Open Access Journal of Physics
ISSN: 2637-5826 | Volume 5, Issue 1, 2023
https://doi.org/10.22259/2637-5826.0501001

RESEARCH ARTICLE

A Non-radiating Atomic Electron Model with an Application to Molecular Structure and the Periodic Table

Donald C. Aucamp, Sc.D.,

Prof. Emeritus, USA.

Received: 20 April 2023 Accepted: 10 May 2023 Published: 30 May 2023

Corresponding Author: Donald C. Aucamp, Sc.D., Prof. Emeritus, USA.

Abstract

In this first of two papers electrons are viewed as strings which are laid out in such a way that, as a group, there is no orbital radiation even though there would be if they existed alone. The proposed model leads to a very simple explanation of the structure of the periodic table, where it is shown the seven row size increases depend on the six numbers, (1,0,1,0,1,0). It is argued that this result is too regular to be happenstance. The model is then used to explain the structure of atoms and molecules. In the upcoming second paper this theory leads to a complete explanation of the radiation process and the physical nature of the resulting photons, as well as proofs of: (a) the law of radii, (b) the atomic numbers of the noble elements, (c) the photoelectric effect, and (d) a formula for Planck's constant which does not depend on the assumption of Einstein's equation.

1. Law of Electrons (LOE)

In Bohr's [1] planetary view of the atom he assumed electrons are particles which orbit in circles around a stationary nucleus. With his model he successfully calculated the energy emissions of the hydrogen atom as electrons move from outer to inner orbits, but he was unable to explain why his orbiting electrons do not radiate when in steady state and how they move when emitting photons. These problems have eluded scientists ever since, and arguably they have led to the creation of quantum theory (QT). Moreover, Bohr's paper did not extend beyond the hydrogen atom.

In this work the following Law of Radii (LOR) for shell sizes will be temporarily assumed as valid for all electrons in all atoms, whether existing alone or in molecules, where n is the shell number. This law will be derived in paper #2, which covers radiation.

Law of Radii (LOR)

1.1 $r_n = n^2 r_0$, ***(n=integer≥1)***

It is noted that Bohr assumed **LOR** in his hydrogen study, where r_0 is his first atomic radius. This formula was first hypothesized in a different form by Rydberg and then extended by Ritz[2] as being valid for hydrogen and the alkalis.

In the Law of Electrons (**LOE**) as developed below orbiting electrons are viewed as strings. In any given circular shell of radius $r_n=n^2r_0$ the strings are attached end-to-end and doubled up to form two overlapping rings. Thus, for example, if six electrons are in orbit in shell *n*, then each of the two overlapped rings contains three electrons, where all the individual electrons in a given orbit have the same length.

From **LOR** the minimum length of a single electron string is seen to be $L_0=2\pi r_0$. It is assumed in **LOE** that the individual strings can be stretched so that they fill out the entire circular orbit of length $D_n=2\pi r_n$. Thus, if the n^{th} shell of radius r_n contains a total of S_n electrons which are situated in two overlapping rings, then each ring contains $N_n=S_n/2$ electrons, arranged end-to-end. From this equation it is seen that S_n must be an even integer for all atomic shells, whether existing alone or in molecules, and that the individual string length is $L_n=2\pi r_n/ N_n$.

Now consider a particular electron with string length *L*. The charge density ρ(x) per unit of length *dx* is

Citation: Donald C. Aucamp, Sc.D., . A Non-radiating Atomic Electron Model with an Application to Molecular Structure and the Periodic Table. Open Access Journal of Physics. 2023; 5(1): 01-04.

assumed to be sinusoidal, as follows:

$$1.2\ \rho(x) = (e/L)\ [\ 1 + \Gamma \sin(2\pi x/L)\ ]$$

In **(1.2)** x is the relative distance as measured from the beginning of an individual string at $x=0$ to the ending node at $x=L$, where Γ is assumed to be a constant. It is seen that the particular form given by **(1.2)** yields $\rho(x)=0$ at both $x=0$ and $x=L$. Then the total electron charge Q of a single electron string is as follows:

$$1.3\quad Q = \int_0^L \rho(x)\,dx = (e/L) \int_0^L [1+ \Gamma \sin(2\pi x/L)]\,dx = e$$

Thus, based on **(1.2)**and **(1.3)**, each single string contains one electron, independent of Γ. Though **(1.3)** is valid for any constant Γ, it is conjectured that $|\Gamma|=1$. For the purposes of this work, the value of Γis unimportant, and it will be viewed as any constant satisfying the following:

$$1.4\ 0<|\Gamma| \leq 1$$

From the above discussion the Law of Electrons applies to all atoms, whether situated alone or in molecules. It is postulated as follows:

Postulated Law of Electrons (LOE)

In any given atom, whether existing by itself or in a molecule, all electrons orbit according to LOR in overlapping, equal length, sinusoidal pairs that have the same nodes. The individual densities, $\rho_1(x)$ and $\rho_2(x)$, of any pair are given by (1.2), where:

$$1.5\quad \Gamma_1 = -\,\Gamma_2$$

It is noted from **(1.3)** and **(1.5)** that:

$$1.6\ \rho_1(x) + \rho_2(x) = 2\,e\,/\,L$$

Thus, from **(1.6)** the totality of the electrons making up a complete ring is a ring with constant charge. Accordingly, though all the individual orbiting electrons would emit non-constant fields and therefore radiate if they existed alone, the total electric field of the entire ring is time-invariant in space. Thus, there is no radiation. From this result the following obtains:

LOE Conclusion: There is no atomic radiation in steady state.

2. Application of LOE to the Periodic Table

2.1

Arguably, the derivation of the structure of the periodic table, which is currently based on quantum theory, is complicated. Nobel Prize winner Richard Feynman himself once commented that nobody understands QT. With respect to the construction of the table as based on QT, it is assumed there are atomic shells and sub-shells, where the number of electrons in each is based on four quantum numbers and the Pauli exclusion principal. While the final result is seemingly a feasible table which gives the correct row sizes, the theory leading up to it is in many ways lacking in needed details. For example, since Schrodinger's ψ is not even a real number, what is its physical meaning other than its probability implication? Moreover : (a) what exactly are the orbiting electrons, (b) what is going on in the radiation process, (c) why is the photon energy equal to $E=hf$, (d) what exactly is a photon, and (e) why do orbiting electrons, which have a charge, not radiate in steady state? Also, since ψ spreads out over time when a photon travels out in space, why is the measured value of λ a constant? The number of unanswered questions such as these seems to be endless. By way of contrast, the **LOE** theory proposed here and employed in paper #2 resolves these questions, and it is far simpler to understand. Accordingly, an argument in its favor rests on the principle of Occam's Razor, which states that the simplest explanation is generally the best explanation.

2.2 The Noble Elements

It is noted that the atomic numbers, $\{Z_n\}$, of the seven noble elements define the structure of the periodic table because they are situated at the ends of the individual rows. Given these values, a simple formula for them will be derived here which is based on the postulated **LOE** and the assumed **LOR**. While **LOR** and the Z_n values are assumed in this work, both will be derived in paper #2.

It is noted that the noble elements all have an even number of electrons in their outer orbits, so from **LOE** they can orbit in pairs. These elements are displayed in **Table 1** below, where S_n is the number of electrons in the outer orbit of the n^{th} noble element. It is emphasized that n is the row number and not the element number. The Z_n and S_n variables are related as follows:

$$2.2.1\ Z_{n+1} = Z_n + S_{n+1} (\text{all } n>0)$$

In the case of helium, $n=1$ and $Z_1=2$. As there is only one shell, then $S_1=Z_1=2$. As neon is the second noble element and $Z_2=10$, then the number of electrons in its outer orbitis given from **(2.2.1)** as $S_2=Z_2-Z_1=8$. The other S_n values are found similarly. The entries for N_n, J_n, and δ_n will be explained in due course.

Table1. The Seven Noble Elements

n	Element	Z_n	S_n	N_n	J_n	δ_n
1	Helium	2	2	1	1	X
2	Neon	10	8	4	2	1
3	Argon	18	8	4	2	0
4	Krypton	36	18	9	3	1
5	Xenon	54	18	9	3	0
6	Radon	86	32	16	4	1
7	Oganesson	118	32	16	4	0

From this table the given Z_n are as follows:

(2.2.2) $\{ Z_n \} = \{ 2, 10, 18, 36, 54, 86, 118 \}$

Also, from (2.2.1) the S_n values are:

(2.2.3) $\{S_n\} = \{ 2, 8, 8, 18, 18, 32, 32 \}$

From the table the *7th* known noble element is Oganesson, which has an atomic number of $Z_7=118$. This element does not exist in nature and must be synthesized.

2.3 Analysis of the Table

It will be shown in paper #2 that the orbits of the noble elements are at the lowest possible energy levels when in steady state, and that these elements are inherently stable. As in the Bohr model, it is assumed that electrons orbit in circles, and the smallest atomic radius is r_0.

Since from **LOE** all atomic orbits are composed of electrons which are arranged in pairs, then the number S_n in the outer orbit must be even, which from **(2.2.3)** is seen to be the case for the noble elements. Thus, if N_n is the number of pairs in the outermost n^{th} row, then N_n is an integer satisfying the following:

(2.3.1) $N_n = S_n/2, \quad (n\geq 1)$

These values are shown in the table, as follows:

(2.3.2) $\{ N_n\} = \{ 1^2, 2^2, 2^2, 3^2, 3^2, 4^2, 4^2 \}$

It is seen from **(2.3.2)** that the N_n values are all perfect squares. Therefore, the following J_n variables as defined by the equation below are all integers:

(2.3.3) $N_n = J_n^2, \quad (n\geq 1)$

From **(2.3.2)** and **(2.3.3)**:

(2.3.4) $\{ J_n \} = \{ 1, 2, 2, 3, 3, 4, 4 \}$

Finally, let δ_n be defined as the increase in J_n, as follows:

(2.3.5) $\delta_n = J_n - J_{n-1}, (n>1)$

From **(2.3.4)** and **(2.3.5)**:

(2.3.6) $\{\delta_n\} = \{ \delta_2, \delta_3, \delta_4, \delta_5, \delta_6, \delta_7 \} = \{1, 0, 1, 0, 1, 0\}$

It is noted that δ_n is not defined for $n=1$ because J_0 has no meaning.

From the above equations, it is seen that the values of J_n, N_n, and δ_n are extremely regular for the noble elements. It is argued here and shown in paper #2 that this is not just a quirk of nature. Also, if it should happen that the eighth noble element gets discovered at some future date, then it seen form **(2.3.2)** that N_8 is projected to be given by $N_8=5^2$, so that $S_8=2N_8=50$ and $Z_8=Z_7+S_8=118+50=168$.

2.4 Extensions to Molecules and Other Atoms

From **LOE** it is argued that all atoms, whether existing singly or in molecules, must have their inner and outer shells arranged in overlapping pairs, so that there must be an even number of electrons in all the rings, where zero is viewed here as an even number. There are presumably five ways these layouts can be accomplished, which are: (a) by borrowing, (b) by lending, (c) by sharing, (d)by doubling-up, and (e) by shedding. In this regard, some arrangements may be favored over others because of energy considerations.

At least in theory, any atom with an even number of electrons in its outer shell can become stable by the process of doubling-up. However, this is not possible when the outer shell has an odd number of electrons such as sodium (one electron). These atoms can become stable by themselves only if they shed an odd number of electrons, there by leaving an even number or zero. Other than this, they can only exist in molecules.

As an example of sharing, consider the hydrogen atom, which has just one electron in its only orbit. As two electrons are needed to form a ring, then one way this can be accomplished is by the formation of a hydrogen molecule (H_2), in which each of the two atoms share an electron.

For a second example, consider oxygen, which has two shells and an atomic number of $Z=8$. These eight electrons are arranged in a stable inner shell of two (consisting of one pair) and an outer shell of six. This outer shell can be made stable by doubling-up to get two rings with three electrons in each, in which case the oxygen atom could theoretically exist by itself. However, since oxygen generally exists in the form of the molecule dioxygen (O_2), then it is concluded this arrangement has less total energy than the two single atom formulations.

As a final example, consider fluorine, which has an atomic number of $Z=9$. This element has an unstable outer shell of seven electrons. Thus, the fluorine atom cannot exist alone without shedding an odd number of outer electrons. Another way it can become stable is by borrowing one electron from some other atom which has one to spare, with the end result being a fluorine ring doublet of four pairs. For example, fluorine could borrow an electron from hydrogen to form hydrogen fluoride, which is a stable molecule.

From the above discussion, except in the doubling-up and shedding operations just described, atoms exist only in molecules. While it is postulated that all the atoms in any given molecule are structured according to **LOE**, how the entire molecule and unattached electrons, if any, are laid out is a subject for future research.

3. Conclusions

Based on a postulated Law of Electrons (**LOE**), along with a temporarily assumed Law of Radii (**LOR**) and a temporarily assumed set of atomic numbers $\{Z_n\}$ of the seven noble elements, the row lengths of the periodic table are shown to be an extremely regular set which is arguably not just a happenstance of nature.

Though assumed in this work, both **LOR** and the atomic numbers, $\{Z_n\}$, of the noble elements are derived paper #2. In that work **LOE** is employed to explain the atomic radiation process in detail and the exact physical shape and make-up of photons, where it is shown they are single electric field corpuscles with energy satisfying $ET=h$ and fixed length λ=cT. Also, a formula for h is derived without the usual Bohr assumption that $ET=h$. Since these corpuscles are non-periodic, single length, electric fields, they have no frequency. It is therefore not accidental that experiments involving photons never measure frequencies. Paper #2 also explains why photons are able to travel through space while maintaining a constant length of λ=cT.

4. References

1. Bohr, Niels, (1913), "On the Constitution of Atoms and Molecules (3 papers): Part I, Part II, Part III", Philosophical Magazine 28.
2. Ritz, W., (1908), "On a New Law of Series Spectra", Astrophysics Jour., 28, 237-243.