Origin of the Natural Laws in a Binary Universe

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Abstract: The great philosophers of cosmology, Clifford, Mach, Einstein, Wyle, Dirac, Schroedinger, have pointed out that only a wave structure of matter (particles) can conform to experimental data and fulfill the logic of reality and cosmology. This Quantum Wave Structure of Matter (WSM) has been found and is the origin of the natural laws. Since the WSM provides a quantitative origin of the fundamental natural laws, it becomes the basis of physical sciences.

Only three basic Principles of Nature determine the wave medium and enable quantitative calculation of the WSM and the origin of the natural laws. The medium of the waves is space. The properties of particles and the laws embedded in them are derived from the properties of space. This single entity, described by three principles, underlies everything. For the electron, the structure is a pair of spherical outward and inward quantum waves, convergent to a center, existing in ordinary space and termed a space resonance. Every space resonance shares its binary wave structure pair with all others in our universe. Thus we exist in an inter-connected binary universe.

The predictive power of the WSM shows how the electron's wave pair is the physical origin of the previously unknown quantum spin. These two waves are a Dirac spinor satisfying the theoretical Dirac Equation. Spin occurs because the inward quantum wave continually undergoes spherical rotation at the center transforming to the outward wave.&#0; The significance of the WSM on &#0;communication, life, and our connection with the binary universe is discussed.

Part I - Introduction

Our knowledge of science is based on the natural laws that describe the behavior of particles. These laws are the rules for calculating electricity, gravity, relativity, quantum mechanics, and conservation of energy and momentum. The origins have been unknown. Now for the first time the origin of the natural laws is found to be a quantitative result of the WSM.

The origins of the laws had been sought for centuries. Finding all of them at the same time and place is a philosopher's dream come true. It is of great importance to science because the natural laws and quantum spin determine the structure of the Atomic Table, which dictates the varied forms of matter: metals, crystals, semi-conductors, and the molecules of life. The deep understanding of basic physics that is revealed opens a door to broad fields of applied technology such as integrated circuits, photonics, and commercial energy. It reveals a universe of real quantum wave structures that we live in but seldom see.

Finding these origins was very simple. The ancient Greek notion of a point particle was replaced with a *spherical wave structure*, which had already been predicted by Clifford, Einstein and Irwin Schroedinger, a century ago. After World War II enthusiasm for wave structure waned for 40 years. It was not complex or difficult but it was different because it disagreed with human emotional experience of point particles that most people were satisfied with. Emotions play a powerful, often hidden role in the motivation for research.

We don't easily see the space medium because our survival as an animal species depends mostly on our ability to fight with other animals seeking food, and to compete for mates that produce children, not closely related to the quantum space medium. In our self-focused human perspective few of us are even aware of the wave medium in which we exist. For survival, it doesn't matter what space is, or whether we can observe it - it exists nevertheless. This situation is much like the life of a fish who cannot comprehend the existence of water because he is too deeply immersed in it.

Like the fish, traditional science has tended to comprehend the universe in terms of our own local experiences. It was assumed that matter particles are like tiny grains of sand - an idea proposed by the Greek philosopher Democritus many centuries ago. As microscopy improved, models were created subdividing grains into other 'grains' - ad infinitum. But only a few people like Einstein saw that grains were impossible or ever asked how the grains communicate forces - unexplained by the old science. Formerly, forces were accepted as faith in Nature.

Human perspective has many biases. We tend to see space as three rectangular dimensions, one of which is the vertical gravity vector of Earth, plus two other vectors perpendicular to it, shaped like the houses we live in. But in the cosmos, the shape of the enormous universe is *spherical* whose important dimensions are *inward* and *outward*, the direction of waves in space. In the vast expanse of the real universe, gravity occurs so rarely, that its direction is inconsequential in the larger scheme of things, despite its local importance to us.

The proof of the WSM is that all the natural laws can be obtained mathematically from the three basic principles describing the wave space medium. This wave structure of matter is simple and matches experimental measurements. In contrast, conventional physics required dozens of assumptions plus many more arbitrary constants to explain the operation of the laws. Even then some laws, like spin, were a puzzle with no origin known. On the atomic scale electromagnetism is inaccurate. The comparison of the old physics with its new wave structure can be compared to the theory of epicycles of the planets around the Earth before Copernicus and Galileo found that the planets traveled around the Sun.

1 . A New Science Odyssey

The discovery of the wave structure of the electron and other matter is a beautiful adventure in which you find the origin of the natural laws, a new powerful tool of technology, and an exciting window on science, cosmology, and ourselves. But some classic concepts must be discarded. For instance, a quantum physicist may expect that all quantum phenomena <u>must</u> derive from Schroedinger's Equation. Instead, it is the other way around; Schroedinger's Equation is derived from the quantum wave structure of the universe.

Some concepts must be changed such as the meaning of charge and mass, formerly assumed to be inherent properties of each independent particle. Instead of this assumption we find, as Schroedinger deduced, that location, charge and mass *are properties of the wave structure* and ultimately of the wave medium - space. This can now be proved.

Understanding our misconceptions comes from anthropology, which teaches that the quantum wave universe is not as helpful to survival of our personal genes as recognizing apples we can eat and avoiding tigers who want to eat us. We need to recognize those quickly. But it was not necessary that nature equip us to observe quantum waves quickly. Lacking personal experience of simple quantum waves, people chose to imagine that the electron is a "particle," like a bullet. Laboratory evidence does not support this human-oriented idea. Accordingly, belief must change from discrete particles to wave structure. But emotional rejection can occur if the new truth conflicts with established belief. Max Planck once said, "New scientific truth does not triumph by convincing its opponents, but because the opponents die and a new generation grows up unopposed to the new idea."

2. History of the New Wave Structure of Matter

A wave structure of matter was proposed 130 years ago by the famous English geometer, William Clifford[1], who spoke before the Cambridge Philosophical Society in 1870, "All matter is simply

undulations in the fabric of space." He developed this concept[2] as three-dimensional dynamics that reduces to four-dimensional kinematics describing matter, electromagnetism and kinetic energy as curvature of a dynamic Riemannian space. His work, the progenitor of the WSM and General Relativity was neglected.

In Clifford's thoughts, the mass and charge substances that we assume, do not exist but are properties of a wave structure in space. In short, space waves were real, while mass and charge points are mere appearances of the wave structure; "Schaumkommen" in the words of Schroedinger[3]. Their proposals were consistent with present day quantum theory, since quantum mathematics does not depend on a belief in particle substance or charge substance.

Ernst Mach and Bishop Berkeley had proposed about 1890, that the law of inertia depended on all the matter of the universe. This was known as *Mach's Principle*. It was the first recognition that a natural law depends on cosmology. Albert Einstein was greatly influenced by it when he deduced the General Theory of Relativity (GTR). Now, Mach's Principle, in a more exacting form, has become Principle II of the Wave Structure of Matter (below) from which all the laws derive.

General Relativity has been succinctly described*: 'All the matter of the universe tells space what it is. Then space tells the matter of the universe how it must behave.'* This remarkable reciprocity in the universe is the heart of the WSM. You will see this when they are reviewed below.

The failure of the point particle concept began to appear. Einstein and Ernst Mach reasoned that space and thus matter cannot be discontinuous so that particles must be "spherically spatially extended in space." Einstein wrote, "…*Hence the material particle has* <u>*no*</u> *place as a fundamental concept in a field theory."*

Paul Dirac was never satisfied with the discrete point particle because the infinity of the Coulomb force law had to be corrected by 'renormalization'. He wrote[4], *⟩This is just not sensible mathematics. Sensible mathematics involves neglecting a quantity because it turns out to be small, not neglecting it because it is infinitely large and you do not want it! Of course the inference is that the basic equations are wrong and radical changes need to be made.*" Dirac seemed to foresee the WSM.

Wheeler and Feynman[5] (1945) modeled the electron as spherical inward and outward *electromagnetic* waves, seeking to explain radiation forces. Unhappily they failed because there are <u>no</u> spherical solutions of *vector* electromagnetic wave equations. Nevertheless, their work pioneered the concept that every particle sends *quantum* waves outward, and receives an inward response from the universe. In hindsight, if they had used *scalar* quantum waves instead, this paper would have appeared 55 years ago! So close and yet so far! "A hair's breadth separates the false and true."

After 1945, research on wave structure stopped until 1985 when Milo Wolff[6,7], using a *scalar* wave equation with spherical quantum wave solutions, found the Wave Structure of Matter described here. It successfully predicted the natural laws and all of the properties of the electron, except one - its spin. Below, this paper reviews the WSM and provides a physical origin of spin that accords with quantum theory and the Dirac Equation.
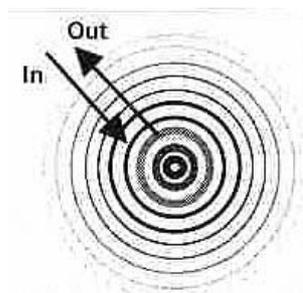

Figure 1. The Dynamic Waves of a Space Resonance

The resonance is composed of a spherical IN wave, which converges to the center, rotates to become an OUT wave, and diverges from the center. These two waves combine to form a standing wave whose peaks and nodes are like layers of an onion. The wave amplitude is a scalar number, <u>not</u> an electromagnetic vector. At the center, the wave amplitude is finite, not infinite, in agreement with observation.

Part II - Review of the Wave Structure of Matter

The wave-structured particle, Figure 1, is termed a *space resonance* (SR). The medium of the waves, and the leading player in the new scenario, is *space* that supposed void of which we formerly knew little. The properties of space resonances and the laws that they produce are derived from properties of space. Thus, this single entity, space, described by three principles, underlies *everything*.

3. Principle I - A Wave Equation

This Principle, an equation, describes how quantum waves are formed and travel in a space medium. The wave amplitudes are scalar numbers. If the medium is uniform, typical nearly everywhere, only *spherical waves* occur. If observed in relative motion, Doppler modulation and elliptical waves appear. If the medium is locally dense, as in the central region of a proton, waves *circulate* like sound waves in a drum or a sphere. Principle I is:

Quantum matter waves exist in space and are solutions of a scalar wave equation.

The wave equation is: $(\mathbf{grad})^2(\mathbf{AMP}) - (1/c^2)\, d^2(\mathbf{AMP})/dt^2 = 0$

Where **AMP** is a scalar amplitude, **c** is the velocity of light, and **t** is the time. Its solutions, Figure 1, are a *pair* of spherical in/out waves that form the simple structure of the electron or positron — an oscillator. The waves decrease in intensity with increasing radius, like the forces of charge and gravity.

There are *two* combinations of the two *basic* in/out waves that form electrons and positrons, with opposite phase and spin rotation. Thus matter is constituted of two *binary* elements - like computer hardware. Although the variety of molecules and materials populating the universe is enormous, the basic building bricks are just two. Is there a profound meaning to this?

As is true for all oscillators in Nature the properties of the waves, such as speed and amplitude, derive from properties of their medium. Formation of the *space* medium is given by Principle II below.

4. Origin of the Natural Laws.

The two combinations contain all experimental electron-positron properties. Charge depends on whether there is a + or - amplitude of the IN wave at the center. If a resonance is superimposed upon an anti-resonance, they annihilate. The amplitude at the center is finite as observed, not infinite as in the Coulomb rule. They obey Feynman's Rule: "A positron is an Electron going Backward in Time."

The properties of quantum mechanics (QM) and special relativity (SRT) are the result of the motion of one space resonance relative to another, which produces a *Doppler shift* in <u>both</u> the IN- and OUT-waves. All parameters of QM and SRT for a moving particle; that is, the de Broglie wavelength of QM and the relativistic mass and momentum changes, appear as algebraic factors in the Doppler-shifted waves exactly as experimentally measured. Details are in the Math Appendix.

5. Energy Transfer and the Action-at-a-Distance Paradox

A necessary new concept is the mechanism of energy exchange. Experience&#0; tells us that communication or acquisition of knowledge of <u>any</u> kind occurs <u>only</u> with an *energy transfer*. Storage of information, whether in a computer disk or in our brain, always requires an energy transfer. Energy is required to move a needle, to magnetize a tape, to stimulate a neuron. There are no exceptions. This rule of nature is embedded in biology and our instruments. Finding the energy transfer mechanism

between particles is essential to understanding the natural laws. It is found naturally in Principle II of the WSM.

A major deficiency of the classical force laws is that they have <u>no</u> theoretical or physical *mechanism* for energy transfer. The formulas contain only constants, "mass" and "charge," - no mechanism. This was an inherent defect of the <u>static</u> point particle model. Einstein, Wheeler and Feynman[5] knew this, recognizing that there must exist a continual dynamic means for forces to transfer energy and sought it in electromagnetic waves. Unfortunately there are no spherical solutions of the *vector* e-m wave equation. Hence the mechanism had to await the *scalar* waves of the WSM. We will see that wave communication is the means.

Ernst Mach's[9] observation in 1883 was the first hint of the mechanism of cosmological energy transfer. He noticed that the inertia of a body depended on the presence of the visible stars. He asserted: *"Every local inertial frame is determined by the composite matter of the universe"* and jokingly, *"When the subway jerks, it is the fixed stars that throw you down."* His deduction arose from two different methods of measuring rotation. First, without looking at the sky one can measure the centrifugal force on a rotating mass m and use the inertia law F = ma to find circumferential speed and position, as in a gyroscope. The second method is to compare the object's angular position with the fixed (distant) stars. Both methods give exactly the same result!

Mach's Principle was criticized because it appeared to predict instantaneous *action-at-a-distance* across empty space. How can information travel from here to the stars and back again in an instant? Again the answer had to await the WSM where Nature's energy exchange mechanism, formerly unknown, is now seen as the interaction of waves in an ever-present universal medium. Space is not empty because it is a quantum wave medium created by oscillating waves from every particle in the universe (Principle II below). Inertia, charge, and other forces are mediated by the pervasive space medium. There is no need to travel across the universe.

6. Principle II - Space Density Principle (SDP)

This principle defines the quantum wave medium - space. It is fundamentally important because the properties of waves depend on properties of their medium. But, since the natural laws depend on the waves we deduce that the natural laws in turn depend on the medium. Thus, space - the medium - is the wellspring of everything.

Principle II is:

At each point in space, waves from all particles in the universe combine their intensities to form the wave medium of space.

The medium = space density $\sim mc^2 = hf = k'[\text{SUM OF:}\{(AMP_n)^2 \times (1/r_n^2)\}]$

In other words, at every point in space, the frequency **f** or the mass **m** of a particle depends on the sum of squares of all wave amplitudes AMP_n from the **N** particles inside the "Hubble universe", whose distance decreases inversely with their range r_n squared. The "Hubble Universe" is of radius R = c/H, where H is the Hubble constant.

This principle is a quantitative version of Mach's Principle because the space medium is the inertial frame of the law F = ma. When mass or charge is accelerated, energy exchange takes place between it and the surrounding space medium. In hindsight, this is the mechanism of charge radiation, unsuccessfully sought by Wheeler and Feynman[4] (1945), attempting to use e-m waves instead of quantum waves.

Because there are a large number of particles, $N \sim 10^{80}$, in the Hubble universe, the medium is nearly constant everywhere and we observe a nearly constant speed of light. But near a large astronomical body like the Sun, the larger space density produces a measurable curvature of the paths of the inward

and outward waves and thus of light and the motion of matter. We observe these as the effect of *gravity* described by Newton and also by the *space curvature* of Einstein's general relativity.

7. The Energy Exchange Mechanism and Charge

Note that the self-waves of a resonance are counted too. Thus space becomes dense near the resonance centers due to their own large wave amplitude. Dense space at the central region propagates waves non-linearly, which allows energy transfer or *coupling* between two resonances. We observe this process and call it 'charge.' But there is no 'charge substance' involved. It is a property of the wave structure at the center.

Can this mechanism be tested? Yes. If a resonance's self-waves can be dominate in its space, then at some radius, r_o from the center, self-wave density must equal the total density of waves from the other **N** particles in the Universe. Evaluating this equality[6,7,8] yields

$$r_o{}^2 = R^2/3N$$

The best astronomical measurements, $\mathbf{R} = 10^{26}$ meters, $\mathbf{N} = 10^{80}$ particles, yield $\mathbf{r_o} = 6 \times 10^{-15}$ meters. This should be near the classical radius, e^2/mc^2 of an electron, which is 2.8×10^{-15} meters. The test is satisfied.

This is called the ***Equation of the Cosmos*** a relation between the 'size' $\mathbf{r_o}$ of the electron and the size **R** of the Hubble Universe. Astonishingly, it describes how all the **N** particles of the Hubble Universe create the space medium and the 'charge' and 'mass' of each electron as a property of space.

8. Principle III - Minimum Amplitude Principle (MAP)

This third principle can be obtained from Principle II, but because it is a powerful law of the universe, which determines how interactions take place and how wave structures will move, I write it out separately:

> *The total amplitude of all particle waves in space everywhere*
>
> *always seeks a minimum.*

This principle is the disciplinarian of the universe. That is, energy transfers take place and wave-centers move in order to minimize total wave amplitude. Amplitudes are additive, so if two *opposite* resonances move together, the motion will minimize total amplitude. This explains empirical rules like, "Like charges repel and unlike charges attract" because those rules minimize total amplitude. The origins of many rules are now understood. For example, MAP produces the *Heisenberg Exclusion Principle*, which prevents two identical resonances (two fermions) from occupying the same state. This is not allowed because total amplitude would be a maximum, not a minimum. The operation of MAP is seen in ordinary situations like the water of a lake, which levels itself, and in the flow of heat that always moves from a hot source to a cold sink.

9. The Conservation of Energy

The transfer mechanism between combinations of resonances is a result of the dense (non-linear) space at resonance centers, which permits coupling or exchanges of wave frequency. When the waves of a potential source and a potential receiver, pass through both centers in an allowed transition, MAP minimizes the total of both amplitudes. In the source, the frequency (energy) of a wave state shifts

downward. In the receiver, there is an equal shift upward. Only wave states (oscillators) with equal frequencies 'tuned' to each other can couple and shift frequency. Accordingly, the frequency (energy) changes must be equal and opposite. This is exactly the content of the *Conservation of Energy law.* The origin of this universal law is reduced to the matching of waves of two particles - not too different from tuning up an orchestra matched to the 'A' played by the first violin!
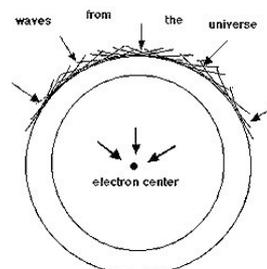
10. The Origin of the IN Waves and the Response of the Universe

Figure 2. Formation of in-waves. The out-wave of every particle interacts with other matter in the universe. The response to the outgoing wave is Huygens wavelets from other matter that converge back to the center of the initial out-wave. When the wavelets approach the center, their combined amplitude becomes larger, forming the IN wave. Thus every particle depends on all other particles for its existence. *We are part of the universe and the universe is part of us.*

At first thought, it is puzzling where the IN waves come from. This puzzle is our own fault - a result of looking at the waves of only one particle, and ignoring the waves of all other particles in space — over simplification! To find reality, we must deal with the *real* wave-filled universe. When we study this question[13] we find a rational origin of the inward waves:

Two hundred years ago Christian Huygens, a Dutch mathematician, found that if a surface containing many separate wave sources was examined at a distance, the combined wavelets appeared as a single wave front having the shape of the surface. This wave front is termed a 'Huygens Combination' of the separate wavelets (Figure 2). This mechanism is the origin the in-waves, as follows: When an outgoing wave encounters other particles, their out-waves are joined with part of the initial out-wave. Then out-waves from all other particles can form a Huygens Combination wave front that is the in-wave of the initial particle. These waves arrive in phase at the initial center. This occurs throughout the universe so that every particle depends on all others to create its in-wave.

We see it is wrong to imagine each particle as one pair of in- and out-waves, because one pair cannot exist alone. We have to think of each particle as inextricably joined with other matter of the universe. Although particle centers are widely separated, all particles together are one unified structure. Thus, *we are part of a unified universe and the universe is part of us.*

Part III - The origin of the electron's spin

As an example of the depth of understanding and universality of the Wave Structure of Matter, I will describe for the first time the origin of the spin of the electron. The physical nature and cause of electron spin has been sought for 75 years ever since a *theoretical* theory of spin had been developed by Nobel laureate Paul Dirac[10] in 1926. He theoretically predicted the *positron*, found in cosmic rays five years later by C. D. Anderson.

11. Dirac's Theory

Dirac was probably not interested in spin but in the philosophical differences between relativity and quantum theories. Dirac studied the connection between the conservation of relativistic energy given by

$$E^2 = p^2c^2 + m_o{}^2c^4 \quad (1)$$

and Schroedinger's quantum theory. **E** is energy and **p** is momentum of a particle of mass m. Schroedinger's procedure was to use an energy relation for a particle, like (1) and change it to a wave equation. His usual way was to change the terms for **E** and **p** into two wave equation operators using,

$$E = (h/i) \ [d \ \textbf{AMP}/dt] \quad p = h[d \ \textbf{AMP}/dx] \quad (2)$$

Where **AMP** is the amplitude of the Schroedinger wave function sought. Then the solutions should describe the amplitude of waves of the particle. No one knew why this worked but the results for the H atom are amazingly accurate so it is trusted.

Unfortunately for Dirac, Eqn (1) uses squared terms whereas Eqns (2) cannot be squared! He had a new idea, 'Try replacing Eqn (1) with a matrix equation:'

$$(\textit{Identity})\textbf{E} = (\textit{alpha})\textbf{pc} + (\textit{beta})\text{m}_o\text{c}^2 \quad (3)$$

Where the new factors (*Identity*), (*alpha*), and (*beta*) are matrix operators. This avoided squares of **E** and **p** but placed severe restrictions on the new operators and their solutions.

Dirac saw that Eqn (1) is similar to squaring the sides of a triangle. He deduced that in Eqn (3) the equivalent of squaring had to become part of the matrix algebra. He found that solutions existed if **E** and **p** had fixed values. This theoretical *matrix* algebra produced correct values of the electron's energy mc^2, and spin h/4pi angular momentum units, but gave no hint of the physical structure of the electron. But Equation (3) became famous.

Dirac also noticed that only <u>two</u> functions were needed in the electron's solution. So Dirac simplified the algebra by introducing number *pairs*, termed *spinors*, and 2x2 matrices *called spin operators* creating a two-number algebra instead of a four-algebra or our common one-number algebra. A detailed reader-friendly review of Dirac's Equation is given by Eisele[10].

12. The Physical Mechanism of Spin

Spin occurs when the in-wave arrives at the center and *rotates* continuously in order to transform into the out-wave. To accomplish rotation there are strict (boundary) conditions on the amplitudes and polarity of the IN and OUT waves. Rotation cannot be allowed to twist up space without limit. The spherical wave amplitudes must continually and smoothly change while changing direction of motion. The in-wave amplitude at the center must be equal and opposite to the out-wave (one half cycle different).
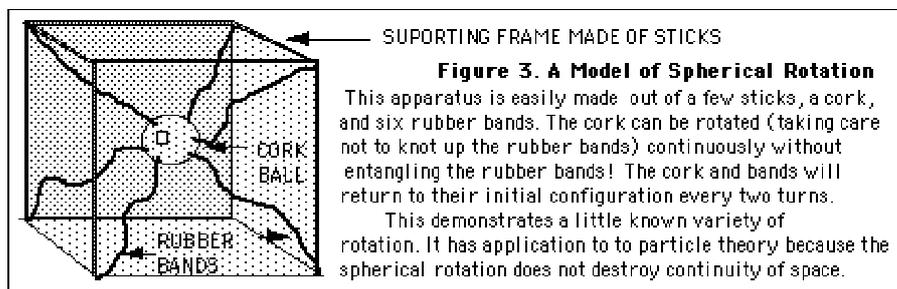
It turns out this happens using a known[12] property of 3D space called *spherical rotation* in which space rotates continually around a *point* and returns to its initial state after <u>two</u> turns. In spherical rotation there is <u>no</u> fixed axis like *cylindrical* rotation of a wheel. Spherical symmetry is preserved because the center of rotation is a *point*. One direction of rotation produces the electron, the other the positron. This is why every charged particle has an anti-particle.

Batty-Pratt & Racey[11] (1980) analyzed spherical rotation and showed that an exponential oscillator, e^{iwt}, was a spinor. Wolff[8] realized in 1989 that the exponential in-out oscillator waves of the WSM were the *real* physical spinors satisfying the Dirac Equation. It is significant that only 3D space[12] has this remarkable property. If this real property of 3D space did not exist, particles and matter could not exist. Life and the universe as we know it could not exist.

13. The Equivalence of the WSM and the Dirac Equation Procedure

It is easy to calculate the rotation of an in-wave of frequency (energy) = mc^2/h and wavelength = h/mc. The rotation rate is two turns each cycle. This produces an angular momentum of $\pm h/4pi$ obtaining Dirac's result simply.

The results are almost the same for both WSM and the Dirac Equation but not quite the same. The energy given by the Dirac Equation is + or $-mc^2$ while the WSM says the electron and positron energy are both a *real* mc^2. Dirac was forced to interpret the puzzling negative energy as an unseen "sea of negative energy particles". This strange concept has never been observed and has been abandoned but the reason was unknown until the WSM.

SUPORTING FRAME MADE OF STICKS

Figure 3. A Model of Spherical Rotation
This apparatus is easily made out of a few sticks, a cork, and six rubber bands. The cork can be rotated (taking care not to knot up the rubber bands) continuously without entangling the rubber bands! The cork and bands will return to their initial configuration every two turns.
This demonstrates a little known variety of rotation. It has application to to particle theory because the spherical rotation does not destroy continuity of space.

What is the correct interpretation of the Dirac result? To find it look at the electron/positron wave algebra in the Mathematical Appendix. In the electron wave write the sign of the product of energy and time as negative, that is: $-Et/h = -wt$. But this is the same as exchanging the in-wave with the out-wave, which changes the electron into a *real* positron! We see Dirac's numerical result was right but the interpretation was wrong. Wrong because he had no wave structure theory to guide him. He assumed the electron was a discrete particle instead of a wave structure! This mistaken assumption has plagued physics for centuries.

Note that the Dirac Equation only describes rotations at the electron center, not the entire WSM. The work of Batty-Pratt[12] (pp 453-455) analyzed only the rotation of *local* exponential waves, found that these spinors and their rotation produced the Dirac Equation.

14. A Model of Spherical Rotation

Spherical rotation in 3D space can be modeled by a ball held by threads inside a cubical frame shown in Figure 3. The threads represent the coordinates of the space and the rotating ball represents the space at the center of the converging and diverging quantum waves. The ball can be turned about any axis starting from any initial position. If the ball is rotated continuously it returns to its initial configuration after every two rotations.

Using the ball or its exponential wave equivalent, you can *reverse* the spin axis, by reversing time (t --> -t) or by reversing the angular velocity (w ---> -w). Both are equivalent to exchanging the outgoing spherical wave of an electron with the incoming wave

Dirac matrices perform geometric operations. For example, *inverting* a spin state is produced by the inversion matrix operating on the spinor.

NOTE: The rule of matrix algebra is to multiply and add the *row* elements of a *spin operator* by the *column* elements of the initial spinor. Each result is the new element of the final spinor.

In these examples, note that inversion and spin reversal are not the same. This differs from our human view of cylindrical rotating objects. The difference is characteristic of the quantum wave electron and is important to understand particle structure.

A rotation in the spherical mode can be represented by any operator that will transform a spinor into another position. It is usual to assign a unit radius to spinor amplitudes. Then the rotations can be described by the mathematics of the SU(2) group

For example, a ball in laboratory space can be rotated 180° about the z-axis by the operator (spin-z). Humans in human coordinate systems (like a lab) create rectangular axes. However the spherical waves of an electron travel in cosmological space which has spherical symmetry. No x-y-z axes exist. Thus only *spherical rotation* around the wave *center* is meaningful.

Nevertheless, if a laboratory magnetic force (field) or electric force (field) is applied to an electron, or if the observer is moving with respect to the electron, an axis is formed. In this case, the in/out waves are changed into an elliptical shape by the applied external effects - forming an axis along the ellipse. Then, spin effects can be measured with respect to that axis.

16. Connecting Quantum Theory and Relativity

Before the WSM, there had been no known physical reason for the theoretical mass increase of relativity. Likewise there were no physical reasons for quantum theory or spin. Were these apparently separate laws connected or not? Indeed, many theorists proclaimed that these phenomena were irreconcilable! Few had thought about a connection because most physicists were satisfied with the separate and reasonably accurate theoretical reasons for each.

Dirac's work was a clue that they are connected because spin, relativity, and QM were joined in Dirac's work, albeit theoretically. The WSM now reveals their simple physical connection - Doppler effects.

The Appendix (20) shows that the increase of mass (energy or frequency) $m = m_o[1 - v^2/c^2]^{-1/2}$ of a space resonance is due to the Doppler increase of frequency seen by a moving observer. This immediately results in the conservation of energy equation used by Dirac:

$$\mathbf{E}^2 = \mathbf{p}^2c^2 + mo^2c^4 \ (1)$$

This energy equation is also found using the wave perspective because $\mathbf{E}$ and $\mathbf{p}$ are super-imposed waves. In engineering the total intensity of two waves is given by the sum of their squares. Likewise, the de Broglie wavelength $L = h/p$ is also a Doppler change of wavelength seen by a moving observer (Appendix 19) and it leads to the Schrodinger Equation. Thus the union of spin, mass increase and quantum theory occurs in the spherical rotation at the wave center, and is part of the WSM in general.

Part IV - Conclusions

We can have confidence that the Wave Structure of Matter is the true physical reality of the universe. The required proof of the WSM is that the experimental evidence, which empirically founded the natural laws, must necessarily agree with the laws predicted by the WSM. It does.

There is further confidence because empirical evidence agrees better with the simple WSM rules than with conventional rules. For example, an infinity of charge potential at r=0 in Coulomb's law is not found experimentally, in agreement with the WSM. There are more examples: Conventional physics has no explanation for the energy exchange mechanism of forces, or the Pauli Principle, or spin, or charge attraction and repulsion. These are now direct conclusions from the WSM.

The philosophical conclusions are fascinating, particularly concerning the connectedness of the universe: *Everything we are and observe here on Earth, matter-laws-life, necessarily depends on the existence of all the matter in the universe*. We must conclude, if the stars and galaxies were not in the heavens, we could not exist! *Thus, we are part of the universe, and the universe is part of us.*

But the practical value of the WSM theory is the insight[14] it provides. It allows scientists to deeply analyze quantum wave structures, the cosmos, and the natural laws. In the R&D laboratory, the new insight should advance electronic applications, especially IC and memory devices because their tiny transistor elements use quantum effects to control the flow of currents.

The new knowledge should improve communication and the efficiency of energy transmission. For example, conduction of electric energy along a wire is a quantum energy transfer process between SRs. Knowing this, energy losses may be reduced, lowering cost and increasing transmission distances.

17. Less Certain Conclusions

Is it possible the nature has made use of the fact that each particle is connected with the waves of other particles? Researchers often find a new discovery, only to realize later that the discovery already existed in nature. "Nature did it first!" is a common occurrence. We can speculate that this inter-connectedness could affect human thinking, physiological, psychological, or genetic processes[15]. That is, quantum energy transfers, as a requirement of the MAP, could create hidden communication links between parts of our bodies or with neighboring matter, like computer programs.

What is the mechanism of these matter wave connections? Each atom of our body structure arranges its waves to form minimum amplitudes that satisfy MAP. In the process, each of its neighbors makes a contribution to its in-wave structure. If one atom is disturbed, others must be affected. This is an elementary information transfer. Since every life cell (each particle) contains the holographic image of waves from other parts (other particles) of the body, each cell is a memory device. So the apparatus of computers appears to be there but whether or not nature has arranged our body cells into a physiological computer we do not know. Indeed, the mechanisms of ordinary sensory communication in the nerves of the body, and in the brain are still poorly known. The new understanding of energy transfer may clarify them but we won't know much about their quantum communication without more lab research.

Interested readers should begin the study of the quantum universe in references 7 and 8 and at the "Quantum Science Corner" web site: http://www.quantummatter.com. A future article *Cosmology* will describe the origin of the Hubble universe and the red shift.

Part V. Mathematical Appendix

18. Solutions of the Wave Equation (Principle I)

The wave equation must be written (following Wolff 6,7,8) in spherical coordinates because cosmological space has spherical symmetry. Uniform density of the medium (space) is assumed which yields a constant speed of the waves (and 'light'). Then the only two solutions describe the *charge waves* of common charged particles including the electron, positron, proton, and anti-proton. They are:

IN-wave amplitude = $(1/r)\{A_{max}\} \exp(iwt + ikr)$ (a)

OUT-wave amplitude = $(1/r)\{A_{max}\} \exp(iwt - ikr)$ (b)

A= wave amplitude, k = mc/h = wave number, w = 2^1f, r = radius from wave center, and energy = E = hf = mc^2.

At the center, the in/out waves are joined by rotating the in-wave to transform it to the out-wave. Superposition of the two amplitudes to produce a standing wave can occur in two ways depending on rotation, CW or CCW. One is the electron, the other the positron, with opposite spins. Write the rotation operators as **R**^{ccw} or **R**^{cw} . Then the two resonance amplitudes are:

The electron = E(-) = {- IN-wave + OUT-wave} **R**^{ccw} (c)

The positron = E(+) = {+ IN-wave - OUT-wave} **R**^{cw} (d)

You can experiment with particle inversions by changing the (+ or -) signs in the amplitude equations. To perform a **T**ime inversion, change t to —t, which converts the positron into an electron. To perform a mirror inversion (**P**arity), imagine that the waves are viewed in a mirror. You will see that a positron is a mirror image of the electron. To change a particle to an anti-particle (**C**harge inversion), switch the in-waves and the out-waves, and the spin direction. Successive **C**, **P**, and **T** inversions returns to the initial state which is a <u>proof</u> of the empirical-theoretical **CPT** rule, now seen to be a property of the wave structure.

If you add the electron amplitude to the positron amplitude, the resulting amplitude is zero or *annihilation*.

19. Origin of Special Relativity (SRT) Mass Increase and the De Broglie Wavelength of QM Theory

Write the equation of a SR, as seen by an observer with relative velocity b = v/c, as shown in Wolff[8]. Then, insert relativistic Doppler factors, g = $[1-v^2/c^2]^{-1/2}$. The amplitudes received by the observer are

Received amplitude = 1/r {(2 **A**-max) exp [ikg (ct + br)] **x** sin [kg (bct + r)]}.

This is an *exponential* oscillator modulated by a *sine* factor. The origin of the de Broglie wavelength (QM) and the relativistic energy and momentum (mass increase of SRT) is as follows:

In the *exponential* factor:

Wavelength = h/mvg = *de Broglie wavelength* with *relativistic* momentum.

Frequency = kgc / 2^1 = gmc^2 / h = mass frequency with *relativistic* energy.

And in the s*ine* factor:

Wavelength = h/mcg = Compton wavelength with *relativistic* momentum.

Frequency = b gmc^2/h = b x (mass frequency) = *relativistic* momentum frequency.

Thus the space resonance *physically* displays all properties of an electron, viz: QM, SRT, forces, annihilation, conversion to a positron, and **CPT** relations between **C**harge, **P**arity (mirror image) and **T**ime; all of which were formerly empirical or *theoretical* properties. These properties depend on the spherical wave structure and ultimately on the wave medium - space.

20. References

1. Clifford, William (1870), "On the Space Theory of Matter", Cambridge Philosophical Society, **2**, pp.157-158.

2. Clifford, William (1882), <u>Mathematical Papers</u>, Editor: Robert Tucker, Chelsea Publishing, N.Y. 1968.

3 Moore, Walter (1989), <u>Schroedinger - Life and Thought</u>, Cambridge U. Press, England, p. 327.

4. Dirac, Paul (1937), "Quantum Electrodynamics" Nature, London, **174**, p. 321.

5. Wheeler, J. A. and Feynman, R. (1945), "Interaction with the Absorber...." Rev. Mod. Phys.,**17**, p.157.

6. Wolff, Milo (1991), "Microphysics, Fundamental Laws and Cosmology", Invited paper at 1st Sakharov Conf. Phys, Moscow, May 21-31, pp. 1131-1150. Proceedings by Nova Scientific Publ., NY.

7. Wolff, Milo (1993), "Fundamental Laws, Microphysics and Cosmology," Physics Essays, **6**, pp. 181-203.

8. Wolff, Milo (1990), <u>Exploring the Physics of the Unknown Universe</u>, ISBN 0-9627787-0-2, Technotran Press, CA.

9. Mach, Ernst (1883 - in German), English edition: <u>The Science of Mechanics</u>, Open Court, London (1960).

10. Eisele, John A. (1960), <u>Modern Quantum Mechanics with Elementary Particle Physics,</u> John Wiley, NY.

11. Battey-Pratt, E. and Racey, T. (1980), "Geometric Model of Fundamental Particles", Intl. J. Theor. Phys., **19**, pp. 437-475.

12. Misner, C. W., Thorne, K. and Wheeler, J.A. (1973), <u>Gravitation,</u> W.H. Freeman Co. San Francisco, p. 1149.

13. Wolff, Milo (1997), "Exploring the Universe", Temple University Frontier Perspectives, **6**, No 2, pp. 44-56. 14. Wolff, Milo (1995), "Beyond the Point Particle — A Wave Structure for the Electron", Galilean Electrodynamics, Sept-Oct, pp. 83-91.

15. Wolff, Milo (1999), "Matter Waves and Human Consciousness", The Noetic Journal, **4,** No 2, pp. 67-75.