

RESEARCH ARTICLE

An Alternative to Quantum Theory, Photon Radiation, Entanglement, Photon Structure, the Wave-Particle Paradox, and Einstein's Photoelectric Effect

Donald C. Aucamp, Sc.D

Prof. Emeritus, SIUE, USA.

Received: 25 August 2023 Accepted: 12 September 2023 Published: 27 September 2023

Corresponding Author: Donald C. Aucamp, Prof. Emeritus, SIUE, USA.

Abstract

In the prior work on this topic orbiting electrons in steady state are viewed as doublets which are laid out in strings in such a way that they do not radiate, even though they would if they existed alone. In this second paper a detailed description of the radiation process is given, as well as an analysis of the properties of the emitted photons. These are shown to be single electric field corpuscles which therefore have no frequency. The theory leads to an equation for the photoelectric effect which is a modification of the Einstein/Planck law. Though the modification can and does happen, it is conjectured this is generally not the case. The theory also leads to a resolution of the wave-particle paradox and a proof of the law of radii. A byproduct of the study is that quantum theory and entanglement are shown to be invalid, as well as Einstein's view that his law also applies to Maxwell radiation.

1. Introduction and Background

In Aucamp[1] orbiting electrons are postulated in a Law of Electrons (LOE) to be attached in paired doublet strings in such a way that they form circular rings which do not radiate even though they would if they orbited alone. This steady state condition is destroyed when electrons are ejected from inner orbits and are replaced by electrons in outer orbits or by free electrons, thereby resulting photon energy emissions. The details of this process will be covered in this work. It will be shown that photons are single electric field corpuscles which have a total emission time T and length

$\lambda=cT$, and therefore no frequency. It is consequently no mystery why experiments only measure wavelengths and never frequencies.

The following Law of Radii (LOR) was assumed in Aucamp[1] and will be used in this work. Though this will give significant credence to its validity, it will be formally proved in an upcoming following work. In LOR the possible atomic orbits have a radius of r_n in the n^{th} shell, which is given as follows:

Law of Radii : LOR

$$(1.1) \quad r_n = n^2 r_0, \quad (n=\text{integer} \geq 1)$$

In this law r_0 is the Bohr[3] radius (his "a"), which is the minimum value possible and is viewed here as a fundamental constant of nature. It is noted that Bohr likewise assumed LOR, but only for the hydrogen atom. It is assumed in Aucamp[1] that orbiting electron strings are connected together to form paired circular rings of radius $r_n = n^2 r_0$, where all the electrons in a given ring have the same length and the minimum length of a single electron is $L_0 = 2\pi r_0$. It is assumed the individual electrons can be stretched so that they fill out the entire orbit of length $D_n = 2\pi r_n$. Thus, if the n^{th} shell contains a total of S_n electrons, then each of the two individual rings contains $N_n = S_n/2$ electrons, arranged end-to-end.

2. Emission Analysis

2.1 Preliminaries

Subsequent to Einstein's [4] photoelectric findings of 1905, Bohr[3] in 1913 theorized in his planetary hydrogen model that only certain orbits are allowed.

Citation: Donald C. Aucamp. An Alternative to Quantum Theory, Photon Radiation, Entanglement, Photon Structure, the Wave-Particle Paradox, and Einstein's Photoelectric Effect. Open Access Journal of Physics. 2023;5(1): 10-14.

©The Author(s) 2023. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

In his work the sudden collapse from a higher energy outer orbit to a lower energy inner orbit gives rise to the emission of a photon whose radiant energy, E , is the difference in orbital energies. In Bohr's theory electrons orbit in circles of radius given by (1.1), at least in his hydrogen model, and are simply not allowed to radiate while doing so. Moreover, Bohr did not analyze how they move from outer to inner orbits, nor was he able to derive the photoelectric equation, one form of which according to Einstein is as follows:

$$(2.1.1) \quad ET = h$$

In this equation E is the photon energy and T is the emission time. While this equation is generally written as $E = hv$, where v is the frequency, it is shown in this work that photons are single wave corpuscles which have a single wavelength and therefore no frequency. Thus, v is replaced by $1/T$ and (2.1.1) is written as $ET = h$. This is the equation used herein.

Since Bohr's work the failure to deal with the non-radiation aspect of orbiting electrons is arguably the principle reason for the creation of quantum theory. In his paper he derived the following equation for the photon emission energy, where an electron moves from $r=B$ to $r=A$:

$$(2.1.2) \quad E = (k_0/2) (1/A - 1/B)$$

In (2.1.2) k_0 is the Coulomb constant (often written as k_e) which is given as follows:

$$(2.1.3) \quad k_0 = e^2 / (4 \pi \epsilon_0) = 89.875517923$$

From the laws of classical physics Bohr also derived the following equations for orbital velocity V , kinetic energy K , and potential energy U :

$$(2.1.4) \quad V = [(k_0 / (mr))]^{1/2}$$

$$(2.1.5) \quad K = m V^2 / 2 = k_0 / (2r)$$

$$(2.1.6) \quad U = \int_{\infty}^r f dr = \int_{\infty}^r (k_0 / r^2) dr = -k_0 / r$$

It is noted that (2.1.2) can be rewritten as the difference in kinetic energies, as follows:

$$(2.1.7) \quad E = (m/2) (V_A^2 - V_B^2)$$

In this equation V_A and V_B are the two steady state orbital velocities,

From (2.1.1) and (2.1.2) it appears that satisfying both E and T is a seemingly hopeless task. For example, suppose the value of A is fixed and B is increased. Then from (2.1.2) it is seen that E increases, so that from (2.1.1) T must then decrease. But how can T decrease when the radial distance traveled, which is $B-A$, increases?

As electrons exist in pairs as given in Aucamp[1], it is assumed that ejections generally involve a pair getting knocked out of orbit at, say, $r=A$. As a result, a pair might then move to replace it from, say, $r=B$, where $B > A$. In this work the A and B notations will continue to be used everywhere in all the analyses.

2.2 Phase 1

Suppose an electron pair is knocked out of orbit at $r=A$, and a pair at $r=B$ moves to replace it. The total movement is broken down into the following two phases.

(a) Phase 1: movement from $r=B$ to the initial arrival at $r=A$

(b) Phase 2: movement after the initial arrival at $r=A$

The movement in Phase 1 is analyzed in this section, where it is assumed that the electron pair initially expands into a ring of radius $r=B$, and then the ring shrinks as it moves toward $r=A$ in such a way that the ring radius is $r=A$ at its arrival. An important assumption concerning Phase 1 is that the electron pair essentially does not radiate. Thus, if ΔE is the radiation, the following law is assumed:

Phase 1 Nonradiation Law

$$(2.2.1) \quad \Delta E = 0$$

The key reason for no radiation in Phase 1 is that radiation involves the outward flow of an electric field, whereas in this case the field is shrinking.

This law is crucially needed to satisfy the photoelectric effect, in that the final photon emission energy E becomes independent of the transit time in Phase 1 from $r=B$ to $r=A$, a time which may be very large compared to T .

As the electron pair moves from $r=B$ to $r=A$, it is reiterated that it is assumed it initially expands to a ring of radius B . Then the electron ring in its travel gets reduced to its final size so that it arrives at the A ring with radius A so that it overlays with it. It is noted this ring is missing one electron pair and is therefore empty if $r=r_0$. At this instant the stage is set for the new arrival to slow down and emit a photon, which happens in Phase 2.

2.3 Phase 2

At the end of Phase 1 there has been no radiation in the move from $r=B$ to $r=A$. Then, in Phase 2 the electron slows down, is compressed to its final size, and radiates. Neglecting the initial travel time from

B to A explains how the emission time T, which is entirely based on Phase 2, can be very small even though the travel time in Phase 1 may be very large. Thus, the photon emission energy E in Phase 2 is the entire Bohr energy gain given by (2.1.2), so that:

$$(2.3.1) E = (k_0/2)(1/A - 1/B) = (m/2)(V_1^2 - V_2^2) = K_1 - K_2$$

In this equation V_1 is the velocity and K_1 the kinetic energy at the start of Phase 2, and V_2 and K_2 the values at the end of Phase 2. It is reiterated that the entire movement during this phase is at or virtually at $r=A$.

It is assumed that the onset of radiation begins when the electron first hits $r=A$ at the end of Phase 1. At this instant t is set to zero, and at $t=T$ the radiation of the photon is complete. Briefly, the process which takes place during Phase 2 is as follows: The arriving electron is a ring with a radius which is virtually equal to A. Since $V_1 > V_2$, this ring is moving faster than the orbiting A ring, which is moving at V_2 . Now let $x(t)$ be the orbital distance traveled by the electron from the start of Phase 2 up to time t , and also define $V(t) = dx/dt$. Then:

$$(2.3.2) x(t) = \int_0^t V(t) dt$$

It is assumed the electron wraps completely around the A orbit in time T, so that the total distance traveled, X_0 , is given by the following law:

Photoelectric Law PEL

$$(2.3.3) X_0 = x(T) = 2\pi A$$

Two of the arguments for PEL are that it leads to the correct equation for the photoelectric effect and the correct equation for h . In the following analysis it is assumed that $x(t)$ is a smooth, well-behaved, function which obeys the following polynomial law:

$$(2.3.4) x(t) = C_0 + C_1 t + C_2 t^2$$

Based on (2.3.4) there are four unknowns, which are C_0 , C_1 , C_2 , and T. These unknowns are resolved by four equations, as discussed below. First, since $x(0)=0$, then $C_0=0$. Also, since $dx/dt(0)=V_1$, then $C_1=V_1$. Inserting these values into (2.3.4) results in the following:

$$(2.3.5) x(t) = V_1 t + C_2 t^2$$

From (2.3.5) it is seen that

$$(2.3.6) V(t) = dx/dt = V_1 + 2 C_2 t$$

Since $V(T)=V_2$, then from (2.3.6):

$$(2.3.7) V_2 = V_1 + 2 C_2 T$$

Thus, from (2.3.3) and (2.3.5):

$$(2.3.8) x(T) = 2\pi A = V_1 T + C_2 T^2$$

From (2.3.7) and (2.3.8) there are two equations involving two unknowns, T and C_2 , where in this analysis V_1 and V_2 are temporarily viewed as independent inputs (since they are functions of A and B). From (2.3.7) the following obtains:

$$(2.3.9) C_2 = - (V_1 - V_2) / (2T)$$

Since $V_1 > V_2$, it is clear that $C_2 < 0$. Then, from (2.3.8) and (2.3.9), it is seen that $2\pi A = V_1 T - (V_1 - V_2) T^2 / (2T)$, so that $2\pi A = (V_1 + V_2) T / 2$. Therefore:

$$(2.3.10) T = 4\pi A / (V_1 + V_2)$$

This equation could also have been deduced by noting from (2.3.6) that the force, $F(t)$, on the emitting electron in Phase 2 is as follows:

$$(2.3.11) F(t) = m dV/dt = 2mC_2$$

Since $C_2 < 0$, this force is negative and therefore serves to slow down the electron. Thus, from (2.3.11) the force is a negative constant which only depends on (A,B). Since F is constant, then dV/dt is constant, and the average V in Phase 2 is $V_{aver} = (V_1 + V_2) / 2$. Therefore, $T = 2\pi A / V_{aver}$, and (2.3.10) is valid.

Next, since E is the loss in kinetic energy in Phase 2, then $E = (m/2)(V_1^2 - V_2^2)$. Thus, from (2.3.10) $ET = (m/2)(V_1^2 - V_2^2) 4\pi A / (V_1 + V_2)$. Therefore:

$$(2.3.12) ET = 2 \pi A m (V_1 - V_2)$$

This result could have been deduced from the constant force given by (2.3.11). In this case $E = -FX_0$ and $FT = m(V_2 - V_1)$, so that (2.3.12) is valid. Since V_2 is the stationary orbital velocity at $r=A$, then from (2.1.4) the following obtains:

$$(2.3.13) V_2 = [(k_0 / (mA))]^{1/2}$$

Next, let $\gamma(A,B)$ be defined by the following ratio:

$$(2.3.14) \gamma = V_1 / V_2 = V_1 / [(k_0 / (mA))]^{1/2}$$

Then $V_1 = \gamma (k_0 / (mA))^{1/2}$. Inserting these values into (2.3.12) results in

$ET = 2 \pi A m (k_0 / (mA))^{1/2} (\gamma - 1)$. It is therefore concluded that:

$$(2.3.15) ET = 2 \pi (Amk_0)^{1/2} (\gamma - 1)$$

Next, from the Law of Radii (LOR), it is noted that $A = n^2 r_0$. Then:

$$(2.3.16) ET = 2 \pi (mr_0 k_0)^{1/2} n (\gamma - 1) = h n (\gamma - 1)$$

In this equation the constant h is defined as follows:

$$(2.3.17) h = 2 \pi (mr_0 k_0)^{1/2}$$

In (2.3.17) the value of h can be found by inserting the following approximate values: $k_0=89.8755$, $m=9.9109 \times 10^{-31}$, and $r_0=5.29 \times 10^{-11}$. Using these values in (2.3.17) yields:

$$(2.3.18) \quad h = 6.62 \times 10^{-34}$$

As this result arguably falls within the experimental limits of Planck's [5] constant, then h will be viewed here as this constant.

It is interesting that the formula for h as given by (2.3.17) was determined by Bohr in another form in his correspondence principle theory, in which he combined his planetary model theory with quantum theory in the special case when $A=n^2r_0$, $B=(n+1)^2r_0$, and $n \rightarrow \infty$. However, Bohr in his analysis postulated the validity of the photoelectric effect, which was not done in deriving (2.3.17). He also placed severe requirements on A and B .

Finally, if $ET=h$, then it is required from (2.3.16) that $n(\gamma-1)=1$. If γ_0 is the solution to this equation, then:

$$(2.3.19) \quad \gamma_0 = V_1/V_2 = 1+1/n = (n+1) / n$$

Thus, based on (2.3.16) and (2.3.19):

$$(2.3.20) \quad \{ET=h\} \iff \{V_1/V_2 = (n+1) / n\}$$

This result will now be studied further.

First, it is noted that there is no radiation in Phase 1. Thus, angular momentum is constant, so that $Vr=\text{constant}$. Since V_B is the starting velocity and V_1 the ending velocity, then $V_B B = V_1 A$ and $V_1/V_2 = (V_B B) / (V_A A)$.

Now let $A=n^2r_0$ and assume that B is the closest upper ring, so that $B=(n+1)^2r_0$. Then $B/A=(n+1)^2/n^2$, so that $V_1/V_2 = [(n+1)^2/n^2][V_B/V_A]$. Also, from (2.1.4) $V = [(k_0 / (mr))^{1/2}]$. Thus, $V_B/V_A = (A/B)^{1/2} = n/(n+1)$. From this result it is concluded that:

$$(2.3.21) \quad V_1/V_2 = (n+1) / n$$

Thus, from this equation and (2.3.19) it is concluded that an emission from $r=A=r_0n^2$ which is replaced from $r=B=r_0(n+1)^2$ results in $ET=h$, which is the nearest orbit, result. However, it is argued this is not the case when $B > (n+1)^2r_0$. To see what happens in this case, note that V_1 increases when B increases for a given value of A . Thus, γ likewise increases and from (2.3.16) ET likewise increases, so that, if $A=n^2r_0$, then the following photoelectric law is obtained:

Photoelectric Law

$$(2.3.22a) \quad \{B=(n+1)^2r_0\} \Rightarrow ET=h$$

$$(2.3.22b) \quad \{B > (n+1)^2r_0\} \Rightarrow ET > h$$

In conclusion, this law validates (2.3.20), so that the $ET=h$ only when an emission is filled from the next higher orbit. Otherwise, $ET > h$. However, it is conjectured that in almost all cases an emitted pair is replaced by a pair taken from the closest ring, so that generally $ET=h$.

3. Fine Points

3.1 The Law of Radii

In (1.1) the Law of Radii (LOR) states that $r_n = n^2r_0$, where n is a positive integer. This law was used extensively in both this work and in Aucamp[1]. Based on this extensive success in these two papers, as well as the experimental success in predicting the value of Planck's constant and the structure of the periodic table in Aucamp[1], it is argued this lends great credence to LOR. It is noted that Bohr[8] assumed this law concerning his hydrogen study. Additionally, LOR will be formally proved an upcoming paper in this series

3.2 Atomic Numbers Zn of the Noble Elements

In Aucamp[1] the atomic numbers of the 7 noble elements were assumed. A proof was promised to be provided in a subsequent work. This proof will be offered in an upcoming paper.

3.3 Rejection of QT and Entanglement

It is clear that QT and its stepchild, entanglement, are rejected as a result of the radiation process covered herein. As a consequence, it is held that a message cannot be sent from point X to point Y and arrive instantaneously.

3.4 Resolution of the Wave-Particle Paradox

Based on the theory proposed in this work, there is no wave-particle paradox. Photons are electric field corpuscles which consist of a single enclosed field having a single length, $\lambda=cT$. As a result, they have no frequency, and they therefore are not waves. Since these corpuscles are small and have energy, they have mass therefore properties associated with particles. However, as each photon is an electric field, and as electric fields can be manipulated, then experiments can be conducted such as the double-slit experiment which give the impression that photons are waves. In this regard it is not accidental that only photon wavelengths are measured and never photon frequencies.

3.5 Maxwell Radiation Versus Photon Radiation

It is noted that Maxwell's electromagnetic fields,

which arise from the accelerations of electrons, are always electric field waves and never photons. It is shown in Aucamp[2] that these waves are actually electric fields which travel at the speed of light with respect to the inertial frame of reference of the source, in contradiction to Einstein's special theory of relativity. Magnetic forces are shown not to exist; they are actually electric field forces when the inertial frame of reference is taken into account.

3.6 Photon Doublets

From the Phase 2 analysis an electron doublet radiates as it decelerates in a move of length $2\pi A$. It is argued that the resulting radiation moves outward, orthogonal to the plane of rotation. Specifically, it is held that each of the two electrons contributes one half of a photon in each direction. Thus, each of the resulting photons actually is made up of two photon halves. This double photon property is a strong argument for the electron doublet proposition in Aucamp[1].

3.7 Conjectures on Photon Properties

Photons are electric field corpuscles of length $\lambda=cT$. It is conjectured that their width is the atomic orbiting diameter, $2\pi A$, or something of this order. Since the radiating electron doublet is spinning around the atomic nucleus, it is conjectured the resulting photon doublet is likewise spinning. It is also conjectured the field strength at the photon boundary is zero, so that it can travel billions of miles through space and not change shape.

4. Conclusion

In Aucamp[1] a Law of Electrons (LOE) is postulated in which electrons are viewed as paired doublet strings that, if attached together in a ring, do not radiate when in orbit even though they would if they existed singly. This companion paper extends LOE to explain the radiation process in detail, which is initiated when inner shell electrons are knocked out of their orbits and outer shell electrons or free electrons move in to fill the gaps. As these moves involve orbital energy losses, the result is photon radiation. The emitted photons are single electric field corpuscles having a

length of $\lambda=cT$ and no frequency. As electron doublets are involved, it is shown that each single emission travelling through space actually consists of two photon halves.

Given that an electron doublet is ejected from radius $A=n^2r_0$ and is replaced by a doublet from radius $B=(n+i)^2r_0$, the resulting photoelectric value of ET is shown to satisfy $ET=h$ only when B is the next higher radius (i.e, when $i=1$). Otherwise, $ET>h$. However, it is conjectured that, as a general rule, the replacement pair will usually come from the next higher orbit, so that usually $ET=h$. A significant result of this analysis is that the correct experimental formula for h naturally arises from the theoretical development. This formula has an advantage over Bohr's correspondence principle formula in that the proof does not postulate the validity of the photoelectric effect and also does not require $A \rightarrow \infty$.

From the results of this work it is clear that every aspect of quantum theory is rejected, including entanglement. Also, with very little extra thought, the wave/particle paradox is easily explained, and various photon properties can be ascertained, such as why photons keep their shape as they travel through space.

5. References

1. Aucamp, D.C. (2023), "A Non-Radiating Atomic Electron Model with an Application to Molecular Structure and the Periodic Table", Open Access Journal of Physics, Open Access J. of Phys,V5(1),01-08.
2. Aucamp, D.C. (2018), "A Single Equation Solution to the Electromagnetic Force Problem", Open Access J. Phys.,V2, Issue 4, pp.1-9.
3. Bohr, Niels, (1913), "On the Constitution of Atoms and Molecules (3 papers): Part I, Part II, Part III", Philosophical Magazine 28.
4. Einstein, A. (1905), "On the Electrodynamics of Moving Bodies", translated in "The Principal of Relativity", Dover, pp. 37-65.
5. Planck, M., (5 papers, 1900/1901), "Ober das Gesetz der Energieteilug im Normalspektrum", Annalen der Physik, 4, 553.