

# A Physical Model for Atoms and Nuclei—Part 3

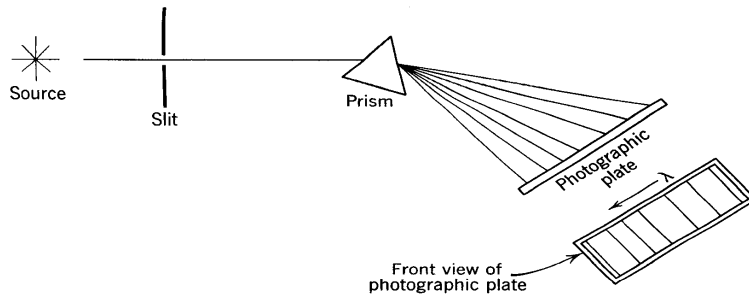
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**Abstract.** A physical Geometrical Packing Model for the structure of the atom is developed based on the physical toroidal Ring Model of elementary particles proposed by Bergman [1]. From the physical characteristics of real electrons from experiments by Compton [2,3,4] this work derives, using combinatorial geometry, the number of electrons that will pack into the various physical shells about the nucleus in agreement with the observed structure of the Periodic Table of the Elements. The constraints used in the combinatorial geometry derivation are based upon simple but fundamental ring dipole magnet experiments and spherical symmetry. From a magnetic basis the model explains the physical origin of the valence electrons for chemical binding and the reason why the Periodic Table has only seven periods. The Toroidal Model is extended in this article to describe the emission spectra of hydrogen and other atoms. Use is made of some of the authors' standing wave experiments in large toroidal springs. The resulting model accurately predicts the same emission spectral lines as the Quantum Model including the fine structure and hyperfine structure. Moreover it goes beyond the Dirac Quantum Model of the atom to predict 64 new lines or transitions in the extreme ultraviolet emission spectra of hydrogen that have been confirmed by the Extreme Ultraviolet Physics Laboratory at Berkeley from its NASA rocket experiment data [5].

***Extension of New Model of the Atom.*** The Geometrical Packing Model presented for the atom and nucleus in parts 1 [6,7] and 2 [7,8] based on the Toroidal Particle Model were very successful in describing some atomic and nuclear data. The physical approach (based on experiment) taken in these papers is more fundamental and straightforward than the mathematical methods (based on unproven postulates) used by Quantum Mechanics. The new model does not incorporate any of the objectionable assumptions and postulates of Quantum Mechanics and replaces those features of the Quantum Models that are known to be inconsistent or in violation of proven laws. Unlike the Quantum Models, the Geometrical Packing Model for ring particles is not simply mathematical, but it is a *physical model with boundaries, sizes and detailed structure that can be verified experimentally*. Thus it satisfies one of the major goals of *physics* which is to *physically* describe the matter of the *physical* universe.

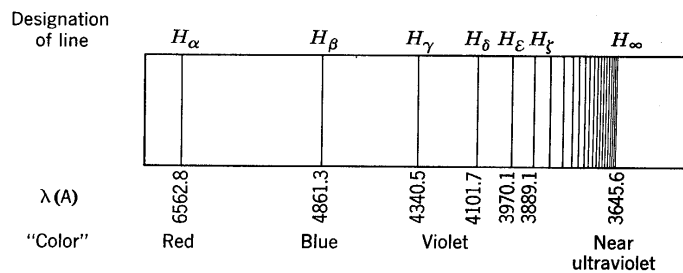
Although the framework of a new theory of matter has been presented, the basic approach needs to be extended to give successful descriptions of blackbody radiation, the photoelectric effect, and the energy levels of the atom giving rise to absorption and emission spectra before it can more fully qualify to displace the Quantum Models. (Please note that this work was initially completed in Joseph's 1994-1995 science fair project "A New Classical Basis for Quantum Physics" which was awarded a Grand Prize, sponsored by NASA, at the 1995 International Science and Engineering Fair in Hamilton, Ontario, Canada.) The purpose of this third article in the series is to extend the application of the Ring Model to the emission spectra of atoms.

**History of Modern Atomic Data and Theory.** When experimenters of the past examined the emitted spectra from hot solids and gases, they discovered that solids emit a continuous spectrum of electromagnetic radiation while monoatomic gases emit radiation concentrated at a number of discrete wavelengths. Each of these wavelength components is called a *line*, because the spectroscopes used to record the spectra on film employed slits with a prism to separate the wavelengths of light or different colored images of the slit (see Figure 1). These spectroscopes were only able to measure those wavelengths near the range of visible light.



**Figure 1**  
Apparatus for Atomic Spectroscopy  
[9, pp. 110-113]

Experimenters observed patterns in the spectroscopic lines of monoatomic gases like hydrogen (see Figure 2). In these patterns or series of lines the spacing between adjacent lines of the spectrum continuously decreased with decreasing wavelength of the lines until it converged at some limit. A number of these series were found for hydrogen gas. About 1890 Rydberg [9, pp. 110-113] found an empirical formula, called the Rydberg Formula, that described these series of wavelengths as shown in Table 1.



**Figure 2**  
Balmer Line Series for Hydrogen  
[9, pp. 110-113]

In 1913, Bohr developed his Quantum Model, called the Bohr Model, to describe the atom and predict the atomic line series described so well by Rydberg's empirical formula. Bohr's model was based on the following postulates [9, p. 114]:

- 1. 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.**
- 2. But, instead of the infinity 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  $L$  is an integral multiple of Planck's constant  $h$  divided by  $2\pi$ , i.e.  $L = nh/2\pi$ .**

3. Despite the fact that it is constantly accelerating, an electron moving in such an allowed orbit does not radiate electromagnetic energy. Thus its total energy remains constant.
4. Electromagnetic energy is emitted if an electron, initially moving in an orbit of total energy  $E_i$ , discontinuously changes its motion so that it moves in an orbit of total energy  $E_f$ . The frequency of the emitted radiation  $\nu$  is equal to the quantity  $(E_i - E_f)$  divided by Planck's constant  $h$ , i.e.  $\nu = (E_i - E_f)/h$ .

**Table 1. Hydrogen Spectral Line Series**

<b>Name</b>	<b>Wavelength Range (<math>\lambda</math>)</b>	<b>Rydberg Formula</b>
Lyman	Ultraviolet	$k = 1/\lambda = R_H [1/(1)^2 - 1/(n)^2]$ $n = 2, 3, 4, \dots$
Balmer	Visible	$k = 1/\lambda = R_H [1/(2)^2 - 1/(n)^2]$ $n = 3, 4, 5, \dots$
Paschen	Infrared	$k = 1/\lambda = R_H [1/(3)^2 - 1/(n)^2]$ $n = 4, 5, 6, \dots$
Brackett	Infrared	$k = 1/\lambda = R_H [1/(4)^2 - 1/(n)^2]$ $n = 5, 6, 7, \dots$
Pfund	Infrared	$k = 1/\lambda = R_H [1/(5)^2 - 1/(n)^2]$ $n = 6, 7, 8, \dots$

where  $R_H = 109677.576 \pm .012 \text{ cm}^{-1}$  is the Rydberg constant.

*Bohr's postulates were very radical. They assumed that some electromagnetic laws, such as Coulomb's force law held on the microscopic scale, but not Ampere's law or Faraday's law. Thus the laws of physics were assumed to be different on the microscopic scale than on the macroscopic scale. Also, Bohr neglected the finite size of the electron.*

The justification for Bohr's postulates was that they led to a model that produced a mathematical equation that predicted the atomic emission line spectra of one-electron atoms. Logically, however, this type of justification is incomplete. One must also justify each of the assumptions or postulates individually. This was never done.

The success of the Bohr theory was very striking, but the Bohr postulates were somewhat mysterious. Also there was the question of the relation between Bohr's quantization of the angular momentum of an electron moving in a circular orbit and Planck's quantization of the total energy of an entity, such as an electron, executing simple harmonic motion since both incorporated Planck's constant  $h$ .

In 1916 Wilson and Sommerfeld [9, pp. 128-131] postulated a set of rules for the quantization of any physical system for which the coordinates are periodic functions of time as follows:

**For any physical system in which the coordinates are periodic functions of time, there exists a quantum condition of each coordinate. These quantum conditions are where  $q$  is one of the coordinates,  $p_q$  is the momentum**

associated with that coordinate,  $n_q$  is the quantum number which takes on integral values, and  $\oint$  means that the integration is taken over one period of the coordinate  $q$ .

$$n_q h = \oint p_q dq \quad (19)$$

The application of the Wilson-Sommerfeld quantization rule to the coordinate  $\theta$  where  $q = \theta$  and  $p_q = L = mr^2 d\theta/dt$  yields

$$n_q h = \oint p_q dq = \oint L d\theta = L \oint d\theta = L \int_0^{2\pi} d\theta = 2\pi L \quad (20)$$

or

$$L = \frac{nh}{2\pi} = n\hbar \quad (21)$$

The application of the Wilson-Sommerfeld quantization rule to a particle of mass  $m$  executing simple harmonic motion with frequency  $\nu$  yields

$$nh = \oint p dx = m x_0^2 \omega \pi = \frac{E}{\nu} \quad \text{i.e. } E = nh\nu \quad (22)$$

Sommerfeld used the Wilson-Sommerfeld quantization rules to evaluate the size and shape of the allowed elliptical orbits as well as the total energy of the electron moving in such an orbit. Describing the motion in terms of the polar coordinates  $r$  and  $\theta$ , he obtained the quantum conditions

$$\int L d\theta = n_\theta h \Rightarrow L = n_\theta h/2\pi \quad n_\theta = 1, 2, 3, \dots \quad (23)$$

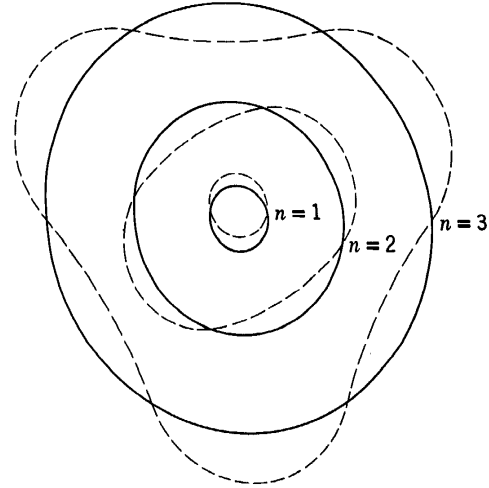
$$\int p_r dr = n_r h \Rightarrow L(a/b - 1) = n_r h/2\pi \quad n_r = 1, 2, 3, \dots$$

By requiring a condition for mechanical stability, *i.e.* the centripetal force is equal to the electrical Coulomb force, a third equation is obtained. Solving them simultaneously he obtained

$$a = \frac{n^2 (h/2\pi)^2}{\mu Z e^2} \quad n = n_\theta + n_r = 1, 2, 3, \dots \quad (24)$$

$$b = a \frac{n_\theta}{n} \quad n_\theta = 1, 2, 3, \dots \quad E = -\frac{\mu Z^2 e^4}{2n^2 h^2} \quad n_r = 0, 1, 2, 3, \dots$$

where  $n$  is called the principal quantum number, and  $n_0$  is called the azimuthal quantum number. The second equation above gives the shape of the orbit, *i.e.* the ratio of the semi-major to the semi-minor axes  $b/a$ . It is determined by the ratio of  $n_0$  to  $n$ . For  $n_0 = n$  the orbits are circles of radius  $a$ . Figure 3 shows to scale the possible orbits corresponding to the first three values of the principal quantum number. Note that for each value of the principal quantum number  $n$ , there are  $n$  different allowed orbits. One of these, the circular orbit, is the orbit described by the original Bohr theory. The others are elliptical.



**Figure 3**  
Standing Wave of Bohr Orbits

The third equation above indicates that all of the different possible orbits for a given  $n$  have the same total energy of the electron. The several orbits characterized by a common value of  $n$  are said to be “degenerate.” Sommerfeld removed this degeneracy by treating the problem using relativistic mechanics. In this approach the size of the relativistic correction depends on the average velocity of the electron which, in turn, depends on the ellipticity of the orbit. Sommerfeld’s derivation showed that the total energy of an electron in an orbit characterized by the quantum numbers  $n$  and  $n_0$  is given by

$$E = -\frac{\mu Z^2 e^4}{2n^2 (h/2\pi)^2} \left[ 1 + \frac{\alpha^2 Z^2}{n} \left( \frac{1}{n_0} - \frac{3}{4n} \right) \right] \quad (25)$$

where  $\alpha = 2\pi e^2/hc \approx 1/137$  is called the *fine structure constant*.

Experimentally, it is observed that transitions only take place between orbitals for which

$$n_{0i} - n_{0f} = \pm 1 \quad (26)$$

This condition for orbital transitions is called a “selection rule.” It states that the change in angular momentum of the electron orbital must be one unit of angular momentum for emission and absorption of electromagnetic radiation. Conservation of angular momentum implies that electromagnetic radiation carries one unit of angular momentum.

This version of quantum theory had a number of notable shortcomings [9, *pp.* 136-137]:

1. **The theory only treats systems which have periodic motion, but there are many systems which are not periodic.**
2. **Although the theory allows one to calculate the energies of the allowed**

**states of a system and the frequency of the quanta emitted or absorbed when the system makes a transition between allowed states, the theory does not reveal how to calculate the rate at which transitions take place.**

- 3. The theory is only really applicable to one-electron atoms. The alkali elements (Li, Na, K, Rb, Cs) can be treated approximately, but only because they are similar to a one-electron atom.**

In 1924 de Broglie [9, pp. 139-141] introduced the idea that particles such as electrons, alpha particles, billiard balls, *etc.* display properties characteristic of waves. De Broglie postulated that the wavelength  $\lambda$  and the frequency  $\nu$  of the waves associated with a particle of momentum  $p$  and total relativistic energy  $E$  are given by the equations

$$\lambda = h/p \quad \nu = E/h \quad (27)$$

The requirement that the waves associated with a particle undergoing any sort of periodic motion be a set of standing waves is equivalent to the requirement that the motion of the particle satisfy the Wilson-Sommerfeld quantization rules. The time independent features of the standing waves associated with an electron in one of its allowed states in an atom was used to explain why the motion described by the standing wave does not cause the electron to emit electromagnetic radiation. **(Note that the fundamental standing wave in the charge density of charge fibers of the toroidal ring is exactly the de Broglie wavelength. The so-called particle-wave duality is only a mystery for point-like particles.)**

The de Broglie postulate says that the motion of a particle is governed by the propagation of its associated waves, but it does not tell the way in which these waves propagate. To handle the case of a particle moving under the influence of forces, we need an equation that tells how the waves propagate under these more general circumstances.

In 1925 Schrödinger [9, pp. 165-170] developed a propagation equation for matter waves, called the Schrödinger equation. It was patterned after the wave equation for strings. He denoted the waves by the mathematical wave function  $\psi(x,t)$ . Instead of using relativistic kinematics,

$$E = P^2/2m_o + V + m_o c^2 \quad \text{where } m = m_o \quad (28)$$

Schrödinger used the classical definition of total energy.

$$E = \frac{P^2}{2m} + V \quad (29)$$

The three requirements that Schrödinger felt his equation must satisfy were:

- 1. It must be consistent with de Broglie's postulate and conservation of energy**
- 2. The equation must be linear in the wave function  $\psi(x,t)$  in order to pre-**

**dict the interference phenomena as observed in the Davisson-Germer experiments**

**3. The potential energy may be a general function of  $x$  and  $t$ .**

On the basis of these assumptions, Schrödinger *postulated* the full non-relativistic wave equation to be

$$-\left(\frac{h}{2\pi}\right)^2 \frac{\partial^2}{\partial x^2} \psi(x,t) + V(x,t)\psi(x,t) = i\hbar \frac{\partial \psi(x,t)}{\partial t} \quad (30)$$

The Schrödinger wave equation contains the imaginary number  $i$ . As a consequence its solutions are complex (real and imaginary) functions of  $x$  and  $t$ , *i.e.* not real functions of  $x$  and  $t$ . Thus the wave function cannot represent the real amplitude of the matter wave that can be physically measured. *The question of what is waving and in what medium can not be answered!!* The original wave equations for strings does not contain imaginary terms, and the real wave function describes the amplitude of the matter wave in the string.

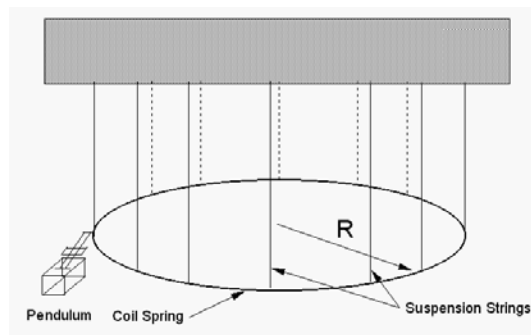
A relationship between the wavefunction  $\psi(x,t)$  and the probability of finding the particle at coordinate  $x$  was suggested by Born [10] in 1926 in the form of the following postulate:

$$P(x,t)dx = \psi^*(x,t)\psi(x,t)dx \quad (31)$$

**“If, at the instant  $t$ , a measurement is made to locate the particle associated with the wave function  $\psi(x,t)$ , then the probability  $P(x,t)dx$  that the particle will be found at a coordinate between  $x$  and  $x+dx$  is such that probability is conserved, *i.e.***

$$\int \psi^*(x,t)\psi(x,t)dx = 1 \quad (32)$$

One problem that the Schrödinger matter wave model has that the Bohr model did not have is that it predicts the existence of  $l = 0$  or S states. Here the electron has no angular momentum about the nucleus and no mechanism due to orbital motion to keep the Coulomb force from pulling the electron into the nucleus. Thus the Schrödinger matter wave model denies the Coulomb force for S-wave electrons, but not for  $l > 0$  electrons. *This is a serious inconsistency in logic.* The relativistic version of the Schrödinger matter wave equation, called the Dirac Matter Wave Equation, also has this problem.

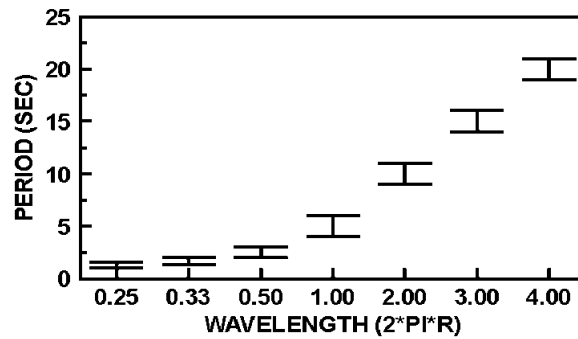


**Figure 4**  
Mechanical Model of a Toroidal Elementary Particle

***New Experiments on Standing Waves in a Ring.***

In order to learn more about standing waves in mechanical rings, a large metal spring 1.5” in diameter and 12” long (Slinky from James Industries, Inc. Beaver Street Extension Hollidaysburg, PA 16648) was obtained with the two ends fastened together to form a ring. The ring was suspended by 100 thin strings 19” long to form a “ring” with a diameter of 48” (see Figure 4). When the ring was perturbed by a metronome pendulum at various frequencies to form standing waves, the very low-energy standing waves had  $\lambda = n(2\pi R)$  and the high-energy standing waves had  $\lambda = (2\pi R)/n$  where  $R = 48$ ” and  $n = 1, 2, 3, \dots$  and  $\lambda$  is the wavelength of the standing wave (see Figure 5).

**STANDING WAVES  
WAVELENGTH VS PERIOD**



**Figure 5.** Experimental Standing Waves in Toroidal Spring

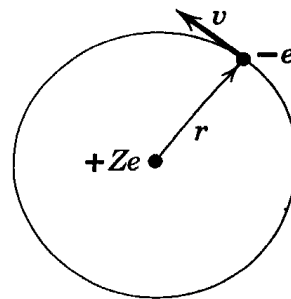
***New Classical Derivation of One Electron Atomic Energy Levels.*** The requirements that the new classical approach to the energy levels of the atom must satisfy are as follows:

1. **Must be based on the proven laws of physics instead of arbitrary postulates.**
2. **Must maintain the fundamental laws of physics to be the same on all size scales.**
3. **Must conserve energy and momentum.**
4. **Must be consistent with de Broglie’s postulate.**
5. **Must have stable equilibrium states in agreement with observation.**
6. **Must be consistent with the Wilson-Sommerfeld quantization rules for standing waves or stationary states.**
7. **Must give rise to a real wave equation describing the current density in the electron ring.**

For a one-electron atom the equilibrium configuration is shown in Figure 6.

Assuming that the mass  $m$  of the electron ring is associated with the charge of the ring, the condition for the mechanical stability of the electron ring is from Newton’s laws and electrodynamics

$$\frac{Ze^2}{R^2} = \frac{mv^2}{R} \tag{33}$$



**Figure 6**  
One-Electron ring



where  $v$  is the velocity of the charge in the ring,  $R$  is the radius of the ring, and  $e$  is the total charge of the ring.

Now the requirement that the waves associated with a particle undergoing any sort of periodic motion be a set of standing waves is equivalent to the requirement that the motion of the particle satisfy the Wilson-Sommerfeld quantization rules. The angular momentum in the plane of the ring for a free electron is given by Bergman [1,11]

$$L = m_e v R = m c R = \frac{e^2}{8\pi^2 e_o c} \log_e \left( \frac{8R}{r} \right) = \frac{\hbar}{2} \quad (34)$$

where  $2\pi R = \lambda_o$  and  $m_e = m_m = m/2$ .

For the atom there are standing waves with two or more wavelengths around the circumference of the ring. In this case

$$2\pi R = n\lambda_o \quad n = 1, 2, 3, \dots \quad (35)$$

Also it is possible to have standing waves where the standing wave has a wavelength equal to multiple times the circumference of the ring. In this case

$$2\pi R = n\lambda_o \quad n = 1, 1/2, 1/3, \dots \quad (36)$$

Thus the most general case is

$$2\pi R = n\lambda_o \quad \text{where } n = \dots 1/3, 1/2, 1, 2, 3, \dots \quad L = n\hbar \quad (37)$$

Equation (33) may be written

$$Ze^2 = mRv^2 = L^2/mR = n^2 \frac{(\hbar/2)^2}{mR} \quad (38)$$

So

$$R = \frac{n^2 (\hbar/2)^2}{mZe^2} \quad n = \dots 1/3, 1/2, 1, 2, 3, \dots \quad (39)$$

Now consider the total energy of an atomic electron. If we define the potential energy to be zero when the electron is infinitely distant from the nucleus, then the potential energy  $V$  at any finite distance  $r$  can be obtained by integrating the energy imparted to the electron by the Coulomb force acting from infinity to  $R$ , *i.e.*

$$V = \int_{\infty}^R \frac{Ze^2}{r^2} dr = -\frac{Ze^2}{R} \quad (40)$$

The potential energy is negative, because the Coulomb force is attractive.

The kinetic energy  $T$  of the electron can be evaluated from equation (33) to be

$$T = \frac{mv^2}{2} = \frac{Ze^2}{2R} \quad (41)$$

The total energy  $E$  of the electron is then

$$E = T + V = \frac{-Ze^2}{R} + \frac{Ze^2}{2R} = \frac{-Ze^2}{2R} = -T \quad (42)$$

From equation (39)

$$E = \frac{-mZ^2e^4}{2\hbar^2} \left( \frac{1}{n^2} \right) \quad (43)$$

From  $\lambda\nu = c$  and  $E = h\nu = hc/\lambda$ .

$$k \equiv \frac{1}{\lambda} = \frac{E}{hc} = R_H Z^2 \frac{1}{n^2} \quad (44)$$

$$R_H = \frac{m_e^4}{4\pi c \hbar^3} = 109681 \text{ cm}^{-1}$$

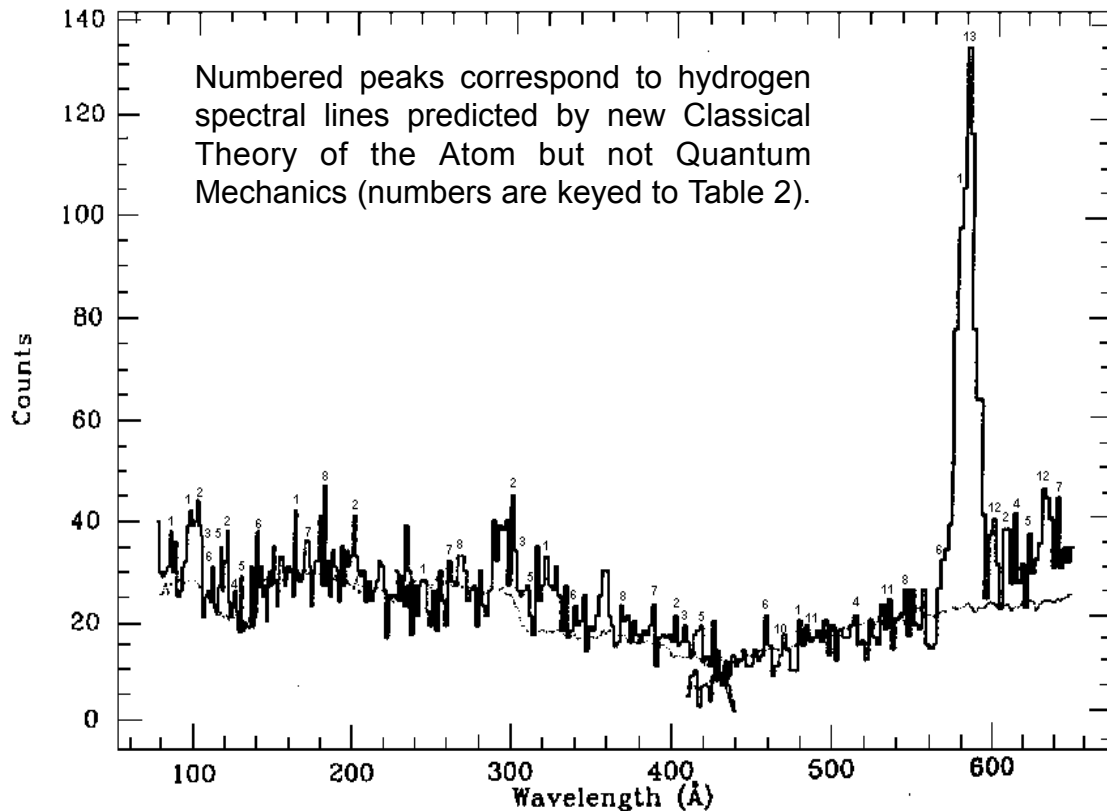
Note that the condition for standing waves in the ring leads to a quantization of the total energy of the electron bound to a nucleus of charge  $Ze$ .

## EXPERIMENTAL CONFIRMATION OF NEW MODEL OF ATOM

When Rydberg analyzed the hydrogen emission spectrum to obtain his empirical formula in 1890, the line spectrum data was only available from the near ultraviolet, the visible and the infrared spectrum. This situation continued through the time that Bohr (1913) developed his model of the atom and Schrödinger (1925) and Dirac (1925) developed their wave equations.

Then in 1991 Labov and Bowyer [5] at the University of California at Berkeley devised a way to measure the extreme ultraviolet spectrum from 80-650 Angstrom ( $\text{\AA}$ ). 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  $\text{\AA}$ . Presumably this part of the universe consists primarily of hydrogen and helium gas. The spectrum obtained is shown in Figure 7. There are a large number of spectral lines or peaks.

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. The new classical model of the atom predicts 64 spectral lines and peaks for hydrogen in this range as shown in Table 2 (at the end of this paper). All of the transition lines of Table 2 are found in the spectral data of



**Figure 7 [5]**  
Extreme Ultraviolet Spectrum for Helium and Hydrogen

Labov and Bowyer[5]. Furthermore the predicted transitional data accounts for most of the principal peaks of the observed spectrum as shown in Figure 7.

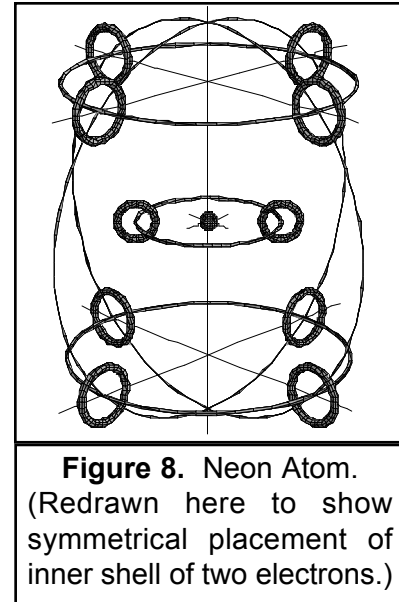
**Multi-Electron Atoms.** The procedures above only apply to one-electron atoms, especially hydrogen. In order to treat atoms with more than one electron, it is useful to review the results of Ampere's experiments for the forces between current loops [12].

- 1. The effect of a current is reversed when the direction of the current is reversed.**
- 2. The effect of a current flowing in a circuit twisted into small sinuosities is the same as if the circuit were smoothed out.**
- 3. The force exerted by a closed circuit on an element of another circuit is at right angles to the latter.**
- 4. The force between two elements of circuits is unaffected when all linear dimensions are increased proportionately and the current strengths remain unaltered.**

The important point to note is that the forces between plain wire loops and wire loops with small sinuosities is the same. Figure 8 shows the neon atom consisting of two complete

electron shells with the magnetic flux loops for each shell drawn and the great circles on which they reside. According to Ampere's experimental law each magnetic flux loop may be replaced by a circular wire. The three resulting parallel circular loops may be replaced by one circular loop with the nucleus at the center. The effective radius may be different from that of the free electron. Thus for closed shell atoms, the atom acts effectively as if it had a single electron ring about the nucleus, just like the Bohr model for a one-electron atom like hydrogen.

For the rest of the atoms the situation is not as neat. If the last outermost electron shell has a number of electrons divisible by four, the symmetry may reduce to an equivalent ring as above.



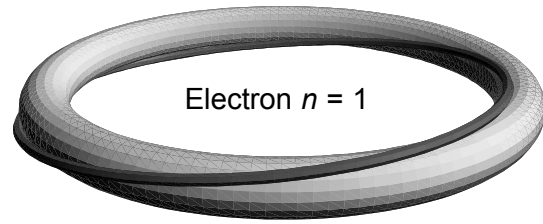
For atoms with an odd number of electrons other than 1 and all other cases, the symmetry may not reduce to a single loop. Some sort of computer modeling program may be needed in order to get precise values for the energy levels and absorption and emission spectra. (Note that the Quantum Models have problems with these atoms also.)

**Fine Structure and Hyperfine Structure in Atomic Spectra.** In the past classical models of the atom, nucleus and elementary particles were unable to describe certain phenomena such as the atomic spectra fine structure due to electron spin-orbit coupling (quantum interpretation) and the atomic spectra hyperfine structure due to nuclear-spin electron-spin coupling, because there was no classical quantity known as the spin of the electron or nucleon. In particular the electron was usually modeled as a sphere with a magnetic moment due to the rotation of charge but no additional quantity called spin. This situation has been rectified by the refinement of the Bergman's[1] Toroidal Model and the Bostick's[13,14] Charge Fiber Model of the electron and other elementary particles by Lucas[15] into a full fledged Classical Electrodynamics Model of Elementary Particles.

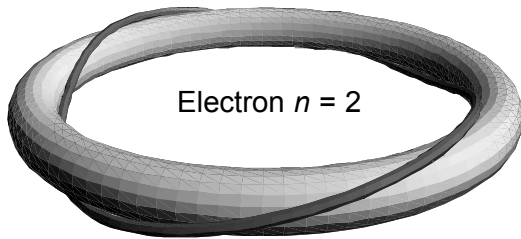
According to the Lucas Model all elementary particles are composed of multiple intertwined primary charge fibers. These primary charge fibers may be complex and consist of multiple intertwined secondary charge fibers. The secondary charge fibers may also be complex and consist of multiple tertiary charge fibers.

In this model the electron is the simplest of all elementary particles. It consists of three simple intertwined primary charge fibers in a toroidal shape. The figures 9, 10, 11,12, 13 below [16] show the  $n = 1$  fundamental or ground state of the electron, the  $n = 2$  first excited state or harmonic of the fundamental, the  $n = 3$  second excited state or harmonic of the fundamental. Also shown are the  $n = 1/2$  and  $n = 1/3$  sub-harmonics of the fundamental. These latter states are characteristic of continuous rods or springs not discontinuous particles. No parallel exists for these latter  $n = 1/2, 1/3, etc.$  states in the quantum orbits of the point electron about the nucleus of the atom.

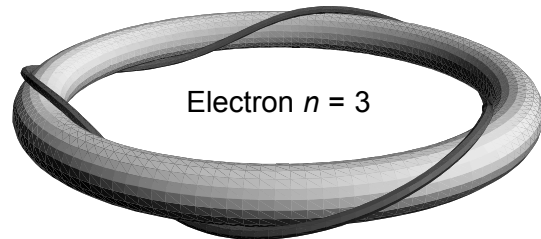
The rotation of the three charge fibers about the thickness of the toroidal ring produces the spin  $s$  of the electron. The number of the harmonic in the ring gives the orbital quantum number  $l$ . The total angular momentum quantum number  $j = l + s$  is merely the total angular momentum of the charge fibers in the electron. The fine structure is due to the “spin-orbit” coupling or the interaction of the spin angular momentum about the cross section of the toroid with the angular momentum about the circumference of the toroid. The hyperfine structure is due to the interaction of the sum of the toroidal neutron and proton spins in the nucleus with the spin of the toroidal electron.



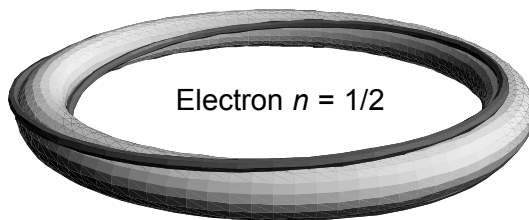
**Figure 9**  
Electron Fundamental or Ground State



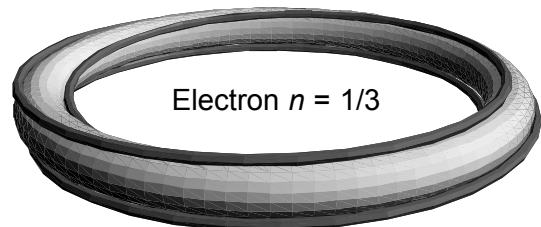
**Figure 10**  
Electron 1st Harmonic or Excited State



**Figure 11**  
Electron 2nd Harmonic or Excited State



**Figure 12**  
Electron 1st Subharmonic



**Figure 13**  
Electron 2nd Subharmonic

The absorption and emission of light by the atomic electrons is explained by a combination of macroscopic string theory and macroscopic antenna theory. A stretched string in a musical instrument is caused to change its vibration mode from the fundamental to the first harmonic by plucking it or hitting it at the appropriate place to transfer additional energy to the vibration. For the vibrating string this additional energy added to the string is dissipated as heat and the string returns to the fundamental vibration. From macroscopic radio antenna theory the wavelength of the radiation emitted is a function of the physical length of the antenna. In this manner one gets radiation as harmonics of the fundamental length of the antenna and as sub-harmonics of the fundamental length. Thus this

Charge Fiber Model for Elementary Particles and the electron in particular gives a physical explanation of absorption and emission on finite size electrons in an atom that is superior to the non-physical explanation of Quantum Mechanics that has no analogy in the macroscopic world.

**Summary.** A new foundation for modern science based upon classical electrodynamics that has been expanded to allow particles to have finite size in the shape of a ring of charge composed of charge fibers is presented. This version of electrodynamics satisfies the rules of logic that undergird the scientific method. It is able to describe the emission spectra of atoms in a logically superior way compared to the politically correct relativistic Quantum Electrodynamics Theory as developed by Planck, Einstein, and Dirac. It is logically superior for the following reasons:

- 1. A simpler approach—only electrodynamics, no Quantum or Relativity theory needed**
- 2. Describes more data—especially the extreme ultraviolet emission spectrum of hydrogen**
- 3. No obviously false assumptions or postulates like the point-particle assumption**
- 4. Uses fewer postulates**
- 5. Allows the laws of mechanics to hold on all size scales as always expected**
- 6. Allows the laws of electrodynamics to hold on all size scales as always expected**
- 7. Describes the physical mechanism for absorption and emission of electromagnetic energy in terms of the harmonic and sub-harmonics of the fundamental vibration/rotation of charge fibers analogous to the way that macroscopic antennas work**
- 8. Eliminates the random chance statistical basis of Quantum Mechanics in favor of a logical cause-and-effect basis**
- 9. Allows absolute reference frames for all physical phenomena**
- 10. Describes the emission and absorption spectra of multi-electron atoms**

This approach, based on logic, leads to an electrodynamic description of the physical universe based upon the logical *laws of cause and effect*. It is compatible with the Biblical view of the universe created and sustained by God via electromagnetic means[17].

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16. These diagrams of the electron were initially drawn by Clayton Harrison, 2728 East Franklin Avenue, Minneapolis, Minnesota 55406, with email clayton@oophda.com, and then redrawn by David L. Bergman, Common Sense Science, P.O. Box 767306, Roswell, Georgia 30076, in terms of a single fiber. Future work will relate multiple split fibers to the unstable "elementary particles."
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**TABLE 2 [5]**

**PREDICTED SPECTRAL LINES IN THE RANGE 80-650 Å**

PEAK #	RING MODEL TRANSITION	ORDER	PREDICTED WAVELENGTH $\lambda$ (Å)	OBSERVED WAVELENGTH $\lambda$ (Å)
1	$k = 1/\lambda = R_H[1/(1/6)^2 - 1/(1/5)^2] - 1/\lambda_C$	1st	82.9	85 ± 5
		Compton He		
		Scattered	96.5	96 ± 5
		2nd	165.8	165 ± 5
		3rd	248.7	246 ± 5
		4th	331.6	332 ± 5
		5th	414.4	415 ± 5
2	$k = 1/\lambda = R_H[1/(1/5)^2 - 1/(1/4)^2] - 1/\lambda_C$	1st	101.3	101 ± 5
		Compton He		
		Scattered	122.5	122 ± 5
		2nd	202.6	202 ± 5
		3rd	303.9	303 ± 5
		4th	405.2	405 ± 5
		5th	506.5	506 ± 5
3	$k = 1/\lambda = R_H[1/(1/3)^2 - 1/(1/2)^2] - 1/\lambda_C$	1st	102.0	103 ± 5
		Compton He		
		Scattered	123.6	124 ± 5
		2nd	204.0	204 ± 5
		3rd	305.9	303 ± 5
		4th	407.9	408 ± 5
		5th	509.9	510 ± 5
4	$k = 1/\lambda = R_H[1/(1/3)^2 - 1/(1/2)^2] - 1/\lambda_C$	1st	102.6	103 ± 5
		Compton He		
		Scattered	124.4	125 ± 5
		2nd	205.1	205 ± 5
		3rd	307.7	308 ± 5
		4th	410.2	410 ± 5
		5th	512.8	513 ± 5
5	$k = 1/\lambda = R_H[1/(1/3)^2 - 1/(1/2)^2] - 1/\lambda_C$	1st	104.2	103 ± 5
		Compton He		
		Scattered	126.8	129 ± 5
		2nd	208.4	209 ± 5
		3rd	312.6	311 ± 5
		4th	416.8	417 ± 5
		5th	521.0	521 ± 5
		6th	625.2	625 ± 5



6	$k = 1/\lambda = R_H[1/(1/3)^2 - 1/(1)^2]$ $-1/\lambda_C$	1st	114.0	112 ± 5
		Compton He		
		Scattered	141.6	140 ± 5
		2nd	227.9	228 ± 5
		3rd	341.9	342 ± 5
		4th	455.9	458 ± 5
7	$k = 1/\lambda = R_H[1/(1/4)^2 - 1/(1/3)^2]$ $-1/\lambda_C$	5th	569.9	570 ± 5
		1st	130.3	129 ± 5
		Compton He		
		Scattered	167.7	168 ± 5
		2nd	260.5	260 ± 5
		3rd	390.8	390 ± 5
8	$k = 1/\lambda = R_H[1/(1/3)^2 - 1/(1/2)^2]$ $-1/\lambda_C$	4th	521.0	520 ± 5
		5th	651.3	645 ± 8
		1st	182.4	183 ± 5
		Compton He		
9	$k = 1/\lambda = R_H[1/(1/2)^2 - 1/(4)^2]$ $-1/\lambda_C$	Scattered	265.1	265 ± 5
		2nd	364.7	367 ± 5
		3rd	547.1	547 ± 5
10	$k = 1/\lambda = R_H[1/(1/2)^2 - 1/(3)^2]$ $-1/\lambda_C$	1st	232.0	233 ± 5
		Compton He		
		Scattered	384.7	385 ± 5
11	$k = 1/\lambda = R_H[1/(1/2)^2 - 1/(2)^2]$ $-1/\lambda_C$	2nd	464.0	465 ± 5
		1st	234.4	233 ± 5
12	$k = 1/\lambda = R_H[1/(1/2)^2 - 1/(1)^2]$ $-1/\lambda_C$	Compton He		
		Scattered	391.3	390 ± 5
		2nd	468.8	470 ± 5
13	$k = 1/\lambda = R_H[1/(1/2)^2 - 1/(1)^2]$ $-1/\lambda_C$	1st	243.1	243 ± 5
		Compton He		
		Scattered	416.2	415 ± 5
14	$k = 1/\lambda = R_H[1/(1/2)^2 - 1/(1)^2]$ $-1/\lambda_C$	2nd	486.3	486 ± 5
		1st	303.9	303 ± 5
15	$k = 1/\lambda = R_H[1/(1/2)^2 - 1/(1)^2]$ $-1/\lambda_C$	Compton He		
		Scattered	633.8	634 ± 5
		2nd	607.8	603 ± 5
16	$k = 1/\lambda_C = \text{Helium Resonance Scattered}$		584.6	584 ± 5