

# *The Stable Atomic Electron Orbits and Quantum Mechanics*

*by*

*Roger Ellman*

## Abstract

The physics of the behavior of atomic orbital electrons is analyzed and it is shown that their stable orbits are those for which the orbital path length is an integer multiple of the orbital electron's matter wavelength because otherwise the Coulomb attraction of the positive nucleus for the negative electron would vary in magnitude from orbital pass to orbital pass.

That fact is in contrast with the 20<sup>th</sup> Century physics contention that the stable orbit is determined by the quantization of the orbital angular momentum, a contention for which there is no cause nor mechanism.

The quantized angular momentum contention of 20th Century physics is arbitrary and was justified only because it produced a correct result even if without having an underlying rational foundation. Unfortunately, however, it led to emphasis on quantization in other situations and to the full blown theory of Quantum Mechanics, which overall still lacks the rational foundation of the causes and mechanisms of contended theory.

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## 1 - The Fundamental Nature of Particles

The fundamentals of particle physics is fully developed in *The Origin and Its Meaning*<sup>1</sup> and is summarized in depth in *Inertial Mass, Its Mechanics – What It Is; How It Operates*.<sup>11</sup> The following develop the concepts.

### Electric Field

- Nothing can travel faster than the speed of light,  $c$ . Given two static electric charges separated and with the usual Coulomb force between them, if one of the charges is moved the change can produce no effect on the other charge until a time equal to the distance between them divided by  $c$  has elapsed.
- For that time delay to happen there must be something flowing from the one charge to the other at speed  $c$  and the electric charge must be the source of that flow.
- The Coulomb Effect is radially outward from the charge, therefore every charge must be propagating such a flow radially outward in all directions from itself, which flow must be the "electric field".

### Unification of Fields

- Except for the kind of field, all of the preceding applies in the same way and with the same conclusions for magnetic field and gravitational field as for electric field.
- Therefore, either a particle that exhibits all three such fields, as for example a proton or an electron, is a source of three separate and distinct such flows, one for each field, or there is only a single flow which produces all three effects: electric, magnetic, and gravitational.
- The only reasonable conclusion is that there is only a single "flow" which produces all three effects and that electric, magnetic, and gravitational field are different effects of the same sole flow from the source particles.

### The Beginning

- Before the universe began there was no universe, there was only nothing. Immediately afterward there was a "flow" of an original primal substance, hereinafter called *medium*, propagated outward. How can one get from the former to the latter while: (1) not involving an infinite rate of change, and (2) maintaining conservation ?
- The only form that can accommodate the change from nothing to something in a smooth transition without an infinite rate of change is the oscillatory form of equation (1a).<sup>3</sup>

$$(1a) \quad U_c \cdot [1 - \text{Cos}(2\pi \cdot f \cdot t)]$$

- The only way that such an oscillation can have come into existence without violating conservation is for there simultaneously to have come into existence a second oscillation, the negative of equation (1a) as in equation (1b).

$$(1b) \quad -U_c \cdot [1 - \text{Cos}(2\pi \cdot f \cdot t)]$$

- That is, the two simultaneous oscillations must have been such as to yield a net of nothing, the prior starting point, when taken together.
- That initial pair was so unstable that it immediately exploded into a multitude of particles, the Big Bang.<sup>4</sup>

### That Which is Flowing

- Contemporary particles are Big Bang successors of the original oscillations with which the universe began. Therefore the outward flow of the original oscillations is a property of contemporary particles. Then, that which is flowing is the same original primal "medium", the substance of the original oscillations at the beginning of the universe.
- Since it is flowing outward from the myriad particles of the universe simultaneously and that flow is interacting with myriad others of those particles without untoward interference, the "medium" must be extremely intangible for all of that to take place, any one particle's flow flowing largely freely through that of other particles, as intangible as – well – "field".<sup>2</sup>

### The Oscillatory Medium Flow<sup>5</sup>

- The initial medium supply of the universe, oscillating per equations (1), came into existence at the Big Bang. Therefore the initial medium supply of each particle, each being a direct "descendant" of the original oscillation at the universe's beginning, must be oscillatory in form per equations (1). Therefore the radially outward flow from each particle is likewise an oscillatory medium flow of the form of equations (1).
- The flow is radially outward from the particle, therefore, the oscillation of the medium supply of each particle is a spherical oscillation. The particle can also be termed a *center-of-oscillation*, which term will also be used here.
- The amplitude,  $U_o$ , of the [1 - Cosine] form oscillation is the amplitude of the flow emitted from the source particle, which flow corresponds to its electric field. Thus the oscillation amplitude must be the charge magnitude of the source particle – the fundamental electric charge,  $q$ , in the case of the fundamental particles, the electron and the proton.
- Then, the conservation-maintaining distinction of amplitude  $+U_o$  versus amplitude  $-U_o$  must be the positive / negative charge distinction.
- The frequency,  $f$ , of the [1 - Cosine] form oscillation must then correspond to the energy and mass of the source particle, that is the energy of the oscillation is

$$(2) \quad E = h \cdot f$$

and the mass is

$$(3) \quad m = h \cdot f / c^2$$

from which the frequency is

$$(4) \quad f = m \cdot c^2 / h$$

- Particle motion affects its pattern of medium propagation in the forward and rearward directions because the flow must be at the speed of light regardless of the motion of the propagation's source.<sup>6</sup>

### The Fundamental Atomic Particles<sup>5,8,10</sup>

The most fundamental atomic particles, protons and electrons, are centers-of-oscillation, oscillating spherically in a pure, simple, single frequency per equation (4) and of [1 - Cosine] form and propagating that waveform spherically outward.

The neutron is a complex particle, a combination of a proton and an electron as evidenced by its natural decay back into those two fundamental particles with a mean lifetime of 881.5

seconds. The combination oscillates as a single center-of-oscillation with a complex waveform that is the sum of the proton and electron waveforms.

The atomic nuclei are complex particles, a combination of a number of protons and electrons [some of the protons conceived as pairing with all of the electrons as nuclear neutrons]. The combination oscillates as a single center-of-oscillation with a complex waveform that is the complex sum of the protons' and electrons' waveforms.

## 2 – Centers-of-Oscillation in Motion

### The Speed of the Flow [The Speed of light]

Every oscillation that we know in nature exhibits, and the very theory of oscillations in the abstract requires, that the oscillation consist of two aspects storing and exchanging the energy of the oscillation back and forth by means of a "flow" between them. (With one aspect varying in oscillatory fashion then when that aspect decreases there must be some "place" for its energy to go, a place in which it is stored until it reappears in that aspect when it increases again. It cannot completely disappear or be lost because the oscillation would die. That "place" is the oscillation's second aspect and it obviously must vary in a manner related to the first aspect's variation, but with its energy storage in opposite phase.)

That condition is true of the oscillations of the centers-of-oscillation and their propagation of oscillating medium. An analog, electrical oscillations have their energy alternately stored in the electrical capacitance and inductance, symbolized as "C" and "L", of the medium in which they exist. Similarly the energy of the centers-of-oscillation and their oscillating propagating medium is alternately stored in the permeability and dielectric of the medium in which they exist, symbolized as  $\mu_0$  and  $\epsilon_0$ .

But where do the  $\mu_0$  and  $\epsilon_0$  come from; how does empty space have those characteristics? It cannot and does not. Before the "flow" of *medium* first appeared [the Big Bang] the empty space was Absolute Nothing, the non-existence of before the origin of the universe. Therefore the only alternative left is that it must be the *medium* itself, the only non-nothing material reality, that is the cause of  $\mu_0$  and  $\epsilon_0$ . Propagating *medium*, then, is like an electrical signal traveling along a transmission line where the electrical signal is the transmission line. Propagating *medium* in effect lays down its own transmission line as it propagates at the speed set by its innate  $\mu_0$  and  $\epsilon_0$ .

$$(5) \quad c = \frac{1}{\sqrt{\mu_0 \cdot \epsilon_0}}$$

### The Resulting Effect of Motion on the Center-of-Oscillation<sup>6,7</sup>

The medium propagated outward in all directions from the center-of-oscillation flows at the speed of light as mandated by the medium's own  $\mu_0$  and  $\epsilon_0$ . But, if the center-of-oscillation is itself traveling at a velocity,  $v$ , then in the forward direction [the direction of  $v$ ] the propagation would flow at  $[c + v]$ , which it cannot. The center is forced to oscillate and propagate at reduced wavelength in the forward direction so that the propagated flow is at  $c$ . In the rearward direction the situation is analogous. There the center's velocity would cause the rearward flow to be at  $[c - v]$  which it cannot. There the center is forced to oscillate and propagate at increased wavelength so that the propagated flow is at  $c$ .

Those two different simultaneous oscillations in the one single center-of-oscillation result in a standing wave. That standing wave, which only occurs in a center-of-oscillation in conjunction with its motion at velocity  $v$  of the particle that the center-of-oscillation is, is the matter wave of the particle, the wave aspect of the particle.

A standing wave is the sum resultant of two waves of different frequency and wavelength in the same space. Because the frequencies and wavelengths of the two are different the resultant

standing wave appears as the form of the higher frequency wave form oscillating in an envelope of the lower frequency wave form as follows.

Let the two waves be at frequencies  $f_1$  and  $f_2$  as

$$(5) \quad \text{Wave \#1} = U_c \cdot \sin(2\pi f_1 t) \quad \text{and} \quad \text{Wave \#2} = U_c \cdot \sin(2\pi f_2 t)$$

where  $U_c$  is the individual wave's amplitude. Then the sum is

$$(6) \quad \text{Wave Sum} = U_c \cdot [\sin(2\pi f_1 t) + \sin(2\pi f_2 t)]$$

which, by using a trigonometric equivalence, can be arranged as

$$(7) \quad \text{Wave Sum} = 2U_c \cdot [\sin(\pi [f_1 + f_2] t) \cdot \cos(\pi [f_1 - f_2] t)].$$

The cosine term is at a lesser frequency than the sine term. If the expression for the wave sum is viewed as the (higher frequency) sine portion with the rest of the expression being the amplitude, as in equation (8)

$$(8) \quad \text{Wave Sum} = 2U_c \cdot \begin{matrix} \text{Cosine} \\ \text{Form Varying} \\ \text{Amplitude} \end{matrix} \cdot \sin(\pi [f_1 + f_2] t)$$

then the resulting wave form is as in Figure 1.

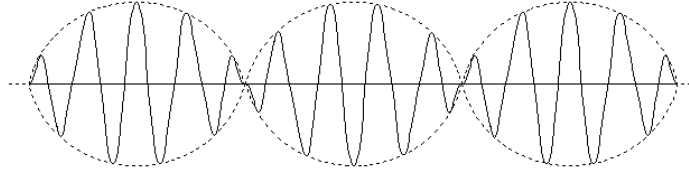


Figure 1 - A Standing Wave

In the case of the propagation of a center-of-oscillation in motion at velocity  $v$  and the interaction of its forward  $[f_f]$  and rearward  $[f_r]$  propagations, the situation is just as above except that the two waveforms involved are of  $(1 - \cosine)$  form. The resultant standing wave is as in equation (9) and depicted in Figure 2.

$$(9) \quad \text{Wave Sum} = 2U_c \cdot \begin{matrix} 1 - \text{Cosine} \\ \text{Form Varying} \\ \text{Amplitude} \end{matrix} \cdot \sin(\pi [f_f + f_r] t)$$

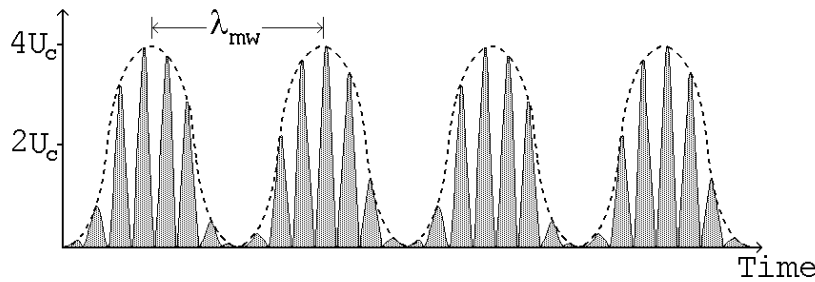


Figure 2

*The Forward-Rearward Pulsation of a Center-of-Oscillation in Motion Which is Its Matter Wave*

Figure 2 depicts the waveform amplitude variation over time. If a person could stand off to the side of the matter wave and could view its amplitude variation, it would appear as that of Figure 2 rotated around the figure's "Time" axis a full 360°. The pulsating nature of the center-of-oscillation and the modulation of the matter wave have a significant effect on the center-of-oscillation's Coulomb Effect [electrostatic interaction] response.

## Orbit Stability

The traditional 20<sup>th</sup> Century physics treatment of the problem of the atomic orbital electrons' "stable orbits" has been that, under the assumption that any acceleration of an electron results in its radiating electromagnetic energy and the fact that an electron in orbit is continuously accelerated radially inward, all orbital electrons should radiate energy and spiral in to the atomic nucleus. The failure of that expected behavior to always take place raises the question of why certain special orbits are nevertheless stable, the electron maintaining in orbit rather than decaying to the nucleus.

20<sup>th</sup> Century physics' solution is to contend that the stable orbits angular momentum is quantized in integer multiples of the Planck Constant divided by  $2\pi$ . No cause nor mechanism for the contention is given.

For a charged particle to emit electromagnetic radiation, which radiation is an emitting of energy, the energy radiated must come from, must be supplied by an effect external to the particle. Conservation of energy so requires. Therefore, the explicit fact is that it is *change of energy, kinetic or potential*, of a charged particle that results in electromagnetic radiation. *Change of direction without change of energy as the radially inward acceleration that only maintains an orbit has no such effect, provides no new energy.*

That being the case, the entire problem of the Bohr atom becomes turned on its head and must be restated. The problem is not that the electron orbits should all be unstable and radiate their energy so that they spiral into the nucleus, with the question left as to why that does not happen to the "stable" orbits. Rather, the problem is that all of the orbits should be stable, so why does only the small number that we call the "stable" orbits have stability and all of the rest not ?

## The Effect on the Coulomb Effect Action

The Coulomb Effect of electrostatic attraction between opposite electric charges is communicated by the "attracting charge" to the "attracted charge" by the "attracting charge's" outward propagating "flow" of *medium*. But, that flow is radially outward and only a small part of it would actually succeed in encountering the "attracted charge". How much ? The "attracted charge" is a target having a cross-section for intercepting incoming flow. That target cross-section depends on the spatial amplitude of the "attracted charge's" oscillation.

Figure 2 demonstrates that on the average the amplitude of the oscillations of a center-of-oscillation in motion,  $2U_c$  is the same as that of a center-of-oscillation not in motion, that is at velocity  $v = 0$ , equation (1a). However, the figure also demonstrates that that averaging is only correct and valid if taken over one or an integer number of matter wave wavelengths.

But if the average is taken otherwise then in effect the amplitude of the center's oscillations varies from electron orbit to orbit meaning that the Coulomb Effect attraction so varies and is unable to properly curve the orbital electron into a stable orbital path.<sup>14</sup>

## The Hydrogen Atom's Stable Orbits

The contention that the orbital electron's angular momentum is quantized, as in

$$(10) \quad m \cdot v \cdot R = n \cdot \frac{h}{2\pi} \quad [n = 1, 2, \dots]$$

is actually merely a mis-arrangement of

$$(11) \quad 2\pi \cdot R = n \cdot \frac{h}{m \cdot v} = n \cdot \lambda_{mw} \quad [n = 1, 2, \dots]$$

the statement that the orbital path,  $2\pi \cdot R$ , must be an integral number of matter wavelengths,  $n \cdot \lambda_{mw}$  long. The latter statement has a clear, simple, operational reason for its necessity: that otherwise the average amplitude of the orbital electron's center-of-oscillation's pulsations varies

from electron orbit to orbit meaning that the Coulomb Effect attraction so varies and is unable to properly curve the orbital electron into a stable orbital path.

The contention of 20th Century physics is arbitrary and was justified only because it produced a correct result even if without having an underlying rational foundation. Unfortunately that led to emphasis on quantization in other situations and to the full blown theory of Quantum Mechanics, which overall still lacks the rational foundation of the causes and mechanisms of contended theory.

### References

- [ 1] R. Ellman, *The Origin and Its Meaning*, 2<sup>nd</sup> Edition, 2004, The-Origin Foundation, Inc., <http://www.The-Origin.org>. The book may be downloaded in .pdf files from the website.
- [ 2] Per 1 above, specifically Section 10, beginning on page 49.
- [ 3] Per 1 above, specifically Detail Notes 2, beginning on page 57.
- [ 4] Per 1 above, specifically Section 20, beginning on page 391.
- [ 5] Per 1 above, specifically Section 12, beginning on page 70.
- [ 6] Per 1 above, specifically Section 13, beginning on page 91.
- [ 7] Per 1 above, specifically Section 15, beginning on page 159.
- [ 8] Per 1 above, specifically Section 17, beginning on page 293.
- [ 9] Per 1 above, specifically Section 18, beginning on page 330.
- [10] Per 1 above, specifically Section 16, beginning on page 232.
- [11] R. Ellman, *Inertial Mass, Its Mechanics – What It Is; How It Operates*, Los Alamos National Laboratory Eprint Archive at <http://arXiv.org>, physics/ [9910027](http://arXiv.org/abs/physics/9910027).
- [12] R. Ellman, *The Problem of the Photon*, <http://www.the-origin.org/The Problem of the photon.pdf>.
- [13] R. Ellman, *Entanglement and Quantum Mechanics*, <http://www.the-origin.org/Entanglement and Quantum Mechanics.pdf>.
- [14] The precise details of the interaction between the “attracting center” and the “attracted center” are more complex and are analyzed in detail in per 1 above, specifically Section 12, beginning on page 70 and Section 16, pages 261-268.