39 Questionable Assumptions in Modern Physics*

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Abstract. The growing body of anomalies in new energy, low energy nuclear reactions, astrophysics, atomic physics, and entanglement, combined with the failure of the Standard Model and string theory to predict many of the most basic fundamental phenomena, all point to a need for major new paradigms. Not Band-Aids, but revolutionary new ways of conceptualizing physics, in the spirit of Thomas Kuhn's *The Structure of Scientific Revolutions*. This paper identifies a number of long-held, but unproven assumptions currently being challenged by an increasing number of alternative scientists. Two common themes, both with venerable histories, keep recurring in the many alternative theories being proposed: (1) Mach's Principle, and (2) toroidal, vortex particles. Matter-based Mach's Principle differs from both space-based universal frames and observer-based Einsteinian relativity. Toroidal particles, in addition to explaining electron spin and the fundamental constants, satisfy the basic requirement of Gauss's misunderstood **B** Law *(div* $\boldsymbol{B} = 0$*)* that motion itself circulates. Though a comprehensive theory is beyond the scope of this paper, it will suggest alternatives to the long list of assumptions in context.

Every good scientist takes pride in listing the assumptions behind his theories, attempting to show their correctness due to the reasonableness of those assumptions. Unfortunately some assumptions are so deeply ingrained, so "obviously true", that they are not even considered or listed. It is these "obviously true" assumptions that are the hardest to spot. Today we smile condescendingly at former beliefs in "flat earth" and "weight-proportional gravity", without realizing that these were once considered "obviously true" and that some of our own present-day assumptions might one day be viewed with the same condescension. Only by questioning the "obviously true" assumptions can we hope to establish new paradigms. As suggested by Thomas Kuhn[1], scientific revolutions occur when new paradigms replace "obviously true" assumptions.

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Here follows a list of some of today's assumptions that may not necessarily be true, with plausible alternatives for each. Many of the alternatives discussed are based on Machian, vortex paradigms, but they should not be taken as a complete theory. Please don't think in terms of proving or disproving these assumptions, but simply recognize them for now as assumptions:

1. *Light is a "thing" that travels from point A to point B.* As Einstein himself noted[2], we "rascals" in science still don't know what "light" is. How can we say that it "travels" at all? If light is an interaction between elements of matter, it isn't an independent "thing". The "thing" idea gained popularity in the 17th Century with Fermat's principle of least time, Newton's corpuscular ('photon') theory of light, and the apparent experimental confirmations of Ole Römer and James Bradley. However, as pointed out by Petr Beckmann[3], many physical phenomena behave "as if" certain physical events actually took place, and quantum electrodynamics suggests that Fermat's principle may be one of these "as ifs". Richard Feynman showed that the phase contributions from all light paths except the "least time" path cancel, making Fermat's principle a prime example of "as if"[4]. Also the Römer and Bradley experiments, like Young's double slit and countless other experiments, can be explained in terms of interference, which doesn't require light as a "thing" in itself. By definition interference implies interaction. The "light is a thing" assumption is listed first because a host of other assumptions are presumed because of it.

2. *Energy (light) can exist without matter.* The concept of "free energy" in quantum physics should not be confused with the same phrase in thermodynamics and alternative science. The quantum FE idea supposes that energy leaves a particle in the form of a "photon", the photon travels through space for a time, ultimately to be absorbed by another particle. During transit, the "free energy" of the photon is believed to exist and travel independent of all matter. Instead, however, if energy exists by virtue of matter, then there is an immediate connection between the energy of space and the matter that produced it. Then all energy is accounted fully by matter, and doesn't require a separate existence in space. Since all experimental measurements are made with detectors composed of matter, there is no way to test for the existence of energy apart from matter.

3. *Photons are "things" in themselves*. To suppose that a photon "travels" independent of the matter that produced it first assumes knowledge of what a "photon" is, a presumption Einstein was cautious to avoid. Whether viewed as a wave or a particle, light may be considered an interaction between elements of matter rather than an independent "thing". D. G. Ashworth and Roger Jennison explained the Compton Effect by means of electromagnetic interactions, without the need for "light quanta"[5], and the Photoelectric Effect can be treated analogously. Rather than demand that light exists in quanta, one may suppose that the interactions between particles are quantized. This way of thinking places the "quantum" with the particle, as understood by Poincaré, rather than with space, as proposed by Einstein. As "phlogiston"

was to oxygen, so an analogy between the creation (annihilation) of a photon and the annihilation (creation) of a bifurcation or saddle point in an electromagnetic field can be demonstrated with toroidal particle models.

4. *The constant 'c' is a property of space.* The notion that space itself somehow impedes light from traveling faster than 'c' presupposes that light is a "thing" that travels (#1). Constants 'e', 'm', and 'h' are understood as properties of particles. Planck derived 'k' as a constant of interaction between particles. Why should 'c' alone fail as a property of particles? Wilhelm Weber theorized in 1846[6], and with Rudolf Kohlrausch showed experimentally in 1856[7,8,9], that 'c' is the speed at which charge must travel for electric and magnetic forces to balance, revealing 'c' as the "speed of charge". Maxwell subsequently proposed its role as the "speed of light", which can be derived from toroidal models.

5. *Nothing travels faster than 'c'.* By Einstein's own admission, his relativity house of cards is held up by this assumption. Though Einstein argued against it, according to Pierre-Simon LaPlace, orbital stability depends on a speed of gravity at least 10^7 times the speed of light[10]. Tom Van Flandern's experiments have confirmed that gravity operates at velocities at least billions of times faster than 'c'[11]. Also a growing body of experimental and theoretical evidence reveals a need for superluminal interactions to properly explain homopolar induction[12], longitudinal forces[13], scalar waves[14], water arcing[15], railguns[16,17], and entanglement in quantum mechanics[18]. These are the very anomalies crying for an explanation in the new energy community.

6. *Instantaneous action at a distance (IAAD) is impossible.* The famous EPR paper and Bell's inequality correctly conclude that either quantum physics is incomplete OR that particles are instantaneously and non-locally "entangled" across space. Einstein viewed "spooky action at a distance" as unthinkable, but the Clauser-Horne-Shimony-Holt (CHSH), Aspect and other experiments have confirmed quantum physics, demanding instantaneous non-local "entanglement". And in spite of Newton's famous, but often misapplied, quote about instantaneous interaction, his gravitational formula operates via IAAD, exhibiting no time dependence. Coulomb's and Gauss's Laws at face value imply IAAD as well. The retarded action theory of Liénard and Wiechert in the late 19th century, a huge influence on Einstein, was created to solve the presumed problem of delayed response. Their work failed to recognize that Wilhelm Weber and Gustav Kirchoff in 1857 independently derived 'c' as the speed of unimpeded electrical propagation along transmission lines using IAAD[8].

7. *All forces must be contact forces.* Aristotle's famous dictum about matter never acting "where it is not" remains valid. The issue with this assumption arises in the definition of "contact". If "contact" is limited to billiard-ball sorts of interactions, with nothing affecting a particle between collisions, we have no observer-independent way of saying whether something is moving at all. However, if the fields of a particle are actually an inseparable part of it, a

particle may be in "contact" with all other matter simultaneously. By Mach's Principle, to say that a particle is moving, other matter must actually be present in some sense at the location of that particle. Since two elements of matter may not simultaneously occupy the same space, the other matter must assert its presence in the form of fields. That is, Mach's Principle demands the existence of fields and denies a billiard-ball view of interactions. Thus, for example, the kinetic theory of Maxwell and Boltzmann, based on billiard-ball mechanics, constitutes an approximate "as if" theory, not a first-principle derivation.

8. *Fields are fundamentally quantum*. Some alternative scientists argue that fields don't really exist, and nobody can point to a field to prove them wrong. What undeniably does exist is interaction, and fields provide a mathematical framework to describe those interactions that billiard-ball models simply can't. Quantum field theory presumes that fields themselves are ultimately quantum, particulate, though there is no way to test such an idea. If instead each element of matter is inseparable from its fields, René Thom's singularity theory or catastrophe theory[19] provides numerous ways to obtain discontinuities or nodes from continuous field or potential structures. As Henri Poincaré believed, the quantum should reside in the particle, not in space itself.

9. *Matter is sometimes a wave and sometimes a particle.* To suppose that matter can't decide how to behave is clearly to misunderstand matter. However, if matter and its fields are two inseparable parts of one whole, wave-particle duality is immediately demystified. The behavior of each mirrors that of the other, and both necessarily exist. Thus the interference/wave phenomena of Davisson-Germer and George Thomson occur because each electron is interacting with all others, even the ones that *don't* pass through a slit. The part of an electron or light beam that doesn't pass exerts an influence on the part that does. By taking all matter into account, interference is the natural consequence, whether considering chunks of matter or the fields they produce.

10. *The energy of a particle resides only locally, where the particle resides*. Under Mach's Principle, matter moves with respect to other matter, and therefore that other matter *must* somehow be present with the moving matter. The principle claims that it is "present" by virtue of its electromagnetic fields, which fill all of space, concentrated in the region nearest the particle. Then the energy of a particle, which exists in its fields, resides not only at its physical location, but is spread throughout all of space. This is exactly what a straightforward interpretation of Maxwell's equations depicts. Thus the energy of a particle interacts with that of every other particle throughout space, which without exaggeration could be called a "sea of energy".

11. *Space is empty.* If space is a sea of energy, it can hardly be empty, so this assumption may perhaps be redundant with the last one. New energy and anti-gravity scientists, who love to taut the non-empty-ness of space, often call the stuff that fills space "ether". Unfortunately the term "ether" has also been

used to mean "a fixed frame of reference from which everything moves", not at all the same thing as electromagnetic (or gravitational) fields.

12. *Mass is a measure of matter or "stuff".* If we define mass as "amount of matter", we may not logically define it also as "resistance to motion" or "inertia". It must be one or the other. And if mass is defined as "stuff", then what is "charge"? Logically they may not be different things and yet both *be* "stuff". If mass is not stuff, the possibility emerges that the mass of a particle doesn't have to remain constant. A particle may also have different "masses" depending on how it's evaluated. The riddle of small variations in particle masses (e.g. neutron vs. proton plus electron, or C-12 vs. twelve protons and electrons) has hope of solution by eliminating this assumption.

13. *Elementary particles never change.* If the mass of a particle can change, perhaps other properties can also change. For instance, a toroidal particle can expand or collapse while maintaining constant action h and charge e. Conceivably the measured "energy" or "mass" of an electron or proton is actually an equilibrium value, about which the particle oscillates. When the "state" of equilibrium changes, the measured energy or mass also changes, accounting for discreet events. Toroidal particles "radiate" with *continuous* changes in size and *discreet* changes in state, but standard quantum particles require postulated bosons and fermions to account for *discreet* changes.

14. *Quantum events can't be described continuously.* Everyone has witnessed the strobe effect of a wheel apparently moving backwards in an old Western or of a Las Vegas roulette wheel. In every case, the strobe results from an integer relationship between two frequencies, with any remainder constituting a phase difference. The "natural", "resonant", or "inertial" frequency (frame rate or 60Hz light bulb) is contrasted with the "actual" frequency of the wheels to create discreet transitions. Toroidal, helical particles, characterized by motion around both the circumference *and* the cross section, have "inertial" or "resonant" frequencies based on their geometry, and "actual" frequencies, based also on their environment. In this way, particles having a continuous structure can take on "quantum" states with phase differences. Furthermore since every particle has a resonant frequency based on geometry, interactions between particles are really interactions between frequencies. Then every conceivable interaction could produce strobe-like discontinuities.

15. *Matter and light must be corpuscular or continuous, but not both.* As described above, toroidal particles may have a continuous distribution, and yet produce discreet phenomena. They have energy, and hence mass, due to geometry alone, but a different energy or mass due to environment. The interaction between them can produce strobe-like consequences. If the energy of space is immediately connected with particles, it should be no surprise to discover discreet or quantum events related to space energy (light) also. As explained by catastrophe theory, it is possible and quite common for continuous spatial functions to exhibit discontinuities. As exemplified by magnetic saddle points, these singularities, vortex centers or 'nodes' always

carry zero energy, unlike the infinitely dense black holes of gravitational theory. There are only a limited number of ways these discontinuities may combine, potentially accounting for the growing number of "elementary particles" in modern physics.

16. *Gravity is a fundamental force.* If mass is not stuff (#12), then gravity, based on mass, is not fundamental, but a consequence of something more fundamental. Andre Assis suggested that the force of gravity could result from a fourth-order, non-canceling attractive term of electromagnetic force[20], and Charles W. Lucas recently derived this very result[21]. The numerous theories of quantum gravity all base their conclusions on the fact that particles oscillate. Ultimately motion itself causes attraction, as we see in Ampere's Law, Bernoulli's Principle, and the flow of water through a river or pipe. If gravity is a tiny net attractive force between electrically neutral elements of matter, it should be no surprise to find that certain non-equilibrium conditions can overcome gravity, creating "anti-gravity" or "electrogravitics."

17. *Gravity is the dominant force in the cosmos.* The Coulomb force between charged particles is 10^{40} times greater than gravity, and yet nearly every cosmological theory is based on the action of gravity. Evidence supporting enormous amounts of charged plasma within the Solar System and the Universe is growing. Following in the footsteps of Hannes Alfven and Winston Bostick, Anthony Peratt has created computer simulations and laboratory demonstrations of plasma filamentary structures identical with the features of all known galaxy types[22], including all of Halton Arp's *Peculiar Galaxies*[23]. The laws of electromagnetism are necessary and sufficient to explain the observed radius-independent velocities of orbiting planets, inexplicable via gravity alone[24]. Electrodynamic forces account for repulsion as well as attraction, obviating the need to speculate about black holes and other mass-dependent fantasies.

18. *Energy from the sun arises from hot nuclear reactions in the core.* If electricity, rather than gravity, is the dominant force in the Solar System, we should expect it to explain the origin of the sun's power, and indeed it can. The electric sun model[25,26] resembles ball lightning, reproducible since Tesla. On the other hand, the hot fusion supposedly taking place in the sun's interior is theoretical only, and has never been reproduced in a lab. The complex and enormous temperature and voltage gradients near the sun's surface, inexplicable to mass-based theories, serve current carrying and regulatory purposes in the Electric Sun model. Visible filamentary discharges in this region may arise from a verifiable source of power: plasma from outside the sun.

19. *Redshift is caused by Doppler expansion of space.* Instead of a well-deserved Nobel Prize, Halton Arp received ridicule for demonstrating correlation between stars with vastly different redshifts[27]. His results reveal high-redshift quasars in the vicinity of low-redshift parent star systems. So the general increase in redshift with distance may hold, but there also exist components of

"intrinsic" redshift, due to the interaction of the stars themselves. Moreover, Doppler expansion offers little explanation for the William Tifft's discovered quantization of redshift with distance from a rotational center[28,29,30]. As the planet spacing in a Bode's Law quantization suggests some sort of interaction between the planets, so Tifft's quantization suggests interaction between the sources of the redshifted light. Compton-like interaction provides a more consistent explanation than Doppler-like expansion. Redshift has more to do with interaction and entropy than with space itself.

20. C*osmic Background Radiation (CBR) results from space expansion.* Andre Assis and M. C. D. Neves wrote an insightful paper on the history of 2.7K CBR[31], clearly showing a long line of scientists, who connected the CBR "temperature" with the blackbody radiation formula. These scientists viewed CBR as a measure of the energy density of "empty" space, long before Penzias and Wilson "discovered" it with their horn reflector antenna[32]. Since the mainstream paradigm sees space as empty, the effect has instead been used to justify the notion of expanding space.

21. *The age of the Universe is the inverse of Hubble's constant (H).* Of all the speculations in modern science, this one skates on the thinnest ice. Technically, it's not an assumption, but a conclusion that follows from the assumptions of Doppler redshift, an expanding Universe, a restricted interpretation of the Cosmic Background Radiation (CBR), and light as a "thing" that travels from A to B. The idea that light must "travel" is the fundamental reason for widespread acceptance of the enormous apparent age of the Universe. Instead we may justifiably regard distance $R_0 = c/H$ as a measure of the "size" of the Universe, since Hubble's original data determined this as the proportionality constant between redshift and distance.[33] If so, and if Dirac's observation that $k_C e^2/Gm_e m_p \sim 10^{40} \sim m_e c^2/hH$ is meaningful, then distance $c/H \sim h^2/Gm_e m_p m_\pi$ is related to particle radii by particle constants. That is, the size of the Universe may be related to the size of particles, and the ratio on the order of 10^{40}.

22. *The Big Bang.* Affectionately called by some "The Big Dud", this too is really more of a conclusion than an assumption, depending on the same assumptions as the Hubble age of the Universe, plus the assumption that mass and gravity dominate over electrodynamics. The number of arguments against the Big Bang is so large that the difficulty is choosing, and so won't be repeated here. In addition to the obvious violation of common sense with infinite densities, it violates known laws of thermodynamics[34].

23. *Point particles exist.* Paul Dirac's famous quantum solutions, upon which modern quantum theory is based, inherited the long-standing assumption of point particles, which dates back at least to Maxwell. Unfortunately what Maxwell deemed an approximation has since become canonical truth. To this day, contrary evidence such as Robert Hofstadter's electron scattering finds no point-particle explanation.[35] More fundamentally, the very existence of

point particles demands infinite densities of energy, charge and matter, repugnant to common sense.

24. *Quantum "spin" exists without current.* There is no comprehensible explanation for particle "spin" without finite size. The concept of rotation itself is meaningless without a finite amount of matter, and common sense informs us that "spin" must be a consequence of rotation. Magnetic moment also must result from circulating charge, impossible with point particles. Nowhere in nature can we find a magnetic field without some sort of current producing it. Why should the rules change at the level of particles?

25. *Quantum mechanics cannot be explained "classically".* This is a ludicrous tautology if we define "classical" as "not derivable from quantum mechanics". If "classical" is defined "through the laws of electromagnetism", the statement reduces to a mere opinion. That so many people have accepted this mantra of Richard Feynman is a tribute to his tremendous influence. On the other hand, if particles have internal structure, there must be laws governing that structure. What laws should govern charged particles having spin? The laws of charge and spin, of course: the laws of electromagnetism. Ironically, it is these very laws (specifically Gauss's **B** Law: div **B** = 0) that demand circulatory motion. Toroidal particles exist precisely because at some fundamental level matter must circulate.

26. *Elementary particles are "things" in themselves.* Nobody has ever "seen" an elementary particle. As with "photons", what we regard as "particles" having "mass" could also be deemed particular types of energy distributions. In 1972, Rene Thom introduced "catastrophe theory" by using Henri Poincaré's topological theory to model discontinuities[19]. Surprisingly overlooked, a correspondence between Thom's seven standard elementary catastrophes or singularity types and the basic so-called elementary particles has been demonstrated[36]. If elementary particles are not billiard balls, but distributions of matter and energy in space, we should expect a finite number of ways these energy distributions interact to produce singularities, bifurcations, "catastrophes" or "nodes". When a device "detects" a muon or pion, it might actually be registering certain configurations of singularities in the electromagnetic fields.

27. *Muons, pions, and even neutrons are "elementary".* There are currently more particles in the "particle zoo" than there were "elements" in Mendeleev's time. Surely not all these "elementary" particles are really "elementary". And in spite of Feynman diagrams, mainstream science has provided no reason why particles decay as they do. If electromagnetism determines the structure of particles, we should expect to find "true" elementary particles composed of discreet units of circulating charge. Thus the number of elementary particles should equal the number of fundamental ways charge can circulate. All other so-called particles are not fundamental, but instead are energy distribution singularities (nodes) having limited stability or "half-life".

Even the neutron has been successfully modeled by its decay products, the proton and electron, plus binding energy[37].

28. *There are two types of charge.* This is *not* equivalent to saying, "There are two types of charged *particles*." Does the existence of "positive" and "negative" charged particles mean that there are really two types of charge? Not necessarily. Since real finite particles must occupy finite three-dimensional space, the fibers or "strings" of circulating charge comprising a toroidal particle must bear some relationship to each other. In the toroidal model, motion around the toroid or "doughnut" of a particle creates an Amperian pinch or attractive force that balances the repulsion of like elements in the direction perpendicular to the current flow. But what balances the repulsion in the direction *of* the flow, that is, between cross sections of the doughnut? There must also be motion around the torus or cross section, creating an Amperian pinch *in* the direction of the current, or the particle would fly apart. Thus for stability, the composite motion must be helical, like a "slinky". Now we may rightly ask, "How many fundamental ways can charge circulate?" According to the toroidal model, the answer is two: right-handed and left-handed. Just as there are only two observer-independent ways a slinky may coil, so there are only two fundamental types of particles. Based on two types of motion, we know them by Benjamin Franklin's convention as "positive" and "negative". And just as right- and left-handed slinkies are mirror images of each other, so the essential difference between "positive" and "negative" particles is helicity of motion, reversed only by a mirror. One type of charge, two types of motion.

29. *Matter can be produced and annihilated in pairs.* Experiments have demonstrated that supposed "electrons" and "positrons" or other "matter" - "anti-matter" pairs are produced and annihilated. But is matter itself no longer conserved? And what is anti-matter? Does it have something to do with time reversal, as Feynman suggested? Only in the sense that helical motion played backwards exhibits reversed handedness. Paul Dirac identified anti-matter as the mirror image of its corresponding matter, not as some spooky, etheric "un-matter". Thus physical electrons and positrons are identical in all respects except in the helicity or handedness of the motion of their charge elements. But do physical electrons pop in and out of existence if they happen to run into physical positrons? Not necessarily. If many so-called particles are really distributions of energy with specific singularities, then electro-magnetic fields could also produce the energy distributions and singularities identical to real electrons and positrons. It's conceivable that such "virtual particles" exist and that these are what get produced and annihilated. The idea that matter itself can be created or destroyed is far from proven, and contains a number of singularity difficulties, similar to those of black holes. As stated above, 'nodes' or field singularities contain zero energy density and so can be produced and annihilated readily enough, but matter is a different matter. Singularities of matter imply infinite energy densities, repugnant to common sense.

30. *The wave function has nothing to do with electromagnetic fields.* The quantum wave function ψ is "normalized" as unitless so that the quantum constants h, m, and c alone can determine the units of a particular quantity. However if h, m, and c themselves exist by virtue of electromagnetic balance, as the toroidal model suggests, it is the fields that determine the quantities, and therefore the wave function is intimately connected with the electromagnetic fields that produced the particles. Though the convention of a normalized wave function is very useful, a different convention in which ψ has units of fields **E** + ic**B** and ψ* has units of **D** + **H**/ic could reasonably be adopted. Their inner product has units of Poynting energy density, and their integral over space could be normalized by the total energy contained in that space. However, since ψ is a complex scalar, another convention involving potentials could also be adopted. Though scalar (V) and vector (**A**) potentials are commonly used for a complete description of a system, any complex vector field is mathematically equivalent to two scalar fields[38]. Moreover V and **A** are potentials associated translation and rotation respectively, and thus their interactions can be mathematically expressed by complex numbers. A rigorous derivation of ψ in terms these complex scalars may require only a fundamental understanding of the connection between matter and fields.

31. *Low Energy Nuclear Reactions (LENR) are impossible.* If the photoelectric effect had been introduced today, it might not have been accepted either. The release of a shell electron by means of a sufficiently high-frequency laser action is similar to the release of an alpha or beta particle from the nucleus by the proper resonance phenomena. Now every toroidal particle has a resonant frequency $\nu = c/\lambda$, where λ is the circumference or path length of the toroidal circuit, and the interactions between particles also produce related resonances. It is no surprise, then, to discover resonance as the key to LENR. Hot and cold fusion are like a sledge hammer and a fine-tuned laser to cut a stone: the sledge hammer destroys the stone in the process, while the laser can actually improve its quality.

32. *Simultaneity is impossible.* Unlike Einstein relativity, with a reference-frame-dependent "instant", Machian relational relativity views an instant as universal, independent of reference frame. Everything interacts with everything else in *every* instant, regardless of distance. Under this paradigm, Maxwell's and other dynamic equations are expressed by total, as opposed to partial, time derivatives, which are independent of reference frame. The total time derivative, first proposed by Heinrich Hertz[39] and recently expounded by Thomas Phipps[40], is identical mathematically to the convective, Lagrangian or hydrodynamic derivative, useful in many seemingly unrelated branches of physics and engineering. In the definitions below, it can be argued that the partial derivatives on the right depend on reference frame velocity **v**, while the total derivative on the left does not. When Ampere's and Faraday's Laws are expressed with total time derivatives, and **v·del** is expanded, we discover terms not found in typical texts. We also realize that the Lorentz forms are approximations, neglecting certain terms in the expansion.

$$\frac{d}{dt} = \frac{\partial}{\partial t} + \sum_{i=1}^{3} \frac{\partial \vec{\mathbf{x}}_i}{\partial t} \cdot \hat{\mathbf{x}}_i \frac{\partial}{\partial \mathrm{x}_i} = \frac{\partial}{\partial t} + \left(\vec{\mathbf{v}} \bullet \vec{\nabla}\right),$$

$$\vec{\mathbf{v}} \equiv \sum_{i=1}^{3} \frac{\partial \vec{\mathbf{x}}_i}{\partial t}, \qquad \vec{\nabla} \equiv \sum_{i=1}^{3} \hat{\mathbf{x}}_i \frac{\partial}{\partial \mathrm{x}_i}$$

$$\vec{\mathbf{v}} \bullet \vec{\nabla}\vec{\mathbf{A}} = \vec{\nabla}\left(\vec{\mathbf{v}} \bullet \vec{\mathbf{A}}\right) - \vec{\mathbf{v}} \times \left(\vec{\nabla} \times \vec{\mathbf{A}}\right) - \vec{\mathbf{A}} \times \left(\vec{\nabla} \times \vec{\mathbf{v}}\right) - \vec{\mathbf{A}} \bullet \vec{\nabla}\vec{\mathbf{v}}$$

$$\vec{\mathbf{v}} \bullet \vec{\nabla}\vec{\mathbf{A}} = -\vec{\nabla} \times \left(\vec{\mathbf{v}} \times \vec{\mathbf{A}}\right) + \vec{\mathbf{A}} \bullet \vec{\nabla}\vec{\mathbf{v}} + \vec{\mathbf{v}}\left(\vec{\nabla} \bullet \vec{\mathbf{A}}\right) - \vec{\mathbf{A}}\left(\vec{\nabla} \bullet \vec{\mathbf{v}}\right)$$

33. *The net voltage around a circuit is zero.* On day one of any electrical engineering course worth its salt, the novice learns Kirchoff's voltage law, that the total voltage around a circuit is zero. According to relational mechanics, this *is* true in a reference frame independent sense, *but* may not be strictly true if the reference frame itself rotates. Thus, a simple closed-loop wire with no battery could experience a current if placed on a sufficiently high-speed rotating platform. A toroidal water pipe would flow even more noticeably if placed on the same platform. Mach's Principle interprets both of these, like Newton's bucket, as rotation with respect to other matter. As long as the charge or water is truly rotating, a **v·del** or '**ω x**' term exists and the partial time derivative of flux does *not* equal the total time derivative, which is zero. However, since rotation is with respect to other matter, after a "relaxation time", the elements of matter in the flow come to "rest" with respect to each other, and the transient '**ω x**' term vanishes. In other words, matter is only truly rotating during the transient relaxation time, after which it "catches up" or is "entrained" in a new equilibrium. It is only during these brief moments, when the net voltage around a circuit is nonzero, that we can capture excess energy found in the "spike" technology of John Bedini and others. Finally, the Sagnac Effect is also analogous, except the thing that "moves" is "light". Since light is not a thing, it isn't entrained by other light and so doesn't ever "catch up". Thus, the Sagnac Effect doesn't die out as the matter-based examples do.

34. *The alteration of clocks is equivalent to time dilation.* Time keeping is *not* identical with time itself, just as the ruler we use to measure distance is not the same as distance itself. If we placed you in deep freeze for 100 years, time itself would not slow down, though your biological processes might. Now if all motions are cyclical, we don't measure time itself, but merely compare one cyclical motion with another. "Day" and "year" are cycles of the earth's rotation and revolution about the sun; oscillations of the caesium atom are the basis for atomic time keeping. Neither GPS[41] nor Hafele-Keating[42] "prove" time dilation, but only that caesium atoms oscillate more slowly under greater gravitation or acceleration. Under Machian relational relativity, the traveling twin of the Einstein's famous twin paradox is only truly "moving" as he accelerates away from earth. His clocks are only slowed when they actually experience a gravitational stress. Thus he spends most of

his trip "at rest" with respect to the ship, the matter creating his environment, and it makes little difference what his velocity is with respect to earth. If anything, the traveling twin ages a miniscule amount more rapidly than the earthbound twin, stuck in earth's gravity. Upon the traveler's return, the two twins would still look the same, though their clocks might be off a few seconds.

35. *Zero Point Energy (ZPE) comes from the ether*. Among alternative scientists, a conception is currently floating around that ZPE floats around in the "ether", possibly passing through space from some higher dimension. This "ether" somehow exists apart from matter, unconnected with the fields of matter. Instead Mach's Principle anchors ZPE directly to matter, and regards it as the energy a particle must have to remain a particle. Isolated from all other matter, a toroidal particle has both repulsive Coulomb energy, due to tension between like elements of charge, and attractive Amperian energy, due to circulatory motion. Even with no interaction from other particles, that is, at zero temperature, the ZP particle does not cease to exist. Furthermore, its total energy, which it has in the presence of surrounding matter, is *not* the same as its "self energy", "inertial energy" or ZPE. The ratio of total energy to ZPE of a particle is a measure of its entropy or entanglement with its environment. The difference between its total energy and ZPE is a measure of its kinetic energy or temperature.

36. *Kinetic and potential energy are fundamentally different*. Mach's Principle views kinetic energy as movement in relation to other matter. Remove the neighboring matter, its environment, and we cannot say whether something "moves" at all. Moreover, according to Mach, the distinction between kinetic and potential energy is a mere matter of reference frame. For example, we say that an object on top of a hill has potential energy in the earth's gravitational field. However, by viewing the same object from the frame that rotates about the earth's center at velocity $v^2 = 2g(h+R)$, we notice no gravity, but see it as orbiting at speed v. So a particle's energy is independent of reference frame, but can be interpreted in many ways depending on how you view it. It translates and rotates with respect to matter, not space. The important distinction is between its self energy or ZPE and the energy due to environment, which could be seen as kinetic or potential. Now the environment always resists translation of a particle, but since a toroidal particle has a ZP spin, the environment may resist or assist a particle to return it to that steady state of rotation. The rare circumstance in which a particle's actual rotation is less than what it would be if in isolation (ZPE), accounts for many anomalies, including superconductivity, anti-gravity, negative resistance, and excess energy. Particle rotation is essential to explain these unusual events.

37. *Observation affects reality.* The logic of this reasoning is typified in the quip, "The moon disappears when nobody looks." Quantum theorists state that the wave function "collapses" to a point upon observation, which a bit like saying that a little gnome comes around whenever you're gone to mess up the

kitchen. Ludicrous, but not falsifiable. The notion that observation actually affects reality itself is a metaphysical leap far beyond saying that measurement affects the measured, which no sane person would deny.

38. *Mind has nothing to do with physics*. To deny observation alone the power to affect the existence of the observed is not to deny the mind the power to affect reality. The typical mainstream physicist runs speedily away from anything hinting at "paranormal", assuming that real science has proven such things don't exist. Yet these same physicists rarely stop to consider that their own thoughts produce actions which physically alter reality. Surely there must be a mechanism that converts a 'thought', with no apparent physical reality, into action. A veritable parade of scientists from Walter Russell and Wilhelm Reich to Hal Puthoff and John Bockris have been ridiculed and misunderstood for research connecting physics with mind. Is it finally time for scientists to get over their dread of the unknown and join the search?

39. *Experiments "prove" theories.* Experiments can only falsify, and even then, only with caution and close attention to assumptions. This is not to belittle experiments, which are extremely important, but to put them in their proper place. A proof is a logical or mathematical argument, while an experiment merely provides evidence for the argument. And even logic and mathematics are more of an art than most people realize. Science today is *filled* with "straw man" arguments, presentations of incorrect or incomplete notions of a theory, which are then mercilessly attacked. If any lesson should be learned from the history of science, it ought to be extreme caution in forming conclusions. For this reason, a healthy attitude of respect towards those with whom we disagree is the best indicator of a true scientist.

Conclusions. By no means is the number 39 significant, since with some thought you could identify double or treble that number of assumptions masquerading as fact in science today. Nor has this paper attempted to present anything resembling a complete theory based on Mach's Principle, toroidal particles, and catastrophe theory. I am well aware of the thousand questions and objections that could be leveled against the proposed alternatives, but urge that serious inquiry into these alternatives can bear much fruit. This paper will have accomplished its purpose if it inspires you to reconsider even one long-held assumption or to investigate just one of the suggested alternatives.

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