

Dirac's Equation and the Sea of Negative Energy

PART 2

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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 involve massive violations of conservation of mass/energy.

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

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

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

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

A "Theory of Everything"?

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

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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 epos fill every cranny in every dimension of the negative energy realm. However, the close quarters and random configurations must frequently put electron adjacent to electron in positions that generate considerable amounts of *positive energy*. (Like charges repel, which is positive energy.) The BEC can't stand positive energy. It *must* get rid of it.

The BECs we can generate, at temperatures near 0°K, need fierce refrigeration to maintain their integrity. The Big BEC is somewhere below zero. How is *it* refrigerated? Where do its waste products go? Where does the BEC take out the garbage, and where is its garbage pile?

I suggest that we are sitting in it. We seem to be, to put it bluntly, BEC excrement.

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

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

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

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no other process is/was of any importance.

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

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

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

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

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

Neutrosynthesis

We might say that the Dirac equation, by having only four roots, *predicts* that everything else, including the neutron, must be made of electrons and positrons. How many *epos* make a neutron? The question is far from trivial. The answer can not be 919, the mass ratio between *epo* and neutron. There would be 919×2 like charges packed into a tiny space. The binding energy would have to be 80 or 90%, to hold such an aggregation together, even if it were mostly “charge condensed.” So 919 *epos* would mass, at most, about 370 electron masses. We might keep in mind the Pauli exclusion principle, which 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. (Element 118 was claimed to have been synthesized at the Lawrence Livermore National Laboratory in 1999, but they have recently retracted that claim [Gorman, 2001].) Completing that shell would give 118 elements, and a tenth complete shell would add another 18, for a total of 136. So if elements were stable to atomic number 136, element 136 would be a noble gas with 136 electrons in 10 complete shells. This means that there are 136 different ways for electrons to vibrate in 10 shells. Each of these shells amounts to an additional *degree of freedom* for the vibrating electron. If we substitute 10 degrees of freedom, or *dimensions*, for these 10 shells, it seems inescapable that there again would be 136 different ways for electrons to vibrate in 10 dimensions.

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

. . . From Eddington’s group-theoretical point of view, creatures to whom space-time has four dimensions will find algebraic structures having 10 elements and 136 elements playing a very fundamental role.

Eddington attempted, unsuccessfully, to derive the

proton-electron mass ratio from the two numbers 10 and 136, together with the number of unity, 1. . . Eddington’s 1, 10, and 136 are members of a well-known mathematical series that goes 1, 10, 45, 136, 325. . .etc. . .The next number in that series is 666. (Sirag, 1977b)

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

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

What would be the mass of such an aggregation? Well, in quantum theory, one measures the energy, or mass, by taking the *temporal sine* attribute of the Ψ wave. Since time is only one of the 10 dimensions, this would give the aggregation a mass of $18360/10$, or 1836 electron-masses. Since it is composed of 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

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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.

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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 $1/2\hbar$, 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 $1/2\hbar$. In order to obey Fermi-Dirac statistics, it must have this half-integer angular momentum, but it is not necessary to assign that spin to an individual electron or epo constituent when it can simply be a property of the extended neutron itself.

The Strong Nuclear Force

However, the prime merit of this model has to be its representation of the strong nuclear force. Here we need to note a strange coincidence: the mass of the proton, in electron-masses, is roughly the same as the strength of the proton’s strong force, in electron-forces. (Mass of proton: 1836 electron-masses. Strength of the electromagnetic force: the “fine structure constant” $\alpha = e^2/hc = 1/137$; strength of strong force: $g^2/hc = \sim 15$. Ratio: $\sim 15 \times 137$, 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 *unobserved* (fifth!) force carried by eight “gluons” (*designed to be unobservable*) between eighteen or thirty-six “quarks” (*also designed to be unobservable*) inside the nucleon. It then “suggests” that this fudged gluon force in some unspecified way “leaks out” of the nucleon to make up the peculiar shape of the measured strong force. However, our “epo model” of the nucleon models this very peculiar shape simply and intuitively.

Because of the uncertainty principle, the nucleon, with its measured diameter of around 1.9 fermis, 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

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into a strong repulsion (since the individual epos have to maintain their average 1.87 fermi separation), keeping the nucleons a stable distance from each other.

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

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

Dirac's Theory of Everything

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

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

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

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

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

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

Further analytical work will have to be done to verify that

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.

this tiny unbalance, which *must happen*, has the force as well as the characteristics of gravitation. If this hypothesis is correct, all of the matter and all of the forces in the universe are seen to be the result of just these four kinds of electron, fulfilling Dirac’s unitary dream.

Inertia

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

Haisch, Rueda, and Puthoff (1994) made a very plausible case that inertia is a residual effect of the ZPE. They were not, however, able to quantify the effect. As this study presents a rather different picture of the ZPE, the question is worth another look. To go along with the “kinetic theory of mass-energy,” we present what might be called the “kinetic theory of inertia.” (Or possibly the “gyroscopic theory of inertia.”)

A gyroscope establishes a 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 mc^2 . However, it also retains its (negative energy) vibration at $\pm c$ in an “imaginary” direction. Thus its oscillation is circular but complex, having both a “real” and an “imaginary” component, and giving it the anomalously large angular momentum of $\hbar/2$ in any “real” direction.

This makes the electron a little gyroscope. However, since this vibration is complex, part “real” and part “imaginary,” this angular momentum plane 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 Ψ that rep-

resents a particle with definite momentum. The length (value) of the complex number Ψ is the same at all positions, but its phase angle increases steadily in the direction of the particle’s motion, the x direction, making it a complex helix in shape.

The rate of this complex rotation in its axial (x) direction is the measure of the momentum. As x increases by a distance of \hbar/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 \hbar/p , on the exact analogy of a coiled spring being compressed. (QM represents momentum as a spatial sine wave or helix.) However, since Ψ is a complex number, acceleration in the (real) x direction increases the pitch of this complex phase angle and so is resisted by the electron-gyroscope. This compression acts to store the energy added by the acceleration according to the Lorentz relationship. Compressing the distance \hbar/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 neutron is a spin 1/2 particle, obeying Fermi statistics. So is the proton, and so is the electron. Therefore, in Beta decay, to conserve angular momentum the neutron must get rid of this half unit of spin, $\hbar/2$, as well as of a random amount of “real” energy. (This energy is the difference between the mass/energy of the neutron and the sums of the mass/energies of the proton, the electron, and the momentum energy of the ejected electron. It is a random amount because the electron emerges with a spread of velocities.) Fermi invented a “particle,” the “neutrino,” on the model of the “photon,” to take away this spin and energy. (Now called the “antineutrino” by modern convention.)

However, like the “photon,” the neutrino has no charge, and therefore violates our kinetic definition of energy. But as the electron emerges from the neutron, it is immediately surrounded by polarized epos, and these can absorb “real” angular momentum. However, absorbing this spin makes the epos 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 antioxygen, anticarbon, and the rest. Is it possible that there are places in our reality where “right-handed” vortices have produced whole galaxies of antimatter? At first sight this seems quite possible, as from afar an antimatter galaxy would be indistinguishable from one made of matter. However, it also seems unlikely that any nearby galaxies are antimatter, as one would think that sooner or later matter and antimatter must meet and “annihilate,” which would produce floods of easily-detectable 0.511 MeV photons, which are not in evidence.

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

Alternatively, the BEC may in some unknown fashion act as a “sorting device,” sending only “left-handed” neutrons to our reality, while expelling “right-handed” neutrons into a reality on the “other side” of the BEC. Presumably this would be into four *more* (“imaginary”) dimensions, which would also have a positive-energy balance, but would be made of antimatter. Perhaps in the future we will find that for some reason the BEC must act as a sorter to “left-handed” and “right-handed” universes. Or, alternatively, we may

find that only “left-handed” vortices are possible. However, there seems to be no way at present of choosing between these possibilities, and there may be more. The important fact is that, locally at least, we get only left-handed neutrons from the BEC; otherwise we would have no net positive energy balance.

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

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

(The following argument is adapted from Taylor [2001].) Take a sample of liquid helium containing a macroscopic number of atoms, N . Cool it until it approaches a state of minimum energy. It then has a wave function Ψ_N . Since this depends on the individual states of all N atoms, it is a very complicated function. If we now examine a sample containing $N + 1$ atoms, it will have a wave function Ψ_{N+1} , depending on $N + 1$ states. By comparing Ψ_{N+1} with Ψ_N , one can define a function $f(x)$. This depends on just one state x , the position of the “extra” atom. This $f(x)$ represents the *order parameter*, and allows the sample to condense, as it defines the quantum amplitude for adding one extra entity. Thus in the condensate this f fixes the order of 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.

Plasmas

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

Any BEC must have an exact balance of positive and negative charges. An ion can't be tolerated, and must be expelled by the BEC. It is suggested that the above behavior of a plasma is not because *it* is self-organizing, but because the universal BEC can't tolerate a collection of unbalanced ions, and so organizes this irritation into a plasma "pocket" of least irritation, tending toward a spherical form. This plasma pocket acts, in some ways, as if it were itself a BEC. The organization exhibited is because some of its attributes, ordered and controlled by the BEC, are governed by a single wave function.

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

The largest collections of plasmas in our vicinity have to be the Sun and the

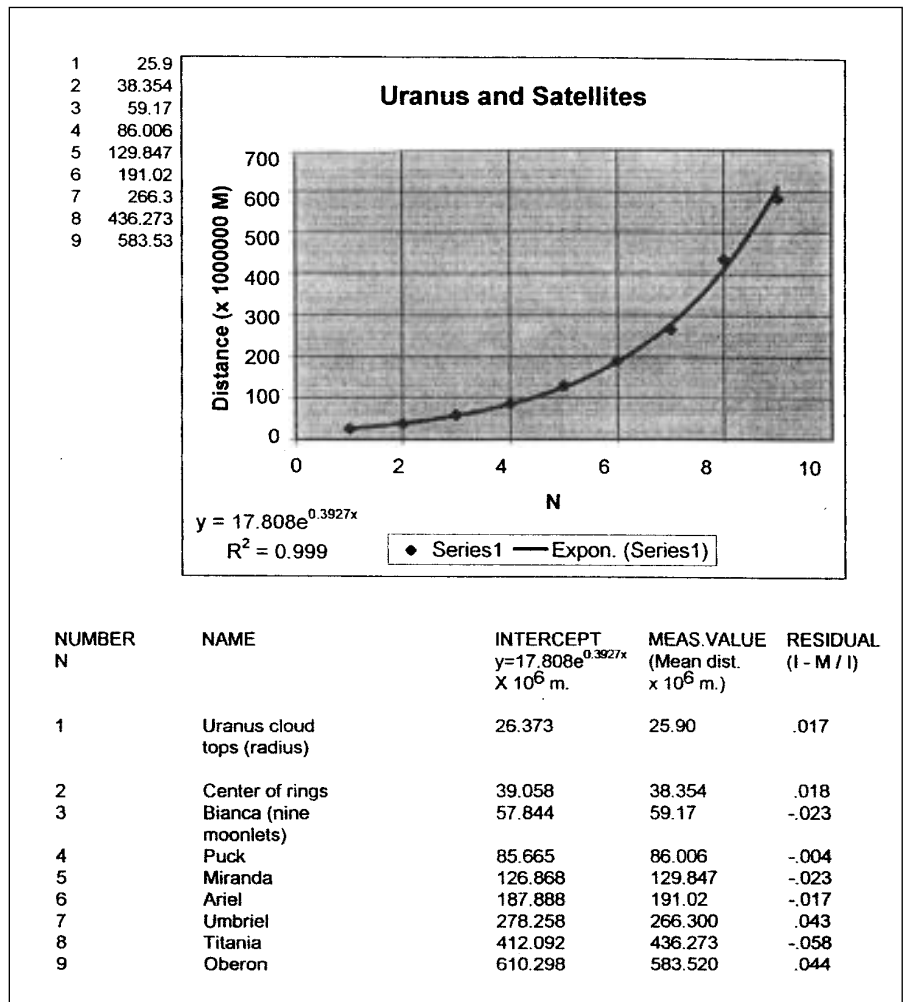


Figure 4. Uranus and satellites.

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

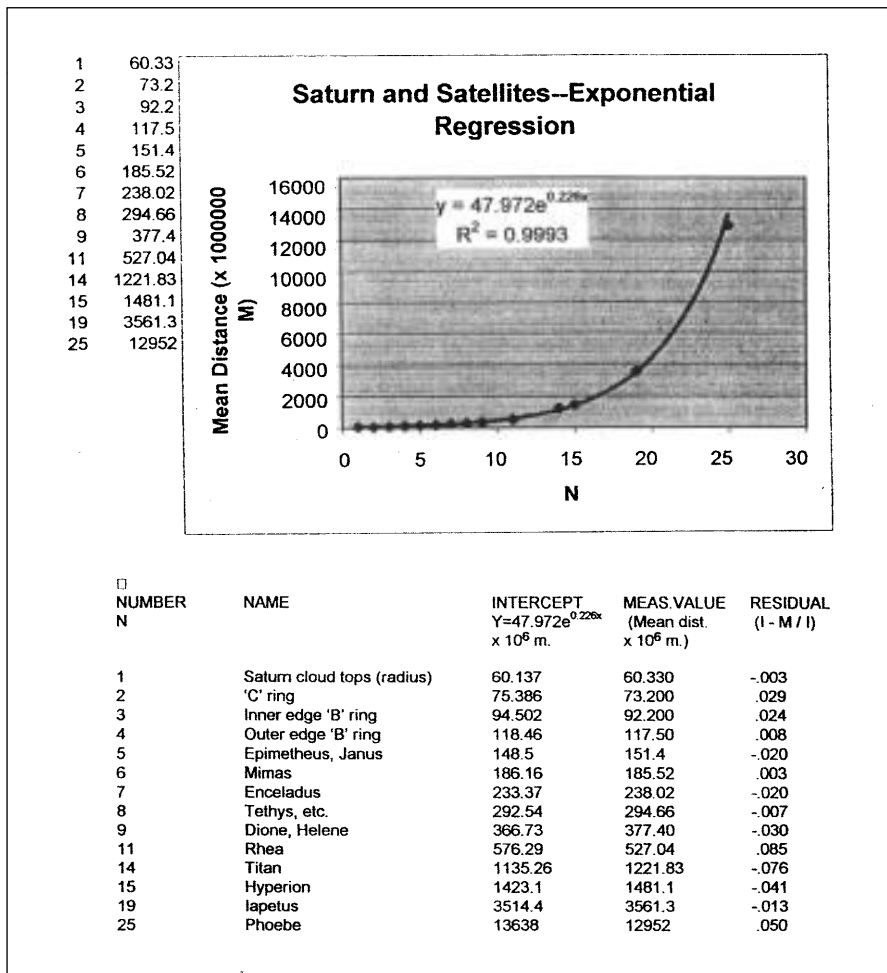


Figure 5. The spacing of Saturn and its satellites—exponential regression.

Jupiter diameters away. *It must be held in place by some force even more powerful than the powerful tidal force, a force totally unexplained by celestial mechanics.*

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

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

should orbit at these nodes.

This is exactly what is shown in 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

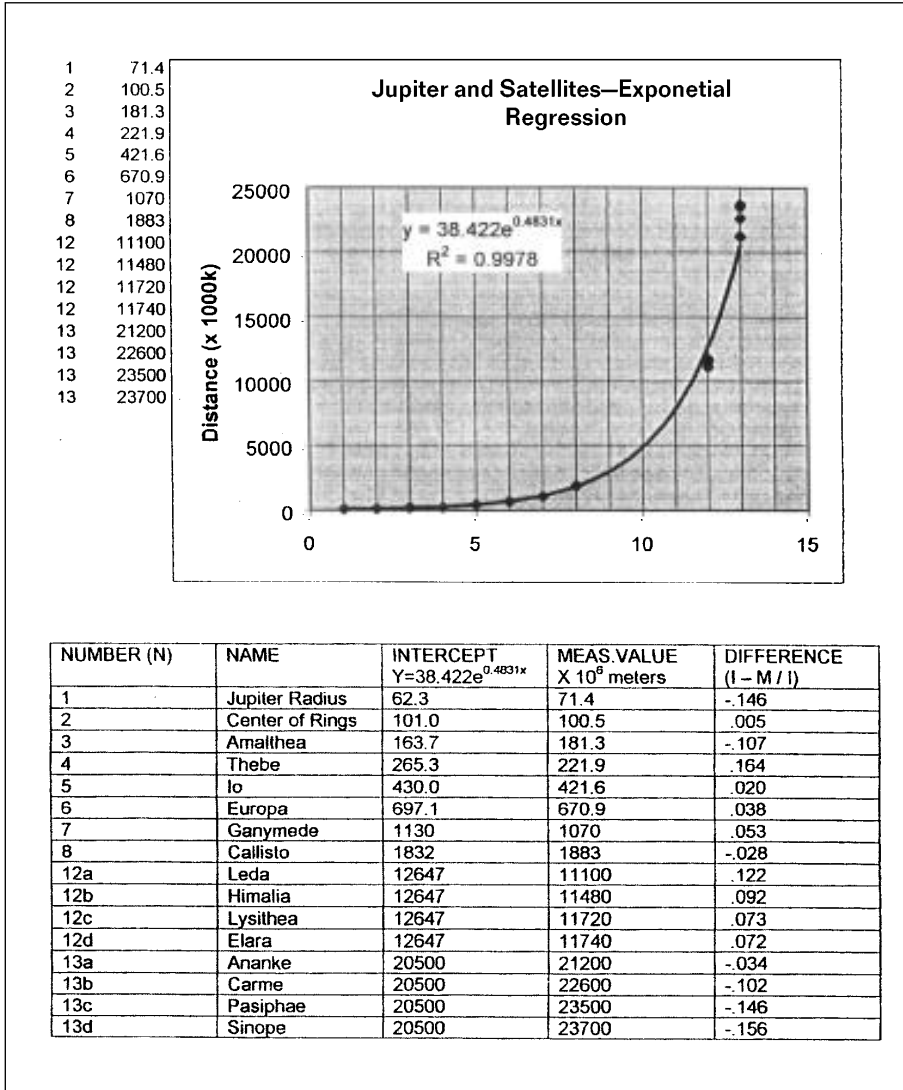


Figure 6. The spacing of Jupiter and its satellites—exponential regression.

[Van Flandern, 1993]. Its present clearly disturbed system exhibits only a limited regularity).

The figures show the best fit value in terms of a power of e , base of natural logarithms. The powers reduce to 1.253 for Saturn, 1.480 for Uranus, and 1.621 for Jupiter. That the satellites regularly fall at harmonics of the planet's diameters is clear. Why nodes fall at those particular harmonics, which are different for each planet, seem to be related to the planets' diameters, hence the periods of their fundamental wave functions. We will discuss this further at a later time.

That we live in an ocean of charge, of which we are as little aware as a fish in an ocean of water, will be difficult for many to accept. Even more difficult to accept is the above proof that a planet such as Jupiter is the source of a standing wave that has amplitude millions of kilometers from its surface. Despite our preconceptions, though, waves in this ocean of charge, as required by Dirac's equation, would seem to be confirmed beyond all reasonable doubt by the above correlations.

Moreover, studies have shown that the planets, particularly Venus and Jupiter, have a pronounced affect on the electron densities in the Earth's ionosphere, the effect peaking when these planets are close to the Earth (Harnischmacher and Rawer, 1981). The authors had no explanation for this effect, so it took considerable courage to publish their findings. But the above standing waves of polarization exactly account for this effect. Venus is the planet that comes closest to us, and Jupiter is a powerhouse whose standing wave affects all of the planets. *This means 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, 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 2^{11} times the diameter of the Sun, that of Uranus is within .0025 of 2^{12} times that diameter, and that of Pluto is within 0.035 of 2^{13} 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 τ , that quantum of time. We live in an ocean of

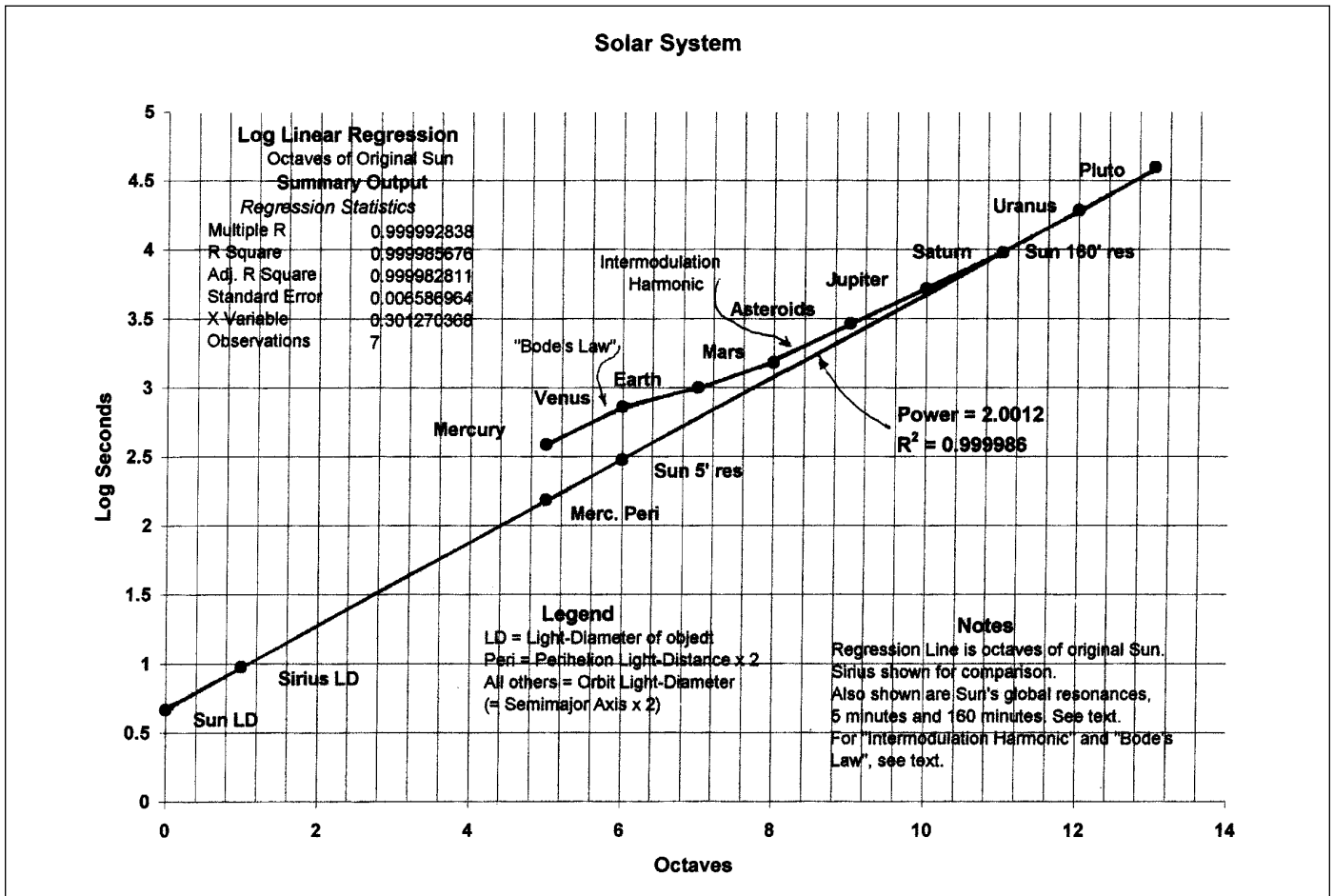


Figure 7. Solar system spacing.

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 10τ should be nearly as important.

Moreover, there is a time, $h/m_e c^2$, equal to 8.09×10^{-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, $m_e c^2/h$, be considered a universal electromagnetic limit frequency. And this time is within 1% of $10\tau \times 2^7$, another indication that octaves of 10τ 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 τ (6.26×10^{-24} s. times $2^{44} = 1.101 \times 10^{-10}$ s. The period of the cesium resonance, $1/9\ 129\ 631\ 770$ Hz, is 1.095×10^{-10} s.) This gets us over half way to the macrocosm without 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: $D = 2(3V/4\pi)^{1/3}$. (Mean diameter of Jupiter = 139,193 km. Light-diameter = 0.46432 s. $\tau \times 2^{76} = 0.47299$ s. or less

Table 1 Solar System Correlations Exponential Regression

Jupiter (τ) Series

ITEM	RELATION	OCTAVE	N	INTERCEPT (SECONDS)	MEAS. VALUE (SECONDS)	RESIDUAL (I - M / I)
$R^2 = 1$ Power=1.99936						
τ ($2e^7/3mc^2$)	$\tau \times 2^7$	1	0	6.2517×10^{-24}	6.262×10^{-24}	-.002
Proton	Light-diam.	1	0	6.2517×10^{-24}	6.2×10^{-24}	.008
Atom Clock	Cesium res.	2^{44}	44	1.0844×10^{-10}	1.0953×10^{-10}	-.010
Jupiter	Light-diam.	2^{76}	76	0.46101	0.46432	-.007
Mercury	Aph. Lt.-dist	2^{85}	85	235.360	232.493	.012
Mercury	Sid. Period	2^{100}	100	7 675 348	7 600 520	.010
Earth	Sid. Period	2^{102}	102	3.0682×10^7	3.1558×10^7	-.029
Mars	Sid. Period	2^{103}	103	6.1344×10^7	5.9355×10^7	.030
Pluto	Sid. Period	2^{110}	110	7.8344×10^9	7.8374×10^9	-.001

The term 'Light-diameter' refers to the time in seconds that it takes light to cross the object. The 'Light-diameter' of a τc object is of course τ . With Mercury the 'Peri. Lt.-dist' is the time light takes to travel from the sun to Mercury at its perihelion position; x 2. 'Aph. Lt.-dist' is the same at its aphelion position.

Sun (10τ) Series

ITEM	RELATION	OCTAVE	N	INTERCEPT (SECONDS)	MEAS. VALUE (SECONDS)	RESIDUAL (I - M / I)
$R^2 = 1$ Power=1.9999						
10τ	$10\tau \times 2^0$	$2^0 = 1$	0	6.2517×10^{-23}	6.262×10^{-23}	-.002
Heis.Fund.T.	$h/m_e c^2$	2^7	7	8.0126×10^{-21}	8.0904×10^{-21}	-.010
Sun	Light-diam.	2^{76}	76	4.7135	4.6432	.014
Sirius	Light-diam.	2^{77}	77	9.4265	9.4721	-.005
Mercury	Peri. Lt.-dist	2^{81}	81	150.79	152.77	-.013
Sun	"5-min. res."	2^{82}	82	301.57	299 ± 3	.008
Sun	"160-min.res."	2^{87}	87	9647.9	9600 ± 30	.005
Saturn	Light-diam.	2^{87}	87	9647.9	9520.0	.013
Uranus	Light-diam.	2^{88}	88	19 294.9	19 153.6	.007
Pluto	Light-diam.	2^{89}	89	38 587.8	39 451.6	-.023
"Io Shout"	Radio noise	2^{90}	90	77 172	76 426	.009
Io	Sid. Period	2^{91}	91	154 336	152 853	.009
Europa	Sid. Period	2^{92}	92	308 656	306 815	.005
Ganymede	Sid. Period	2^{93}	93	617 281	618 105	-.002
Venus	Sid. Period	2^{98}	98	19 748 065	19 414 000	.016
Neptune	Sid. Period	2^{106}	106	5.0535×10^9	5.2004×10^9	-.029

Note: Sirius and "Io Shout" shown for reference—not used in regression. "Light Diam" for Saturn, Uranus, and Pluto is the time light takes to cross its mean orbit. (Semimajor axis x 2). 'Heis. Fund. T.' is the 'fundamental time' ($h/m_e c^2$) proposed by Heisenberg (1944).
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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 Sirius, 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 $10\tau \times 2^{77}$, an almost exact octave both of 10τ and of the Sun's light-diameter.* Other stars have also been measured, but the probable errors of these measurements are so large that one can only say at present that it *looks like* their diameters *might* all be harmonics of τ or of 10τ . 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 τ with octaves of τ and 10τ predominating.

We need to deal here with two objections sure to be raised to these figures. It has been objected that the "light-diameter" of a massive body could not be important, because the velocity of light in a body such as the Sun would be very different from that in a vacuum: $c = 1/(\mu_0 \epsilon_0)^{1/2}$. Light in a massive body slows, depending on its permittivity and permeability. However, the wave function is determined by the BEC, in which the wave always travels exactly at c_{max} . The above wave functions of the gas giant planets support this; and we will present further evidence to this effect in what follows.

Second, it has been objected that figures based on octaves, beats, and harmonics

“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 τ or of 10τ . *Every body of the solar system has a major period that is within a few percent of an octave either of τ or of 10τ .* (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 of τ ($6.26 \times 10^{-24} \times 2^{102} = 3.174 \times 10^7$ seconds; sidereal period of Earth = 3.156×10^7 seconds. Difference = 0.57%). The farthest from an octave is Mars, whose sidereal period falls a fat 6% from an octave value. However, Mars, as we will see, falls much closer to another, stronger harmonic.

This result beggars coincidence. The resulting regression statistics (see Table 1 and Figures 8 and 9) for both τ and 10τ

have R^2 values of better than 0.999999, meaning that there is no question that the figures are related, and related to their (quantum) period numbers, which are octaves, powers of 2. Again, this is the clearest possible *wave signature*.

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 τ or 10τ 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

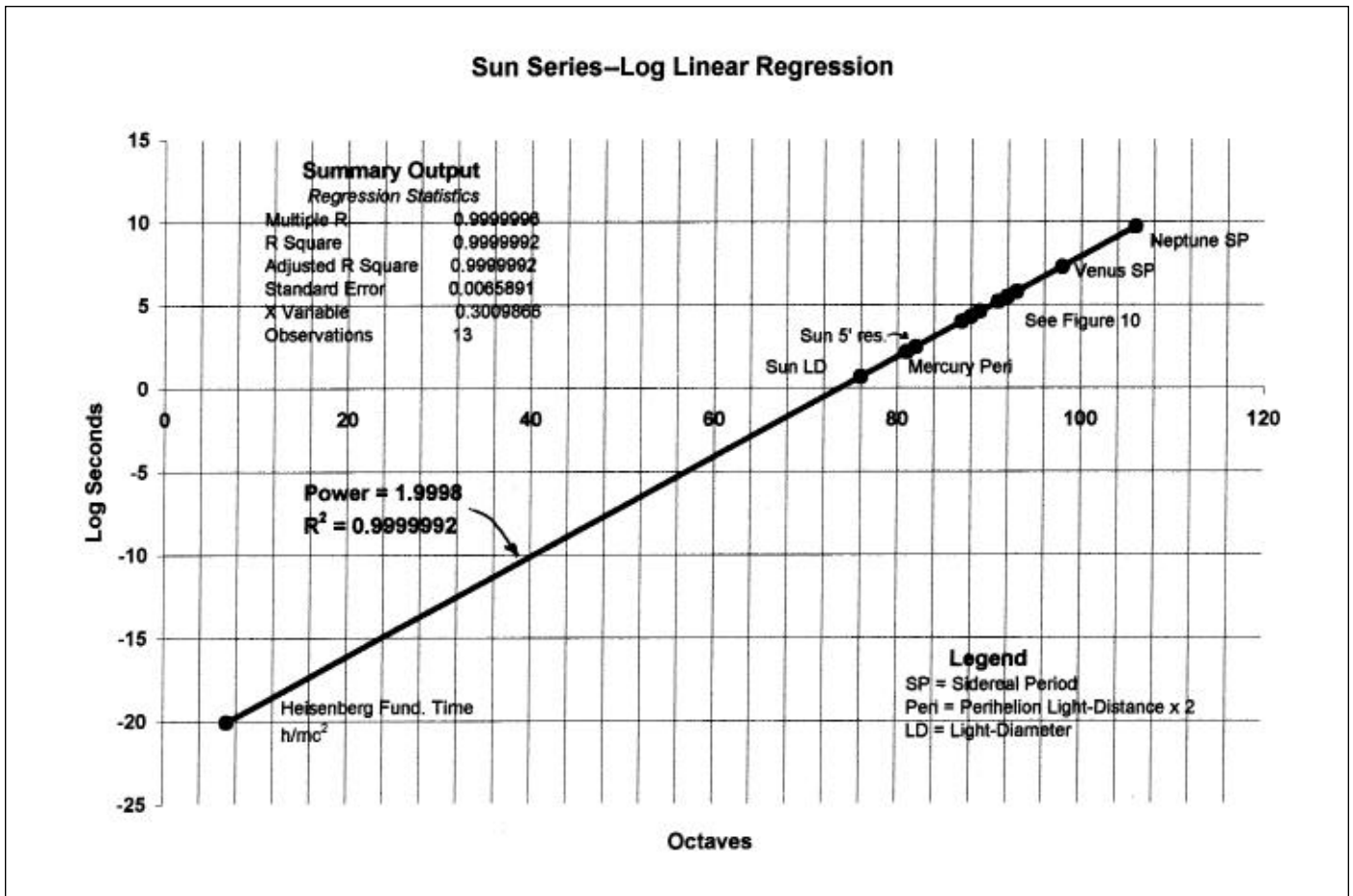


Figure 8. Sun series—log linear regression.

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 τ 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 τ harmonic and the Sun's 10τ 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 τ 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-

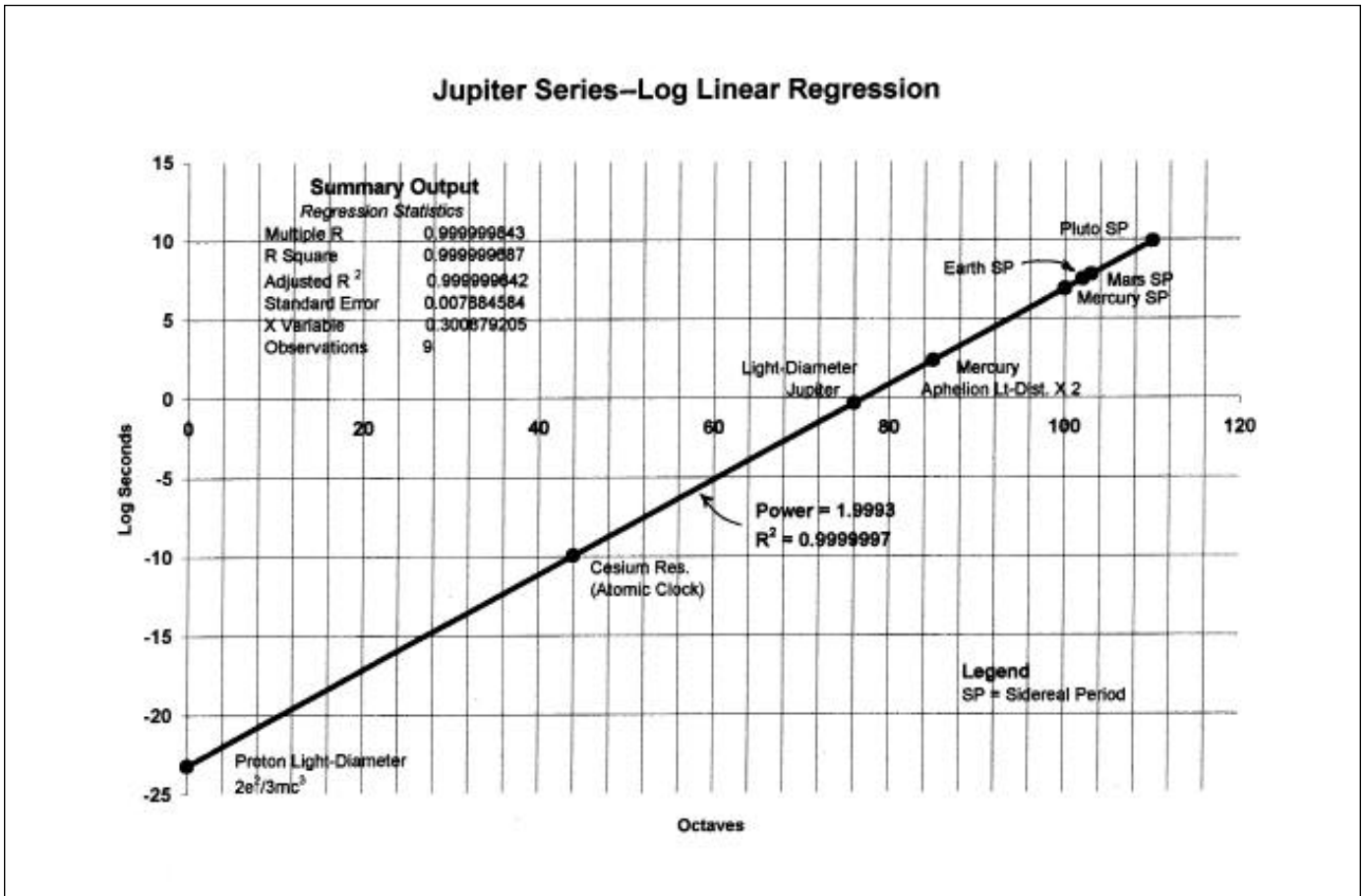


Figure 9. Jupiter series—log linear regression.

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.

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. As it turns out, both of these global resonances are exact octaves of each other and of the light-diameter of the Sun. (Light diameter of Sun = $4.6432 \text{ s.} \times 2^6 = 297.2 \text{ s.}$ $5 \text{ m.} = 300 \text{ s.}$ Diff. = 0.009. $5 \times 2^5 = 160$). This has never before been noted, probably because of the above men-

tioned fact that light does not travel at c_{max} inside the Sun. However, these global resonances are direct evidence for our hypothesis that a body of plasma’s wave function is set by the BEC, which always vibrates at c_{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 10τ 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 $1.6^3 \approx 2^2$. (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.

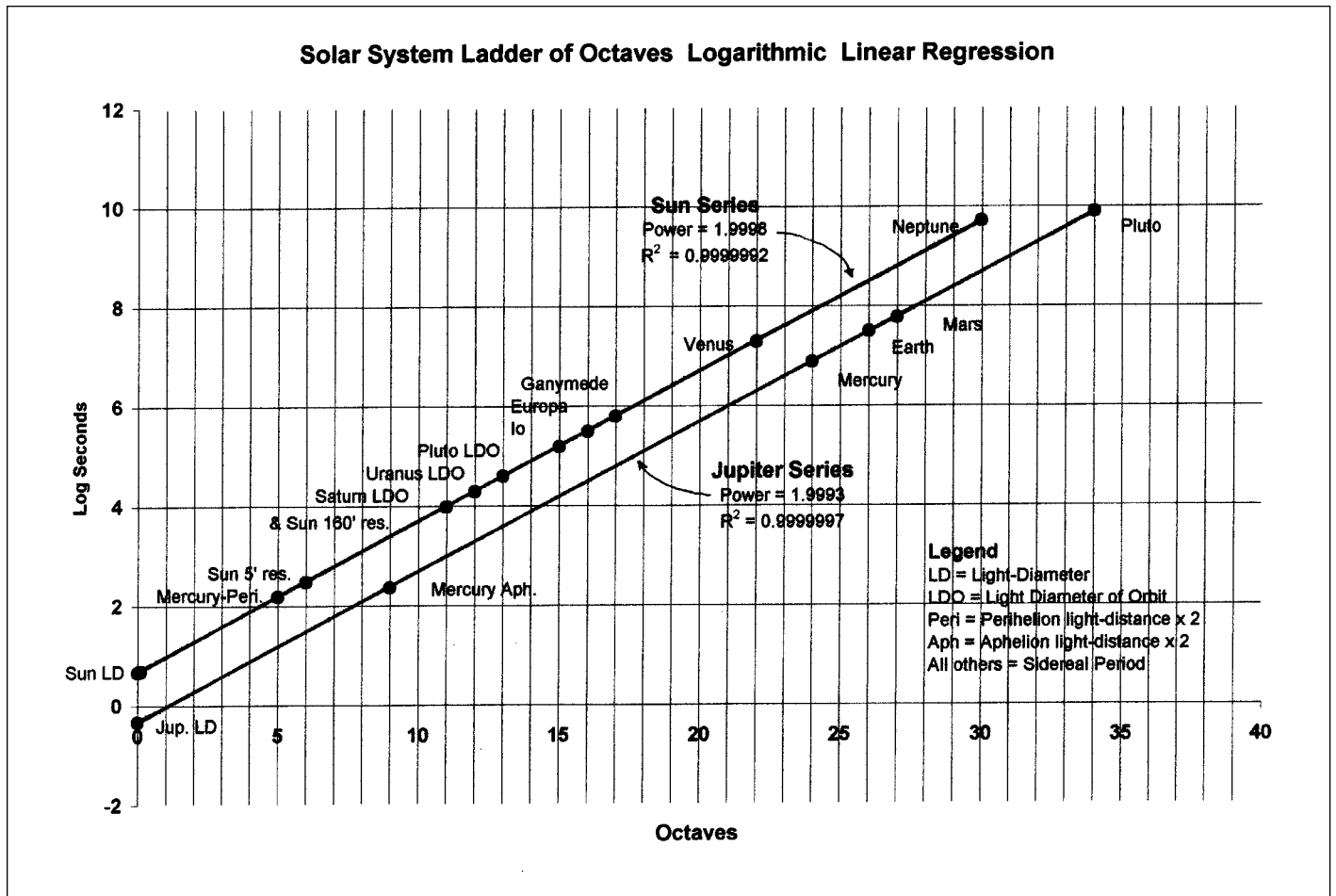


Figure 10. Solar system ladder of octaves logarithmic linear regression.

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::2::4 ratio already noted. Is there such a number n ? There is

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indeed; and it turns out to be the highly interesting number 137, the inverse of the electronic Fine Structure Constant α . (This constant is a pure number, not exactly 1/137, but 1/137.0359722. Eddington tried to derive it from the numbers 1 and 136, used in our “Neutrosynthesis,” but of course this was dismissed as numerology.)

What is the ratio of the electronic Fine Structure Constant 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.* Moreover, we have shown above that waves of polarization with amplitudes millions of kilometers from the gas giant planets operate to move their satellites into the normal mode nodes of those waves.

No one knows where the electronic fine structure constant comes from anyhow. Feynman (1985) calls it “the *greatest* damn mystery in physics.” As the Nobelist Lederman (1993) says, “The fine structure constant. . .[α]. . .can be arrived at by taking the square of the charge of the electron

divided by the speed of light times Planck's constant. . . 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 10τ 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 10τ energy. However, it has achieved stability on the intermodulation harmonic between its τ energy and the Sun's 10τ 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 seems to act as an enormous generator—and dissipator—of 10τ 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 ($\tau \times 2^{76}$). 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, $\tau \times 2^{75}$.

Anomalies

Dirac's equation, followed logically, requires space to be a "plenum" rather than a "vacuum." It is a BEC full of vibrating charges. 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 $1/r^2$ 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 $1/r^2$ 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 $(2 + \epsilon)$ power, where ϵ is a small number of about 10^{-7} (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 3.4° inclination, is caught half way 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 5×10^{-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^{-7} 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 billionth of g.

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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, having regard to such eternal verities as *conservation* and *causality*. The mathematicians who have taken over the discipline manage to ignore these verities, or wish them away with the wave of a magic tensor. Richard Feynman, one of the last real physicists, famously remarked that, “If all of 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, are shifted into the red end of the spectrum, indicating a loss of energy apparently proportional to the distance the signal has traveled, thus exactly fulfilling the Second Law and von Nernst’s prediction. Further measurements only confirmed the relationship between distance and this redshift loss of energy, and seven months after Hubble published his findings, the Cal Tech physicist Zwicky (1929) renewed the interpretation that 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, should lose energy in transmission over long distances. That the measured loss of energy is proportional to the distance traveled is direct evidence that light is a real signal in a real medium that obeys the Second Law. This interpretation is further supported by von Nernst’s valid, *a priori* scientific prediction, which was *fulfilled* by Hubble’s findings. But will you find this logical chain of events, including this fulfilled scientific prediction, mentioned in any 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 oxymoron, like "curved empty space." Let empty space expand as much as it jolly well pleases, the expansion still can't move so much as an electron. As Newton pointed out, to move anything physical takes something physical pushing or pulling on it. 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

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.

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

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

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

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

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

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 super-clusters 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 epo chains would gradually lose their induced attraction, hence their coherence. When the epos in a chain fell below the critical "temperature" of 2.7°K, they would drop back into the big BEC, and cease to attract at $1/r^2$. Thus gravitation, like any other real force, would have a limited range, rather than magically extending to infinity.

If our magnetogravitation is a correct model, this range should be calculable. We predict that this range will be found to be approximately 2 kiloparsecs. As Van Flandern (1993) shows, if the range of gravitation were about this distance, it would explain the "flat" velocity curves of stars in the spiral arms of galaxies without the need for any (unobserved) "missing dark matter." This "missing dark matter" must, to explain the observed velocities, amount in some regions to thousands of 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 epo 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 (Phipps, 1976, 1986; Simhony, 1994; Rothe, 2000) have suggested models based on electron-positron 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 epo 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 fea-

tures, 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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