A New Foundation for Modern Physics

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Abstract. Principles of logic and criteria for acceptance of theories in science are presented. According to logic, whose purpose is to guide science toward truth, Maxwell's Equations, Einstein's Special and General Relativity Theories, Quantum Mechanics, the Bohr and Dirac theories of the atom, the Quantum Electrodynamics Theory of elementary particles and Newton's Universal Law of Gravitation are *not* acceptable theories for science.

A new foundation for modern physics is presented that is based on the fundamental empirical laws of Classical Electrodynamics for finite-size elastic elementary particles in the shape of a toroidal ring and composed of plasma filaments. Using combinatorial geometry, three-dimensional physical models of the atom and nucleus have been developed that describe the Periodic Table of the Elements and nuclear shell structure better than quantum theories. Blackbody radiation, the photoelectric effect, and atomic emission spectra are explained in terms of toroidal shaped electrons. New spectral lines for hydrogen in the extreme ultraviolet (not predicted by quantum theories) are predicted and found experimentally by the Berkeley Extreme Ultraviolet Physics laboratory from rocket-based experiments in space.

A gravitational force law obtained from corrected Classical Electrodynamics is superior to that of Newton (even with Einstein's general relativistic corrections incorporated) as shown by analysis of Solar System data.

Principles of Logic and Criteria Undergirding Science. Since the days of the ancient Ionian, Greek, and Roman natural philosophers, the role of logic in guiding science toward truth has been clearly understood. The most celebrated example of this was Euclid's "Elements." Natural philosophers considered the development of a scientific theory as analogous to the proof of propositions and theorems in Euclidean Geometry.

Some of the rules of logic that have been continuously held for thousands of years are as follows:

1. No scientific theories are allowed based upon postulates or assumptions known to be false.
2. No scientific theories are allowed that cannot explain all the valid relevant experimental data.
3. All scientific theories must be self-consistent with one another.
4. All different types of valid measurements of the same quantity in science must be self-consistent with one another.

Since the discovery of the infinite range of the gravitational force between massive particles and the discovery of the infinite range of the electromagnetic force between charged particles, an additional rule has been added, *i.e.*

5. All scientific theories must acknowledge in a self-consistent way the mutual interaction and interconnectedness or unity of all parts of the universe—Mach's Principle.

The famous philosopher, mathematician, and physicist Henri Poincaré [1] added an important logical criterion for fundamental theories. According to logic, each fundamental theory in science may have one or more fundamental constants associated with it. No two fundamental theories may employ or use the same fundamental constant. If they do, one of them is not fundamental. In the case of Special and General Relativity, the fundamental constant is c, the velocity of light. Since c is also the fundamental constant of the larger theory of electrodynamics, Poincaré argued from logic that Relativity is not a fundamental theory and that relativistic effects are merely electromagnetic effects with an electromagnetic explanation.

Since in Quantum Theory the quantized energy $E = nhv = nh2\pi c/\lambda$ also involves the fundamental constant c, one can also argue that Quantum Theory is not a fundamental theory and that quantum effects are merely electromagnetic effects with an electromagnetic explanation.

Einstein's General Theory of Relativity also incorporates c, the velocity of light, in explaining some gravitational effects. Thus, Poincaré predicts that gravity is of electromagnetic origin as well as the correction terms due to the General Theory of Relativity.

Selected Works Contributing to a Purely Electromagnetic Foundation for Modern Physics

In 1825, André Marie Ampère [2] suggested that electric currents consist of moving magnetic molecules. These magnetic molecules (electrons) interact like tiny loops of charge. Ampère found that the force of interaction F_e was

$$F_e = ii' \frac{\mathbf{ds} \cdot \mathbf{ds}}{r^2} \left(\sin\theta \sin\theta' + \frac{1}{2} \cos\theta \cos\theta' \right)$$

where $i = qv$ and $i' = q'v'$.

This force law was different from Newton's Law of Gravitation for F_g

$$F_g = \frac{Gmm'}{r^2}$$

in that there were *angular dependencies* as well as the $1/r^2$ dependence. It challenged the Newtonian concept of force and its associated nonphysical concept of action-at-a-distance.

In 1856 [3] and 1871 [4] Wilhelm Eduard Weber extended the work of Ampère to obtain the force F_e between identical magnetic molecules (electrons) as

$$F_e = \frac{ee'}{r^2 - \frac{2r m_e + m_e'}{c^2 m_e m_e'} ee'} \left[1 - \frac{1}{c^2}\frac{dr^2}{dt^2} + \frac{2rf}{c^2} \right]$$

where f refers to external catalytic forces in addition to their mutual interaction force. This force law further challenged the Newtonian concept of force by showing a *velocity dependence* in addition to the $1/r^2$ dependence.

From the denominator in the force law changing sign at $r = 2e/m_e c^2$, Weber deduced that this was the distance of closest approach of two magnetic molecules (electrons). Thus, he predicted the classical electron radius to be

$$r_e = \frac{e^2}{m_e c^2}$$

for electrons consisting of a continuous loop of charge.

In 1901, Sutherland [5] deduced that the origin of the lines in atomic emission spectra arise from kinematical effects within the atom. He explained the spectral lines in terms of the nodal subdivisions of a circle.

In 1911, Rutherford determined by analyzing alpha particle scattering off of thin metal foils that most of the mass of the atom and all of its positive charge was concentrated in a very small region in the atom called the nucleus.

In 1913, Bohr introduced his model of the atom in which a point-like electron moved in a circular orbit obeying the laws of Classical Mechanics. Bohr chose to attribute Sutherland's circle to the circular orbit of a point-like electron.

This choice caused a number of problems in logic for the Bohr model. In order to quash these problems, Bohr made the following postulates: [6]

Postulate One. An electron in an atom moves in a circular orbit about the nucleus under the influence of the coulomb attraction between the electron and the nucleus, and obeying the laws of Classical Mechanics.

Postulate Two. However, instead of an infinite number of orbits, which would be possible in Classical Mechanics, it is only possible for an electron to move in an orbit for which its angular momentum is an integral multiple of Planck's constant h divided by 2π.

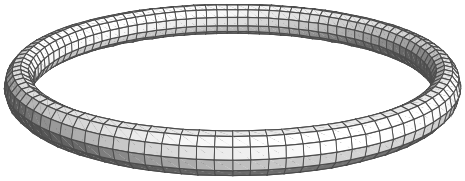

Figure 1.
Spinning Ring Model
of the Electron

A ring of charge circulates across the surface of a toroid.

Postulate Three. Despite the fact that the electron is constantly accelerating and must continually emit radiation according to electrodynamics, an electron moving in such an allowed orbit does *not* radiate electromagnetic energy. Thus its total energy E remains constant.

Postulate Four. Electromagnetic radiation is emitted if an electron, initially moving in an orbit of total energy E_i, instantly and discontinuously changes its motion (which is impossible!) so that it moves in an orbit of total energy E_f. The frequency of the emitted radiation v is equal to the quantity $(E_i - E_f)$ divided by Planck's constant h.

In 1915, Parson [7] reintroduced Ampère's notion that the electron was not a small point-like sphere as Bohr assumed, but a very thin ring about 1.5×10^{-9} cm in radius on which the negative charge revolves at a velocity of approximately the velocity of light c (see Figure 1).

In Parson's model, the electrons did not orbit the nucleus. By the forces of electric and magnetic fields, electrons came to stable equilibrium at some finite distance from the nucleus with the electrons arranged in spherically symmetric stable configurations (see Figure 2). Parson used this stable configuration to explain various types of chemical bonds and other chemical phenomena.

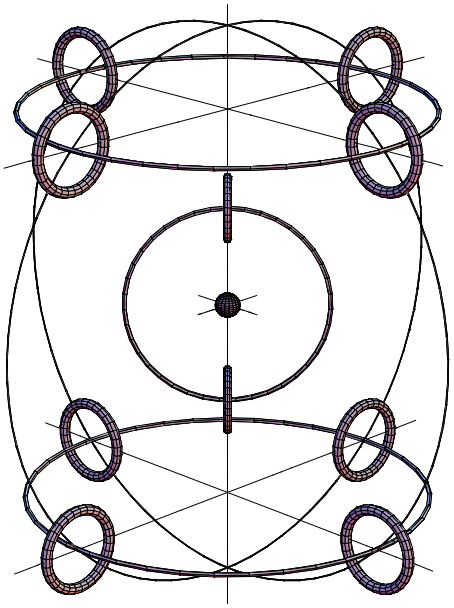

Figure 2. Neon-20 Atom

Electrons take up stationary positions around the nucleus. Two electrons fill the first shell. Eight electrons fill the second shell. The axes and the three principal lines of magnetic flux pass through the electrons.

Parson's continuous Ring Model of the electron has electromagnetic energy stored in the form of a *non-radiating* standing wave—correcting an error in Bohr's atomic model. Parson also noted that the alternating force of a light wave can induce charge oscillations on the ring capable of absorption and

emission of electromagnetic energy. This corrected another error of Bohr who required the electron to instantly and discontinuously make a transition from one orbit to another (the infamous "quantum leap"). Finally, the condition for stable standing waves in the ring explains the mysterious angular momentum postulate of the Bohr model.

In 1916, Grondahl [8] confirmed Parson's model of the electron experimentally for free electrons within an iron wire.

Also in 1916, Page [9] published a theory of blackbody radiation based purely on Classical Electrodynamics in which an oscillator contains a rotating degree of freedom storing energy in a non-radiating form. Under certain conditions this energy can be transformed by an internal mechanism between the radiating and non-radiating degrees of freedom.

Shortly thereafter Webster [10] at MIT showed that Page's oscillator was Parson's ring electron. In 1917, Webster [11] went on to define the theory of electromagnetic mass for Parson's magneton or ring electron.

Also in 1917, Compton [12, 13] published a series of experimental papers on the size and shape of the electron in which he analyzed hard X-ray and gamma ray scattering. He showed that the results are consistent with scattering from thin flexible rings of electricity, i.e. ring electrons. Furthermore, he found that the size of the electron in the stable atom is larger than the size of the free electron associated today with the classical electron radius and the Compton wavelength. Compton [14] also derived Owen's experimental law for fluorescent absorption of X-rays based on the electron Ring Model.

In 1919, Allen [15] presented the case for a ring electron to the Physical Society of London. After that there were no more papers published on the Ring Model for nearly 50 years.

Starting in 1956 Bostick, one of Compton's last graduate students took the lead in developing plasma-focus devices and plasma-jet devices in the plasma fusion effort. With these devices he was able to demonstrate the existence of plasmoids, i.e. force-free, minimum-free-energy structures (like spherical droplets) carrying their electric currents in slender, force-free, tensile-strength-possessing vortex strings.

In 1961, Robert Hofstadter received the Nobel Prize in Physics for using beams of scattered electrons to measure the finite size and charge density of the proton, neutron, and various nuclei (see Figure 3).

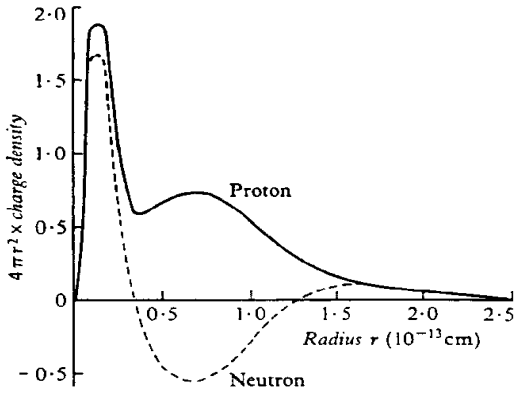

Figure 3.
Charge Density of Proton and Neutron [16]

In 1966, Bostick [17, 18] proposed that the electron is a string-like submicroscopic force-free plasmoid constructed by the self-energy forces of electric **E** and magnetic **H** vectors. He found that a string of charge that makes up the electron naturally assumes the configuration of a helical spring that is connected end-to-end to form a deformable ring or torus (see Figures 4 and 5).

The cornerstone of this completely electrodynamic model of the universe was *electric charge in the form of an extremely slender, electrically charged, electromagnetic fiber that is in stable equilibrium by its own self-forces*—and whose electromagnetic energy is 2.5×10^{18} GeV. [18] Bostick proposed this physical structure as the origin of all superstring effects and gave arguments that

- all mass, momentum, and energy are electromagnetic in character,
- the strong force is due to the electromagnetic forces between two finite-size toroidal particles, and
- the transverse deformation waves on the filament are equivalent to the De Broglie waves of Quantum Mechanics.

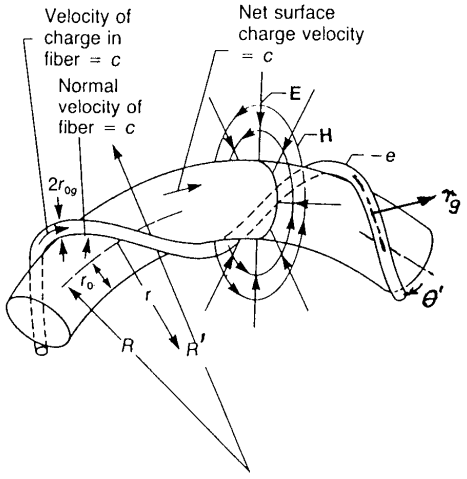

Figure 4. Helical Fiber Forming Torus

In 1978, Barnes [19] showed that if one takes into account the finite size and elasticity of charged elementary particles, then Faraday's Law, Ampere's Law, and Gauss's Law predict a feedback effect on charged particles in motion. He showed that the induced magnetic fields due to the charged particle's motion change the equilibrium shape of the particle, *e.g.* from spherical to ellipsoidal. Barnes derivations showed that this change in shape due to the motion of a charged particle is responsible for the so-called "relativistic" change in the electric and magnetic fields of the particle, its change in mass, and its change in decay half-life. Thus Barnes was able to show that the fundamental laws of electrodynamics combined with the Galilean coordinate transformation are able to predict all the observed "relativistic" phenomena for elementary particles in agreement with Poincaré's argument from logic.

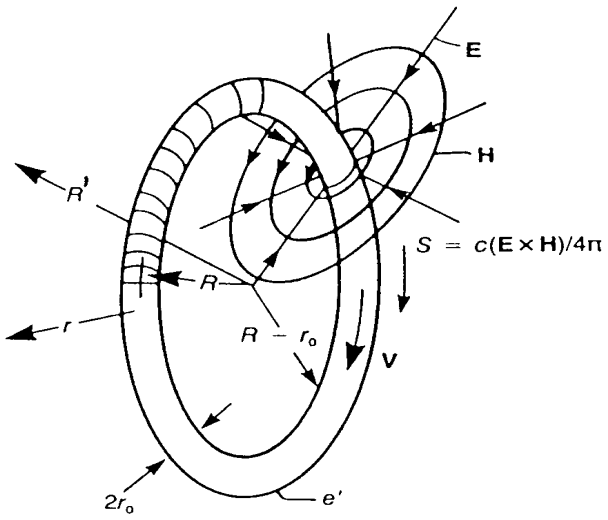

Figure 5. E and H Fields of Torus

Also in 1978 and 1992 Charles Lucas [20] published an article pointing out two major problems in logic with Maxwell's

equations. First, when one derives Maxwell's equation from Faraday's Law, displayed here,

$$\int_C \mathbf{E}'(\mathbf{r}') \cdot d\mathbf{l}' = -\frac{1}{c}\frac{d}{dt}\int_S \mathbf{B}(\mathbf{r}) \cdot \mathbf{n}\, da$$

then the field transformation information in the law is discarded. Second, the *point-particle approximation* is used on a surface integral

$$\int_S \left(\nabla \times \mathbf{E} + \frac{1}{c}\frac{\partial \mathbf{B}}{\partial t} \right) \cdot \mathbf{n}\, da = 0$$

to obtain the differential form of Faraday's Law*, i.e.*

$$\nabla \times \mathbf{E}_i = -\frac{1}{c}\frac{\partial \mathbf{B}}{\partial t} - (\mathbf{v} \cdot \nabla) B_i(r,t) \approx -\frac{1}{c}\frac{\partial \mathbf{B}}{\partial t}$$

The second term on the right above is *not zero* for finite-size particles. Thus, the four-vector version of Maxwell's Equations is not proper or rigorous. Furthermore, the application of the Theory of Relativity to electrodynamics is an unwarranted duplication, since electrodynamics already has in Faraday's Law the transformation from the observer's frame of reference to the charged particle's (or circuit's) rest frame. [21]

In 1990, Bergman and Wesley revived the spinning charge Ring Model of elementary particles of Figure 1. [22]

In 1996 Joseph Lucas [23], a student at Caltech and son of Charles Lucas, published the first holistic physical model for the atom including the nucleus. Using combinatorial geometry, the number of stationary electrons that will pack into the various electron shells about the nucleus was predicted in full agreement with the observed structure of the Periodic Table of the Elements. The constraints used in the Combinatorial Geometry derivation were based upon Joseph's fundamental ring dipole magnet experiments and spherical symmetry. From the perspective of magnetics, the physical geometrical model is able to explain the physical origin of the valence electron structure and the reason why the Periodic Table has only seven periods. electron structure and the reason why the Periodic Table has only seven periods.

Using combinatorial geometry with the same constraints as for the electrons, the same model is able to describe the physical geometrical packing of protons and neutrons in the shells of the nucleus. The holistic model accurately predicts all the nuclear "magic numbers" indicative of nuclear shell structure as well as suggesting the physical origin of nuclide spin and the "liquid-drop" features of nuclides. It also predicts the spin of all observed nuclides, a feat that comparably simple quantum shell theories of the nucleus cannot match.

In 1996-1997 Charles and Joseph Lucas [24] explained the fundamental phenomena that established Quantum Theory, *i.e. blackbody radiation*, *the photoelectric effect*, and *the emission spectra of atoms*, in terms of the toroidal Ring Model of the electron. The

explanation of these phenomena turned out to be logically superior to that of Quantum Physics—with none of its problems in logic. Furthermore, the new physical model of the atom predicted emission spectra lines for hydrogen and other atoms in the extreme ultraviolet.

In 1991, Labov and Bowyer [25] at the University of California at Berkeley devised a way to measure the extreme ultraviolet spectrum from 80-650 Angströms. They put a grazing incidence spectrometer on a sounding rocket to get above the earth's atmosphere. Flying in the shadow of the earth and pointing away from the sun toward a dark area of the universe, the spectrometer measured the spectrum from 80 to 650 Angströms. Presumably this part of the universe consists primarily of hydrogen and helium gas. A large number of spectral lines or peaks were obtained as shown in Figure 6.

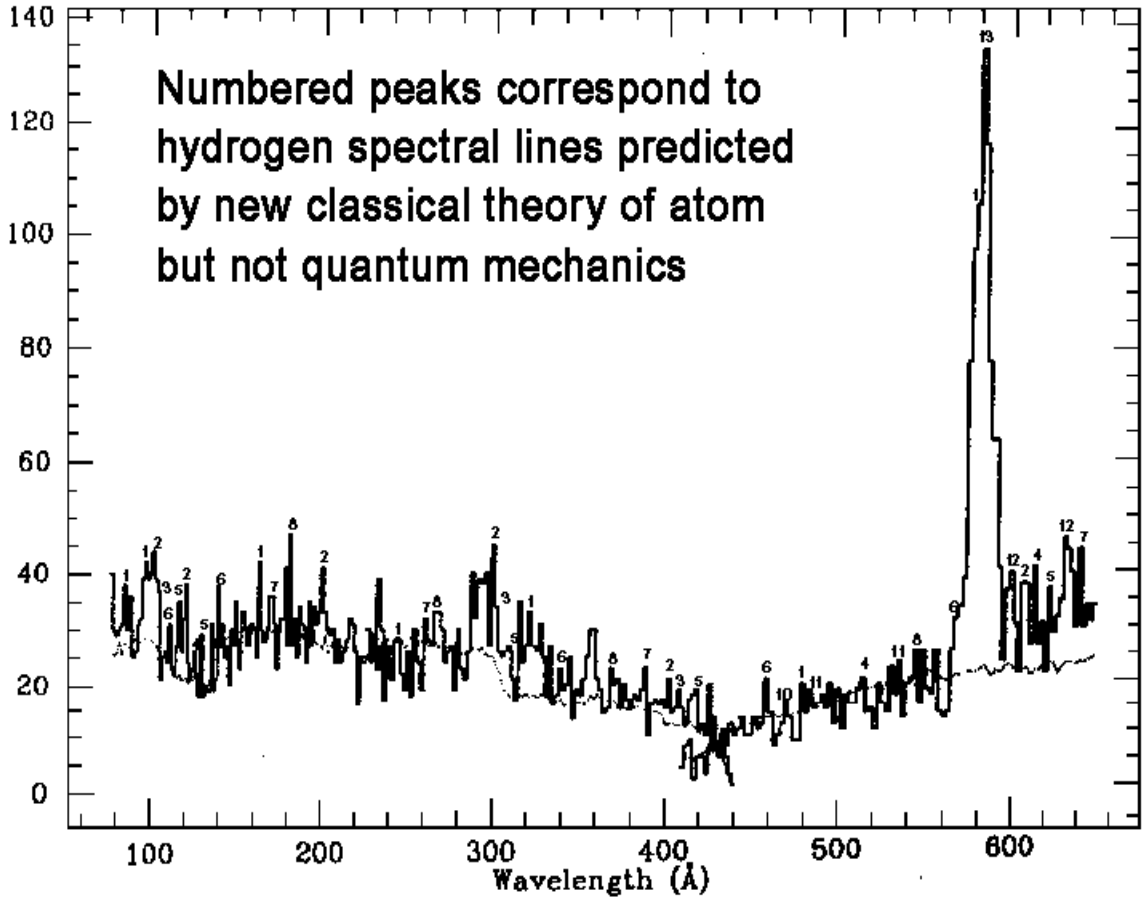

Figure 6.
Extreme Ultraviolet Spectrum for Helium and Hydrogen [25]

The Quantum Theory of the Atom does not predict that there are any spectral lines from hydrogen or helium to be observed in this range. But, the Ring Model of the Atom predicts up to 7 orders of 12 spectral lines in this range. All of the predicted spectral lines and their various orders are observed in the spectral data of Labov and Bowyer.

Note that the predicted spectral lines and their various orders account for most of the principal peaks of the observed spectrum as shown in Figure 6.

In 1998, Harrison [26] began taking a serious look at how various molecules would be constructed using the Ring Model of the Atom. He is finding that the symmetries of the atom are extended into the molecular structures. The cubic structure of the *valence shell electrons* is very prominent in the molecular structures (see Figures 7 and 8).

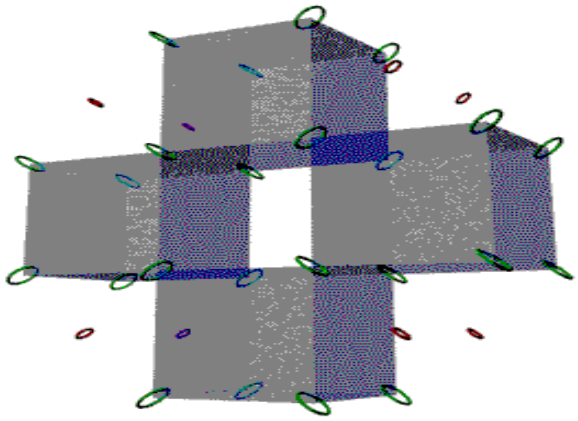

Figure 7. Cyclobutane C_4H_8

The three types of chemical bonds in molecules correspond to magnetic bonding on a corner, an edge, and a side of the valence cube. The bonding angles of various atoms can be predicted from symmetry considerations. The formation of lattices again is based on magnetic bonding.

In 2000 Lucas [27] extended his previous work [20, 24] to obtain a more complete electromagnetic force that includes the force of gravitation with angular and velocity dependencies that go beyond Newton's Universal Law of Gravitation and Einstein's General Theory of Relativity. An analysis of Solar System data confirmed these results.

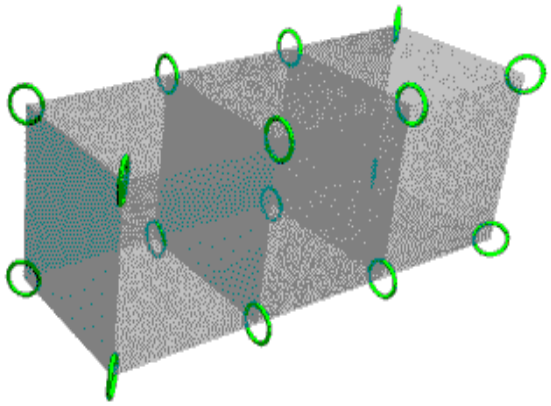

Figure 8. CO_2 Molecule

Charles and Joseph Lucas are continuing to refine the toroidal Ring Model by incorporating the plasma filaments of charge observed by Bostick and other plasma physicists. They are working to derive, from electrodynamics alone, the stability conditions on the filamentary toroidal ring. They expect to obtain from the conditions for stability a quadratic equation for the ring radius for each possible charge-state giving rise to four stable massive elementary particles, i.e. the proton, antiproton, electron, and positron. From these derived radii, it should be possible to predict from electrodynamics alone the mass, the spin, and the magnetic moment of each particle. In addition Planck's constant h should also be predicted from pure electrodynamics and given a physical interpretation. This would complete the second part of Poincaré's argument from logic that Quantum Mechanics is not a fundamental theory but a part of electrodynamics.

Summary

This paper references key experiments, theoretical developments, and arguments from logic that are to form a new working foundation for modern physics which is based on Classical Electrodynamics. Some long-standing errors in classical physics have been fixed so that the corrected theory acknowledges particles to have finite sizes in the shape of toroidal rings formed by helical filaments of charge. The new and improved version of electrodynamics appears to satisfy all the rules of logic that undergird the Scientific Method. In its current rudimentary form, this approach is able to give the first holistic description of the atom—including its nuclear structure and spins, blackbody radiation, the photoelectric effect, and the emission spectra of atoms. This new approach in physics is logically superior to relativistic Quantum Electrodynamics Theory (QED). In addition, it explains the electromagnetic origin of gravity and gives many correction terms to Newton's Universal Law of Gravity without invoking the General Theory of Relativity.

The corrected electrodynamics theory is superior in logic for the following reasons:

1. A simpler approach—only Classical Electrodynamics, no additional Quantum or Relativity or Gravity Theory needed.

2. Describes additional fundamental data—*e.g.,* the extreme ultraviolet emission spectra of hydrogen and solar system data.

3. No obviously false assumptions such as those that infect Quantum Electrodynamics.

4. Allows the laws of mechanics and electrodynamics to hold on all size scales as always expected—Quantum Electrodynamics does not.

3. Describes the physical mechanism for absorption and emission of electromagnetic energy by particles—Quantum Electrodynamics does not.

4. Eliminates randomness and the chance-statistical basis of Quantum Mechanics in favor of a logical basis in *cause and effect*.

7. Allows physical laws to be observer-independent as always expected.

8. Predicts the gravitational force law with velocity, acceleration, radiation reaction, *etc.,* terms—Newton's Universal Law of Gravitation (even when modified by Einstein's General Theory of Relativity) does not.

9. A single force law accounts for electrodynamics *and* gravitation phenomena.

10. Explains all forces as physical contact forces by means of the particles' electromagnetic fields—QED uses an unphysical exchange of non-material "particles," *i.e.* bosons.

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