Chapter 11. Invariance: The Physics and Mathematics of Immortality

In this section we will discuss the principle of invariance in physics. Then we will begin to explore the phenomenon of symmetry breaking in the light of invariance principles and theories of subatomic physics. If an impulse of force disturbs a physical system, that impulse tends to spread evenly as a wave in all directions throughout the system unless it is distorted by a wave guide. "The wave equation in one space dimension can be written as follows: $\partial^2 u / \partial t^2 = c^2 (\partial^2 u / \partial x^2)$. This equation is typically described as having only one space dimension x, because the only other independent variable is the time t. Nevertheless, the dependent variable u may represent a second space dimension, if, for example, the displacement u takes place in y-direction, as in the case of a string that is located in the x-y plane." (**Wikipedia**, "Wave equation".) The symbol c stands for the propagation speed of the wave. In three dimensions of space $\partial^2 u / \partial t^2 = c^2 \nabla^2 u$, where ∇^2 is the shorthand Laplace operator for the various spatial dimensions.

With the advent of quantum mechanics Erwin Schrődinger developed his famous quantum Wave Equation.

* $i\hbar (\partial \Psi (\mathbf{r}, t) / \partial t) = \hat{H} \Psi (\mathbf{r}, t)$,

where i is the imaginary unit, $\hbar$ is the Planck constant divided by 2π, the symbol $\partial/\partial t$ indicates a partial derivative with respect to time t, Ψ (the Greek letter psi) is the wave function of the quantum system, and $\hat{H}$ is the Hamiltonian operator (which characterizes the total energy of any given wave function and takes different forms depending on the situation). (**Wikipedia**, "Schrődinger equation"). Below is the time dependent Schrődinger equation for a single non-relativistic particle.

* $i\hbar (\partial \Psi (\mathbf{r}, t) / \partial t) = [(- \hbar^2 / 2 \mu)\nabla^2 + V (\mathbf{r}, t)] \Psi(\mathbf{r}, t)$,

Below is the **time-independent form** of the Schrődinger wave equation and its solutions where $\psi(\mathbf{r})$ is a function of position only.

* $(- \hbar^2 / 2 M)\nabla^2 \psi + V(\mathbf{r}) \psi = E \psi$.
* $\Psi (\mathbf{r}, t) = \psi(\mathbf{r})e^{-i\omega t}$.

Experiment: Put some water in a large bowl. Allow the water to become calm. Then with a dropper allow a single drop of water to fall into the center of the water. Watch as ripples spread out in all directions from the disturbance caused by the water drop. The energy from the disturbance eventually dissipates into the environment, and the water returns to its flat calm.

Experiment: Pluck a string on a guitar. If you do not have a guitar, just stretch a rubber band between two nails or pegs and pluck it. Watch the "standing" wave vibrations that occur along the band between the boundaries of the pegs. This is a special wave guide.

The vibrations eventually die down due to the loss of energy through friction. But with the rubber band or guitar string you can see the idea of a wave that stands on its own for a while with stability and has a characteristic vibration that you can hear. If a system can

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retain its energy in a closed system without dissipation, the standing wave form will persist in time indefinitely. At the quantum level, such systems exist that can vibrate in specific dynamic patterns for extremely long durations. If we consider the total energy of a system (for example, via a wave function) we can locate the non-changing aspect of the system that persists even as the system passes through various phases or configurations.

"In quantum mechanics, the **Hamiltonian** is the operator corresponding to the total energy of the system in most of the cases. It is usually denoted by H, also $\check{H}$ or $\hat{H}$. Its spectrum is the set of possible outcomes when one measures the total energy of a system. Because of its close relation to the time-evolution of a system, it is of fundamental importance in most formulations of quantum theory." (**Wikipedia**, "Hamiltonian (quantum mechanics)". Theoretical study of invariance therefore often proceeds from a time independent Hamiltonian ($\hat{H}\ \psi = E\ \psi$), which is a general mathematical relationship designed so that it remains invariant under various transformations and is a simplified expression of the time-independent Schrődinger equation given above.

We can define various operators that perform global transformations on functions for **closed** systems. The Hamiltonian remains invariant under such a transformation. The operator thus commutes with the Hamiltonian, and this leads to a conservation law regarding that particular operation. Hamiltonian mechanics was developed in the 19th century by William Rowan Hamilton as an alternative formalism for classical Newtonian mechanics just as the Lagrangian formalism we discussed earlier was developed by Joseph-Louis Lagrange in the 18th century. Both the Lagrangian and the Hamiltonian formalisms turned out to be very useful in the formulation of quantum mechanics in the twentieth century. Below is a brief introduction to the Hamiltonian approach. Follow the curious logic.

Consider a situation (x) with a transformation that results in a small displacement of the situation in the system $x' = (x + dx)$. The Hamiltonian (H) is set up so that:

* $H\ (x') = H\ (x + dx) = H\ (x)$.

The Hamiltonian shows that with the displacement the situation (x) remains unchanged. We define an arbitrary operator (X) to operate on some function of (x) to cause a small displacement. These can be wave functions or whatever you like.

* $X f\ (x) = f\ (x + dx)$.

Then we set up the following function:

* $f'\ (x) = H\ (x) f\ (x)$.

Apply our operator (X) to that function.

* $X f'\ (x) = X\ H\ (x) f\ (x)$.

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By comparing with our definitions of the Hamiltonian and our operator, we get:

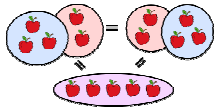
* $X f'(x) = f'(x + dx) = H(x + dx) f(x + dx) = H(x) f(x + dx) = H(x) X f(x).$

Equating this result back to our operator application we get:

* $X H(x) f(x) = H(x) X f(x).$
* $[X H(x) - H(x) X] f(x) = 0.$

* $[X, H] = 0.$

So the operator X **commutes** with the Hamiltonian H.



Example of the commutative property in the operation of addition: $3 + 2 = 2 + 3 = 5$. I can add in any order and get the same results. Ordinary multiplication is also commutative: $3 \cdot 2 = 2 \cdot 3 = 6$. (See **Wikipedia**, "Commutative Property")

We can substitute any operation we are exploring into the commutation relation here and find the **conservation law** related to that operation. **This is a very general finding.** (My above brief summary is based on the definition given by Martin and Shaw, **Particle Physics**, 2nd ed., pp 80-81.)

Frauenfelder and Henley (**Subatomic Physics**, chapters 7-9) have a good discussion of the issue with many examples. Feynman's "Lecture # 52" in Vol. I of his **Lectures on Physics** also gives us an insightful non-technical discussion. And there are many other sources that discuss this important principle of science and mathematics. So we won't discuss too many technical details here.

A key point emerges in the study of invariance that relates back to the discussion in section one of this work regarding continuity and discontinuity: **Invariance that is continuous results in additive systems, and invariance that is discontinuous results in multiplicative systems**.

An example from physics of a continuously varying system is rotation. One can rotate a spherical object by **any angle of any arbitrary spatial dimension**, and its symmetry is preserved with invariance. But as soon as you do an operation where you spin the sphere, it forms an axis with two poles. Quantum spin, as we have seen, results in a quantum unit of charge that combines in a strictly **additive** fashion. On the other hand, a mirror reflection is an all-or-nothing response. It is discontinuous but interactive. When reflections interact, you must multiply them. In our discussion of phase conjugation we saw how we multiply [W] times its conjugate (reflected) wave [W*].

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This principle is quite general. For a simple everyday example, let's say that I eat lunch in a certain restaurant. This is an invariant feature in my life. The menu contains 4 entrees, 3 beverages, and 2 desserts. The menu is discontinuous, but interactive. I always eat a complete meal, so I must choose one item from each category. Once I decide, then that is the meal for the day. I can choose each item in a category by flipping a coin in some manner, and that is my operator. In the entree category, for example, two heads might mean item one, a head and then a tail is item two, a tail and then a head is item three, and two tails is item four. How many different meals can I have at the restaurant? At each meal I choose one from four entrees, and then one from 3 beverages, and then one from two desserts. We multiply those choices -- 4 times 3 times 2 -- and find that each day I choose one from 24 possible meal combinations.

We can determine the Hamiltonian for this system, which will be an entree, a beverage, and a dessert. We can then perform operations within the system, such as changing the sequence in which I place my order. The waitress may write the ticket in a different order (dessert, entree, beverage), but I get the same complete meal (1 entree, 1 beverage, 1 dessert) out of the 24 possibilities. Any operation that gives me a complete meal will commute with the Hamiltonian (1 from $4\times3\times2 = 1$ from $2\times3\times4 = 1$ from 24 options). Making only two choices for a meal would not. Going to a different restaurant takes me out of the closed system.

They serve me a pot with 512 cc of tea at the restaurant. I can drink the tea at any pace, sipping, drinking, or gulping. But I only get one pot, and I finish the pot each time. That is the invariance in my tea drinking. The drinking operation is continuous over the range of the contents of the pot since I can drink the tea in any amounts I want within the limits of the teapot. So all the cupfuls and sips, and gulps, whatever their size or speed, add up to one pot of tea. This system is additive. We do not multiply the cupfuls times the sips to get a potful, we simply add them all up.

In our discussion of the relation between mental and physical systems we found that discontinuous items (like the menu choices) are random and arbitrary in terms of outcome – e.g., what you eat that day. We see from this example that each meal starts with 24 possibilities and if I randomly pick one, it could be a different one or the same one from one day to the next. On the other hand continuous items (like pots of tea) are predictable in terms of outcome -- i.e., one pot of the same kind of tea is emptied. Regardless of the procedure you follow in drinking the tea, as long as you stick to your invariant routine of 1 pot of tea, you always end up with an empty pot. In our mental world, we associate discrete values such as whole numbers with orderliness and predictability of outcomes. That's how whole numbers behave in our mental world: 1, 2, 3, 4, ... Yet in the physical world, the meals seem random even though I flip my coins in an orderly fashion one after the other.

A mental (mathematical) continuum has no clearly preferred points within it. Any point is the same as any other point, and there is always an infinite number of points on either side of any point. The continuum apparently is filled with numbers that have random orders to their digits and can not even be written down precisely. (Actually, in the real

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world we always do an arbitrary cutoff in the real value of a point in a "continuum" and end up with a rational number. No physical measurement has infinitely precise physical resolution.)

Perhaps the key to this role-reversal transformation between the mental and physical worlds is the discovery that when you find the invariance in a continuous system, you gain a sense of wholeness that guarantees completion. Even though you drink in all sorts of ways, you always finish the pot. The empty pot is your invariant outcome. It is very reliable.

The invariance of the discontinuous physical system (eating one full meal at the same restaurant each day) gives no such guarantee that you will ever eat all the choices on the menu by any certain date. It only guarantees that you will eat complete meals and that they will be selected from the 24 possible combinations. However, if you combine the mental order of whole numbers with the random order of discrete objects, you can get a sense of completion. You can simply list out all the possible menu choices, number them from 1 to 24, and then work your way down the list day by day rather than making choices by flipping coins. In less than a month you complete the list. The same result of completion can be achieved in a random manner by postulating that your choice each day is truly random, and then giving your self no specific time limit for completing the project of eating all menu combinations. But you also must give yourself lots of patience and perseverance. This is the inevitability and completeness of the Poincare Peak that guarantees recycling of the finite universe -- if we accept the mission postulate to persevere until the ultimate inevitable happens.

You might have the patience to do this at a restaurant with just a few items on the menu, but do you have the patience to do this with the whole universe that has a phase space of maybe $(((10)^{10})^{10})^{10}$ or more? You might want to load the dice instead of waiting out the mindless shuffling of possibilities.

The way we bring order to the random mental continuum is by noticing that we use a step by step approach to finish the pot. Regardless of the gulp sizes, we always finish the pot sip by sip. We turn the continuum into a set of discrete steps all headed in the same direction. If we randomly added cupfuls of tea to the pot as we drank, we might be at it for a long time.

In the same way, if we impose a set of "gauge" units, such as whole numbers or cupfuls, on the continuum, then we can easily navigate from 1 to 10. Using rational numbers we can navigate from 0 to 1 -- **if** we organize our "rational gauge" properly. Each sip defines a gap set of so many tea molecules. We label the cupfuls with whole numbers, but we actually drink the gaps between the whole numbers, chunking all the rationals and irrationals within a specific metric into our cup at once. So we don't even need to worry about counting the cupfuls, because we know we'll get all the tea drunk when the pot is empty. This is the gauge principle. We can unify continuity and discontinuity. We can also integrate mental and physical realms.

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Invariance and Conservation

There is a close relationship between invariance and conservation. In the tea-drinking situation the invariance is the daily completion of one pot of tea. We have conservation of pots, which means that, to maintain our closed system, we must have a way to recycle the water, tea, and brewing temperature into the same pot or an equivalent pot every day. This is how invariance gets involved with ecosystems. For invariance of meals the restaurant must be able to supply every day on demand whatever makings of the meal are listed on the menu. So we can describe a rule of invariance also as a rule of conservation. We shall now propose a fundamental law of conservation from which all other laws of conservation derive.

* **CONSERVATION OF UNDEFINED AWARENESS**: BY DEFINITION UNDEFINED AWARENESS REMAINS IDENTICAL AND INVARIANT UNDER ANY POSSIBLE TRANSFORMATIONS. (The identity transformation.)

* **CONSERVATION OF VIEWPOINT**: A VIEWPOINT IS MAINTAINED UNTIL IT SHIFTS BY DEFAULT OR IS DELIBERATELY SHIFTED. WHEN A VIEWPOINT SHIFTS, THE ENTIRE VIEWPOINT OR SUBVIEWPOINTS OF THE VIEWPOINT **MAY** BE ABANDONED (NOT EXPERIENCED). ALL ABANDONED VIEWPOINTS AND SUBVIEWPOINTS CONTINUE TO EXIST IN THEIR PREVIOUS VIEWPOINT FRAME(S) UNTIL SUCH TIME THAT THEY ARE FULLY EXPERIENCED IN THEIR ORIGINAL VIEWPOINT FRAMES AND THEREBY DECREATED BACK INTO UNDEFINED AWARENESS.

* FROM THE VIEWPOINT OF UNDEFINED AWARENESS THERE ARE NO VIEWPOINTS TO BE DEFINED OR EXPERIENCED, INCLUDING THIS VIEWPOINT, SO ULTIMATELY ONLY UNDEFINED AWARENESS EXISTS.

The third principle brings up the paradoxical situation that we define undefined awareness as undefined. We gain no linguistic sense from that definition, because it is a back-propagation from a state of definition and assumes the prior condition of definition without clarifying how we got there. We are unable to know what "undefined" means until we have known definition. This is like the problem that 0 assumes the prior existence of something and thus is not a good way to start the natural numbers or a unified theory of the universe. How do you get from 0 to 1? We have here another logical self-referral situation that still does not destroy logic, because it anchors itself in experience just like the assertion about beliefs. Defined and undefined states may be experienced. In fact, the two assertions ("you experience what you believe" and "undefined awareness is awareness without definitions") are closely related, because you must experience the presence or absence of definitions to know whether they are there within awareness. A belief is basically the same as a definition, and a viewpoint is a particular type of belief-definition.

Viewpoint definitions may be created and/or dissolved. They are created by belief, and dissolved by experience. Because they move, change, and shift, they involve **energy**. Creation involves a **deliberate shift of energy**. Energy that moves something through a

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displacement is called **work**. We can shift viewpoints deliberately or non-deliberately (by default). A deliberate viewpoint shift is the creation of a new viewpoint. A non-deliberate viewpoint shift is caused by default interactions with abandoned and/or unexperienced (forgotten, disregarded, etc.) viewpoints. Creation of a viewpoint localizes the energy of the viewpoint in a certain defined space. Dissolution of a viewpoint via full and complete experience delocalizes the energy, releasing it back into undefined awareness and making it available for further creation. Unlimited energy is available in principle due to the undefined nature of undefined awareness, but because we operate through localized defined identities, the available energy for a system becomes limited by our self-imposed boundary conditions and our ability or lack of ability to work efficiently within those conditions.

The conservation principles of physics derive from the above-mentioned conservations of awareness. Here are some of the major conservation laws and their relations to symmetry.

* The **symmetry of translation** in space leads through quantum mechanics to **conservation of momentum**.
* **Rotational invariance** is reflected as **conservation of angular momentum**.
* The sums of all the energies involved in a process remain constant. The **conservation of energy** corresponds in quantum mechanics to **the symmetry that laws can be translated in time**. **(T = Time reversal)** Antiparticles can be considered particles moving backwards in time.
* Mirror image structures and processes form **conjugate pairs, seen in particle-antiparticle pairs. (P = Parity reflection = flipping the sign of a spatial coordinate)**
* **Charge conjugation** in EM theory is known as "**gauge invariance**." (**C = Charge conjugation**) Charged antiparticles have the reverse charge of their corresponding particles.

Conservation rules imply inherent symmetry and very general viewpoints. CPT symmetry apparently holds for all physical phenomena, with a few special cases such as I will mention below.

Gauge invariance means that if we shift the quantum mechanical phase of a wave function (ψ_0) by some arbitrary constant (e^{iD}), where (D) is the arbitrary constant, and (e) is the natural log base, and (i) is the imaginary number $(-1)^{1/2}$, the laws are unchanged. In quantum mechanics the wave function represents a pattern of amplitudes of some process. To find the probability of an event occurring in this process we take the absolute square of the amplitude.

* $(\psi_1) = (\psi_0)\ (e^{iD})$
* $|\psi_1|^2 = |\psi_0|^2$.

The constant (e^{iD}), when varied, oscillates like a sine wave. Absolute squaring of the constant corresponds to unity, which magically leaves us with the original wave function

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squared!

* $e^{iD} = \cos D + i \sin D$.
* $|e^{iD}|^2 = \cos^2 D + \sin^2 D = 1$.

Thus, if a wave function's phase is shifted by an arbitrary constant, its absolute square equals the absolute square of the original wave function. This corresponds to the conservation of charge quantum numbers in a system. Although the phase of the wave function varies in time and space, the electromagnetic potential changes with it in a corresponding way so that there is no net observable change in the total charge.

Although some violations of C and P invariance show up in the weak interactions, they indicate a deeper combined invariance called CP invariance. The odd case of Kaon CP-violation is handled by assertion of a deeper level of CPT invariance. The Kaon decays have time delays that just balance out the CP violation.

There is a beautiful symmetry between the laws of electrostatics and magnetostatics.

$$\nabla \cdot \boldsymbol{E} = \rho / \varepsilon_o .$$

$$\nabla \times \boldsymbol{E} = 0 .$$

$$\nabla \times \boldsymbol{B} = j / \varepsilon_o c^2 .$$

$$\nabla \cdot \boldsymbol{B} = 0 .$$

The inverted delta (often called “del” or a Laplacian operator) means a vector with three component derivatives for 3-D space. The term $j / \varepsilon_o c^2$ is equivalent to $\mu_o j$. In the static condition the electric and magnetic aspects seem unconnected, but have an interesting symmetry. Electrostatics has zero curl and a specified divergence, whereas magnetostatics has zero divergence and a specified curl. When there is relative motion involved, then the time derivatives ($\partial \boldsymbol{B} / \partial t$ and $\partial \boldsymbol{E} / \partial t$) that are invisible in the static version of Maxwell’s second and third equations respectively make the electric and magnetic fields clearly interlocked and mutually dependent. The Maxwell relation $\mu_o \varepsilon_o c^2 = 1$ shows that light (via c^2), electricity (via ε_o), and magnetism (via μ_o) are all bound together as a single holistic phenomenon forming the dynamic essence of the vacuum state. Light speed expresses the Will as attention flow, whereas ε_o and μ_o express the resistance inherent in the vacuum that prevents EM radiation from traveling at infinite velocity and thus makes a physical universe practical. The “vacuum state”, formerly called the “aether” is another name for undefined awareness with a bit of bias toward objectification, just as “undefined awareness” has a flavor of subjectification. It is a state of equilibrium, but contains the huge potential of all possibilities in a virtual state. Attention/light has to plow through all those possibilities on its way to a specifically defined actuality. The development of quantum mechanics has revealed that the world of physics is the resultant of all of the countless possibilities constantly vying to become real. However, unless conditions are appropriate they can only form virtual bubbles that immediately pop and return to potential. The virtual bubbles

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nevertheless are real enough that they result in a measurable influence on physical phenomena, one being that EM radiation has finite velocity. Not only is it finite, it forms the balancing point between retarded ($< c$) and advanced ($> c$) velocities. It also forms the balancing point between its electric and magnetic components.

The Neutrino Mysteries

The neutrinos remain something of a puzzle in current physics. They seem to have neutral charge and spin ½, but only move with their spin oriented oppositely (left-handed) to the momentum of the particle they decay from. Antineutrinos only show preference for "right-handedness". In decay patterns neutrinos are associated with anti-leptons and anti-neutrinos are associated with leptons. Also, the neutrino flux from the sun seems way below what it should be from the standard model of the sun and this has been found to be due to neutrino oscillation, which requires some amount of neutrino mass contrary to the old standard theory. Finally, we don't know precisely what the various neutrino "rest" masses are.

If a neutrally "charged" neutron is made from a positive proton, plus a negative electron and an antineutrino (which is what neutron "beta" decay reveals), then, according to the law of conservation of charge, the neutrino must lack charge, or else the neutron would end up with a charge -- or else charge is not conserved.

* $m_n \rightarrow m_p^+ + e^- + \nu_e^*$ (neutron beta decay)
* $\nu_e^* + m_p^+ \rightarrow m_n + e^+$ (inverse beta decay)
* $m_p^+ + e^- \rightarrow m_n + \nu_e$ (electron capture, another form of inverse beta decay)

In our notation we mark <u>antiparticles</u> with a star (*) if they have neutral charge. If they have positive charge, we assume they are essentially antiparticles. In the second example shown above an energetic antineutrino from a large beta decay bombardment supposedly hits a proton and drives out a positron from it that quickly annihilates with an electron releasing two gamma photons, leaving a free neutron that later then decays back to a proton with the beta decay that is the usual spontaneous process for free neutrons. Thus "inverse" beta decay is used to demonstrate that the antineutrino really exists as a **particle**. This form of inverse beta "decay" suggests **there is <u>at least</u> one positron participating in the ensemble of a proton**. The positron is running backward in time, and gets sucked into the neutron to give it a positive charge. If you move the positron to the left side of the formula so it appears as an electron, you see the exact mirror image of ordinary neutron beta decay as in the first formula. The other inverse beta decay example in the third formula requires energy to stuff an electron into a proton. This is called electron capture and usually occurs in proton-rich nuclides. In the notation when a particle crosses from one side of the event to the other, it changes from a particle into an antiparticle or vice versa. This keeps the charges balanced. Charged particles are negative, and charged antiparticles are positive. The third formula is probably the proper general format, and can go either direction, but energy-wise tends to go from neutron to proton (for reasons I discuss elsewhere).

As we mentioned in our last chapter, the constant velocity c of light ensures that we get

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quantum units of charge and magnetic moment (spin) in fundamental fermion particles. If the neutrino has half-integer spin, it would seem to require a mass **AND** a charge, although the mass could be very, very small -- so small that it could almost be treated as massless, -- perhaps just a very strong linear momentum. Evidence of a very tiny neutrino mass has accumulated and is now widely accepted. But why is there no charge?

There are two reasonable explanations, one of which depends on the nature of the quarks. The first possibility is that there is a **threshold** for charge. Could it be that the "rest" energy of the neutrino is so low that its charge "winks out". How might that work? We observe that the electron seems to be the smallest unit of mass that will support a charge. This suggests a threshold for onset of charge somewhere just below the mass of the electron. We may also consider the possibility of a range of very light neutrinos that are chargeless and have very small masses. We already know of three types of neutrino, the electron-, muon-, and tau-neutrinos. The problem here is that a tau neutrino has no charge but is fatter than an electron. If the tau neutrino is not just a highly energized resonance of the electron or muon neutrino, we have a problem with the threshold idea. Below is a rough picture of the lepton masses. Our information about the neutrinos is pretty sketchy because they are so small and they do not interact very much. Mostly they are used as an accounting procedure so that conservation of mass-energy can be maintained. Without them that theory gets into serious difficulties. On the other hand the threshold theory gets into difficulties, starting with the *tau* being something like 47 times fatter than the electron!

* $m_{ne} < 15$ eV / c^2.
* $m_{n\mu} < 0.17$ MeV / c^2.
* $m_{n\tau} < 24$ MeV / c^2.

* $m_e = 0.511$ MeV / c^2.
* $m_\mu = 105.6$ MeV / c^2.
* $m_\tau = 1777$ MeV / c^2.

We suppose that the electron is the mass threshold for a particle to carry charge. Then we can begin probing for such a threshold with the Bohr magneton (μ_B).

* $\mu_B = \hbar\, e / 2\, m_e = 9.274 \times 10^{-24}$ J / T.

This value expresses the quantum threshold (in Joules per Tesla) of the magnetic moment for electrons in orbits. The magnetic moment derives from the angular momentum of the electron's motion. In the same way that Planck and company looked at ($\hbar\, c$) and ($\hbar\, G$) let's consider the interaction of the unit of charge with Planck's constant -- ($\hbar\, e$). If we take out the velocities via dividing by (c^2), this expression looks very much like the interaction of two of our proposed constant particles: the proton and the neutrino. If we use the same radial distance for each component, the distances cancel leaving us with two interacting masses.

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* $(\hbar / c\ \%)\ (e\ \% / c) = \hbar\ e / c^2 = 1.876\times10^{-70}\ \text{kg}^2$.

The square root of that comes out to 1.369×10^{-35} kg.

If we use the electron instead of the proton, we get:

* $m_e\ (\hbar / c\ \%) = 10.12345679\times10^{-74}\ \text{kg}^2$.

We take the square root and get: 3.18×10^{-37} kg.

This naturally falls right in the middle between our idealized neutrino mass and the electron mass. The electron has charge and the photon does not, nor does the neutrino. Here we have replaced a photon with a neutrino in an interaction. We divide by the fine structure constant squared, which is the probability of the photon-electron vertex interaction, and add another electron mass for the other vertex. That brings the "average" mass pretty close to the electron threshold:

* $(m_e^2\ m_{ne})^{1/3} / a^2 = 8.446\times10^{-31}$ kg.

This gives us a threshold for vertex interactions of electron pairs and neutrinos considering both charge and electrical influences. We get an "average" mass that is right about at the electron. We have imagined an electron emitting or absorbing a neutrino instead of a photon, an event that does **NOT** occur as far as we know. Why not? Why don't electrons decay into neutrinos or absorb them? **This never happens**, thereby locking in conservation of quantum charge. There can be lepton mixing, but not so as to violate conservation of charge. This is an important observation. Maybe neutrinos really are of a different species than the leptons (electron, muon, tau). Maybe neutrinos are free quarks or quark sparks!! But then we have to show how all quarks really lack charge, -- which is definitely not in the standard theory!

* $m_e \rightarrow m_{ne} + \gamma$??? ($\gamma$ = Photon).

Electrons are very stable and do **not** decay individually into neutrinos. What we wrote above was **not** an interaction.

* $m_e^- + m_e^+ \rightarrow \gamma + \gamma^*$. ($\gamma^*$ = anti-photon)

Electrons DO annihilate with positrons. The neutrino pair may constitute an invisible transition stage in a pair annihilation cascade. The neutrino pair then annihilates into photons.

* $m_e^- + m_e^+ \rightarrow m_{ne} + m_{ne}^* \rightarrow \gamma + \gamma^*$.

If extra energy is added, the outcome can be boosted to muon neutrinos, or even a pair of muons or taus. The electron and positron charges balance, so we do not see any charge reflected in the neutrino outcomes, and that is no problem there.

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The standard QED Feynman diagram has two electron trajectories converging at a photon trajectory to form a Y-vertex. The electron is a one-way trap. A single electron can move up to become a muon or tau, but it will not decay back down into a neutrino. That, in itself, is a clue that maybe the neutrinos belong to a different species, but just happen to show up a lot with the charged leptons -- as their sidekicks, I like to say, since I used to be a fan of Lone Ranger and his sidekick, Tonto. Electron decay back into photons by particle "annihilation" is very useful for locking in the stable EM theater of the electron and proton. The proton is another stable window that goes up, but not back down -- except by antiparticle annihilation. These two resonating energy harmonics, electron and proton, are very stable self-reinforcing loops of energy. They work together, but each has a specific identity, though they have equal and opposite charge.

We are carving out a rough first draft at solving the mystery of the neutrino's lack of charge but presence of fermion spin (like a Newtonian calculation for a black hole) with a general approach which we can then refine.

Perhaps the tau neutrino (discovered in 2000) is like superheated water that has not yet boiled. The tau tends to either oscillate flavors or rapidly decay into smaller neutrinos or a neutrino and an electron-positron pair, or perhaps even a neutrino and a hydrogen atom. These decay paths also suggest that the tau neutrino may be a form of evanescent free quark. The triple neutrino could be a quark triplet and result in a neutron or even a hydrogen atom.

Now let's begin to sketch a tentative theory of leptons assuming that the neutrinos are a kind of **free quark sparks**, "quarks" all being **confined** rather than free, and thus questionable as actual fundamental particles. I call this theory tentative, because we could use a lot more solid information about neutrinos and quarks. Our theory will look a little bit like quark theory, and it will run right on from the neutrino leptons into the baryon quarks without stopping for tea. I call it the neutrino-quark bootstrap ladder. The energy resonances and exchanges have to be worked out in detail and experimental data (such as neutrino masses) are missing or imprecise, but here is the basic scheme.

We recall that our model for all baryons is a pair of B_u bosons resonating together. The neutrino complex occupies the lowest mass-energy window in the form of quasi-quarks. The B_u boson pairs are like energy bubbles that may not have any inherent charges. Such boson pairs can and do radiate neutrinos as well as their usual protons and neutrons, as is shown by neutron beta decay. With the appearance of the third "quark" in the overlapping lens we now have a 3-body system. Each B_u boson, is a spin-one boson made of two half-spin fermions coexisting and orbiting around each other. The mini black hole becomes a spin 1/2 fermion. The radiation loop for the basic neutrino is equal to a neutrino mass -- too small to generate a charge, and sometimes too energetic to swallow back again -- which explains the decay of neutrons by emitting an electron and an electron antineutrino. Both are too energetic due to the Heisenberg relation to stay in a free neutron, so the neutron has to let off "steam" so to speak.

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The radius of the proton is around 8.8×10^{-14} m. The proton's reduced Compton wavelength is about 2.1×10^{-16} m. The reduced Compton wavelength of the electron is about 3.86×10^{-13} m and the classical radius of the electron (**Wikipedia**, "Classical Electron Radius") is:

* $$r_e = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{m_e c^2} = 2.8179403267(27)\times10^{-15}\mathrm{m}$$
* $$r_e = \frac{\alpha\lambda_e}{2\pi} = \alpha^2 a_0$$ (where λ_e is the Compton wavelength)
* $$r = \frac{k_C e^2}{m_0 c^2} = \frac{\alpha\hbar}{m_0 c}$$ (where k_C is Coulomb's constant, a is fsc, m_o is any rest mass.)

The neutrino's "'wavelength" is probably over 3 meters, which means that it normally is a very spread out wave of energy. To fit inside a proton or a neutron, a lepton has to be scrunched up like a tightly coiled spring, or it has to be held in place by the internal black hole lens of the proton or neutron. The nucleonic lens has an effective mass at that scale of about 5.4×10^{8} kg, and this is what accounts for the so-called "strong" force.

Nucleon Inner Workings and Interactions

Now we can do some "napkin" calculations to get some rough idea of what might be going on inside the nucleon and between protons in a nucleus. Suppose we have two charged leptons interacting at a distance of about 10^{-14} m inside a nucleon. The radius of a proton is commonly thought to be about 10^{-15} m, but we will give it some flexibility. The Coulomb constant k_C times the charge squared e^2 is about 2.307×10^{-28} kg m^3/s^2 and we divide by about $r^2 = 10^{-28}$ m^2, which gives us an electrical force of about 2.3 N. This can be attraction or repulsion, depending on which charged leptons are interacting. Two positrons push apart, but an electron nearby cancels most of the charge of one positron (also canceling some of the space between them), so the proton has net +1 charge with two positrons that can coexist with an electron plus gravity canceling their repulsion. The quark energy acts as a buffer and also adds mass.

Consider the gravitational force at the B_u scale where the electrical and gravitational forces balance. There seems to be an overall interactive gravitational mass of 1.67×10^{-27} kg for each proton. Consider two protons in close proximity. Again we have an electrical repulsive force of about 2.3 N when their charge centers get to be about 10^{-14} m apart. According to Heisenberg uncertainty, if the proton separation is probable within a range of 10^{-10} m, then there is a probable motion by the proton of 10^{3} m. What happens if the gap brings the protons to within 10^{-15} or 10^{-16} m? According to Heisenberg's uncertainty relation, this imparts more momentum to the proton, tending to drive it away. We assume that the proton mass is constant. However, if the shift is between 10^{-15} and 10^{-16} m, it forces the velocity to accelerate past c. The only other recourse is for the proton to increase its mass. A change in the probable separation to 10^{-15} puts the velocity up to c. So any increments in this range of probability will increase the probable mass of the proton considerably, and this will manifest as the production of a new particle, probably a proton or a neutron -- or a mass arising from

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below the zero point in the Dirac sea. Perhaps such shift of proximity even may produce many such real or virtual nucleons. $(10^{-27\ +8\ -15}) \rightarrow (10^{-26\ +\ 7\ -15}) \rightarrow 10^{-34}$. Maybe this turns into relativistic mass increase in the microworld.

So there are many forces at work: gravitational force, Coulomb force, Heisenberg uncertainty, Hawking radiation, relativity, and so on. In any case, if a particle shifts position (i.e., moves) faster than light within a very short distance, it might as well be considered two or more particles. Einstein would say it is relativistic mass increase. Others would say it is nano-black-hole dynamics. Basically among nucleons and among the lepton components of nucleons there is inherent uncertainty about the position, mass, and motion of the participating components because of the small scale. If Einstein is right about relativity, then the density of mass and hence the gravitational force goes way up at extremely small scales. Others speak of a hypothetical strong force with various color charges when atomic nuclei form clusters of nucleons with a binding force stronger than electric charge. The hypothetical strong force is supposed to hold the protons together. This may provide the "asymptotic freedom" that defines the behavior of the strong force and the quark interactions. However, we may not need any new strong force that suddenly appears at nuclear range. Quantum chromodynamics (QCD) with its various "gluons" may just be a complicated way of explaining the phenomenon.

We know that there is electro-gravitational equilibrium when the interaction of two like quantum charges is balanced by a product of any two interacting masses that comes to $3.456896408\times10^{-18}$ kg^2. The mathematics says nothing about how the mass should be apportioned between the two interacting particles. From a quantum mechanical perspective the mass could be anything, but will tend to fall in the waterholes of stable quantum particle masses. A proton (1.67×10^{-27} kg) can be electro-gravitationally balanced by another particle with a single positive charge and a mass of 2.0667518×10^{9} kg. Do you see a mini black hole here spitting out a proton by Hawking radiation? Each additional nucleon adds another over 10^9 equivalent of nuclear mass from beneath the zero-point surface of the Dirac sea. This tends to crunch the nucleons closer together. Thus the protons tend to stay in the nucleus and not move away.

This "Dirac" mass could fluctuate, perhaps up to 10^{10} kg, but will tend to respond to the nucleon and lepton "watering hole" masses. We will discuss more about this in the next two chapters after we go into details about the quarks, nucleon structure, and an overview of how atoms and molecules form. As nucleons are added to a nucleus, there is also a tendency to add neutrons that add more mass but no additional charge. The key point is that if the protons move slightly apart, their charge repulsion and the gravitational force drop off rapidly until the protons are easily peeled off the nucleus. The hole continuously spits out protons and neutrons due to its Hawking radiation, but they do not go far. They only experience what physicists call "zitterbewegung", a kind of jittering vibration, an interference between positive and negative energy components.

Nuclides with even *Z* (atomic) and *A* (mass) numbers tend to be more stable, and as the nuclide gets larger, it tends to get less stable. Of 90 naturally occurring elements on Earth 81 have at least one stable form. Technetium (43) and promethium (61) have no

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stable forms, and both have odd atomic numbers and technetium also has an odd number of neutrons. From radium on through the actinides, all nuclei are unstable. This indicates that these fat nuclides (Z 88 and above) begin to extend outside the strong influence of nuclear gravity, so the binding force drops off quickly. Radioactivity usually takes the form of alpha particles (helium nuclei), protons, neutrons, beta particles (electrons and positrons), neutrinos, and gamma rays (photons). These forms of radioactivity may be considered examples of Hawking mini black hole radiation and also include some ephemeral particles such as mesons. Collisions among heavier atoms or bombardment by energetic light elements can also cause heavier elements to split into various lighter elements. The details of nuclear chemistry go beyond the scope of this book, and what I have mentioned is only to show that atomic nuclei can be split or fused, though splitting is generally easier than fusing, and varies with the size and composition of the individual nuclei. The union boson theory of baryon creation accounts for the ability of protons to exist in close proximity so as to form nuclides in spite of their charge repulsion.

Neutrino Looping

The looping photon energy of the free neutrino doesn't realize that it is looping in a cycle and thinks that it is still out cruising in space. Relatively speaking on the level of scale (about 16 degrees of magnitude) it IS out cruising in space. A neutrino is quite spread out and fuzzy due to Heisenberg uncertainty once it leaves a proton event horizon. Some interpret it as a wave propagating through the quantum "grid", which is what some like to call the quantum aether. What appears to be empty space to us is filled with energy that is in equilibrium, and that includes electric and magnetic charges, but most importantly the aether has an energy density that is inversely proportional to its scale. This is reflected in the way that shorter EM wavelengths have greater energy. Theoretically it would seem that a zero wavelength would have infinite energy, but that is not the case. Energy does not exist in a static condition except as a potential. It only can manifest kinetically over a finite distance, so any measurement of energy, as any measurement of displacement, must involve an interval, in other words a $\Delta\lambda$, Δv, ΔE, or Δp. Energy and momentum, time and space, are limited by Planck's constant:

* $\Delta E / \Delta v \geq h.$
* $\Delta p \, \Delta x \geq h.$

An inertial system is equivalent to being at rest. If there is change in position, there must be a change in momentum. But if $\Delta x = 0$, there is no change in position or momentum. However, the natural value of h is 1, not zero. It is the ground state defining reciprocal relations. Thus a tiny change in position generates a large change in momentum. Momentum is mass times velocity. The maximum physical velocity is c, and the maximum physical mass is the mass of the universe: $E_{tot} = mc^2$. This m includes all rest mass and kinetic mass. Velocities above c up to infinity become phase velocities, and only exist relative to spatial interactions with other viewpoints, such as two parallel plane surfaces coming together. So zero velocity means inertia, and infinite velocity is simultaneous phase interaction of two inertial systems. The physical constants that contain mass (h, G, ε_o) automatically define limits to the amount of mass-energy available to the finest level of the aether.

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Neutron Clumping

We need to get further into the details of the proton inner structure and immediate neighborhood to see what might be going on there. But a neutron definitely needs to be bolstered by one or more protons to hold onto the energetic quantum jiggle of its internal electrons and neutrinos. Neutrons by themselves tend to clump together slightly, but have no net electrical charge, so they mostly just randomly bang around in the environment and are generally invisible. Experiments may be possible to show evidence of their existence. They would only clump to a certain degree and then start shedding neutrons or experience beta decay. Clumps of neutrons only begin to play an active role when they lose electrons and thus gain charge or combine with protons to make atomic nuclides. The simplest ones are the stable but rare deuterium D ($^2_1$H) and tritium T ($^3_1$T), which is unstable and beta decays into helium 3. ($^3_1\text{T} \rightarrow {}^3_2\text{He}^{1+} + e^- + \nu_e$*) It seems very likely that tritium can evolve from a triplet of neutrons that first has one beta decay and then a second one. The first decay is just not noticed because the neutron has no charge and such an event is not being looked for.

Perhaps what we end up with in a proton or neutron is that the B_u ensemble makes quark triplets that each have no charge and net spin 1/2. Loosely bound B_u pairs become unstable mesons, also without charge, and quickly decay. The B_u quark is an unstable bubble of energy that can throw off sparks (neutrinos) of energy and whorls of energy (charged leptons). Only the charged leptons (e, μ, and τ) have charge and are spin 1/2. Quantum spin is connected to charge in standard theory. In this analysis it seems that only those three kinds of tight photon whorls have charge.

We can think of the neutrinos as "clumpy" photons, photon bubbles, or quark sparks rather than whirling "point" particles like the charged leptons. Free neutrinos are big, fuzzy, and spread out, have very tiny rest masses, and no charge, but spin 1/2. They can oscillate as they pass through the aether shifting in their mass-energy values (electron, muon, and tau flavors), but we are unable to observe that directly. We can only detect with great difficulty a few neutrinos when they interact with other particles. So, as far as we are concerned, the neutrinos, especially the fatter two kinds, are virtual particles that exist only as slight disturbances in the aether. So the neutrino mass-energy boundary is not so well defined. There is a large energy gap between a low energy electron neutrino and an electron. But the neutrino easily can move at nearly light speed and thus carry a lot of relativistic momentum. It is a slippery customer and can get highly energized, a condition that makes it appear much more massive than it really is.

When it gets energized, it rapidly increments by multiples of quantum neutrino masses. At some point of incrementing neutrino masses (which could be a whole slew of them moving along together from an emitting source), the resultant mass becomes a muon neutrino. This is a relatively stable window, and much more clearly defined as a particle. A growing neutrino can rest there. As we get a better experimental value for muon neutrino mass, we'll know better why that is a good window. We can think of a muon neutrino as a momentary (10^{-6} s) skinny free quark. **Three muon neutrinos** just about have the mass-energy of an electron, but are still without charge -- unless under

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certain circumstances they can take on charge:

* 3 (0.17 MeV / c^2) = 5.1 MeV / c^2.
* $m_{n\mu A^-} + m_{n\mu E^{+*}} + m_{n\mu A^-} \rightarrow 1\ m_{e^-}$.

Each proto-muon neutrino has a rest mass of about 3×10^{-31} kg, or one-third of an electron (by the additive relation).

This relationship suggests that a mutrino (muon neutrino) is made from an increment of eutrinos (electron neutrinos). Neutrinos can appear to clump just like neutrons, and, of course, the quarks that make up the neutrons. Unlike quarks, eutrinos and mutrinos are not always bound. They are much lighter than quarks. I believe the charge of the electron has to do with the electron vortex dynamics. The electron behaves as a quasi-"point" particle because it forms from a whirling photon vortex that is tightly contracted and has a central focus or source singularity. This is quite a contrast from the eutrino that is spread out over a fuzzy region that can be at least several meters long. My model of the electron neutrino is a pair of photons (rather than a photon-antiphoton pair, $\gamma\gamma^*$) interacting like a tiny binary system. At the level of electron mass, the energy begins to really focus like a small top spinning around a point. This is the beginning of true "particles". The eutrinos are not yet full-fledged particles. They do not have a non-local circuit that emits and absorbs EM radiation ($\gamma\gamma^*$ pairs). However, mutrinos do not exist as stable free particles just as quarks do not exist as free particles. They transform a bit more slowly (in about 10^{-6} s) than quarks that almost immediately morph into another configuration (possibly passing through a meson phase with local virtual quarks). Mutrinos only occur under certain conditions of lepton mixing. Even then the charge conjugation makes "charged mutrinos" virtually undetectable, just like neutron clumps. So the electron usually runs about in space or gets grabbed by protons, which are also positive and have heavier mass.

We have the funny situation that inside the protons are quarks that seem permanently confined because of the low average environmental energy levels and because of the B_u-mini-quark process. This leads us to some tentative ideas:

1) The neutrinos are free "quarks".
2) The "charges" of the neutrinos are "externalized" in the charged leptons.
3) The tau neutrino is like a very light neutron. It is relatively stable, but can decay into electron-positron pairs and lighter neutrinos. (No one has actually seen a tau neutrino. It is only an inference based on conservation of energy and angular momentum, and probably is a highly clustered clump of electron neutrinos.)
4) The tau lepton is really a hadron in disguise, the only restriction being “conservation of lepton number” during decay.

Secrets of Spin

The spin issue is important in all this. In 1987 the "proton spin crisis" occurred when it was discovered by the European Muon Collaboration (EMC) that, contrary to expectations, the spin of the proton was not governed by the spins of the quarks. When

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we put this together with the connection between spin and charge, we come to the possibility that the quarks may not actually have any charge. In 2008 they found that the quarks account for a bit more than half the proton spin and the rest is thought (rather vaguely) to be the result of the quarks' "spatial angular momentum . . ., relativistic effects, and other QCD properties" (**Wikipedia**, "Proton Spin Crisis".) I theorize that the quark triplet is really the B_u pair and its attendant "mini black hole". I also call B_u pairs heavy bosons. As such they should form a spin 1 particle, really consisting of a spin pair like the photon-antiphoton pair. That adds up to 3 half-spin components, for a net 1/2 spin. Then all the leptons in the ensemble balance out their various spins. That leads to as many as 5 more half-spin pairs that all balance out. The quarks are then without charge, and they account for a minimum of 3/13ths (about 23%) of the spin components of a baryon, or 1/3 of a proton. The maximum may be 100% of the spin.

* p^+ = 3 neutral quarks + 2 e^+ + 2 ν + e^- + ν*

There is also the (e^- + ν_e*) that is emitted when a neutron beta decays into a proton. Thus a proton has 9 components and a neutron has 11. We will get into the quarks in more detail a bit later.

If a charged lepton inside a baryon should have a neutrino sidekick (as neutron decay strongly suggests), then we must wonder about the antineutrino sidekick for the core electron. This question is akin to the question about the chirality of neutrinos. Why are all neutrinos left-handed? My theory is that the right-handed antineutrinos split off and become part of our consciousness at the foundation of "creation". Anti-photons are the "material" of attention (light subjectified by an observer viewpoint), and right-handed neutrinos encode special photon waves in the aether that form part of our deep Akashic memory.

At the core of each proton is a positron with the extra positive charge that is characteristic of the proton. The positron has a sidekick neutrino that is a particle that helps the corresponding right-handed neutrinos of **memory in your non-local mind** to know the **position and condition of every baryon in the universe**, including both protons and neutrons and other normally unstable high-energy baryons. In this manner the full potential of consciousness is able to be aware of and indeed resides in the core of every bit of matter. So the neutrinos seem relatively uninvolved, but actually the fact that they spit out during particle decays indicates that they indeed play a fundamental role in the construction of matter and in what happens to matter. They, the photons, and the quarks represent the role of **neutral attention** at the finest level of material phenomena. However, only the photons and the electron neutrinos are stable outside of nuclei. Quarks are not. So in the proton we have three chargeless quarks (spin 1/2 for each), two positrons (each with spin 1/2 and a two spin 1/2 electron neutrino sidekicks), plus an electron whose antineutrino sidekick is locked inside your mind as a nonlocal memory attention particle so you can track the proton, and thus is not observable in the physically expressed particle, but still adds its relative spin. Neutrons are the same, except that they have an extra electron and antineutrino inside, and the electron's negative charge cancels the second positron's extra positive charge leaving the neutron with a net neutral

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charge but a telltale magnetic momentum. The second antineutrino inside a neutron is there to track the neutral attention component related to the external changes occurring with nucleons. When the second electron leaves a neutron, the antineutrino also leaves making a record of the event in neutral awareness. The electron leaves a record in charged awareness that results in an external negative charge and a proton's internal positive charge.

Our sketchy neutrino "model" allows for the 1/2 spin of the neutrino and its neutral charge whenever it is observed directly or indirectly. It also provides a mechanism for integrating not only the lepton family, but also integrates that family with the hadron family, showing that they all arise from harmonic vibrations of our single (B_u) pair interacting at the crossover point between electromagnetism and gravity.

Our model for the generation of the leptons and lepto-quark unification suggests that just as charge, spin, and energy behave quantum mechanically, rest mass also is completely quantum mechanical. This should not be a surprise. If energy is quantum mechanical, governed by ($\hbar$), then via Einstein's mass-energy relation, we expect mass to be quantum mechanical: for example, $\lambda = h / m\, c$.

Thus quantized, every mass is some multiple of the fundamental neutrino mass quantum unit: ($n\, \hbar / c\, \%$), where n is a quantized scaling factor -- 1, 2, 3, . . . , and % is the scaling displacement relationship between $\hbar$ and c.

* $\boldsymbol{E_q = (n)\ (\hbar / c\ \%)\ (c^2) = (n)\ (\hbar\ \mathbf{c}\ /\ \%).}$

This is an important principle in quantum mechanics that needs emphasis: the mass quantum unit that corresponds to the energy quantum unit.

The (%) represents the fundamental wavelength of the electron proto-neutrino, or eutrino.

* $E = \hbar\, \boldsymbol{c} / \boldsymbol{\lambda} = \hbar\, \boldsymbol{c} / \%.$

We set ($\boldsymbol{\lambda}$) at a wavelength of % = 3.16227766 meters and we get an energy of 10^{-26} J. It is hardly a very solid particle. It has a frequency of about 94 MHz, which is in the microwave VHF range. This suggests that we can make eutrinos easily using microwaves and ordinary light. X-rays can make very excited electron neutrinos. As the neutrino becomes more and more energetic, it appears to move faster and its wavelength appears to shrink. By the time we get to a mutrino, the energy is 2.733×10^{-14} J, and the wavelength becomes 1.15×10^{-12} m. The frequency is right at the boundary between gamma rays and cosmic rays. Muons are like low-end cosmic rays, which is probably why cosmic rays hitting Earth's atmosphere "decelerate" and generate showers of muons. Electrons are in the same region, just slightly more energetic. By the time we get to protons, we are in the middle range of cosmic ray frequencies.

These energy ranges are within the capability of modern technology to use energy resources to suck particle pairs out of the vacuum aether using particle "bait". Even

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proton pairs can be generated in this way. The electron's wavelength comes to 3.8×10^{-13} meters. This is (8.2×10^{12}) times smaller than the electron neutrino wavelength and gives an idea how much more focused the electron has become compared to neutrinos. Divide 3.16227766 meters into 8.2×10^{12} tiny steps. One of those steps is the electron's footprint compared to the neutrino. (Of course the electron's footprint as a wave packet can spread over time by Heisenberg uncertainty, but we are just making a scale comparison.)

With regard to the low flux of solar neutrinos reaching earth compared to the predicted amount, we propose that there is a tendency for neutrinos to "decay" from high energy fast moving particles to slower moving ones which are not detected by the earth-bound neutrino detection experiments. This slowing of neutrinos suggests that their kinetic energy has been converted to mass. According to our model we would expect this to occur, for example, in an analogous way to stellar nucleosynthesis. If the high temperature and density of a star can "cook" up higher increments of the proton in the form of heavier nucleons, the periodic table of elements, then we would expect it to do the same much more easily for neutrinos. Many of the neutrinos produced by stellar processes are "cooked" in the sun's core until they become stabilized as mutrinos or tautrinos, or even electrons and protons. These move at a much slower pace than electron neutrinos. Others have thought of this possibility (at least the heavy neutrino part), and experiments are under way to test this hypothesis more thoroughly. Researches since this was written have confirmed the existence of neutrino oscillation as my analysis predicted in the early drafts of this book. The oscillation would be caused by energy "beats" in the aether's EM grid, analogous to the way two sounds can interact to generate oscillating wah-wah beats.

The handedness issue with neutrinos is a symmetry breaking, and you've got to stay with your choice from the start unless you want to go back and start all over with a new ecosystem, which of course is always a theoretical option, but doesn't solve any problems.

When the first transcendental observer looked at a photon in such a way that she split it into two opposite eddies, she created left-handed neutrinos and right-handed consciousness. So that's the way it is in our current universe. Most of the particles in the universe are neutrinos. Theoretically in the Unified Field they are of both kinds. But the neutrinos that form our universe are all left-handed. Furthermore, they are the basic building blocks of all physical matter. Once the system was set, it copied itself into all the bricks that built the building, the same way that every living organism on the planet has a common chemical template of RNA-DNA marked by molecular "handedness" from which it builds its physical structure. Thus Observer Physics predicts that chargeless right-handed neutrinos represent an important quality of neutral awareness in an observer.

There is a story that when Penzias and Wilson were working on an antenna to monitor celestial radio signals, they thought bird droppings were causing static interference in their signals. They tried cleaning the antennas and adjusting them this way and that, but

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nothing got rid of the annoying and puzzling noise. Finally they realized that they were listening to the echo of the Big Flash when electrons suddenly dropped out of the cosmic soup into orbits around protons and released a vast cosmic flash of photons.

The same may be true for the puzzling over the neutrino helicity. When Goldhaber and others began finding that neutrinos always seemed to be left-handed, they thought it was an anomaly. How could a type of matter have a preferred direction? Such an idea violates our "instinctive" notions about balance and symmetry. Further work has shown this pattern to be universal. The only exception is a relativistic effect with heavy neutrinos, where they can look right-handed due to relative motion.

This "handedness" may be the appearance of "proto-charge". The neutrino is too small to carry a charge, but it does have a preferential twist that corresponds to a charge. Antineutrinos have the opposite twist, just like heavier antiparticles have an opposite charge to their particle twins.

When particles are created from photon energy in the vacuum state, there is conservation of parity and angular momentum. Photons do not care which direction they go, although they may be correlated due to initial conditions. The photon couplets ($\gamma\gamma^*$) have linear momentum, no charge, and a spin of $(1/2) + (1/2) = 1$. When a photon curls into a particle, its partner antiphoton splits off. Half the team becomes a particle with inertial mass (a fermion), and half becomes a antiphoton particle of consciousness with mental mass (call it a "memnon", a type of attention particle). The one makes physical matter, and the other makes mental matter -- seeds of thoughts and ideas. This is how attention creates solid matter. This is also why the fermions -- the source of solid physical objects -- only have half-integer spins. The other half is spinning somewhere in the vast space of consciousness that precisely mirrors the physical world. The appearance of a physical world is a kind of schizophrenia. We are looking through a vacuum state lens in which we imagine we are seeing things that are not really there. They are virtual phenomena. What we are seeing is just a reflection of our own resistance to our attention that has created a viewpoint that we decided to abandon. So we set it adrift upon the field of all possibilities. And in so doing we set ourselves adrift on the same ocean of consciousness. This is relativity again.

The position of the observer in the operation that generates the primordial Ur-particle is "non-local". There's no other choice, since no "place" exists at that level. This generates a relative momentum between the observer and the vacuum state. Since the vacuum state is undefined and unobservable, we can not see the "right-handedness" of unbounded awareness quietly spinning in the vacuum. That is what we ARE as source. It's hard to see yourself. But you can see your reflection in the mirror. The only trace we have of this event is recorded in the neutrinos moving with left-handed helicity. They are mirror reflections of the "right-handed" attention particles spinning in consciousness!!

We mentioned earlier in our discussion that we could think of the neutrino field as a kind of Akashic record -- or Ritam (Right Awareness) tablet -- on which are recorded certain

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key events in the unfolding of the universe. The left-handed helicity of neutrinos is such a record that far predates the Big Flash recorded in the background radiation. This valuable piece of information about the history of our cosmos goes back to the moment of symmetry breaking that separated gravity from the electromagnetic field. It is a simple recording found everywhere for all time in the record of this universe cycle. It will be erased only when the universe dissolves back into the pure vacuum state of the Unified Field. The apparent loss of "handedness" in particles occurs as particles increase in mass and complexity in exactly the same way that time reversibility appears lost as particle systems become statistically huge on a large scale. The result for statistical systems is a washout of T invariance and the onset of the illusion of "entropy", a fascinating subject that we will explore in later chapters.

The mass-energy system works just the opposite. Greater mass-energy brings particle systems closer to an image of the unification from which they sprang and restores the lost symmetry. The tau neutrino, or tautrino, shows helicity preference fading even though its charge is neutral. The electron with its charge has lost it quite thoroughly and so have the other more massive particles. Electromagnetic and gravitational tidal forces that are much larger wash out the neutrino helicity preference. Only the neutrinos are quiet enough, small enough, and uninvolved enough to retain a memory of it.

I propose that the left-handedness of neutrinos is a peek into the very beginnings of things -- the first observation, when God (whoever He or She is) sitting in the void of the vacuum state said, "Let there be Light," and then there was Light, and then He (She) looked at it and saw that it was good. But it wasn't good. Because He couldn't see anything. Everything was still blank. So He tried "turning around" in transcendental space to see what He had done that didn't work. He rotated his viewpoint so that He got a light field (c^2). He found that He could only "see" the light if He rotated 180 degrees. What He saw was Himself in the mirror, the first conjugate pair. Unfortunately, He still didn't see any "thing" because He had no body, no terminal with which to absorb the light.

This was not real "seeing" yet, because He had no electrons to absorb the virtual photons. They were still just virtual photons fluctuating in the vacuum state. So He had to shift viewpoint again and look at a photon in such a way that it seemed to curl up and chase its own tail. So He shifted 90 degrees and into transcendental space again. From transcendental space straight lines look like little circles and planes look like little bubbles, just like from a point in space transcendental space looks like a big bubble sphere. This is another conjugate pair. It is a fundamental principle of projective geometry, with which we have already played enough to grasp this mental perception.

But when He did this, He had to "peel off" the advanced photon of His attention from the photon pair. This meant one photon shifted into transcendental awareness, turning it into consciousness with little bits of attention spinning in it. The other photon seemed to continue whirling around endlessly in a circle like a tiny automaton. It was a tossup situation, but, yes Einstein, God flipped a virtual coin to break the symmetry into a "right-handed" consciousness with no boundaries and a "left-handed" creation spinning in

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boundaries. [He did this trick again on another level when He created DNA-based organisms and again with sugars. Then we could "tell" which was right-handed and which was left-handed.]

By this time He was getting really frustrated. He still didn't see anything. He tried to throw his arms up into the air, but this was hard to do because He had no arms and there was no air. But the virtual idea existed in the vacuum state as a possibility. And putting attention on the idea began to shift it from a mere possibility toward becoming a reality.

He did notice that now the vacuum was spitting out virtual neutrinos as well as virtual photons. The neutrinos were stable and could continue, while the photons were still just virtual photons. The two did not interact, so not much was going on. And there was another funny thing. Just like his photons that came in pairs, the neutrinos came in pairs. The real pairs were virtual B_u particles. He actually let the vacuum spew out all possible pairs, but only the B_u's had the right size so they could balance His true desire (gravity) and his frustrated resistance (electricity). He did not notice it, but He also now had a preferred helicity in his consciousness. He did notice that the neutrino helicity tended to be oriented in the opposite direction of the particle's momentum. This was an echo of his advanced photons. Now He was observing something "externally" that had previously just been His own attention. As He got more and more interested in this virtual bubble, His attention focused more and more until He pumped so much energy into it that the whole idea burst out of the vacuum as a reality that corresponded to the intensity of his attention energy. Most of it quickly dissolved back into the vacuum, except for a bunch of these B_u pairs with photons whipping around at just the right frequency so that everything balanced when they conjoined into a binary system. The resultant energy found its ground state as the neutrino B_u pair, the original Adam and Eve of matter. Only those that married survived. So some B_u neutrinos survived the first great extinction. But those that survived were neutral and did not interact in any interesting way. They also were identical.

What's more, now He had two "eyes" combined into one consciousness and two bosons becoming one fermion. Why was it a fermion? Because there was also a heavy core particle in the middle that gave an extra spin and a resultant mass. Aha! The core particle could have almost any mass value, just like we have seen for the Heisenberg relation. By playing the whole range of quantum increments on his heavy electric guitar, he found that certain values were inherently more interesting because of their stability and mutual interactions. Two of these happened to be the electron and the proton. But they had very unequal masses differing by a ratio of about 1836/1. This allowed him to use the play and display of desire and resistance to create more and more complex electromagnetic configurations of resistance and build a whole universe. With the electron and proton he finally saw himself in his true identity. It turned out he had a proto-family all linked together in and made entirely from His frustrated resistance to pure Euclidean-geometry space:

* $m_p\, m_e / m_{ne}\, \varepsilon_o\, a^2 \approx \%^3$.

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* $\boldsymbol{m_p\, m_e\, m_{ne}{}^* \approx \varepsilon_o\, \%^3\, a^2}$.
* $\boldsymbol{m_p\, m_e\, c\, /\, \hbar\, \varepsilon_o\, a^2 \approx \%^2}$.

Division by the neutrino means an anti-neutrino. The alpha squared is the charge interaction of proton and electron. The electric constant is the fundamental mass density of free space. The anti-neutrino and electron did not make sense by themselves. First there was big Mommy ($\boldsymbol{m_p}$). Then there was little Daddy ($\boldsymbol{m_e}$), and then along came tiny baby ($\boldsymbol{m_{ne}}^*$), or maybe baby came first and then the parents. They lived and played together in a spherical quantum bubble called the Garden of Eon ($\boldsymbol{\varepsilon_o\, \%^3\, a^2}$).

With His proto-family all working together, he finally had a neutron that decayed into a hydrogen atom, the "clay" of the physical world from which to build an image of himself with stars in his eyes and a scale by which to ascend the heights of evolution.

So the Union **Ensemble** ($B_u{}^2$) seems to form the whole First Family all at once, not as separate unrelated events. The Garden of Eon is a density. The Vacuum has a built-in constant resistance to mass-energy, because by its nature it is empty -- a perfect equilibrium. When the particle ensemble ($\boldsymbol{m_p\, m_e\, m_{ne}}^*$) appears in empty space ($\boldsymbol{\varepsilon_o\, a^2\, \%^3}$), the space permits only a certain density ratio of mass-energy per volume of space $\boldsymbol{\varepsilon_o}$ = 8.854×10^{-12} kg/m^3. This ensures a fundamental relation between physical matter (the World) and geometry (the Mind). Any ensemble must obey this relationship. By the principle of mass conjugation, wherever the ensemble appears, the resistive space it exists in also constitutes a diffuse particle we will call the ($m_{\varepsilon o}$).

* $\boldsymbol{m_{\varepsilon o} = (\varepsilon_o)\, (a^2\, \%^3) \approx 1.49\times10^{-14}\ \text{kg}}$.
* $\boldsymbol{m_p\, m_e \approx m_{ne}\, m_{\varepsilon o}}$.
* $(1.67\times10^{-27})(9.109\times10^{-31}) = 1.52\times10^{-57}$.
* $(1.111\times10^{-43})(1.49\times10^{-14}) = 1.655\times10^{-57}$.

This is close enough on a napkin that we know something is going on here. The vacuum aether has a curious property that **it itself is a particle playing with the family of particles it has created** -- and this also gives us another expression for the union boson that is made from the mass-density of aether and the geometry of spheres.

$B_u = (k_C\, e^2 / G)^{1/2}$
$B_u = (\hbar c a / G)^{1/2}$
$B_u = \text{Ss} / \pi\, k_C{}^2\, \varepsilon_o$

Below I summarize some major points confirmed by the new experimental findings about neutrinos that have emerged since 1999.

** Neutrinos definitely have mass.
** Kamiokande places electron neutrino mass in the range of .05 to .18 eV or 10^{-37} kg.
** The Majorana theory is supported. The neutrinos seem to be their own antiparticles.

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** The current standard solar model is now supported strongly, to the relief of solar scientists and astrophysicists.
** The Standard Model that predicts massless neutrinos is in trouble, although many already suspected this problem. The idea of massless particles that interact as fermions is quite a contradiction, just as bosons with mass cause a problem with the gauge theories.
** More of the missing Dark Matter gets accounted for by confirmation of neutrino mass. Other missing Dark Matter is turning up in the form of black holes. And later on we will present a theory that probably accounts for the rest.
** The missing neutrinos turn out to be muon and tau neutrinos that I predicted from my theoretical model that I developed in the 1990's.
** The neutrinos appear to either oscillate in the aether (quantum indeterminacy of mass?) between the 3 flavors as they travel....or
** Alternatively, Learned has proposed that they may decay into antitau neutrinos. Learned puts neutrino mass at .316 eV, or 5.62×10^{-37} kg.

More refined data and new findings will be forthcoming for sure. All in all these are very exciting developments.

I estimated the electron neutrino rest mass to be just over 10^{-43} kg (6.24×10^{-8} eV). But maybe I have neglected some factors in my purely theoretical approach. For example, if we include an (a^{-2}) coupling constant factor, that takes us down to 2.085×10^{-39} kg. That's only off from Learned's estimate by a factor of about 37 in 39 orders of magnitude. If we throw in ($4\ \pi$) that brings us to 2.62×10^{-38} kg. That brings us to within a factor of (2.145). That's pretty close to Learned's number and not far from Kamiokande. In any case, the research on neutrinos is hot and heavy these days and is bringing in exciting new advances to our knowledge about these mysterious particles. Neutrino physics is a great frontier. Neutrinos are like fossils from the beginnings of time that preserve a record of how the world is put together. We'll get to a much more refined neutrino mass estimate now that we have more people "believing" that neutrinos definitely have mass. Currently (**Wikipedia**, "Neutrino") the accepted procedure is to fudge all three neutrino flavors together: "0.320 ± 0.081 eV/c^2 (sum of 3 flavors)". See Hitoshi Murayama, "The Origin of Neutrino Mass", **Physics World**, May, 2002 for attempts to reconcile neutrino mass with the Standard Theory. Also see Clara Moskowitz, "New Experiment Aims to Crack Neutrino Mass Mystery", Scientific American, Nov. 4, 2014, tells of a new experiment to examine the neutrino oscillation, and James Foley, "Mass of Neutrinos Accurately Calculated for First Time, Physicists Report", Nature World News, Feb. 10, 2014 describes the rationale behind the fudge calculation of a triple scoop ice cream cone cited above from **Wikipedia**.

A lot of work with neutrinos is a subtle, low-energy physics, different from the approach of the high-energy people who like to scatter particles in colliders (although scattering is one way to generate neutrinos). I'm not criticizing the high energy work. It has great value and contributes much to our understanding. But other approaches are also worthy to be considered as well. By getting very quiet and subtle you can peer nicely into high-energy situations. Just find the right kind of lens, and you can magnify the whole

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situation. The background radiation discovered by Penzias and Wilson is a good example of this approach that allows us to measure a relic from the early universe. (However, care must be taken when trying to read oracles from the "tea-leaf" residue patterns of the Big Flash.)

The "decay" that Learned speaks of is like the one I mentioned. It is a backward decay from kinetic energy to greater mass. The idea of neutrino oscillation is very interesting. Because neutrinos lack charge, there is nothing to keep them from clumping. We need to understand why the so-called muon and tau neutrinos like those particular "clumps" and how that relates to their muon and tau partners. In my description of the photon behavior I mentioned that the photon pairs are constantly annihilating and recreating themselves because they are their own decay remnants. That's a nice recipe for immortality. You die and fall apart into another identical version of yourself. Just like magic. Of course this behavior is a reflection of the **conservation laws**. We saw this same principle echoed in our discussion of the proton's stability. We also saw it in the quantum phase shift related to charge. You "kill" the phase by shifting it by any arbitrary amount and it magically reappears in the same configuration. That results in conservation of charge.

The conservation of charge takes on added significance now that we know charge is the physical correlate to what we mean in the vernacular when we say someone has some charge on an issue. Charge means resistance. Conservation of charge means that no matter how you shuffle your resistances around, the thing or situation you are resisting will always re-appear with the same value with which you are resisting it. You have only two solutions. One is to neutralize your resistance, and the other is to transcend. When you transcend by just shifting dimensions, the charge remains. You just do not experience it temporarily from that transcendental (orthogonal) viewpoint. That is how martial arts work. Instead of absorbing a punch straight on, you shift until you are tangent to it, so the force slides by, and you can even direct the force with a slight touch. When you neutralize charge, it is still there, and you are in the situation, but it becomes virtual, and you feel no friction, stress, or other signs of resistance. The one approach requires you to become aloof. The other allows you to get into things without getting zapped or zapping something delicate. This is the purpose of grounding. It neutralizes built up charges. It lubricates relationships.

Whatever mass the electron neutrino is determined to have by experiment, anything below that neutrino mass threshold will have to be a photon. The photon can have effective mass due to its linear momentum. However, it has no rest mass, because photons never rest, even in principle, and even when they seem to be absorbed. Therefore, the lowest neutrino mass is a crossover point or threshold between matter and energy, rest mass and linear momentum. It is a fuzzy crossover, because it takes some buildup of mass before it stabilizes as "rest" mass. There is a range in which energy crosses pretty easily back and forth between wave mode and particle mode, energy mode and mass mode.

Also, the possibility that neutrinos can oscillate between or among neutrino "flavors"

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while they are zipping along is extremely suggestive from the viewpoint of our theory. Regardless of how other theories handle the situation, it seems odd for a particle to oscillate back and forth spontaneously between two particle states -- i.e. two masses. Nevertheless, in quantum mechanics this sort of thing can be quite a usual situation, since different outcomes tend to overlap when they are expressed as probabilities. With our theory oscillation of mass state is a natural possibility that becomes very probable at the low mass-energy level and chargeless condition of a neutrino.

We know the photon already does something very similar in its normal way of life. As it travels it oscillates with a wave motion. In the case of a very light particle such as a neutrino, the vibrations among nearby particles with similar momenta can be in a mode where they significantly cross-beat. This is a kind of wave mixing that sets up interference patterns. Standing waves in one direction and standing waves in a nearly, but not quite, orthogonal or parallel direction resonate with a phase difference that causes the particle to exhibit beats, much like two humming sounds that are very close to the same pitch, but slightly out of phase. The two hums combined make a wah-wah beating sound that alternately gets loud and soft. The resultant for a neutrino would be a mass that would oscillate from one stable window to another back and forth. To an observer it would seem to change from one particle to another and then back again as if by magic. This is particularly possible because the neutrino is smeared out in space quite significantly as it moves and its wave nature is quite strong. So two or more neutrinos traveling in parallel from the same source could easily mix and interfere constructively or destructively as they moved along. Because of the quantum nature of mass-energy, they would tend to pop back and forth from one state to the other.

As particles acquire greater and greater mass, the beats no longer spontaneously cause the particle to oscillate from mass flavor to mass flavor. The "stable" mass-energy windows are too far apart and the inertial mass is too high to completely shift to another particle. So instead the particles just wiggle in space-time with their zitterbewegung as they go along. This is why the electron has a wave function, and not just a function describing a classical particle moving in a straight line. The wiggling still strongly echoes the creation and annihilation capability of a photon and the flavor oscillation of a neutrino. When an electron orbits a nucleus, it forms only discrete quantum energy levels in its orbits. The wiggles of an orbit must be whole number values or the wiggle wave functions will interfere destructively and annihilate the particle, radiating all its mass away as X-rays, the same way matter falling into a black hole does. But none of that happens because of the quantum balancing act that brings kinetic motion into dynamic equilibrium.

If the neutrino oscillation evidence is more clearly supported by further data, then it serves to strengthen our theory. It also suggests that this effect can be deliberately modulated in the same way that atoms can be stimulated to emit photons of highly specific frequency and coherency. In nature the tidal forces in the heavier particles tend to disallow spontaneous "beats" from showing up in them, but you can see echoes of this in the swapping around of identities between protons and neutrons in the nucleus, not to speak of the quark mixing that underlies it. Of course, in our theory there is not a

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cluster of particles in the nucleus. There is only a proton resonating at some frequency so as to resemble a cluster of nucleons. But the principle is the same. The standing wave will exhibit periodic fluctuations due to the internal dynamics. And, as a standing wave, it can only allow whole number multiples of its base mass.

For example, in a deuteron we have a two-proton quantum level with a neutron "flavor" on one of the protons. The neutron flavor and proton flavor can rock back and forth from one side of the lens to the other as the lens vibrates. The extra quanta of energy shift from side to side as the lens vibrates up and down like a lenticular drumhead. Under the right conditions a group of individual protons could be set up to oscillate between neutron flavor and proton flavor just like a deuteron or a larger nucleon. But, since the neutron flavor tends to decay out at the low densities of individual particles, we need to use laser techniques to pump energy in and stimulate the process artificially. How might we do this?

Semi-Leptonic Charged Weak Currents

The energy exchange between proton and neutron is known as a charged weak current. The process is called "semi-leptonic" because it involves not only leptons but also hadrons, rather than only leptons or only hadrons. Weak currents can occur in all three combinations of leptons and hadrons. Probing the weak current of neutron decay takes us into the world of the weak interactions and the intermediate vector bosons (W and Z). The weak interaction works by analogy with the electromagnetic interaction, and we can use Feynman diagrams to represent it. As in the case of QED, we need to modify Feynman's drawings and couple two vertexes in order to maintain the conservation laws with a complete energy transaction.

Principle: All gauge bosons have spin 1 and lack charge. They function as mechanisms to exchange mass and energy and may also change the flavor of a quark. (Standard theory assigns charge to the W bosons and also includes a set of gluons, which are probably an unnecessary complication, since micro-gravity does the job of holding nuclei together well enough. The heavy masses of the W and Z bosons constitute a major problem for the standard theory that tries to use massless field theory to describe the interactions. Boson mass is not a problem for Observer Physics, because it is integrated at the core of the system in the universal constants and is explained as primary observer resistance.)

The example we will start with is the well-known beta decay of the neutron. Beta decay refers to the emission of an electron as the neutron decays into a proton. When this event was first studied, physicists were puzzled by the smooth continuous energy curve they got for the emitted electrons. The distribution falls in the range of 10^5 eV, with a peak at around 3×10^5 eV showing the maximum electrons. If the electrons had quantized energy units in the atom, how could they come out with a smooth energy curve?

The first realization was that these electrons were not coming from ordinary electron orbits as when an atom ionizes. They were coming from a nucleon dropping to a lower

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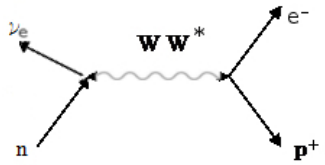
quantum level and releasing a "negative" orbit electron. But the question still remained. Pauli "solved" the problem by proposing the neutrino as the energy accountant. The combined energy of the electron and an antineutrino resulted in a constant value. So you can have a hot electron and a cool neutrino or a hot neutrino and a cool electron, but the combination of the two gives you the proper quantum of energy. It sounds like Pauli was cooking the books to keep the accounts balanced.



Neutron-Proton Interaction, Diagram 1

It is common to use a Feynman diagram to analyze particle interactions. In our first examples time moving to the future goes upward and space extends to the right or left. In the first diagram a neutron comes in from the left, and a fast neutrino goes off to the left. Going out to the right are a slower electron and a proton. The space-like wavy line in the middle is the path of a WW* boson pair weak current flickering in the interaction zone as the Dirac deep-sea component governing the energy exchange with almost no elapse of time. In my system the WW* pair is a chargeless boson of total spin 1/2 + 1/2 = 1 and merely transports mass-energy and spin because there is a split of charge and net spin between the electron and the proton (the neutrino and neutron are both neutral). The WW* pair also carries mass (around 80 GeV) because the electron is much heavier than the neutrino and the proton is lighter than the neutron by more than an electron mass. The neutrino going out, however is (usually) seen as an antineutrino on the right side going in (as in diagram two below). There it is running backwards in time and supplies the extra energy that makes up the difference between the proton and the neutron that the electron does not provide. There are several ways of interpreting what happens, depending on how you look at it.

The modified version below shows the neutron apparently "decaying" into a proton, an electron, and an antineutrino. The proton and antineutrino are going backwards in time, and the neutron and electron move forward in time. It may seem odd that protons are classed here as antimatter and seem to go backwards in time, but that is because we are not seeing the whole picture in this diagram. The baryons are actually particle clusters that contain both matter and antimatter. We also discussed earlier the inverse decay in which an antineutrino joins a proton and then we get a neutron and a positron. In any case there is a scattering event in which everything adds up. The proton has less energy than the neutron, so the reaction tends to go from neutron to proton. We can interpret the neutrino as a contribution to or from the vacuum state via the WW* boson pair since the neutrinos are subtle wave disturbances in the aether grid.

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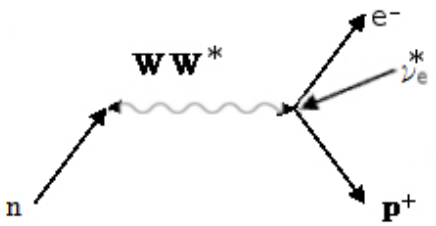

Neutron-Proton Interaction, Diagram 2

In diagram two we simply move the neutrino to the right side. In doing so, we must reverse the arrow direction in time and flip it into an antineutrino. Moving forward through time a neutron encounters a bidirectional WW* boson pair whose brief appearance is almost instantaneous (less than 10^{-24} s) and represents a bubble in the aether vacuum facilitating a transition. The neutron bounces off the WW* pair so that it comes off looking like a proton with a net motion backward in time. (All positive charges indicate a net antimatter bias. Thus protons in standard theory are wrongly represented as matter.) When the neutron encounters the WW* pair in diagram one, an electron neutrino careens off and carries away some of the neutron energy. Another portion of time forward energy emerges as an electron moving slower than the neutrino, while the proton bounces off with some time reversal bias. In the second diagram the neutron bounces off the WW* boson pair and becomes a proton and an antineutrino moving "backwards", while an electron moves forward. In both cases a neutrino boosts the proton energy plus the electron to neutron level and the charge is split between the electron and the proton, but in the second diagram the electron and antineutrino look like a jet, except that the antineutrino is entering the nucleon rather than leaving. Or you could say it is bouncing off the WW* boson pair, reversing in time, and turning into an electron. In the neutron condition there is an electron in a negative orbital inside the neutron's nucleon space. These diagrams are only preliminary analysis, because both the neutron and the proton are ensembles of finer quantum particles. So as we move forward we will look at the finer details of what goes on with the quarks and leptons inside the event. Contrary to standard theory the W boson is a chargeless pair of bosons (total spin 1) and thus is bidirectional. It only transports mass and charge in what is called the weak interaction, very much analogous to the way photons function. The ins and outs of a real Feynman diagram must always be even in number (paired) and the charge and spin must balance. As you can see there are various observer viewpoints one may take to understand the event. Just on this level it is quite fascinating.

Under certain conditions the neutron seems to "decay". Actually we see from the diagram that nothing ever decays; it just transforms. One of the conditions that favors neutron "decay" is if a neutron gets separated from other nucleons so the extra charge and mass is no longer available to hold the neutron together -- specifically to help hold down the springy vibration requirements of the leptons in its nest. Heavier nuclei can beta-decay without emitting a proton or neutron. The electron that was in the negative orbital of the neutron pops out, and also an antineutrino pops in. The electron may have too much speed to go into orbit, so the proton just grabs another one floating around free in the neighborhood. These leptons reside as virtual particles with various

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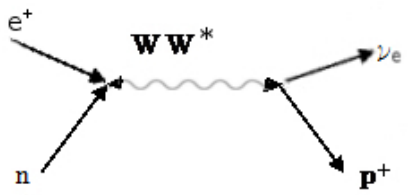
energies in the vacuum state or just float around "available" to be pulled into action as the 1*s*-orbital electron of a hydrogen atom.

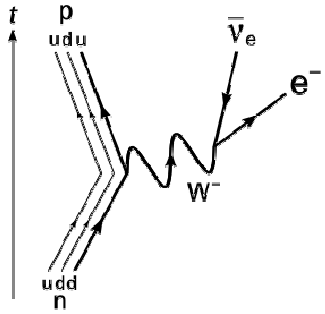


Neutron-Proton Interaction, Diagram 3

In diagram three we see the inverse beta decay that supposedly identifies the neutrino as a particle. In this case we read from right to left because the interaction is being forced against its usual "decay" tendency (from high energy to low energy). Neutrinos can be their own antiparticles, so the neutrino seems to hit the proton and cause it to become a positron plus a neutron, both of which are unstable. The neutron beta decays back to a proton, electron and antineutrino. The neutrino and positron disappear -- the former just flying off, and the latter annihilating with an electron and releasing two gamma photons.

We need a more complete picture. If we subtract the rest mass of the electron from the rest mass of the proton, we get around 23×10^{-31} kg. This is about 2.53 times the mass of the electron. That's only about 1.29 MeV. The neutrino contribution is at maximum a rest mass of around 10^{-37} kg and maybe as little as 10^{-43} kg. The WW* boson is supposed to have 80 GeV. That's a factor of almost 62,000. So the WW* boson pair is a heavy particle weighing in at about 1.424×10^{-26} kg. It is 85.27 times heavier than a proton. That makes it somewhat like a slightly underweight Rubidium atom (Rb 85.4678). Rubidium is a heavy alkali metal. The silent weight pulled by the W boson reminds us of the way the Union Boson's mini black hole lens operates from behind the scenes.

The next diagram is a usual Feynman diagram showing the "details" of the neutron beta decay. Next to the p (for proton) and n (for neutron) we find the notations udu and udd. These represent the standard quark structures of these nucleons, said to consist of various combinations of up and down quarks (noted as u and d respectively).



(See **Wikipedia**, "Weak Interaction".)

The right hand side of the drawing agrees with how we drew the electron and antineutrino part of the interaction in diagram two. The problem is that the proton is not

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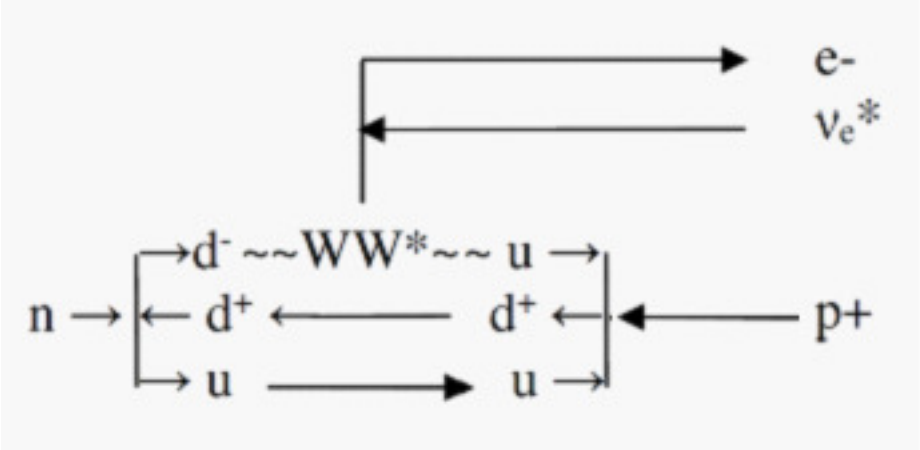
shown with a positive charge. Thus charge conjugation is violated. Furthermore, the boson component is drawn as W^-, as if the boson provided the negative charge for the electron. That makes no sense. You have two negative charges and no positive charge. It is all unbalanced. Furthermore, it looks like the W boson has somehow magically changed the flavor of an up quark to a down quark. Below I will represent the detailed flow of beta decay from neutron to proton. First, we must understand that the u quark is chargeless and its own antiparticle. The d quark can have either a positive or a negative charge. The d^+ is an ensemble that consists of $u^* + 2e^+ + 2\nu_e$, $+ e^- + \nu_e^*$ and has a net -1/2 spin. The d^- is a simpler ensemble that is merely $u + e^- + \nu_e^*$ (net +1/2 spin). So ordinary neutron decay looks like this. You have to fill in the quark details to see what is going on. We conventionally give fermions +1/2 spin and anti-fermions -1/2 spin.



Neutron Decay

We find that although two quarks flow forward in time, but the d+ quark has a very strong backward time flow bias. The internal activity of a baryon is a very dynamic flow in both space and time. We see from this diagram also that the role of the W boson is only to facilitate the release of the electron and antineutrino from the d- quark region so that it expands and becomes a nonlocal component of the baryon ensemble. There is a cyclical flow of the electron and antineutrino and another cyclical flow of the d+ and d- quarks. The two flows link together, sometimes inside the baryon and sometimes in and out. The heavy WW* boson pair forms an anchor or keel in space-time for the whole system. There is an underlying quark structure of three u quarks flowing among each other in equilibrium as an overall union boson structure. The charges are due to lepton whorls of photon vortexes that govern energy flow in hyperspace.

W Boson Structure

The W boson's Compton radius (where m_W is the W boson mass, about 85.67 proton masses or 1.43×10^{-25} kg, that is 80.385 GeV/c^2) is approximately:

* $R_W = \hbar / m_W c = 2.46\times10^{-17}$ m.

The W boson is definitely a tiny unstable black hole in the quantum vacuum aether grid that decays within a very short distance in both time and space and it has quite a large

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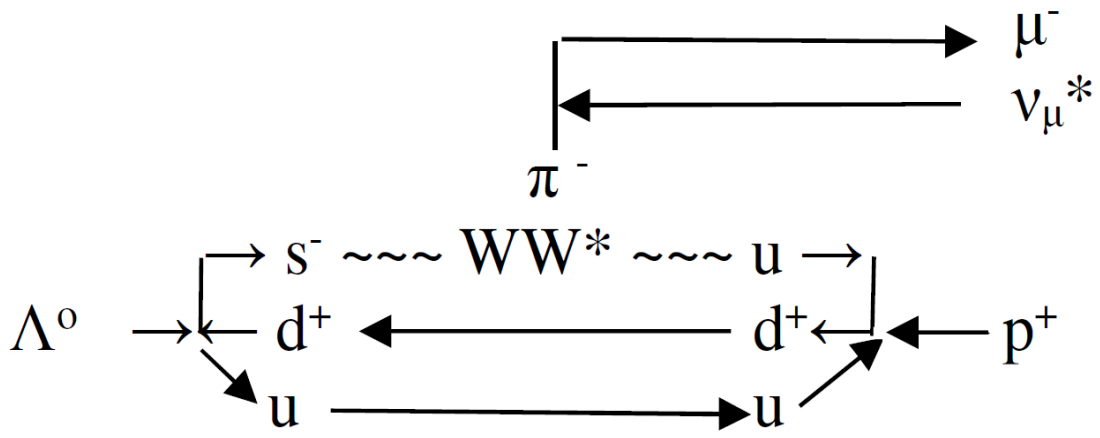
effective mass compared to the proton. Most of the known hadrons get only up to the range of 6 proton masses. The W boson is over 85 proton masses. The WW* boson pair is a virtual particle production-annihilation event that acts as a catalyst to neutron decay and other weak current interactions. The weak interaction has a Fermi coupling constant $G_F/(\hbar c)^3$, where a_W is a dimensionless constant like the EM coupling constant a:

* $G_F/(\hbar c)^3 = 1.166364\times10^{-5}$ GeV^{-2}
* $G_F/(\hbar c)^3 = 4\,\pi\,2^{1/2}\,a_W/(m_W c^2)^2$
* $m_W = 80.4$ GeV/c^2
* $m_W c^2 = 80.4$ GeV
* $(m_W c^2)^2 = 6464.16$ GeV^2
* $a_W = (1.166364\times10^{-5})(6464.16) / 4\,\pi\,2^{1/2} = 424\times10^{-5} \approx 4.24\times10^{-3}$

It happens in the same manner that we can accelerate a space probe by slinging it around massive Jupiter. The WW* boson pair appears and disappears just momentarily out of the vacuum state to act as a gravitational slingshot. It can't use the EM force on the neutrino, because the neutrino has no charge, so the mechanism requires the proper gravitational mass. Contrary to popular opinion, the W boson doesn't really have any charge, though it appears to because it causes a separation of balanced charges. The charge shift comes from slinging the electron out from its negative orbit inside the neutron. That splits the neutral neutron charge into a positive proton and a negative electron. So the purpose of the W boson momentarily poking its head out of the vacuum is to act as a gravitational slingshot and suck a little over 2.5 electron masses from the neutron and convert it into a combination of electron, antineutrino mass, and kinetic energy. The WW* boson pair is like a bubbly wall of energy or a ping pong paddle that pops from the zero point and bats the leptons out of the neutron's ensemble.

The Lambda neutral is an unstable baryon with a negative strange quark and hence neutral charge. It looks like a repeat of neutron decay, but at a higher energy level.



Neutral Lambda Decay

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The s^- (strange) quark is made of a neutral (u) quark plus a muon and a muon antineutrino.

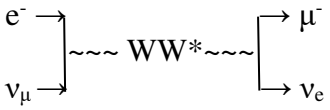
* s^- u, μ^-, ν_μ*

The s^- quark is heftier than a d^- quark and has a negative charge. The Lambda's s^- quark decays into its ground state u quark configuration, releasing a negative pion (*pi* meson) that then decays into a muon and muon antineutrino ($\pi^- \rightarrow \mu^- + \nu_\mu$*). The u quark then forms a proton (ud^+u) and the lepton pair continue their decay process. The *pi* mesons occur as "fringes" to the much heavier W boson and baryon. The leptons become free particles.

The charmed quark (c) is a hopped up strange quark (s). It analyzes as a negative strange quark boosted by a positive tau lepton and perhaps a tau neutrino, while the anti-charm is a positive strange boosted by a negative tau lepton and perhaps a tau antineutrino. The c quark itself is neutral, and forms the next "neutrino" window above the u quark.

* $c \rightarrow s^-, \tau^+$
* $c^* \rightarrow s^+, \tau^-$

The WW* boson pair never appears alone except as a virtual particle. It is always a mediator for an energy exchange interaction among a suite of particles, just like the photon. The W boson's heavy gravitational mass allows it to flip the time direction of particles, especially leptons, thus reversing their charges. The W boson itself moves very little because it is so much heavier. Let's look at W behavior with leptons in the low energy limit.



Here all the leptons move forward in time, just skimming by the boson rather like the Compton effect, so charge and time direction remain unchanged. The electron encounters a mutrino and picks up mass from it in the collision. The exchange is transmitted via a WW* boson pair that emerges from the vacuum in the scattering zone. The electron is energized up to muon status, and the mutrino emerges from the transition zone dropping down to electron neutrino status as it gives up mass and perhaps also a lot of momentum. This process is similar to the Compton effect, but with a W boson involved and a larger energy exchange. The dominant muon decay diagram, however, shows an energetic anti-eutrino moving backward in time, and then encountering a muon. As it enters the scattering zone, the whole ensemble momentarily resembles a WW* boson bubble. Time moves from left to right in the diagram below.

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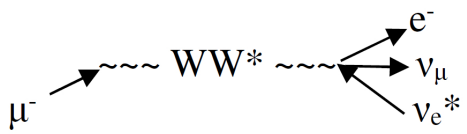

Muon Decay (Time →)

The muon loses mass and drops down to a stable electron state as it passes through the WW* boson scattering zone, and the fast moving electron antineutrino conjugates, bouncing forward in time from a head-on collision with the boson scattering zone. This slows the neutrino down, reverses it in time, and amps its mass up into a mutrino. It picks up mass from the muon, and also converts some of its momentum into mass. The neutrinos and the electron are all stable.

This family of "ground state" W boson interactions becomes ambiguous as to the charge preference of the W. The charge really is just passing through, riding on the W boson for a moment as the mass adjusts. Reversal of charge is caused by reversal in time. Time reversal is caused by "head-on" collisions. The W boson's main role here is to step up the mass or step it down, just like a photon steps the excitation of an electron up or down. It has no preference regarding charge. It just manifests as the center of the scattering zone and catalyzes transfer of mass and momentum. Particles that have "head-on" encounters with the scattering zone tend to bounce sharply, reversing in time. When a particle reverses in time, its charge also reverses.

Generally when scattering occurs, at least four fermions are involved in each event. The neutrinos play the role of maintaining conservation of mass-energy and angular momentum. This is "four-particle" mixing and corresponds to four wave mixing in phase conjugation. The four particles can be variously oriented in time and space. The W sits for a moment in the zone of interaction and catalyzes the exchanges. Whereas in EM energy exchanges the photons translate over distance between charged particles, and do most of the running, the massive W bosons like to sit still and let the leptons do most of the running. The photon and intermediate boson processes are thus complements of each other at different mass-energy scales.

You can begin to see here that proper Feynman diagrams of these processes show each particle maintaining its integrity as a particle. The only thing that can happen is for them to mix and match exchanging some mass and/or momentum and possibly to be reflected forwards or backwards in time. In the latter case the charge reverses and the particle becomes its conjugate partner. The W boson appears to have a charge, but that is due to the charged lepton or antilepton (or charged quark) that is passing through the interaction zone. The quark pair or pion a W boson may seem to decay into is just a token for the basic hadron energy quantum.

The resonances that reverse the W boson "unlocking" process of "decay" are usually mediated by pions on the surface levels as decay products. In other words, we tend to speak of pions when we boost the energy up, and W bosons when the energy decays

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down. These are conjugate operations going up and down with energy. The pion is the lightest of the mesons, with a quark structure given as:

* $\pi^+ = u\ d^+$
* $\pi^- = d^-\ u^*$
* $\pi^o = [uu^*\ d^-\ d^+\ 2^{-1/2}]$.

The d^+ quark is an "antiquark". All positively charged quarks are "antiquarks". The negative pion has the general decay pattern as follows. (See exercise on p. 11-44.)

* $\boldsymbol{\pi^- = d^-\ u^* \rightarrow (u, u^*, e^-, \nu_e^*) \rightarrow e^-, \nu_e^*, \gamma\sim, \gamma\sim \rightarrow (\mu^-, \nu_\mu^*).}$

Conversely, a **positive** pion produces a **positive** antimuon and a muon neutrino. We need muons to transport the extra internal (π^o) energy.

If we excite the pions and beam them into some liquid hydrogen, we get a series of neutron generating resonances with the following pattern (using the negative pion this time:)

* $(\boldsymbol{\pi^-})$, (p^+) $(\sim\sim WW^*\sim\sim)$ (X_o), (n).

Here (Xo) stands for a resonance with neutral charge.

.
* $Xo \rightarrow (\boldsymbol{\pi^+}), (\boldsymbol{\pi^-})$.

The two charges balance out. The resonance decays into a pion-pair, which is what we actually see in the experiment. The presence of the (Xo) resonance is extrapolated from the pions. The pion particles "bounce" off this "hot" jiggly (Xo) quantum bubble in the vacuum state like ping pong balls. Boson pair trajectories are very flat and parallel because their mass is greater and their velocity is much slower, but fermion trajectories can be quite separated. Charged particles at non-relativistic velocities swerve more in magnetic fields.

We are looking here at a step-up formula for shifting protons upward into neutron mode. When the neutron decays back down stairs to the proton level, an electron and an antineutrino bounce off. To push a proton up into its neutron mode, we use a negative pion. As the $\boldsymbol{\pi}^-$ gets close to the proton, it swerves in toward it and entices a virtual W boson from the vacuum. It then decays into a muon and an antimutrino. The antimutrino goes on its way, but the muon decays into an electron and an anti-eutrino and another antimutrino. The virtual W boson subsides back into the vacuum but leaves a recoil wake in the form of pion pair production. The electron and its sidekick anti-eutrino fall in step with the proton for a while and then leave through the beta decay process we described above, which is just about the reverse of this process. In essence the negative pion has passed on through the interaction, and the W boson pair has created a positive pion balanced by a negative electron and a bunch of neutrinos. The pions then all decay by stages into other electrons and neutrinos. The pion interaction with

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the proton is just like the Compton effect, except that the proton trajectory is not only changed, it is energized upward into a neutron. The pion swings by and its energy and swerve combine to generate a pion pair. Of the two negative and one positive pion, the decay products of one negative pion "stick" to the proton for a short ride.

Here we are running inverse neutron beta decay, so we have to pump energy into the system. We can run this simple operation at various energy levels. Below about 1.4 GeV elastic scattering dominates:

* $(\pi+/-), (p+) \rightarrow (\pi+/-), (p+)$.

There is also some charge-exchange scattering:

* $\{(\pi-), (p+)\}$~~WW*~~$\{(\pi_o), (n)\}$. (There's the neutral pion again. These interactions are right out of Martin and Shaw and translated into my notation.)

When we raise the energy level, we get extra π_o's coming out with the charged pion pairs, and we get some cases of:

* $\{(\pi-), (p+)\}$~~WW*~~$\{(\pi+), (\pi-), (n)\}$.

Here the high-energy negative pion seems to have sucked the charge away from the proton. The charged pion pair is the recoil reflection as the proton absorbs the original negative pion's energy. There are several other pathways that detail the process, and each has a certain probability. Here's another one.

* $\{(e-), (e+), (\pi-), (p+)\}$~~W~~$\{(\pi+), (\pi-), [(p+), (e-), (\nu_e*)] (\nu_e)\}$.

The energetic pion comes into the proton's arena with a Compton-like effect and pulls an electron-positron pair and an electron neutrino pair out of the vacuum. The positron picks up energy and puffs into a positive pion. The electron and antineutrino synch with the proton for a while to put it in neutron mode -- the portion in square brackets -- and then decay away into the constituent particles. An extra neutrino sails off unseen. When we study the mesons in the next chapter, we will see how this is really quark mixing and a telltale clue indicating the important but unrecognized role of anti-leptons and antiquarks in protons.

We can't see the uncharged neutrino pair, but we can detect the antineutrino's presence by the momentum and energy shifts of the neutron "decay" process.

One other example of proton pumping gives the following class of interactions:

* $\{(\pi-), (p+)\}$~~WW*~~$\{(\Delta^o)\}$~~WW*~~$\{(\pi^o), (n)\}$.
* $\{(p+), (p+)\}$~~WW*~~$\{(\Delta^+), (p+)$ ....., $(\Delta^+)\}$~~WW*~~$\{(\pi+), (n)\}$.

These show lifting of protons to the neutron state via delta resonances. From the above

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discussion of the pion-pair interaction you can fill in the missing details. We'll look at delta resonances in more detail in the next chapter when we study the detailed quark structures of particles.

The above paragraphs give some glimpses into the lifting of a proton into its neutron mode. Since there is no sharply slanted quantum negative energy notch for the neutron, a relaxation of the system allows the neutron to revert back to proton status.

The term fusion is a misnomer in the energy arena. There is no fusion going on in fusion. There is only the incrementing of proton quanta within a single nucleon, whose ground state (hadronic localized equilibrium) is the proton. Actually helium is the true atomic ground state. From our viewpoint fusion and proton incrementing looks the same. Another good exercise for exploring proton shifting is to shuttle between nuclear isobars, such as ^{7}Be and ^{7}Li or ^{14}C, ^{14}N, and ^{14}O. This is just proton-neutron oscillation manifesting in heavier nucleons. We should be able to run the whole gamut of stellar cooking processes in the lab using nanotechnology and quantum mechanical principles such as phase conjugation without resorting to monster Shiva machines.

In addition to boosting protons upward in the energy ratchet from which they settle into helium and give energy, we might explore finding the ratchet tooth to slip a proton down to a positron. This actually involves releasing the positron that lies at its core. Everything else annihilates except the neutrino. The extra u quark would probably form a pion and then decay.

* $p+ \rightarrow (u, u^*)\ (e-, e+)\ (\nu_e, \nu_e^*),\ (u),\ (\nu_e),\ (e+)$ + energy

This process releases a lot of energy, including the annihilation of the extra positron when it meets an electron. The u quark has much more mass than the neutrino, but the neutrino balances with lots of linear momentum. So far, the only way we know how to produce this effect is with proton pair annihilation. That certainly does the job. But I suspect there are other ways to unlock the proton's automaton structure that do not require the energy commitment of manufacturing antiprotons. By the way, proton pair annihilation is not exactly that. The proton is an ensemble, so what happens is that you get lots of jets with mesons and leptons that decay and annihilate. Ultimately, everything decays down into photons, and photons are their own antiparticle reflection, so a photon is a photon is a photon. They are all the same, so there is really just light and awareness playing with itself. The Z boson, which we will consider in a moment, makes this clear.

Here are some of the theoretically possible intermediate boson catalyzed decay routes:

* $p+ \rightarrow \pi^o, e+.$
* $p+ \rightarrow \pi+, \nu_e.$

The neutral pions will decay into photons. The positive pion cascades first to a positive muon, and then a positron, releasing neutrinos along the way. The positron will

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annihilate with an electron, resulting in a pair of photons. All of these (as yet unobserved except for pair annihilation) proton decay routes tell us that indeed, hiding inside the proton is a positron. The missing positrons that are needed to match up with all the electrons around the universe are locked up inside the protons. Everything adds up beautifully. Fortunately, the proton is pretty well phase locked.

Or we could explore the forbidden decay of electrons into neutrinos and photons.

* $e^- \rightarrow \nu_e, \gamma\sim$. (Illegal!)

This reaction has a serious problem because it violates conservation of charge. But, from our discovery of the missing positrons, we realize that the only way to reduce an electron is by annihilation with a positron. The antiproton contains within it an electron. It is the puffed-up version of the electron. The proton is the puffed-up and then "stabilized" (phase-locked) positron. This system protects the two particles from completely annihilating. Now we understand why electrons can not decay into neutrinos. Electrons are the point-like centers or foci of energy vortexes, and the energy flows in an endless circuit with other leptons. They are not really "particles". The neutrinos and u quarks are the actual particles. That is to say, they represent the pulses of the wave fronts, whereas the positrons and electrons represent the foci around which the wave fronts move.

During the expansion cooling of the universe, a quantum fluctuation occurred during which the symmetry of electron and positron whirls was broken. The proton energy window is just right for a positron antimatter vortex to form in the middle. This trapped a bunch of them as the primordial quantum soup cooled. So when all the electrons and positrons annihilated in a big flash, the ones trapped inside proton bubbles got left behind. Their electron partners had no one to "go out" with, so they have been wandering around as unfulfilled bachelors until now. They buzz around the protons like bees around flowers, sensing that there's something good inside, but they can't get far enough in to consummate their desire to go out in glory. They end up sending a lot of QED e-mail to each other talking about the problem, but usually nothing much ever gets accomplished.

Each of these reactions, if realized, would release large amounts of energy. The only way to get the electron reaction is via annihilation with a positron. There would be no problem of radioactive hazardous material. Working with very small amounts of hydrogen, for example, could provide an unlimited supply of clean energy if we figured out how to efficiently strip away the u quarks in protons to expose the internal positrons and let them annihilate with electrons.

Another area to study is deuterium. By creating a coherent macroscopic quantum boson state for a collection of deuterons, we may be able to coax them into believing they are really helium nuclei.

In their introduction to "Interactions" Frauenfelder and Henley (**Subatomic Physics**, 2nd ed., 1991) outline a fundamental principle of interactions.

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"Bosons can be created and destroyed singly. Lepton and baryon conservation guarantee that fermions are always emitted or absorbed in pairs. The simplest interaction is thus one in which a boson is emitted or absorbed. . . . The interactions occur at the vertices where three particle lines are joined. The fermion does not disappear, but the boson either is created or destroyed. In both cases, the strength of the interaction can be characterized by a coupling constant. . . ."

This is how Feynman diagrams are all drawn. This principle is fundamentally misleading, but is commonly held and further promoted by the way Feynman drawings are done. The discussion we had about phase conjugation shows how misleading the notion of bosons acting singly is. There is no such thing as creation and destruction. That is an illusion brought about by a shifting of attention. There is only backgrounding and foregrounding in attention. Or we can say that mass-energy scatters in various ways, appearing to change shape. Apparent creation and destruction of particles or states is due to viewpoint shifting. All possible events coexist in the phase space of undefined awareness.

Bosons like to travel in pairs, or we can say they are made of pairs of components. The fermion pair "bounces" at the vertex, and at low energies usually has a wide angle of incidence and reflection. Boson pairs seem to run parallel or close to parallel. That is why they are taken as one particle. Sometimes a particle reflects in space, and sometimes it reflects in time. Reflecting in time, a particle becomes its own antiparticle relative to an observer. The boson reflects in time and becomes its own antiparticle. This is true of mesons, and it is true of photons, and it is true of W bosons. It is also true of B_u pairs. However, the B_u pairs do not propagate apart. They remain local and pulsate back and forth within each other shifting not in space but in a dimension of mass-energy governed by gravity and electric forces. The principle is the same. Each boson wave function has a conjugate wave function that carries the reflecting particle. They generally travel together as a pair whether in space or time or mass-energy dimensions.

Fermions imitate this behavior when they emerge from the vacuum as fluctuations with pair production. An electron and a positron can emerge and appear, and then merge and disappear. At each vertex there are found photons. Electrons propagating between photons form the conjugate event that corresponds to photons propagating between electrons. Two electron wave functions and two photon wave functions interacting generate four-wave mixing. The difference is that the electrons make separate tracks that diverge and then merge. The different mass-energies have different coupling angles. These trajectories can be followed with tracking devices. The photons move parallel at c and have no charge. They do not separate to form a bubble but take a geodesic trajectory resultant path to the absorbing electron, which can be the same electron-positron pair at a different space/time location in the case of virtual photons.

There is no fundamental difference between fermions and bosons. They are the same thing looked at from a different viewpoint. We only separate them with a +1 in the

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Fermi-Dirac statistics and a -1 in the Bose-Einstein statistics.

"Both Fermi–Dirac and Bose–Einstein become Maxwell–Boltzmann statistics at high temperature or at low concentration . . . . The expected number of particles in an energy state *i* for Bose-Einstein statistics is

* $$n_i(\varepsilon_i) = \frac{g_i}{e^{(\varepsilon_i - \mu)/kT} - 1},$$

with $\varepsilon_i > \mu$ and where n_i is the number of particles in state i, g_i is the degeneracy of state i, ε_i is the energy of the ith state, μ is the chemical potential, k is the Boltzmann constant, and T is absolute temperature. For comparison, the average number of fermions with energy ϵ_i given by Fermi–Dirac particle-energy distribution has a similar form,

* $$\bar{n}_i(\epsilon_i) = \frac{g_i}{e^{(\epsilon_i - \mu)/kT} + 1}.$$" (**Wikipedia**, "Bose-Einstein statistics")

These equations describe two classes of particles in "a quantum system in thermal equilibrium with a thermal reservoir of temperature *T* and capable of exchanging energy with this reservoir." (H. Kroemer, **Quantum Mechanics for Engineering, Materials Science, and Applied Physics**, Sect. 22-3, "Bosons, Fermions, and Spin" in "Indistinguishable Particles: Fermions and Bosons.") Kroemer then points out that we really tell the difference by whether the spin is an integer multiple or a half-integer multiple of $\hbar$. Then, like Feynman, he says that the "proof" lies in relativistic quantum field theory and leaves it at that. The Maxwell-Boltzmann statistics are

* $$\langle N_i \rangle = \frac{g_i}{e^{(\varepsilon_i - \mu)/kT}} = \frac{N}{Z} g_i e^{-\varepsilon_i/kT}.$$

Here N_i is the number of particles in the set of states with energy ε_i, ε_i is the ith energy level, g_i is the number of single particle states with energy ε_i.

The spin states of these two particle classes seem different because we count bosons in pairs and we count fermions in single units that are really half of a pair. If you count the complete fermion pair, as in the case of Cooper pairs, then you get the viewpoint of Bose-Einstein behavior. It's just a matter of observer viewpoint. The Bose-Einstein condition appears for fermions when they form a Bose-Einstein condensate, so we know it is just a conditioned observer point of view that sees the types as different.

(For example, see H. Kroemer, **Quantum Mechanics for Engineering, Materials Science, and Applied Physics**, Sect. 22-3, "Bosons, Fermions, and Spin" in "Indistinguishable Particles: Fermions and Bosons.")

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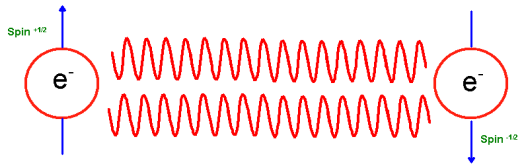

Above is a sketch of a Cooper pair of electrons. The spins are mutually reversed and the pair functions as if it is a spin ½ + ½ = 1 boson. Notice the EM interaction between them. In a stretched out manner this mimics the photon-antiphoton pairing property of the EM interaction itself. The relatively flipped spin on the electron mimics the positron.

Phase Locking

We need a mechanism to explain how it is that there can be extremely stable energy windows to allow the existence of matter built up in quantum increments from protons and electrons in such a way that the edifice will not just collapse at any time. The quanta can increment upward, and they can increment downward, but there are points where the energy sticks, just like a ratchet is held in place by a pawl.

Richard Feynman gave a wonderful talk in his **Lectures on Physics** (Volume I, Chapter 46) entitled "Ratchet and Pawl". He used this simple mechanical device to explain how a system in equilibrium is incapable of doing work, but looked at another way it also demonstrates the secrets of phase locking (and unlocking). The ratchet and pawl device appears at first glance capable of translating random motion into positive work. Gas particles in a chamber can bat against a paddle wheel, turning it this way and that randomly. But the wheel's axle is connected to a ratchet and pawl. So when the paddle turns one way it sticks, but when it turns the other way it ratchets around by a notch, thereby moving forward in a specific direction. It seems as if the symmetry of the energy system is broken, and it can develop one-way motion all by itself. This contradicts the notion that a system left to itself will reach equilibrium and then go nowhere beyond that. Yet that is the second step in our formula. First we break the symmetry, and then we set up a localized equilibrium.

Closer inspection of the ratchet and pawl system reveals that the pawl requires a spring to push it back into the next notch after the ratchet tooth has pushed it out. When the pawl falls into the notch, it will bounce back up and allow the ratchet to slip backwards. So the pawl's spring must be damped. The damping causes heat to build up, which causes the system to get jittery, so the pawl eventually overheats and just jumps around, allowing the ratchet to slip backwards as well as forwards. The net result is that equilibrium sets in and nothing happens but random motion of the axle.

Feynman's discussion starts to head us into thermodynamics and the theory of entropy, which we already touched on in distinguishing bosons and fermions. We'll hold that deeper discussion for now and just concentrate on the model of a ratchet and pawl as a tool for something we can call **phase locking**. To make the system easier to visualize, we'll imagine that our ratchet is linear, a long saw with a serrated edge. The saw blade slides along without friction in a groove, and the pawl has a spring that keeps it snug to the surface of the saw blade.

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Let's step back for a minute and generalize our saw and pawl system. Imagine the teeth on the saw get smaller and smaller until the blade is completely smooth. We have a good lubricant, so we ignore friction. Now the blade can slide effortlessly in both directions and the pawl just slides along doing nothing at all, despite the spring. All we need is the energy to overcome the inertial mass of the blade, and it slides along. The pawl might as well not be there. With no teeth and no friction, our degenerate ratchet becomes a continuous system with reversible symmetry. It moves in both directions equally well. It is like a Newtonian particle in a 1-D free space. It sits there quietly until given a push, and then it just slides along in its 1-D groove.

Now let's add some sine-wave bumps to our blade so it starts to look like a cam. However, the wavy surface of the cam is still smooth, so the pawl can slide easily in both directions. The only difference is that it takes a little extra energy to push the pawl up over the bumps on the blade. If we give the blade a push, it will move a bit, but then rock back and forth and settle at a place with the pawl pushed into the low point of a valley between bumps on the blade. The energy of our system is starting to become quantized. If the blade is a circular cam, there can only be a whole number of bumps (although you could have bumps of various heights distributed around it.) The system is still reversible and symmetric (disregarding varying bump sizes). You can push it either direction, forward or backward with a little effort. Notice that this cam system serves as a mechanism for dimensionally shifting the direction of a portion of the energy flow orthogonally. Some of the energy goes into pushing the pawl out along the slope of the bump against the opposing force of the spring. The extra energy we need to move the blade is what is needed to push against the spring.

The next step is to let the bumps evolve from sine-waves into cycloids or zigzags. Now the bumps are sharply articulated along the surface of the blade. This does not really change the behavior of the system. It just makes the valleys more sharply defined. The system still settles into the low points of valleys and is reversible.

The next step is to let the zigzags develop a slanted angle of serration. Suddenly the behavior of the system changes dramatically. The **symmetry is broken**. The blade only slides in one direction. If you push it backwards, that just drives the pawl tightly into the valley between teeth and jams it. Pushing it forward, the system behaves as before, except that there will be sharp drops after energy peaks. The system gets jerky and clicky and only moves forward in one direction. Reversibility disappears.

The ratchet saw and pawl system requires a main system and a subsystem. The main system is the saw blade and its groove. Until the serration becomes slanted we really do not need the pawl except as a mechanism to settle the saw at certain points -- to quantize its windows of relaxation. The pawl's usefulness is to transfer energy patterns into an orthogonal direction. That's how we use a camshaft in an automobile to control the timing of valve operations. It is a mechanical clock mechanism.

Once we have the slanted serration, the pawl takes on a new role. It makes the system

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irreversible. The backward slants represent relatively negative energy valleys. If we imagine the system running vertically, gravity pulls the blade downward, and the pawl locks it so it will not slip on down the groove to the bottom of the shaft, the "ground state". The system thus achieves a **localized equilibrium** that holds it at an energy level quite high above its ground state.

We need to add energy to push the blade upward. Whenever the pawl passes a tooth on the saw, it drops into the notch above it and locks the system in place so it will not slide back down. To get it to slide down, we would have to mechanically push the pawl back out of the way so the tooth could slide by. This requires energy applied orthogonally to the orientation of the saw. Feynman got that energy from randomly directed motion generated by heat. To keep the ratchet from losing its effectiveness, Feynman would have to have a mechanism that sucked excess heat out of the system, but that would also cool the system's ability to ratchet upward.

Our quantum particle system is a combination of rounded bumps with sharp slanted notches at certain points. The system can "decay" downward after being pushed past a rounded bump, but it locks in place once it is pushed up past a slanted notch. On the other hand, we see that, under the right conditions, it can cascade down past a locking notch. For example, a *tau* particle has more mass than a proton and yet it can decay down past the proton level into smaller leptons. How can it do this? There is also a total release mechanism that allows the saw blade to drop all the way to the bottom of the groove. If a proton encounters an antiproton, both particles can annihilate, dropping the whole system into a cascade back into its vacuum ground state.

Going back to our mechanical example, let's analyze how we might deliberately release the locking mechanism. We can take as our example hydrogen gas, whose ground state is helium. Gravity pulls the hydrogen downward toward helium. That is an innate tendency built into the system -- the hydrogen wants to move toward its ground state, but is locked into its quantum phase by a "ratchet mechanism", which in this case appears to be the mutual repulsive force of the protons that prevents them from coalescing into a helium nucleon. We do not need to push upward to higher excitation, we only need to shift the spring lock mechanism that locks the pawl into the quantum ratchet notch. It takes some energy to push against the the pawl that is held in lock position by the spring.

Without the ratchet tooth of proton repulsion (the spring mechanism on the pawl), relaxation causes the particle to drop into its ground state. The quantized energy we see in orbiting electrons is a zigzag system that will hold itself in place from falling until a tiny downward tug is given (such as a lower energy environment nearby, and then it will drop a notch or more back toward equilibrium. Given an upward push by entry of excess photon energy, it will move up a notch or more. .When we have an upward slanting tooth on the blade, we have to apply a force against the pawl's spring mechanism and oriented orthogonal to the "blade" in order to lift the pawl out of the way so that the blade will slide down according to its innate tendency. In principle we do not need any random energy in the blade's dimension. We need energy only in the pawl's dimension. How do we do it? There could be a number of ways. The most efficient way is simply

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to lift the pawl clear of the tooth that locks the saw in place with no other expenditure of energy.

In his lecture Feynman describes how a system with a damped spring left to itself randomly vibrating would build up heat in the pawl and spring mechanism until the pawl would be jumping and bouncing about all excited. This would give the blade an opportunity to slip downwards. Such a situation is analogous to the current approach to high energy physics and fusion research. You need to heat the system up to high energy and get the pawl jumping about wildly. Then the blade will "effortlessly" slip down where you want it to go.

This is what we call the "brute force" approach. From our analysis we see that we only have to lift the pawl. We do not have to cook the whole system!! We know that the pawl's spring is oriented 90 degrees orthogonal to the blade system. All we have to do is apply a gentle push in that one direction to lift the pawl, and then the hydrogen will naturally slip into its helium configuration and release a large burst of potential energy as kinetic energy that can be used in various ways. We do less in the dimension of the hydrogen blade. What we need to do is focus just a bit more on manipulating the spring dimension of the proton repulsive charge.

We already know that the proton is a relaxed form of neutron, and neutrons have no charge and can easily clump together. What makes a neutron is an electron. So perhaps instead of trying to force protons together into helium nucleons when their charge mechanism resists like a powerful spring, why not first just clump four neutrons together (since their "springs" are deactivated), and then let half of them release their electrons by beta decay leaving two protons and two neutrons in the form of a helium nucleon? Electrons are the key to deactivating the proton charge spring mechanism.

We discussed the Heisenberg relation in terms of momentum and position. We can also look at it as a phase space defined by time and energy.

* $(\Delta t)\,(\Delta E) \geq \hbar$.

Planck's constant defines a minimum required phase space. Once we fulfill that minimum requirement, it does not matter how we distribute the "shape" of the phase space. It can be a circle, a square, a long skinny rod, a wiggly shape, or even scattered about like dust, so long as it totals the minimum area of phase space required by the system. In this case, it is defined as Δt in one dimension and ΔE in another dimension. We can calculate the duration (Δt) that the pawl is in the air far enough for the tooth to clear past it. That corresponds in our example to the time that the proton charges are neutralized by properly inserted electrons. Then we figure the minimum energy (ΔE) required to accelerate the blade one tooth length within that time duration so that hydrogen slides into its natural helium configuration.

I had a nice example of this principle in the front gate to my apartment building in Yongho. It had a lock with a spring-latch mechanism that automatically locked the door

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when I closed it. However, if I was in a hurry and slammed the gate shut a little too fast, the gate rebounded off the door-frame too fast for the latch-spring to respond and hold the gate shut and locked. The result was that the gate bounced back open behind me, and I had to go back and close it again more gently.

Unfortunately we do not see a high tooth just above the proton. This complicates the situation. In fact, we find that the neutron is the "tooth" just above the proton. Instead of being a high, slanted tooth, the tooth on a free neutron is shaped more like a shallow bump. Unless something is done to raise it and slant it, the pawl slips back down into the proton notch with its tight spring action. This is a very clever trick set up by the "Designer" to protect the energy lock on the proton from being slipped through using the technique outlined above.

We might consider going from lithium down to helium. Of course, we run into the same clever braking mechanism. In between stable lithium and stable helium we must pass through another neutron level. As if anticipating this sort of "end run", lithium usually has an extra neutron for a total of 3 protons and 4 neutrons. This provides a nice gauntlet to run if we try to come down to helium. However, we find that by boosting ^{7}Li by a 1 proton increment, we can get it to bifurcate into two ^{4}He's. So this is another promising location to explore. We can go down by going up!! The ^{12}C catalytic fusion cycle is also worth studying, but it is more complicated.

Our example of sliding the saw and pawl is a simple macroscopic mechanical example of quantum tunneling. The principle is universal, and the scale can be adjusted using Phase Conjugation, another universal principle. The locking notch on the blade is like a quantum well. The pawl is like a quantum particle. The spring and the negative "energy" configuration of the notch keep the pawl trapped in the notch. Imagine an electron trap quantum well. The particle can not pass through the walls of the well. But the particle has a wave function. This wave function has a probability for the electron to be everywhere, including on the outside of the well. By proper manipulation of the electron's wave function, we can cause the electron to either stay trapped in the well indefinitely, or to tunnel right through the wall and appear on the outside.

Similarly, the Aharonov-Bohm Effect allows a quantum wave function to be split and passed around a solenoid. The solenoid's magnetic field is trapped inside the toroid. But when the quantum wave functions are recombined, they form interference fringes that show influence from the invisible magnetic field trapped inside the torus. The magnetic influence has tunneled through the impenetrable "wall" of the torus to cause quantum phase shifting. These effects are well covered in current textbooks, and so we will not go into details. But they are fascinating quantum effects that are universal and just beginning to be explored. They provide insights into quantum techniques for setting up quantum phase locks and slipping past quantum phase locks. The key to nuclear chemistry may turn out to be a subtle quantum technology of manipulating electrons.

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The Z Boson

In addition to the WW* boson pairs, weak interactions are also mediated by the ZZ* boson pairs. Whereas the decay particles associated with the WW* boson pairs are leptons and their neutrino sidekicks (as in the neutron beta decay we discussed), the ZZ* boson pair decays into a particle-antiparticle pair. Thus the ZZ* Boson pair has only three basic Feynman vertex structures.

* $ZZ^* \rightarrow \nu_e, \nu_e^*; m_l, m_l^*; m_q, m_q^*$.

Here ν_e refers to neutrinos, m_l refers to any charged lepton, and m_q refers to the quarks. The ZZ* does not show mixing of quark flavors or charged leptons. It can be produced in quantity by high-energy electron-positron colliders. It is an important link in the electro-weak unification theory since it has dominant reactions that look like higher energy resonances of the electromagnetic interactions.

* $e^-, e^+ \sim\sim\gamma\gamma^*\sim\sim \mu^-, \mu^+$.
* $e^-, e^+ \sim\sim ZZ^*\sim\sim \mu^-, \mu^+$.

Here we see that the role of the photon $\gamma\gamma^*$ pair and the ZZ* boson pair is exactly the same. The difference is just in the energy level. The process shows that the formation and decay of a photon pair and a ZZ* boson pair are exactly parallel. Every photon interaction includes a certain ZZ* factor, and vice versa. At low energies the $\gamma\gamma^*$ factor dominates, and at high energy the ZZ* factor dominates, appearing as a sharp resonance peak in the total cross-section for the electron-positron reaction. At around 91 GeV the low-energy behavior gets swamped by the ZZ* boson peak. The only ZZ* decay routes are $\nu_e, \nu_e^*; m_l, m_l^*$; or m_q, m_q^*.

The ZZ* boson pair's mass is quite close to the WW* boson pair's mass, but the ZZ* pair's heaviness means that these two types of boson still cover a pretty large range of 11 GeV / c^2. These two bosons are close cousins, similar to the proton and neutron. They differ only by a small constant. There also is a different coupling constant (g_z) for the ZZ* boson pair.

Intuitively we would say that the WW* boson pair should be around 82 GeV instead of 80 GeV, and the (m_z / m_w) ratio should be 10/9, an echo of the $\hbar^2$ ratio. That gives us a ZZ* boson pair of 91.11 GeV. But there may be another small factor involved.

From the number 91.11 GeV given above it appears that the ZZ* boson pair has a curious relation with the electron's 9.11×10^{-31} kg. The two have widely separated energy levels. But their mass-energy is related by the ratio $(e / c^2)\times10^{30}$ m^2 / kg s = 1.78×10^5. In other words,

* $(ZZ^*) / (1.783\times10^5) = .511$ MeV/$c^2 = m_e$.

(Figured in kilograms: Z = 1.622×10^{-25} kg; $m_e = 9.11\times10^{-31}$ kg).

Figured in MeV / c^2, we say that:

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* $ZZ^* = (1.78\times10^5)(m_e)$. ($ZZ^* = 91.1$ GeV / c^2; $m_e = .511$ MeV / c^2).
* $ZZ^* = 9.11\times10^4$ MeV / $c^2 = 5.11\times10^{-26}$ kg.
* $m_e = 5.11\times10^{-1}$ MeV / $c^2 = 9.11\times10^{-31}$ kg.

Furthermore, if we take the ratio 9.11 and multiply it by 1.783×10^3, we get within a factor of close to 1.054 of the ratio of the proton!! There's the $\hbar$ ratio again, coupled with the proton ratio.

* $(m_e)(1.783\times10^3)(1.054) = 1.7\times10^{-27}$ kg $\approx m_p$.

Thus the ZZ* boson pair is a fundamental gravitational resonance in the vacuum state that acts as a mediator for both the electron and the proton. The ZZ* pair mediates lepton, semi-lepton and hadron interactions and forms a link between the weak currents and the so-called "strong" force as well as being the energetic form of photon exchange. The number 1.783 is the conversion between the electron volt and the kilogram.

* 1 eV/ $c^2 = 1.783\times10^{-36}$ kg.

Oddly enough, the factor $4\ \pi\ 2^{1/2}$ from the W boson coupling constant comes out to 17.77, which recalls the *tau* mass: 1777 MeV/c^2.

The current experimental ratio between the ZZ* and the WW* is about 1.1318 / 1. This is very close to the square root of the $\hbar$ ratio times the basic "neutrino" ratio of $\hbar^2$.

* $(1.054)^{1/2} \times (1.054)^2 = (1.054)^{5/2} = 1.14$.

This pattern of intricate pattern of interrelationships between energy and mass deserves closer study. I believe the importance of the D-Shift Operator in these relationships (showing up as various powers of $\hbar c$) has to do with that operator's function of shifting dimensions in geometry and scale in physics. The intermediate bosons do the same with mass in the physical world.

The gauge theory of QED is based on the fundamental principle of gauge invariance. A gauge transformation of electromagnetic potential requires a corresponding gauge transformation of the wave function. This approach successfully explains QED phenomena. However, one outcome is that the rest masses of the photons that are exchanged have to be zero. As we have seen, this is not a problem, since the photon is always in motion at the velocity c and has only linear momentum and zero rest mass. The theory of QCD (quantum chromodynamics), which is built by analogy to QED, involves hypothetical bosons called gluons. The gluons are massless and thus also pose no problems for a gauge theory, but they may be massless because they do not exist, since no one ever has seen them.

Our model of the nucleon suggests that the proper way to build a theory of quark interaction and nuclear binding energy is through something I would call "lens

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harmonics". Lens harmonics is similar to drumhead harmonics, and a cousin to spherical harmonics. It can be modeled visually on a computer to study the various types of geometry that would emerge. Whether we call the nodes and wrinkles particles or not is an interesting question.

When Weinberg and Salam developed their theory of the weak interaction and they moved to reach electro-weak unification, they ran into a problem. The W and Z bosons all have considerable mass. As gauge bosons they mess up the gauge invariance of the theory. The electroweak unification condition they arrived at is:

* $e / 2 (2 \varepsilon_o)^{1/2} = g_w \sin O_w = g_z \cos O_w$.

Here g_w is the coupling constant for the W boson and g_z is the coupling constant for the Z boson, and (O_w) is the weak mixing angle, which is analogous to the Cabbibo angle for quark mixing. The weak mixing angle is based on the (W / Z) mass ratio, which we discussed briefly above.

The unification condition connects the coupling constants. The charges must also be taken into account. For that the "anomaly condition" is postulated. It states that the sum of the lepton charges plus three times the sum of the quark charges equals zero. The six leptons and six quarks satisfy this condition. Presumably that is the whole family. I consider all charges to be due to non-neutrino leptons. Thus I consider their rule meaningless and ad hoc. I do not expect any leptons above the *tau*, because the next window up is the deuteron, which is already occupied. Everything else is just excited protons.

Speaking generically, and just for the leptons, we would expect the possible interactions of an electro-weak unification theory to include all possible combinations of the particles, including identity transformations. By the gauge principle we have to include a gauge boson.

* $m_l^- \rightarrow n$ "W^-".
* $n \rightarrow m_l^-$ "W^+"
* $m_l^- \rightarrow m_l^- Z^o$.
* $n \rightarrow n Z^o$.

The first two cases are the so-called "charged" current interactions (where the boson passes charge through), and the latter two cases are the neutral current interactions. The masses of the W and Z bosons seem to require yet another transformation to be added that would keep the gauge field invariant. This involves adding a scalar field called the Higgs field. The specialty of this field is that it has non-zero expectations in the vacuum state. It is a kind of negative mass field in the vacuum that balances the masses that arise as excitations. But it is not the same as the Dirac hole theory of antimatter. The Higgs field theoretically generates uncharged Higgs quanta (*HH**) just like photons are the uncharged quanta for the electromagnetic field. The specialty of Higgs bosons is that they mediate the generation of mass for the (W) and (Z) bosons, and perhaps also for

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fermions. The Higgs has a theoretical coupling constant analogous to (a) and (a_w). The Higgs would produce vertexes like this:

* $HH^* \rightarrow X + X^*$.

Here X is any quark or lepton, charged or uncharged.

So far no clear-cut Higgs particle has shown up, and there is no precise prediction as to its "mass", although they are eliminating some possibilities already. On 4 July 2012 a preliminary announcement was made of the discovery of a particle of the "predicted" Higgs mass at the Large Hadron Collider in CERN. I am somewhat skeptical of the ability of physicists to find a Higgs particle with the high-energy colliders. What they have found is almost certainly just a high energy resonance, of which many exist. Proponents of the Higgs theory must devise a way to produce lots of HIggs particles and then demonstrate in some experiment how they generate mass in the heavy bosons. Otherwise, we have only an asserted claim attached to a predictable resonance.

My candidate for the "real" Higgs particle is the *Bu* boson. This boson weighs in at 1.86×10^{-9} kg. Interestingly, that is quite close to 1.054×10^{27} eV / c^2. I do not think they are going to reach those energy levels any time soon with colliders. However, the model I have given suggests the direction for the string theorists to point their energies. Some of the quantum techniques I have mentioned will allow us to probe the *Bu* structure within the common proton, perhaps with more finesse and further insight. In the meantime, by all means keep building bigger and better colliders to probe the high-energy end.

Grand Unified Theories (GUTs) bring together the electro-weak and the strong forces. The most remarkable prediction they make is that of proton decay.

* $p^+ \rightarrow \pi^o, e^+$.
* $p^+ \rightarrow \pi^+, \nu_e$.
* $p^+ \rightarrow \mu^+, \pi^o$

In the above discussion it should be clear that, unlike photon emission from energized electrons, spontaneous proton decay is highly improbable -- but not impossible. (Long-term studies at Japan's Super-Kamiokande suggest that the proton lifetime frame is longer than initially expected – the old positron and pi meson decay route time frame of 10^{31} years [1 per year out of 10^{31} protons] is revised to longer than 1.29×10^{34} years for positron decay and 5.9×10^{33} years for a decay route via a K meson to muon, pi meson, and neutrino). Rapid proton decay would render our universe very unstable. However, stimulated decay, like stimulated photon emission, may be possible and even practical, just as proton-antiproton annihilation is not only possible, but a practical mechanism for operating high energy colliders. I have suggested some approaches to probing the transition conditions for the proton. The challenge, as with any energy process, is how to get the effect most efficiently.

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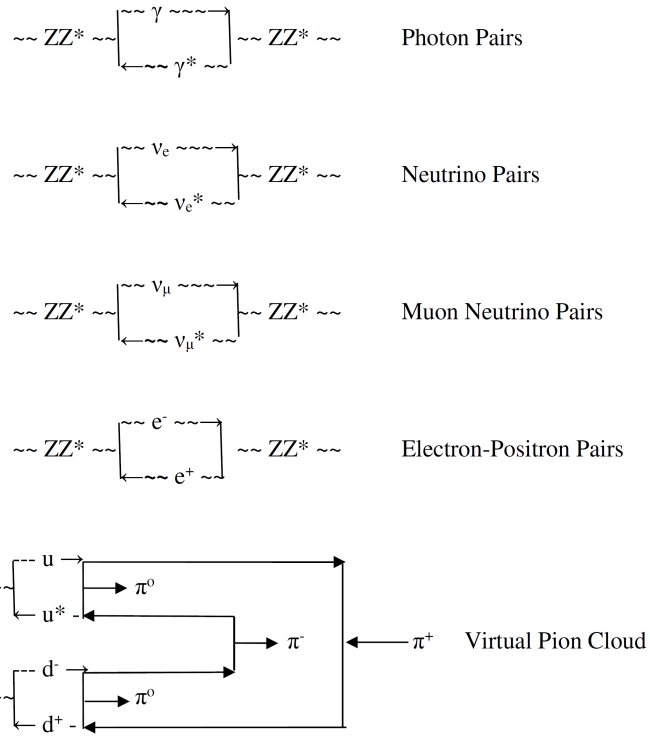
A further tool for probing this question is the study of the interface between physical particles and attention particles. The model I created shows that the apparent stability of the proton is a very dynamic system in which the proton is almost instantaneously appearing and disappearing to and from the vacuum state. The proton thus is not inherently stable. It is the incursion of a core belief structure that has locked the proton into an automaton cycle of repeated deaths and rebirths with a positron jewel trapped in the middle. If we "wake up" the proton, it may step out of that zombie cycle. Who knows what might happen then? Of course, if you like to play in the physical world as we have made it, then maybe you should let the sleeping elephants continue sleeping and tiptoe quietly. But I believe we can manage the situation and train a few elephants.

In our approach we have gone straight to a model that skips the need for "strong" forces and unifies gravity with the electromagnetic force. If the B_u particle serves as our Higgs, then we have completed the electro-weak unification program. The B_u particles appear at first glimpse to have charge, but so do the W and Z bosons. The B_u mechanism is different from the Higgs and can have a net zero charge between the two B_u particles in the pair. A task remains to see whether the B_u model can supplant the need for a separate Higgs field and settle the problem of the interference by the nonzero W and Z masses with the field theory gauge principle requirement of zero masses. Future experimental methods and results will provide more insights. Chapters 12 and 13 continue to develop the B_u model into a general theory of how to construct stable universes.

Some Z Boson Interactions

The Z boson pairs can generate virtual or actual pair creation and annihilation.



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Exercise: Below is a list of various quark lepton interactions written using our new notation. Can you tell which ones are allowed and which ones are not? Can you tell why? (Answers are given below the list of interactions.)

A. $\nu_\mu, u \rightarrow \mu^+, d^-$
B. $\nu_\mu, d^- \rightarrow \mu^-, u$
C. $\nu_\mu, u^* \rightarrow \mu^-, d^+$
D. $d^+, u \rightarrow \mu^-, \nu_\mu^*$
E. $\nu_\mu^*, u \rightarrow \mu^+, d^-$
F. $\nu_\mu^*, u^* \rightarrow \mu^-, d^+$
G. $\nu_\mu, d^+ \rightarrow \mu^+, u^*$
H. $d^+, u \rightarrow \mu^+, \nu_\mu^*$
I. $\nu_\mu^*, d^+ \rightarrow \mu^+, u^*$
J. $d^-, u^* \rightarrow \mu^-, \nu_\mu$
K. $\nu_\mu^*, d^- \rightarrow \mu^-, u$
L. $d^+, u \rightarrow \mu^+, \nu_\mu$
M. $d^-, u^* \rightarrow \mu^-, \nu_\mu^*$
N. $\nu_\mu, u \rightarrow \mu^-, d^-$

Answers: "Y" = yes, allowed; "N" = no, not allowed.
(A. N, B. Y, C. Y, D. N, E. Y, F. N, G. N, H. N, I. Y, J. N, K. N, L. Y, M. Y, N. N)
(A), (F), (G), (H), (J), (K) all violate parity.
(D), (N) violate charge conservation.
For example:
Case (K) can be: $s^- \rightarrow u, \mu^-, \nu_\mu^*$;
or $(\pi^-) \rightarrow u^*, d^- \rightarrow u^*, u, e^-, \nu_e^* \rightarrow \mu^-, \nu_\mu^*$. (i.e., Case M.)

The Structure of Electrons and Anti-Electrons
An electron or an anti-electron (positron) is an energy vortex that functions like a curved wave guide. The energy density also strongly refracts the photon energy. Thus the frequency remains constant, but, to a hypothetical "outside" observer, photons nearer the singularity of the vortex seem to move slower than at the de Broglie radius. They have **shorter, contracted,** wavelengths unlike the longer wavelengths that photons moving through glass or other material have. The electron is a mini white hole, and the anti-electron is a mini black hole. Energy flows into the positron, is swallowed into its singularity like water flowing down a drain, and then tunnels through hyper-space (below the zero point) to emerge from the singularity of an electron. It spirals out from the singularity and is sucked through ordinary space at light speed toward a positron. Here (m_e) is the electron mass, and (λ_e) is the wavelength loop "cycle" of the vortex energy as it swirls around the singularity. The expression (λ_e / 2 π) gives the radius, where (λ_e) is the wavelength.

* $m_e v_e \lambda_e = h.$

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* $(\lambda_e / 2\,\pi) = (\hbar / m_e\,c)$.
* $R_{edb} = 3.86\times10^{-13}$ m. (Effective de Broglie radius of electron.)
* $\lambda_{edb} = 2.426\times10^{-12}$ m. (Wavelength loop at de Broglie radius.)

The event horizon of an electron ($R_{eh} = 2\,G\,m_e / c^2$) is way below the Planck length, so the electron inherently "leaks" energy in the form of EM charge. The Planck length [$\lambda_P = (h\,G / c^3)^{1/2} \approx 4\times10^{-35}$ m.] defines the circumference of the tube around the singularity through which energy leaves an anti-electron and flows through hyper space to an electron. Photon energy flows into an electron through this tube. The electron and positron are joined at this tube at the time-space point-moment of pair production. Outside the de Broglie radius an electron's photon energy is very diffuse and tends to stream through space as "free" photon-antiphoton pairs moving at c toward an anti-electron attractor, generating the phenomenon of electric charge. The tube through the center also forms a magnetic pole. The whole thing looks rather like the pictures we see of black holes swallowing material at their equators and spewing out at the poles, except that the process runs in reverse, since the electron is a white hole. Positrons operate like black holes.

Physicists do not imagine the electron energy spinning at c because then, as the particle "spins", they suppose the outer parts would have to move at superluminal speeds. So they say that the electron is just a mathematical point -- which gets them into other problems. The electron does not work like that. Inside the de Broglie radius speeds actually undergo the wave guide effect and are split into group and phase components. There is also a refraction effect that slows the velocity of the photon and shifts its wavelength in the dense core.

* $c = (f)\,(\lambda_o)$.
* $(v_e) = (f)\,(\lambda_e)$.
* $n = (\lambda_o / \lambda_e)$.
* $n\,(v_e) = c$. (The refraction formula)

Here (f) is the constant frequency, (λ_o) represents the wavelength of EM radiation from electrons as its emitted photons move through space, and (λ_e) represents wavelength inside the de Broglie radius. As (v_e), the internal group velocity of a photon inside the electron, drops below (c), (λ_e) also decreases. The frequency stays the same. This tells us that photons at the super dense core of the electron vortex move extremely slowly. At the Planck scale (v_e) may be around 10^{-15} m / s, and the Planck loop is about 10^{-35} m. As a photon moves outward on a spiral path, the energy density drops off, and the photon speed and wavelength both increase until the wavelength reaches 2.426×10^{-12} m. At this point the photon (with its characteristic frequency of 1.237×10^{20} Hz) is moving at (c) and finds itself in free space.

* $(2.426\times10^{-12}\text{ m})(1.237\times10^{20}\text{ Hz}) = c$

(Other group wave effects arising from the motions and energy states of the electron as a whole -- for example, an electron in an orbital -- may contribute modifications to the

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fundamental frequency-wavelength relationship, but that is a separate, well-studied, question that we will not discuss here.) A perfect tangent to the energy loop would have no energy at all. But the photon oscillates and keeps a linear momentum as it streams toward its lepton partner.

We could represent the electron's vortex with a simple Archimedean spiral. In polar coordinates with the angle (A) and a constant radial progression of (a), we might write the photon's radial distance from the electron's singularity (R_{fe}) as:

* R_{fe} = a (A). (Or we can use the parametric equations:)
* x = a(A) cos (A); y = a(A) sin (A).

However, I suspect that the spiral is more likely a *phi-pi* spiral. Such a spiral allows the photon to constantly maintain the Einstein/de Broglie Velocity Relation [(v_{fe}) $(v_p) = c^2$] as it moves out from the singularity toward the de Broglie radius. Thus we modify the Archimedean equation as follows, again taking (A) as the relative angle. *Phi* is the Golden Ratio of 1.618....

* $R_{fe} = \varphi^{(A/\pi)} \lambda_P$. (Radial distance of a photon inside an electron)
* $R_P = 10^{-35}$ m. (The Planck Radius used as the base unit.)
* $R_{fP} = \varphi^{(0/\pi)} R_P = 1 R_P$. (The photon emerging from its hyper space tube)

As the photon spirals outward, (A) increases, and the wavelength grows longer, and the photon appears to accelerate, because each loop is larger and thus has a longer path, and the photon must travel around each loop in the same amount of time.

R_{fe}	A	*Phi*	
10^{-35} m.	0 π / 2	$\varphi^{(0/\pi)} = 1 \lambda_P$	$v_{eP} = 10^{-15}$ m / s
1.27×10^{-35} m	1 π / 2	$\varphi^{(1/2)} \lambda_P$	
1.618×10^{-35} m.	2 π / 2	$\varphi^{(2/2)} \lambda_P$	
2×10^{-35} m.	3 π / 2	$\varphi^{(3/2)} \lambda_P$	
2.618×10^{-35} m.	4 π / 2	$\varphi^{(4/2)} \lambda_P$	
3.325×10^{-35} m.	5 π / 2	$\varphi^{(5/2)} \lambda_P$	
. . . . .			
2.426×10^{-12} m.			$c = 3\times10^8$ m / s.

Rough Sketch of Photon's Spiral Path in the Electron Wave Guide

In this model the spiral path of the photon is a curved logarithmic spiral. One unit on the grid represents the Planck radius ($R_P \approx 10^{-35}$ m). In the squared off version you can see how the spiral begins and verify the Velocity Equation, because the frequency is constant.

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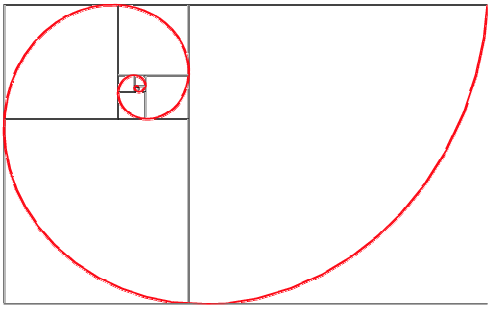

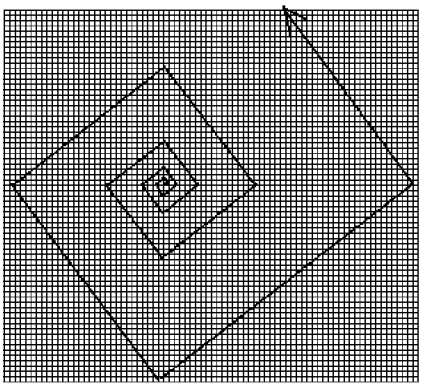

To see the Einstein/de Broglie relation, look, for example at the point where A = 2π.

* $R_{fe} = \varphi^2 = (2.618)(10^{-35})$ m.

At that moment the outward progress (v_g) of the photon is 2.618 times its initial velocity. Its actual instantaneous motion is 3.325 times the initial velocity, and the phase velocity (v_p) is 4.236 times the initial velocity. As the photon reaches the de Broglie radius around 2.426×10^{-12} m., its instantaneous outward progress (group velocity) will be 2.36×10^{8} m/s, it will move forward at $c = 3\times10^{8}$ m / s, and its phase velocity will be 3.818×10^{8} m/s, which indeed appears to be faster than light. Once the photon leaves the electron and travels in free space beyond the electron's wave guide effect, the group and phase velocities coalesce and all become c. On the other hand, at the moment when the photon pops out of the tunnel at the singularity, it moves at around 10^{-15} m / s, its centrifugal velocity. It moves forward at around 1.27×10^{-35} m / s, and its phase velocity is 1.618×10^{-35} m / s.

The whole operation is a tiny version of the Hawking radiation system. The electron-positron pair forms a single black hole that is split apart. The "anti" energy falls into the positron vortex, and the energy spins out of the electron vortex. Pair creation causes the two halves to seem separated, but they remain together, connected through the vacuum hyper space. Multiple pairs share energy and the streaming photons distribute themselves quantum mechanically among the members of the system according to the relevant probabilities.

To Summarize:

* $\lambda_{edb} = h / m_e c = 2.426\times10^{-12}$ m. (electron's de Broglie wavelength)
* $f = m_e c^2 / h = c / \lambda_{edb} = 1.237\times10^{20}$ Hz. (electron's fundamental frequency)
* $(f)(\lambda_{edb}) = c = 3\times10^{8}$ m / s. (Photon velocity at the de Broglie wavelength)
* $\lambda_P \approx 4\times10^{-35}$ m. (Planck scale wavelength)
* $v_{eP} = (f)(\lambda_P) \approx 4.95\times10^{-15}$ m / s. (Photon velocity at Planck wavelength)

(The spirals in the charts below are drawn as Archimedeans to show more vortex detail.)

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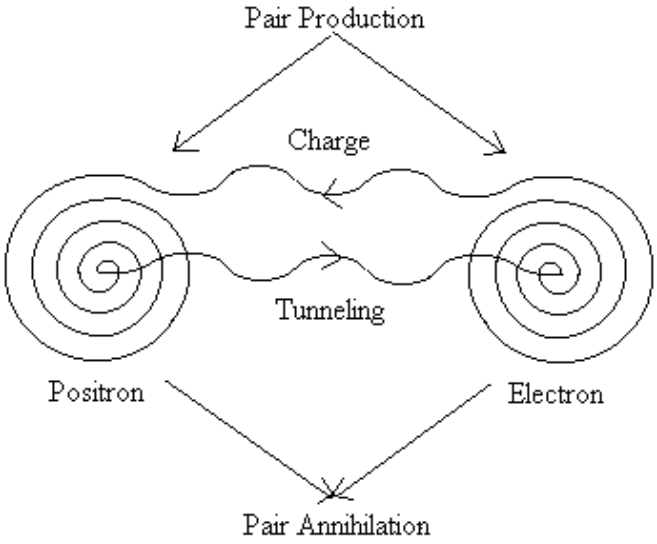
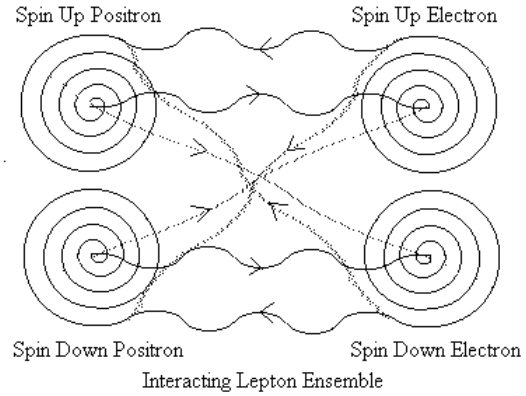


The above example of a lepton ensemble could be an electron in a hydrogen atom interacting with a positron that lurks at the core of the proton.



Interacting Lepton Ensemble

The electrons function as the "white hole" portion of the system, receiving antiphotons at the singularity and spitting photons out from the periphery to feed the positrons. The positrons function as the "black hole" portion of the system, sucking photons in at the periphery, and feeding them to the electron singularity as antiphotons via the quantum tunnel under the vacuum zero point. All electrons and positrons are identical and arise spatially from a single original pair, so the photon-antiphoton pairs follow the path of least action, and all the pairs share the energy. The sketches of transverse waves traveling through space are rough representations of the pulsations of the photon-antiphoton pairs as they interconnect charged leptons. The pulsation is due to the photon-antiphoton pair annihilation and recreation at the frequency appropriate to the relativistic motions of their charge-bearing terminals.

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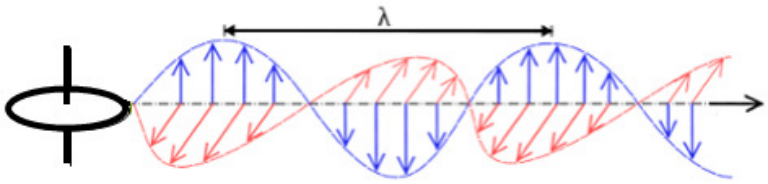

The D-Shift Operator, %, and φ.
The value of the D-Shift Operator as the square root of 10 meters may seem to be an arbitrary choice made with regard to the use of a base-ten number system, but it is not. The square root of ten is the product of the square root of two and the square root of five and all of this is based in Euclidean geometry.

* $(2^{1/2})\ (5^{1/2}) = (10^{1/2}) = 3.1622....$

The square root of two is the length of the diagonal of a unit square. The square root of five (approx. 2.236...) is the length of the diagonal of a doubled unit square. The square root of ten is the length of the diagonal of a tripled unit square. The square root of five is also the fundamental component of **φ**, the Golden Ratio, and a fundamental relationship by which Nature builds structures in fractal patterns from simple seed relationships. The product of the *n*th member of the Fibonacci series multiplied by the square root of five approaches as a limit the *n*th power of *phi* as *n* increases in value.

* $(21)\ (5)^{1/2} = 46.957...$ approx. $= (1.618)^8 = 46.97....$

This, of course, means that any member of the series divided by the previous member in the series also approximates the value of *phi* with increasing precision as one selects larger numbers in the series.

* 21/13 = 1.61538; 34 / 21 = 1.619.....

If you use the Lucas series (2, 1, 3, 4, 7, 11, 18, ...) together with the Fibonacci series and the square root of five, you get the **exact** value of *phi* for each ratio of two adjacent numbers in the series.

Magical Numbers

Step	Fibonacci Series			Lucas Numbers	Power of phi
1	$(5^{.5})$ =	2.236		1	
2	$(00)(5^{.5})$ =	0	2	0	$phi^0 = 1$
3	$(01)(5^{.5})$ =	2.236	1	1	$phi^1 = 1.618$
4	$(01)(5^{.5})$ =	2.236	3	2	$phi^2 = 2.618$
5	$(02)(5^{.5})$ =	4.472	4	3	$phi^3 = 4.235$
6	$(03)(5^{.5})$ =	6.708	7	4	$phi^4 = 6.8537$
7	$(05)(5^{.5})$ =	11.18	11	5	$phi^5 = 11.089$
8	$(08)(5^{.5})$ =	17.888	18	6	$phi^6 = 17.942$
9	$(13)(5^{.5})$ =	29.069	29	7	$phi^7 = 29.03$

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10	$(21)(5^{.5})$	=	46.957	47	8	$phi^8 = 46.97$
11	$(34)(5^{.5})$	=	76.026	76	9	$phi^9 = 75.99$
12	$(55)(5^{.5})$	=	122.98	123	10	$phi^{10} = 122.95$
						$phi^{(n+1)} / phi^n = phi$

$F_{(n+1)} / F_{(n)} \rightarrow phi$. (F = some member of Fibonacci series.) As n gets larger, the ratio approaches *phi*. $L_{(n+1)} + F_{(n+1)} / L_{(n)} + F_{(n)} = phi$. This ratio is always *phi* for all natural values of n. The following chart shows how to figure a Lucas number: Starting denominator = 2;

Starting numerator = $(1 + (5^{.5}))$. (L) = Lucas number, (F) = Fibonacci number

			(L) (F)		
2	2	= 2 =	(2 + 0 (2.236))		
3	$(1 + (5^{.5}))$	= 3.236.. =	(1 + 1 (2.236))	(3.236 / 2) =	1.618
4	$2 + (1 + (5^{.5}))$	= 5.236 =	(3 + 1 (2.236))	(5.236 / 3.236)=	1.618
5	3.236 + 5.236	= 8.472 =	(4 + 2 (2.236))	(8.472 / 5.236)=	1.618
6	5.236 + 8.472	= 13.708 =	(7 + 3 (2.236))	(13.708 / 8.472) =	1.618
7	8.472 + 13.708	= 22.18 =	(11 + 5 (2.236))	(22.18 / 13.708) =	1.618
8	13.708 + 22.18	= 35.89 =	(18 + 8 (2.236))	(35.89 / 22.18)=	1.618
9	22.18 + 35.89	= 58.07 =	(29 + 13 (2.236))	(58.07 / 35.89) =	1.618
10	35.89 + 58.07	= 93.96 =	(47 + 21 (2.236))	(93.96 / 58.07) =	1.618
11	58.07 + 93.96	= 152.03 =	(76 + 34 (2.236))	(152.03 / 93.96) =	1.618
12	93.96 + 152.03	= 245.99 =	(123 + 55 (2.236))	(245.99 / 152.03) =	1.618

In the above tables we can substitute for the constant diagonal of the doubled 1-meter Unit Square (square root of five meters) the ratio of the D-Shift Operator (% = 3.1622 meters) to the diagonal of a 1-meter Unit Square. We derived the "Root Unit" or "Unit Radius", R = 1 meter Unit Value directly from the fundamental quantum relationship of the proton to its charge and light speed.

* $R = m_p c / \pi e$.

In other words the ratio of the light-speed momentum of the proton to *pi* (π) times the quantum unit of charge is one meter (**Mech a**).

The Mystery of the Frozen Flux and Other Non Sequiturs in Electrodynamics

Electrodynamics is the study of electromagnetic forces generated by charges in various space/time relationships. The force acting on a charge depends on the size of the charge, its position, and its velocity. The model chosen in the current paradigm to express the laws of electrodynamics involves the notion of a field. There is an electric field with three dimensions of space and one of time. Each point in the electric field represents a value of the field expressed as a vector **E**. There is also a magnetic field with three dimensions of space and one of time. Each point in the magnetic field represents a value of that field expressed as a vector **B**. The key principle in treating electrodynamics from the field point of view is that a vector value can be specified for

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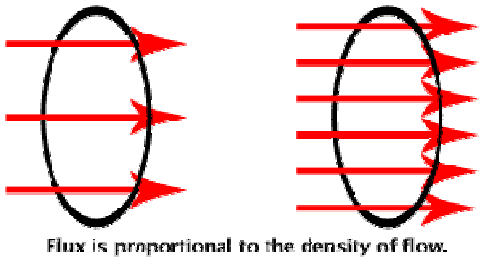
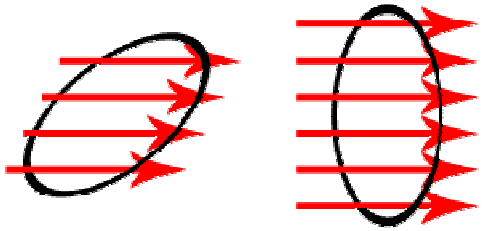
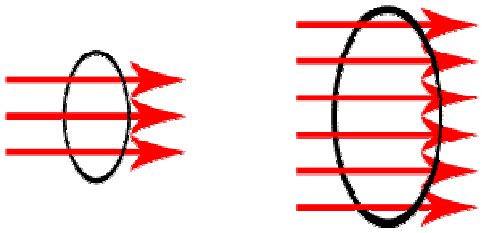
each point in the space/time of the field.



Flux is proportional to the density of flow.



Flux varies by how the boundary faces the direction of flow.

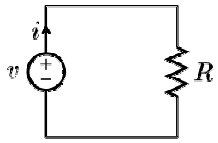


Flux is proportional to the area within the boundary.

(**Wikipedia**, "Flux")

With this vector field model we can examine electrodynamic behavior. Two fundamental types of EM behavior are "flux" and "circulation". Flux is the velocity (moving positions of point charges in the 3-space field over time) interacting with some boundary surface. So the flux is expressed as a velocity times an area.

Circulation involves the motion of charges in a loop and would be expressed as the average tangential component of a vector in the field along the loop times the distance around the hypothetical loop, as shown below in the example of a simple electrical circuit.



Wikipedia, "Circuit"

Here is where the first major problem with electrodynamics arises. We can not observe the charges in the field unless they interact in some way. The boundary surface that marks a "flux" involves some interaction. Likewise the circulation "loop" must form some kind of boundary that interacts with the charges in the field. Otherwise we simply can not "see" the vectors in the field to know for sure they are there.

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This led the framers of electrodynamics to set up the mathematical descriptions of the field behavior in such a way that they only took into account the interactions going on in the boundary regions or by the insertion of some "detector" (another physical surface or loop) into the field to "read" its value at some location. The model of the field was then arbitrarily modified to restrict it to this biased viewpoint. "Circulation" occurs only within a "circuit" loop, and all the rest of the field is frozen out of the picture and becomes irrelevant. As Tom Bearden puts it, this is like putting all our attention on the wind that billows the sail on the boat we are in and ignoring the wind that blows about over the rest of the ocean. Just because we don't happen to have a sail or a weather vane available to see it, does not mean it is not there playing a vital role in providing the wind that blows the sail we are currently using.

Even the brilliant Feynman commits this *non sequitur* in his generally brilliant introduction to "Electromagnetism" (**Lectures**, II.1.5): "Suppose that we instantaneously freeze the liquid everywhere [in a velocity field that describes the flow of a liquid] except inside of a tube which is of uniform bore, and which goes in a loop. . . ." He then surmises that the momentum of the liquid trapped in the loop would cause it to continue circulating around the loop.

The problem here is that Feynman has set up his fluid-in-a-field analogy, and then arbitrarily introduced a "flash freeze" process and taken the field out of the picture. Such a "flash freeze" does not follow from the model or from experience. The point is that we are not justified to suddenly shift our viewpoint from the model of the field as a whole down to the interactive boundary region of the loop we are interested in and then forget about the rest of the field. This is the same kind of observer viewpoint shift that we have noticed occurring in quantum mechanics quite often.

There is nothing inherently wrong with making such a viewpoint shift per se. However, the physicist should be aware that when he shifts viewpoint from a non-local frame to a local frame for the sake of calculation convenience, he may be throwing out lots of babies with the bath water. In this case he shifts his attention down into the "fluid" circulation that occurs in the boundaries of the local frame (the circuit loop) and forgets about all the other circulation that is still going on in the non-local field. This limitation may close off opportunities to better understand important and general types of behavior that may have significant impact on the way he treats problems in electromagnetism.

A second major problem with electrodynamics as traditionally taught is that the standard Maxwell equations are based on the assumption of a classical vacuum state filled with an inert aether. However, Michelson and Morley supposedly disposed of the aether with their experiment that showed the earth relative to the aether might as well not be moving at all. But then the development of quantum mechanics during the past century has amply demonstrated that the inert vacuum model is completely false. The vacuum is filled with virtual energy that is constantly boiling with possibilities. Open space constantly vibrates at every possible frequency, and Casimir has shown that, by the use of filters (Casimir plates), one may screen out certain virtual frequencies and produce a net

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negative energy "gap" in the vacuum. Photons passing through such a gap may even exceed *c*, presumably because of reducing the permittivity and permeability of the vacuum within the gap. This opens up the possibility of research into a whole range of Zero Point phenomena, an exploration that is just in its infancy. Recently Mendel Sachs has pointed out ("The Mach Principle and the Origin of Inertia from General Relativity", in the proceedings of the International Workshop on Mach's Principle and the Origin of Inertia, Kharagpur, India, in press, 2003) that, from the viewpoint of quantum mechanics, relativity, and unified field theory, we must accept the holistic viewpoint that all mass-energy in the universe is interrelated, thus in a sense verifying Mach's Principle. However, he also says that the influence of far galaxies is so small as to be negligible on a local scale, but at or below the scale of 10^{-18} m we enter a realm where virtual processes in the vacuum can have significant impact. (In this paper Sachs also develops a mathematical model for the generation of inertial mass from first principles, although it is not clear from the paper whether his model predicts the specific rest masses of the fundamental particles, something that is required by a unification theory.)

A third major problem with electrodynamics is the tendency to ignore the effects of Einstein's General Relativity. The study of electromagnetism assumes that space/time is flat and Euclidean in the classical Newtonian manner. Einstein has shown that this is only a special limiting case. The more general condition of space/time is that it appears to have curvature when an observer in a resting frame observes accelerating frames. The amount of curvature also depends on the density of mass-energy in the region under consideration. This varies greatly according to the location of a charge in the field relative to other charged or uncharged particles. The existence of such curvature gradients introduces nonlinear aspects to electrodynamics that are generally ignored. Study of magnetism on a fine scale reveals that it is based on relativistic effects. There may be much more to this than meets the eye.

In the paper mentioned above Sachs presents a model that supports a naturally oscillating cosmology. [Attractive gravity dominates in a rarefied and low kinetic mass-energy environment and repulsive anti-gravity dominates in a dense and high kinetic mass-energy environment.] This view is generally in accord with a certain level of Observer Physics as we shall see as we develop more fully our theory of quantum gravity in later chapters. Observer Physics nevertheless holds that the Observer always remains totally free and is never bound by any particular pattern of cosmology other than what s/he deliberately creates/accepts.

Given that all experimental evidence to date appears to support both special and general relativity, it seems odd that the foundations of modern electrodynamics have not been adjusted to reflect the nonlinear effects of curved space/time on EM phenomena except in a few advanced areas.

A fourth major problem is that modern electrodynamics has not yet digested the significance of the Zel'dovich principle of phase conjugation. This is a paradigm shift of major proportions that demands a major rewriting of the theory of electromagnetism in such a way that this principle is at the foundation. As early as 1903 E.T. Whittaker

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("On the Partial Differential Equations of Mathematical Physics", **Math. Ann.**, 57, 1903, 333-355) presented an elegant mathematical framework that he specifically mentioned could be applied to the description of EM and gravitational phenomena. Using quaternion algebra he showed that the wave equation could be reduced to spectral analysis of harmonic longitudinal plane waves that naturally occur in conjugate pairs. We have only just begun to gather the implications and phenomenology that flow from the foundational principle of phase conjugate wave forms. Electrodynamics for the past century has been at least half blind, ignoring for the most part the conjugate time-reversed waves inherent in all EM processes -- essentially the attention wave-particles of the observer. And the blinded portion holds the key to vast new realms of discovery and exploration. Furthermore, because ALL human experience is gated through EM interactions, the impinging of photons on, in, and as the very structure of the nervous system, we arrive at the inescapable conclusion that human attention has the form of a conjugate time-reversed EM wave propagation from the observer to any object of perception. Even the most advanced proponents of phase conjugation and the new theories of electromagnetism have failed so far to grasp this fundamental point, without which it is impossible to develop a complete theory of EM phenomena. (It is very likely that certain classified military projects do have some concept of this and have been attempting to embody the principle into "weaponized" applications such as the alleged Russian development of "bioenergetics" and "psycho-energetics", the highly secretive psy-ops branches of the military -- and, of course, "smart weapons". However, the notion of "smart weapons" is a horrendous oxymoron. We must stress here that the ongoing "weaponizing" of the phase conjugation principle for "destructive" purposes in everything from laser-guided weapons to mind-control psy-ops applications is **inherently a contradictory process** that can only lead to the ultimate self-destruction of those who attempt to use it for destructive purposes. The principle of phase conjugation allows the deliberate creation of a bubble of coherent quantum potential anywhere in space/time. That quantum potential bubble must be totally self-coherent. Therefore the notion of "killing" someone else while "preserving" oneself violates the integrity of a coherent quantum potential. It seems that the old M.A.D. philosophy is still alive and well, just morphing into subtler formats.

The current system of electrodynamics also suffers from the same self-destructive mindset. The burning of fossil fuels to force EM energy through power lines or to operate engines is seriously degrading the biosphere of our planet. John Houghton, former key member of the Intergovernmental Panel on Climate Change says, "I have no hesitation in describing it (global climate change as a result of fossil fuel burning, which is dominated by the U.S.) as a weapon of mass destruction (WMD)". Fuel is burned to set up an EM dipole. Energy flows through the dipole gate, but is then unaccountably looped back around so that it destroys the dipole. So more fuel must be burned to recreate the dipole and also work against the back EMF. No thought is given to how a simple electron can continuously and perpetually generate its charge or how this EM energy loops through space/time. (In our next chapter we will go on developing this principle to unlock the secrets of the proton and its quarks so that the whole foundational process, including the entire particle zoo, is open to view.)

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A fifth major problem in electrodynamics is the dedicated ignoring of the importance of the superluminal massless phase velocities that correspond to the scalar waves Bearden speaks of. These have been known since the work of de Broglie in the 1920's or earlier. We call them phase waves, but they are also known as de Broglie waves in honor of the man who developed awareness of them. All particles of matter, he showed, are really just interference patterns of waves. These waves have particular velocities. Whereas photons travel at cc^*, that is, they generally propagate as conjugate pairs at light speed, matter waves behave like EM waves in a wave guide. The conjugate pair is split into a group wave and a phase wave in such conditions. The de Broglie (phase) velocity is c^2 / v_g, where (v_g) is the velocity of the particle under observation. The group velocity must always be less than c, so the de Broglie phase wave always moves faster than light. The principle of phase conjugation brings the importance of the "massless" faster-than-light de Broglie wave components to the fore.

These days an important thrust of the so-called "non-conventional" physics community (i.e. people who are aware of the non sequiturs and other weaknesses in the "standard" model) is to update the laws of electrodynamics into a more general form. In addition to the incorporation of quantum and relativistic effects, efforts include research into such topics as “cold fusion” and so-called "free energy" devices. The physics "establishment" generally brands "free energy" projects as "crackpot" efforts along the line of searches for "perpetual motion" machines, ignoring the fact that every electron is a perpetual motion free energy device. As entrenched interests they try to keep funding directed at their extremely expensive pet projects, such as hot fusion and further exploitation of fossil fuels. Although such projects are fine (as long as they do not degrade our environment), they do not represent the only options, or even necessarily the most efficient options for allocation of resources. As Bearden points out (see his web site at www.cheniere.org), "perpetual motion" is simply Newton's first law, and the notion of cold fusion is quite reasonable under the principles of quantum mechanics. The cold fusion researchers simply need to find ways to optimize to a useful level the process of cold fusion that is going on naturally all the time in an extremely reduced and transient manner. The various efforts to capture "free energy" are simply variations on the well-established theme of harnessing "clean" energy from environmental energy reservoirs such as sunlight, gravitational influences, wind, and water. The Zero Point Energy researchers simply want to harvest energy from the quantum energy potential stored in the virtually unlimited reservoir of the vacuum state, a natural reservoir that has been amply demonstrated to exist for many decades. The only things special about Zero Point Energy resources are that (1) you can't see the vacuum state, and (2) the possibility of tapping into such a huge reservoir boggles the mind when you actually get around to putting some attention on it.

Tom Bearden and his associates have now thrown down the gauntlet to the scientific community and the energy industry. On March 26, 2002 U.S. patent #6,362,718 was issued for a "Motionless Electromagnetic Generator" (MEG) device. The issuing of a patent implies that the proposed device actually works. This places the energy community in a serious fix. If the device actually works, then the establishment leaders have to explain why they do not quickly adopt it, develop it to commercial viability, and

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make it available to the general public. Furthermore, since its operation is "impossible" under the current "standard" theory of electro-magnetics, they must immediately revise the theory to fit the "data" or adopt the theoretical model proposed by Bearden et al and based on the work of Sachs, Evans, and others -- for example, perhaps the O(3) model rather than the U(1) model. If the device **does not** work, then they also have a problem. As Bearden points out, "If it CANNOT be done, then that falsifies the gauge freedom principle itself, which in turn falsifies gauge field theory and most of the advanced physics of the day." (Email communication to J.L. Naudin on 11/07/01, posted on the page "The Tom Bearden Free Energy Collector Principle".)

This patent for a generator with no moving parts (regardless of the current state of its efficiency) is of such potential importance to the evolution of physical science, engineering, and the future evolution of the energy industry and consumer electronics industry that it is worth quoting from the abstract. (The abstract goes on to mention an alternative design involving alternating plates, posts and magnets.)

"An electromagnetic generator without moving parts includes a permanent magnet and a magnetic core including first and second magnetic paths. A first input coil and a first output coil extend around portions of the first magnetic path, while a second input coil and a second output coil extend around portions of the second magnetic path. The input coils are alternatively pulsed to provide induced current pulses in the output coils. Driving electrical current through each of the input coils reduces a level of flux from the permanent magnet within the magnet path around which the input coil extends. . . ."

Bearden comments: "Free energy dipolar antenna sources are everywhere; we just have to learn how to break the symmetry in their energy flux exchange with the vacuum, collect some of the freely flowing influx, and distribute that collected excess energy to an isolated load to separately power it. In other words, we simply have to implement circuitry that operates analogous to the standard heat pump cycle."

He also points out: "All conventional electrical power systems already contain fully functional free energy systems in their source component. Each conventionally designed system is, however, deliberately suicidal, since part of the system's own energy is utilized to work against itself and destroy itself." ("Additional Information On The Final Secret of Free Energy", Update 15 February 1994. © 1994 by T.E. Bearden.)

At his web site Bearden has listed 34 major flaws in classical EM theory. I highly recommend that you find time to peruse his web site at www.cheniere.org. It is filled with fascinating and profound material. Of particular interest are the essays, "The Unnecessary Energy Crisis: How to Solve It Quickly", "The Final Secret of Free Energy", "Additional Information On The Final Secret of Free Energy", "On the Principles of Permissible Overunity EM Power Systems", "Practical Overunity Electrical Devices", "Explanation of the Motionless Electromagnetic Generator with O(3) Electrodynamics" (co-authored with others), Explanation of the Motionless Electromagnetic Generator with Sach's Theory of Electrodynamics" (co-authored with others), **Foundations of Physics Letters**, Vol. 14, No. 4, 2001, plus many good charts, diagrams, and email discussions

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with correspondents. Bearden is a highly experienced aero-space engineer and nuclear physicist. He also has some books available, including **Energy from the Vacuum: Concepts and Principles**, Cheniere Press, 997 pp., and **Fer de Lance**, an exposé of secret weapons projects developed in Russia.

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