Physical Models of Matter*

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A theory of physical matter based on fundamental laws of electricity and magnetism is presented. A new physical model for elementary particles, the atom, and the nucleus implements scientific principles of objective reality, causality and unity. The model provides the experimentally observed size, mass, spin, and magnetic moment of all the stable charged elementary particles. The model is based on a classical electrodynamic rotating charge ring. From combinatorial geometry, the complete structure of the *Periodic Table of Elements* is predicted, and the nuclear spins and structure of nuclear shells are correctly predicted. Unlike modern mathematical models based on point-like objects, a physical model has characteristics of size and structure—providing a causal mechanism for forces on objects and the interchange of energy between objects. From the fundamental laws of electrodynamics and Galilean invariance, the so-called "relativistic" fields of a charged particle moving at high velocity have been derived. The results are mathematically identical to those predicted by the *Special Theory of Relativity*, but the origin of the effect is entirely physical. The model even accounts for the interaction of light and matter, and the physical process for absorption and emission of radiation by an electron is explained from classical electrodynamics. Using a ring particle absorption mechanism, classical explanations are given for blackbody radiation and the photoelectric effect.

INTRODUCTION

About 20 years ago, Thomas G. Barnes began publishing his research on electromagnetism and elementary particles.[1,2] This remarkable work abandoned Atomist assumptions and proceeded with scientific principles of *objective reality, causality* and *unity* of the universe. The new physics (Common Sense Science) that emerged from Barnes' approach is re-establishing true science by developing a causal theory of matter and providing rational explanations for natural phenomena observed in common experience and by scientific experiments.[#]

A principal goal of fundamental physical science, known by the shorter name of "physics," is to achieve a theory of matter that describes physical reality in a way that is consistent with experimental observations and free of internal contradictions. The fundamental goals in a theory of matter are (1) to accurately describe physical objects and (2) to accurately describe the interactions between physical objects. A suitable and proper model of matter must meet these criteria:

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* A shorter version of this paper with the title **Physical Models for Elementary Particles, Atoms & Nuclei** was first presented at the *IVth International Conference: "Problems of Space, Time & Motion"* at St. Petersburg, Russia, September 23-29, 1996.

[#] "Rational explanations" means here that events involving inanimate matter (*e.g.* motions and interactions with light) have reasons in accordance with the law of cause and effect. An endorsement of the Enlightenment philosophy of Rationalism is not implied.

- Models of elementary particles must be physical models with structure in order to explain the physical nature of matter. Mathematical *equations* that ignore or make approximations to physical structure are inferior to physical models that imitate physical reality. Of course, mathematics has an important function in science, and Herrmann identifies useful roles of *mathematical models* when he remarks:[3]

  > Karl Popper notwithstanding, it is not the sole purpose of mathematical models to predict natural system behavior. The major purpose is to maintain logical rigor and, hopefully, when applicable to discover new properties for natural systems.

- Models of elementary particles, atoms, and all other forms of matter must be consistent with experimental data and validated laws of physics based on observed data. Features of the models and the associated theory of matter must be consistent and free of self-contradictions. The law of noncontradiction is fundamental to the scientific method.

- A general theory that simplifies and explains a large body of fundamental phenomena without contradiction or contrivance is preferred to numerous theories, multiple assumptions, and various models.

- There must be some mechanism for fundamental processes that occur within and between physical objects. Models must depend upon the laws of physics on all scales for all times in accordance with the law of cause and effect, so that the order assumed to exist in the physical universe may be studied and described rationally. Evidence cited below shows that atoms and elementary particles in the real world have finite size and an internal distribution of charge. They passively respond to the presence of one another by changing their size and rest-mass energies as they interact with one another.

These criteria are the foundations of Common Sense Science, and they have now been applied to develop a proper and successful theory of matter. We present a new physical model for elementary particles, the atom, and the nucleus because the current relativistic quantum models are incompatible with some of the experimental data and violate the logical basis of science as expressed in Mach's Criterion for scientific theories:

> Only those propositions should be employed in physical theory from which statements about observable phenomena can be deduced.

Mach's Criterion for scientific propositions[4] is similar to the rules of logic employed in doing proofs in Euclidean geometry. In the development of a new scientific theory, the criterion forbids the use of any assumption or sub-theory proven false. Now in the case of relativity theory, quantum mechanics, and the Dirac theory of the atom, there were some assumptions employed in these theories that were known to be false. The primary one was that all elementary particles were point-like or point-particles. Common sense tells us that no elementary particles are point-particles. Lucretius [5, pp. 13-14] shows that even early atomists held this view:

> ...if Nature had set no boundary to breaking things, the particles of matter had been so cracked and riven by time gone by that at no given moment could anything begin with them and fill out a full life-span.

Point-like particles are used in such science theories as relativity theory, quantum mechanics, and the Dirac theory of the atom. But a point-particle is a figment of one's imagination. The small but finite sizes of elementary particles have been determined by measuring the deflection angles of electrons aimed at other charged particles. These electron scattering experiments described by Olson *et al*.[6] show that elementary particles have finite size, multiple charges inside, and a somewhat elastic charge distribution (Figure 1).

While points cannot provide a physical mechanism for the exchange of energy between particles, a finite-sized object will change size and shape in response to the presence of another object. Consider an illustration: when a spring is compressed by holding one end fixed and applying a force to the other end of the spring, the spring becomes smaller and potential energy is added to the spring. The spring with its resistance to the external force of compression provides a mechanism for storing energy. There is a cause and effect relationship: the spring is compressed because of the external force. The spring has releasable energy because it has been compressed.

Now, instead of a spring, consider if a point-object of zero size might store energy. Potential theory shows that a point cannot store energy. There is no compression possible for a point, and no energy can be stored in the point-object. Although we have imagined the point-object to exist, and can even perform mathematical operations on it, it is incapable of the property of deformation needed to store energy. So, we can assume the existence of a point-object and its characteristics, but we cannot derive its properties from the laws of potential theory because the point-object has no physical mechanism capable of storing energy in any form. The point-object is therefore not a proper, rational model to explain the phenomena observed for objects of the physical world.

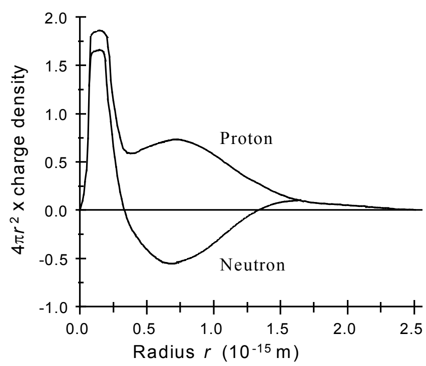

Figure 1. Charge densities in the proton and neutron extend to more than 1 x 10^{-15} meters. Evidently, the proton charge is entirely positive while the neutron has both positive and negative components of charge (after Olson, *et al.).* [6, p. 286]

Modern theories of matter present the electron as a point-like particle and omit or subtract unwanted mathematical terms associated with infinite energy. Dirac [7, p. 148] states that the aim is "not so much to get a model of the electron as to get a simple scheme of equations which can be used to calculate all the results that can be obtained from experiment.[p. 148] The point-electron is still a dominant feature of the modern model of the electron. Not long ago, Nobel Prize winner Hans Dehmelt [8, p. 539] wrote about the "structureless point particle predicted by the Dirac theory." Even more recent statements published in the official journal of the American Institute of Physics demand that elementary particles be considered as point-like:[9]

> Physically, an elementary particle is regarded as a stable, point-like, structureless entity (structureless except for having mass, spin and other possible quantum numbers), which in its free state, moves on a world line with momentum *k.*
>
> ... a particle is a point object that moves on a world line (as [Eugene] Wigner emphatically told [Arthur] Broyles).

But the electron, proton, and neutron all have measured amounts of spin (angular momentum) and magnetic moment. These features can only exist because the particles have structure and a finite, non-zero size. So, a self-contradiction in the common theory and a violation of Mach's Criterion are evident: On one hand, the particles are said to be point-like; on the other hand, they are known to have a finite size with a spin $p = mvR$, magnetic moment $\mu = \pi R^2 I$, and a measurable distribution of charge.*

Even when a point-particle model is used for physical calculations, the particle is also said to have a *wavelength* λ that must be used in other calculations. Additional evidence that elementary particles have a finite size was provided by Hofstadter[10] whose experiments showed that protons and neutrons have a measurable finite size, an internal charge distribution (indicative of internal structure), and elastically deform in interactions. Since 1961, when Hofstadter received the Nobel Prize in physics, there has been no reasonable doubt that fundamental particles have a finite size.

The point-electron model used for convenience has additional problems of structure called a "mystery" by Sellin [11, p. 212]:

> A good theory of electron structure still is lacking.... There is still no generally accepted explanation for why electrons do not explode under the tremendous Coulomb repulsion forces in an object of small size. Estimates of the amount of energy required to 'assemble' an electron are very large indeed. Electron structure is an unsolved mystery, but so is the structure of most other elementary objects in nature, such as protons [and] neutrons.

Concentration of the electron charge in a point would require an infinite amount of energy and an infinite force to balance the outward directed Coulomb Force. If the rest-mass energy is infinite, then the equivalent mass $m = E/c^2$ must (by common theory) also be infinite. But the rest-mass of an electron has been measured, and it is not infinite. Evidently, the point-particle assumption is contradicted by the known rest-mass of an electron.

Bowman attempted to discredit the non-zero finite size of the electron but nevertheless reluctantly conceded (twice) the contradiction between the size and mass features of the point model:[12]

> The divergences mentioned above [point electron versus finite rest mass] are well known and occur with the [quantum] model of an electron.
>
> It is simply not true that a finite, non-zero size is required for particle spin and magnetic moment. The Dirac equation accurately describes the behavior of charged elementary spin-1/2 particles and predicts their associated magnetic moments. The Spin-Statistic Theorem relates the particle species' possible particle occupation numbers to the species spin. Quantum field theory also explains why all particles of

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* These well-established equations of mechanics and electricity give the relationship between an object's size and its spin and magnetic moment. The same equations predict, without discontinuity, that the object's spin and moment become zero in the limit as its size approaches a point. But the non-zero measured values of spin and moment provide convincing evidence that the particles indeed are not point-like.

One physicist, a journal editor, defends a supposed reality of a point-electron by writing "I believe that the scattering results show no structure for the electron of the order of 10^{-13} meters." This weak argument ignores evidence that (1) scattering experiments of Nobel laureate Hofstadter had to use high velocity electrons to reduce their size and make them small enough to probe the smaller protons and neutrons,[13] (2) physical evidence is not established upon what on one person doesn't know, (3) a good scientific approach considers all experimental data, not just data from scattering experiments, and (4) much evidence, cited above, exists in theory and experiment to establish a finite size for the electron.

a given species have the *exact same* values for mass, charge, spin, magnetic moment, parity, *etc*. No such constraints come from classical physics however [*sic*, the reader may refer to *Quantum Features of the Ring Model* found later in this article]. (Why a given species of particles has the mass that it does *is* somewhat problematical in that the calculations for predictions of particle masses are extremely complicated and hard to perform and have met with mixed success.)

The preceding quotes reveals an area of modern theory that ultimately depends upon the theory itself and a fabricated mathematical equation (instead of an equation for a proven law of physics). Worse yet, for the theory, the modern theory of elementary particles leads to a logical contradiction between the electron size and mass that is far more serious than the reluctant admission that the mass is "divergent" and "somewhat problematical."

Although it is *logically* acceptable to formulate and propose a mathematical equation to describe natural phenomena, Mach's Criterion for *scientific theories* requires invalidation of any theory contrary to observed facts. The proper scientific objective is a description of truth, and the legitimate method of validating a postulate is, at a minimum, an application of the law of noncontradiction. Quantum theory has not and cannot be validated by Mach's Criterion.

The significance of a proper model has become apparent: It is impossible to derive such features as the stability, spin, mass or magnetic moment of an electron from an infinitesimal point, so modern theory assumes the electron is stable and has the right value for its spin and moment.

"RELATIVISTIC" FIELDS

The current version of electrodynamics, which is dominant worldwide in the scientific community, is based upon a point-particle idealization that is embedded in Maxwell's equations. This idealization has necessitated the invention of special relativity theory in order to describe high speed electrical phenomena, and quantum mechanics was produced to describe the stable states of the atom.

Now we describe a proof that the so-called "relativistic" fields of a fast moving charged elementary particle are due entirely to particle finite-size effects. First, the derivation of Maxwell's differential equations is reviewed showing where the point-particle approximation is employed. This shows that Maxwell's equations are not as fundamental as the laws of Coulomb, Ampère, and Faraday.*

From these fundamental laws of electrodynamics and Galilean invariance, the so-called "relativistic" fields of a charged particle moving at high velocity have been derived by Barnes[2] and Lucas and Lucas.[14] The derivation takes into account the finite size of the particle, the magnetic field induced by the current of the moving particle, and how this induced magnetic field changes an elastic shape of a charged particle. Furthermore, the so-called "relativistic" change in mass and decay half-life with velocity are correctly predicted by the same finite-size effect.

FARADAY'S LAW OF MAGNETIC INDUCTION
LOSS OF FIELD TRANSFORMATION INFORMATION

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* We believe the *law of conservation of mass and energy* is fundamentally imbedded in these laws of electricity and magnetism and that Gauss's law and other laws are statements and consequences of the inverse square law imbedded in the fundamental laws.

Faraday's law states that the electromotive force $\mathcal{E}$ around the circuit is proportional to the time rate of change of magnetic flux ϕ linking the circuit:

$$\mathcal{E} = -k\frac{d\phi}{dt} \tag{1}$$

Before the development of special relativity, it was understood, although not explicitly stated, by all physicists that physical laws should be invariant under Galilean transformations. That is, physical phenomena are the same when viewed by two observers moving with a constant velocity v relative to one another, provided the coordinates in space and time are related by the Galilean transformation, *i.e.,* $x' = x + vt,$ and $t' = t.$ In particular, consider Faraday's observations. He experimentally verified that the same current is induced in a probe circuit for either of the following conditions when the same relative motion is maintained: (1) The probe circuit remains fixed while another circuit with current is moved, or (2) the probe circuit is moved while another circuit with current stays stationary.

Let us now consider Faraday's law for a moving circuit and see the consequences of Galilean invariance. Expressing Faraday's law in terms of integrals over electric field **E'** and magnetic field **B**, we have

$$\oint \mathbf{E}'(r')\,dl = -k\frac{d}{dt}\int_S B(r)\,\mathbf{n}\cdot d\mathbf{a} \tag{2}$$

The induced electromotive force is proportional to the total time derivative of the flux. The flux can be changed by changing the magnetic induction or by changing the shape or orientation or position of the circuit. Equation (2) gives a relation between the fields themselves. Jackson[15] cautions that

> It is important to note that **E'** is the electric field at *dl* in the coordinate system in which *dl* is at rest, since it is that field which causes current to flow if a circuit is actually present.

Our treatment and labeling of the fields in the relativistic manner is in complete agreement with the work of Faraday and Jackson's interpretation of Faraday's work. By actually performing the Galilean transformation, we obtain the Galilean invariant form for the electric and magnetic fields of a moving particle. Jackson does not perform the Galilean transformation to get the **E** and **B** fields in the same frame of reference. As a result, he obtains one of Maxwell's differential equations that is invalid for high velocity. A second theory (special relativity) is needed in order to obtain agreement with experiments at high velocity. But, by a better approach that evaluates the fields properly in the same frame of reference, one predicts the high velocity experimental results without any recourse to special relativity theory.

The way that Jackson and other physicists obtain the differential equation for Faraday's law to get one of Maxwell's equations is technically and logically incorrect. Thus Maxwell's equations are not correctly representing the Galilean invariant information in the fundamental laws of electrodynamics. We now proceed to obtain Maxwell's equation for Faraday's law in order to see where and how the field transformation information is discarded and where a point-particle approximation is made.

Faraday's law (2) can be placed into differential form by the use of Stokes' theorem provided the circuit is held fixed in the observer's reference frame so that **E'** and **B** are defined in the same frame. (Note how the field transformation information is excluded by this approximation! Even Jackson was aware of this and tried to find another way to do it.) The transformation of the line integral for the electric field into a surface integral leads to

$$\int_S \left(\nabla \times \mathbf{E} + \frac{1}{c}\frac{\partial \mathbf{B}}{\partial t} \right) \cdot \mathbf{n}\, da = 0 \qquad (3)$$

This integral is normally assumed to vanish at all points in space in order to obtain the differential equation

$$\nabla \times \mathbf{E} + \frac{1}{c}\frac{\partial \mathbf{B}}{\partial t} = 0 \qquad (4)$$

It does vanish for any arbitrary surface if we have only point-particle sources. However, for finite-size elementary particles, the surface must account for the induced fields and feedback effects. Induction fields exist in the space surrounding the particle, but the approximation omits the effects from induction that become most important at high velocities. Thus, equation (4) excludes all induced fields and finite-size effects.

We have shown that Maxwell's equations are not equivalent to the equations for the fundamental laws of electrodynamics, because the induced field effects relevant to real particles with finite size and structure are ignored when the laws are cast into differential equation form. Discarding finite size and the effects of structure leads to the point-particle approximation in electrodynamics. This causes Maxwell's equations to fail for high-speed phenomena where internal charge rearrangement and induced field effects are largest.

The results we have derived[2,14] are mathematically identical to those predicted by relativity theory, but the origin of the effect is entirely physical. Quantum relativity theory has never claimed to be physical in this regard and employs a number of non-physical assumptions, such as the point-particle assumption and a finite rest-mass that violate the Mach's logical criterion for a scientific theory.

SPINNING CHARGED RING MODEL OF ELEMENTARY PARTICLES

The new physical model for elementary particles is based on a classical electrodynamic rotating charge ring presented by Bergman and Wesley.[16] The structure of the ring is stable for those particular radii for which the Coulomb repulsive electrical force is balanced by the magnetic pinch effect resulting from the magnetic field induced by the current in the ring moving at the speed of light. In terms of this model, Bergman showed[17] that the experimentally observed size, mass, spin, magnetic moment, and gyromagnetic ratio of all the stable charged elementary particles, *i.e.* the electron, positron, proton, and antiproton, are correctly predicted.[*] Even Planck's constant *h* can be derived in terms of the structure of the ring.

Parson was the first to introduce a ring of rotating charge,[18] and in 1919, Allen was showing that the magnetic moment and finite size of the ring electron accounted for many characteristics of matter observed in atoms and molecules.[19] Nevertheless, the Parson model of the electron was not widely accepted. Advocates of this first electron ring model erroneously thought the ring model predicted particle spins equal to Planck's constant instead of the one-

[*] Several correspondents have challenged this statement about only four stable elementary particles by pointing to the Standard Model of Elementary Particles, or the theory and high energy collisions that reveal quarks, or the gyromagnetic ratio of a muon. But quarks, muons, and hundreds of other so-called "particles"—created by the collisions of electrons, protons and their antiparticles—are very short-lived, leaving short tracks with a duration of only a fraction of a second. Short tracks are evidence of short lifetime and absence of stability.

half unit that came to be accepted about that time. Other characteristics of the Parson ring model were not rigorously derived from theory, and the attention of physicists turned from Parson's model to the point-electron postulated in the new Quantum Theory and its point-particle assumption.

In spite of its defects, the vast majority of physicists expanded Quantum Theory and adopted Einstein's two theories of relativity, making these the dominant theories of modern science. The greatest success for Quantum Theory was a continual increase of precision in measurement and theory to predict the gyromagnetic ratio whose *g*-factor $g = 2(1 + \alpha/2\pi + ...)$ represents the ratio of an electron's magnetic moment and its spin. So, when Shuichi Iida, a physicist at the University of Tokyo reintroduced a better, revised ring model in 1974,[20] he was careful to show that the ring predicted the correct value of *g*-factor. The abstract of his paper titled "**A Persistent Electric Current Model of the Electron with a New Explanation for *g* = $2(1 + \alpha/2\pi)$**" reported that a ring of finite size could account for the spin phenomenon while a point-like particle cannot:

> A tiny persistent ring current with the electromagnetic energy of mc^2 can describe most of the non-wave properties of the electron accurately. Self-consistent equations yield the radius of the ring, $R_o = 2(1 + \alpha/2\pi)\ (\hbar/mc)$ and the *g*-factor of the model, $g = 2(1 + \alpha/2\pi)$. This semi-classical model has a definite advantage over the point charge model, because it includes the spin phenomenon intrinsically with no divergence problem in its leading term.

Just five years later in 1979, physicist R. C. Jennison described some of the fundamental issues with photons and agreed with Planck that "radiation itself was simple waves of the Maxwell-Hertz type."[21] Jennison then proceeded to show the analogies of the electron to a phase-locked cavity, and even demonstrated that the mass and (anomalous) spin properties of the electron have their origin in electromagnetic fields of two spinning standing-waves that electrically are in phase quadrature. Since Maxwell had shown that two such standing-waves correspond to a constant voltage at the surface of a spinning charged ring, it is surprising that Jennison didn't present his model as a ring (a physical object that most people can more easily comprehend); instead, he described his new model for the electron as a "phase-locked cavity," even though the two models are equivalent.

PROPERTIES OF THE CHARGED RING

Historically, spheres of electrostatic charge were first suggested as models of the electron. Spheres were unsuccessful because a rotating sphere large enough to account for the electron's magnetic moment is much too large to account for the electron's energy and rest-mass. The physical shape of a ring gives it one more degree of freedom than a sphere has. A thin ring of radius 3.86×10^{-13} m and charged with one unit of electrostatic charge is able to account for the properties of the electron. Bergman showed that the same ring model accounts for the properties of the proton where the size is smaller by the ratio of proton to electron mass, 1,836.[17]

The three ring models for the electron (by Iida, Jennison, and Bergman & Wesley)[20,21,16] are all classical electrodynamic models with essentially the same features. All are fundamentally derived from electrical field theory without any assumption of a material mass; *no rotating matter is involved.* Each of three independent approaches that modeled the electron predicted its numerous characteristics, including the electron's inertial mass, anomalous spin, and gyromagnetic ratio.

Table I. Physical and electrical characteristics of the free electron.[22]

Charge, e	-1.6×10^{-19}	Coulombs
Mass, m	9.10963×10^{-31}	kilograms
Magnetic Moment, μ	-9.28483×10^{-24}	J/T
Radius, R	3.86607×10^{-13}	meters
Half-thickness, r	7.42214×10^{-200}	meters
Shape, ln R/r	429.931	-
Rim velocity, v	c	meters/sec
Rotation, ω	7.75445×10^{20}	radians/sec
Current, I	–19.77357	Ampere
Capacitance, C	3.12812×10^{-25}	Farad
Inductance, L	2.0891×10^{-16}	Henry
Magnetic flux, ϕ	-4.13089×10^{-15}	Weber
Electrostatic energy	4.10312×10^{-14}	Joule
Magnetostatic energy	4.08412×10^{-14}	Joule
Spin, p	$\hbar/2$	Joule-sec

Table I shows the characteristics of the free electron* based upon a spinning charged ring model. The electrical properties of the ring are those of a current loop. The ring dimensions give it inductance and capacitance. Surrounding the ring are electrostatic and magnetostatic fields that form a standing-wave that surrounds the ring, while moving charge of the ring itself circulates at the speed of light.

One of the most fascinating features of the model is that it defines the electron as a ***particle*** with size, shape, boundaries and structure; but is also able to account for the ***wavelike properties*** of electrons as a result of its resonance features. The resonance features may be calculated from the ring's inductance and capacitance. We do not need or accept "particle-wave duality" to describe the electron.

The electron's rest-mass energy is stored in the electrostatic and magnetostatic energies in fields surrounding the ring. Bergman and Wesley[16] showed by potential theory that the energies of the two fields are very nearly equal, but the slightly greater energy in the electrostatic field leads to the anomaly of the gyromagnetic ratio.

It was a great surprise when physicists learned that the electron spin was only one-half unit of Planck's constant. The equal division of energy between electrostatic and magnetostatic energies accounts for the reduced spin factor of 1/2 since only magnetostatic energy is associated with motion of the angular momentum:

$$p = mvR = \hbar / 2 \qquad (5)$$

where the electron mass from motion of the charge is only one-half of the total mass.

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* For an electron bound in an atom and subject to electrical fields of other nearby particles, classical electrodynamics predicts forces on the spinning charged ring that change its size and other characteristics. Evans[23] adopts the opposing view of Quantum Theory and writes that "[e]mpirically, it was necessary to assume that each electron possesses an intrinsic angular momentum as though it were a spinning rigid body." Of course, these assumed intrinsic properties of a particle do not change with its environment, so Quantum Theory maintains that the properties of a free electron or proton do not change when it is bound in an atom. Accordingly, Ivars Peterson[24] reports that modern physics is greatly concerned about the origin and anomaly of the proton spin (which seems to high by a factor of 2.79); however, Bergman[17] explained the anomaly by making a distinction between the spin of a free proton and a spin of a bound proton.

Because a rotating ring of charge does not radiate spontaneously, the model meets one of the requirements for stability. The charge at the surface of the spinning toroid has a balance of an outwardly directed Coulomb force and inwardly directed magnetic pinch force (a well-known result of Ampère's law) from the charge velocity equal to the speed of light.

The same spinning charged ring model applied to the electron has been successfully adapted to the remaining charged, stable particles, *i.e.,* the proton, positron, and antiproton.[17]

QUANTUM FEATURES OF THE RING MODEL

Quantum theories assume point-like elementary particles and give no physical explanation of the processes occurring inside the particle during absorption of radiation. But the physical and electrical properties of the spinning charged ring combine to produce the standard quantum features that the electron and proton are known to possess. The quantum features of the ring model are:

- one unit of electrostatic charge e that obeys a conservation of charge law
- one unit of magnetostatic charge ϕ that obeys a conservation of flux law
- Because the electron is a rotating charged system, the quantum atomic constant is the product of electrostatic and magnetostatic charges: $h = e\phi$
- The shape of the ring, *i.e.,* its ratio of radius to cross section thickness radius is conserved and quantized as Planck's constant: $h = e^2 \ln (8R/r)/(2\varepsilon_o c)$
- Angular momentum is quantized as $p = \hbar/2$
- The wavelength of spectra absorbed or radiated by the charged ring is an integer multiple or sub-multiple of the circumference: $\lambda = (m/n)\,C$ where $m = 1,2,3,...$ and $n = 1,2,3,....$
- Energy is quantized as $E = (n/m)\,h\nu$

Any scientific theory than can predict a fundamental constant of physics should be considered more fundamental and superior to competing theories that assume the existence of the constant. The preceding equations show how the fundamental constant of atomic physics, Planck's constant *h,* enters into a theory of elementary particles in multiple ways.

SPECTRA

The spinning charged ring model of elementary particles provides a model with physical mechanisms to explain the interaction of light and matter. In this charged ring theory, the interaction of light and matter is governed by Faraday's law of magnetic induction. Magnetic flux of incoming radiation induces an electromotive force and current in the finite-size ring of electrostatic charge. This classical electrodynamics approach identifies the physical process that explains absorption and radiation by the electron. When light of wavelength λ is incident upon an elementary particle, such as an electron, the light is absorbed if its wavelength is an exact multiple of the circumference of the ring $\lambda = m(C)$ or the circumference of the ring is an exact multiple of the wavelength $C = n(\lambda)$. The charge density of the ring at any time consists of the initial charge density plus the Fourier components representing the wavelengths of the absorbed radiation.

Following a standard approach of atomic theory and using the ring particle absorption model, the energy levels of one-electron atoms have been derived. The usual quantum energy levels for the principal quantum number $n = 1,2,3,...$ are predicted. However, additional energy levels for $n = 1/2,\ 1/3,\ 1/4,...$ are also predicted which quantum models do not predict. Joseph

Lucas observed these modes and combinations of integers *m/n* in a mechanically vibrating ring.[25]

The extreme ultraviolet spectra data for hydrogen was first measured by Labov and Bowyer of the University of California at Berkeley.[26] The data confirmed the existence of all twelve of the newly predicted energy levels of hydrogen in the measured spectral range of 60-850 Å. Mills reports experiments for the existence of the $n = 1/2$ state of hydrogen and has been successful in producing energy by stimulating hydrogen into this lower energy state.[27]

BLACKBODY RADIATION

Using this ring particle absorption mechanism, we provide classical explanations for blackbody radiation and the photoelectric effect. In contrast to our approach, quantum theories employ non-physical assumptions about point-particle harmonic oscillators which deny the laws of electrodynamics and optics on the microscopic scale when explaining these phenomena.

Quantum theories of blackbody radiation are based on the notion that point charges undergoing *simple harmonic motion* in the blackbody are absorbing and emitting radiation. This picture leads to oscillation of point-electron charges that are too big for the electron to remain bound in the atom. The empirical laws of electrodynamics and optics are denied by the point-particle theory on the microscopic scale.

In the new classical ring model, radiation may be continuously absorbed by the ring structure somewhat like an antenna absorbs radio waves. Since the electron is a continuous ring structure, the laws of electrodynamics do not require it to re-radiate the energy absorbed. Panofsky and Phillips have provided a rigorous proof that no radiation of energy occurs when the moving charge in a loop is *continuously* distributed.[28] Jackson also recognizes this characteristic of the spinning ring model. Unlike the *orbiting* ring electrons in the Bohr model of the atom, the spinning ring electron finds a stationary position in the atom.[15, p. 697] Joseph Lucas shows that because the spinning charged ring electron does not lose energy, the stability of an entire atom is possible and predicted by laws of electricity and magnetism.[25]

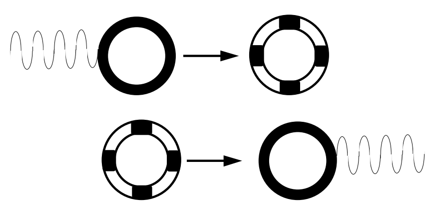

Figure 2. Interaction of light and matter. The electron can absorb radiation by intercepting magnetic flux of arriving light. Faraday's law of magnetic induction governs the exchange of energy between the light and the electron. For an exchange of energy to take place, the wavelength of the light must correspond to a multiple (or sub-multiple) of the electron ring circumference.

When electromagnetic energy or light is absorbed by the ring, there is a disturbance of the flow of charge around the ring, resulting in oscillations of the electric charge distribution flowing around the ring at the speed of light. These oscillations reflect the wavelength of the light being absorbed. The flow of charge around the ring may be thought of as the superposition of the original continuous flow plus the oscillations of charge resulting from the absorption of various light waves (Figure 2). A ring particle in a state of high energy oscillations at a high temperature will emit radiation until its excess energy is dissipated as the ring cools and retains only its rest-mass energy at a temperature of absolute zero.

The original state of the ring, *i.e.* the continuous flow of charge around the ring, is known as a stationary state. The surrounding electrostatic and magnetostatic fields form a standing-wave, and no change can be detected over time. Additional stationary states of the ring structure exist when the angular variation of the charge produced by absorption of radiation has a wavelength which is exactly an integral number of circumferences of the ring, *i.e.,* $\lambda = m(C)$ where m = 1,2,3,... ***or*** the circumference of the ring is exactly an integral number of wavelengths $C = n(\lambda)$ where n = 1,2,3,.... The ring may retain the radiation energy in a stationary state indefinitely. The laws of electrodynamics do not require it to emit any radiation. However, if the ring has a collision, or significant interaction with another moving ring, the laws of electrodynamics now require the excited ring to radiate. We make the reasonable postulate that radiation from ring structures may only occur from one stationary state to another where the energy E_{mn} of the stationary states is

$$E_{mn} = \frac{nh\nu}{m} \tag{6}$$

and $\lambda\nu = c$, n = 1,2,3... and m = 1,2,3....

This classical model has many more stationary states than Planck's quantum model, but it leads to a mathematically equivalent blackbody radiation spectrum described by equation (7).

$$\rho_T(\nu) = \frac{8\pi\nu^2}{c^3}\frac{h\nu}{e^{(h\nu/kt)} - 1} \tag{7}$$

The derivation of equation (7) from the additional stationary states is provided in the Appendix.

This electrodynamic and physical model for blackbody radiation is logically superior in that:

1. It does not violate any law of electrodynamics.
2. It does not use an unrealistic point-particle model for the electron.
3. It does not require an amplitude of electron oscillations that is too large for the electron to remain in the atom.
4. The physical model allows one to calculate the value of Planck's constant *h.*
5. Simple harmonic motion of point charges is not the physical mechanism involved in blackbody radiation.

PHOTOELECTRIC EFFECT

The classical approach to the photoelectric effect was too simple because it treated the electron as a point-particle. In our model of a finite-sized ring, when a free electron is captured by an ionized atom, it gives off light as it approaches the ion and changes from one stationary state (or standing-wave charge configuration) to the next.

In order to free the electron from the ion, it is necessary for the electron to absorb at least as much electromagnetic energy as it radiated off earlier. Although the electromagnetic energy was radiated away from the electron in a series of long wavelength electromagnetic waves, it cannot be freed by absorbing a series of low energy long wavelength electromagnetic waves, because of the short lifetime and quick decay of these excited stationary states back to the minimum energy bound state. Thus, for all practical purposes, all the energy to unbind the electron must be absorbed in a single, one wavelength cycle. This is why there is a minimum value of the wave energy being absorbed to free the electron. The absorption cannot be a multi-step process.

In the physical ring model, absorption of radiation produces changes in the current density in the ring such that it has Fourier components synchronous with the absorbed electromagnetic wave. For the same reason, a ring electron can only emit radiation of such wavelengths as it has synchronous Fourier components in its current distribution. In order for this to occur in the observed time frames, the electric and magnetic fields of the ring electron must interact with individual electromagnetic wave quanta.

ATOMS

In the new physical model of the atom developed by Joseph Lucas,[25] the electrons do not orbit the nucleus. Rather they come to a stable equilibrium some distance from it. For this approach it is possible to predict the way that electrons pack themselves in layers or shells about the nucleus from geometry. Figure 3 illustrates the atomic structure for the neon (Ne_{20}) atom. Surrounding the nucleus is a closed shell of two electrons in the first shell. The principal line of magnetic flux that links the two electrons is shown. The next shell is filled with two groups of four electrons each. In each group of four electrons, magnetic flux lines link the group like a set of four bar magnets in a circle. For the second shell of eight electrons, the electrons lie on two great circles.

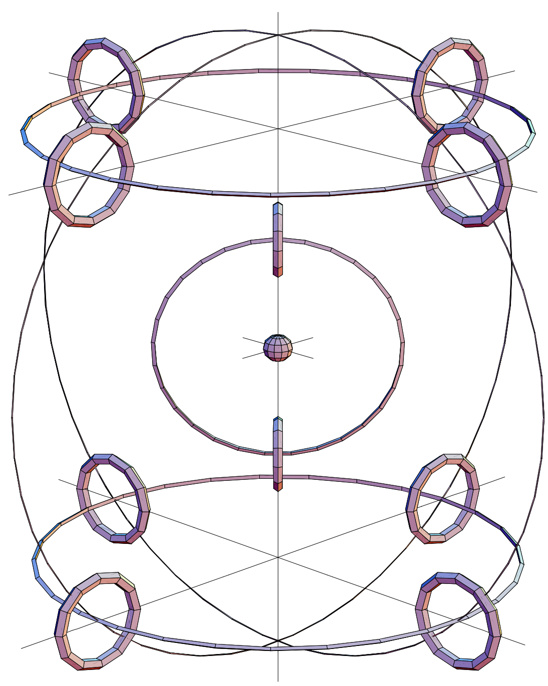

Figure 3. Lucas model of the atom—illustrated by Ne_{20}—shows details of the first filled shell with two electrons and the second filled shell with eight electrons. The spherical symmetry of position for the electrons achieves a minimum magnetic moment in the atom. For the positions shown, the electrostatic and magnetic forces on each ring are in balance and achieve a minimum of potential energy.

The hydrogen gas molecule (H_2) consisting of two electrons and two protons is shown in Figure 4. The smaller rings are protons which are not shown to scale because they are 658 times smaller than the electrons of molecular hydrogen. A computer simulation of this configuration included both Coulomb and Ampere forces (computed from Weber electrodynamics) and showed that each elementary particle was located at a minimum energy potential.

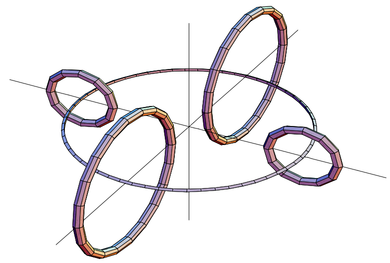

Figure 4. Diatomic hydrogen is the simplest form of stable matter found in nature. The molecule has no neutrons but consists of two large electrons and two smaller protons. Each spinning ring particle has a dipole field, somewhat like a bar magnet with a North and South pole. The strong magnetic force of a North pole attracts an adjacent South pole—so that the four rings lock to each other magnetically.

Two features of the ring model are especially important for the atomic shell structure: (1) the physical size of each electron and (2) the magnetic dipole of each electron. From observation and general symmetry principles, each shell of the atom must be constructed in such a way that the total magnetic moment in each shell sums to zero and the cancellation of the magnetic moments is perfectly spherical.

The forces on some small ring magnets were measured by Joseph Lucas,[25] son of Charles Lucas, to discover magnetic constraints in geometrical packing. Simple experiments showed the basic arrangements of magnet dipoles that are tightly bound. An apparatus illustrated in Figure 5 was used to measure the binding force of some configurations. A group of four ring magnets was found to have the greatest binding strength; a group of 10 or more ring magnets is no more strongly bound than a poorly bound group of an odd number of magnets.

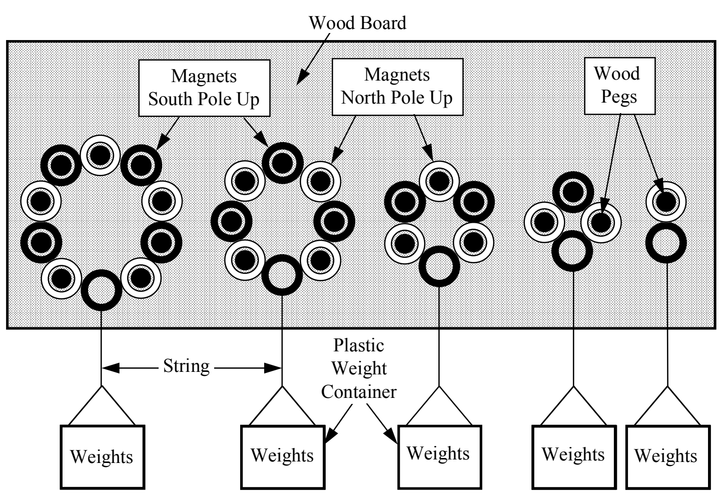

Figure 5. Experimental apparatus used by Joseph Lucas to perform fundamental experiments of forces on magnetized rings.[25]

Spherical symmetry and the constraint to minimize the total magnetic moment in each shell leads to the configurations of ring electrons in atomic shells shown in Table II. After the first shell, which pairs with the nucleus, each atomic shell is matched with another atomic shell until a total of seven shells completes the possible atomic structure.

Table II. Configuration of ring electrons in atomic shells. The “magic numbers” of the *Periodic Table of Elements* are 2, 8, 18, and 32—the number that can fit symmetrically in each shell. There are only seven rows because a group of ten electrons is too weakly bound to form a stable shell.

Shell Number	Size	Electrons/shell
1	1 great circle of 2 electrons	2
2	2 great circle of 4 electrons	8
3	2 great circle of 4 electrons	8
4	3 great circle of 6 electrons	18
5	3 great circle of 6 electrons	18
6	4 great circle of 8 electrons	32
7	4 great circle of 8 electrons	32

Figure 6 shows a periodic table of the elements with this same number of periods and electrons in filled shells. From combinatorial geometry, the complete structure of the *Periodic Table of the Elements* was predicted using new fundamental ring dipole magnet data plus spherical symmetry.

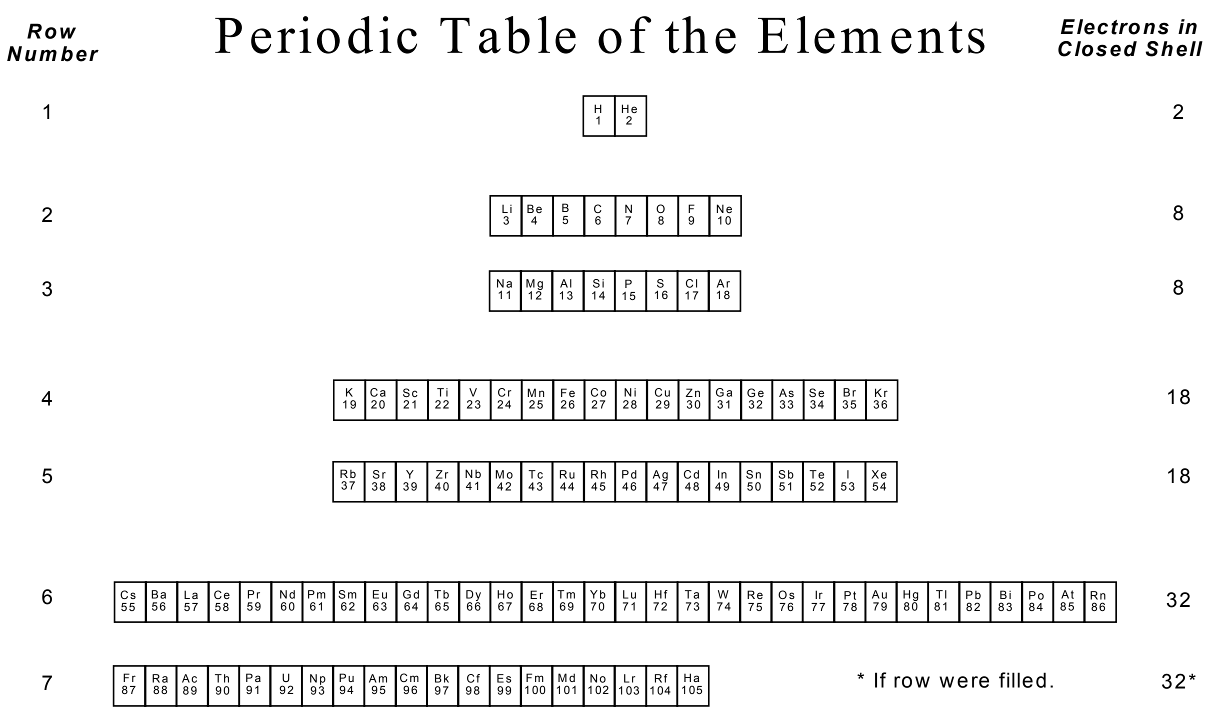

Figure 6. The *Periodic Table of the Element* has been arranged to show the seven periods that correspond to the seven shells of atomic structure. By arranging the table in this manner, the number of electrons that can fit in a shell may be counted and is seen to correspond with the “magic numbers” for closed electron shells.

This approach identified the physical origin of “magic numbers” for filled shells and predicts only seven periods in the periodic table. In contrast, the Dirac quantum theory gives no explanation for the origin of the “magic numbers” and places no limit on the number of periods.

NUCLEAR STRUCTURE

The same principles used to determine atomic structure enabled Joseph Lucas to determine the arrangement of elementary particles in the nucleus.[25] From combinatorial geometry the known nuclear spins and structure of nuclear shells have been correctly predicted.

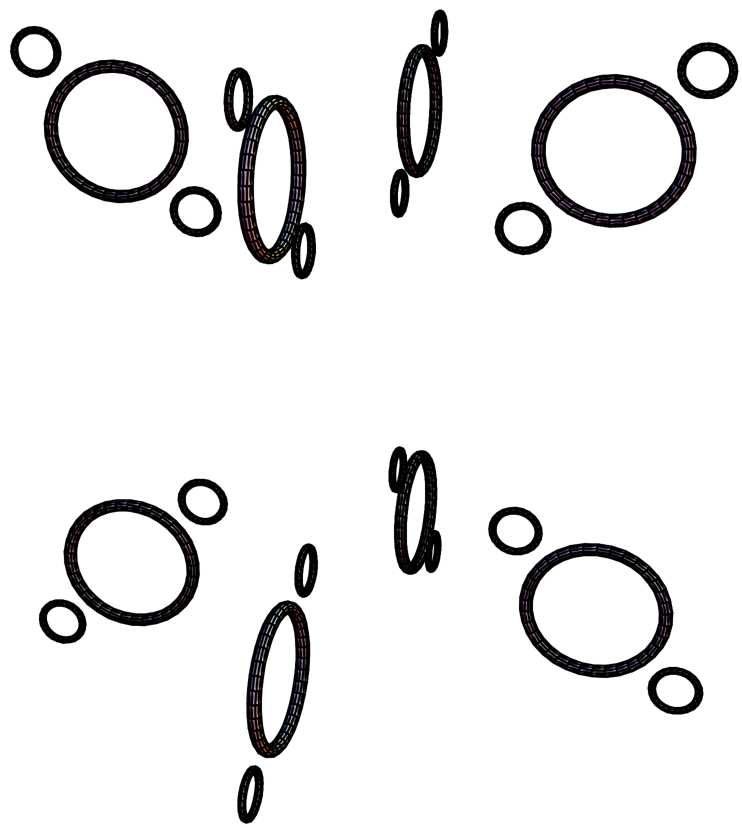

Figure 7. Approximate arrangement of the oxygen nucleus consisting of eight electrons and 16 protons arranged as triplets in a shell. Due to electrostatic and magnetic forces at the surfaces of the electrons, they are much smaller in size than free electrons and are able to fit in the nucleus.

The nucleus is composed of protons and neutrons; however, according to our model, the neutron is not a legitimate elementary particle but a bound combination of one electron and one proton. Outside the nucleus, a neutron will disintegrate into one electron and one proton. Figure 7 illustrates the structural arrangement of the Oxygen (O_{16}) nucleus. Notice a triplet structure of two protons on either side of an electron. This triplet arrangement repeats in larger nuclei such as Pb_{208} shown in Figure 8.

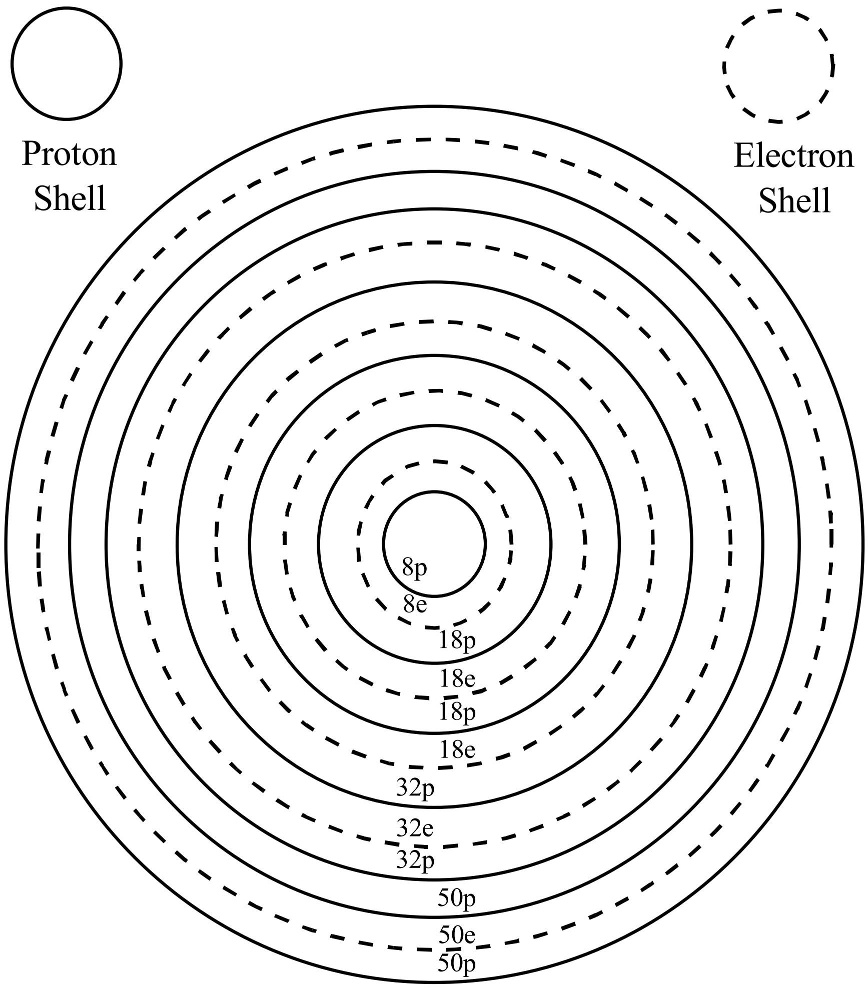

Figure 8. Schematic diagram of the nuclear structure of Pb_{208} shows how electrons and protons form in shells.

The quantum nuclear shell model is incompatible with the liquid-drop nuclear model, because it is a central potential type theory. But in the physical geometrical packing model, there is a physical basis for the nuclear liquid-drop model to describe fission processes. Note in Figure 8

> that in the innermost part of the nucleus, electron and proton shells alternate as one proceeds from the center of the nucleus outward. This alternating sandwich effects keeps them tightly bound together. However, at three shells from the outermost shell, there are always two proton shells in a row for the larger nuclides. This causes the last three alternating sandwich of bound shells to be repulsed by the inner nucleus. Thus, they are only weakly bound to the inner nucleus. This weak binding allows the outermost triplet of shells to have liquid-like properties and forms the proper justification for a liquid-drop model of the nucleus.—Joseph Lucas[25]

CONCLUSIONS AND IMPLICATIONS

The new physical model for elementary particles, the atom, and the nucleus presented here describes a universe completely electrodynamic in nature and governed by the laws of cause and effect. The so-called nuclear "strong" and "weak" forces that describe the forces between finite-size nucleons are replaced by proven laws of Coulomb and Ampere. The new model represents a return to science based on causality as opposed to non-physical mathematical models wed to random statistical processes in nature. The new physical model achieves a fundamental goal of physics to provide a theory of matter that explains the structure of real objects.

APPENDIX
DERIVATION OF EQUATION FOR BLACKBODY RADIATION

Consider the derivation of the blackbody radiation spectral energy distribution $\rho_T(\lambda)$ as a function of temperature T and wavelength λ. The assumption is made that the radiation from the ring electron only occurs from one stationary state to another. (Planck's quantum theory makes the same assumption but has no physical basis for defining the stationary state.)

The first step is the evaluation of the average energy contained in each standing-wave of wavelength λ or frequency $\nu = c/\lambda$. According to classical physics, the particular energy of a wave can have any value from zero to infinity. The actual value is proportional to the square of its average amplitude, *i.e.,*

$$\varepsilon = \frac{\overline{E^2}}{4\pi} \qquad (8)$$

However, if we have a system containing a large number of identical ring electrons which are in thermal equilibrium with each other at a temperature T, the classical theory of statistical mechanics requires that the energies of the standing-waves are distributed according to a definite probability distribution which is a function of T.

From the law of equipartition of energy, the average kinetic energy ε of the standing-wave in the rings is

$$\overline{\varepsilon_{KE}} = \frac{kT}{2} \qquad (9)$$

where $k = 1.38 \times 10^{-16}$ erg/deg is Boltzmann's constant. For an electromagnetic wave where only the amplitude of the wave executes simple harmonic oscillations, the total average energy is just twice the average kinetic energy, *i.e.,*

$$\bar{\varepsilon} = kT \qquad (10)$$

The Boltzmann probability of finding the wave in an energy state between ε and $\varepsilon + d\varepsilon$ for a system containing a large number of ring electrons with waves is

$$p(\varepsilon) = A \exp\left(-\varepsilon / kT\right) \qquad (11)$$

The average energy of a wave is given by

$$\bar{\varepsilon} = \frac{\int_0^\infty \varepsilon\,\rho(\varepsilon)d\varepsilon}{\int_0^\infty \rho(\varepsilon)d\varepsilon} \tag{12}$$

Now under the assumption that radiation can only occur from the transition of one stationary state to another in the electron rings, one must recalculate ε by replacing all integrals over ε by summations, *i.e.,*

$$\bar{\varepsilon} = \frac{\sum_{n=0}^{\infty}\sum_{m=1}^{\infty} \varepsilon_{nm}\,\rho(\varepsilon_{nm})}{\sum_{n=0}^{\infty}\sum_{m=1}^{\infty} \rho(\varepsilon_{nm})} \tag{13a}$$

$$\bar{\varepsilon} = \frac{\sum_{n=0}^{\infty}\sum_{m=1}^{\infty} \varepsilon_{nm}\exp(-\varepsilon_{nm}/kT)}{\sum_{n=0}^{\infty}\sum_{m=1}^{\infty} \exp(-\varepsilon_{nm}/kT)} \tag{13b}$$

where $\varepsilon_{nm} = (n/m)\,h\nu$. Substituting $(n/m)\,h\nu$ for ε_{nm} in eq. (13) gives

$$\bar{\varepsilon} = \frac{\sum_{n=0}^{\infty}\sum_{m=1}^{\infty} \frac{n}{m}h\nu\exp(-\frac{n}{m}(h\nu/kT))}{\sum_{n=0}^{\infty}\sum_{m=1}^{\infty} \exp(-\frac{n}{m}(h\nu/kT))} \tag{14}$$

Using the expansion

$$\sum_{n=0}^{\infty}\exp(-n\alpha h\nu/m) = 1 + x + x^2 + x^3 + \ldots \tag{15}$$

where $\alpha = 1/kT$, $x = \exp(-\alpha h\nu/m)$ and the binomial expansion

$$\frac{1}{1-x} = 1 + x + x^2 + x^3 + \ldots \tag{16}$$

the average energy of a wave becomes

$$\bar{\varepsilon} = \frac{-\sum_{m=1}^{\infty} \frac{d}{d\alpha}\left(\sum_{n=0}^{\infty} e^{\frac{-m}{n}\alpha h\nu} \right)}{\sum_{m=1}^{\infty} \sum_{n=0}^{\infty} e^{\frac{-m}{n}\alpha h\nu}} = \frac{-\sum_{m=1}^{\infty} \frac{d}{d\alpha}\left(\frac{1}{1-e^{-\alpha h\nu/m}} \right)}{\sum_{m=1}^{\infty}\left(\frac{1}{1-e^{-\alpha h\nu/m}} \right)}$$

$$= \frac{-\sum_{m=1}^{\infty}\left[\left(\frac{-h\nu}{m} \right) \frac{\left(e^{\frac{-\alpha h\nu}{m}} \right)}{\left(1-e^{-\frac{\alpha h\nu}{m}} \right)^2} \right]}{\sum_{m=1}^{\infty}\left(\frac{1}{1-e^{-\alpha h\nu/m}} \right)}$$

$$= \frac{\left[\frac{h\nu e^{-\alpha h\nu}}{\left(1-e^{-\alpha h\nu}\right)^2} \right] \left[\sum_{m=1}^{\infty} \frac{1}{m} e^{(1-1/m)\alpha h\nu \frac{\left(1-e^{-\alpha h\nu}\right)^2}{\left(1-e^{-\alpha h\nu/m}\right)^2}} \right]}{\frac{1}{1-e^{-\alpha h\nu}} \left(\sum_{m=1}^{\infty} \frac{1-e^{-\alpha h\nu}}{1-e^{-\alpha h\nu/m}} \right)} \tag{17}$$

$$= \left(\frac{h\nu}{e^{\alpha h\nu}-1} \right) \frac{\sum_{m=1}^{\infty} \frac{1}{m} e^{(1-1/m)\alpha h\nu \frac{\left(1-e^{-\alpha h\nu}\right)^2}{\left(1-e^{-\alpha h\nu/m}\right)^2}}}{\left(\sum_{m=1}^{\infty} \frac{1-e^{-\alpha h\nu}}{1-e^{-\alpha h\nu/m}} \right)}$$

$$= \frac{h\nu}{e^{\alpha h\nu}-1}$$

By numerical evaluation with 50 significant figures using *Mathematica*, a general software system for mathematical applications developed by Wolfram,[29] the ratio of these non-convergent series was found to converge to 1 (for $T = 1646°K$ and $\nu \gg 1$).

Now the spectral energy density $\rho_T(\nu)$ for a specific temperature T as a function of frequency ν is

$$\rho_T(\nu)d\nu = \frac{\bar{\varepsilon}\,N(\nu)\,d\nu}{V_{\text{ring}}} \tag{18}$$

where $V_{\text{ring}} = (2\pi R)(\pi r^2)$ is the volume of the ring and $N(\nu)\,d\nu$ is the number of allowed frequencies in the frequency interval ν to $\nu + d\nu$. Following Eisberg,[30] $\nu + d\nu$ is independent of the shape of the ring and depends only on its volume V,

$$N(\nu)d\nu = \frac{(2\pi R)(\pi r^2)\,8\pi\nu^2 d\nu}{c^3} \tag{19}$$

This gives the result that

$$\rho_T(\nu)d\nu = \frac{8\pi}{c^3}\frac{h\nu^3}{\exp(hc/\lambda kT)-1}\,d\nu \tag{20}$$

Transforming to the variable λ where $\nu = c/\lambda$, $d\nu = -c/\lambda^2$ and $\rho_T(\lambda)\,d\lambda = -\rho_T(\nu)\,d\nu$, we obtain

$$\rho_T(\lambda) = \frac{8\pi hc}{\lambda^5}\frac{1}{\exp(hc/\lambda kT)-1} \tag{21}$$

This spectral distribution, equation (21), is mathematically the same as the blackbody spectral distribution derived by Planck in his quantum theory. Planck discovered empirically the formula that describes blackbody radiation. He then developed a quantum theory from which he could derive the empirical spectral distribution. What Planck did not realize was that there were other sets of stationary states that included his set (but were more complete) and also give rise to the same blackbody radiation spectral distribution. Furthermore, Planck's quantum theory has a number of outstanding problems, as follows:

- It does not identify exactly what charged particles or structures are executing simple harmonic motion. (If point-like electrons were undergoing simple harmonic motion, the amplitude would have to be greater than the measured size of the atoms, and the electrons could not stay bound to the atom. If atoms or molecules were undergoing simple harmonic motion, there should be a difference in the radiation spectrum from one blackbody to another due to the differences in their constituent atoms and molecules. Only if electrons are involved would one expect the properties of blackbody radiation to be independent of the blackbody material as observed.)
- The fundamental laws of electrodynamics, *i.e.,* Faraday's Law and Ampere's Law, are violated for simple harmonic motion of electric charges requiring continuous emission and absorption of radiation, because there are no stationary states of a simple harmonic oscillator.
- Planck's theory of blackbody radiation is not compatible with optical reflection, refraction, and diffraction phenomena due to its emission of radiation that is discontinuous in time.

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