Preface

Dirac's Equation has profound implications both for science and for the search for new energy. If we continue to use the wrong model (and the Standard Model is profoundly wrong) we will continue to get confusing results that are difficult to replicate.

The enclosure shows the nature of the energetic, non-stationary aether that Einstein missed, that Dirac's equation demonstrates, and that Heisenberg and others destroyed when they dismantled this equation. It further suggests that special conditions, catalysis, and energy available to a plasma may cause the synthesis, rather than the release, of free neutrons, causing transmutations and the release of energy via beta decay.

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.

Abstract

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 electromag-
ngetic 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.

Great theorists from Bohr to Feynman have asserted that “no one understands quantum mechanics.” The student is warned for the sake of her sanity not to try to understand “how it can be like that,” but to take all its strangeness on faith (Feynman, 1985). Like the White Queen in Alice, quantum physicists must “believe six impossible things before breakfast.” However, merely with the single assumption that the Dirac equation means what it says, these features are intuitively, understandably resolved: all the “strange” or “odd” features of quantum mechanics follow simply, logically, naturally, and necessarily.

**Introduction**

The principle criteria for a successful scientific theory would seem to be the following:

**Criterion 1. Simplicity.** It should embody as few “entities” as possible, preferably only one. (This is William of Ockham’s test, known as “Ockham’s Razor”: “Multiplicity ought not to be posited without necessity.”)

**Criterion 2.** It should have few, preferably no, adjustable parameters. (Also known as fudge factors.)

**Criterion 3.** It should be mathematically consistent.

**Criterion 4.** It should satisfy all of the known data, including data unexplained, anomalous, or dismissed as “coincidence” according to previous theories.

**Criterion 5.** It should obey causality: every effect should have a proximate cause, with no “action at a distance.”

**Criterion 6.** It should be falsifiable, making testable predictions.

The first of these, Ockham’s razor, can be used as a general test of the soundness of a theory, as the general trend of successful science is from disorder and complexity toward order and simplicity. Before the advent of modern chemistry, although matter was thought to consist of the four “elements” earth, air, fire, and water, these could combine in unlimited ways. Thus contemporary thought allowed for an infinite number of “entities” with no valid rules for their combinations.

By 1890 science had shown that all matter consists of ordered combinations of ninety-two “irreducible” elements, or atoms. The “gravitational field” was another entity, and Maxwell had unified electricity and magnetism, so the “electromagnetic field” was another. Therefore, by this time the progress of science had reduced this infinite number of entities to less than one hundred.

The discovery of radioactivity showed that these “elements” were not irreducible after all, and by 1932 after Chadwick’s discovery of the neutron it was found that all stable matter consists of ordered and understood combinations of just three entities—electron, proton, and neutron. In addition to these there was Anderson’s newly discovered positron, the photon which was now widely considered to be a particle, and the gravitational and electromagnetic fields. Thus in 1932 the number of entities recognized by science totaled no more than seven. The unifying progress of science had over time reduced the number of entities from infinity to less than one hundred to a mere seven. (The actual low water mark had been reached a decade or so earlier, before the discovery of the positron and the neutron. The neutron was then supposed to be an electron/proton fusion, and the photon wasn’t yet considered a particle, so the entities then recognized by science totaled merely four.)

So far so good. It seemed obvious that this process of unification would continue, and reduce the number of entities still further. Great scientists such as Einstein dedicated their entire lives to unification. Nonetheless around that time the simplifying trend reversed, and by the end of the century, the accepted Standard Model (SM) of particle physics called for around thirty-six “fundamental” particles, most with an antiparticle, and each with its very own “field”: again almost one hundred separate entities. What happened? William of Ockham’s test would seem to indicate that science took a very wrong turn sometime around 1932.

Well, perhaps the universe doesn’t shave with Ockham’s razor—maybe it really is that complicated. But the evidence points the other way. 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.

Computer science shows that operations of unlimited complexity can be built up from just two binary components, yes/no, on/off, plus/minus. Since two binary components are all that is necessary, by Ockham’s razor and the universe’s demonstrated parsimony, two binary components should be sufficient. This is not to suggest that the universe “is” a computer (although several respected scientists, such as David

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The problem with the medieval debate over how many angels could dance on the head of a pin was that angels were unobserved entities, and so could have any desired properties. Each of these classes of unobserved entities in the SM amounts to a fudge or patch applied to save a failing theory. So long as these fudged entities are made unobservable in principle, like the angel or the quark, they are safe from experimental falsification.

Deutsch [1997] think it is), merely that computer logic and the logic of building a universe appear, necessarily, to be parallel.

As an exercise, consider for a moment in broad terms how a computer of unlimited capacity might go about modeling the physical universe, using merely its two entities. The ultimate aim must be the unlimited complexity and flexibility of the unlimited numbers of chemical compounds. But the first thing a binary computer must do is construct the three. Three is the builder. A triangle is the simplest figure to enclose space, a stool needs three legs, a universe needs three dimensions. And all stable matter requires just three entities.

Let’s suppose that the computer, constrained by the universe’s physical laws, manages to model the electron, proton, and neutron using just its two entities, which is certainly possible, as we will later show. Then, again constrained by physical laws, 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.

By William of Ockham’s test, therefore, the SM is far off track. How does it fare judged by the other above criteria? Even worse.

In contrast to the ideal of no adjustable parameters (Criterion 2), the SM requires at least nineteen adjustable parameters, values which have to be entered by hand. Since it can be proven that $2 + 2 = 3$ with just one adjustable parameter, this would seem to be a major defect.

Further, the SM is not mathematically consistent (Criterion 3). The SM calculations of many ordinary values, such as the rest mass of the electron, come out to be infinite. However, from experiment we know the electron’s rest mass to be 0.511 MeV. To get rid of this “impossible” result, “renormalization” is invoked: the positive infinity is, in effect, divided by a negative infinity. Since the result of this mathematically forbidden procedure is indeterminate, the desired value of 0.511 MeV is then simply entered by hand. This admitted fudge would not work if we didn’t already know the answers.

Feynman, who originated the “renormalization” process (with Schwinger and Tomonaga), himself called it a “. . . shell game. . . Having to resort to such hocus-pocus has prevented us from proving that the theory of quantum electrodynamics is mathematically self-consistent. . . [renormalization] is what I would call a dippy process!” (Feynman, 1985) Asked for what he had won the Nobel Prize, Feynman replied, “For sweeping them [the infinities] under the rug.” (Gleick, 1992)

On the face of it, if the results of calculations of ordinary values come out to be infinite, in case after case, shouldn’t we take this as a gentle hint that something basic must be wrong, and start looking for a better model? Instead, like the freshman who looks up the correct values in the back of the book, we fudge the answers. A student who pulled such a stunt would flunk. The three famous professors who pulled it shared a Nobel Prize.

This grant of a Nobel Prize for what is, after all, nothing but an elaborate fudge, testifies to the malaise of current theory. This incredible award legitimized the fudge, which as a result is now an accepted, even rewarded scientific procedure. With this, physics lost the ability to self-correct, as a fudge can always be concocted to bring any datum, however discordant, into at least apparent accord with the current paradigm. As a direct consequence, most of the nearly one hundred entities required by the SM are unobserved. The problem with the medieval debate over how many angels could dance on the head of a pin was that angels were unobserved entities, and so could have any desired properties. Each of these classes of unobserved entities in the SM amounts to a fudge or patch applied to save a failing theory. So long as these fudged entities are made unobservable in principle, like the angel or the quark, they are safe from experimental falsification.

The SM also has a major problem with mass. Gordon Kane (1995) argues that the Standard Model should really be called the “Standard Theory” because it is nearly perfect—just a few minor flaws. He then goes on to mention one of them (p. 117):

In its basic form, the Standard Theory is a theory for massless particles. All the leptons, quarks, and bosons must be particles without mass, or the mathematical consistency of the theory is destroyed. The photon and the gluons indeed have no mass, but the others do. Why not just insert a mass for them in the equations? Unfortunately, in a quantum theory all aspects of physics are so highly interconnected that if the masses are just put in, then calculations start to give infinite values for many ordinary measurements. (In the language of the last section of Chapter 4, the theory is then not renormalizable.)

In other words, the Standard Theory is a beautiful theory—but it applies to some other universe, one in which all particles oblige the theorists by being massless. Unfortunately, in our universe, the stubborn particles perversely persist in having mass, while stubborn theorists persist in clinging to
It is an axiom of science that no theory will remain valid forever. That being so, the “current paradigm” is by definition invalid! “Defense of the paradigm” is therefore indefensible. Each new datum should be cause for a review, not just of the current paradigm, but of every choice that led up to it.

a theory that treats them as if they didn’t. The current hope is that two more fudged entities, the (unobserved) Higgs field and its supposed quantum, the (unobserved) Higgs boson, will somehow solve this dilemma.

The remaining above criteria (4-6) are also violated by the SM, as will be shown in what follows. The roots of most of these violations go back to the early 1930s as well. The infinities that so plague the model, as we will demonstrate, also have their origin in the early 1930s, in an apparently wrong turn taken by science.

The Fork in the Road

By the above criteria, then, the SM would appear to fail in nearly every possible way, and all of its failures seem to stem from the early 1930s. By all indications science seems to have taken a wrong turn about this time. After three hundred years of progressively simplifying the description of the universe, with fewer entities and simpler laws, it suddenly turned the other way, with complexity and entities multiplying like rabbits. (Quantum Field Theory [QFT] in the SM is now so mathematically complex with its thirty-six or so [unobserved] fields that, as Treiman [2000] puts it, “There are no remotely realistic theories that are exactly soluble.”)

Science frequently makes choices between alternatives. Once the choice is made, however, scientists tend to unify behind the accepted alternative to the extent of denying and eventually forgetting that there was any “real” choice made. Subsequent textbooks gloss over any possible alternatives, depicting science as a straightforward march up the one correct path toward truth. Since it is forgotten and denied that such choices existed, the results of these choices are rarely reviewed. Not only is there no provision, or incentive, for such a review, there is positive, and powerful, peer pressure against any such questioning of basic premises. (The inexcusable treatment of the astronomer Halton Arp [1998] is just one example.)

However, it is an axiom of science that no theory will remain valid forever. That being so, the “current paradigm” is by definition invalid! “Defense of the paradigm” is therefore indefensible. Each new datum should be cause for a review, not just of the current paradigm, but of every choice that led up to it. Let’s suppose that, over the course of the history of science, ten paradigm-affecting choices are made. In each case, suppose that the rejected alternative has only one chance in three of being right. In each case, clearly science will choose the more probable outcome. Nonetheless, over the ten cases, the probabilities are over three to one that at least one of the ten rejected alternatives is correct, and that the adopted paradigm will be partially or completely wrong as a result.

Moreover, if the choice involves a paradigm change, the odds may be totally the other way, as it seems we will choose the alternative that defends the paradigm if that alternative has any plausible chance whatever of being right (Arp, 1998).

Many such choices were made in the early 1930s. Of course, in real cases the actual odds are difficult or impossible to assess. One choice in particular stands out, however, because of the passion aroused by the controversy, and because of its far-reaching effect on the shape of subsequent theory. This controversy involved the Dirac relativistic wave equation (Dirac, 1928a, 1928b), a relativistic generalization of the Schrödinger equation:

$$\sum_p \left[ \sum \gamma \left( \frac{\partial}{\partial x^\mu} + \frac{mc}{h} \delta_{\mu p} \right) \right] \psi_p = 0,$$

$$x^\mu = x^t, ic^t$$

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 $\Psi$ 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:

$$\pm E = (c^2p^2 + m^2c^4)^{1/2}$$

[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.

Dirac’s “sea” of filled negative energy states, while it satisfied the equation, didn’t at all satisfy the physicists. Heisenberg (1928a) wrote to Pauli: “In order not to be forever irritated with Dirac I have done something else for a change.” A little later he wrote, “The saddest chapter of modern physics is and remains the Dirac theory.” He further added that Dirac’s “magnetic electron had made Jordan melancholic.” (Heisenberg, 1928b)

Later, after the discovery of the positron, again in a letter to Pauli, who had reported himself “Your (drowned in Dirac’s formulae) W. Pauli,” Heisenberg remarked, “I regard the Dirac theory…as learned trash which no one can take seriously.” (Heisenberg, 1934a)

These emotional responses were not limited to Heisenberg, Pauli, and Jordan. They were general among the physics community. Their objection was not to the success of the Dirac equation, but to its requirement of a sea of negative-energy states. They were all good Machians, insisting that theory should be based on observables alone. They were not at all open to a suggestion that they might have been missing half of reality all these centuries, as Mach had missed the atom. (Mach insisted to his death in 1916 that the atomic hypothesis “went beyond the data.”) Heisenberg had developed the first successful version of quantum mechanics on a Machian basis, and an unobserved, ubiquitous “sea” was anathema.

Worse, it harked back to an old war, the “aether” conflict. On largely Machian grounds, Einstein in 1905 had declared the “luminiferous aether,” the supposed carrier of light, to be unobserved, hence nonexistent. [Lorentz’s electromagnetic aether (Lorentz, 1904, 1909) answered all of the other objections to a carrier of light, including the results of the Michelson-Morley experiment, so the only remaining objection was the Machian one.] For a generation, the “Aether War” had raged in every faculty. By 1930 the tide was definitely running with the Relativists, and most remaining aether enthusiasts were dying out. (Lorentz, their doyen, died in 1928.) They were far from forgotten, however. Any reference to a universal substance that undetectably filled space sounded too much like an aether.

The final argument was always that negative energy is impossible, with no imaginable physical meaning. Of course, pronouncements of the kind are impossible have a long history of looking foolish in retrospect, but this one seemed persuasive at the time, and is still heard. (We will later suggest a very possible physical meaning for negative energy.)

Heisenberg’s “Window”

Heisenberg 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 x b = -b x a. Grassman’s elements look even stranger. In them, a x 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 puzzle 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 “epsilon”). Experiment verified that these epsilon 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 epsilon 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.

Along with the other Machians, Heisenberg had for six years been trying to find the “obvious” mistake in Dirac’s “learned trash.” He failed utterly: the equation was mathematically flawless, it was Lorentz invariant, it accounted for virtually everything concerning the electron and positron, and it was becoming increasingly useful. But it called for the unthinkable, the politically incorrect “sea” of negative-energy epsilon. 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...
As Dirac noted, physicists had always arbitrarily ignored the negative energy solutions. If they were real in some sense, as Dirac’s “learned trash” insisted, they had all been mortifyingly, catastrophically wrong all these years, ignoring exactly half of reality. And that other half of reality, alarmingly, seemed to resemble the anathematized ether.

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 baseline. We call them “Zero-Point Fluctuations.” When a dolphin is ill-mannered enough to jump out of this non-existent 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.

In defense of Heisenberg, the experimental evidence had indeed begun to look as if “creation” and “annihilation” were actually happening. In cloud chamber studies of cosmic rays, high-energy gamma rays (photons) suddenly gave birth to electron-positron pairs (epos), which separated at high velocity. The photon then would approach another electron, and the two would disappear, being replaced by high-energy (0.511 MeV) photons.

There was, however, one immense difference: Heisenberg’s “creation operator” required the creation of unlimited numbers of electron-positron pairs (epos) without any high-energy photons, or, indeed, any measurable energy input at all. And when they are “annihilated” by the other operator, the epos vanish without a trace, producing no high-energy photons or any other detectable energy.

This massive violation of conservation bothered Heisenberg only momentarily, because there was a seeming “energy window” in the uncertainty relations that he himself had famously developed. These limited what one could know (measure) about a quantum state: if one measured the position of a particle exactly, then its momentum was maximally uncertain, and vice versa. He developed a similar expression for energy and time, namely that if ΔE and Δt are the respective latitudes in energy and time of observation, then ΔE • Δt ≥ h/2π. He took this to mean that if one observed for a sufficiently brief interval of time, (Δt approaches 0), then the energy available would be effectively unlimited (ΔE approaches infinity).

He therefore decided that these “created” epos must be “virtual” rather than “actual” (though the equations suggest no such thing), coming into being (in unlimited numbers) for a brief instant of time using energy “borrowed” (in unlimited amounts) from this relation. And when they “annihilate,” he argued, they merely “pay back the loan” to the uncertainty relation.

Operationally, of course, “virtual” here means “having whatever properties we chose.” One of the handy properties chosen for these unlimited numbers of “virtual” epos is that, although formed of unlimited amounts of energy, they somehow don’t gravitate. Thus they violate General Relativity, which states that such unlimited energy should curl the universe into a little ball. Every electron, surrounded by unlimited numbers of epos, should be a “black hole.”

So stood the question in 1934. The Dirac equation was a direct threat to the reigning paradigm. As Dirac noted, physicists had always arbitrarily ignored the negative energy solutions. If they were real in some sense, as Dirac’s “learned trash” insisted, they had all been mortifyingly, catastrophically wrong all these years, ignoring exactly half of reality. And that other half of reality, alarmingly, seemed to resemble the anathematized aether. Though his interpretation seemed to violate either conservation or General Relativity, or both, Heisenberg’s mathematical conjuring trick offered an escape route, a window, however tiny and iffy. Perhaps the paradigm could yet be saved.

As we know, science took this escape route and never looked back. They saved the paradigm. But were they right to do so? Let’s try to set up some kind of balance sheet.

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.

Arthur C. Clarke pointed out that if a man in a long white coat tells you that something is possible, he is prob-
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ably right. But if he tells you something is impossible, he is almost certainly wrong. Yet here we are told that something called for by both of these most respected of relations is impossible. There are about eight different things that the Dirac equation got exactly right, but this one thing it got wrong? Surely, if it is completely wrong on something so basic, it would have given wrong answers or fewer answers elsewhere as well. To be so certain it is wrong science, we must have direct evidence that negative energy doesn’t exist, right?

Well, that’s a problem—you can’t prove a negative. There is no way to prove that negative energy won’t someday be shown to be real, with a physical meaning. For the moment, let’s leave the question hanging.

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 epos exists, this 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 $h\nu$ 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 10100 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 boldly 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.

We will later look at this question more closely, and show why this “raising in state” requires no additional energy, resulting merely from the ion’s unbalanced charge. First we need to look at more problems with “annihilation.”

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 pseudatom 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 sup-
The astronomer Halton Arp noted that when faced with a choice involving a paradigm change, scientists will almost invariably choose the alternative that will save the paradigm, regardless of the evidence.

pose 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. Almost 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.

In this, they obeyed what we might call “Arp’s Axiom.” The astronomer Halton Arp (1998) noted that when faced with a choice involving a paradigm change, scientists will almost invariably choose the alternative that will save the paradigm, regardless of the evidence. “[C]an we count on conventional science always choosing the incorrect alternative between two possibilities? I would vote yes, because the important problems usually require a change in paradigm which is forbidden to conventional science,” Arp, 1998.] Yet in this case, the odds that they made the wrong choice would seem almost incalculably high. Surely they were high enough that someone, in the time this question was being debated, would at least have suggested examining the ramifications of the other choice: of the negative energy electron-postron “sea.” At the least someone might have suggested that the choice be held in abeyance until more evidence was in.

But neither of these appear to have been suggested; if they were suggested, they were certainly not done. [H. Bondi (1957) appears to be an exception. Much later, he examined negative energy within General Relativity. Also, T.E. Phipps, Jr. (1976, 1986) explores both negative energy (the “hole theory”) and negative (or “imaginary”) momentum in his “Beta Structure Hypothesis.”] The case seems to have been decided with apparent unanimity soon after Heisenberg’s “window” became widely known. (That Furry and Oppenheimer [1934] independently made similar suggestions of course would seem to strengthen Heisenberg’s case.)

Even Dirac appears not to have pursued negative energy much farther. His objections to QED were on the grounds of infinities (Pais, 1994).

Would the decision have changed, had the question been held in abeyance? To consider this, we have to look at the results of this choice, immediate and longer-ranged.

The first result was highly questionable by William of Ockham’s test. Heisenberg introduced four new (unobserved) entities, bringing the total number of entities instantly from seven to eleven. (The virtual electron, the virtual positron, the virtual photon, and a “relation” gone into the loan business, with infinite energy to loan out.) This was a considerable abandonment of his Machian principles. And as we know, entities have proliferated without limit ever since.

Furthermore, 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 calcula-
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.”

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, \( \tau \), which must elapse before the wave function “changes appreciably.” [This minimum time appears to be \( 2e^2/3mc^2 \), or \( 6.26 \times 10^{-24} \) seconds. We will discuss this later.] This means that the wave function changes only in increments of the constant \( \tau \). 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 \( \Delta t \cdot \Delta E \geq \hbar \) is really the inequality \( \tau \cdot \Delta E \geq \hbar \). (We will examine this apparent quantization of time in more detail later.)

If time is a constant that can only come in increments of \( \tau \), as this inequality relation shows, then obviously it can not 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 interval. If that is not the case, as the above “smoking gun” emphatically shows, then Heisenberg’s window doesn’t exist.

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.

The blame for this appears to fall on Ben Franklin, who flipped a coin and chose to designate static electricity with a deficiency of electrons “positive” and that with a surplus of electrons “negative.” He assumed correctly that there was a “unit of electricity,” that electricity was the transfer, the flow of some charged entity; but he guessed exactly wrong as to which one. By this mischance the electron, the very unit of electricity, was saddled with a minus sign. Ben’s mistake had far reaching consequences. Had he guessed correctly as to what was flowing, both the electron and what we now call “negative energy” would have had a positive sign. In this much more logical case, would we have been so certain that something called “negative energy” is impossible? Would we have been so quick to say that “positive energy” is impossible?

All through science, we observe almost total symmetry between positive and negative. Charges come in positive and negative, forces come in positive and negative, particles are symmetric between matter and antimatter. This last came as a great shock to physicists in the 1930s, but after it was accepted, symmetry became the justification for many of our theoretical structures. Only in energy do we deny that such a symmetry exists. This prejudice would seem to have its roots in the past, in a time when most scientists were profoundly religious. To them, “negative energy” perhaps sounded like something invoked by someone calling on Powers of Darkness, and they were only too glad to ignore it and deny its existence. But surely it is time to rise above such superstition, especially when we realize that, but for Franklin’s mistake, “negative energy” would be “positive energy.”

Surely the forces that combine, that draw things together, that build, in all propriety should be considered positive forces. Yet Ben’s mistake saddles them with a minus sign. And just as surely, the forces that force apart, that break down, that explode, we would normally call negative forces. Had Franklin made the right choice, this illogic would be cured. But mark the sequel: our reality then would have been seen to have a large negative energy balance.

In this case, since both the energy equation and Dirac’s equation are symmetric with respect to positive and negative energy, surely someone would have postulated a symmetrical reality somewhere with a balancing positive energy surplus. The solutions to Dirac’s equation amount to a matter field containing unlimited, symmetrical amounts of negative and positive energy. This implies that there exists a symmetrical “sea” with a surplus of energy opposite in sign to that of our matter/energy. This would restore the symmetry between negative and positive energy called for by these successful equations.

This will require a change of focus, especially for physicists who have worked with the “single-entry” bookkeeping for so long. However, a more logical “double-entry” system works equally well with everyday energy issues, and it clears up places where the “single-entry” system has problems, such as near absolute zero. Just as an exercise, try to think of “positive energy” as the result of positive forces, and “negative energy” as the result of negative forces. Then, in the lowering in state called for by Dirac’s equation, when all positive energy is removed from an electron and positron and they drop into the “sea,” the only force between them is the negative Coulomb force, and they clearly would have only “negative energy.” And since they are then apparently undetectable, it would seem that “negative energy” doesn’t gravitate or have inertia. (“Mass” is only the result of positive energy.) We will discuss the reason for this in what follows.

There are other clear indications that negative energy does exist, but has merely been mislabeled. According to Feynman’s “parton” model, the nucleon consists of a swarm of charged particles which are held together by the “strong nuclear force,” which is negative in sign. As many of these partons have like charges, these are strong positive energy forces trying to blast the nucleon apart, which must be balanced by the even stronger negative strong nuclear force. To avoid calling the results of this force “negative energy” is a purely semantic prejudice. To be stable, the nucleon must be a balance of negative and positive forces, hence negative and positive energies.

The measured mass of an alpha particle is substantially less than the sum of the mass-energies of the two protons and two neutrons that make it up. To avoid the proscribed term “negative energy,” this difference is called the “mass deficit” or the “binding energy” or “negative potential energy.” (“Potential energy,” in general, is a euphemism for the dirty term “negative energy,” used when the energy supplied by a negative force such as gravitation is unavoidable.) But each nucleon still has its like “parton” charges, so when you add the two protons, the “bound” nucleus must have more (positive) energy than its “unbound” constituents. (The positive Coulomb repulsion between the two protons in these close quarters is enormous.)

The only way in which a “bound” nucleus with more total energy can have less positive energy is if this “binding energy” is negative energy. (Its sign of course is negative, as is the sign of the strong nuclear force that binds the nucleus together.) Since the strong nuclear force is negative in sign, and since the “binding energy” that results from it is negative in sign, it seems clearly doubletalk to say that negative energy doesn’t exist.

When two additional positive charges are added in the formation of an alpha particle, all of the parton charges are still there. Thus, the particle has more blasting-apart (positive) energy, and by conventional thinking should mass more. However, to be stable, the negative energy-positive energy balance must change. So the alpha particle as it forms divests itself of some positive energy, the energy that powers the sun, thus giving the particle a higher percentage of (non-gravitating) binding negative energy, and making it stable again in spite of the additional two positive charges.

**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 \( t \), \( x \), \( y \), and \( z \) (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 (Sraig, 2000). General Relativity as well calls for ten tensors, or "dimensions of curvature" (Sraig, 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 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 \( \pm c \) 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, 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)

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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 \( \pm c \). Doesn’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 (\( \Psi \)) 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 \( \frac{1}{2} \) 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. Since in the least-energy arrangement their spins and charges would cancel, the epo (a one-dimensional string, with a “point particle” at each end) equal to \( \tau_c \), 2e²/3mc², or 1.87 x 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 \( mc^2 \) 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 \( mc^2 \), around 1.5 x 10⁸ MeV. As it is, because of our four “real” dimensions, the component of this complex spin energy in any “real” direction appears to be \( 4\hbar^2(mc^2) \) 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 can not 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 conservation 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...
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. 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 a 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 \(\frac{2\pi}{3}\), 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" \(\tau\) would then represent the "reporting cycle" of this process, the minimum time between "reports." 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 energy proportionate to the "quantum of time." This is the fundamental relation is that of energy proportionate to the "quantum of time." This is the fundamental relation is that of energy proportionate to the "quantum of time." This is the fundamental relation is that of energy proportionate to the "quantum of time."
able.” Notably:

\[ E = \sqrt{(cp)^2 + (mc^2)^2} \]

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 can 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 the negative energy that 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. 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 “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 “miracle.”

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 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 requires and assumes 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 non-local extended structure. We will later demonstrate that these non-local actions are not literally instantaneous, but take the finite time ε. 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 of all negative-energy, one-dimensional epos, all with identical negative energy (but no “mass”). Each epos 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.
The Electromagnetic Field

We have seen above that Dirac, Oppenheimer, and Heisenberg all proved that every ion must immediately be surrounded by unlimited numbers of the opposite charged ends of epos. Experiment has since confirmed this to better than ten significant figures. However, if these are “real” epos “created” by the charge, this makes the mass of the ion “slightly infinite.”

There is a further problem with the conventional view. Unlimited numbers of epos means that in every direction from an electron, for instance, there would be the positron end of an epo. This would completely neutralize the charge of the electron, so that it could not be felt or measured outside of this surrounding sphere of positrons. Recognizing this, conventional theory supposes that the “bare” charge of the electron must be some unknown higher value, probably infinite, which the sphere of positrons reduces to the “dressed” charge that we measure (Pais, 1994). But this supposition ignores one little matter: if the “bare” charge of the electron were infinite, so would be the charges of the positron ends of the epos. Whatever “bare” charge one chooses to assign to the electron, it would be completely neutralized by this sphere of epos. Moreover, if the “bare” charge of the electron were infinite, the “bare” charge of the proton would also have to be infinite.

We have shown above that electron and positron must set up a stable relationship at a distance of \( r_c = 1.87 \times 10^{-15} \) m. However, this is the measured diameter of the proton, and in a nucleus the nucleons are packed closer together than this. Therefore, there is no way that the two protons in an alpha particle, for instance, could be shielded from each other, so if the proton had an infinite charge the alpha particle would instantly explode. What is true of the alpha particle is a forlorn true of nuclei with even more protons packed closely together. From this one must conclude that the proton can

“half a boson.” In terms of energy, “half a boson” is \( \hbar \nu / 2 \).

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 \( \hbar \nu \). In this case \( \nu = 1/\tau \), around \( 1.6 \times 10^{22} \) Hz. This would give the epos an energy \( (E = \hbar \nu) \) 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 epos” is also “half a photon.”

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 epos—hence

half a boson.” 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.

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only have a charge of exactly +e. However, a proton ion, as shown by experiment, must instantly be surrounded by a sphere of unlimited number of the electron ends of epos. Since its charge must be exactly +e, this charge would be completely neutralized, which we know is not the case. So something is terribly wrong with the “conventional” view.

However, all of these difficulties disappear when regarded from the new viewpoint of an infinite sea of negative energy epos. An ionic electron must instantly be surrounded by a sphere of the positron ends of polarized epos, as has been verified by experiment. The positrons must form a sphere of diameter c/c. But this takes no energy, since in the infinite sea there is already a positron and an electron at the exact points necessary to make that sphere of polarized epos, each radial to the ion. The only difference is that these are now positive energy epos, as their vectors point in real directions. So far this is the same as the conventional view, except that it does not violate conservation.

The story is not over, though, as each positron in the inner she has a potential induced by the ionic electron. (At that tiny distance, the force between electron and positron is enormous.) This would unbalance the epos, inducing a potential between the positron and its electron, which would again force the electron end to polarize another epos, and so on indefinitely, forming chains of polarized epos. These chains would continue into space until they terminated at a charge of opposite polarity. (See Figures 1 and 2.) Again, this is a way the same as the conventional view: the equations call for unlimited numbers of epos. They do not, however, say where they are, and the conventional view does not carry the process to its logical conclusion, which is shown in Figures 1 and 2.

The equations call for a negative-energy BEC that fills all space, but nearly undetectably, since it vibrates in “imaginary” directions. It is full of equal numbers of positive and negative charges, but they are “charge condensed,” so that each charge only “sees” its paired antiparticle charge, making a one-dimensional vibrating object similar to the “strings” in many of the popular string and superstring theories. This one dimensional string-epo can vibrate in any “imaginary” direction, but it must average c/c in distance from its antiparticle.

However, a BEC cannot tolerate an unbalanced charge. Therefore, an unbalanced charge, an ionized electron for instance, must immediately be neutralized. As we have seen above, the equations call for it to be instantly surrounded by the positive ends of an unlimited number of polarized epos.

We can now see that this “neutralization of a bare charge” called for by the equations is a requirement of the BEC, which can’t tolerate an unbalanced charge; however, it has unlimited (infinite) numbers of epos that it can throw at it, to neutralize it.

Therefore, each “bare” electron is immediately surrounded by unlimited numbers of epos. However, once again this would not solve the BEC’s problem. Only when every unbalanced charge is neutralized by chains of epos connecting it to and neutralizing every opposite unbalanced charge is the BEC again stable. So the very stability of the BEC requires chains of epos in the patterns shown in these two figures. (And of course Dirac’s equation calls for unlimited numbers of polarized epos—as is verified by experiment—but it doesn’t state where they are. So this pattern is a direct solution to the equation.) Note that this result is only possible if the total number of positive and negative charges in the universe, whether in the “positive energy” realm or the “negative energy” realm or both, is exactly equal. And this means that the numbers in each can only change in pairs—epos.

Furthermore, however many epos the BEC “sacrifices” to accomplish this neutralization, the number of epos in the BEC remains exactly the same. Infinity minus infinity is still infinity.

According to the Zeroth Quantum Field and the “unex-purgated” Dirac equation, verified by experiment, this pattern must happen. Moreover, since this complete sphere of positrons would neutralize any charge of the “bare” electron, this induction pattern is the only way any charge on the electron could be felt or measured outside this sphere. Charge is carried by proxy by these chains of epos. The strength of the charge measured anywhere would vary as the inverse square of the distance, as the Coulomb gauge requires. (This strength would be measured in “epo chains per unit area,” just as Faraday would have us measure “lines of force per unit area.”) Since this pattern must happen, and since it duplicates every aspect of the electromagnetic field, as is easily verified, we submit that this is the electromagnetic field, much as Faraday or Maxwell would have drawn it, with Faraday’s “lines of force” exactly duplicated by chains of epos.

The model exactly combines the properties Maxwell expected his mechanical ether to exhibit, embodied in his equations. This ether must, he argued, be in a condition of mechanical stress.

The nature of this stress is, as Faraday pointed out, a tension along the lines of force combined with an equal pressure in all directions at right angles to these lines. . .From the hypothesis that electric action is not a direct action between bodies at a distance, but is exerted by means of the medium between the bodies, we have deduced that this medium must be in a state of stress. (Maxwell, 1873)

In this “epo model,” the “tension along the lines of force” is supplied by the attraction between the aligned unlike charges in the epo chains. The pressure in all directions at right angles to the epo chains is supplied by repulsion between the like charges in different chains lined up roughly parallel to each other. This also accounts for the repulsion between like charges of “real” ions, as seen in Figure 2. (These features are recognized in plasma physics, where they are called “MHD” or “Alfven” waves. No satisfactory explanation has hitherto been given for them. It is, moreover, an effect that can not possibly be explained by the photon model.) And as Rosser (1971) showed, the magnetic force can be derived from the Coulomb force for charged particles in relative motion. A charged particle, negotiating this “field,” would follow a curved trajectory exactly in accordance with Maxwell’s equations.

Note that, in SED, the quantized electromagnetic field is successfully modeled as a collection of one-dimensional oscillators, each a vector whose direction and force are determined by its place in the “field.” Our “epo model” of a vector field of one-dimensional (massless) oscillators is an exact analog of this model, “already quantized.” The same is true of conventional quantum theory. As Taylor (2001) remarks:

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In quantum theory, the electromagnetic field behaves exactly as an assembly of arbitrarily many massless particles. The number of particles of a given momentum and energy just corresponds to the energy level of the corresponding electromagnetic oscillator.

Further, we note that what had been taken to be a mathematical abstraction, the “electromagnetic field,” now has a definite physical reality.

So, merely by considering what Dirac’s negative energy “sea” must represent, we are presented with an unexpected bonus: the first direct contact, causal, workable model of an already quantized electromagnetic field.

**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. It thus initiates a vector line of epo, each carrying the amount of energy carried by lines of epo 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 $\Psi$ 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 $1.87 \times 10^{-15}$ 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 $\Psi$ 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 on the “least action” path 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

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.
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 $\Psi$ 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 generated by the jump of a single electron, the “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 “photon” that doesn’t violate the kinetic theory of energy.

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.

In Part 2 (IE #44), the specific implications of the negative energy sea will be examined, which include everything from altered nuclear physics to the spacing of the planets.

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Dirac’s Equation and the Sea of Negative Energy

PART 2

D.L. Hotson*

Summary of Part 1 (Infinite Energy, Issue #43)

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 invoke 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 ±c, which can only be in an “imaginary” direction. It also explains the electron’s anomalous spin of h/2.

The solutions to Dirac’s equation describe a “spinor” field in which electron changes to positron every τ, the quantum of time, (2e²/3mc³, equal to 6.26 x 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 can not exist in the presence of unbalanced charges, so every unbalanced charge must instantly be surrounded by epo’s 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 epo’s 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 epo’s that surround it, forming a wave of epo’s carrying angular momentum, which carry the “photon” according to the Feynman “path integral” version of QM. The pattern of these epo’s form the photon’s “η” 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). Then, when he found that it had multiple solutions, he thought that one of its solutions must be the proton—as at that time, the proton and the electron were the only known particles, and it was fervently believed that they were the only particles. This is why Dirac, in several of his early attempts to use the equation, entered in as the mass the average mass of electron and proton (Pais, 1994). This didn’t work, convincing him that the other “real” particle (the other positive energy one) had to have the same mass as the electron, but the opposite charge. Thus he predicted the positron, but gave up his dream that his equation was a “Theory of Everything.” (Of course the discoveries of the neutron and the positron, and the conviction that the photon also was a particle, didn’t help any.)

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.

What if Dirac was right to begin with about his equation? What if those four kinds of electron, two negative and two positive, are all one needs to build a universe?
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.

What if Dirac was right to begin with about his equation? What if those four kinds of electron, two negative and two positive, are all one needs to build a universe? There are, after all, no wave equations for quarks, or for gluons, or for any of the other supposedly “fundamental” particles—yet they all wave. Could this mean that they are not fundamental at all? We will leave this question hanging while we consider a related one.

**Where Do You Take Out the Garbage?**

This famous question, invariably asked of architecture students with regard to their beloved projects, has much wider applicability. No organism (or energetic machine, for that matter) can function indefinitely in an environment of its own waste products. (A dilemma that increasingly confronts the increasing numbers of mankind.)

The BEC, as these equations outline it, is not perhaps an organism, but it is an energetic machine. Overall, it 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 epo 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 BECs we can generate, at temperatures near 0˚K, need fierce refrigeration to maintain their integrity. The Big BEC is somewhat 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, its “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 can not 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 2.7˚K, 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.

**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, on 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 always almost 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 produced 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 2π in length, or 1.87 x 10⁻¹⁵ meters long. If the neutron is made of epo, 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 neutron.

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 epo: 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 epo make a neutron? The question is far from trivial. The answer can not be 919, the mass ratio between epo and neutron. There would be 919 x 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 epo would mass, at most, about 370 electron masses. We might keep in mind the Pauli exclusion principle, which regu-
lates 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.

(Electron 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.

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 “pirated” 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 \( \Psi \) 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 9180 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

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.
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.

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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 1/2, 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 1/2, 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 1/2. 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 1/2ν. 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 ego 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” α = e^2/hc = 1/137; strength of strong force: g^2/4πhc = -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 “shapes” 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 unobservable (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, can not 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
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.

into a strong repulsion (since the individual epo 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.

Einstein spent much of his life trying to unify the “four forces.” We have shown that the “strong nuclear” force is nothing but electromagnetism. Moreover, the “weak nuclear” force has since been unified with the electromagnetic in the “electroweak” theory (Weinberg, 1967; Salam, 1968). This leaves only gravitation. Puthoff (1989, 1993) suggests that gravitation is a residual effect of the ZPF of the vacuum electromagnetic field, i.e. a residual effect of electromagnetism. Again, however, this paper suggests a different structure and origin for the ZPF. Moreover, Puthoff’s gravitation is “pushing together” gravitation, similar to LeSage’s “ultramundane corpuscles,” whereas the other negative-energy forces act by “pulling together.” We suggest a model on the lines of these other “pulling together” (negative-energy) forces, which also utilizes a residual effect of electromagnetism.

**Magnetogravitation**

Dirac’s equation predicts that the magnetic moment of the electron should have a value of $\frac{e}{2m}$. 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 epo 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 $\tau$). 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
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.

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 vectorial plane of angular momentum. Any change in the angle of that vectorial 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 mc². However, it also retains its (negative energy) vibration at ±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 $h/2\pi$ 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 can not 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 vectorial 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 vectorial plane rotating in a complex space. How this results in inertia can be seen by looking at the wave function $\Psi$ that represents a particle with definite momentum. The length (value) of the complex number $\Psi$ 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 $\Psi$ 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 an 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 vectorial 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 neutrino 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, $h/2\pi$, 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 “anti-hydrogen” and presumably antioxidant, 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, as it defines the quantum amplitude for adding one more entity. Thus in the condensate this fixes the order of the 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.
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 can not 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

Figure 4. Uranus and satellites.
Figures 4, 5, and 6, for Uranus, Saturn, and Jupiter. Mean distances (semi-major axes) of the satellites are from the Astronomical Almanac for 1996. Since the rapidly spinning gas giants are notably oblate, the top of clouds (equatorial radius) is used as the first node.

These systems match the exponential regression curves with $R^2$ (coefficient of determination) values ranging from 0.9978 to 0.9993. (A statistician would say that $R^2$ is a measure of the proportion of variation in $y$ that can be explained by the regression line using $x$. The remainder is the percentage attributable to chance, "chaos," or to other variables.) This indicates that at least 99.78% of the value of the semi-major axis, the satellite’s orbital position, can be attributed to the function of the $x$-value, its (quantum) period number. This leaves rather little (from 0.07% to 0.22%) to chance or to other variables. In nature, such (quantum) periodicity is exhibited only in the normal modes of wave behavior. Therefore we can say with some certainty that each of these three figures constitutes a wave signature, as clear and definite as the well-known Airy pattern that they resemble. And since the wave clearly originates with the gas-giant planet, as explained by the sea of charge required by the Dirac equation, the wave’s existence can be considered confirmed. Moreover, it is clearly more powerful than the powerful tidal forces. (With Jupiter, something else is also going on. We will discuss this later.)

This would seem to be the clearest kind of evidence for this requirement of the Dirac equation. Each of the figures demonstrates that a wave of polarization, at least 99.78% determined by its normal mode period number, originates with these spinning bodies of plasma. That all three show the same wave behavior would seem to eliminate all further doubt. Moreover, as is to be expected, the inner satellites of each planet, where the wave function would have the largest amplitude, fit best.

The only selection involved in these figures is in the rings, in which small chunks of matter are evidently disintegrating under extreme tidal forces and evolving from one node to another. (Neptune, the other gas giant, is not included. It shows evidence of some major disturbance that stripped it of Pluto and Charon, its former satellites should orbit at these nodes.)
However, by far the largest body of plasma in our system is the Sun, with over 99.7% of the system’s mass. What of its standing waves?

**The Sun**

By the argument used with the gas giant planets, the planets of the solar system should fall on nodes that are harmonics of the Sun’s radius. (In the Sun’s case, we will demonstrate that these harmonics are octaves, powers of 2.) But the gas giant planets are far from the Sun and rotating very rapidly, so that their waves of polarization are the strongest influence on their satellites, as shown in Figures 4, 5, and 6. The solar system, however, is dynamic, changing with time. The Sun is an energetic furnace that exports angular momentum to the planets, as the Nobelist Hannes Alfvén (1981) first demonstrated.

This is the principal, supposedly conclusive argument that is advanced by conventional astronomers against such attempted correlations as Bode’s Law. They say the positions of the planets must change with time, so any correlation at present would not have been so in the past, and will not be so in the future, and therefore must be coincidence.

The Sun exports angular momentum by means of the solar wind, the Sun’s magnetic field, tidal forces, and radiation pressure. All of these transfer angular momentum from the Sun to the planets, both slowing the Sun’s rotation and increasing the planets’ distances from the Sun. Together, at least for the inner planets, these forces are clearly stronger than the polarization caused by the Sun’s wave function. Therefore, all of the planets out to Jupiter have over billions of years been moved from their original octave positions. This is one reason for the seemingly anomalous distribution of angular momentum in the solar system, in which the planets, notably Jupiter, have much more angular momentum than the “parent” body. (This may not have been the case in the early solar system, when the Sun was rotating much faster, as the strength of this wave function would seem to be a product, among other factors, of the velocity of rotation of the body of plasma.) However, Ovenden (1972) with his “least interaction action” calculations,
showed that interactions between the planets serve to keep them in approximately equal spacing. Thus the planets, as they evolved from original octave positions, would maintain their approximate spacing, so that their present positions show the roughly regular spacing indicated by Bode's Law, the limit of which is the original octave relationship. (See Figure 7, a logarithmic plot of the solar system.)

The principle argument by conventional astronomers is that, because the solar system is dynamic, Bode's Law must be coincidence. However, because Ovenden's "least interaction action" keeps the spacing regular, at any time during their evolution from octave positions, the planets would have formed a "Bode-like" configuration, merely with different coefficients. So this argument fails. (We will later suggest a further factor which might act to keep the spacing of the planets regular. We will further show that though these inner planets have retreated from their original octave positions, they all now orbit on another harmonic node.)

Planets inside of Mercury either have been vaporized by the Sun, or never managed to gather into a planet. Mercury itself keeps "one foot" in the original octave position, its perihelion distance falling at the original octave node, and its travels through higher amplitude regions of the wave function might, as we will see, account for the excess rotation of its perihelion without recourse to "curved empty space." (An oxymoron, as Phipps [1986] pointed out.)

However, Saturn, Uranus, and Pluto remain at the original octave positions. (See Figure 7.) The mean diameter (semi-major axis x 2) of Saturn's orbit is within .0035 of 211 times the diameter of the Sun, that of Uranus is within .0025 of 212 times that diameter, and that of Pluto is within 0.035 of 213 times that diameter. (Since the diameter of the Sun is somewhat imprecise and seems to vary by about 300 kilometers over the course of the 11-year cycle [Gilliland, 1981] these octaves can be considered "exact.")

Neptune, as Van Flandern (1993) shows, was the victim of some energetic event, probably a collision or "close encounter" with some major body, which, we propose, caused it to lose sufficient angular momentum so that it dropped into its present (non-octave) position. This freed its satellites Pluto and Charon to continue around the Sun with the approximate semi-major (octave) axis of the original Neptune, with their added orbital angular momentum (which was originally around Neptune) throwing them into their present eccentric orbit. Pluto then captured Charon as its satellite.

Kepler's Universal Harmony?
Quantum theory treats everything as wave at all times, except for a measurement situation, which no one understands. Both the Schrödinger and the Dirac equations are wave equations. We predicted above that wave functions, harmonics, beats, and interference will ultimately prove to be as important in the macrocosm as they are in the quantum world. However, since time is quantized, the important harmonics should be harmonics of $\tau$, that quantum of time. We live in an ocean of
charges vibrating at that quantum beat. Therefore the harmonics, particularly the octaves (powers of 2) of that beat should, by Hamilton's law, be the least-energy configurations of energetic bodies, particularly bodies of plasma, in the macrocosm. Every energetic body of plasma should act, in some ways, as a quantum object. And the quantum object it resembles, as we will show, is the BEC, which organizes its wave function. However, the nucleon, which makes up about 99.97% of the universe's mass, is a structure that vibrates in ten dimensions. Therefore the harmonics of 10t should be nearly as important.

Moreover, there is a time, h/mec², equal to 8.09 x 10⁻²¹ seconds, that Heisenberg considered to be the "fundamental time" (Heisenberg, 1936, 1938a, 1944). In 1925, when Einstein recommended de Broglie's theory of matter waves to his thesis committee, he suggested that the inverse of this time, mec²/h, be considered a universal electromagnetic limit frequency. And this time is within 1% of 10t x 2⁷, another indication that octaves of 10t should be important.

It has been objected that harmonics of quantum objects can not be projected to macrocosmic dimensions because small errors would be so magnified as to lose all accuracy. However, since time is quantized, and since we live in an ocean oscillating at that frequency, the exact harmonics would be reinforced all along the way, with the least-energy configurations tending to minimize any such errors. An example is the resonance between two of the hyperfine levels of the cesium atom, used in the atomic clock because of its rock-solid stability. This frequency, which defines the international second, is within 0.005 of being an exact octave of 10⁻²⁴ s. times 2⁴⁴ = 1.101 x 10⁻¹⁰ s. The period of the cesium resonance, 1/9 129 631 770 Hz, is 1.095 x 10⁻¹⁰ s.) This gets us over half way to the macrocosm with-out notable loss of accuracy.

The second thing we note is that the mean light-diameter of Jupiter, the second most energetic body in the solar system, is also almost an exact octave of this quantum of time. (This would be the period of its wave function.) Since Jupiter is notably oblate, the mean diameter is based on its volume: D = 2(3V/4π)¹/³. (Mean diameter of Jupiter = 139,193 km. Light-diameter = 0.46432 s. t x 2⁷⁶ = 0.47299 s. or less than 2% different.) Equally remarkably, the diameter of the Sun (1,391,980 km.) is, to 5 significant figures, exactly 10 times the mean diameter of Jupiter. And the diameter of just one star has been measured with any accuracy. That star is the blue giant Sirus, the brightest star in the sky, which has been repeatedly measured by stellar interferometer. By the average of its measurements, its diameter is 2.04 times the diameter of the Sun, its light-diameter within 0.0013 of 10⁻¹⁰ s. Much more refined measurement techniques are now possible; however, astronomers appear to shy away from such measurements. Could they be afraid of what they will show? We predict that all measurable stars will prove to have light-diameters that are harmonics of t with octaves of t and 10t predominating.
“sound like numerology.” This is a favorite ploy to discount numbers we don’t like—as if there were something wrong with numbers, or as if we could present and collate data other than numerically. Numbers we like are “data”; numbers we don’t like are “numerology.” However, as noted above, almost the only place in physics where whole (quantum) numbers appear is in the normal modes of wave behavior. But we also have indicated, and will demonstrate in what follows, that all physics is quantum physics, since all matter is wave, and therefore all physics devolves ultimately to the (quantum) normal modes of wave behavior. Ultimately, therefore, all physics is “numerology.”

With this in mind, a quick look through the Nautical Almanac reveals a host of periods or resonances of macroscopic objects that are almost exact octaves either of $\tau$ or of $10\tau$. Every body of the solar system has a major period that is within a few percent of an octave either of $\tau$ or of $10\tau$. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.) Many have more than one octave value. The sidereal period of Earth, for instance, falls within about half a percent of an octave either of $\tau$ or of $10\tau$. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.) Many have more than one octave value. The sidereal period of Earth, for instance, falls within about half a percent of an octave either of $\tau$ or of $10\tau$. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.) Many have more than one octave value. The sidereal period of Earth, for instance, falls within about half a percent of an octave either of $\tau$ or of $10\tau$. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.) Many have more than one octave value. The sidereal period of Earth, for instance, falls within about half a percent of an octave either of $\tau$ or of $10\tau$. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.) Many have more than one octave value. The sidereal period of Earth, for instance, falls within about half a percent of an octave either of $\tau$ or of $10\tau$. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.) Many have more than one octave value. The sidereal period of Earth, for instance, falls within about half a percent of an octave either of $\tau$ or of $10\tau$. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.) Many have more than one octave value. The sidereal period of Earth, for instance, falls within about half a percent of an octave either of $\tau$ or of $10\tau$. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.) Many have more than one octave value. The sidereal period of Earth, for instance, falls within about half a percent of an octave either of $\tau$ or of $10\tau$. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.) Many have more than one octave value. The sidereal period of Earth, for instance, falls within about half a percent of an octave either of $\tau$ or of $10\tau$. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.) Many have more than one octave value. The sidereal period of Earth, for instance, falls within about half a percent of an octave either of $\tau$ or of $10\tau$. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.) Many have more than one octave value. The sidereal period of Earth, for instance, falls within about half a percent of an octave either of $\tau$ or of $10\tau$. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.) Many have more than one octave value. The sidereal period of Earth, for instance, falls within about half a percent of an octave either of $\tau$ or of $10\tau$. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.) Many have more than one octave value. The sidereal period of Earth, for instance, falls within about half a percent of an octave either of $\tau$ or of $10\tau$. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.) Many have more than one octave value. The sidereal period of Earth, for instance, falls within about half a percent of an octave either of $\tau$ or of $10\tau$. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.) Many have more than one octave value. The sidereal period of Earth, for instance, falls within about half a percent of an octave either of $\tau$ or of $10\tau$. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.) Many have more than one octave value. The sidereal period of Earth, for instance, falls within about half a percent of an octave either of $\tau$ or of $10\tau$. (This period is either the light-diameter of the object, the light-diameter of its orbit, or its sidereal period.)

With a range of 110 octaves, the exponential regression charts are meaningless, so we have shown logarithmic linear regressions both of the entire range (Figures 8 and 9), and of the range covering only the solar system (Figure 10, which shows both regressions over the range of the solar system). Taken in any detail or combination, the $R^2$ values of better than 0.999999 show that the octave relationship is unquestionable, with the possibility that the relationship is chance being less than 1 in 1,000,000. Moreover, the “Sun series” and the “Jupiter series” remain almost exactly parallel, exactly an order of magnitude apart, throughout their entire ranges. There is a slight divergence from a power of 2 in both regressions (on the order of 1.9995) which is probably not significant, indicating merely that in the upper reaches of the regression the bodies are far away from the source of the harmonic wave.

It seems evident that when the inner planets were forced out of their initial octave positions by the angular momentum transferred from the Sun, they moved relatively rapidly to the next nearby harmonic. (By Kepler’s third law a planet whose period is an octave of $\tau$ or $10\tau$ would have a light-diameter that is also a harmonic, though not an octave.) They could “defend” this harmonic position for a longer period, before being forced to the next harmonic. This would seem to be why most of the planets not still at octave
distances have octave periods.

However, Jupiter is the powerhouse of the planets. It has the most angular momentum, both rotational and orbital, and its harmonic is the primary, the $\tau$ harmonic. It is noteworthy that the plane of the ecliptic is roughly the plane of Jupiter's orbit. The Sun rotates a full 7° away, and only nearby Mercury orbits over the Sun's equator, with Venus splitting the difference with an inclination of 3.4 degrees.

Moreover, the Sun's export of angular momentum stops at Jupiter. The outer planets orbit, apparently undisturbed, at their original octave distances. But Jupiter has moved to an apparently unassailable position, the intermodulation harmonic between its $\tau$ harmonic and the Sun's 10$\tau$ beat. (Its orbit's light-diameter is within a percent of $(\tau + 10\tau) \times 2^{86}$.) Moreover, there apparently is a “back-eddy” of this intermodulation beat that affects the next two inner periods, the asteroids and Mars. Those asteroids which remain orbit where Jupiter permits them. The average mean orbit light-diameter of the ten largest asteroids is exactly at $12\tau \times 2^{85}$, the intermodulation beat. And Mars, next in, is within 2% of $13\tau \times 2^{84}$, which apparently also allows it to be near an octave period harmonic. (Jupiter's $\tau$ harmonic. See Table 1.) (Yes, this “sounds like numerology” again. But once we acknowledge that we live in an ocean of charge, then waves, beats, interference, and harmonics become data, not numerology.)

Mercury is a fascinating case. We mentioned that it keeps “one foot” at its original octave position—its perihelion light-distance is within less than a percent of $10\tau \times 2^{80}$, the Sun's octave. Yet its aphelion distance is within a couple of percent of $\tau \times 2^{84}$, Jupiter's harmonic. Like a good quantum object, it oscillates between the Sun's harmonic and Jupiter's harmonic. Meanwhile its sidereal period is within 1% of yet another octave, $\tau \times 2^{100}$. No wonder all the angular momentum exported from the nearby Sun can't budge it from its position—it is locked into three separate harmonics.

This would appear to solve a long-standing problem concerning Mercury. The dynamics of a small body orbiting close to a large body tend to remove the eccentricity from the small body's orbit and place it on a node of its standing wave. The Galilean satellites of Jupiter, for instance, have eccentricities ranging from 0.002 to 0.009—they are in perfectly behaved, almost perfectly circular orbits. The inner satellites of Saturn have even less—Tethys has a measured eccentricity of 0.00000. By contrast, Mercury, closest to the Sun, has by far the most eccentric orbit (0.2056) of any planet, if you exclude Pluto, which is probably an escaped satellite of Neptune. But like the cesium atom's resonance between two hyperfine levels, the Mercury quantum object resonates between two harmonics while orbiting on a third.

Table 1 requires some further comment. The Sun has two measured global resonances—a well-known “5-minute” resonance, and a “160-minute” resonance measured independently by two different teams of astronomers (Brooks et al., 1976; Severny et al., 1976). Their findings have been replicated by Scherrer and Wilcox at Stanford and by a French-
American team (van der Ray, 1980) and the “160-minute” solar resonance shown to be stable over more than 1400 periods. The Russian group tracked the oscillation for more than four years. However, this resonance has been discounted and ignored because it does not fit the standard solar model. Time and again we find scientists saying, in effect, “These are the theories on which I base my facts.” This is what the Churchmen told Galileo. Discounting measured data because it disagrees with a theory is the antithesis of science.

Moreover, these global solar resonances are direct evidence for our hypothesis that a body of plasma’s wave function is set by $c_{\text{max}}$. Moreover, these global solar resonances are interesting from another standpoint, one having to do with the Jovian system. We have noted the power of Jupiter, with all its angular momentum—that it can reach down and impose its harmonics even on Mercury. Yet, as shown in Table 1, the three inner Galilean satellites, mere flies on the face of Jupiter, nonetheless have sidereal periods that are octaves of the Sun’s 10$\pi$ harmonic! This startling result demands an explanation, especially as we have earlier seen that these three satellites’ semi-major axes fall on an exponential regression with Jupiter’s radius as the first term.

One answer, of course, is Kepler’s third law. So long as the satellites maintain ratios of distances that are powers of about 1.6, as Jupiter’s satellites do, their periods will have ratios that are roughly powers of two, as $1.63 \approx 2^2$. (The actual ratios with these three satellites are 1.5913 and 2.0074, which of course exactly obey Kepler’s law.) The remarkable thing, which we will examine, is that these ratios are exactly the same between Io and Europa as between Europa and Ganymede.

The other unanswered question, of course, is how these periods “just happen” to fall on exact octaves of the Sun’s harmonic. The period of Io, in particular, is within half a percent of 2$^{15}$ times the Sun’s light-diameter.

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**Figure 10. Solar system ladder of octaves logarithmic linear regression.**
Io is perhaps the most unique body in the solar system. It is connected to Jupiter by a "flux tube" of electrons conservatively estimated to be 5 million amps at 400,000 volts or more than 50 times the combined generating capacity of all the nations of Earth. Yet this immense power still accounts for less than 1% of the power dissipated by Io! This power is literally ripping Io apart, making it the most volcanically active object known. Sulfur ions spewed forth by these volcanoes form a torus in the shape of Io's orbit. And whenever Io, Jupiter, and the Sun form a right triangle, Io emits an immense burst of radio synchrotron energy with a power greater than 5000 times the combined generating power of all the nations of Earth (Time-Variable Phenomena in the Jovian System, 1989). This report in summary concluded that among the anomalies they can't presently account for are "...dramatic short-term changes in the jovian system, including changes in the Galilean satellites' orbits, geology, and geophysics, and the planets' internal structure." For one thing, they have measured the periods of these satellites accurately to nine significant figures, only to find, the next time they measure them, that they are different in the sixth or even the fifth significant figure.

These short-term changes in the Galilean satellites' orbits seem to be connected to Io's explosive burst of radio noise which occurs whenever the three bodies reach a right angle relationship, the angle between the electric and the magnetic fields. This explosion is called, in Table 1, the "Io Shout." It is synchrotron energy, directed along the tangent of Io's path as it reaches elongation; thus, once every period of Io, it is directed in a cone more or less exactly at the Sun. As noted, this occurs on an exact octave of the Sun's harmonic.

What happens to a resonant body when it is energized by a vibration exactly at its resonant frequency? Surprise: it resonates. Positive feedback, like the public address system squeal. This might begin to explain the Sun's two global resonances, both octaves of the Sun's harmonic, both octaves of the "Io Shout," both largely or totally unexplained by conventional solar theory. (This "Io Shout" takes about 43 minutes to reach the Sun. It is a prediction of this theory that the "Io Shout" and the 160-minute global resonance should be in phase, when this 43 minute lag is taken into account. Someone with access to the raw data should check this.) Moreover, the 160-minute resonance has been shown to vary greatly in its amplitude (Severny et al., 1966) and this has led to some of the doubts about its existence. But this amplitude variation is exactly what we would expect if it is related to the strength of the variable "Io Shout."

Another factor to be taken into account is the inclination of Jupiter. Io rotates almost exactly above Jupiter's equator, but Jupiter's 3.12° inclination would cause the effect of the "Io Shout" to vary in intensity throughout the jovian year, reaching a maximum as the inclination passes the ecliptic every six Earth years or so.

But there is more to the story. Despite these dramatic short-term changes in the Galilean satellites' periods, the relationship between the periods remains the same, that found by Laplace. He studied this relationship, calling it a "three-body orbital resonance" and showed that the mean orbital motions \( N_1, N_2, \) and \( N_3 \) are connected by the equation

\[ N_1 - 3N_2 + 2N_3 = 0 \]

The net effect is that, when two bodies are in conjunction on one side of Jupiter, the third is always on the other side. This, however, hardly begins to explain what is going on here. What, exactly, is resonating, in this three-body resonance? How was it set up, how is it maintained, through millions of years in the heart of Jupiter's intensely energetic system? With the noted short-term changes in these satellites' periods, what maintains this resonance? No one has ever been able to explain dynamically how such a system could come into being, or connect it to Jupiter's gravitation or spin.

For the relationship shown in Laplace's formula to occur, the three inner planets must reach successive conjunctions at elongation (relative to the Sun) in some period of time, keeping in mind that one planet will always be on one side of Jupiter, the other two on the other side. Let's start our timing at one of these conjunctions. For a conjunction to recur at the same elongation, say between Ganymede and Europa, there must be some whole (quantum!) number of Ganymede's periods \( n \) such that \( f(n) = 2n + 2 \). In other words that Europa must have made exactly \( 2n + 2 \) revolutions while Ganymede made \( n \). Such a relationship, implied by Laplace's formula, could hardly be coincidence; it would mean that they were truly synchronous, only on a much longer period than the simple \( 1 \cdot 2 : 4 \) ratio already noted. Is there such a number \( n \)? There is indeed; and it turns out to be the highly interesting number 137, the inverse of the electronic Fine Structure Constant \( \alpha \).

(This constant is a pure number, not exactly 1/137, but \( 1/137.0359722 \). Eddington tried to derive it from the numbers \( 1/137 \) and \( 1/137.0359722 \).) What is the ratio of the electronic Fine Structure Constant \( \alpha \) doing in the fine structure of the ratios of Jupiter's satellites? Well, we have shown above that there is only one force, the electromagnetic. Conventional astronomers claim that the only force operating between the planets is gravitation, but since we have shown that gravitation is a residual effect of electromagnetism, we can now confidently state that the only force operating between the planets is electromagnetism.

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divided by the speed of light times Planck's constant. 33 this one number, 137, contains the crux of electromagnetism (the electron), relativity (the velocity of light), and quantum theory (Planck's constant). He notes that Heisenberg and Pauli were obsessed by this "137" mystery, and that Feynman suggested that all physicists should put up a sign in their homes or offices to remind them of how much we don't know. The sign would read simply: 137. (Lederman chose this number as his home address.) However, if "everything is electromagnetism," it is no more (or no less) mysterious to find the electronic fine structure constant in the fine structure of the ratios of Jupiter's satellites than it is to find it in the fine structure of the atom, and another indication that this unitary thesis is correct.

The Jupiter system appears to be a generator, extracting immense amounts of energy from the BEC by what seems to be a three-octave tuned resonance tuned to the Sun's harmonics. It would seem to hold clear clues as to how we might extract this energy.

In any case, if n = 137, f(n) = 276; f(276) = 554. It looks like this: Ganymede: 137 per. x 7.1546631 days/per. = 980.18884 days Europa: 276 per. x 3.5511431 days/per. = 980.11550 days Io: 554 per. x 1.7691614 days/per. = 980.11543 days

After less than three years, all three line up again at elongation, although one is on the opposite side of Jupiter from the other two. Ganymede trails 3.7 degrees behind, but Io and Europa arrive at elongation within six seconds of each other. Six seconds in three years is better timekeeping than the original Atom Clock, an error of 1 part in 14 million. (Of course, these periods change almost daily, as noted above, and another set of periods will find Ganymede catching up to the others. These numbers are from the 1976-77 Handbook of Chemistry and Physics, but every edition has different values for these periods. When calculated as above, however, all of them average to 980.14 days.)

There is also an out-of-phase series of elongations, the 2n + 1 series, based on 137/2, when Ganymede reaches its elongation at the opposite side of Jupiter:

Ganymede: 137/2 per. x 7.1546631 days/per. = 490.09442 days Europa: 138 per. x 3.5511431 days/per. = 490.05775 days Io: 277 per. x 1.7691614 days/per. = 490.05771 days

Whenever one of the other satellites arrives at elongation at the same time as Io, the "Io Shout" is orders of magnitude more powerful. However, as Jupiter orbits around the Sun, these conjunctions at elongation will occur at different angles relative to the Sun. Only once in every eight 490-day periods will the conjunctions of all three planets occur with Io at elongation with its synchrotron energy pointing directly at the Sun. (Of course, a whole series of near-conjunctions will occur leading up to and trailing away from this time.) And eight 490.07 day periods amount to 10.73 years. Could this have something to do with the Sun's 11-year sunspot period? If the Sun's global resonances are caused by the Io Shout, which peaks in intensity every 10.73 years, there would indeed seem to be a connection. More study, in conjunction with Jupiter's inclination, will be necessary to answer this question.

However, we seem to see the outlines of a "harmonic cycle" here, analogous to the terrestrial "oxygen cycle" and "nitrogen cycle," and so forth. The orbiting planets cause tidal and other disturbances in the Sun. The Sun's export of angular momentum (necessarily on its 10t harmonic) seems to be required for its own stability, to push these disturbing factors further away. Jupiter, with its immense magnetic field, absorbs large amounts of this 10t energy. However, it has achieved stability on the intermodulation harmonic between its t energy and the Sun's 10t energy, and can't absorb any more angular momentum in its orbit, so all of this angular momentum must go to increase Jupiter's already enormous rotation, or it must be dissipated somehow. The Jupiter-Io-Europa-Ganymede system acts to seem as an enormous generator—and dissipator—of 10t harmonic energy, much of which is thrown back at the Sun, completing the cycle.

Earlier we left unanswered the question of why the harmonics of the gas giant planets were factors of 1.25 for Saturn, 1.48 for Uranus, and 1.62 for Jupiter. We have since seen that the Jupiter system's diameters must have a factor of around 1.6 for its satellites' periods to have a factor of 2, and resonate with the Sun's octave harmonics. There may be a harmonic reason as well for the other two factors. Since their light-diameters are not octaves of τ, they must "beat" with τ. Saturn's factor is 5/4 (1.25). 5/4 times the mean light-diameter of Saturn is within 1.5% of the nearest octave harmonic (τ x 275). Uranus's factor is approximately 3/2 (1.48); similarly, 1.48 times the mean light-diameter of Uranus comes to within 5% of the nearest τ octave harmonic, τ x 275.

Anomalies
Dirac's equation, followed logically, requires space to be a "plenum" rather than a "vacuum." It is a BEC full of vibratcharging. Moreover, this universal BEC is sensitive to every slightest change in ionization, instantly adjusting to maintain its own integrity. As we have seen, there is clear and overwhelming evidence that rotating bodies of plasma such as the Sun and the gas giant planets set up standing waves in this sea of charge which have physical effects on any matter they encounter. This would indicate that the present celestial mechanics, computed using only gravitation, could not accurately account for the behavior of bodies anywhere but at nodes of these standing waves. And this means that any body not at a node must have small anomalies in its celestial mechanics. As we will see in what follows, there do appear to be anomalies that seem qualitatively to account for these necessary discrepancies. Since we can't yet quantify the standing wave, the anomalies can not be considered proof of this hypothesis. However, if such anomalies were not present, this would constitute disproof of the hypothesis. Therefore it is important to look at them.

The Solar Corona
Since the planets between Mercury and Jupiter no longer orbit at nodes which are octaves of the Sun's diameter, we would expect there to be sizable anomalies near the Sun and with the inner planets, with their amplitude diminishing at roughly 1/r² with distance from the Sun. And with the Sun itself we have a major indication that our hypothesis makes sense. For while the surface of the Sun is a "cool" 5800 K or so, the surrounding corona has temperatures that routinely reach 1,000,000 K. The corona is expanding from the surface, and by the gas law should cool as it expands. How can the expanding, cooling exhaust be 170 times hotter than the furnace? This is regularly called "the greatest problem in solar physics." All kinds of answers have been proposed,
magnetic “pinching” being the latest, but none comes within orders of magnitude of the energies required. However, if, as shown above, the Sun’s surface is the node of a powerful macrocosmic polarization wave, it is easy to understand that the node would be relatively cool, while anything flowing away from the node into areas of higher amplitude would be excited to high temperatures. And of course we would expect this effect to be strongest closest to the Sun, and to diminish in amplitude at roughly 1/r² away from the Sun.

The Planets

There are minor but persistent anomalies in the celestial mechanics of each of the inner planets, starting with the well-known one at Mercury. (The Mercury anomaly is roughly explained by GR, but none of the others are.)

Newcomb (1897) calculated, and Doolittle (1912) confirmed, that the celestial mechanics of three planets yielded anomalous differences with measurements that were very much greater than could be attributed to errors. The first anomaly was the celebrated advance of the perihelion of Mercury, for which Newcomb calculated a difference between observed and computed values of 41.24 ±1.35 seconds of arc per century. For this the GR correction is 42.98”, or not quite within the probable error (computations are from Spolter, 1993). The second anomaly, the motion of the node of Venus, Newcomb gives as 10.14 ± 1.86 seconds of arc per century. GR gives no correction whatever for this anomaly. The motion of the perihelion of Mars is the third anomaly. Newcomb calculates it to be 8.04 ±2.43 seconds of arc per century. The GR correction for this is only 1.35”, which is only about 17% of the measured advance.

If GR is the final answer to gravitation, and gravitation is the only force operating between the planets, GR should provide answers to all of these anomalies. And there are other reasons for suspecting that GR may not be the final answer, primarily because space appears to be Euclidean at every scale, and “curved empty space” is a contradiction in terms, as Phipps (1986) observed. Also, the “Magnetogravitation” outlined herein seems to be a simpler and more elegant answer, but does not in itself explain the advance of Mercury’s perihelion.

However, the advance of Mercury’s perihelion, Newcomb also calculated, could be explained by a local modification of the force of gravitation from the inverse square to the inverse (2 + ε) power, where ε is a small number of about 10⁻¹⁰ (Van Flandern, 1993). Such a local modification of the force of gravitation is exactly what would be required by our hypothesis that the Sun is the source of a macrocosmic vacuum polarization wave. In fact, since Mercury is only on a node of the Sun’s octave wave at its perihelion position and travels through regions of high activity the rest of the time, it must be said that if Mercury’s perihelion did not experience such an advance, it would disprove our hypothesis. And while we can’t yet quantify it, the above modification is qualitatively in the right direction and seems reasonable for such a force at the distance of Mercury.

Furthermore, a large polarization of the vacuum in the vicinity of the Sun would necessarily cause a refraction (bending) of light passing near the limb of the Sun, and so might explain another of the supposed proofs of GR. (The corona itself also causes such a refraction, which was not taken into account in the supposed proofs of GR in 1919.)

Both Venus and Mars would be expected to have measurable anomalies in their celestial mechanics, as Newcomb found. These anomalies can not be explained either by GR or by conventional celestial mechanics. Both planets are caught between the powerful polarization waves of Jupiter and the Sun. However, we noted above that the plane of the ecliptic is roughly the plane of Jupiter’s orbit, with only Mercury orbiting above the Sun’s equator, 7 degrees away. However, Venus, with a 3.4º inclination, is caught halfway between these influences, and this might explain the otherwise puzzling motion of its node.

This effect, with the Earth, might be expected to reveal itself in how well the planet observes Kepler’s third law. It should now be possible to measure even tiny discrepancies using radar, laser, and spacecraft ranging observations. Since the ranging observations are considerably more accurate than the old optical data, astronomers now set the size of the Earth’s orbit by these ranging (distance) observations, and then use Kepler’s third law to compute the Earth’s period. However, according to Van Flandern (1993) a small but significant discrepancy persists with the optical data, which insists that the Earth’s period is about 5 x 10⁻⁹ different from that given by the radar data. Astronomers can give no reason for this discrepancy; it is currently considered an unsolved mystery. However, the discrepancy is similar to the amount we would expect from our macrocosmic vacuum polarization wave if the magnitude of the effect is of the order of 10⁻¹⁰ at Mercury.

The Earth itself has limited amounts of plasma, and rotates slowly. So it would be expected to be a relatively weak source of such vacuum polarization waves. Moreover, we live primarily at the surface of the planet, at a node, where they would be at their weakest. It is noteworthy, therefore, that most of the anomalous gravitational measurements which recently led to the hypothesis of a “fifth force” took place away from the surface: deep in mines or high in towers (Stacey, 1981; Holding, 1984; Eckhardt, 1988; Zumberge, 1988).

These anomalies were all “explained away” as being “possible” density variations in the Earth. Since such an explanation was barely possible, though certainly not proven, it was instantly accepted as a paradigm-saving explanation, and the anomalies wished away. However, the number and scientific rigor of these experiments must surely create doubt that all of them “just happened” to be performed in regions of massive and hitherto unobserved density variations. Moreover, the Holding experiment was performed in an Australian mine complex, where surrounding densities are well known; the Zumberge experiment was performed deep in the Greenland ice sheet, whose densities are also well known; and the Eckhardt experiment high in a tower, where earth density variations should have minimal effect. It would seem that vacuum polarization might provide the first remotely plausible explanation ever given for these anomalous measurements.

So we see that there are a number of unexplained anomalies, at least one associated with the Sun and each of the inner planets. The magnitude of these anomalies is very large at the Sun itself, where it amounts to “the greatest problem in solar physics,” large at Mercury, and diminishing in intensity at Venus, Earth, and Mars. And, of course, the powerhouse Jupiter system contains several immense anomalies.

There is even a tiny anomaly measured with respect to the Pioneer 10, 11, and Ulysses spacecraft which have completely exited the solar system. They seem to be experiencing an unexplained “sunward pull” of about 1/10 billion of g.
Richard Feynman, one of the last real physicists, famously remarked that, “If all of mathematics disappeared, physics would be set back exactly one week.”

Since the anomalies diminish in magnitude with distance from the Sun, the source of all of these anomalies is clearly the Sun itself. All of these anomalies can be explained, qualitatively at least, by our hypothesis of a macrocosmic polarization wave originating in the Sun’s spinning plasma.

Cosmological Consequences

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, regarding 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 mathematics disappeared, physics would be set back exactly one week.” (Of course, M. Kac replied “Yes—precisely the week in which God created the world.”)

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 that 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. A photon from a distant star starts out very small, with atomic dimensions, but because of the uncertainty principle by the time it reaches here it can have a diameter larger than a continent. These immense photons have been measured by stellar interferometry, where they can be made to interfere with themselves over these large distances (Herbert, 1985). Such a transformation must, by the Second Law, entail at least some 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 (von Nernst, 1921). 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, were 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 red shift 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, would 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 mainstream treatment of the red shift? 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.

Suppose, when you were a child, your mother called out the window to you, and you couldn’t hear her clearly. Did you assume 1) that she was far away, and the signal had attenuated with distance, or 2) that she was moving away from you at a large fraction of the speed of sound, and accelerating as she goes? Surely, in the case of light, the natural presumption must be that the signal has attenuated with distance.

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 red shift 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 with 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 oymoron, 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. How then did such an unphysical concept as “expanding empty space,” with its gross violation of causality, come to be accepted dogma?

It would seem that Einstein created this monster in SR when he argued that a “field,” i.e. empty space powered only by mathematical equations, could move things about. (Mathematical physicists seem to believe that their equations actually have this mystic power.) He compounded this when, in GR, he invented the concept that empty space could somehow curve and magically waft planets about. 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 whole superclusters of galaxies to 99% of light speed, without the ghost of a force to move them. Or, if you 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 over-invested 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 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 moves 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.

We have seen that without extreme prejudice on the part of scientists in the early 1930s the Bang would never so much as have been suggested. Therefore we will not attempt a detailed critique of the hodge-podge of mutually incompatible theories collectively known as the Big Bang, as that has been done elsewhere (Arp, 1987, 1998; Lerner, 1991, 1992; Van Flandern, 1993, 1996, 1998, 2000; LaViolette, 1995, 1996). All versions of the Bang massively violate conservation and causality, all outrage common sense and the eternal verities of physics, all have failed every observational test. They currently survive only by means of ever-proliferating patches and fudges, epicycles tacked on to save the incredibly cumbersome failed concept. As the astronomer R.B. Tully famously observed, “It’s disturbing to see that there is a new theory every time there’s a new observation.” (Lerner, 1991)

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 superclusters and gaps 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 epos 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/r². 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 times 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 to gravitation would explain a stable, static universe, and many other astronomical mysteries.

Ockham’s Razor—a Summary

Merely the assumption that all of the solutions of Dirac’s equation are both real and meaningful has brought us a long way toward Dirac’s unitary dream. We have seen that there are several different reasons for supposing that everything is made of just the four entities that are really two that could be considered only one. The first, of course, is that these are the only solutions to this very general equation that describes “everything that waves.” Since two of these solutions are “above 0,” the other two must be “below 0.” This leads to the necessity of a universal BEC completely filling negative-energy space. The refrigeration requirements of such a BEC automatically require an adjacent positive-energy space for it to dump its waste products. And if our positive energy balance comes from the BEC, as seems necessary, then everything must ultimately be built of epos, as that is all the BEC has to offer. The “electromagnetic field” and the ψ wave are seen to be epos structures the BEC must form to maintain its integrity. And the “photon” is very successfully modeled, not as a “particle,” but as positive energy carried by successive waves of epos to conserve angular momentum. The measured frictional loss of energy over large distances is evidence that light is a real wave in a real medium.

This model explains things about the electron never before understood, particularly its immense angular momentum and its “complex” structure, its spin being partly “real” and partly a vibration in an “imaginary” direction. And this complex vibration gives us the “gyroscopic” model of inertia, in which inertia is seen to be a local phenomenon, not depending on unmediated action-at-a-distance by the
“fixed stars.” And the unbalanced magnetic moment exhibited at the same phase by all matter gives us a natural model of gravitation as one more necessary function of the BEC.

So merely with the one assumption that the Dirac equation means what it says, we are within sight of a truly unitary view, not only of our present reality, but of its origin as well. If a field must give rise to unlimited numbers of particles, as QFT insists, then the Dirac spinor field or, alternately, Treiman’s “Zeroth Order Field” must fill some space with epos, forming a BEC which, as we have seen, must energize an adjacent space with its exhaust. So “creation” is seen not as a miraculous one-time occurrence, but as a continuing, necessary process depending merely on the properties of a quantized field.

We can see that QFT is exactly and completely right—however, just one field is all that is necessary, therefore all that is used. We see this economy of means all through nature. Only two particles are necessary, therefore only two are used. From these can be made the three entities that are both necessary and sufficient to build 92 atoms, which suffice for maximum complexity. Four entities are both necessary and sufficient to code DNA, the most complex known compound.

This same parsimony of means is seen in the positive-energy states of epos. The sea of negative-energy one-dimensional epos, vibrating in imaginary directions, forms a virtually undetectable background, like “off” pixels in a perfect computer screen. And like a three-way light switch, they “turn on” in three stages, each stage vital to our reality. Epos vibrating in one “real” dimension form the electromagnetic field. Vibrating in two “real” dimensions, they carry angular momentum around at the speed of light: the “photon.” And vibrating in three “real” dimensions, they form matter.

As shown above, changes both in gravitation and in the electromagnetic field must propagate much faster than light. Bell’s theorem and the proofs thereof show that phase-entangled quantum objects also share information much faster than light. As Nick Herbert says, “A universe that displays local phenomena built on a non-local reality is the only sort of world consistent with known facts and Bell’s proof.” In requiring our reality to be imbedded in a BEC, the one extended structure shown, in the laboratory, to demonstrate non-locality, Dirac’s equation provides exactly that non-local reality in which our local universe is imbedded. These demonstrations of non-locality therefore constitute evidence for the BEC.

Not all of this is original, of course, even to Dirac’s equation. The French physicist Le Bon suggested in 1907 that the ether consists of “weightless combinations of positive and negative electrons,” which, considering the date, is positively clairvoyant. Others (Philips, 1976, 1986; Simhony, 1994; Rothe, 2000) have suggested models based on electron-poston pairs, but none has approached the simplicity, elegance, and range of problems solved by the complete Dirac equation.

However, at all times we must keep in mind that this is only a model. The map is not the territory, the menu is not the meal. We must remain flexible. This model must fail to match the terrain in major and unexpected ways, as all of our theories are by definition invalid. Our ego model of the nucleon explains the size of the nucleon, the mass of the nucleon, the very individual and peculiar shape of the strong nuclear force, the strength of the strong nuclear force, and several other features that no other model has begun to explain. However, it is perhaps at a stage similar to the original Bohr model of the hydrogen atom. It explains many hitherto unexplained features, but it is perhaps oversimplified and wrong in details, and lacking in quantitative analysis.

We can say with some finality, however, that the Big Bang and the Standard Model are to the physics of the future as Phlogiston is to modern chemistry.

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Commentary on the Work of Don Hotson

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/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.

Those two years encompassed a long and difficult journey for Don Hotson and during that time I learned some of how the first two articles were written and realized the tremendous effort and concentration that was put into their creation. In the fall of 2007 I visited Don for a few days in the San Francisco Bay area and I think in that time we spent about 20 or so hours in the most interesting conversation that I have had with one person in that kind of timeframe. Most of this time I was driving as we were seeing the sights of the Bay area. There have been an amazing variety of experiences and thoughts that have contributed to his work over the years. The three articles are a result of more than a twenty year effort to resolve the inconsistencies and unknowns in physics.

Don has studied a lot of physics but does not have a formal degree in it. In an undergraduate course he was told to forget a career in physics because he insisted on asking questions that exposed embarrassing inconsistencies that the professor could not answer—and, for that matter, that no one could answer at the time. He pursued other things, including French literature and a career in land surveying, but the questions lingered and decades after they were asked he started to work on the answers. The pursuit became serious, like a job, then almost an obsession. That is what it takes when the questions are fundamental and no one in the world knows the answers. Some give answers but you know they are wrong. That makes it even harder because there are few “experts” to consult and most of the best have their own theory because they, too, know the given answers are wrong. The existing paradigm becomes under siege from multiple fronts but each attacker has a weakness that denies final victory. Furthermore, the attacks do not lend themselves to a coordinated effort because the weapons are not compatible. Scientists working outside the paradigm tend to work alone on the deeper and more radical aspects of their theories.

Don stood on the shoulders of giants as all good thinkers do, but his contribution to the theory had to deal with a formidable array of unanswered questions and also had to comply with facts derived from massive amounts of empirical evidence gathered over many years by thousands of researchers. The Dirac equation has four roots, two of them negative, and at the time it was derived in 1931 no one knew what to do with the negative ones. The equation’s implication was that the universe could be made up of electron-positron pairs (eops), two of them with positive energy and two with negative energy. The negative roots were taken out of discussion by making some assumptions and declarations that seem to have stalled physics for over 70 years. Don has studied the implications of taking the equation at face value and extending the theory and seems to have derived a very impressive set of answers to the most intractable problems with the standard model. Among them are the following:

1. It solves the problem that got Don in trouble in physics class—the apparent violation of conservation of energy that occurs during “pair production” when a photon of at least 1.022 MeV “creates” an electron-positron pair and does not account for the large spin energy in the “created” particles. Don shows that the spin comes directly from the negative-energy “sea,” restoring conservation.

2. The concept of “zero point” or “vacuum energy” grew out of the equations of the vacuum electromagnetic field. These equations showed that, if one removes all positive energy from any mode of this field, there still remains an energy of $\hbar \nu/2$, and this vast energy, calculated to be greater than the energy density of a neutron star, was supposed to exist at the “zero point.” This however is impossible, as the zero point has no volume. How can a point of no volume contain almost unlimited energy? But if one removes all positive energy, what remains, Don showed, is negative energy. This energy belongs to the negative-energy Bose-Einstein Condensate (BEC) which is all-pervasive, but undetectable except by its effects on our dimensions, such as non-locality. Don also showed that this vast BEC is the power supply for all matter. The spin energy possessed by all particles, which conservation cannot explain, comes directly from the BEC.

3. The concept of negative energy is broadly encompassing and has been kept under the rug for over 70 years. Both the Dirac equation and the energy equation, including the momentum term, have positive and negative roots. This theory describes the result and its implications for the structure of the universe. The view of the whole universe changes dra-
matically when it is included and understood.

4. The nature of the electromagnetic field is revealed and explains for the first time how it can act at a distance and also instantaneously. Neither can be explained by conventional theory.

5. It explains the roughly equal numbers of electrons, protons and neutrons in the universe. Electrons appear to be simple particles, not made up of parts, whereas protons and neutrons appear to be made up of many parts, so one would expect that there would be far more electrons than protons and neutrons. The theory makes a strong case for the universe to have started from neutrons with the other particles resulting, in their observed numbers, from beta decay.

6. This synthesis also produces electrons and protons of exactly equal charge even though they differ radically in mass and structure.

7. Experiments show matter and antimatter to be created in exactly equal amounts, but we observe a very small portion of antimatter in the universe. This theory shows that the quantity of antimatter is equal to the quantity of matter and explains why it is not observed.

8. The size and mass of the nucleons is derived and explained. Conventional theory gives no rationale for either

9. The strong force is explained and unified with the Coulomb force. The strong force is observed and measured but so unlike any other force that the standard model has no explanation for it. It is nearly 2,000 times stronger than the Coulomb force and operates in a completely anomalous matter: up to a distance of a little more than a Fermi it is very strongly repulsive to keep the nucleons from merging. At that distance it turns strongly attractive to hold the nucleons together and after that it decays rapidly until, at a distance of about three Fermis, it is no longer measurable. Instead of a fundamental rationale, the conventional theory is patched with the invention out of thin air of the gluon, made unobservable, and assigned it the role of holding the nucleons together. The Dirac/Hotson theory accurately models both the strength and the very peculiar shape of this force. This is a very strong indication of the merit of the theory because the odds of obtaining this kind of precise fit with observation of such anomalous values is vanishingly small as an incidental byproduct of an erroneous theory. The unification of the strong force and the Coulomb is a major achievement.

10. The theory explains the nature of gravity and unifies it with the electromagnetic force. This description is consistent with the observation that gravity seems to act instantaneously. Gravity is shown to be limited in distance so that it is weakened near the edges of galaxies. This eliminates the need for so-called dark matter that has been invented in an attempt to save the current theory of gravity.

11. The structure of atoms is addressed (in the current article) to give a solution that can justify the observed strength of materials in spite of the huge proportion of empty space compared to the size of the nucleus and electrons. A proposed structure of a hydrogen atom is given that offers a rationale for the rigid positioning of the electron at a given radius around the proton and how this builds a structure that prevents the intrusion of other electrons and atoms.

12. One of the great strengths of the theory is that it is not limited in scope. All forces are unified and applied to the macrocosm as well as the traditional quantum world. The spacing of the planets and moons in the solar system that follow Bode’s Law is shown to be a result of gravity in combination with a wave of polarization that originates with them. This explains a number of anomalies about the behavior of planets and moons that have not had satisfactory explanations to date.

13. The implications on the theories of cosmology are profound. In 1921 the German physicist Walther von Nernst predicted that light from distant galaxies would be found to have lost energy in transit as every other example of transmission over a distance had demonstrated. This “tired light” theory did not gain acceptance because it was argued that space was empty so that the energy lost in transmission would have nowhere to go. Thus the red shift was attributed to the Doppler effect and has profoundly shaped cosmology ever since. This theory overcomes the objection to the loss of energy and resulting red shift and is a much better explanation. Thus the “big bang” is not needed and probably never happened.

These highlights are profound, but much more is offered by this theory and all science is affected by extension. Among them are the transmutation of elements that seems to occur in experiments that on the surface seem to be only chemical in nature and that seem to occur in plants and animals. These transmutations have been noted many times for over 100 years but seem never to attract the attention of mainstream science. The probable reason is that there is no current explanation for them and they are only an embarrassment if discussed. A better understanding of these phenomena may facilitate the science of cold fusion as well as biology and the medical profession.

Another very controversial subject is the existence and properties of so-called psi phenomena, which encompasses a variety of currently unexplainable events such as telepathy, remote viewing, telekinesis, ability to see future events, and even extending to some UFO phenomena. A lot of serious work (as well a lot of nonsense) has been devoted to this subject without it being seriously considered by science in general. Again, this is mostly because there is no room for it in mainstream thinking and also because it is notoriously irreproducible. However, as the cold fusion community knows, and the Wright Brothers knew, early experiments are not based on a sound understanding of the science and there is a lot of fumbling in the dark. The Dirac/Hotson theory opens a door for the study of these things. Even if it is all nonsense except for a single event that cannot be explained by the existing paradigm, then the paradigm has to change to accommodate it. I think there is plenty of evidence that psi is real and that science has a lot of explaining to do. IE has cited the work of William Tiller and other well respected scientists who have offered proof and some explanations for psi and Don extends this thinking in the paper presented in this issue.

The theory presented in the Hotson papers is radical in nature and huge in scope. It is the result of over 20 years of hard creative work but is just the beginning of a potentially
very important and comprehensive addition to our understanding of the universe. Others must now comment and extend the thinking. Some ideas may not be valid upon further study, but the theory addresses so many open questions so well that a very strong case is made for it being worthy of further study. IE readers include a significant portion of the thinkers that may be able to make constructive comments and we welcome them. There is a good chance that a lot of new science can come from this effort. The value of that would be hard to over-estimate. The whole view of quantum mechanics, relativity and cosmology would change radically and as the engineering community gained an understanding, exciting new technologies would be developed. The current paradigm would be in chaos and heads would roll, but new and better ones would replace them and a new era in understanding of the universe could begin.

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Dirac's Equation and the Sea of Negative Energy, Part 3: Structure and Unification

Donald L. Hotson*

Introduction

The preceding two-part article published in Infinite Energy 44 and 45 (see web links to both documents in Bill Zebuhr’s Introduction) was entirely predicated on the proposition that a true physics must be based on simplicity and causality. If Dirac’s equation means what it says—that it describes everything that waves or every possible particle—it arguably provides the first basis, simplicity: the universe must be built of the four kinds of electron which are the roots of the equation. We have shown at least plausible ways this might happen, ways that solve the glaring problems with conventional physics. Moreover, we have shown direct contact, causal solutions to the problems of the “electromagnetic field” and gravitation, in which we have shown that both represent physical, non-local structures, responses the Big BEC (Bose-Einstein condensate) must make to balance imbalances and maintain its own integrity.

There are a number of developments, unmentioned in Parts 1 and 2, which greatly strengthen the case presented there. First, the Nobelist Dr. Norman Ramsey convinced his colleagues that negative absolute temperatures made thermodynamic sense. Since it is the quantity of positive energy in a substance that gives it its positive energy temperature scale, it should be a perfectly obvious corollary that negative energy must be a prerequisite for negative absolute temperatures. This compliments our symmetry arguments, and the fact that both the energy equation and Dirac’s equation have negative as well as positive roots.

Dr. Benni Reznik of Tel Aviv University has demonstrated that the “vacuum” as a whole violates Bell’s inequalities, and so acts like a BEC.2 (Bell’s inequalities, and the now voluminous proofs thereof, show that two particles or photons, created in the same event, remain “entangled” with each other, sharing the same wave function, no matter how far apart they may move. Thus an action on one instantaneously causes a complimentary change in the other.)

Dr. Reznik demonstrates that two unentangled probes, inserted into the “vacuum” at random distances, rapidly become phase-entangled. This is behavior one would expect from a BEC, not a “vacuum,” and can hardly be understood except in terms of a universal BEC. Since the Dirac papers insist that the “vacuum” is a universal BEC, this represents an immense verification of its thesis.

This is only one of a number of demonstrations, recent and ancient, that entanglement and superluminal effects are real and fundamental factors. For instance, it has been known since Laplace that gravitation must act much faster than light, or the earth/sun system would form a “couple” and the earth would spiral off into space.3 That gravitation acts almost instantaneously has been shown by studies of contact binary stars, which show that it must act many orders of magnitude faster than light. Astronomer Dr. Tom Van Flandern has shown that General Relativity, though it gives lip service to the “light speed limit,” simply goes on to assume instantaneous “changes in the curvature of space” in its equations, and so is non-local.4

Further, it has been known for decades that electromagnetism acts faster than light, according to a whole series of experimental results starting with the Sherwin-Rawcliffe experiment5 and continuing with those of the Graneaus6-10 and Pappas.11-13 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.

A BEC has been shown by laboratory experiments to be all one thing, so that an action on one end of a BEC causes an instantaneous reaction at the other end. Therefore a universal BEC is the only plausible explanation for these burgeoning superluminal effects.

But we require a further, in-depth look at causality.

Causality

Physics, as practiced by Newton, Faraday, Maxwell, Lorentz and company, had causality as its very basis: the study of physical effects on physical objects. The American Heritage Dictionary defines physics as “the science of matter and energy and the interactions between the two.” Until the twentieth century, Newton’s pronouncement on “action at a distance” was considered an axiom:

. . .that one body may act upon another at a distance through a vacuum without the mediation of anything else, by and through which their action and force may be conveyed from one to another, is to me so great an absurdity that I believe no man who has in philosophical matters a competent facility of thinking can ever fall into it.14

Maxwell introduced the “field” concept, but only as a computational device, never doubting that there was a physical mechanism operating to perform the functions involved. But starting with Einstein, and his abandonment of a substantial “aether,” the “field” became a supernatural
device that magically wafted energies across the void whenever needed, and allowed us to forget we had abandoned physics when we abandoned causality.

Ask a physicist exactly what a “field” is made of, and how it acts to magically convey energy across the void, and you won’t get answers, only hand-waving and formulae. But with this “field” devoid of any physical mechanism, a hocus-pocus wave of the wand was introduced at the heart of the discipline, and we all became magicians.

Thereafter, whenever experimental evidence contradicted current theory, we had a ready-made answer. An invented “field” and its invented particles, designed to be unobservable, hence not subject to falsification, could always produce at least apparent conformity with theory. This validation of the fudge factor was then duly ratified by the Nobel Committee, in its awards for the infamous “renormalization” fudge. This meant that regardless of the experimental evidence, the theory didn’t have to be modified, and no one had to change their ideas or (horrors!) learn anything new. As in the Mikado, “And you are right, and we are right, and everything is quite correct!” This has fossilized physics, preventing any real debate or change, and led to the currently fashionable “string theory”—an exercise in pure mathematics, devoid of any suspicion of physical content. As Carver Mead famously remarks, “It is my firm belief that the last seven decades of the twentieth century will be characterized in history as the dark ages of theoretical physics.”

In Mead’s book, we have seen that extensions of Dirac’s equation restore causality to electromagnetism and gravitation. This must be counted among the triumphs of this approach. But there is one further, glaring instance where modern theory substitutes magic for physics. According to QM, QED, and the Standard Model, “solid matter” is a vacuum much more vacuous than outer space. To illustrate this, let’s set up a scale model of the solar system (Figure 2).

We are quite close to the sun, with respect to the rest of the solar system. (Remember that Mercury and Venus are even closer to the sun.) Let’s suppose we could blow up the hydrogen atom, resizing it to the dimensions of the solar system, with the proton now the size of the sun, and the electron’s innermost Bohr orbit at the same scale. Our cozy picture is of the electron orbiting like a planet. (In the Bohr atom model, it would be much closer than Mercury.) So where would be the electron’s innermost orbit, in this scaled-up model? Among the inner planets like earth? Among the gas giants? Sorry, it wouldn’t orbit anywhere in the solar system.

To show the electron’s orbit in its relative position, we need to enlarge the scale again. Once more, the sun, with the proton the same size, is at the left. But now the entire huge solar system, enclosed by Pluto at 39 AU, is just one electron is nasty, and acts instantaneously to keep it out? What samples the incoming electron’s quantum numbers, and decides if they are different, and allows it in, or the same, and instantaneously excludes it? Obviously magic, not physics.

Bohr Magic

Since Niels Bohr developed his atomic model nearly a century ago, the cozy representation of the atom has pictured a nucleus at the center, like the sun, with electrons orbiting nearby, like planets. (See Figure 1.)

But the solar system is a vast, empty space. We are 93 million miles or one Astronomic Unit (AU) from the sun, and Pluto orbits at 39 AU, 39 times further from the sun than we are, or more than 3½ billion miles away. To illustrate this, let’s set up a scale model of the solar system (Figure 2).

We are quite close to the sun, with respect to the rest of the solar system. (Remember that Mercury and Venus are even closer to the sun.) Let’s suppose we could blow up the hydrogen atom, resizing it to the dimensions of the solar system, with the proton now the size of the sun, and the electron’s innermost Bohr orbit at the same scale. Our cozy picture is of the electron orbiting like a planet. (In the Bohr atom model, it would be much closer than Mercury.) So where would be the electron’s innermost orbit, in this scaled-up model? Among the inner planets like earth? Among the gas giants? Sorry, it wouldn’t orbit anywhere in the solar system.

To show the electron’s orbit in its relative position, we need to enlarge the scale again. Once more, the sun, with the proton the same size, is at the left. But now the entire huge solar system, enclosed by Pluto at 39 AU, is just one
inch in diameter. So where would be the electron’s innermost orbit in this model? The electron would orbit six inches from the sun/proton, twelve times as far from the sun/proton as is Pluto, over 45 billion miles away. This is 490 AU, or 490 times further from the sun/proton than we are (Figure 3).

Not a cozy little solar system model any more, is it?

It is now evident that the “Bohr atom” picture amounts to a Little Lie. It has been known to be nonsense for nearly a century, but it is still widely pictured and publicized and almost never contradicted. It is clearly designed to hide from the public (and perhaps from physicists themselves) the vast unlikelihood of the nonsensical concept, preached by conventional physics, of “empty solid matter” (an oxymoron if ever there was one).

For this supposed point-electron must police this immense spherical volume, on this scale over 13,000 times the volume of the entire solar system out to Pluto. How can it possibly keep everything else out, up to pressures of thousands of atmospheres, especially from something approaching from a direction opposite to the electron’s supposed instantaneous position? To look at it in terms of the antisymmetric Pauli Exclusion Principle, how can something this vast distance away, 980 AU on our scale, possibly be said to “occupy the same space” as our electron? How can this be anything but the most non-physical “action at a distance”? Einstein called it a “ghost field” (Gespensterfeld), since this miraculous field carries no energy, yet can resist enormous pressures. This is a direct indication that we are dealing with magic, not science.

This immense problem has never been given any but vague hand-waving by conventional physics. Calling it the Pauli Exclusion Principle names it, but doesn’t even attempt to give any kind of explanation. You can perhaps “stand on your principles,” but only in broadest metaphor. Schrödinger thought that his equation’s \( \Psi \) wave meant that the electron was perhaps “smear out” over this immense volume, but the Born interpretation of \( \Psi^2 \) as “probability” removed even this “ghost field” of an explanation.

This totally non-physical “action at a distance” which causes the oxymoronic “empty solid matter” to be somehow capable of resisting immense pressures, is only one of the severe problems posed by this solar system model. We might call it Miracle 1.

Consider next the case of a lone electron, approaching a lone (ionic) proton. They are impelled together by the strong Coulomb force between them, which increases at \( 1/r^2 \) as they approach, accelerating towards each other all the way. Yet when the electron reaches the appropriate Bohr radius, where its velocity and the Coulomb attraction are relatively huge, it instantly turns at right angles without any force being applied to it, and begins to orbit the proton as a hydrogen atom. We might call this repeal of the law of inertia Miracle 2.

Next: whenever an electron is accelerated, as is well known, it emits electromagnetic radiation. In the hydrogen atom, our electron is orbiting in continual acceleration around the proton; it should lose energy and spiral into the proton. But somehow, against everything we know about accelerated electrons, it does not radiate. We might call this Miracle 3.

Furthermore, the hydrogen atom is electrically neutral. Yet in the Born “probability” interpretation, the electron is somewhere within the confines of the \( \Psi \) wave: it simply has a certain “probability” to be in a certain place. But wherever this electron actually is, any measurement of the atom’s charge, except where electron and proton are exactly the same distance away, should show the atom not to be neutral. Yet the hydrogen atom is electrically neutral, from any angle. Moreover, the electron and the proton should be impelled together by their Coulomb force, so that even if the electron’s orbital motion balanced the electrical force impelling it toward the proton, the proton still must feel this force and oscillate rather than remaining stationary, which is not observed. Thus the electron charge must be somehow “shared” by the entire sphere surrounding the proton, or the atom would not be either neutral or stationary. We might call this Miracle 4.

Born’s “probability” explanation does not address this problem. If there is a certain tiny “probability” for the electron to be at a certain place in this huge volume, there is a much higher probability that it is not going to be elsewhere, and the atom would not be neutral or stationary, absent other forces.

There is a further problem with gravitation. Since the electron is such an immense distance from the proton, if it orbited around the proton, the common center of gravity of the electron-proton system would be quite a distance outside the proton, and the proton would orbit around this common center, causing a “jitter motion” which is not observed. We might call this Miracle 5.

So we see that this tidy solar system model of the hydrogen atom requires at least five major miracles to sustain it. However, in other instances where such supposed “action at a distance” seems to occur, we have found the action to be mediated by a physical direct-contact structure of epos, formed into a BEC-like configuration: the electromagnetic field, the \( \Psi \) wave of the photon, even the nucleon itself.

Here we might note that every “law of nature” in our positive-energy realm turns out to be merely something that the Big BEC must do to maintain its own integrity: balancing unbalanced charges, expelling positive energy and maintaining it “out of the way” in our “energy dump” of a reality.

To accomplish this, the Big BEC has an infinite number of epos to throw at any problem—since infinity minus infinity is still infinity, there is no chance that the BEC is going to “run short” of epos.

Any ion is a huge irritant to the BEC—it must connect it, even across galaxies, with its corresponding positive charge, and maintain a large “electromagnetic field” to service it. So the BEC would seek a permanent, neutral “box” for the irritating ions, one that would be the least-energy solution.
(The BEC can’t just put a proton and electron back together as a neutron, as that requires more than the available energy, and anyhow the neutron is unstable, and would just decay to produce more ions.)

At this point, we need to take a new look at the “epo,” because comments made concerning the first Dirac article have shown that the epo wasn’t clearly explained.

Both the energy equation and Dirac’s equation call for both positive and negative energy. Negative energy has been ignored and all reference to it deleted. But the Standard Model, currently in use, is a theory for massless particles. Incorporating mass throws the Standard Model into chaos, producing infinities which have to be fudged away, and an unobserved entity, the unlikely Higgs Boson, has been invented to “endow” particles with mass in some unspecified manner.

But the only logical definition of mass/energy, which is the same thing according to the energy equation, is a kinetic one, in line with the Lorentz equations, in which motion increases mass/energy. By this definition, energy is the motion of charges and “mass” is a standing reciprocation of charges. And by this definition, positive energy would be charges vibrating in “real” directions and negative energy would be charges vibrating in “imaginary” directions, those indicated by $i$, the square root of minus one, which indicates a direction at right angles to our ordinary three. The square root of minus one appears in most of the equations of quantum mechanics, and is a “wild card”—no one knows what to make of it. But the answer is simple—any time an equation calls for this, it indicates a function that has amplitude in one of these “imaginary” dimensions. (This also is its function in electronics.)

Dirac’s equation has four roots, two positive and two negative. I called them “four kinds of electrons.” This is imprecise, for Dirac’s equation has no mass term: the mass has to be put in “by hand.” This is what Dirac did, when he first attempted to use the equation: thinking that the two positive roots must refer to electron and proton, the only two particles known at that time, he entered the average mass of the two. As this didn’t work, he realized that the positive energy particle had to have the same mass as the electron, and so predicted the positron, which was soon discovered in the laboratory.

What the equation actually describes is two kinds of bosons, one with negative energy and one with positive: a spin-1 boson with no rest mass, a string if you will, Tau $\tau$ in length, with a positive charge at one end and a negative charge at the other. These charges reciprocate, exchanging the negative and positive charge every Tau. I call this an epo. The negative energy epo vibrates in some imaginary direction, and so has negative energy of $h\nu$. This is proven by the equations of the vacuum electromagnetic field, which show that if all positive energy is removed from any mode of the field, there remains an energy of $h\nu/2$. But if all positive energy is removed, what remains but negative energy? Thus any mode of the field, with positive energy removed, still contains one end of our negative energy boson, thus a negative energy of $h\nu/2$. This proves not only that our negative energy boson field is ubiquitous, but also that, since it is composed of bosons below zero, it is necessarily a Bose-Einstein Condensate (BEC).

According to quantum field theory the simplest quantum field must necessarily be populated with unlimited quantities of identical, neutral, spin-1 bosons. Since the negative energy quantum field is below zero, this field of bosons would necessarily be all one thing: a Bose-Einstein Condensate. This again exactly describes our negative energy sea.

How a particle acquires “rest mass” is illustrated by “pair production.” A photon of at least 1.022 MeV interacts with one of these ubiquitous negative-energy epos, and each end of it acquires $mc^2$ of positive energy, with a half unit of spin from the half-epo. The energy it acquires is a vibration at $c$ in two “real” directions. Thus it is a spherical standing vibration in two “real” dimensions and one “imaginary” one.

However, the equations of QM have famously shown that any bare charge, say an electron, is instantly surrounded by an unlimited number of epos, their positive charged ends toward the electron. This ring of epos is further surrounded by a further ring of epos, and so forth. This has led to the most exact match of calculated with experimental values in all of science, the electron’s magnetic “$g$” factor. Since the opposite happens at a positive charge, this would in itself create the electromagnetic field. (See Figure 4.)

However, QM postulates that these epos are real electrons and positrons, “created” by the charge, which makes the mass and charge of the electron infinite, something to be fudged away. But Dirac’s equation shows that these are massless epos merely raised in state from the BEC, from pointing in imaginary directions to pointing in “real” ones. Thus they have “real” energy, capable of “carrying” the electromagnetic force. And since there are epos everywhere, this takes no energy.

To visualize what happens, imagine that the two opposite charges in Figure 4 are an ion electron and proton. They are strongly attracted to each other by the Coulomb force, and must, one would think, collide. However, despite the Coulomb force increasing at $1/r^2$ as they approach, they do not do so. Why not? Well, imagine that the epos between them, instead of merely dropping back into the BEC, begin to form a spherical structure at the “permitted (Bohr) radii” around the proton, in the shape of the $\Psi$ wave, particularly populating the radius whose energy agrees with the electron’s kinetic and potential energy as it approaches. They form a crystal-like structure, with every positive charge surrounded by six negative charges, and vice versa, like an ionic salt.

Then, when the electron arrives, its energy sets up a “standing wave” around the proton, and the electron supplies the “order parameter” which allows the structure to

Figure 4. Vacuum polarization around unlike charges.
condense as a BEC or BEC-like object, “all one thing” under the electron’s wave function. If this is an “excited” state, it lasts only a fraction of a second, collapsing to the first Bohr radius, emitting a “photon” (transferring angular momentum to nearby epos) and setting up a BEC there. (See Figure 5.) Note that the resulting Figure 6 would be a tremendously strong structure, supported by “spokes” emanating from the proton, and having the symmetrical strength of a Buckminster Fuller dome. It has an epo structure wherever the Ψ wave has amplitude, explaining the minor mystery of why the Ψ wave has a tiny amplitude all the way down to the proton. Its strength could probably be computed by structural mechanics, and could resist enormous pressures.

Such an immensely strong BEC-like structure would solve the problem of “What the Bleep are we standing on?” or Miracle 1, above. What about the other miracles?

Since the electron’s kinetic energy is totally absorbed by the epo structure as it arrives, and spread throughout the structure possibly as an “excited” state which emits a photon to revert to the “ground” state, Miracle 2 is not needed.

Further, this “Atomic BEC” is a uniform structure with the electron’s charge and other properties collectively shared by the entire BEC, which eliminates Miracles 3, 4, and 5.

And since the electron’s properties are spread throughout the BEC structure, it would explain Born’s statistical explanation, and justify Schrödinger’s feeling of a “smeared-out electron” as well. (A measurement of the electron’s position, say by an incoming alpha particle, would of course place the electron at the random location where the alpha particle interacted with the BEC.)

Also, since a BEC is non-local, this fact would explain the instantaneous “God-damned quantum jumping” to which Schrödinger so objected. This occurs when an electron in an “excited” state emits a “photon” and reverts to the lowest Bohr energy level, and can be understood when it is realized that the electron’s properties, spread among the entire excited structure, also include a certain Ψ wave amplitude at the lowest Bohr level. When the “photon” is emitted, the upper “excited” structure is simply vacated, all the epos reverting to the BEC, and the electron’s properties instantaneously inhabit the lower energy level. In the obverse case, where an incoming photon “excites” an electron to a higher state, the photon’s energy populates the higher orbital state, which the electron then simply occupies for a few microseconds.

“Self-Organization”

We see the phrase “self-organizing” often with respect to plasmas. It has a long history. David Bohm’s early work at Berkeley Radiation Laboratory included a landmark study of plasmas. 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, Melrose, and others, and is now a commonplace of plasma physics.

However, no one has ever explained how a collection of ions can “self-organize” to act in concert. What is this “self”? How can a collection of ions act in concert, as an individual organism? From a physical standpoint, the phrase self-organizing is nonsensical. To attribute a self to a few ions is the worst kind of anthropomorphism. What it really means is, “This behavior happens, we don’t have any idea why, so
we give it a name, forget the dilemma, and go on about our business.”

This “self-organization” has become a buzz-word which hides from us the fact that we have no idea how this can happen. Consider the following abstracts:

NONLINEAR PHENOMENA IN PLASMA AS A CONSEQUENCE OF SELF-ORGANIZATION
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Department of Plasma Physics, “Al.I.Cuza” University, 6600 Iasi, ROMANIA

Abstract
Recent experiments performed on physical plasma revealed the possibility to establish a direct relationship between non-linearity and the creation of space charge configurations with behavior usually attributed to living beings. Such a “viable” self-organized complexity acts as the “vital” part of a plasma oscillator working with differential negative resistance and, in certain conditions, as the genuine cause of the so-called Turing instability.

FUNCTIONAL DOUBLE LAYERS EMERGED IN PLASMA BY SELF-ORGANIZATION
E. Lozneanu, D. G. Dimitriu, L. M. Ivan, M. Sanduloviciu
Physics Department, “Al. I. Cuza” University of Iasi, Romania, e-mail: dimitriu@uaic.ro

Instead of considering the double layer (DL) as generated by two plasma maintained at different potentials, we show that it actually acts as a functional structure that, performing the operations “learned” during its emergence by self-organization, it is itself able to sustain a proper potential drop that separates the two plasmas. We prove this by two facts. First, the self-assemble process of a DL is a nonlinear process during of which thermal energy from the plasma is directly converted into energy of the electric field of the DL.[1] Locally, and for a very short time, the second law of thermodynamics is not active during this process. Second, for its surviving the DL emits entropy in the form of incoherent light, i.e. it formally acts as a system that produces negative entropy.[1] Possessing memory, the DL acts as an “intelligent” circuit element that attributes to the plasma diode the ability to work as a bistable/multistable circuit element.[1-3]

[2]. E. Lozneanu et al., Chaos, Solitons & Fractals 17 (2003) 243

These reports are typical of experimental work with plasma double layers. Note the profusion of assumptions that a plasma, a group of ions, can exhibit “learned,” “intelligent” behavior. Such language seems inevitable when contemplating the heretofore unexplained behavior of the plasma double layer.

However, the concept of a universal BEC gives the first plausible solution to this dilemma. Instead of being self-organized, it is now clear that a collection of similar ions, a huge irritation to the BEC, is organized by the BEC into the least-irritating, least-energy configuration. We submit that it is surrounded by a structure similar to that in Figures 5 and 6, except for the central proton.

Such a structure, organized by the BEC, would account for all of its apparent “learned,” “intelligent” behavior without attributing a self or a purpose to a bunch of ions.

Note that the electron sheath around a proton exhibits most of the behavior attributed to the double layer. Acting as a BEC-like structure, it sustains a potential drop between the atom and the surrounding environment, making the atom electrically neutral. In the plasma, this sheath can support huge potential differences between plasma and plasma, or between plasma and vacuum or “ordinary” gas or matter.

As such, it is governed by the same wave function, and so acts in concert. The BEC acts to isolate this irritation in a pocket, tending toward the spherical, isolating it by means of a membrane called a double layer (also unexplained by current theory) which separates the irritation from the neutralized condition of normal matter.

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, 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 “Atomic BEC”
From the standpoint of the Big BEC, the resulting “Atomic BEC” (hydrogen atom, or any neutral atom) is the least-energy configuration. Ions are a huge irritation, which the BEC must “service” continually. A lot more energy (and an anti-neutrino) would be required to combine the electron and proton back into a neutron, and the result would still be unstable. But this Atomic BEC is a tidy, electrically neutral, non-irritating, non-radiating “package” that the BEC can just ignore, unless disturbed (ionized) by an outside influence. This is the BEC’s preferred solution to any group of ions. The BEC just wants to wrap up every irritating ion in a cocoon of epos so it can ignore it.

This Atomic BEC structure is, from the BEC’s standpoint,
like an “object” in Object-Oriented Programming (OOP). The BEC can simply set it aside and ignore it, until it is ionized or otherwise disturbed. And like the programmer’s “object,” it has a handy “label” (the wave-function of the order parameter electron).

This handy label apparently includes the whole atom, including the nucleus. This suggests how massive transmutations can occur, by removing the label. This can apparently be accomplished by catalysts, by high “B” fields, high surges of electricity, and possibly other means. Then a collection of objects dissolve into a bunch of ions ramming around looking for a home, and transmutations occur as the ions come together in different “object” configurations. This can be illustrated by an actual experiment, that by Leonid Urutskoev. With the author’s permission, I quote from a description of the experiment by Georges Lochak which was presented at a scientific conference in Marseille, France.

LOW-ENERGY NUCLEAR REACTIONS AND THE LEPTONIC MONOPOLE
Georges Lochak*, Leonid Urutskoev**
*Fondation Louis de Broglie, Paris, France
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In 1998, to solve some applied problem, our research group studied the electric explosion of titanium foil in water. By pure accident, in mass-spectrometric analysis of the titanium powder formed after the electric explosion, we noted a pronounced distortion of the natural isotope composition of titanium. The principle of the experiment was as follows. Two banks of capacitors with the total energy store \( W = 50 \text{ kJ} \) and the voltage \( U = 5 \text{ kV} \) are discharged synchronously and independent of each other to two foil loads over time \( t \sim 0.1 \text{ ms} \). Of course, during the long period of our studies, we employed different experimental block diagrams, and I cannot describe all of them. The most general experimental diagram is shown in Figure 1.

The figure shows a half of the setup. The load is located in the explosion chamber, which is a leak-tight strong metallic container, whose internal structure is made of high-density polyethylene. The design of the explosion chamber includes facilities for the gas exhaust and bleeding-in and for taking gas samples into cylinders. The
The key result is as follows. The remainder of the titanium foil shows a distorted titanium isotope ratio (Figure 2). It can be seen from the Figure that the situation looks as if $^{48}$Ti “disappeared” at the instance of the pulse. Please, pay attention that the $^{48}$Ti isotope was not transformed into another isotope but disappeared, while other isotopes remained approximately in the same proportion, of course, to within the error of measurements. The deficiency of $^{48}$Ti in some experiments is ~5% while the error of measurements is ±0.4%. Simultaneously with disappearance of $^{48}$Ti, a sharp (ten-fold) increase in the impurity content in the samples was detected by mass-spectrometry, X-ray fluorescence analysis and so on. The percentage of the new impurities corresponded to the percentage of the lost $^{48}$Ti. The chemical composition of the resulting foreign components is shown in Figure 3. All the components that could be present from the beginning have been subtracted.

I am not going to analyze the experimental results, as this analysis has been published in [1]. Nevertheless, the results were so unexpected that they called for an independent verification. This was done by our colleagues from Dubna (Kuznetsov’s group). The verification was thorough, and the results were published in [2]. An important result is that, unlike Fleischmann and Pons, we claim that no neutrons are observed in our experiments, depending, I believe, on the mind-set of the experimenter. For the wave function is a necessary to produce the “foreign components” in Lochak’s Figure 3. They also show the error of measurements is ±0.4%. Simultaneously with disappearance of $^{48}$Ti, a sharp (ten-fold) increase in the impurity content in the samples was detected by mass-spectrometry, X-ray fluorescence analysis and so on. The percentage of the new impurities corresponded to the percentage of the lost $^{48}$Ti. The chemical composition of the resulting foreign components is shown in Figure 3. All the components that could be present from the beginning have been subtracted.

The paper goes on to show that the amount of $^{48}$Ti missing is almost exactly equal to the total amount of “foreign components” shown in Lochak’s Figure 3. They also show that the energy roughly balances as well—the energy released in the disintegration of $^{48}$Ti is almost completely balanced in the endothermic and exothermic reactions necessary to produce the “foreign components” in Lochak’s Figure 3.

Readers of this magazine will be well aware that such transmutations can and do occur. This suggests a hitherto unexplored “pathway” which could start to explain most, or all, of these transmutations. This makes use of the “label” concept, and notes the vast differences in the results of LENR experiments, depending, I believe, on the mind-set of the experimenter. For the wave function is a thought, and in conditions far from equilibrium, as Prigogine stresses (The End of Certainty), the path back to equilibrium can take byways that are governed by thought.

This is shown most clearly in biological transmutations, particularly the famous ones studied by Dr. Kervran, in which both animals and plants are seen to have transmuted a wide variety of elements.

A special consensus seems necessary for a miracle to happen. But plants and animals must each contain a special consensus within them, or chickens in the farms of skeptical farmers would cease to produce calcium eggs.

The special consensus is most easily seen in the experiments of Dr. William Tiller21 in which he uses a team of Chi Gong masters to “condition” the sites of his experiments, after which the experiments work without exception. The same kind of special consensus is found surrounding certain faith-healers.

Recently, a whole series of books has been published, citing the “wholeness” principle that seems mandated by Quantum Connectedness: among many others, The Conscious Universe (Radin, 1997), The Self-Aware Universe (Goswami, 1993), The Non-Local Universe (Nadeau and Kafatos, 2001), and Entangled Minds (Radin, 2006).

Radin’s books, in particular, establish beyond any reasonable doubt the proofs for a range of psi phenomena; as he says, “The evidence is based on analysis of more than a thousand experiments investigating various forms of telepathy, clairvoyance, precognition, psychic healing, and psychokinesis.” All, he shows, are established to combined odds against chance of $10^{104}$ to one. (Radin, 2006, p. 275). “The evidence for these basic phenomena is so well established that most psi researchers no longer conduct ‘proof-oriented’ experiments. Instead, they focus largely on ‘process-oriented’ questions like, What influences psi performance? And how does it work?” (Radin, 1997, p. 6).

These experiments, and others, show that mind and mind, and mind and matter, are connected non-locally. All these books are looking for the non-local medium that connects everything, as they show it is connected, but an explanation of these connections is lacking.

The dilemma for physics is pointed out by Radin. He asks: “What is the nature of this hypothetical medium in which mind and matter are intimately intertwined?” (Entangled Minds, p. 236) Further (p. 261), “For physics, we must reside in a medium that supports connections transcending the ordinary boundaries of space and time.”

The answer, from Dirac’s equation, seems to leap out: the Big BEC, called for by those equations, provides exactly the required ubiquitous, non-local medium connecting everything to everything else in the universe. We have seen that it gives the first explanations for quantum entanglement and the non-local effects of gravitation and electromagnetism. The question is how does it make these connections?

The work of Radin and many other researchers shows that the BEC acts like a non-local, infinitely reactive jelly surrounding and pervading everything. It is thought-sensitive, so that a mind thinking of someone or something here causes a reaction in the object of the thought there.

Radin and others suggest that thinker and the object of the thought are quantum entangled, like the photons in Aspect’s experiments, and like the unentangled probes inserted into the vacuum by Reznik et al., which rapidly become entangled.

But Reznik ignores the connection between thinker and object of thought demonstrated by these multiple experiments. It seems evident from this that it is the thought of the experimenter which causes the quantum entanglement, not the properties of the “vacuum” per se.

The “Double Layer”

We have seen above that a plasma, immediately surrounded
by a double layer, seems to act like a living thing, because it is isolated by the BEC. These completely isolated plasmas seem to offer handholds on such phenomena as ball lightning (see “The Missing Science of Ball Lightning” in Vol. 17, #3 of the Journal of Scientific Exploration).

Some of these extreme cases of plasmas completely isolated and maintained at voltages differing by billions of volts, called “EVOs,” are noted by Kenneth Shoulders in his Infinite Energy article (Issue 75, p. 41) and his articles posted on the Web at http://www.svn.net/krsclfs/.

It seems evident that Shoulders’ EVOs are extreme examples of plasma pockets of many electrons at extremely high voltages isolated by the BEC by a sheath of insulating epos that maintains the plasma pocket in its radical voltage difference from the outside environment.

But there are plasmas with much smaller potential drops between plasma and the atmosphere which are not all-excluding. An example might be the bioplasma which Russian scientists have detected surrounding the human body, and have identified with the aura of metaphysics. This has a mere few volts of potential difference, but can have several layers, and studies have shown that it is maintained by the body and reflects the thought of the mind and the health of the body, with illness showing up first in it.

This bioplasma, intimately connected to the BEC, seems to act like an antenna, sensitive to the health and thought of the subject. Further, it would appear to react to, for instance, the thought of another person, or being stared at by another person, both effects which have been demonstrated by experiment to astronomical odds against chance. In both cases, the body’s autonomic system reacts, but whether the subject is consciously aware of the intrusive thought or sight depends on a number of factors, which seem to include whether the subject easily receives signals from her bioplasma.

This would seem to provide a model for at least some of the psi results proven by experiment. The thinker’s bioplasma is connected through the BEC with the object of the thought, and causes corresponding changes in the object’s bioplasma. They are connected non-locally, quantum-entangled. The amount of information that can pass through this channel seems to depend on the degree of their entanglement. Merely thinking about a total stranger, under laboratory conditions, has been shown to affect the stranger’s bioplasma. They are connected non-locally, quantum-entangled to a certain extent. But a mother and child, for instance, will be deeply quantum-entangled and will retain this connection throughout life. Thus the occasional complete “visions” which seem to occur in life-threatening situations and seem to occur most frequently with these persons who are deeply quantum-entangled.

Quantum entanglement alone, however, doesn’t seem to explain the more robust cases of psi, such as “remote viewing” and psychic healing, both of which have been established by multiple experiments. Nor does it explain the related “Out of Body” (OOB) experiences. These are not readily accessible to repeatable experiments, so these have not yet met with total acceptance by parapsychologists. However, a large and growing body of the closely-related “Near Death Experiences” (NDEs) have been studied under clinical conditions. See, for instance, the two books Recollections of Death and Light and Death, by Michael Sabom, a cardiologist who reports a systematic study of OOBs in near-death experiences. His subjects, from a “second body” hovering above their near-dead body, (in one case, a body clinically brain-dead), were able to describe in detail operations on their bodies which they could not possibly have physically observed. A burgeoning number of similar studies, while they may fall short of absolute proof, lend considerable credibility to anecdotal reports.

One such is Mindsight by Kenneth Ring and Sharon Cooper (1999). This careful study shows that persons born blind nonetheless can see when out of body, and can describe persons, instruments, and surgical procedures they have never seen when in their blind physical bodies. They study 31 cases, some utterly inexplicable except by the OOB hypothesis.

“Reality”
At this point I would like to exercise the prerogative, which is everyone’s right, to offer my answer to the question “What is really going on?”

I am going to suggest something that should have been evident from the time of Planck’s discovery that our reality was not continuous, but grainy, or “quantum,” as it came to be called. This caused a great shock to the materialists. A greater shock came with the discovery that when an electron around an atom jumps from one energy level to another, emitting a photon, it disappears from one level and reappears at the other without occupying any intermediate position. This is the “God-damned quantum jumping” that Schrödinger so deplored.

Further, according to Quantum Mechanics, a quantum object, or “quon,” making a visible path through a cloud chamber cannot be said to have a continuous trajectory, but in essence is said to be “re-created” each time it interacts with the substance of the cloud.

Almost worse, it was found that when an electron interacts, it does so at a point of immeasurably small dimensions. Quantum electrodynamics, one of the most successful parts of quantum mechanics, in fact treats electrons as mathematical points, having no dimensions. How can a “real” particle literally have zero dimensions? Where does one find mathematical points but in mathematics, or in a mind doing mathematics?

Moreover, quons of the same type in the same state are indistinguishable from and interchangeable with each other: you might call them “radically identical.” “Real” objects are always slightly different in detail. Even if stamped from the same mold, there will be flaws or imperfections which distinguish them, at least microscopically; they are not radically identical. It is only in the realm of ideas that you achieve radical identity: The difference between 3 and 4 is radically identical to the difference between 1001 and 1002, because an integer is an idea, not a real object.

In his famous Lectures, Richard Feynman famously said that everything in quantum physics ultimately comes down to the two-slit experiment, which demonstrates the wave-particle duality of quons. And in this experiment, as physicists have found to their utter consternation, the electron or photon must somehow “know” not only whether one slit or two is open, but whether we are watching or not. It must “know” the entire experimental setup, in principle including the entire physical universe, in order to “know” where to hit the screen. Similarly, a photon, approaching a partially
reflective surface, must “know” not only what kind of surface it is approaching, but also how many surfaces there are, in order to “know” how to interact with it. As Feynman asks, but doesn’t answer, “Can we have a theory in which light knows what kind of surface it is hitting, and whether it is the only surface?”

Thus quons such as electrons and photons are ideas, not “real” objects. They consist totally and exclusively of their information, which appears to be what is conserved. We have suggested that the uncertainty principle is best explained as an analog-to-digital conversion. In this, the analog wave formed by the quon’s possibilities (the \( \Psi \) wave) collapses to a single result at a measurement, and is referred to a mathematical point every Tau, with the uncertainty being the light-distance between measurements. If no interaction or measurement is made, as for example when a photon leaves a distant star, the possibility wave (where it is possible for that photon to interact) simply keeps spreading, and may be larger than the earth itself, until an interaction occurs, collapsing the possibility wave. Thus the information of that distant quantum jump, which created the photon, is conserved.

Since our reality, as we have shown, is built entirely of such integer-like, radically identical quons, each distinguished only by its information, we can make a very large generalization: it is clear that our reality is a virtual, not a “real” reality. It is a mental construct, like a video game, built of information and nothing but information. Information is conserved, and it is all that is conserved, since matter and energy are merely information. (That we live in a virtual reality is, of course, what Eastern philosophies have been saying for thousands of years—that we live in Maia, the Grand Illusion.)

Our virtual reality appears to work very much like a hologram, with the “least count” frequency acting as the hologram’s reference frequency: every Tau, or \( 6.26 \times 10^{24} \) times a second, a “recording” is made, with every interaction referred to a mathematical point. During the next interval, the analog wave created by each quon’s possibilities spreads, until the next “recording” or interaction collapses it again. This reference frequency is the refresh rate of the universe, everything being re-created each Tau, like the refresh rate of a hologram, or of a television screen, refreshed 60 times a second. Thus the complete information of the entire universe is conserved.

When we are enthralled in physical reality, or are playing the space-time-illusion game, we experience this information serially, one frame at a time, like spectators at a film. However, the analog wave from which the film is generated contains information about the past and future, as the director of a film knows what happens next. This perhaps explains the precognitive experiments cited in the above books.

Further, it appears that the universe is “fine tuned,” as Sir Fred Hoyle pointed out, specifically to permit and promote life, which is “information rich.” Information, in scientific information theory, is something you haven’t run into before: something new under the sun. It is unpredictable; and life, particularly human life, is most unpredictable, hence produces the most information.

To recapitulate: our virtual reality consists solely of information, and seems to exist to create and record information. “I” am not my body, but my information, and this can exist separate from my body, and survive bodily death.

Acknowledgement
Thank you to my son, Clayton Hotson, for preparing most of the figures for this paper.

References
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In the second part of the Dirac papers (Issue 44, “Dirac's Equation and the Sea of Negative Energy, Part 2), I attempted to show that the solar system is harmonic, arrayed in octaves of $T$ (Tau), $2e^2/3mc^3$, the Least Count of the universe, and octaves of 10 $T$. The sun is organized on an octave of 10 $T$, with Jupiter organized on an octave of $T$. The largest influences on the Solar System were demonstrated to be the sun, with most of the mass, and Jupiter, with most of the angular momentum.

The positions of the planets, I demonstrated, are the resultants of a harmonic “war” between these titans, the planets between Jupiter and the sun occupying positions at the intermodulation nodes of this war. Mercury, like a good Quantum Object, oscillates between a harmonic of Jupiter and a harmonic of the sun. The other planets, and the asteroids, occupy intermodulation positions, explaining the rough symmetry of Bode's Law. Jupiter itself occupies an intermodulation position, 11/10 of an octave of Tau. The outer planets, Saturn, Uranus, and Pluto, again occupy positions which are near-octaves of the sun's diameter, with Neptune on a one-half octave position.

The argument 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 intermodulation 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 huge 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.

There are further anomalies with all of the inner planets, anomalies celestial mechanics cannot explain, and which seem to diminish in magnitude at roughly $1/r^2$ from the sun, as would be expected. The advance of the perihelion of Mercury is well known, and is supposedly explained by General Relativity. But the GR answer is outside the probable error. And GR gives no correction for the Venus anomaly, and for Mars, the GR correction is only about 17% of the measured discrepancy.

So GR doesn't seem to provide the answer. Moreover, Van Flandern\(^1\) observes that there is a small but persistent discrepancy concerning the Earth's period between the optical and the radar data. However, a harmonic influence, diminishing at $1/r^2$ such as we suggest, might well explain all of these unexplained anomalies.

Further evidence for this is provided by the gas giant planets. In the Dirac paper it was shown that the satellites of three of these planets occupy harmonic positions, with the first harmonic being the diameter of the gas giant. The paper showed that the satellites of three of the gas giants, by regression analysis, occupied harmonic positions with $R^2$ values approaching unity. The satellites of Neptune have since been shown by Glen Perry (personal correspondence) to obey the same rule, making it four out of four.

The second part of the paper also made a case that the Jupiter system might be responsible for the sunspot cycle. Successive conjunctions at elongation of Jupiter's three inner Galilean satellites produce explosive pulses pointed directly at the sun, and are exactly on the harmonics of the sun's resonant frequency. The sunspot cycle rises and falls in lock-step with these elongations, and the sun responds with its cyclic magnetic activity. This produces not only the sunspots, but also the 160-minute pulsation. This major resonance of the sun has been documented for 35 years by a Ukrainian team of scientists led by Dr. Valery Kotov.\(^2\) This pulsation amounts to a rhythmic expansion and contraction of the sun’s surface by hundreds of meters, and has been rock-solid for the 35 years of their study. Dr. Kotov reported in personal correspondence to me:

We measured 160-min solar pulsations from 1974 through 2008. The pulsation $P_0 = 160.0101(2)$ min. was present only during the first 9 years, from 1974 through 1982. But during the total 35-yr length of the observations, from 1974 to 2008, the other period was dominant: $P_1 = 159.9656(4)$ min.

Please note the $P_1$ pulsation was absent in 1985-1986 and 1996-1997, i.e. at the very epochs of solar minima.

Notice: the beating period of $P_0$ and $P_1$ is equal to $399(4)$ days, i.e. the synodic period of Jupiter. The origin of this phenomenon is unknown.

Preliminary data indicate that the pulsation is again
Table 1. Length of Day (LOD) Correlation to Solar Cycle

<table>
<thead>
<tr>
<th>First sunspot</th>
<th>Solar Max</th>
<th>LOD rate change</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 54</td>
<td>1958</td>
<td>1962 – slower (-3 seconds)</td>
</tr>
<tr>
<td>May 1996</td>
<td>2001</td>
<td>2003 – slower (-1 second so far)</td>
</tr>
<tr>
<td>Jan 2008</td>
<td>2012</td>
<td>2014 – faster ??</td>
</tr>
</tbody>
</table>

* Solar Max is a 2-3 year event, dates are approximate only
field, which as shown above is powerful enough to speed up and slow down the earth's rotation.

However, we have seen a progression here. Most LENR happens at surfaces. Nanoparticles with increased surfaces are seen to enhance LENR, but only if small enough so that they are mostly surface, with anomalous magnetic fields. And microclusters, smaller yet, exhibit "amazing magnetic properties," so much so that thin films are being examined as potential superconductors. This all happens with the platinum group metals, the "transition group," so named because they have half-filled (or half-empty) outer shells.

Late last century, a cotton farmer named David Hudson claimed to produce exactly such "monatomic" particles, all members of the platinum group. And surprise surprise, he claimed to produce such "amazing magnetic properties," so much so that thin films are being examined as potential superconductors. This all happens with the platinum group metals, the "transition group," so named because they have half-filled (or half-empty) outer shells.

Continuing this progression, what would we imagine to be the properties of a single atom of the platinum group, one not associated with any other atom? It would be all surface, and so would exhibit the above peculiarities, only magnified. It would have "amazing magnetic properties" and would perhaps exhibit room-temperature superconductivity because its "giant magnetic anisotropy" would perhaps produce a Meissner field. With all of its conduction electrons spin-orbit coupled, they would be unavailable for chemical bonding.

By capturing the power of the sun's harmonic magnetic resonance, they further hold promise of uses like "spin batteries," ones that would self-recharge even while powering a vehicle. And because they exist in abundance in sea water, and in ordinary soil, they may be the hitherto undiscovered 'motor' that powers hurricanes and tornadoes.

The challenge to science is immense. If the properties of these monatoms remain the province of amateurs and alchemists, while major inventions are made utilizing them, science will receive a deserved black eye of historic proportions. A major scientific effort is required to capture, tame and understand the properties of these "stealth atoms," but the benefits are unlimited.

References
Don Hotson has recently written an article exploring Dirac's relativistic wave equation and theory of a sea of negative energy. In this article Hotson independently has arrived at some of the important insights into the foundation science that I call Observer Physics (OP). Dirac was a strong inspiration underlying the development of the OP theories. I recall back in the late 50's the deep impression I got from first encountering Dirac's ideas of the negative energy sea and his remarkable prediction of the positron.

I have a few helpful suggestions for Mr. Hotson's approach that I will mention below, but generally I agree with most of his main points, data, and logical arguments. I will have to make a few revisions to OP based on points he brings up, but generally we are in amazing agreement. The OP models of the electron and proton and neutron plus ways of linking the Dirac equation with recent discoveries will definitely help us bring a revived and refined vision of Diracian ideas into the lab for verification.

Hotson is right that we need to step back and look at all the theories we have concocted and evaluate them from fundamentals, testing them logically and objectively against our best data, with no fear of letting go of a paradigm when it is proven wrong. Scientists tend to be cranky, but that is no excuse for becoming afraid to do real science. Sometimes people who appear trained as scientists sell out to political and/or economic interests, but they should realize that sooner or later the facts will discredit them and that will lessen their status as scientists. The politics of fear can lead to abuse of science. On the other hand, the appearance of new data that disproves your theory is not a disaster. As Hotson points out, "With new discoveries made almost daily, no theory can be expected to be the final answer." We are all on a learning curve. As scientists we should NEVER question new data, especially if it contradicts a recognized theory. Replicate the experiment that gave the data and devise other ways of testing both the data and the theory. If the anomalous data stands up to testing, then the theory changes -- unless you want to play God and redo the universe to fit your theory. That's always a possibility, but then you will have to take responsibility for how the whole thing shakes out. If the data fails the tests, then we see if we can account for the aberration of the data. Were the instruments off? Did other factors, objective or subjective, distort measurements? And so on.

Here are some suggestions for refining Hotson's interpretation of Dirac.

Hotson manages to go through his whole discussion of a unitary Theory of Everything without bringing up the consciousness of the observer. In a personal communication to me he has indicated that he has some ideas about this, but opted to omit them from his article. Perhaps he will bring these ideas up in another venue. I look forward to what he has to say on this subject. By sticking mostly to waves he avoids getting too involved in the collapse of the wave function and the role of the observer, subjects that go
right to the heart of QM. As Wolf has already suggested (Star Wave, 1986) we can interpret the imaginary (i) aspects of the psi waves, or perhaps the conjugate (Starred) psi* wave as observer consciousness. OP develops these ideas much further, building on the discoveries of the ancient yogis, Maharishi, Palmer, etc. and integrating them with modern QM.

Hotson criticizes the unobservables that populate the theories of the Bangers (supporters of Big Bang theory) and SMers (supporters of the Standard Model) as a bunch of fudge factors, but then gives us an unobservable and UNDETECTABLE ether and a set of unobservable imaginary spin dimensions. These are fudge factors in the grand old tradition of the SM and BB theories. I suggest that we work on ways to detect the ether and the invisible dimensions. OP takes the viewpoint that anything we claim has existence must in principle be observable in some manner. If we can only observe indirectly, then we take the observable features as the definition of the non-observable that we have postulated. By observation we mean some mode of experience, direct or indirect.

Hotson proposes that Dirac's sea of negative energy is the ether that scientists have debated for so many years. He goes further and describes the whole universe as a giant Bose-Einstein Condensate (BEC). According to his interpretation positive energy in the form of atoms and their interactions represents the heat exhaust from the process of cooling the cosmic BEC. This does not explain the mechanism for the cooling process. If the mechanism is the obvious standard procedure of adiabatic expansion, then he is back to a Big Bang hypothesis. Like the Bangers he then also has to explain what sets up the initial conditions of the Big Bang. According to OP the problem with the BB theorists derives from their failure to understand the nature of Time as it interacts with consciousness. Of course this is due to their systematic avoidance of any consideration of consciousness in their theories. However, they presumably consider themselves conscious when they frame their theories. And this is where the problem arises. They frame their theories from the viewpoint of a human being in a little body on a little planet living somewhere between the arbitrarily defined 20th and 21st centuries "A.D." They project time in terms of earth years. They forget that human consciousness has only been around on this planet for perhaps 3 or 4 million years, and the individual life span is usually less than 100 years. The cosmos operates on a time frame of billions of years. A day in the life of an earthling is practically nothing compared to a Day of Brahman (the life span of consciousness during an entire universe). A Day of Brahman is practically nothing compared to the total universe cycle.

OP brings up the principle of the Poincare Peak to solve the problem of where the extreme bias of the Big Bang comes from. The brilliant mathematician and theoretical physicist, Henri Poincare, pointed out that if the universe is quantum mechanical and oscillates randomly according to its Tau Clock pace through all its possible permutations, then sooner or later it will automatically configure itself into various highly biased states. Some of these will be biased enough to form black holes. Others will be biased enough to produce the concentrations necessary for Big Bangs. The usual mode of ridiculing this idea is to talk about how impossible it is for all the molecules of air in a room to
suddenly gather into one corner. Several thousand years ago the Taoist eccentric Zhuang-zu pointed out that a little sparrow hopping around in the bushes has no idea what it is like to be a giant Roc that can fly from North Pole to South Pole with a flap of its wings. This is the problem of the relativity of viewpoint in consciousness. There are two basic solutions to the molecule problem. One solution is simply to wait patiently for the Poincare Peak -- an event that will surely arrive as long as the system remains intact, undisturbed from the outside. The other solution is to intervene from outside the system. We pump the room full of coherence until it forms a Bose-Einstein Condensate. This is equivalent to saying that we chill the room until the air freezes and drops into a corner. Where does the coherence come from? It comes from the Will of the Observer. He simply decides in a coherent manner how he wants things to be. He takes a viewpoint in which there is no interference with the desired notion. The highly biased state is highly unstable and will immediately expand and explode unless he deliberately pumps the state with coherence.

This situation is exactly analogous to the function of a laser. We pump the nonlinear medium of the laser to invert the population. That means we deliberately raise its excitation level to an extremely biased high state and then let the system explode, cascading back to its equilibrium state. It takes energy to pump the laser and intervene into its natural cycle of spontaneous absorption and emission and generate stimulated absorption and emission.

Therefore the BLGs (Big Lazy Guys) simply check out of the Quantum Clock Mechanism. They hang out in a multi-dimensional realm of undefined awareness that we might call the Eternal Presence from which they can assume any viewpoint in space-time or any other dimension that they prefer. This is an altogether much more efficient and effortless procedure. A good mathematician has a feel for this, because he is very adept at this procedure in his mind. He hangs out in a mathematical manifold from which he can define and explore any mathematical system he likes. He is not necessarily quite so adept at this in the creation of his physical experience of reality. Physicists are hampered by the belief that there is a "Real World Out There" that is just a certain way and that they must describe with some equations and verify with some experiments. They like to use mathematics but are loath to adopt the true freedom of a mathematician toward their own field of exploration.

Another problem with Hotson’s interpretation of Dirac’s program and also with all of modern physics is what to do with the funny photons. Hotson calls photons ephos. Modern physics has photons travelling magically across empty, etherless space. In Hotson’s interpretation photons are quantum waves that propagate across the BEC ether. This is an interesting idea, but there are still questions about how Hotson’s photons can transmit across the BEC ether. If we pack the ether with negative energy electrons, then photons would seem to propagate instantaneously. Line up some marbles in a gully. Push a marble at one end, and the marble at the other end appears to move simultaneously. Actually it does not do so. The interaction is just too fast for you to measure. The impulse of your push must travel as a wave through the marble medium. The efficiency of the interaction between the atoms determines the speed of the wave.
However one might wonder why such waves would move at c for all observers.

The OP solution to this question is simply that photons do not propagate. It is all an optical illusion in the observer's mind created by his resistance to certain experiences. Once we realize that photons do not propagate, we eliminate the problem of the undetectable ether AND the problem of how photons can propagate across an apparently empty medium. (Even Hotson admits that we can not detect the ether by any physical means.) We also resolve the paradox of how photons seem to propagate at the same speed for all observers. If they are not propagating, then by definition they all propagate at the same speed. The only problem that remains is why they appear to propagate at the particular constant speed c. The answer to this question is that all observers observe by means of attention in the same medium of awareness. Photons are the reflections of attention particles. The mechanism and medium are the same no matter who observes or when or where they observe. In other words, the speed of photons is something that gets defined as one of the basic constants of the universe.

The basic physical constants are very few: h, c, G, e, and e o establish all the physical relationships between mass, energy, space, and time. Planck's constant sets the inverse ratio of energy to time (or momentum to space). Light speed sets the ratio of space to time. The Gravity Constant sets the ratio of potential energy through a distance to two interacting neutral masses. The charge constant sets the ratio of mass to time, and the permittivity constant sets the ratio of mass to space.

It is not clear how motion can occur in the Dirac field equations. They would seem to just sit there. Somebody has to give them a push to get things started. This is a problem with all field theories. I am glad to see mass coming out of Hotson's interpretation of Dirac's equation. OP has a definite theory of how to get things moving. All appearances of motion derive from the observer creating and shifting viewpoints. The observer can create the appearance of automaton systems by designing belief programs that contain attention feedback loops. He then partitions his awareness and delegates part of his attention to operate these loops. He persistently runs them as subroutines in background awareness. Habits are what we call background awareness. He can always bring a background subroutine back into the foreground of deliberate primary attention and then turn it off or modify it. This is exactly what you do on your computer when you open up the control panel and change your default settings. Usually at that time you have to temporarily shut down other programs. Depending on the domain of influence of the reset parameters, you may have to reboot the system in order for the system to function under the new default settings. Thus the observer is responsible for all appearances of motion. The physical constants described above are the core settings for the current conventional universe that we are playing in.

In his article Hotson shows how we can obtain the proton-to-electron mass ratio from theoretical considerations. OP derives quite accurately not only this ratio, but also the specific masses of the proton and the electron. Of course we can only measure these masses in terms of the universal constants that define our cosmos.
Hotson brings up a lot of the problems with the theory of cosmic redshift, but that does not mean that optical Doppler is a myth. Astronomers detect blue shifts from objects that are approaching us, such as some aberrant galaxies and, of course, the side of a galactic disk that turns toward us, not to speak of radiation from highly accelerated particles in the labs. I am quite glad to reconsider the universal Doppler idea and pursue further research to test the idea, but see a necessary physics for local Doppler. Special relativity does seem to hold with regard to particles and EM phenomena.

I like Hotson's approach to the problems of galaxy formation and galactic rotation. I suspect that his interpretation boils down to the way I treat galactic rotation curves, and adds another logical reason why the formula I use is correct and all the unobservable Dark Matter speculation is fantasy. See my paper on MOND and Dark Matter and rotation curves for the details of how to calculate galactic rotation curves.

If the universe really is a steady state system and has existed for an indefinite length of time ticking away at its universal absolute quantum time tau rate, there should be evidence of that in the form of some really OLD stuff out there. Let's find some. The BEC substrate (cosmic consciousness) must be immortal or nearly so. The essential medium of this substrate -- what I call Undefined Awareness -- exists beyond time and space, although it willingly accepts such attributes. Some of the really OLD ONES should include forms of consciousness that go right off the scale of evolution -- perhaps characters that make GOD look like a kid in a playpen. We may think of ourselves as the pinnacle of evolution on local earth, but we may be hardly even up to microbe level in comparison to the OLD ONES. Let's figure out how to get in touch. Having been around so long -- maybe forever -- the OLD ONES and TIMELESS ONES must be pretty good at attaining and enjoying a high quality of life. They may have some helpful suggestions to bring us out of our self-inflicted messes (SM). They certainly would be harmonious and friendly, since the destruction of others usually ends up leading to one's own destruction -- a pretty crude approach to survival and evolution. Scientists note that most species on this planet are extinct.

Hotson mentions the idea of three dimensional steps by which our visible world emerges (Pt. 2, p. 23. I outline a similar unfolding. For a brief summary, see the summary in my review of McCutcheon's Final Theory, available at www.dpedtech.com. The articles in the OP volume explore this theory in more detail. Hotson describes the steps a little differently than I do since he interprets gravity as an EM phenomenon, which is OK from his particular unitary viewpoint. 1D --> EM field, 2D --> angular momentum epos at speed c, 3D --> nucleons and atomic matter.

I suggest that we take a good hard look at Dirac's complete equation in the light of the current theory of 4-wave mixing phase conjugation, a paradigm that I consider one of the foundations of OP. Like Dirac's wave equation, phase conjugation also is a completely general theory of waves, a true Theory of Everything. Many people seem to think of phase conjugation as a specialized aspect of optics -- lasers, holography, and that sort of thing. I point out in OP that de Broglie's demonstration of the wave aspect of matter means that we can talk of 4-particle mixing. This is a key part of my approach to
modeling gravity. The wave equations for phase conjugation theory may turn out to be basically the same as Dirac's relativistic wave equation. They certainly do a lot of the same things. Optical phase conjugation is a well-respected field with lots of real-world observable applications. AND it is only the tip of the iceberg. The basic wave equation for phase conjugation forms a totally general mathematical model of reality. We merely need to identify what kind of data we want to put into the equation.

Hotson's theory of inertia is quite good. In his view it seems inertia is indirect evidence of invisible dimensions. There would be ways to test this. First we have to establish evidence of the so-called invisible dimensions. A dimension is anything that we can measure against a standard. We can treat these mathematically using n-ion algebra and matrices. But there is no reason why the dimension should be invisible. We can not see heat, but we can measure it with a thermometer and represent it numerically against a standard as a temperature. If a neutron is a 10-dimensional hyperspace energy bubble, then eleven points will define it.

Geometry teaches us that two points determine a line, and two intersecting lines (3 corners of a triangle) determine a plane. Four non-coplanar points determine a 3D space (tetrahedron), and so on. If this is the case, and if the neutron is built from 10 dimensions, we would expect to find that it contains 11 component particles. This would be experimentally verifiable evidence for its 10 dimensional geometry. When we project such a hyper-dimensional figure into a 2D plane, we see a center point within an inverted pentagon within an upright pentagon -- the magician's pentagram and the suit of pentacles in the Tarot deck.

2-D Projection of a 10-Dimensional Neutron

Hotson also correctly predicts that both the neutron and proton contain positrons. In OP I make the same prediction. According to my calculations the neutron consists of exactly 11 subatomic components: 2 quarks, 1 antiquark, 2 positrons, 2 electrons, 2 neutrinos and 2 antineutrinos. Since these 11 components are all in intimate interaction and function as a single particle, we must represent them mathematically as a product of the 11 factors that represent those components. Almost all of the mass is concentrated in the quarks. The charge is in the electron/positron vortexes. The neutrinos just add spin momentum. Therefore, when we multiply the factors together, the product of the three quarks gives us a value very close to the rest mass of the neutron. Two quarks have positive energy, and one quark has negative energy -- i.e. is an anti-quark. The product of the masses of the electron/positron factors comes to unity. The pair of electrons have positive energy and opposite spins forming a Cooper pair. The pair of positrons have negative energy and opposite spins, forming a Cooper anti-pair. The charges (spins) all balance out, as do the neutrino and anti-neutrino spin momenta.
A proton is a neutron in which one electron and one antineutrino have shifted out to larger orbits in order to satisfy the Heisenberg requirements for a single stable nucleon. It thus has 9 central components plus two peripheral components. The loose antineutrino wave packet spreads out far to allow the remaining components to keep their compact standing wave bubble stable. Projected into three dimensions this particle with 9 components looks like a center point inside an inverted tetrahedron inside an upright tetrahedron or a center point inside a cube. If we squash this 3-D projection further down into two dimensions, it looks schematically like an octahedron with a center point.

3-D and 2-D Projections of a Hyper-Dimensional Proton

We have to remember that the proton projection has an electron and an antineutrino forming outer energy shells. I did not draw them in the above sketches.

* \( B_u^2 = H c a / G. \) 
* \( B_u^2 = e^2 A_o / A_s P e o G. \)

\( A_o = \text{area of circle with radius } R_u = 1 \text{ m.; } A_s = \text{area of sphere with radius } = 1 \text{ m.; } e_o = \text{permittivity constant.} \) Here we simply substitute Bohr’s derivation of the fine structure constant: \( (a) = e^2 / 4 P e o H c. \) However we can derive each result separately from different lines of reasoning. The first case argues from exploring the theoretical microscopic limit to the physics of black holes, and the second derivation argues from the ratio of the electric force (Coulomb’s Law) to the gravitational force (Newton’s Law).

The experimental verification of the mass in the latter case was actually discovered long ago by Robert Millikan in his famous oil-drop experiment when he found out that charge occurs in discrete quanta. The inertial mass of an oil drop with a single electron charge on it that will exactly levitate in his magnetic field indirectly gives us the mass of the hidden Higgs particle. Millikan realized the significance of the charge quantum but missed the importance of the mass of the oil drop that carried that charge. That mass marks the cross-over point between the electric and gravitational forces. (See OP, ch. 9-10.)

* \( B_u = (4 P e o) (S_s) (A_s / A_o) = 1.86 \times 10^{-9} \text{ kg}. \)

Here \( S_s = \text{the volume of a sphere of radius 1 m., and } P \) is pi. The expression \( (4 P e o) \) is of course the constant that shows up in Coulomb’s Law. \( S_s, A_s, \) and \( A_o \) are all...
fundamental constants of the geometry of circles and spheres. The ratio As/Ao is independent of radius, but Ss takes the magic radius $Ru = 1$ m. that we find in the formula for the proton. The expression $P Ru = 2 P (.5 Ru)$, the wavelength of a specific photon helix, one circular loop around if it stays in place.

* $Mp = (e/c)(P Ru) = Bu^2 Bd$. (*Mp is the rest mass of the proton.*)
* $Bu = 1.86x10^{-9}$ kg. (*This is an up quark.*)
* $Bd = 2.07x10^{-9}$ kg^-1. (*Approximation. This is an anti-down quark.*)

The $Bu$ and $Bd$ quarks are bosons. The $Bd$ has negative energy. All the components are nodes in the hyper-dimensional nucleon. Shortly we will give a more refined estimate of the negative energy of the anti-down quark.

The characteristic period ($Te$) for the electron is:

* $Te = Me / e = 5.686x10^{-12}$ s.
* $Fu = c / P Ru = 9.55x10^7$ s^-1.
* $Tu = P Ru / c = 1.0472x10^x^{-8}$ s.

Fu is the characteristic quantum spin frequency of the electron neutrino with a radius of half a meter, or half a wavelength.

My independent derivation of the mass of the electron neutrino ($Mne$) is as follows:

* $Mne = H / c \%$. (*$\% = 3.16227766 m. = [10 m^2]^{.5}$.)

The value $\%$ is a universal constant of distance that relates to the physical constants h-bar and c and stabilizes the fractal generation of space/time geometry. We get the characteristic period for this theoretical particle as follows:

* $Mne c^2 / H = c / \% = 1.054x10^{-8}$ s.

As you can see this period differs from the inter-nucleonic neutrino period that we just derived in a totally different way by only a very small margin.

* $\% / P Ru = 1.006585$.

This ratio apparently plays an important role in physics that needs to be explored experimentally. If we take the measured rest mass of the neutron as our standard, we have:

* $Mn = 1.674954x10^{-27}$ kg.
* $(P Ru) (e / c) = 1.6789687x10^{-27}$ kg.

The discrepancy from our theoretically predicted mass is a ratio of about 1/1.0023969. If we divide 1 m. by this number we get .9976 m. If we substitute this refined value for
Ru into our ratio, we get:

* \( \% / P \text{Ru} = 1.0090067. \)

The fourth root of this refined ratio comes to 1.002244, extremely close to giving us the missing discrepancy. This suggests there is a fractal relationship here involving powers of the \( (\% / P \text{Ru}) \) ratio. The separately derived theoretical period of the neutrino: \( T_{\text{ne}} = 1.054 \times 10^{-8} \) s already suggests a fractal relationship, since \( h \text{-bar} (H) = 1.054 \times 10^{-34} \) kg m^2/s. The constants H, c, and \( \% \) form a trinity that echoes throughout creation in many scales and dimensions.

* \( (T_{\text{ne}})(H) = 1.11 \times 10^{-42} \) kg m^2.
* \( \text{M}_{\text{ne}} = H / c \% = (H T_{\text{ne}}) / \%^2. \)

So here are our complete formulas for the proton and the neutron.

* \( \text{M}_{\text{p}} = (e e^{-1} e^{-1})(F_u F_u F_u^{-1})(B_u B_u B_d) (e) (F_u^{-1}). \)
* \( \text{M}_{\text{p}} = [(e e)(F_u F_u F_u)(B_u B_u B_d)] (e) (F_u). \)

In the second expression we simplify the notation by underscoring the antiparticles. Mathematically we show the interaction of positive energy particles by multiplication and negative energy particles by division. Thus a particle/antiparticle pair reduces to a factor of unity and has no effect on the mass-energy of an interaction. The above formula gives us 9 components: 1 electron, 2 positrons, two neutrinos, an antineutrino, two up quarks, and an anti-down quark. We represent the electron/positrons as charges and the neutrinos as photon vibration frequencies.

Theoretically there could be any number of virtual electron/positron pairs in a proton. Why do we end up with 9 components? The quark bubble determines this. It starts as an overlapping pair of mini black holes that stabilize into a dynamic feedback loop. The overlap between the two quarks forms an anti-quark negative energy region. This gives us three quarks. The vortexes through which the energy flows form electrons and positrons. We must have one for each quark. But the vortexes must also loop around, so they must form pairs. This requires an extra electron to hang around somewhere. Each quark will have an antielectron, and each antiquark will have an electron. Each electron will have an antineutrino, and each antielectron will have a neutrino. It perfectly weaves together a balance between quarks, electrons, and neutrinos.

The proton and the neutron are the same particle seen from different perspectives. We simply rearrange the factors to show this. The small increase in the neutron's mass over that of the proton comes when we include the extra electron mass and the helicity of the antineutrino into our laboratory calculations. The calculation of the proton rest mass ignores these. The tiny discrepancy between our predictions and the measured values can be easily handled in an adjustment of the anti-down quark’s mass, which we have no way to directly measure. We therefore work backwards from the measured neutron mass through the measured Millikan mass (the cross-over oil drop mass) to find the Bd
mass. We will use the following constant values:

* $H = 1.0545887 \times 10^{-34} \text{ kg m}^2/\text{s}$.
* $c = 2.99792458 \times 10^8 \text{ m/s}$.
* $G = 6.672 \times 10^{-11} \text{ m}^3/\text{s}^2 \text{ kg}$.
* $a = e^2 / 4 \, P \, e \, H \, c = 0.072973564 = 1/137.035927$
* $Bu^2 = 3.4579 \times 10^{-18} \text{ kg}^2$.
* $Bu = 1.859543 \times 10^{-9} \text{ kg}$.
* $Mn = 1.674954 \times 10^{-27} \text{ kg}$.
* $Bd = Mn / Bu^2 = 4.84385 \times 10^{-9} \text{ kg}^{-1}$.
* $Mn = [(e \, e \, e) (Fu \, Fu \, Fu)(Bu \, Bu \, Bd)]$.
* $Mp = [(e \, e \, e) (Fu \, Fu)(Bu \, Bu \, Bd)] (e \, (Fu))$.
* $Mn --> Mp + e + Mne$.

We find that the anti-down quark has a negative mass about 2.6 times heavier than the up quark. The exact value depends on our calculations of the other values since we can not extract this virtual bubble from the nucleon. However researchers have detected it as a bump vibrating around inside the nucleon. The leptons are too small in comparison to the quarks for our apparatus to detect them inside the nucleon. We can only detect them when they move outside the average nucleonic radius. The final expression shown above is the usual formula showing the equivalence of the proton and the neutron. The arrow shows that the reaction tends to move in the direction of beta decay -- i.e., the neutron emits an electron and an antineutrino and decays into a proton.

One thing that does not seem predicted by this formula is the left-handed helicity of the neutrino. Actually, what the formula shows is that the neutrino is not really a particle, just a particular photon resonance. The photon is its own anti-particle. The $Fu$ and $Fu$ will have opposite helicities. It just so happens that $Fu$ has the left-handed orientation, so $Fu$ has the right-handed orientation. As I discuss elsewhere in my analysis of the neutrino, this is an arbitrary result of spontaneous symmetry breaking that occurs when the primordial observer created primordial consciousness at the founding of this universe. It is a telltale trace of that cosmic event.

In OP I use Dirac’s energy sea and several other concepts and calculations to show how the neutron-proton bubble can maintain a dynamic equilibrium indefinitely. This equilibrium is inherently structured in the constant ratios under which our current universe functions ($h$-bar, $c$, $G$, $e$, $eo$) and the inherent structure of Euclidean geometry ($\pi$ and some other spatial relations.) The structure of these ratios is quasifractal and sets up a feedback loop that shields the positrons from the electrons by bulking them up to proton size. The stable positron bubble is armored with quarks. The up quarks are really a pair of heavy Higgsish background shadow particles that can be verified both theoretically and experimentally in a number of ways, the simplest being the Millikan oil-drop experiment. In the tradition of Dirac my equations also require negative energy to keep the system stable. Hawking’s formula for black hole radiation is an important key for understanding the internal thermodynamics of the proton system. I discuss this elsewhere in the OP articles.
The proton and the electron and the neutrinos are the only stable particles. All other particles decay. Anything other than a neutron decays extremely fast. That is because such so-called particles are really dissonant states of the nucleon quantum bubble. Any extra energy gets thrown off as radiation or leptons. The only way to build stable structures is in the same way that electron orbits build. They must be integral quanta of the original bubble. In other words, they must be integral multiples of the fundamental nucleon.

The Helium atom forms a stable tetrahedron bubble with the two protons and two neutrons rapidly changing positions. They are really just rapid vibrations of the original nucleon bubble. The quantum harmonic resonance states only allow integral nucleon numbers, but the density adjusts the number of protons versus neutrons. The electron shells recapitulate the configuration of protons in the nucleus. Once we fully understand this structure, we will be able to transmute elements at will simply by adjusting the harmonic resonance states. The emerging field of controlled low temperature transmutation suggests that physicists are discovering this principle. Indications are that this will lead to unprecedented progress in the development of advanced materials and new energy resources. Many of these processes will result in the sloughing off of excess energy as the resonance states shift. This occurs because various resonant states become slightly off from integral values at different nuclear densities. There is a nonlinear fractal aspect that comes into play.

In my paper on Dirac-current positron generation I describe a theory of stimulated positron emission. Mastery of this procedure may lead to controlled proton decay, although probably it will temporarily transmute virtual positrons into real ones much as we do currently with the common procedure of pair production. The model I describe is analogous to Einstein's (1916) wild but elegant and simple theory of stimulated photon emission, an idea that eventually led to the discovery of lasers and optical phase conjugation -- technologies that are now transforming our daily lives. Einstein’s notion was that materials pumped by EM radiation form a dynamic equilibrium that generates a coherent quantum field. Whereas excited electrons tend to spontaneously decay back to their least excited orbits, protons do not spontaneously decay. However neutrons do. So although stimulated positron emission from protons may be a bit tricky, we definitely can (and commonly do) get positrons from the vacuum, and it should be quite easy to get all kinds of transmutation effects by stimulated neutron decay (stimulated beta decay.) The currently proliferating research on low temperature controlled transmutation (aka "cold fusion") is a good example of this approach. Certain electrolytic solutions pumped with an electric current may stimulate all sorts of interesting atomic transmutations via the simple process of neutron beta decay and subsequent rearrangement of nucleons. Electron-positron pair production is basically a kind of
reverse bremsstrahlung. Both processes utilize the interaction of EM radiation with nucleons.

The above Pair Production Feynman diagram is not complete. We need to show what happens to the positron. The highest probability is that it will soon encounter an electron. This will lead to pair annihilation. Therefore the overall picture is that an electron has zigzagged sharply in space/time, reversing briefly to travel backward relative to our sense of time.

We can view this process as an electron so excited that it is in a "free" orbit relative to the nucleus it interacts with. During the interaction it cascades down to "free" orbits with lower and lower momenta relative to the nucleus. In both pair production and bremsstrahlung the electron also exchanges a photon with the nucleus. This is proof that bremsstrahlung must occur in the lower electron orbits. We can not see the photons that exchange with the nucleons in all three cases (pair production, bremsstrahlung, and stable electron orbits.) We can only detect as indirect evidence a slight disturbance of the nucleus and the electron the photon energy (linear momentum) exchanges between them. This phenomenon generates the quantum vibratory pattern of the electron shells and a portion of the nuclear vibration, both of which we can observe indirectly through various detection processes.

Dirac's equation in its complete form predicts four kinds of electron. We have a positive energy electron with negative charge and spin up or spin down. We also have a negative energy electron (positron) with positive charge and spin up or spin down. The
up and down spins like to form Cooper pairs. The model I have arrived at fits this very
nicely. I use what I call 4-particle fermion mixing. This is based on 4-wave boson
mixing, but looks a little different because of the different properties of bosons and
fermions. A simple example of 4-wave mixing is a laser. Here is a general schematic.

![Diagram of 4-wave mixing](image)

The key point to notice here is that both the pump and probe beams are bi-directional.
They consist of phase conjugate waves that are coherent -- that is, strongly quasi-
monochromatic. The beams consist of photon-antiphoton pairs that all match up and
form standing wave patterns. The result is a time independent quantum bubble that
transcends "ordinary" incoherent space/time. Photons are bosons, so the beams ride
right on top of each other with no problem at all. They like that.

Now let us look at 4-particle mixing with electrons. The electrons are "point" particles.
They represent vortex centers, the foci of an energy system that forms a dynamic
equilibrium. We can think of our model as a tiny binary star system. The stars that you
see pulsating and shining as they orbit each other are not the actual core of the system.
The inner working of a binary star system consists of four invisible dynamos. Here is a
very schematic drawing of such a system with our electron vortexes drawn in. This is a
neutron. We label the electron with spin up (e - +), and the one with spin down (e - -).
The positrons work the same way.

![Diagram of electron vortexes](image)

The whole diagram resembles a fractal tai-ji diagram. In this diagram you see the four
electron types forming the foci for the orbits of a pair of up quarks. The figures are not
at all to scale, and I have greatly exaggerated the elliptical shapes so you can see the
relative component positions. The whole thing is much more compact and spherical.
The tiny circles are neutrinos, the dark ones being positive energy whorls and the light
ones being negative energy whorls. The positions of the up quarks actually are not so
well defined. They smear around in the orbits forming a standing wave. Imagine the
Tai-ji diagram.
The whole system is a resonant standing wave of electro-gravity. The two quark orbits overlap to form a positive charge anti-down quark. An anti-down quark is the same as an anti-up quark plus two positrons (one spin up and one spin down) and a negative energy electron that orbits outside the down quark nucleon nucleus and neutralizes one of the positive charges. A second electron neutralizes the second positive charge. In a neutron the second electron stays at or near its proper focus. In a proton the Heisenberg relation pushes the second electron out of the nuclear radius. The proton by itself lacks enough density to hold the electron in place.

The down quark is made almost entirely from negative energy except for the two poles of positive energy formed by the neutrinos. Its center of mass is right in the middle between the two positrons, but I have drawn it spread out to include the whole lenticular overlap region. The positive energy up quarks each have a negatively charged electron as a focus. The negative energy anti-neutrinos represent the helical whorls as the nuclear bremsstrahlung whorls in a helical path into a positron vortex.

The positive and negative energies are balanced. When the neutron beta decays, one electron moves out of the nuclear radius. It can be either one, and the electrons actually swap. The shapes of the p-orbitals show that the orbiting electrons routinely cycle in and out of the nucleus and undoubtedly alternate with the inter-nuclear electrons. The Heisenberg effect explains the difference between the up quark with an electron focus in place and the up quark whose electron has a distended focus. The only differences among all these particles is the relative positions they hold in the dynamic photon energy loop that forms the illusion of matter. How we classify them as up or down quarks is quite arbitrary as long as we see the eleven points of space/time energy that cooperate to form a 10-dimensional nucleon.

Each electron type has a neutrino sidekick of the opposite energy type. The up quarks are like giant neutrinos. They have no charge and are just loose whorls of energy like the electron neutrinos. Negative energy neutrinos are anti-neutrinos. Here is one way of grouping the components that gives us the quarks for a neutron.

\[
\begin{align*}
* & \quad u \\
* & \quad d^- = u, e^- +, u_e_- \\
* & \quad d^+ = u, u_+, e^+ -, u_e, u_e, u_e_-
\end{align*}
\]

A proton contains two up quarks and a d+ quark. The product of the masses of the three quarks equals the mass of the neutron. We use the product rather than the sum because quarks are bound inextricably into their interactions. If we could treat them as independent particles, then we could have instances where we sum their masses.

\[
* \quad H / Mn \ c = 2.1 \times 10^{-16} \ m.
\]
This is approximately the radius of a nucleon. Since Mn is the resultant mass of the neutron, the action of its eleven components must on average occur within that radius. We can think of the neutron as a bubble of energy potential that is vibrating harmonically so that it has eleven vibration nodes.

The most important component of the nucleon is the electron quartet. So to understand the internal dynamics of the nucleon we must study the dynamics of the electron quartet. We know that the electron spins, and its spin involves a curious rotation of 720 degrees rather than what we think of as the normal 360 degrees. This rotation is a key part of electron 4-particle mixing. There are four rotations of 180 degrees each. So we can think of the electron quartet as a single electron spinning through four seasons faster than light so that it seems to our slowed-down senses to be four different particles. To get an idea of how the electron needs 720 degrees to complete one round, fill a cup with water and hold it in your right palm about a foot from your torso. Now, without spilling any water, rotate the cup 180 degrees clockwise. Your fingers now point toward your body. Now it gets a bit tricky. Rotate another 180 degrees clockwise by lifting your elbow up above your palm. Now you have completed a 360-degree clockwise turn. But your elbow started out pointing down, and is now pointing up in the air. Do another 180-degree clockwise turn, keeping your elbow up in the air. Finally make another 180-degree clockwise turn while dropping your elbow back to the downward pointing position. You can spin like an electron. The electron does the same thing. The only difference is that it flips from electron to positron during two half turns. We do the same thing by flipping our elbow from down to up position. In our analogy the finger direction represents spin orientation, and the elbow direction represents energy type (and charge type). During the rotation we can continuously turn the glass of water without spilling any water. We simply move through four separate modalities of posture instead of two. Practice this beer hall waiter routine until you have it down and you will get a feel for electron spin. It is a real physical procedure, not just a mathematical trick.

Go back and redo the exercise once more. Slow down and watch carefully what happens. When you complete the first half rotation, your fingers face inward, but the elbow is still in the down position. Then, when you rotate another 45 degrees, the elbow rotates 90 degrees. Add another 45 degrees to the palm, and the elbow shifts another 90 degrees. As the palm turns 90 degrees, the elbow rotates 180 degrees. Now continue with another 90 degrees. The fingers again face inward, but the elbow is still in up position. Add another 45 degrees to the palm, and the elbow shifts down 90 degrees. Then add another 45 degrees to the palm, and the elbow shifts back into fully down position. This is a remarkable mechanical feat.

We can further understand the electron’s internal dynamics by watching its external behavior, its body language. The electron has electric charge. If we propel an electron through a vacuum that is subject to a magnetic field, the electron will curve about in a circular trajectory normal to the magnetic field lines. This is the cyclotron ratio. Every charged particle obeys this ratio that results in a constant frequency of circulation for each charged particle of a specific mass.
\* \* \* \( f = \frac{V}{2PR} = \frac{e}{2PM_e} \).  

Here \( P \) is pi, \( R \) is the radius of the cycle, \( V \) is the velocity, \( e \) is the electron charge quantum, \( B \) is the strength of the magnetic field, and \( M_e \) is the rest mass of the electron. We must adjust the above version for relativistic effects if the electron moves close to the speed of light. We can do that by just sticking in the special relativity factor.

The cyclotron ratio has a certain weirdness that threatens to tell us something important about the structure of the electron (or the proton). Physicists love this ratio, because it allows them to control beams of particles in accelerators. The mass spectrometer is another useful application of the cyclotron. Any charged particle in a constant magnetic field in a vacuum will move in a flat circular orbit without any nucleus, and its frequency of cycling will be constant so long as the magnetic field is constant. Velocity is a ratio of space to time, and the cyclotron ratio is a relationship of velocity to space (or space to velocity). This means that it de-ratios the velocity ratio and separates space from time. In other words it gives us a nice quantum clock. This clock is a symptom of the internal structure of the electron. Electron spin itself is a constant -- the internal clock of the electron.

If we start with an electron nearly at rest and steadily increment the magnetic field as physicists do in a simple double-D cyclotron accelerator, the electron will move in an Archimedean spiral \([R = a(A)]\). \( R \) is the radius, \( (a) \) is a constant increment and \( (A) \) is the angle of rotation in radians. However, if the fast-moving electron enters a space with a constant magnetic field and filled with a gas such as water vapor in a cloud chamber, it will interact with the molecules and gradually lose its momentum. As the velocity drops, the radius also shrinks in the constant magnetic field according to the cyclotron ratio. Thus the electron takes on a corkscrew trajectory. The velocity and radius will continue to shrink until the electron regains equilibrium in a roughly circular orbit that is so small that it seems at rest amid the spaces separating the molecules. However, the molecules are moving about randomly, so they will perturb the electron and cause it to jiggle about restlessly once the corkscrew motion erases the electron's forward momentum.

The tightness of the corkscrew depends on the strength of the magnetic field, and the density of the gas, and the strengths of the electric fields that disturb the cyclotron ratio.

This corkscrew behavior is a major clue to the internal structure of the electron. As the electron starts to spiral, the distribution of the electric field influences in the gas is statistically the same in all directions. Whichever way the electron turns it will have close encounters with electric fields generated by molecules. The electron thus finds itself in a roughly constant magnetic field and a roughly constant electric field. If we assume that an electron is made from a set of identical photons, that means that the electron's internal environment must consist of constant electric and magnetic fields. As with the electron in the gas, the only thing that changes is the density. The cyclotron relation remains constant.
Photons translate in space/time according to the velocity equation. When they are in open space, they move at light speed (c), forming photon-antiphoton pairs. When photons move through a wave guide, the pairs split apart, and one member slows down while the other member speeds up. The product of the two members always comes to c^2. This is the real significance of Einstein’s famous mass-energy conversion equation, \( E = M \frac{c^2}{2} \) or \( E / M = c^2 \). What we call mass is really the inverse of the group velocity. What we call energy is the phase velocity. \( E = \frac{(M V^2)}{2} \). The masses cancel out. \( \frac{(M V^2)}{2 M} = c^2 \). \( V^2 / 2 = c^2 \). The \( V^2 \) actually contains two different \( V \)'s. One \( V \) is for the speed of the particle, \( V_g < c \). The other \( V \) is for the speed of the particle’s phase wave. Since the \( \beta \) is a constant, we can readjust the value of the phase velocity to include that constant, and just call it \( V_p \). Since \( V_g \) is less than \( c \), \( V_p \) must be greater than \( c \). There are many other ways to derive this relation, but it is inherent in the principle of relativity. Here we simply show that the notion of mass is a meaningless token that physicists substitute for the observable, \( V_g \). The phase velocity propagates along a line of sight normal to the photon velocity, because the wave front generates it, and the wave front by definition is normal to the photon trajectory.

One of the simplest ways to see this is to observe the behavior of radio waves in a rectangular klystron wave guide tube. The photons zigzag back and forth from side to side, reflecting down the tube from the source at one end. The zigzag path means that the actual forward progress of a photon down the tube is less than \( c \). The photon’s wave front sweeps along the klystron wall at the phase velocity. The geometry of this relationship ensures that the phase velocity in the wave guide always goes faster than light. At the cutoff point the photons simply bounce back and forth across the tube without moving down the tube. In that case the phase velocity runs parallel to the tube and thus becomes infinite. All the velocities involved in a wave guide are resultant interference patterns generated by scattering of photon wave bubbles throughout the tube. Hence they are all really group waves.

According to this analysis we expect the internal structure of the electron to be a disc-shaped wave guide. Recall that the cyclotron effect generates a flat circular orbit for the electron to move in. The center of this orbit is an imaginary axis that is normal to the cyclotron orbit and parallel to the magnetic field vector \( \mathbf{B} \). This tells us the fundamental structure of the electron. We do not need to build huge accelerators to see into the interiors of subatomic particles. We only need to observe closely their orderly behavior under simple, well-defined conditions.

So now we know that the electron has a disc shape with an imaginary axis spindle through its center that generates the appearance of its magnetic poles. The corkscrew motion of the electron in the electric field tells us about the detailed structure of the disc. Electrons emit and absorb photons, so perhaps they are built entirely from photons. Perhaps they are simply a flow of photons. From an electron’s viewpoint, it emits photons and absorbs antiphotons. Antiphotons are simply photons moving backward in space/time.
The cyclotron orbit and the corkscrew path are wave guide effects. Lacking such influences a free electron in open space just keeps moving forward under its given momentum. We can imagine that the electron’s cyclotron orbit is a klystron bent into a circle (actually a spiral). The cyclotron orbit is analogous to a black hole. The electron cannot escape. The corkscrew path and the electron’s disc then represent a klystron tube bent into a spiral shape, sucking the electron (or the photon) in toward a singularity just like a black hole. In fact the electron is a mini white hole because it habitually spits out photons. It is a time-reversed black hole.

We know that photons emitted by an electron leave the de Broglie radius and move into open space at velocity c.

* \( R_{eb} = \frac{H}{Me c} = 3.86 \times 10^{-13} \text{ m.} \)

Redb is the electron’s deBroglie radius, defined as Planck’s constant (h-bar) divided by the light-speed momentum of the electron. This radius is larger than a proton radius, so it must be the minimum radius for an electron. It is also then the minimum radius for the ground state electron orbit around a proton (hydrogen atom.) It turns out that other factors are involved because of the interaction of the electron with the proton, so as Bohr showed, the minimum hydrogen ground state radius is around two orders of magnitude larger.

* \( R_1 = \frac{h^2 eo}{P Me e^2} = 5.29 \times 10^{-11} \text{ m.} \)

In order for the ground state electron of hydrogen to emit a photon in the outward direction, it must first absorb an antiphoton and move up to an excited orbit. However, the electron continuously emits photons that enter the proton as bremsstrahlung. Since the electron is not constantly absorbing antiphotons from outside its orbit, in order not to lose momentum and spiral into the proton, the electron must also continuously absorb antiphotons transmitted to it by the proton. The two flows must balance or else the electron will leave its orbit and quickly fall into the nucleus. But Heisenberg uncertainty usually will not allow this, so there must be a constant energy loop between the electron and the nucleus.

Our theory is that we have a wave guide effect that splits the photon-antiphoton pairs into separate components. The orthogonal relation between the photon trajectory and the wave front -- the electric field and the magnetic field -- controls the relation between the photon and antiphoton in the wave guide. We want to find a relationship that allows a photon to move through the spiral wave guide of the electron in such a way that the relationship of the Velocity Equation remains steady.

The simplest way to do this is by means of a phi spiral. The phi relationship allows us to keep a constant ratio as the photon spirals out of the electron vortex. We must also take into account a refraction effect as the photon moves through decreasing self-imposed densities as it progresses outward from the center of the electron.
* \( c = f \, \text{Lo} \) \quad (f \text{ is photon frequency and Lo is its wavelength in open space.)}
* \( \text{Ve} = f \, \text{Le} \) \quad (\text{Ve} \text{ is the photon velocity inside the electron.})
  \quad (\text{Le is the wavelength.})

Notice that the frequency remains constant as required by the cyclotron relationship.

* \( n = \text{Lo} / \text{Le} \). \quad (\text{This is the ratio of the two wavelengths.})
* \( n \, (\text{Ve}) = c. \) \quad (\text{The refraction formula, n being the index of refraction.})

We can see from this that the refraction formula is the same as the cyclotron formula. In both cases the frequency remains constant while the wave length and velocity change.

* \( f = \text{Ve} / \text{Le} = \text{Ve} / 2 \, \text{P} \, \text{R}. \) \quad (\text{refracted photons})
* \( f = \text{Ve} / 2 \, \text{P} \, \text{R}. \) \quad (\text{electrons in cyclotron})

For the free electron one wavelength is one circuit in the cyclotron. So we frame our spiral in terms of phi, the Golden Ratio: \( a / c = c / b; \ ab = c^2 \). The Velocity Equation IS the Golden Ratio expressed in terms of velocity. Since Nature loves to build things according to this ratio (actually using the Fibonacci sequence as its "real world" quasi-fractal approximation,) we would be quite surprised if the most elementary of elementary particles were not built from pure light unfolding in the Fibonacci/phi ratio. Here is a formula for the construction of an electron.

* \( \text{Rfe} = \phi^{(A / 2 \, \text{P})} \, \text{Rpl}. \)

Here Rfe is the radial distance of a photon as it unwinds in the electron’s disc. Rpl is the Planck radius (approximately \( 10^{-35} \) m.) Phi is the constant, 1.618.... P is pi, and A is the angle of the photon’s rotation in the disc expressed in radians. Every loop around of 2 P radians we get the following relationship between the new radius (Rn) and the radius from one loop before (Rm):

* \( \text{Rn} / \text{Rm} = \phi^{(2 \, \text{P} / 2 \, \text{P})} = 1.618... \)
* \( \text{Rfpl} = \phi^{(0/P)} \, \text{Rpl} = 1 \, \text{Rpl}. \)

This is the status of the photon when it emerges from the Planck-scale core at the center of the electron’s axis. Antiphotons flow in along the axis, moving backward in time. Then they do a 90-degree turn at the center of the vortex and shift into forward time photons spiralling outward on the disc. Due to the cyclotron relation, the relative velocity of photons near the electron axis is extremely slow, around \( 10^{\text{-15}} \) m / s. As the radius of the spiral grows, the photon velocity increases. By the time the photon reaches the de Broglie radius of the electron disc, the photon is moving at its open space velocity of c.

The positron is a temporal reflection of an electron. Almost all positrons sit inside nucleons. Neutrons have a balance of positive and negative charge, so they have no electrons in orbit around them. The electron in orbit around a proton is a projection
from the positron that is inside the proton. The two particles constantly exchange energy in a loop until such time as the electron can annihilate with its positron partner. Photons absorbed by a positron flow into the outer edge of the positron disc as electric energy and then spiral inward in slower and slower cycles that maintain the constant frequency as the radius decreases. When the photons reach the positron axis, they shift 90 degrees and move out the axis as antiphoton magnetic energy. The axis forms another klystron tube. As such it also marks the Zero Point axis.

Think of an electron as a lawn sprinkler. Water flows down the hose into the central axis of the sprinkler. It flows up the central axis and then shifts 90 degrees and flows into the rotating sprinkler arms. It then spirals out the arms and sprays outward in curving arcs. The linear momentum of the spray drives the circular "spin" of the sprinkler head. The hose is the time connection between the water source and the sprinkler head. The positron is a drain in a reservoir. It provides water pressure. The water on the lawn evaporates and then falls as rain into the positron reservoir. It then spirals down the drain at the center of the reservoir tank, shifting from spread out horizontally in the tank to flowing downward vertically.

The electron and positron are two strokes of a single process. Their apparent separation in space and time is an illusion generated by observer-defined viewpoint. The electron is an amazing fractal clock that tracks the evolution of the universe from its inception near the Planck scale to the present moment with particles spread out interacting in space.

There is another key issue we must deal with. If the photons move at $c$ when they range around the de Broglie radius, then we must consider the problem of what happens when the electron as a whole moves in space. This creates a Lorentz invariance issue. It appears as if the photons could be moving faster than light.

We know that this is not the case. We must make a relativistic adjustment. The Velocity Equation tells us how to do this. Recall Einstein' s light clock. It is a nice picture of what happens in the electron, which we have just described as a light clock. Instead of reflecting back and forth between plane mirrors, the photons swirl around in a cyclotron spiral. But the result is still a light clock. When the Einstein clock moves along at a velocity $V_g < c$, we know that it is the group velocity for the system. The distance the clock moves in a unit of time is $V_g \Delta t$. The distance that the clock’s photon moves in the same time interval is $c \Delta t$. If we imagine the clock as a long rectangular tube mirror -- a light klystron, then we note that the wave front of the photon moves along the mirror at the phase velocity $V_p > c$. The ratio is the golden ratio: $V_g / c = c / V_p$. The time intervals all cancel out and are not relevant.

So what happens when the electron vortex begins to move in space is that this motion becomes a group velocity. When the light clock is at rest, the group velocity is zero and the phase velocity is infinite. By the way, this tells us that nothing can be at absolute rest and remain manifest in the universe. At absolute rest we have the velocity relation between nothing and infinity, which is meaningless as an experience, although it may well be a reality from the level of undefined awareness and our light clock can function
very well in that condition. When the observer is at rest relative to the clock, he experiences the clock just as it is, with no distortions. As soon as the clock moves (or the observer moves relative to the clock), distortion begins to occur.

Relative to itself a photon never moves. Relative to any object it moves at $c$. However, the photon’s group and wave velocities do not do this. The group velocity moves slower than $c$, and the phase velocity moves faster. The "$c" relative to an object in a rest frame and the "$c" relative to an object in a moving frame are different. Obviously the diagonal trajectory in the light tube takes longer than the pathway that is normal to the mirror wall. We can either say that there is time dilation or that the photon slows down. Einstein liked to say that time dilates. But if we have a cyclotron, and the cyclotron starts to move relative to the observers, then that means the cyclotron frequency slows even though all else stays the same. In super high-speed accelerators this becomes an issue. Adjustments must be made for the distortions of time and mass in order to get the right momentum for the particles.

This tells us exactly what happens when an electron starts to move relative to an observer. The photon cyclotron gets distorted. The photons in the spirals appear to slow even more than usual. Or we can say that the electron’s cyclotron frequency slows down. This is like saying that the photon velocity in the vortex slows. The radius is linked to the velocity. So the electron shrinks. If we could accelerate an electron up to the speed of light, its radius would shrink to zero and the electron would identify with its central axis. It would then shift 90 degrees and move into the positron world. Change in the velocity of an electron produces the equivalent of redshift inside the electron vortex. So there is no problem with relativity. Nor do we need to invoke any hidden dimensions that we take on faith from the mathematics. Theoretically we can test this model by building a cyclotron and moving it at high speed.

The photon in the light clock at rest is like the photon in the electron spiraling about the axis. When the electron moves in a vacuum with no magnetic field, we can not see anything unless it interacts with something. If it moves under electric influence, we can detect it. At high speeds we will see what appears to be the relativistic distortion of the electron. But the actual situation is that as the group velocity approaches $c$ from zero, the phase velocity approaches $c$ from infinity.

At the electron’s edge you are at $c$, move inward and slowing until you stop at the center. Shift 90 degrees and move at infinite velocity. Gradually move out of the positron, reducing that infinite speed down to $c$ at the edge. "Infinite speed" really just means a 90-degree shift. Recall that in the klystron tube the group velocity reaches zero when it bounces back and forth across the tube. When the group velocity goes straight down the tube, it goes at $c$. When the phase velocity is normal to the tube walls, it moves at $c$. When the phase velocity points straight down the tube it moves at infinite speed. The electron axis is oriented 90 degrees from the photon vortex orbit. When the photon jumps from positron to electron along the hyperspace Zero Point axis, it jumps instantly at infinite speed.
We do not need to build huge particle accelerators in order to probe the early universe and the structure of subatomic particles. We simply use quantum microscopy. The structure of the universe is quasi-fractal. We can trace backwards from careful observation of the macroscopic behavior of particles to discover their internal structures and origins.

The electron is a space/time klystron tube that transports photons from the Big Flash to our present moment. The proton’s positron core takes them back to the Flash. The cyclotron provides a macroscopic model of the relation between the electric and the magnetic components of radiation. The electron moves in a circle. This is electric current, the essential electric field. The magnet provides the axis of rotation. So electrons in the cyclotron will line up their axes with the magnetic field and roll around the orbit at a constant "spin" defined by the ratio of the particle’s mass to its charge.

\[ e B = 2 P Me f. \]

This is the relation of the electric charge quantum to a magnetic field. The Bohr magneton is \( m = (e H / 2 Me) = 9.27 \times 10^{-24} \text{ A m}^2. \) (A is for amps. We can also think of A m^2 as Joules.) If we combine these two equations, we discover that Planck’s constant can be seen macroscopically as the ratio of the Bohr magneton \( m \) times a particular magnetic field to pi times the cyclotron frequency \( (fc) \) for an electron in that particular field.

\[ H = m B / P fc. \]

A frequency is nothing more than a number of periods a system cycles through per second. At the center axis the photons theoretically achieve zero radius and zero velocity. Time stops at this point like it does at the high swing of a pendulum. But then it reverses direction. The sweep of the clock pendulum runs at a constant tick.

\[ \tau = (2 e^2) / (4 P eo) (3 Me c^3) = 6.26 \times 10^{-24} \text{ s}. \]

This is the time gap between each photon pulse. It also generates the apparent spin of the electron. Since the whole system is a photon circuit, we detect four phases. The electronic unwinding phase, the spatial electric photon transmission phase, the antiphoton magnetic windup phase, and the magnetic temporal transmission phase. The spatial transmission is the emission of photons by an electron from its disc edge. The temporal transmission phase is the injection of photons from positron to electron via the magnetic axis.

The electric field represents the spatial transmission of photons. The magnetic field represents the temporal transmission of antiphotons.

Physicists spend much time modeling the world to our peculiar observer viewpoint that is based on stereoscopic vision. This is fine for the applied aspects of physics that we must interface with our perceptions of the world. But when we realize that such a
viewpoint is totally arbitrary and simply designed for the convenience of our particular habitual mode of operation as organisms, we can release ourselves from that cross-eyed viewpoint and look for one more suitable for Mr. Ockham's wonderful Razor Principle. If we start with a single unitary particle, it is logically clear that we will need some sort of Big Bang plus superluminal inflation (to get the illusion of multiple particles) and a few other clever twists to get to the world as we see it. There may not be any real conflict between the steady state theory and the BB theory -- just viewpoint differences. (See my article on McCutcheon's expansion theory for more details.)

In OP the EM fields become virtual standing wave photon bubbles. These bubbles are projections into subjective space/time generated by the observer's particular chosen viewpoint. There is no vacuum of space (or ether). The emitting electron and the absorbing electron are the same particle. The observer projects the emitting electron as Not-Me, and then creates the myth of photons translating across an abyss of space and time. We use frequencies, wavelengths, size-scale, distortions, and all kinds of fun-house mirror effects as ways of calculating how much we resist accepting the reality of who we are. A lot of it is done faster than light, which I guess is why Einstein specifically told us not to think about faster-than-light phenomena even though his own equations tell us that the FTL world is just a mirror reflection of our apparent slow world. I agree with Mr. Hotson that the history of physics over the past 100 years is indeed bizarre and definitely took a few unwarranted turns, perhaps with certain parties deliberately obfuscating or suppressing information. But many great discoveries also have occurred, and we continue to make progress even though our SM paradigm is a bit skewed lately. Enough people are working on it now that I think we'll have a much clearer picture in the next ten years or so. The free flow of information on the Internet is quite helpful in this regard. Let us hope that our friends who believe in "protecting" us from the "bad" guys and the hackers who like to show off by throwing monkey wrenches into the works do not choke off this remarkable resource.

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If we go back to our Planck formula, and apply it to the electron, we get $H / Me c = 3.857 \times 10^{-13}$ m. This is a larger minimum radius than the proton. So it must be something like the radius of the minimum ground state orbit of hydrogen, since the electron functions as a satellite orbiting the proton nucleus. The proton's EM field is constant, so we know that the electron, undisturbed from the outside, will maintain a standing wave orbit around the proton.