be electrons and protons in exactly equal numbers, and neutrons in approximate equality. And since all stable matter in the universe is composed of just these three products in just these proportions, it follows that no other process is/was of any importance.

"So just from this, we can be almost totally certain that whatever else happened, **the universe we know began as a whole bunch of *neutrons*,** and nothing but neutrons. (Another indication that no Bang happened) **But, there is one other significant fact. Beta decay is a "weak" interaction. As such, it does not obey the symmetry rules obeyed in virtually all other interactions. It is "left-handed." Specifically, it violates both parity (P) and charge conjugation (C) (Pais, 1994), which is the production of matter and antimatter in equal amounts.** Since a massive violation of C is necessary to produce a universe of matter rather than antimatter, beta decay's violation of C is highly significant. (We will examine the specifics later.)

"Sherlock Holmes was of the opinion that "singularity is almost always a clue." And concerning the neutron we have three singularities, each reinforcing our thesis that the universe began with large numbers of lone neutrons. **Each neutron was born anomalously left-handed, with the extraordinarily long mean lifetime of 15 minutes, and with the further very peculiar property of being completely stable once inside a nucleus. Without any one of these unique properties, the neutron's decay would not produce the peculiar abundances of the universe we observe. Each of these peculiarities would seem to be evidence for this scenario; together they virtually exclude any other.**

"So the big question now is: How does one make a neutron? Well, this argument certainly suggests an answer. We have seen that according to every experiment ever performed, matter and antimatter are always produced in exactly equal amounts. **The experimental evidence therefore demands a universe equally of matter and antimatter.** Since the universe must be composed of equal amounts of matter and antimatter, and since the early universe was composed uniquely of neutrons, **the neutron must be composed of equal amounts of matter and antimatter.** It's very simple: the neutron must be made of electron-positron pairs.

"One further indication: we showed earlier that the epo one-dimensional "string" must be τc in length, or 1.87 x 10^{-15} meters long. **If the neutron is made of epos, presumably this "string" length would have to be the diameter of the neutron.** Within the limits of the scattering measurements, *this is exactly the measured diameter of the nucleon*.

"So it would seem that there are several different approaches, all of which suggest that Dirac was right the first time about his equation. Perhaps it is a Theory of Everything, and a unitary one at that. Everything seems to be made of epos: the electromagnetic field, the Ψ wave, the photon. If the neutron could be made of them also, that would be a clean sweep, at least of the universe's stable entities.

"Neutrosynthesis

"We might say that the Dirac equation, by having only four roots, predicts that everything else, including the neutron, must be made of electrons and positrons. How many epos make a neutron? The question is far from trivial. The answer cannot be 919, the mass ratio between epo and neutron. There would be 919×2 like charges packed into a tiny space. The binding energy would have to be 80 or 90%, to hold such an aggregation together, even if it were mostly "charge condensed." So 919 epos would mass, at most, about 370 electron masses. **We might keep in mind the Pauli exclusion principle, which regulates how many electrons may occupy a given shell in an atom by the possible number of different vibrational modes (different quantum numbers).**

"We have seen earlier that for reasons of symmetry the universe must have ten dimensions, six of them (the negative energy realm of the BEC) in "imaginary" directions with respect to our four (Dirac, 1963; Sirag, 1977b, 2000). How many different ways can an electron or positron vibrate in ten dimensions? We might answer that by an analogy with the periodic table.

"Each electron shell contains the number of electrons that can vibrate in different ways. (The electron's quantum numbers) At present, the periodic table consists of 100 elements in eight complete shells (if you count the rare earth elements) with 16 or so elements in an incomplete ninth shell. (Element 118 was claimed to have been synthesized at the Lawrence Livermore National Laboratory in 1999, but they have recently retracted that claim [Gorman, 2001]) Completing that shell would give 118 elements, and a tenth complete shell would add another 18, for a total of 136. So if elements were stable to atomic number 136, element 136 would be a noble gas with 136 electrons in 10 complete shells. This means that there are 136 different ways for electrons to vibrate in 10 shells. Each of these shells amounts to an additional degree of freedom for the vibrating electron. If we substitute 10 degrees of freedom, or dimensions, for these 10 shells, it seems inescapable that there again would be 136 different ways for electrons to vibrate in 10 dimensions.

"These numbers figure prominently in one of the possible designs for a neutron made of electron-positron pairs. This model was largely suggested by Saul-Paul Sirag (1977a) as a "combinatorial" model of the proton. He, however, considered it mere number-juggling. The last time I talked to him, he was no longer interested in it, so I "pirate it" without scruple. With a few minor additions and changes, it turns out to be a plausible model of the neutron.

> . . . From Eddington's group-theoretical point of view, creatures to whom space-time has four dimensions will find algebraic structures having 10 elements and 136 elements playing a very fundamental role. Eddington attempted, unsuccessfully, to derive the proton-electron mass ratio from the two numbers 10 and 136, together with the number of unity, 1. . . Eddington's 1, 10, and 136 are members of a well-known mathematical series that goes 1, 10, 45, 136, 325. . *etc*. . .The next number in that series is 666. (Sirag, 1977b)

Eddington's series is $(n^2)(n^2+1)/2,\ n = 1, 2, 3,\ etc.$ As Sirag points out, this group-theoretical point of view accords with Dirac's above statement that four-dimensional symmetry requires ten dimensions of curvature, or degrees of freedom, in General Relativity (Dirac, 1963). Several of the string and superstring theories also require a space of ten dimensions (Sirag, 2000), and as we saw, an electron can vibrate in 136 different ways in ten dimensions. If we order these 136 vibrational modes two at a time—one for electron, one for positron (as in the epo)—this would give 136 x 135, or 18,360 different ways for a lepton, joined as an epo, to vibrate in 10 dimensions. (This is Sirag's computation, but he lacked the idea of electron-positron pairs. He ordered them two at a time ". . .*e.g.*, one for proton, one for electron. . .")

"Thus a combination of 9180 electron-positron pairs would be a very stable arrangement, filling all of the possible vibrational modes in ten dimensions. We might imagine them arrayed in a 10-dimensional vortex or "hypersphere." (Note that this arrangement would come about in the negative-energy BEC. **As is well known, the only way that a BEC can rotate is in a vortex.**) Moreover, Krisch (1987) has shown that colliding protons act like little vortices, shoving each other around preferentially in their spin directions.

"What would be the mass of such an aggregation? Well, in quantum theory, one measures the energy, or mass, by taking the temporal sine attribute of the Ψ wave. Since time is only one of the 10 dimensions, this would give the aggregation a mass of 18360/10, or 1836 electron-masses. Since it is composed of 9,180 electron-positron pairs, such an entity would have 0 charge, it would be neutral.

"All symmetries are conserved in this arrangement, with exactly equal amounts of matter and antimatter. There is no reason why such an entity might not be produced and expelled from the BEC (thrust into "our reality") whenever the random fluctuations of the BEC produced a positive energy of 1836 electron-masses, and spin energy in all ten dimensions. (The suggestion is that it

would be produced in a vorticular "storm" in the BEC, which would have spin energy in all ten dimensions.) Moreover, since it has only 10% positive energy and 90% negative or "binding" energy, such an entity would be stable despite packing 9180 charges of like polarity into a very small hyperspace. This is the Sirag model of the nucleon, slightly modified. **Note that in our BEC of unlimited density, there is already an electron and a positron in exactly the positions required for this synthesis (nothing needs to move), so only the positive energy and the spin is required to produce a neutron.**

"The mass of a neutron is, of course, 1838.684 electron masses, not 1836. However, mass is a tricky business. The "effective mass" can be quite different from the "bare mass," as is shown in the conduction atoms of a metal (Pais, 1994). Because of their interaction with other electrons and with the positive core, their effective mass can vary from 0.3e to over 10e. And in a superconductor, "condensed state" electrons can have an effective mass that can be 1000 times the "real" electron mass. We will later show that epos in a nucleon are in a semi-condensed state. Furthermore, there are indications that mass may vary with time (Narlikar and Das, 1980).

"Among the felicities of this model, Sirag points out that if you divide the 18360 successively by 9, 8, 7, and 6, you get the approximate mass-ratios of the other baryons, the Lambda, the Xi, the Sigma, and the Omega. Since they have larger ratios of positive (disrupting) energy to negative (binding) energy, these baryons are progressively less stable.

"With this single, simple model for the production of neutrons from the unique solutions to Dirac's equation, we arrive at the extremely anomalous numbers of electrons, protons, and neutrons in our reality. Moreover, this also explains the preponderance of hydrogen over every other atom. Also explained is the oddity that electron and proton, which are seemingly very different particles, nonetheless have exactly the same electric charge. A proton is seen to be simply a neutron that has lost a single electron, leaving it with an extra positron. And the electron is not "created" as it leaves the neutron; it was there all along.

"Moreover, it would seem to admit of the possibility that energy, special conditions, and catalysis might synthesize neutrons at low temperatures, possibly explaining some or all of the neutrons, transmutations, and excess heat produced in cold fusion.

"This model must, however, address the spin of the neutron. T.E. Phipps Jr. (1976, 1986) also suggests a model of the neutron made of electron-positrons, but his model runs into difficulty with the neutron, which has a spin of $\hbar / 2$, just like the electron and positron. But if one has equal numbers of electrons and positrons, each with opposite and canceling spins, the resulting neutron should have spin 0, whereas it of course has spin $\hbar / 2$, like all of the fermions.

"But this reflects current physics' tendency to regard the spin of the electron as somehow not a "real" spin, but a "pure quantum effect," as Bohr liked to call it. But we have shown above that it can indeed be regarded as a real spin, with real angular momentum, if one regards it as a complex spin, having angular momentum in one or more "imaginary" directions as well as its c^2 spin in "real" directions.

"Moreover, some 90% of the epos that make up the "Sirag model" have 0 spin being pure one-dimensional vibrations in imaginary directions. The remaining 10% share "real" angular momentum, mostly canceling, which must, overall, amount to spin $\hbar / 2$. But as this is a "real" spin, there is nothing to say that a "real" extended neutron with the large "real" mass of some 1838e is not "really" spinning with a "real" angular momentum of $\hbar / 2$. In order to obey Fermi-Dirac statistics, it must have this half-integer angular momentum, but it is not necessary to assign that spin to an individual electron or epo constituent when it can simply be a property of the extended neutron itself.

"The Strong Nuclear Force

"**However, the prime merit of this model has to be its representation of the strong nuclear force.** Here we need to note a strange coincidence: the mass of the proton, in electron-masses, is roughly the same as the strength of the proton's strong force, in electron-forces. (Mass of proton: 1836 electron-masses. Strength of the electromagnetic force: the "fine structure constant" $\alpha = e^2 / hc = 1/137$; strength of strong force: $g^2 / hc =$ ~15. Ratio: ~15 x 137, somewhere around 2000 [Shankar, 1994])

"Thus the ratios of the masses and of the forces are roughly the same, "around 2000." This is a major clue to the nature of the "strong force."

"Gravitation and the Coulomb force both have simple inverse square "shape," that operate over long distances. Theoretically, at least, they never drop to zero. However, the shape of the strong force between nucleons is radically different and very peculiar. Up to a distance of around a fermi (10^{-15} m.), it is very strongly repulsive, keeping the nucleons apart. Then, for no apparent good reason, it changes abruptly to very strongly attractive, then drops off very rapidly, so that at a distance of around three fermis it becomes immeasurable. This peculiar shape has never been successfully modeled by any theory.

"Note how current theory, in which the fudge is an accepted scientific procedure, "solves" this problem. Since current theory can't model this observed force, it simply ignores it, and instead invents (fudges) an unobserved (fifth!) force carried by eight "gluons" (designed to be unobservable) between eighteen or thirty-six "quarks" (also designed to be unobservable) inside the nucleon. It then "suggests" that this fudged gluon force in some unspecified way "leaks out" of the nucleon to make up the peculiar shape of the measured strong force. However, our "epo model" of the nucleon models this very peculiar shape simply and intuitively.

"Because of the uncertainty principle, the nucleon, with its measured diameter of around 1.9 fermis, cannot be a perfect sphere, but must be a pulsating spheroid. However, the epos that make it up have "asymptotic freedom"—they vibrate individually, and each lepton is free to form a relationship with any available antiparticle. **This means that, as two nucleons approach each other, at a distance of about three fermis, electron-positron pairs will begin to form, not just within the nucleons, but between them. (Pairs of "internucleon" epos would have to form at the same time, keeping the total number of paired charges in each nucleon at 9180.) This would cause a strong, short-range attraction between the nucleons as more and more pairs formed. This would increase to a maximum at around 1.5**

fermis, after which it would rapidly turn into a strong repulsion (since the individual epos have to maintain their average 1.87 fermi separation), keeping the nucleons a stable distance from each other.

"Moreover, a maximum of 918 such "internucleon" pairs could form, the number vibrating in the direction joining the two nucleons, one-tenth of the total. This would give the interaction the strength of 1836e, and exactly explain the strength of the strong force, "about 2000 times as strong as the Coulomb force" (Shankar, 1994).

"Now, what is the chance that a completely wrong model of the nucleon would exactly match both the strength and the very peculiar shape of this most individual of forces? After fifty or so years of effort, the huge physics establishment admittedly has failed utterly to provide a model that comes close to matching that peculiar shape of the nuclear force. Yet Dirac's equation provides a model that fits like lock and key.

"Dirac's Theory of Everything

"This model simply, intuitively, and clearly explains the size of the nucleon, the mass of the nucleon, the very peculiar shape of the strong nuclear force, the strength of the strong nuclear force, and the strange fact that the very different proton and electron have charges of exactly the same strength. No other model explains any of these features, including the very cumbersome "Quantum Chromodynamics" of the SM.

"The neutron thus constructed is the source of electron, proton, and neutron in their very anomalous abundances, hence of all stable matter in the universe. This makes the amounts of matter and antimatter in the universe exactly equal, as experiment demands, and as no other model provides. We saw earlier that the "electromagnetic field," "the photon," and the Ψ wave are all epo manifestations necessary for the stability of the BEC. So we have complete closure: the BEC "must" be produced by the Dirac "zeroth quantum field." For its stability, it in turn "must" produce our universe, using only the particles called for by the Dirac equation, which as we can now see predicts that the entire universe is made from just these four kinds of electron.

"Magnetogravitation

"Dirac's equation predicts that the magnetic moment of the electron should have a value of $e\hbar/2m$. This is the magnetic moment balanced by the BEC, attaching every unbalanced charge to a charge of opposite polarity, thus bringing the BEC back into balance. **As shown above, however, the presence of unlimited numbers of epos and their associated photons give Dirac's value a tiny unbalanced correction, multiplying Dirac's value by 1.0011596522, the 'g' factor. This figure represents the best agreement between theory and experiment in all of science.**

"As a consequence, every electron has a tiny unbalanced magnetic moment at the same phase of its cycle. Since time is quantized, every electron will reach this phase of its cycle at the same instant. For its stability, the BEC must balance this tiny imbalance as well. It can only do this by initiating one extra epo chain. This epo chain will have far less induced strength than the other, balanced chains, since it is induced by this feeble unbalanced magnetic moment rather than the powerful Coulomb force. However, it cannot connect anywhere, since every electron has the same unbalanced moment at the same phase angle. (So does every positron, at the opposite phase angle.) Thus these feeble epo chains will simply extend into space, connecting at one end to every electron and positron (hence to all "real" matter), but being unconnected at the other end. However, these unconnected chains, extending into space, will cause a tiny unbalanced attraction between all matter. **Since the number of chains per unit area of space will decrease as $1/r^2$, it is evident that this tiny unbalanced attraction has the form of gravitation.**

"**Moreover, this "magnetogravitation" reacts to changes in mass instantaneously (or at least in time τ.)** This explains why the Earth and Sun don't form a "couple," and why the Earth "feels" gravitation from the Sun at the Sun's instantaneous position, rather than its retarded position, as is shown by astronomical observations (Van Flandern, 1998).

"This model of gravitation solves many problems with other models, including numerous experiments which seem to show that gravitation can be shielded, contrary to Newtonian gravitation and General Relativity (Majorana, 1930; Allais, 1959; Saxl, 1971; Jeverdan, 1991, and Van Flandern, 1998). In a careful ten-year series of experiments, Majorana demonstrated that lead shielding between the Earth and a lead sphere measurably lessened the weight of the sphere, while shielding above the sphere had no effect. This would seem to support "pulling together" gravitation and to disprove "pushing together" models such as LeSage's, Van Flandern's, and Puthoff's. Allais, Saxl, and Jeverdan carefully observed the behavior of various kinds of pendulum during different solar eclipses. All three pendulums exhibited major anomalous behavior at the onset of totality, indicating that the moon strongly interfered with the gravitational connection between the Earth and the Sun at that time. **This provides major evidence for our "epo chain" model of gravitation.**

"Further analytical work will have to be done to verify that this tiny unbalance, which must happen, has the force as well as the characteristics of gravitation. If this hypothesis is correct, all of the matter and all of the forces in the universe are seen to be the result of just these four kinds of electron, fulfilling Dirac's unitary dream.

"Inertia

"Inertia, however, has been a riddle ever since Foucault showed that his pendulum responded, not to any local frame of reference, but apparently to the frame of the "fixed stars." This became the basis of Mach's principle, which states that the "fixed stars," or (since they aren't fixed) the "sum total of mass in the universe," somehow reaches out to affect pendulums and gyroscopes. (And somehow knocks you down when the subway starts suddenly). Though this "action at a distance" appears to violate causality, and its apparently fixed frame of reference violates relativity's ban of any such fixed frame, Einstein set out to incorporate Mach's principle into relativity. In the end, though, he had to admit he was not successful.

"Haisch, Rueda, and Puthoff (1994) made a very plausible case that inertia is a residual effect of the ZPE. They were not, however, able to quantify the effect. As this study presents a rather different picture of the ZPE, the question is worth another

look. To go along with the "kinetic theory of mass-energy," we present what might be called the "kinetic theory of inertia." (Or possibly the "gyroscopic theory of inertia")

"A gyroscope establishes a vectoral plane of angular momentum. Any change in the angle of that vectoral plane is strongly resisted. As shown by Dirac's equation, an electron has a circular vibration in two "real" directions, giving it a "real" energy of mc^2. However, it also retains its (negative energy) vibration at $\pm c$ in an "imaginary" direction. Thus its oscillation is circular but complex, having both a "real" and an "imaginary" component, and giving it the anomalously, large angular momentum of $\hbar / 2$ in any "real" direction.

"This makes the electron a little gyroscope. However, since this vibration is complex, part "real" and part "imaginary," this angular momentum plane cannot point in any "real" direction, as is also the case with the orbital electron's angular momentum vector, as mentioned above.

"This means that acceleration in any "real" direction must act to change the angle of the electron's (complex) angular momentum vectoral plane and thus will be resisted with a force equal to and in a direction opposite to the acceleration, and proportional to the electron's "real" mass-energy.

"Dirac's "Operator Theory" or "Transformational" version of QM represented the wave function as a vector rotating in phase space. This "kinetic theory of inertia" represents a vectoral plane rotating in a complex space. How this results in inertia can be seen by looking at the wave function Ψ that represents a particle with definite momentum. The length (value) of the complex number Ψ is the same at all positions, but its phase angle increases steadily in the direction of the particle's motion, the x direction, making it a complex helix in shape.

"The rate of this complex rotation in its axial (x) direction is the measure of the momentum. As x increases by a distance of h / p, this phase angle makes one complete rotation (Taylor, 2001). Increasing the momentum (an acceleration in the "real" x direction, increasing p) acts to decrease the distance h / p, on the exact analogy of a coiled spring being compressed.

"(QM represents momentum as a spatial sine wave or helix.) However, since Ψ is a complex number, acceleration in the (real) x direction increases the pitch of this complex phase angle and so is resisted by the electron-gyroscope. This compression acts to store the energy added by the acceleration according to the Lorentz relationship. Compressing the distance h / p to zero would require (and store) infinite energy. (One might picture this complex helical oscillation as the particle's flywheel, storing energy as it is accelerated.)

"Since the complex gyroscope-electron must resist acceleration in any "real" direction, what can this resistance be but inertia? And since this resistance must be proportional to its "real" mass-energy (that rotating in "real" directions) it would seem to meet all of the criteria. It is also simpler and more intuitive than any other, depending solely on the undeniable fact that the electron's rotation is complex. We suggest that any time a QM relationship includes i (and most of them do) the resulting function will only be explained by reference to these extra dimensions.

"We have shown that all stable matter, and arguably all matter, is compounded of electron-positron pairs with large "imaginary" components, so that all matter would exhibit this "gyroscopic inertia" in proportion to its "real" mass-energy.

"Note that this is a local model of inertia, depending on the fact that the spins of all "real" particles are complex, extending into extra dimensions. Thus it eliminates the magic action-at-a-distance of Mach's principle, in which the "fixed stars" somehow reach out across light-years to knock you down when the subway starts suddenly. It further explains why only "real energy" particles, with complex spins, have inertia, hence mass. Negative energy epos, and also the positive-energy epos that make up the electromagnetic field, have one-dimensional vibrations, hence no vectoral plane, hence no mass or inertia. This is why the negative energy "sea" and its effects, which collectively may be termed "the aether," is virtually undetectable, and offers no resistance to the motion of "real" objects.

"The "Neutrino"

"Several matters remain to be explained, however. The first is another question of spin. The neutron is a spin 1/2 particle, obeying Fermi statistics. So is the proton, and so is the electron. Therefore, in Beta decay, to conserve angular momentum the neutron must get rid of this half unit of spin, $\hbar / 2$, as well as of a random amount of "real" energy. (This energy is the difference between the mass/energy of the neutron and the sums of the mass/energies of the proton, the electron, and the momentum energy of the ejected electron. It is a random amount because the electron emerges with a spread of velocities.) Fermi invented a "particle," the "neutrino," on the model of the "photon," to take away this spin and energy. (Now called the "antineutrino" by modern convention)

"However, like the "photon," the neutrino has no charge, and therefore violates our kinetic definition of energy. But as the electron emerges from the neutron, it is immediately surrounded by polarized epos, and these can absorb "real" angular momentum. However, absorbing this spin makes the epo a "spin 1/2 boson," which is unstable. It must immediately pass on the spin the way the "photon" (epho) passes on the "spin 1" energy, forming a "neutrino wave" on the model of our "photon wave" of polarized epos, which would travel at signal velocity. However, no "real" electron can accept 1/2 unit of spin, so the (anti)neutrino wave must continue on indefinitely, until it meets with rare and exceptional conditions such as one in which an electron and a proton can combine with it to re-form into a neutron. (Such conditions are not so rare in a star.) It is the detection of such rare interactions as this which have been proclaimed the "discovery" of the "neutrino." **Thus the "neutrino" is no more a separate particle than is the "photon."**

"The Antineutron?

"We must deal with one further difficulty. We have suggested that a vorticular storm in the BEC seems to be the source of the neutrons which, ejected into our four dimensions, have produced the stable matter of "our reality." **However, vortices come in "left-handed" and "right-handed" versions. Presumably, a "left-handed" vortex would produce only "left-handed" neutrons, and expel them into our reality. But, what about a "right-handed" vortex?** It would presumably produce "right-handed" neutrons (antineutrons) which decay into antiprotons and positrons. (Particle accelerators produce both kinds.) These

would form "antihydrogen" and presumably antioxygen, anticarbon, and the rest. Is it possible that there are places in our reality where "right-handed" vortices have produced whole galaxies of antimatter? At first sight this seems quite possible, as from afar an antimatter galaxy would be indistinguishable from one made of matter. However, it also seems unlikely that any nearby galaxies are antimatter, as one would think that sooner or later matter and antimatter must meet and "annihilate," which would produce floods of easily-detectable 0.511 MeV photons, which are not in evidence.

"There are at least two more possibilities. First, the BEC may be separated into a "northern hemisphere" and a "southern hemisphere." On our planet, the vortices we call "hurricanes" or "typhoons" rotate exclusively counterclockwise in the northern hemisphere and clockwise in the southern. This would place a "great gulf" between the matter galaxies and the antimatter galaxies, so that they would seldom or never meet. (Astronomers have mapped several such "great gulfs" or "voids" around 200 million light years across in which few or no galaxies are found. If such a gulf separated matter galaxies from antimatter galaxies, there would be no "annihilation," hence no means of distinguishing an antimatter galaxy.)

"Alternatively, the BEC may in some unknown fashion act as a "sorting device," sending only "left-handed" neutrons to our reality, while expelling "right-handed" neutrons into a reality on the "other side" of the BEC. Presumably this would be into four more ("imaginary") dimensions, which would also have a positive-energy balance, but would be made of antimatter. Perhaps in the future we will find that for some reason the BEC must act as a sorter to "left-handed" and "right-handed" universes. **Or, alternatively, we may find that only "left-handed" vortices are possible.** However, there seems to be no way at present of choosing between these possibilities, and there may be more. The important fact is that, locally at least, we get only left-handed neutrons from the BEC; otherwise we would have no net positive energy balance. **See left-handedness below.**

"Other important matters remain unexplained. The 9180 pairs of epos in the neutron must perform an elaborate ballet in the form of a ten-dimensional vortex. Mathematical analysis of this elaborate dance is needed, which should show why this structure is slightly unstable, while the proton's similar dance, performed with one "empty chair," is apparently completely stable. It should also show why this stability is extended to the neutron, when it joins in the even more elaborate dance of the compound nucleus. (Neutron and proton apparently "change places" during this dance, so that the "empty chair" feature is shared between them, possibly offering a hint to this stability.) **See 'Neutron Decay and Proton Stability: the result of Harmonics' below.**

"A study of condensation offers further clues to this stability. Ninety percent of the epos in a neutron vibrate in imaginary directions at any one time; therefore the neutron has a large negative energy balance, and could be said to be poised on the verge of condensation.

The following argument is adapted from Taylor [2001]. "Take a sample of liquid helium containing a macroscopic number of atoms, N. Cool it until it approaches a state of minimum energy. It then has a wave function Ψ_N. Since this depends on the individual states of all N atoms, it is a very complicated function. If we now examine a sample containing $N+1$ atoms, it will have a wave function Ψ_{N+1}, depending on $N+1$ states. By comparing Ψ_{N+1} with Ψ_N, one can define a function $f(x)$. This depends on just one state x, the position of the "extra" atom. This $f(x)$ represents the order parameter, and allows the sample to condense, as it defines the quantum amplitude for adding one extra entity. Thus in the condensate this f fixes the order of every helium atom, breaking the symmetry to give the entire condensate the same, arbitrary phase angle, hence the same wave function. The loss of a single electron, in the case of the neutron, would give the resulting proton an extra positron, which might similarly define its order parameter, making it a totally stable condensate.

"If this model is correct, this analysis should also yield exact agreement with the experimental values of the magnetic moment of the neutron and proton, which are lacking in the SM. Moreover, analysis of the proton as a condensate should explain many of the scattering results, which now are obscure. **It should also eventually be possible to model all of the unstable particles revealed in cosmic rays and particle accelerator collisions as fragmentary, temporary associations of epos.** (We note that the binary is the base of all number systems, and suggest that any particle that seems to require combinations of three-based quarks can also be modeled using binary epos. The quark is a noble effort at order and simplicity—it simply is not basic enough.)

"However, the model also makes predictions that should have readily measurable effects in the macrocosm. Those effects should manifest themselves wherever there are large numbers of ions, which force the BEC to extraordinary lengths to balance this instability in its midst. These large numbers of ions are called plasmas.

"Plasmas:

"David Bohm's early work at Berkeley Radiation Laboratory included a landmark study of plasmas (Bohm, 1980, 1987). To his surprise, Bohm found that ions in a plasma stopped behaving like individuals and started acting as if they were part of a larger, interconnected whole. In large numbers, these collections of ions produced well-organized effects. Like some amoeboid creature, the plasma constantly regenerated itself and enclosed all impurities in a wall in a way similar to the way a biological organism might encase a foreign substance in a cyst. Similar behavior has been observed by Rausher (1968), Melrose (1976), and others, and is now a commonplace of plasma physics. However, no one has ever explained how a collection of ions can act in concert. But this is exactly the behavior of one of our BECs, formed in the laboratory at temperatures near 0°K and consisting of an aggregation of bosons.

"Any BEC must have an exact balance of positive and negative charges. An ion can't be tolerated, and must be expelled by the BEC. It is suggested that the above behavior of a plasma is not because it is self-organizing, but because the universal BEC can't tolerate a collection of unbalanced ions, and so organizes this irritation into a plasma "pocket" of least irritation, tending toward a spherical form. This plasma pocket acts, in

some ways, as if it were itself a BEC. The organization exhibited is because some of its attributes, ordered and controlled by the BEC, are governed by a single wave function. Our hypothesis is that any aggregation of plasma will behave to a certain extent as a single unit, acting as if self-organizing, because, since it is intolerable to the Big BEC, it is isolated as a body, organized by the BEC, and thus partially governed by a single wave function. Since the wave function is determined by the BEC, whose components vibrate only at c, the period of the wave function would necessarily be, for a spherical plasma pocket, its light-diameter. This is according to Hamilton's Law of least action also, as in quantum theory the longest-wavelength vibration will have the least energy. Thus the light-diameter vibration will be the stable, least energy one.

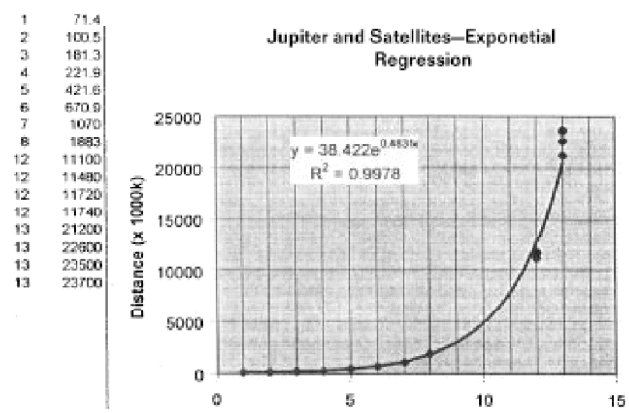
"The largest collections of plasmas in our vicinity have to be the Sun and the gas-giant planets. All of them have anomalies, mysteries we can't explain. Regularities in the spacing of the satellites of these planets have long been noted, and ascribed vaguely to "resonances," though resonances of what has never been specified. Celestial mechanics, based solely on gravitation, has never been able to account for them. For one thing, resonances are invoked to explain the "Kirkwood gaps" in the spacing of asteroids in the "belt" between Mars and Jupiter. These are periods in which no asteroids are found, and which occur at harmonics (1/2, 1/3, *etc.*) of the period of Jupiter. However, some of these harmonics have a clumping of satellites, rather than a gap. And the three inner Galilean satellites of Jupiter are locked into near octave harmonics, with periods within 0.0036 of a 1::2::4 ratio, and there are other octave relationships in the satellites of Saturn. A gravitational "resonance" can't explain both a gap (an instability) and a stable relationship at the same harmonic ratio, so some other factor must explain one or the other.

"There is a very strange unexplained anomaly in the cases of the gas giants and their satellites. The semi-major axis of our Moon's orbit is some 30 Earth diameters, whereas the innermost satellites of these gas giants orbit no more than one or two diameters of the primary from these giant dynamos. With the Earth and the Moon, tidal forces slow the Earth's rotation and force the Moon ever further from us.

"However, Jupiter's moon Io orbits only 3.5 Jupiter diameters away. Tidal forces on Io are strong enough to wrack the satellite, making it the most volcanically active object in the solar system. Why haven't these fierce tidal forces long since moved Io far away from its primary? It cannot be a new satellite, as Io exhibits profound differences from the other Galilean satellites, indicating that these powerful tidal forces have wracked Io for many millions of years. Yet instead of having been moved away by these tidal forces, as required by celestial mechanics, it seems locked immovably in place, a mere three and a half Jupiter diameters away. It must be held in place by some force even more powerful than the powerful tidal force, a force totally unexplained by celestial mechanics.

"It has further been noted that the spacing of the satellites of these gas giants seems to follow a distribution similar to "Bode's Law" for the planets, though this defies explanation, given these immense tidal forces (Miller, 1938; Richardson, 1945; Ovenden, 1972; Spolter, 1993.) **Our new understanding of Dirac's equation, however, does offer an explanation. These giant spinning bodies of plasma are organized by the BEC and therefore have a single wave function. They are charged bodies spinning in an ocean of charge, and must set up standing waves in that ocean.**

"For it has never before been remarked that the first term of the "Bode-like" distribution, in each case, is the equatorial radius of the rapidly rotating body of plasma that makes up the gas giant planet. (See Figures 4, 5, and 6) The wave function governing the spinning body of plasma necessarily has a node at the surface of the planet. By Schrödinger's equation, however, that wave function would not be limited to the planet itself, but would extend, with greatly attenuated $(1/r^2)$ amplitude out from the planet, forming a (longitudinal) standing wave. **Everywhere but at a node, the waveform has amplitude, and would act to "polarize the vacuum." (It would raise in state epos from negative to positive energies, polarizing them to point in "real" directions.) But because the waveform caused by the spinning plasma "polarizes the vacuum" everywhere but at a node, this "vacuum polarization" would add amounts of energy to any matter (dust, gas, asteroids, etc.) not at a node, nudging the matter towards a node. There it would collect over millions of years, like sand on a tapped drum head, forming rings of material, which eventually would collect into one or more satellites. These nodes would necessarily be at harmonics of the planet's radius. Its satellites, unless they are new captures in transition, or disturbed somehow, should orbit at these nodes.**



NUMBER (N)	NAME	INTERCEPT $Y=38.422e^{0.4631x}$	MEAS.VALUE X 10^6 meters	DIFFERENCE (I – M / I)
1	Jupiter Radius	62.3	71.4	- 146
2	Center of Rings	101.0	100.5	.005
3	Amalthea	163.7	181.3	- 107
4	Thebe	265.3	221.9	.164
5	Io	430.0	421.6	.020
6	Europa	697.1	670.9	.038
7	Ganymede	1130	1070	.053
8	Callisto	1832	1883	- 028
12a	Leda	12647	11100	.122
12b	Himalia	12647	11480	.092
12c	Lysithea	12647	11720	.073
12d	Elara	12647	11740	.072
13a	Ananke	20500	21200	- 034
13b	Carme	20500	22600	- 102
13c	Pasiphae	20500	23500	- 146
13d	Sinope	20500	23700	- 156

Figure 6. The spacing of Jupiter and its satellites---exponential regression." End of quotes from Part 2.

Cosmological Consequences from Hotson Parts 1 & 2

"Let's step back and take a look at the universe revealed to us by our modern instrumentation. We shall try to look as a physicist such as Newton or Faraday might have looked, having regard to such eternal verities as conservation and causality. The mathematicians who have taken over the discipline manage to ignore these verities, or wish them away with the wave of a magic tensor. Richard Feynman, one of the last real physicists, famously remarked that, 'If all of the mathematics disappeared, physics would be set back exactly one week'.

"Newton pointed out the absurdity of unmediated action at-a-distance. His laws of motion state that if something physical changes its state of motion, something physical must have pushed or pulled on it to cause such a change. Faraday regarded his "lines of force" as real, physical entities. Maxwell regarded his "field" as a mathematical fiction, a convenient way of representing the (physical) I-don't-know-what causes the observed push or pull.

"Dirac's equation, as shown above, supplies that physical I-don't-know-what for both electromagnetism and gravitation, restoring causality. Faraday's lines of force are shown to be real, physical entities, connecting all charges and directly causing the changes in states of motion referred to as "the electromagnetic field." **Our "Magnetogravitation" shows gravity to be a similar, though much weaker physical connection. Similarly, 'the photon' is shown to be a real wave carrying real angular momentum in a real, physical medium.**

"Among the characteristics of real waves in real physical media is friction. However efficient the transmission, some energy must be lost in the process. This is a characteristic of all real waves, and is a requirement of the Second Law of Thermodynamics. **One way of expressing the Second Law is that any transformation of energy must entail a loss of energy.**

"So natural is this expectation that, in 1921, the German physicist Walther Von Nernst predicted that light from distant sources would be found to have lost energy in transmission. Then, later in the decade, Edwin Hubble (1929) published a finding showing exactly that. The characteristic spectrographic emission lines of light from distant galaxies, he showed, are shifted into the red end of the spectrum, indicating a loss of energy apparently proportional to the distance the signal has traveled, thus exactly fulfilling the Second Law and von Nernst's prediction. Further measurements only confirmed the relationship between distance and this redshift loss of energy, and seven months after Hubble published his findings, the Cal Tech physicist Zwicky (1929) renewed the interpretation that redshift is a frictional loss of energy.

"Nothing could be more normal and natural, and consistent with the laws and eternal verities of physics, than that light, like every other real signal, should lose energy in transmission over long distances. That the measured loss of energy is proportional to the distance traveled is direct evidence that light is a real signal in a real medium that obeys the Second Law. This interpretation is further supported by Von Nernst's valid, a priori scientific prediction, which was fulfilled by Hubble's findings. But will you find this logical chain of events, including this fulfilled scientific prediction, mentioned in any main stream treatment of the redshift? Not a chance. This is because this natural frictional loss of energy was somehow interpreted as a Doppler shift, supposedly indicating that everything in the universe is rushing madly away from us in every direction at velocities approaching light speed. How this came about, and came to be enforced as the official and only permitted interpretation, must surely be one of the strangest aberrations in all the history of science.

"How, then, were we saddled with this bizarre Doppler interpretation? Well, Einstein in SR had rejected the aether on Machian grounds. He called it "superfluous," because there was no measured evidence of an aether, such as a frictional loss of light's energy. Therefore, when exactly such a frictional loss of energy was later predicted by Von Nernst and measured by Hubble, to save the paradigm (and prevent a lot of red faces) it had to be explained away as something else. **Thus was born, out of desperation, the Doppler explanation—an explanation that Hubble himself rejected, calling it "a forced interpretation of the observational results"** (Hubble. 1936). It is therefore a gratuitous insult to his memory to call the supposed rate of expansion of the universe the "Hubble Constant."

"Unfortunately, at this time Einstein's GR was looked on as the "shape" of the universe—and it was unstable, rushing toward collapse without the "cosmological constant" that he added as a fudge factor, But if the universe was expanding at a sufficient rate, the stability problem was solved, as Friedmann showed. **So the Doppler interpretation of the measured redshift was seized upon to solve both problems—to evade the specter of the aether, and to prevent the collapse of GR.**

"But there are major problems with the Doppler interpretation, as Hubble knew. The observed red shift is of course symmetrical, increasing the distance in every direction with us at the center, exactly as a frictional loss of energy would require. But this is a disaster for the Doppler interpretation. It is pre-Copernican, as it would put us once more at the center of the universe. To evade this objection, the Bangers add an epicycle. Though there is no evidence for such a bizarre assumption, we are told that this is not an expansion into empty space, but an expansion of empty space itself, so that the expansion is uniform everywhere.

"But this doesn't work either. If space itself is uniformly expanding, then the space between proton and electron should expand; the space between the Earth and the Sun should expand, the space between the Sun and Pluto should expand. Such an expansion at the Hubble rate would easily be measurable, and simply does not happen (Van Flandern, 1993). So yet another epicycle must be added**: the Tensor fairy is invoked, to wave a magic equation and decree that space expands only where we can't directly measure it, but magically avoids expanding anywhere we can measure it.**

"Further, with millions of galaxies accelerating to inferred velocities approaching light speed, there is no known source of energy that could possibly fuel such expansion. Therefore, the Doppler interpretation flagrantly violates conservation. Just on the basis of the argument thus far, the frictional loss of energy explanation would be vastly preferred to the Doppler one on the basis of physical law and of Ockham's razor. **The Doppler interpretation violates conservation, it violates the Second Law,**

and it requires two epicycles so unlikely that they tower into fantasy.

"There is worse. "Expanding empty space" is another oxymoron, like "curved empty space." Let empty space expand as much as it jolly well pleases, **the expansion still can't move so much as an electron.** As Newton pointed out, to move anything physical, takes something physical, pushing or pulling on it. Once one admits into science this gross violation of causality and conservation, the door is open for empty space to perform any miracle you please, such as to accelerate -- super clusters of galaxies to 99% of light speed, without the ghost of a force to move them. Or, if you can believe the "Inflation" magicians, it can accelerate them to 10^{48} times faster than light.

"Moreover, the expanding universe and the static universe which results from a frictional loss of energy make different predictions for a number of matters we can now measure with modern instruments. Van Flandern (2000) lists seven such tests, the results of which overwhelmingly favor the static universe. He concludes: "If the field of astronomy were not presently overinvested in the expanding universe concept, it is clear that modern observations would now compel us to adopt a static universe model as the basis of any sound cosmological theory."

"There have, of course, been objections raised to the frictional loss of energy concept. The first has always been, "But space is a vacuum—where would the energy go?" Dirac's equation, of course, provides the answer to that, the BEC. The second is the problem of scattering—that anything which absorbs and re-emits light would scatter it. Our epho model answers this. The third has been that light-energy is quantized: that light presumably could lose energy only in discrete quanta. However, a long series of observations by Tifft (1977, 1990, 1991) Arp and Sulentic (1985) Arp, (1987, 1998), and Guthrie and Napier, (1988) have all shown that redshifts from stars, galaxies, and clusters are quantized. The redshifts step up in small, discrete, consistent amounts, indicating that photon energies step down in small, regular quanta. Though the details are not clear at this time, we will show that this can only be a BEC characteristic, indicating that light loses energy to the BEC only in discrete quanta.

"In our laboratories, a superfluid such as ^{4}He confined to a circular ring exhibits the same behavior, which is characteristic of the BEC, in which every part must have the same wave function. **If angular momentum is applied to the ring of superfluid, it will not move at all, storing the energy somehow, until every boson component has a whole quantum of angular momentum. Then instantly the entire ring will be in uniform motion.**

"The same behavior has recently been observed with cold neutrons falling in response to a gravitational field (Van Flandern, 2002). The neutrons don't accelerate smoothly, but in velocity steps of 1.7 cm/second. For instance, a neutron falling at 10 cm/sec in a gravitational field has that constant velocity for an increment of time, then instantaneously is moving at 11.7 cm/sec then an increment of time later it is moving at 13.4 cm/sec, and so forth. This has been called "Possible Detection of a Gravitational Quantum," but if gravitation itself were quantized as crudely as that, the effect would have been detected long ago.

"However, we have shown that neutrons are 90% negative energy, and so are in a semi-condensed state. And like the superfluid above, the neutron as a whole cannot accelerate until every one of its 918 "real" boson components has acquired a quantum of momentum. Therefore, like the superfluid, the neutron accelerates in quantum steps, just as the photon, which is also a BEC phenomenon, loses energy in quantum steps.

"Quasars exhibit the same behavior. They behave like superfluids, and their redshifts repeatedly have been measured to step down in regular quantum steps (Arp, 1998). **But because neither of these repeated, confirmed observations of redshift quantization can possibly be explained as a Doppler phenomenon, both have been ignored, denied, and suppressed by Big Bang theorists.** Again, the Bang is the theory on which they base their facts.

"No other remotely plausible explanation has been given for any of these three classes of observed phenomena. Together, they amount to additional proof both that the nucleon is in a semi-condensed state, and that we are immersed in a universal Bose-Einstein condensate.

"So we see that two incredibly bad choices were made, both at about the same time, both for the same bad reason: to save the paradigm, to evade the increasing evidence for the anathematized aether, to keep some "experts" from being wrong and looking foolish. The first bad choice resulted in the truncation of Dirac's equation, and ultimately in the enormity that is the Standard Model. The second bad choice resulted in the enormity that is the Big Bang.

"Earlier, Dirac's Equation had shown that the "microwave background" is much more likely to be exhaust from the negative-energy BEC than a residuum from a Bang at infinite temperatures. **Moreover, this energy is uniform, isotropic to better than one part in 100,000, as would be required of exhaust from the BEC. However, such a hot, uniform gas as the fireball that, on the Bang supposition, would have caused it could never condense into anything, much less the vast structures of super clusters and gaps (voids) that we observe.** And even if this uniform fireball of hot gas could somehow condense, it could not form these huge observed structures. At the maximum observed intergalactic velocities, these huge structures would take at least 100 billion years to form, seven times the maximum time from the initial Bang (Lerner, 1991). So the microwave background actually disproves any Bang.

"**With the above argument, showing that light is a real wave in a real medium which loses energy in discrete quanta to that medium, we have removed the last vestige of experimental evidence for the unlikely supposition that the universe arose "from nothing" in a magical explosion. Instead, creation is seen to be a continuing, natural process, without a necessary beginning or end, depending merely on the properties of a single quantized field.** Thus it obeys the "perfect cosmological principle" that the Bang disobeys, namely that we occupy no special place, either in space or in time.

"There is one further consequence of magnetogravitation as outlined above. If gravitation is to be recognized as a "real" electromagnetic force, rather than some magical, unmediated action-at-a-distance, by the second Law of Thermodynamics the electromagnetic medium that "carries" the force must "charge" a tiny amount for that conveyance. Thus, the epo chains would gradually lose their induced attraction, hence their coherence. When the epos in a chain fell below the critical "temperature" of

2.7K, they would drop back into the big BEC, and cease to attract at $1/r^2$. Thus gravitation, like any other real force, would have a limited range, rather than magically extending to infinity.

"If our magnetogravitation is a correct model, this range should be calculable. We predict that this range will be found to be approximately 2 kiloparsecs. As Van Flandern (1993) shows, if the range of gravitation were about this distance, it would explain the "flat" velocity curves of stars in the spiral arms of galaxies without the need for any (unobserved) "missing dark matter." This "missing dark matter" must, to explain the observed velocities, amount in some regions to thousands of time the amount of matter present in stars. This limited range would also, as Van Flandern observes, explain a large number of other unexplained phenomena, such as the sizes of galaxies.

"Conventional cosmology has never been able to explain why matter clumps together into galaxies of a certain characteristic range of sizes, rather than either dispersing completely or massing into a single superclump. **Using gravitation of unlimited range, Einstein's GR equations are unstable, requiring a "cosmological constant" (i.e. fudge) to explain observations. But a limited range of gravitation would explain a stable, static universe, and many other astronomical mysteries" End of quotes from Hotson Part 2**

Dirac's Equation and Coulomb's Law

"A Challenge to Coulomb's Law [8] Implications For Gravity And Matter Structure"
by Jaroslav Kopernicky e-mail Jarok@attcanada.ca
& Wm. L. Hughes (deceased)

"Yet we cannot rest satisfied until the deeper unity between the gravitation and electrical properties of the world is apparent"-Sir Arthur Eddington. "Universal gravitation is merely a residual phenomenon of electrical attraction and repulsion"-Michael Faraday. Any idea that attractive and repulsive forces are of even slightly different magnitude flies in the face of Coulomb's law. But experiments with magnets have tended to support such an idea. This paper reports on an ongoing research program in which a past GED author has been joined by his then-reviewer to carry on with the idea and really explore its ramifications.

[Kopernicky-Hughes] Conclusions

"This paper summarizes a rather large body of work by the two authors. It is explained in detail on the website that the experimental and mathematical conclusions arrived at by Kopernicky, the mathematical analyses, computerized solutions, and experimental results obtained by Hughes, and the predictions of Weber/Zollner were all arrived at independently of each other. Yet they all agree to within an order of magnitude or so of the phenomenon.

"The authors respectfully offer the following suggestions:

1) The part of coulomb's law that states that the attractive force between unlike charges (of equal magnitudes) and the repulsive force between like charges (of the same equal magnitudes) are equal should be revised. This conclusion is based on both the experimental and theoretical work outlined here and presented in much more detail on www.electmag.com. It is suggested that when Coulomb's law was formulated over two centuries ago, the nature of the force between unlike charges could be verified experimentally at least reasonably well. However, the nature of the force between like charges was probably assumed, and not verified experimentally to any degree of accuracy.

2) The fact of attractive and repulsive forces being very slightly different when carefully analyzed provides a plausible reason to believe that gravitational forces are a secondary manifestation of electric and magnetic phenomena (the Kopernicky's hypothesis). The difference accounts for the facts that the inverse-square-law requirement of gravity is met, and that gravitation is always an attractive phenomenon.

3) Kopernicky's hypothesis may also provide a plausible reason for the formation of crystalline structures, and an explanation for why crystalline and amorphic molecular structures are stable.

4) Kopernicky's hypoyhesis also gives a classical explanation for the nature of lattice vibrations in crystalline materials.

5) These facts do no violence to the understanding of other established classical electromagnetic phenomena, and they may suggest a tenuous but long-sought bridge between classical and quantum physics.

6) For over two centuries, Coulomb's law has been used as an argument that gravity is not an electromagnetic phenomenon. A major purpose of this discussion and work is to indicate that such reasoning is not valid.

7) It appears that if Kopernicky's hypothesis is true, then the macroscopic nature of the Universe is apparently a manifestation of the microscopic nature of matter. That would seem to be a non-trivial result."

In the above paper by Jaroslav Kopernicky and Wm. L. Hughes, **'A Challenge to Coulomb's Law', for the epo to work as Dirac's Equation requires, plus and minus charges must be exactly equal, only a phase change causing them (the epo) to exchange signs. So Coulomb's Law is correct. However, the above paper does support Hotson's magnetogravitation, as it is the unbalanced '*g*' factor that causes the differences between attraction and repulsion that Kopernicky and Hughes are measuring, and so accounts for what we measure as gravitation.**

Structure Formation: [9-12]

A little history and common sense about structure formation in the Universe and our Milky Way Galaxy

At some time after the decoupling of matter from radiation, the Big Bang consisted of a hot, expanding, homogeneous, and isotropic volume of space containing only Hydrogen, Helium, and minute amounts of Deuterium, and Lithium with no dust. Nothing… No stars, no black holes, no galaxies, nothing, except Hydrogen, Helium, Deuterium, and Lithium. In such an environment, there is absolutely no way to initiate gravitational collapse of the gas to form structures. None. See "Structure Formation In The Universe By Spin And Matter Creation" in Proceedings of The Natural Philosophy Alliance Vol. 1, No. 1 Spring 2004 page 109-113 by Billie Westergard.

Yet, the Big Bang theory would have us believe that just 400 million years after the start of the Big Bang, quasars and galaxies with massive black holes in their cores had already formed. **Now**

everyone at this conference ought to know that black holes are thought to form from the collapse of old stars that have consumed large amounts of energy and time to form, evolve and eventually collapse!!!

The decoupling of matter from radiation occurred about 200 million years after the **start** of the Big Bang at a temperature of about 3500 degrees K. The Big Bang was expanding, but even a cloud of non-expanding Hydrogen (with dust) must be at a temperature of less than 100 degrees K and have a critical Jeans mass (density) in order for collapse to begin.

The age most often quoted for the Big Bang Universe is '10 to 20 billion years old'. **However, the inflationary Big Bang requires the age of the Universe to be 8.3 to 12.2 billion years old, which is related to the plausible extremes of the Hubble expansion rate of 80 and 55 kps per million parsecs respectively.** However, some globular star clusters in our Milky Way Galaxy are in fact over 19 billion years old. And some of the most metal poor stars are even older than the oldest globular clusters. According to the standard theory, the first stars created, the population 3 stars, would be metal free and therefore even older than the metal poor stars of population 2 which populate the oldest globular star clusters in our Galaxy. However, no stars are observed to be metal free. It is thought that the oldest metal free stars have long ago evolved into white dwarfs. The latest and most extreme age for the Big Bang Universe is now quoted to be 13.7 billion years old, which is touted to be 'The Age'. But this is not possible, and the correct Hubble expansion rate should relate to an age of about 10 billion years, if the Big Bang is correct.

Milky Way globular star clusters are not all the same age, and did not form before the Galaxy, as some astronomers have espoused in order to justify the age of the globular star clusters (which appear to be older than the Universe) and to save the standard theory. A wide range in age separate the 200 or so globular star clusters in the Milky Way Galaxy. They orbit the Galaxy beyond the orbital limits of most of the stars in the Galaxy. The globular star cluster Hodge 11, located in the Large Magellanic Cloud, (which is a small young companion galaxy of our Milky Way) is only 10 million years old. **It is very unlikely that the Milky Way Galaxy is the oldest galaxy in the Universe!** The Universe must be much older than the Milky Way due to the fact that some extra galactic structures (large strings and groups of galaxies) would take at least 100 billion years to form the associations that we observe!!!

Look at the Hubble Ultra Deep Field photograph and check out the colors of the member galaxies. All of them are located near the most extreme distance from our Galaxy. (Just Google 'UDF Skywalker' and enjoy the view). The color represents the age of that particular galaxy. Blue galaxies are young and red galaxies are old. The red galaxies in the field are thought to be red because of redshifting due to universal expansion, but why are the blue galaxies in the same field not redshifted? In any event, the red galaxies in the UDF are much older than the blue galaxies, so how did the red galaxies become older than the blue galaxies during the same lapse of time? The ultra deep field is supposed to represent a time period of the early Big Bang Universe about 12 billion years ago. Yet, some of the member galaxies appear to be as old as our Milky Way Galaxy. Look at the evolved structure of the UDF galaxies. Our 15 billion year old Milky Way Galaxy rotates 360 degrees in about 250 million years. Do the UDF galaxies look like they have only gone through one or two rotations since birth? Do they look less than 200 million years old? Why do we not see huge amounts of leftover Hydrogen if collapse of gas resulted in galaxy formation 200 million years prior to formation of the photons in this photograph? Where has all the Hydrogen gone? Think about that.

No quasars (at the same redshift as the high redshift galaxies in the field) are seen in any of the deep fields taken by the Hubble telescope. Why? If quasars are the brightest and most powerful objects in the Universe, and if their number counts increase as a function of look-back time (redshift), and if they are the progenitors of galaxies, (as some astronomers believe), we ought to see many of them in the Hubble deep fields. The reason is because quasars are not as distant from us as their redshift indicates. They are nearby extra galactic members of lower redshift galaxies, having much lower luminosities (than their redshifts would indicate) and are not bright enough to be seen at the distance of the ultra deep field.

There has been a monumental effort over the past 80 years to justify the age of the Big Bang Universe. The only way to do this is to reduce the observed and calculated age of the structures in our Milky Way Galaxy so that the oldest stars and globular star clusters fit within the age limits of the Big Bang.

As shown above, it is not possible to form stars or galaxies in an expanding Universe. The astronomical community has been unable to find a workable model able to form stars even in our own Milky Way Galaxy which contains huge amounts of hydrogen at low temperature that is not expanding with respect to universal expansion. Yet, it is **assumed** that all of the observed stars in our Galaxy were products of gravitational collapse. But, they have not been able to show how gravitational collapse of hydrogen can form stars of any mass!

By every conceivable way possible, the Big Bang proponents have only been able to reduce the age of the oldest stars (in our galaxy) to within three billion years older than the maximum age of the Big Bang Universe. No effort has been made to provide a plausible and logically believable **older** age for the stars and globular clusters in our galaxy, only younger ages are allowed to be sought. However, it is stated in Annu. Rev. Astron. Astrophys. 1996. 34:461-510, "**the unexplained discrepancy between this bright RR Lyrae magnitude zero-point and the fainter one derived via B-W and statistical parallax studies of field RR Lyrae stars leaves open the possibility that systematic errors remain in the distance scale. If the fainter scale turns out to be the correct one, then the age derived for M92 (one of the oldest globular clusters) based on the same models mentioned above, would be ~19Gyr, (19 billion years old not including formation time).**

"The quest to determine accurate globular cluster ages and to ascertain when the first of these objects formed in the Galaxy is, without a doubt, one of the grand adventures in astronomy. It involves nearly all aspects of stellar astronomy and has profound importance for some of the biggest questions our species has ever asked: How did our Galaxy form? How old is the Universe? Is the Universe infinite? Will it exist forever? It has taken the effort of many researchers in many countries around the world to get

to where we are now. Despite the enormous progress that has been made, the answers to such age-related questions remain elusive."

Two examples of attempts to save the Big Bang (Pebles and Dicke 1968 Ap. J. 154:891) tried to develop the idea that globular clusters formed a few billion years before galaxies. So what would the 200 or so globular clusters in our Galaxy have orbited about? There was even an attempt to stop the Big Bang expansion to allow time for galaxies to form and restart the expansion. It may be mathematically possible, with a few fudge factors, but nature does not work that way.

The Black Hole? A Paradigm Whose Time has Run Out! The Dynamics of Degenerate Hydrogen Wells

It has been shown by Chase, Crothers, Heaston, Westergard and others, **that it is not possible to form singularities and event horizons under any circumstances**. Therefore, it can be concluded that black holes do not exist. **However, massive degenerate gravitational wells do exist.** A White Dwarf star is prevented from collapse by electron degeneracy pressure if its mass is below the Chandrssekhar Limit (1.38 solar masses). If additional mass is added the star will collapse to form a neutron star. A neutron star is prevented from collapse by neutron degeneracy pressure if its mass is below about 2-3 solar masses. However, if additional mass is added the neutron star will collapse to become a **Massive Degenerate Gravitational Well regardless of temperature.** Collapse of degenerate matter, below the White Dwarf state, does not produce heat.

The collapse of a massive degenerate star (beyond the neutron star state) causes a phase change of mass energy to spin energy and prevents the formation of a singularity. The spin energy is understood to be identical to photonic spin having no mass, but simply the conservation of angular momentum in the form of a massless left-handed vortex near zero degrees absolute which, at the center of the degenerate well, becomes the storehouse of entropy. The vortex is comprised only of left-handed massless angular momentum in the form of a vorticular storm (the Heaston Force, having no particles, inertia or gravity, and is surrounded by a degenerate neutron gravitational well).

All matter in the degenerate well, **prior to the phase change**, consisted only of neutrons, with inertia and electromagnetic fields. **In a degenerate gravitational well with a very large mass, the contraction would be so strong that wave length and amplitude of the particles would be compressed to near zero and we would expect that evolution to the Phase Change of mass energy to spin energy is under way even prior to the Planck Scale, perhaps nearer to the area which (according to the SM) would have been the event horizon.**

Although the degenerate vorticular storm is only a reality of our positive energy Universe, it does have an effect on the negative energy BEC. In the degenerate gravitational well every epo is surrounded by unlimited numbers of negative energy epos in the BEC. The degenerate vortex at the center of the well has no positive temperature but does have spin that provides a pathway that allows huge amounts of negative energy epos to flow into the vortex adding angular momentum to the vorticlar storm. The BEC can't tolerate spin or positive energy and must get rid of it into its 'dump' (our positive energy reality). But regardless of the furious activity caused in our reality, the BEC itself, each tau, must reach its unchanged, unmoving, perfectly balanced, still, unaffected, all under the same wave function state.

Left-Handedness

At the phase change (from mass energy to spin energy) the degenerate epos become left-handed degenerate angular momentum.

For epos exhausted from the BEC into the vortex, the spin must be left-handed because our left-handed positive energy Universe is the origin of the vorticular storm. The road map is already in place, the BEC has no choice in the matter. Right-handed spin is not an option. The BEC consists only of mass less negative energy epos having photonic angular momentum, but no inertia or mass. The vortex acts similar to a huge suction pump, and the epos pulled up from the BEC are forced to become part of the existing left-handed vorticular storm. **The effect of increasing the momentum acts to decrease the distance h/p (analogous to a coiled spring being compressed) which stores entropy** (see **Inertia** above).

However, the degenerate gravitational well surrounding the vortex provides temporary stability until the vortex reaches a critical value of degenerate spin. The angle of the vectoral plane of angular momentum, the spin of the vortex, must point in both real and imaginary directions. **Due to the Heaston Force, ejection of the degenerate angular momentum vortex must occur at some critical spin value.**

After ejection, the environment of the angular momentum is in a relaxed state, free from the gravitational well and, due to symmetry, begins a Phase Change from spin energy to mass energy in quantum steps, which result in the formation of massive amounts of epos which undergo fragmentation into globules of non uniform mass. The epos quickly combine to form neutrons which, via beta decay, produces Hydrogen within the globules. This becomes the birth place of proto-stars of various mass in our reality. Gravitational collapse is not required to form stars because the Hydrogen is already in a collapsed (but not degenerate) state after ejection and the nuclear reaction in stellar cores has begun. All structure formation in the Universe originates from ejected, cold, angular momentum.

Our Universe is old, very old, perhaps with no beginning and no end. Formation of structures is an ongoing process with new stars, planets, galaxies, quasars, gas, and dust being formed continually from existing degenerate positive energy matter in our reality combined with negative energy epos supplied from the BEC. Stellar birth is an inside-out phenomenon. The gas and dust surrounding the globules are the dissipating remnants of the ejection and stellar birth process.

It is quite possible that a large portion of the ejected angular momentum remains as an intrinsic property of the created particles similar to the intrinsic spin of the mass less photon. If so, it is speculated that this intrinsic property would continue to spin down in lengthening quantum increments of time over the lifetime of the universe. This effect could cause the redshifting observed in distant quasars rather than a Doppler shift. I predict that the redshift of very high redshift quasars will be found to move toward the blue end of the spectrum in quantum steps over a period of time as small as 25 years. This effect could be observed using current technology.

Unification

Unification can only take place within the confines of a **Degenerate Gravitational Well** and only within the degenerate spin energy vortex at the center of the well. The degenerate vortex, at absolute zero degrees, is the location where the electromagnetic, weak nuclear, strong nuclear and gravitational forces become one. This is called 'Unification' which is nothing more than left-handed Degenerate Angular Momentum under enormous density at zero degrees K.

Unification is allowed by the phase change from mass energy to spin energy near zero degrees K, because the spin has no mass or inertia, and therefore no gravity, no electromagnetic fields, no strong or weak nuclear force. Degenerate Angular Momentum is the only force left! But, it has spin in imaginary and real directions, and must turn 720 degrees for one complete rotation (spherical angular momentum), and in effect, is able to store energy like compressing a spring. See the Journal of New Energy Vol. 7, No. 3 Fall 2003 top of page 197, Proceedings of the National Philosophy Alliance International Conference, June 9-13, 2003, By Billie Westergard

After ejection, the formation of neutrons from the epo sea (which are no longer degenerate) allows the reappearance of the magnetic 'g' factor (gravity) and the electromagnetic field. In effect, the Phase Change from spin energy to mass energy causes the restoration of the four fundamental forces.

So, if black holes, event horizons, and singularities do not exist in nature; what should we call the massive degenerate gravitational wells which do exist, (MDGWs)? I think not… Due to the fact, according to Halton Arp, (who I think is the greatest observational astronomer of all time), Fred Hoyle, Geoffrey Burbidge, Jaant Narlikar, and a host of others who have shown that the illusion known as a black hole ejects quasars as well as other forms of matter and radiation, we could think of a name to honor them. However, it has been shown in this paper that massive degenerate gravitational wells are the source of neutrons (the neutron sea), which decay to form protons and electrons which quickly combine to form Hydrogen, which ultimately provides the fuel for the nuclear cores of stars. I think we should call them '**Degenerate Hydrogen Wells'.**

Neutron Decay and Proton Stability: the Result of Harmonics

What causes a neutron to be stable for only 14.8 minutes, whereas all of the other known unstable particles decay in nanoseconds or less. Yet the proton is completely stable from decay.

The distance that light travels in time tau is 1.87×10^{-15} meters. That distance is the diameter of the proton, and is also the diameter of the neutron. The proton and neutron are not fundamental; they are composed of electron/positron pairs. However, the neutron has one extra electron and slightly more angular momentum. This is the difference in stability between the proton and neutron. Each, are made up of 9,180 epos in 10 dimensions, plus one extra electron for the neutron. A configuration in which harmonics plays an important role. Our Universe has a 'heart beat' (clock speed of least count) every τ (equal to 6.26×10^{-24} seconds). All epos, protons and neutrons beat at the same instant throughout the entire Universe. The proton is completely stable because all of its constituent parts are located within the distance that light travels in τ. The neutron being slightly more massive, having one extra electron, is slightly unstable due to the harmonics of its constituents. During the quantum of time τ, the harmonic motion of that one extra electron causes its location to be normally inside, but sometimes outside the limit of the τ distance. If its location is outside the τ distance limit at the instant of a new quantum of time, it causes the phenomenon of Bata decay and that electron is lost from the neutron, causing it to become a stable proton and an electron. However, if a lone neutron is absorbed into a molecule during its 15 minute mean lifetime, it is then completely stable because that extra electrons motion is now confined, due to its molecular association, then the neutron becomes as stable as the proton.

Harmonics may also answer many questions about the stability of galaxy clusters. Due to our belief that gravity has an **'effective'** range, possibly somewhat less than the radius of a normal galaxy; harmonics must keep a galaxy clusters members in a bound unit.

Many clusters are thought to contain enormous amounts of dark matter that holds the cluster together. This is called the virial theorem or condition. However, harmonics may cause the orbital positioning of cluster members, and may be more important than gravity in the determination of the orbital location of stars in each of the member galaxies and also the orbital location of each galaxy member in the cluster.

We believe that the **'effective'** range of gravity allows harmonics to be the dominant force at work in galaxies and galaxy clusters. This would eliminate the virial condition as it relates to galaxy clusters and the orbital velocity of stars in the outer regions of all galaxies, thus eliminating the need of the dark matter fudge.

Harmonic forces are a result of angular momentum and the BEC, in which our universe is immersed. And, may not be limited in range. The force of harmonics has been neglected by physics over the course of human history.

The only requirement for dark matter is to increase the mass density (Ω) of the Inflationary Big Bang Universe to a value equal to unity. However, the observed Ω of all the baryonic matter (stars, galaxies, quasars, degenerate matter, gas, dust, elements) in the Universe is only equal to 2% of the needed value. This means that in order for the Inflationary Big Bang to be correct we must find a staggering amount of missing mass, corresponding to 98% of the needed Ω. Is it any wonder why the virial condition is so important to the Big Bang Theory.

Don Hotson states in "The Music of the Spheres 2", Infinite Energy Volume 15, Issue 86, 2009.

'The agrument is that a spinning body of plasma sets up a standing magnetic wave. The prime wavelength is the diameter of the body, with a node at the surface. Since a wave cannot be confined to a single wavelength, this wave spreads in octave wavelengths and has amplitude (pulls up epos from the BEC) everywhere but at the octave nodes, which, like sand on a tapped drumhead, become the locations of the planets. (This rule is modified, with the inner planets, by the out of phase Tau harmonics of Jupiter, so that they occupy inter-modulation positions.)

Further, it was argued that while we couldn't perhaps prove that the sun was the source of a standing harmonic spin wave capable of moving huge planets into position, it was observed

that there are anomalies at least consistent with that assumption. Since none of the inner planets are at nodal positions, each should exhibit anomalies which conventional astronomy cannot explain. The review of these started at the sun, with the hugh anomaly that the solar "exhaust" is 50 times hotter than the "furnace": the solar corona achieves temperatures of over a million degrees Kelvin, while the sun's surface, at the node, is a mere 5,800 degrees K. Since the corona is expanding away from the sun's surface, it should, by the gas law, cool as it expands. Instead, it is violently heated. Moreover large numbers of protons are accelerated in the same region to relativistic velocities, forming the "solar wind," another unexplained phenomenon.' All must read the three pages about harmonic forces at work in our solar system in the above paper by Hotson.

The BEC

The BEC does not exist only to provide our positive energy Universe with background radiation at 2.76K; The BEC provides a dump for our zeroth quantum field; A place to accept any epo from our Universe which loses its positive energy. The BEC also provides our positive energy Universe with negative energy mass less epos, which are pulled up by the degenerate vortex. Somehow the BEC is responsible for the distance that the ejected spin travels away from the origin point in the center of a Galaxy to the location of the newly formed matter. We do not observe its actual ejection, only the globules and remnants of the ejection (the huge amount of gas and dust in our galaxy) are observed. Most of the gas, elements, dust, etc that we observe between the stars in our galaxy are the remnants of ejection from Degenerate Hydrogen Wells and not from the gravitational collapse of elements created in a Big Bang.

The remnants of the ejection process are cold and eventually dissipate, pushed away by stellar winds and harmonics to become part of the galactic arm system. It seems as though the ejection is superluminal; just look at a typical barred spiral galaxy and observe the right angle turn of the arms, which represent the time when an ejection of matter from the core of the galaxy took place. It can be seen how far the galaxy has rotated since ejection, which represents the elapsed time since the event occurred.

All of the hydrogen gas in our galaxy is the product of ejection from a Degenerate Hydrogen Well, a remnant of the formation process caused by degenerate angular momentum and the BEC. The epos pulled up from the BEC do not add mass to the degenerate gravitational well, only angular momentum is added over a long period of time. The actual ejection of angular momentum from the Degenerate Hydrogen Well is a cold, non-violent event.

All we detect of the event are its effects on our reality; what the BEC must do to maintain its total integrity: 'electric fields', the results of the BEC's necessity to balance any isolated charge by connecting it to a charge of opposite polarity, 'magnetic fields', the effect of electric fields on spinning electrons or protons, 'gravitational fields', the result of the unbalanced magnetic 'g' factor, 'Tesla waves', longitudinal standing waves of polarized epos, 'matter', energy and spin in a stable, standing wave configuration.

Since spinning plasmas cause the BEC to spit out the greatest numbers of epos to maintain this integrity, these effects are greatest around spinning plasmas, and any spinning plasma is probably the source of 'matter creation', if only a few neutrons or so at a time, as in 'cold fusion'.

Think of a spinning plasma as a huge suction-pump, scooping up immense numbers of epos, aggregating them together as neutrons or carriers of fields, and spitting them out, each tau, into 'our reality', where, in a 'disturbed galaxy', they generate even more positive energy and spin, resulting in a fountain of tremendous amounts of matter and energy which is ultimately ejected from a degenerate hydrogen well.

The formation of neutrons from the epo sea is due to the density of the ejected matter, which also allows the reappearance of the magnetic 'g' factor (gravity) and the electromagnetic field. In effect, the Phase Change from spin energy to mass energy causes the restoration of the four fundamental forces.

The Bohr model of the Hydrogen molecule, if viewed at the same scale as our solar system with the proton now at the same diameter as the sun, the electron would orbit 490 astronomical units away from the proton/sun. That's over 45 billion miles away. Remember, Pluto orbits the sun at a distance of 39 AU and the earth orbits 1 AU or 93 million miles; and yet, the electron polices the spherical area of its orbit to exclude another electron from entering (the Pauli Exclusion Principle). Hotson explains why.

In Part 3 of Dirac's Equation and the Sea of Negative Energy, [13] Hotson explains details about the Pauli Exclusion Principle, self-organization, the atomic BEC, Bode's Law, the 'tired light' solution, transmutation of elements, communication faster than light speed, and the psi phenomena (of telepathy and remote viewing).

Conclusions

Our positive-energy Universe is immersed in a negative-energy ocean, which we refer to as the BEC (Bose Einstein Condensate).

Black Holes do not exist in nature. However, Degenerate Hydrogen Wells do exist, and represent the womb of our Universe.

We live in a replicating steady-state Universe with little expansion, which may have no beginning or end.

The speed of gravity is at least 10^{10} times faster than light.

Unification is possible only near zero degrees absolute.

The BEC should allow communication across and throughout the Universe in time Tau.

The microwave background near 2.7K is the boundary between our positive energy universe and the negative energy BEC.

The Universe is composed of equal amounts matter and antimatter, the Epo (electron and positron pairs), which is the basic unit of matter. All massless particles, such as photons, neu trinos, and other entities found in particle accelerator experiments are not basic, but are only the carriers of angular momentum.

It is not possible to create something from nothing, as required by the Big Bang, which is ruled out.

Every molecule and every Epo in the Universe seem to have a common consciousness or knowledge of the whole, which is a characteristic of the BEC.

The BEC is responsible for our reality. Our positive energy universe would not exist without the negative energy BEC which is the cause of the observed 2.7K microwave background.

The BEC supplies negative energy epo's to Degenerate Hydrogen Wells. The negative energy epo's become positive energy when they combine with the degenerate angular momentum in the vorticular storm, adding angular momentum to our reality.

From the view point of observational astronomy it would appear that degenerate angular momentum ejected from Degenerate Hydrogen Wells must travel at superluminal velocity until matter begins to form, which applies a breaking action to the ejection process.

The Hotson - Westergard Universe model is of course a work in progress. The model is less than nine years old and many improvements lie ahead. We believe this model answers most, if not all, of the problems associated with the standard model 'the infamous Big Bang' which is profoundly wrong and has become an embarrassment to intelligent thought.

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A Hypothetical Experimental Device that uses the Phenomena of Light Aberration to Demonstrate that the Speed of Light is Not Necessarily Relative to the Observer

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The intention of this work is to describe a hypothetical experimental device for measuring the aberration of light consisting of a disk capable of rotation. In addition, the apparatus possesses a fixed central light source that emits a beam which reflects, when aligned and not rotating, off of a tangential *y* oriented peripheral retro-reflective mirror, whereby it returns back to the source and a fixed detector, the latter also located at the disk's center. A retro-reflective mirror reflects light back to the source regardless of the angle of incidence of the incoming light beam, so compared to a normal mirror it is different. On one hand, in the non-rotating mode, from the reference frame of the mirror, moreover when aligned, the incident light beam is reflected normal to the mirror's plane, consequently directly back to the source and detector. On the other hand, during rapid rotation, from the reference frame of the peripheral mirror, again when aligned, due to the phenomena of light aberration, the incident light beam will not be oriented perpendicular to the mirror's plane. Rather it will be slanted at an angle, so it will not be reflected back to the either the source or detector. What is more this article will take into consideration possible light source aberration as well. Assuming local light aberration can be detected, then the outcome can be indicative of a preferred frame for the speed of light other than the observer [Ether], or else the speed of light is relative to the source, both of which are inconsistent with Einstein's SRT. However this concept does not invalidate SRT rather it is only an alternative interpretation. Nevertheless by using the concepts developed in this article, it will be shown how one could possibly invalidate SRT.