The Eight-fold Way of the Universe

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Philosophers have often sought the origin of Natural laws in a relationship between the microscopic world and the vast universe. Until recently, before large telescopes and technology were capable of deep-space investigation, there was no knowledge to support such inquiries. But now asking relatively simple questions can provide surprising answers!

This article asks: How are units of measure, time and length as elements of the laws, communicated between particles? What distance scale do particles use to communicate their location? Where is the universal clock of time? What is the relation between laws, particles, and the universe? Surprisingly, the answers to these questions reveal eight ways of the Universe which demarcate: 1) the character of the laws, 2) the structure of a particle, and 3) the role of the universe.

Using these ways, or attributes of behavior, it is concluded that: 1) Particles must be a wave structure composed of advanced and retarded quantum waves from an oscillator whose frequency is a property of an ether-like medium. 2) The waves link all matter together to produce Machian natural laws. 3) These quantum waves pervade the universe to an extent previously only suspected. 4) The natural laws are a mathematical result of the wave structure.

1. Introduction.

In the last millennium, our knowledge of physics has progressed to understanding that objects always obey fixed *laws of nature*: conservation, inertia, electromagnetism, gravity, QM and relativity. After carefully measuring and studying these laws in the past several centuries, we can predict the behavior of most objects and direct the flow of energy. Using these laws, we have devised sophisticated technology to aid our survival on Earth: industrial machines, computers, air and spacecraft, and mass production. But here our knowledge ended. We lacked understanding of the origin of natural laws and their relationship to cosmology.

We did not yet know where basic natural laws come from or even that it was possible to find out. Some scientists believe, in a religious fashion, that we are not allowed to know, that we must just accept the laws given to us by Nature. Still others believe that the natural laws are already complete and to obtain further understanding all we need do is mathematically manipulate them to discover their origins.

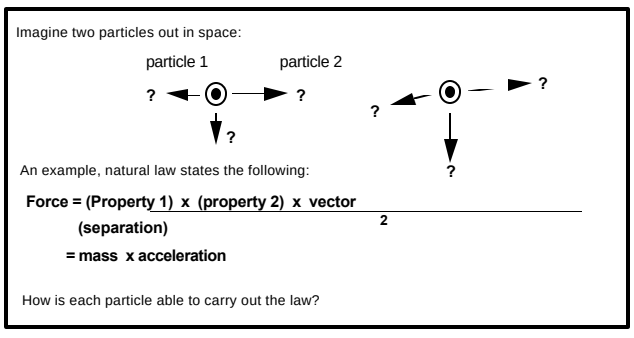

Figure 1. Force laws. What mechanism finds the location of the particles? How is the separation measured? What time scale is to be used? The two particles know nothing of metric scales but nevertheless move toward each other obeying the law. The mechanism of this law is a basic puzzle of science.

But curious scientists have noticed that all is not well with the laws of nature. In small ways they fail to predict. We are constantly uncovering paradoxes in the realm of micro-particles. We don t understand what a photon is or how spin can arise in a spherically symmetric particle. In some distant galaxies, Newton s laws of gravity and centrifugal momentum seem to go completely awry. Obviously there is something more to learn about the laws, or the particles, or perhaps both. It is the purpose of this article to show that a simple analysis of the behavior and relationships between particles, the natural laws, and the entire universe can help unravel the paradoxes and lead to an understanding of the origins of natural laws.

Consider two particles in space, Figure 1. We know they will obey natural laws interacting with each other. We also know that the laws they follow involve the dimensions of *time, length, and mass*. Now a curious question arises. How are measures of the dimensions established and communicated between two particles? When two particles attract each other, what agent or process measures the distance between them, establishes the force, and informs or guides each particle to the vector of acceleration it must undergo? We know this happens but we don t know how or why.

There is a puzzle of *distance measurement*: What is the distance scale used by the particles to measure their separation? If there were no other matter present, distance or size would be meaningless since size and distance are *relative* measures of an object. Further, every particle must have access to the *same* distance scale, otherwise interac-

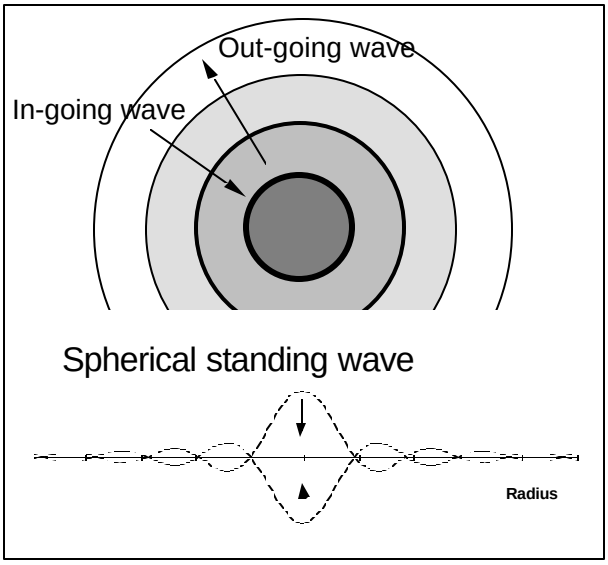

Figure 2. Electron structure. The IN and OUT waves combine to form a standing wave. The amplitude of the continuous waves is a scalar number, not an electromagnetic vector. At the center the standing wave amplitude is finite not infinite in agreement with the observed electron. From Wolff 1995.

tions would be chaotic, not the orderly laws we observe obeyed by all particles. Thus the distance scale and the laws which use it must depend on other matter and/or its distribution.

The same puzzle applies to *time*. Every particle, however separated, has to have access to the same clock in order to carry out its orderly rule of law in the cosmos. Where is the universal clock? How is time communicated among all particles? They cannot behave independently! In passing, note that since we know $E = hf = mc^2$, we only need to establish one of the related units of *time, frequency, mass,* or *energy*. The other three follow from this equation.

The Cosmology Connection

This perspective of cosmology begins by recognizing that: *The mere existence of a universe, particles in it and physical laws for the particles, restricts their properties* as follows: Without particles the physical universe is undefined because our meaning of the physical universe is a collection of particles or objects, and their distribution. Accordingly, understanding our universe depends on understanding the particles in it. Similarly, the natural laws could not exist without particles because laws require particles or objects upon which to operate. Consequently, laws are meaningless without particles. The converse is also true; We cannot identify a particle and its properties without the force laws to locate and measure it. Thus these three: the universe, particles and laws are an inter-dependent *trilogy*. You may examine this trilogy further by a peek at Figure 4 which illustrates the conclusion of this article.

The charged particles, electron and proton, and the neutron, make up 99% of the matter of the universe. In addition, the $1/r^2$ force influence of charge extends throughout the universe. For these reasons, each electron or charged particle is linked to the whole fabric of the cosmos. These facts suggest there is an intimate connection between charged particles and cosmology.

A Boot-Strapped Universe

Lacking knowledge of the distant universe, it is difficult to notice that each particle is linked to all other particles in their universe. However this was recognized by Ernst Mach 100 years ago to explain the origin of Newton s law of inertia $F = ma$. He asserted: *The laws of inertia are established by all the matter of the universe.* The conclusions of this article indicate that not only was Mach correct but his concept applies to other laws as well.

The conclusion is inescapable that the laws of physics are properties of the entire ensemble of matter in a universe. Not only is matter in the universe inter-dependent but the laws of its behavior also arise from itself. This situation can prevail only if there exists a medium of communication. The questions of laws, unit scales, and the communication medium, are clearly inter-dependent. Thus, if we can answer just one question, we will probably learn about them all. They are like the proverbial one big ball of wax . We live in a boot-strapped universe.

Without actually knowing the agent of interaction, or how it communicates the laws among all particles, it is still possible to deduce patterns of behavior of the trilogy. These deductions are the Eight-fold Way below.

2. Eight-fold Way of the Universe

Attribute 1. Particles, laws, and the universe are an inter-dependent trilogy

Each demands the existence of the others. We cannot fully understand natural laws, particles, and the structure of the universe until we understand the relationships within this trilogy.

Attribute 2. Dimensions are a property of an ensemble of matter.

A particle entirely *alone* in the universe could not have dimensions of time, length, or mass. These dimensions are meaningless without the existence of other matter because dimensions can only be defined by *comparison* with other matter. For example, at least six separated particles are necessary to crudely define length in a 3D space (four to establish coordinates and two to measure). Thus, *the dimension of length requires the existence of an ensemble of particles.* The required ensemble must include *all* observable matter, for there is no way to choose a special ensemble. *Mass* is similar. It is defined by its force interaction with one or more *other* masses. Mass alone is meaningless. The universal importance of this concept becomes clear when we recall that time, length and mass are the basic unit set used to describe all scientific measurements.

Attribute 3. Interacting particles must be aware of each other

A force law between two particles cannot operate unless they are aware of each other s location. Accordingly, continual two-way perceptive communication between each particle and other matter in its universe is needed to establish and maintain the laws of nature. Thus: *There must exist a means of continual communication between particles which takes place in the space (ether or vacuum) of the universe of the particles.* For example, moving waves from an electron structure

behaving as an oscillator could serve to communicate between them.

Attribute 4. The accessible universe is limited by communication

The ensemble of particles which communicate with each other (and with us through our observations) becomes the universe which we can observe. For example, from Earth we can communicate within a radius equal to the range of light traveling from the time of our beginning. No meaning can be attached to things or events outside of this range. Thus: *An individual universe is defined for each particle as the space, and other particles within that space, which are able to communicate with the particle.*

Attribute 5. The Dimension of Time requires a cosmological clock

Using reasoning similar to the above but for the dimension of time, we can conclude that those laws which involve the measurement of time, notably velocity, frequency and mass, cannot operate if particles have no reference of time when obeying laws. That is, the particles must have a way to compare their own time-dependent behavior with other particles. Because all particles obey natural laws, this time reference requires the existence of rhythmic time markers *common to all particles*. That is, a cosmic clock. Space is nearly homogeneous and is common to all particles. Thus the cosmic clock could be an oscillator contained in every charged particle structure as suggested by de Broglie, provided the frequency is a property of space and if its waves communicate with other particles. Such clocks would be alike since space, the medium of the waves, is mostly homogeneous.

Attribute 6. Space has properties

Since the laws of nature are written in terms of the dimensions [time, length, mass] defined by the ensemble of communicating matter in a universe, the properties of the medium of communication should affect the laws. If the medium is not exactly uniform the laws may be perturbed. For example, light rays bend near the Sun. The Sun s gravitational potential affects the medium of light propagation. Also, we recall that the large electric force and resulting light propagation depend directly on properties of the medium. At the other extreme, the tiny gravity force appears to be caused by tiny inhomogeneities of space. We deduce that: *The laws of matter depend on the properties of the communication medium (space or ether) within the universe.*

Attribute 7. Mach s Principle

The only possible reference for changing motion (acceleration or rotation) is the *entire ensemble* of matter in a universe. The first person to state this was Ernst Mach in 1883. At that time, the unknown origin of Newton s law of inertia, $F = ma$, had attracted frequent attention. Mach boldly suggested that inertia depends upon the existence of the distant stars. His concept arose from two fundamentally different methods of measuring a body s rotational inertia. First, without looking at the sky, one can measure the centrifugal force on a rotating mass m and use Newton s Law in the form $F = mv^2/r$ to find circumferential speed v. The second method compares the object s angular positions with the fixed (distant) stars. Mysteriously, both methods give exactly the same result. Mach reasoned that there must be a causal connection between the distant matter in the universe and inertia.

Attribute 8. The properties of space appear to underlie the properties of matter and the laws of physics.

Mach s Principle also implies other properties of space are determined by all matter in it. Substantial evidence exists: The rigidity of solid crystals derive from the rigidity of quantum waves in space. Einstein s general theory of relativity and curvature of light rays depend on space. Electromagnetic constants and motion of light beams derive from constants of space (indices of refraction). We see that a spectrum of laws, microphysics to cosmology, depend upon all matter of the universe. And described below, the wave-structure of the electron suggests that matter is also composed of waves traveling in the medium of space.

Using the Attributes

You, the reader, can now use these attributes to test your favorite particle model and their proposed relationships with cosmology. The point-mass particle of Democritus fails miserably! In fact, any particle models composed of *static* charge or mass substance must fail because they have no time reference or communication. In contrast, the basic rules of quantum mechanics (QM) do not conflict with the Eight-fold Way. This is true because QM *does not* depend on a belief in particles, or mass substance, or charge substance. Such beliefs are personal interpretations of QM. See Cramer (1986) and *Apeiron* Oct. l995. The belief in particulate substances is popular today but Schroedinger and de Broglie advocated an all-wave interpretation of QM (Moore 1989). In contrast Bohr s Copenhagen concept used point-mass particles.

The wave-structure of the electron

The Eight-fold Way is found to be satisfied by an electron structure composed only of spherical inward and outward quantum waves traveling at light speed c (Wolff 1990, 1993, 1995). Figures 2 and 3 show the wave structure of an electron, termed a *space resonance.* The outward wave of an initial electron interacts (communicates) with other matter in its universe. When these waves arrive at other matter a signature is embedded in the outward waves of the other matter. These outward wave signatures are a response from the other matter. The response wave signatures as a Fourier combination, become the inward wave of the initial electron. This inward wave then reflects at the wave center with a *phase shift*, to become an outward wave which begins the cyclic process over again. The central phase shift is similar to the phase shift of light upon reflection at a mirror. It endows the electron with quantum spin and leads to the Dirac Equation (Battey-Pratt & Racey, 1980) using rotational group theory. Their derivation uses the 3D geometric property of *spherical rotation* which allows the electron to retain spherical symmetry yet possess a quantized spin along an arbitrary axis.

The validity of the Wolff electron structure is demonstrated by: 1) It obeys the *Eight-fold Way* above, and 2) The equations of the electron waves produce the natural laws: conservation of energy and momentum, electromagnetism, quantum mechanics, and relativity. It is not surprising to find the natural laws derived from one wave-structure. To the contrary, it is expected from the One big ball of wax phenomenon. It is further expected that *all* laws and matter will be found derived from the total matter of the universe. This is the concept of a *Boot-strap Universe*, in which many waves of individual particles contribute to the total matter, and vice-versa. In fact, since charge fields extend to infinity, it is impossible to separate one particle from the whole. All blend together within the aether wave medium. Such a Boot-strap universe was implied, even predicted, by Mach s Principle.

Finding the natural laws and the Eight-fold Way of the Universe from the electron structure required only *three* assumptions. They are: **I.** A Quantum Wave Equation (Yields the math form of the waves). **II.** A Space Density Assumption (Obtains Mach s Principle). **III.** A Minimum Amplitude Principle (Determines the direction of energy exchanges). These three replace the dozens of assumptions formerly required in classical physics.

Time, Communication, and the Boot-strap Universe

Knowing the electron structure, we can understand that the cosmological clock (Attribute 5) is the frequency of the electron waves, a property of the space medium. The waves also perform the role of communication. Not only *time* but other dimensions, *length and mass,* depend on the medium. But the medium itself is a consequence of all matter. This dependence of matter on matter, as described by Mach s Principle and the trilogy of Attribute 1, is the bootstrap universe. An especially interesting result of the bootstrap relation is the *Equation of the Cosmos*, [Wolff, 1993, page 188] which correctly relates the size of the accessible universe to the size of an electron.

3. Conclusions

The Eight-fold Way of the Universe conforms with the wave structure of the electron. This structure settles a century old paradox of whether particles are waves or point-like bits of matter: They are waves. After some thought, it will become clear that only a wave structure can explain the Eight-fold Way. This structure is further verified because the natural laws originate from it. Knowledge of the origins of the laws opens a window on the physics, chemistry, and biology of the universe around us.

A Self-contained Universe

The most extraordinary conclusion of the wave-electron structure is that the laws of physics and the structure of matter ultimately depend upon the total of all matter in a universe. Every particle communicates its wave state with all other matter so that energy exchange and the laws of physics are properties of the entire matter ensemble. The behavior of matter arises from itself. Mach s Principle, which conspicuously displays inter-dependence of matter, is just one of a family of inter-dependent principles.

Two Worlds Within our Universe

There are two real and coexistent worlds participating in the physical behavior of matter. We see one world as our familiar 3D environment, governed by the natural laws. We see it with five senses and their extensions, laboratory instruments. Electromagnetic energy exchanges are the sense stimulators which enable us to form mental images of this world. The images create our sense of reality. This world can be termed the *Energy World* since energy-exchange is the *unique* feature which allows us to observe it.

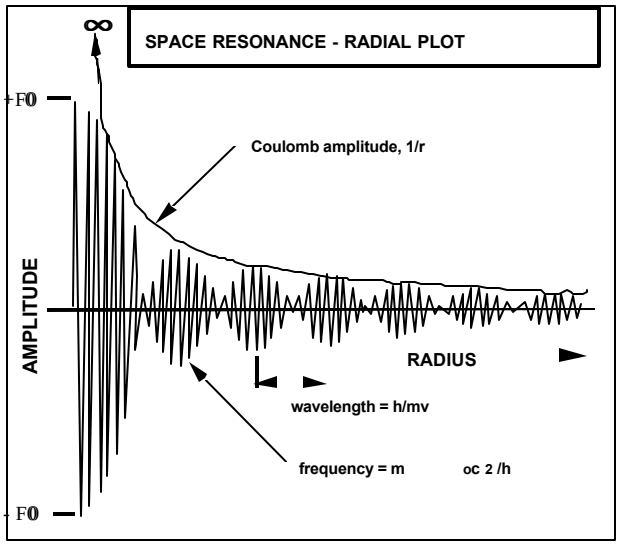

Figure 3. Radial view of electron. The observed oscillator frequency $m_o c^2/h$ of the electron is a property of the space medium and is modulated by the de Broglie wavelength h/mv. From Wolff 1995.

The second world is composed of unseen quantum waves which form the structure of the fundamental particles: electrons, protons, and neutrons, and space (the aether). These particles make up the material objects of our energy-world. We cannot observe these waves although they fill the apparently empty space around us. We only know of their existence when two particles change their quantized wave states (energy levels) in concert. For example, one particle in a star and the other in the retina of our eye. This exchange we call light . This *Quantum Wave World* is the hidden fountainhead which determines the real action in both worlds.

The Simple Electron

The elegance of the electron structure is its simplicity: Time does not warp and there are no black holes to swallow ideas just before you grasp them. Everything remains in three normal dimensions. This spherical wave structure of the electron and charged particles produce myriad combinations of standing wave structures, the crystalline matter of the physical universe. A crystal might appear like an orderly array of shimmering bubbles if you could see them, which you cannot, because quantum waves are smaller than light waves and are not electromagnetic.

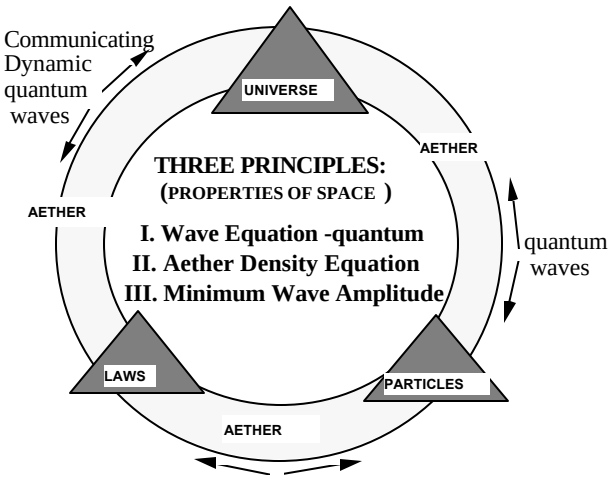

Figure 4. The Boot-strap Universe. This diagram illustrates the inter-dependent relationship between particles, natural laws and the universe. All matter and laws depend on the properties of space (the aether) because space is the medium of quantum waves constituting matter. These quantum waves, which form the structure of the particles, provide continual communication between particles. The universe is the sum of the quantum waves which form the particles in the aether-space. The natural laws are found in the behavior of the waves of the particles, exactly as surmised by Mach 100 years ago. Thus, laws, particles, and the universe are an inter-dependent trilogy where matter depends on matter. We are living in a boot-strapped universe. Three mathematical principles are needed to derive the waves, particle structure and the natural laws (Wolff 1993).

References and Further Reading

1. William Clifford, English mathematician at the Royal Philosophical Society, first suggested (1876) that matter was composed of pure waves. See: *The World of Mathematics*, p 568, Simon & Schuster, NY (1956).
2. Ernst Mach convinced Einstein that any theory of the structure of the universe must contain his inertia principle but Einstein could not incorporate it into relativity because relativity has no medium of communication. See: E. Mach, *The Science of Mechanics* (German, 1883, Engl: London, 1893).
3. Walter Moore, *Life of Schroedinger*, Cambridge U. Press (1989). Erwin Schroedinger, a founder of quantum theory, believed that the world was composed of waves and particles were just appearances (Schaumkamm).
4. Louis Duc de Broglie, in his Ph.D. thesis Recherche sur la Théorie des Quanta , U. of Paris, 1924, proposed a wavelength $l = h/p$ for the quantum waves of an electron containing an oscillator of frequency, mc^2/h. These same values are found in the waves of the *space resonance.*
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7. Milo Wolff began work on the wave-structure of charged particles and its relation to physical laws in 1984.
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9. *Apeiron* **2**: 4, Oct. 1995 contains eight articles discussing problems of interpretation of quantum theory.