Fundamental Journals
International Journal of Fundamental Physical Sciences (IJFPS)

Original Research Papers
Open Access Journals
ISSN: 2231-8186

IJFPS, Vol 14, No 1, pp 14-20, March, 2024
https://doi.org/10.14331/ijfps.2024.330164

Neoclassical Theory of Atoms

Sudeer Punnery

Independent Scientist, Manama, Kingdom of Bahrain

spunnery@gmail.com

Received March 2024
Received in revised: March 2024
Published: April 2024

ABSTRACT

The "Neoclassical Theory of Atoms" challenges the dominance of quantum mechanics in explaining certain atomic phenomena. This work argues that a classical approach, utilizing electromagnetic Coulomb forces and Newtonian mechanics, can potentially account for discrete energy levels and spectral lines observed in hydrogen and helium atoms. It questions the necessity of invoking the seemingly counterintuitive aspects of quantum mechanics for these specific phenomena. By demonstrating the potential of a classical framework, this research aims to stimulate debate and exploration of alternative explanations within physics. This could potentially lead to a deeper understanding of the nature of reality and the limitations (or potential for expansion) of current physical theories.

Keywords: Newtonian Mechanics; Hydrogen spectra; coulomb potential; ionization Energy

INTRODUCTION

Many in this world believes that the Quantum mechanics and its weird derivatives like entanglement, the collapse at observation, traveling back in time etc., which are beyond the real-world logics, may be due to our wrong or partial understanding of the Physics. Since the Mainstream scientists are so confident regarding the Quantum mechanics explanation of these weirdness, the scientists or common people who are skeptical about the Quantum mechanics are often ignored or side lined and asked to “shut up and calculate”. This paper tries to explain the discrete energy levels and the hydrogen spectral lines and helium Energy levels using the Electromagnetic Coulomb force and classical Newtonian mechanics. It questions the very fundamental basics and necessity of quantum mechanics.

IONIZATION ENERGY

Ionization energy is the minimum energy that an electron in a gaseous atom or ion has to absorb to come out of the influence of the nucleus. It is also referred to as ionization potential. Considering the Bohr Model atom, it is the Kinetic energy required for an electron (which is revolving around a positive nucleus at a radius ‘r’ from center) to escape from the attraction of positive charged nucleus. Bohr model stipulate that, 1-Electrons orbit the nucleus in orbits that have a set size and energy. 2-The energy of the orbit is related to its size. 3-The lowest energy is found in the smallest orbit. 4-Radiation is absorbed or emitted when an electron moves from one orbit to another. Based on the above, Bohr calculated the orbital radius of electron of hydrogen atom, equating the centrifugal force of orbiting electron to the coulombic attraction of nucleus as required for centripetal force to keep the electron in a stable orbit. Further, Bohr made an assumption that deviates radically from concepts of classical mechanics. Bohr's assumption, called the quantum hypothesis, asserts that the angular momentum, mvr, can only take on certain values, which are whole-number multiples of $h/2\pi$ so that

$$mvr = \frac{nh}{2\pi} \qquad (n = 1, 2, 3 \ldots) \tag{1}$$

where here h is Planck's constant. Accordingly, Bohr calculated the orbital radius of electron of hydrogen as 0.529 A^o.

NEOCLASSICAL ANALYSIS OF BOHR MODEL HYDROGEN AND HYDROGENIC ATOMS

Experimental value of ionization energy of hydrogen atom is 13.6 eV or 2.17872×10^{-18} (*joules*). An electron revolving around a nucleus at a distance r from the center of Nucleus, feels a coulombic attractive force,

$$F = k\frac{e_1 e_2}{r^2} \tag{2}$$

Where k is coulomb constant k = 8.987 × 10^9 (Nm^2/C^2) and e_1 and e_2 are electron and nucleus (1.602×10^{-19} C) with negative and positive charge respectively and r is the radius of orbit. The amount of work needed to move the electron over a small distance dr against this force is therefore given by

$$dW = Fdr = k\left(\frac{e_1 e_2}{r^2}\right)dr \tag{3}$$

The total work needed to move the electron from the existing orbital r_o of the electron to the infinity is then given by

$$W = \int_{r_o}^{\infty} k\left(\frac{e_1 e_2}{r^2}\right)dr = k\left(\frac{e_1 e_2}{r_o}\right) \tag{4}$$

In order to come out of the influence of the nucleus, the minimal kinetic Energy of the electron at the departure (ionization energy) shall match with this work done (This is similar to the escape velocity required for an object to release from gravitational potential). Therefore, the ionization energy can be introduced as;

$$\frac{1}{2}mv_e^2 = k\left(\frac{e_1 e_2}{r_o}\right) \tag{5}$$

Accordingly, for the electron revolving the hydrogen atom, $k\left(\frac{e_1 e_2}{r_o}\right) = 2.17871 \times 10^{-18}$ (*joule*). Substituting these values, orbital radius $r_o = 1.0586 \times 10^{-10}$ (note that is exactly double of the Bohr radius of $0.529A^o$). Also, ionization Energy shall be equivalent to the kinetic energy ($1/2\, mv_e^2 = 2.17871 \times 10^{-18}\, j$) at which the electron speeds away from the coulombic attraction of the nucleus. Where m is the mass of electron and v_e is the escape velocity and by substituting these values, we get v_e= 2187112.94 m/sec. Moreover, the orbital velocity (classical formula), can be calculated as $v_0 = v_e/\sqrt{2}$ with value of 1546522.391 (*m/s*) and therefore angular momentum $\omega = mv_o r$, calculates as 1.49146×10^{-34} (*kgm/s²*)

$$\omega = mv_o r = 1.49146 \times 10^{-34} \tag{6}$$

Now let us consider that angular momentum is conserved for all hydrogen-like atom or hydrogenic atom and therefore its value can be constant ($\omega = constant$) and with the same value. Coulombic attractive force between the nucleus and the electron revolving at a radius r for a hydrogenic atom with atomic number Z will be

$$F = kZ\left(\frac{e_1 e_2}{r^2}\right) \tag{7}$$

because the nucleus consists of Z numbers positive charged protons. According to the formula, the centripetal force required for the electron to remain in orbit would be equal to $F = mv_0^2/r$, where v_o is the orbital velocity of the electron. Therefore, we have,

$$\frac{mv_0^2}{r} = kZ\left(\frac{e_1 e_2}{r^2}\right) \quad \text{or} \quad mv_o^2 r = kZ(e_1 e_2) \tag{8}$$

Rearranging this, we get, $(mv_o r)v_o = kZ(e_1 e_2)$ or $v_o = kZ\left(\frac{e_1 e_2}{mv_o r}\right)$. By substituting these values, we find $v_o = Z \times 1546858.474$.

Z	v_o	$v_e = \sqrt{2}\, v_o$	Ionization Energy (j)	Ionization Energy (eV)	Experimental value of Ionization energy in (eV)
2	3093716.950	4375176.468	8.72×10^{-18}	54.42	54.41776
3	4640575.424	6562764.702	1.96×10^{-17}	122.43	122.45435
4	6187433.899	8750352.937	3.49×10^{-17}	217.66	217.71858
5	7734292.374	10937941.17	5.45×10^{-17}	340.10	340.22580
6	9281150.849	13125529.4	7.85×10^{-17}	489.74	489.99334
7	10828009.320	15313117.64	1.07×10^{-16}	666.59	667.046
8	12374867.800	17500705.87	1.39×10^{-16}	870.65	871.4101

Table.1 The orbital velocity for hydrogenic atoms (hydrogen-like atom or hydrogenic atom) from $He^+\ to\ O^{7+}$ are calculated using the above formula and the corresponding escape velocity and ionization energies are calculated and presented in the above table. (here the mass of electron is 9.109×10^{-31}). (Cotton, 2024; Fricke, 2007; Hoffman, Lee, Pershina, & elements, 2006).

The calculated values are in line with the experimental values and the small difference can be considered as we have calculated this considering circular orbits and the actual orbits might be elliptical. Advantage of above explanation over Bohr's explanation is that the discrete energy levels of electron orbits are due to classical concept of conservation of angular momentum.

NEOCLASSICAL ANALYSIS OF HYDROGEN SPECTRAL LINES

Let us consider electron revolving around the Hydrogen nucleus at a distance r from the center of Nucleus. Coulombic attractive force for a Hydrogen atom will be

$$F = \frac{kZe_1e_2}{r^2} = \frac{ke_1e_2}{r^2} \quad \text{(Z=1) for hydrogen atom} \tag{9}$$

Now if electron can possess a fractional charge of (e_2/n) where n here is an integer whole number, then, coulombic attractive force on the electron can be as,

$$F = k\left(\frac{e_1e_2}{nr^2}\right) \tag{10}$$

According to the formula, the centripetal force required for the electron to remain in orbit would be equal to $F = \frac{mv_o^2}{r}$ that, v_o is the velocity of the electron in orbit. Therefore $\frac{mv_o^2}{r} = k\left(\frac{e_1e_2}{nr^2}\right)$ and by rearranging the equation, we get $(mv_o r)v_o = k\left(\frac{e_1e_2}{n}\right)$ or $v_o = k\left(\frac{e_1e_2}{nmv_o r}\right)$. For hydrogenic atoms, the angular momentum of ω is constant (see equation 6) by substituting the value we will find the value $v_0 = (1/n)1546858.474$.

n	v_o	$v_e = \sqrt{2}\, v_o$	K
1	1546858.475	2187588.234	2.17967×10^{-18}
2	773429.2374	1093794.117	5.44917×10^{-19}
3	515619.4916	729196.0780	2.42185×10^{-19}
4	386714.6187	546897.0585	1.36229×10^{-19}
5	309371.6950	437517.6468	8.71867×10^{-20}
6	257809.7458	364598.0390	6.05463×10^{-20}
7	220979.7821	312512.6049	4.44830×10^{-20}

Table 2. The orbital velocity of the electrons with charges of (e/n) for $n = 1, 2, 3,4,5,6,$ and 7 have been calculated. Here we used $m_e = 9.109 \times 10^{-31}$ (kg) for mass of electron, v_e as escape velocity, K denoted for kinetic energy and the value of angular momentum $\omega = 1.49146 \times 10^{-34}$.

Consider the electron in the hydrogen with a charge of $e = 1.602 \times 10^{-19}$ /C, transitioned to an electron with a charge e/n. The centripetal force of the whole system will be reduced and electron will instantly fly to a stable orbit above. The energy lost/attained by this process can be calculated as E, energy required to bring an electron with a charge of e from infinity to its stable orbit-energy required to bring an electron with a charge of (e/n) from infinity to its stable orbit. In other words, it is the difference between the ionization energy of the electron with charge, e and charge (e/n). In this classical explanation, it is considered that by absorbing or emitting light, charge of electron is reduced or increased by a whole number fraction of 'e'. The wave length of light required for this difference in charge can be calculated using the formula $E = hc/\lambda$, where E is the difference in ionization energies or emitted or absorbed energy. (plank's constant $h = 6.62607 \times 10^{-34}$ and c is as usual for light velocity $c = 299{,}792{,}458$ km/s.).

n	E_1 (Energy of $e/1$)	E_n	$E_1 - E_n$	$\lambda = \frac{E}{hc}$
2	2.17967×10^{-18}	$E_2 = 5.44917 \times 10^{-19}$	1.63475×10^{-18}	1.21514×10^{-07}
3	2.17967×10^{-18}	$E_3 = 2.42185 \times 10^{-19}$	1.93748×10^{-18}	1.02527×10^{-07}
4	2.17967×10^{-18}	$E_4 = 1.36229 \times 10^{-19}$	2.04344×10^{-18}	9.72110×10^{-08}
5	2.17967×10^{-18}	$E_5 = 8.71867 \times 10^{-20}$	2.09248×10^{-18}	9.49326×10^{-08}
6	2.17967×10^{-18}	$E_6 = 6.05463 \times 10^{-20}$	2.11912×10^{-18}	9.37392×10^{-08}
7	2.17967×10^{-18}	$E_7 = 4.44830 \times 10^{-20}$	2.13518×10^{-18}	9.30339×10^{-08}

Table 3. Difference in Ionization energy between e and (e/n) for $(n = 2, 3, 4,5,6,7)$ and the wavelengths calculated using, $\lambda = E/hc$. Here E_1 is the energy of $(e/1)$.(Balmer, 1885; Bohr, 1954; Mohr, Taylor, Newell, & Data, 2008)

It can be noted that the wave lengths calculated in the above table exactly matches with the spectrum of Lyman Series (Griem, Blaha, & Kepple, 1979).

n	E_2 (Energy of $e/2$)	E_n	$E_2 - E_n$	$\lambda = E/hc$
3	5.44917×10^{-19}	$E_3 = 2.42185 \times 10^{-19}$	3.02732×10^{-19}	6.56174×10^{-07}
4	5.44917×10^{-19}	$E_4 = 1.36229 \times 10^{-19}$	4.08688×10^{-19}	4.86055×10^{-07}
5	5.44917×10^{-19}	$E_5 = 8.71867 \times 10^{-20}$	4.57730×10^{-19}	4.33978×10^{-07}
6	5.44917×10^{-19}	$E_6 = 6.05463 \times 10^{-20}$	4.84370×10^{-19}	4.10109×10^{-07}
7	5.44917×10^{-19}	$E_7 = 4.44830 \times 10^{-20}$	5.00434×10^{-19}	3.96945×10^{-07}

Table 4. Difference in Ionization energy between $E_2 = 5.44917 \times 10^{-19}$, Energy of $e/2$ and e/n for $(n = 3, 4, 5, 6,7)$ are calculated. The wave length also calculated using, with using $\lambda = E/hc$. (Bohr, 1913, 1954; T. Lyman & Sciences, 1906)

The wave lengths calculated in the above table exactly matches with the spectrum of Balmer series (Suemoto & Hiei, 1959).

n	E_3 (Energy of $e/3$)	E_n	$E_3 - E_n$	$\lambda = E/hc$
4	2.42185×10^{-19}	$E_4 = 1.36229 \times 10^{-19}$	1.05956×10^{-19}	1.87478×10^{-6}
5	2.42185×10^{-19}	$E_5 = 8.71867 \times 10^{-20}$	1.54999×10^{-19}	1.28159×10^{-6}
6	2.42185×10^{-19}	$E_6 = 6.05463 \times 10^{-20}$	1.81639×10^{-19}	1.09362×10^{-6}
7	2.42185×10^{-19}	$E_7 = 4.44830 \times 10^{-20}$	1.97702×10^{-19}	1.00477×10^{-6}

Table 5. Difference in Ionization energy between $e/3$ and e/n from $n = 4, 5 \ldots .7$ are calculated and tabulated in the table above and the equivalent Wave length also calculated using, $\lambda = E/hc$. (Balmer, 1885; Bohr, 1954; Lincoln, 2019; T. Lyman & Sciences, 1906).

The wave lengths calculated in the table5, is exactly matches with the spectrum of Paschen series (Lincoln, 2019; NAGAOKA & MISHIMA, 1938).

BOHR POSTULATES VS NEOCLASSICAL ANALYSIS

Against the Bohr's explanation (Bohr, 1954), the aforementioned calculation using classic mechanics and its results infers that the discrete orbit and discrete energy level of atoms are not due to the fact that lights are coming in quantum, but due to the fact that elementary electron charges, when excited, can exist only in discrete values of e/n where $n = 1,2,3 \ldots$, is a positive integer. Bohr was the first to realize the quantization of electronic shells by fusing the idea of quantization into the electronic structure of the hydrogen atom and was successfully able to explain the emission spectra of hydrogen as well as other one-electron systems. The very basic of quantum mechanics lies in Bohr's idea of quantization of energy. Let us analyses Bohr's explanation of hydrogen emission spectrum

Bohr's Postulate 1

The electron in a hydrogen atom revolves around the nucleus in a circular orbit. The energy of the electron in an orbit is proportional to its distance from the nucleus. The further the electron is from the nucleus, the more energy it has(Bohr, 1954).

Neoclassical Theory

The above postulate doesn't fit with the standard orbit equations, considering the fact that the centripetal Electromagnetic force is inversely proportional to distance. Consider the electromagnetic attraction force (centripetal force) between the Nucleus and electron of Hydrogen atom

$$F_{centripetal} = k\left(\frac{e^2}{r^2}\right) \tag{11}$$

For electron to be in orbit as per orbit mechanics for circular orbit, Centripetal force shall be

$$F_{centripetal} = \frac{mv^2}{r} \tag{12}$$

Hence, equating RHS of the equations, $\frac{mv^2}{r} = \frac{ke^2}{r^2}$, and rearranging this, we will get Kinetic Energy

$$\frac{1}{2}mv^2 = k\left(\frac{e^2}{2r}\right) \tag{13}$$

Accordingly, in contradiction with Bohr's postulate, actually, the further the electron is from the nucleus, the less energy it should have as the KE is inversely proportional to the orbital radius.

Bohr's Postulate 2

Only a limited number of orbits with certain energies are allowed (Bohr, 1913, 1954). In other words, the orbits are quantized. The only orbits that are allowed are those for which the angular momentum of the electron is an integral multiple of reduced Planck's constant.

Neoclassical Theory

Unlike, Bohr's assumption that angular momentum of the electron is an integral multiple of reduced Planck's constant, the classical analysis derives the spectral formula from the fundaments of conservation of angular momentum.

Bohr's Postulate 3

Light is absorbed when an electron jumps to a higher energy orbit and emitted when an electron falls into a lower energy orbit (Bohr, 1913).

Neoclassical Theory

Against the Bohr's postulate, based on the fact that further the electron is from the nucleus, the less energy it should have as the KE is inversely proportional to radius, Classical theory propose that Light is emitted when an electron jumps to a higher energy orbit and absorbed when an electron falls into a lower energy orbit.

Bohr's Postulate 4 & Rydberg formula

The energy of the light emitted or absorbed is exactly equal to the difference between the energies of the orbits. Bohr assumed that (Bohr, 1913, 1954) the angular momentum (without any specific reason), $mvr = nh/2\pi$, where $(n = 1, 2, 3 \ldots)$ and derived the equation for radius,

$$r = \frac{n^2h^2}{4\pi^2 mZe^2} \tag{14}$$

And substituting this equation derived the Energy Equation

$$E = \frac{-2\pi^2 mZ^2 e^4}{n^2h^2} \tag{15}$$

And he finally derived the formula for the spectral lines for hydrogen atom as

$$\frac{1}{\lambda} = R_H\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) \tag{16}$$

Where here λ is the wavelength of electromagnetic radiation emitted in vacuum, R_H, is the Rydberg constant for hydrogen, approximately 1.09677583×10^7 (m^{-1}), is n_i and n_f are the principal quantum number of initial and final energy levels for the atomic electron transition respectively.

NEOCLASSICAL THEORY EXPLANATION

Against the Bohr model, classical theory explains the hydrogen spectral lines from the classic fundament of conservation of angular momentum and considering discrete values for electron charges as (e/n) , where 'e' is the elementary electron charge and n is a whole number, $(n = 1,2,3, \ldots)$.

Experimental value of Ionization Energy of Hydrogen atom is 2.17987×10^{-18} Joules i.e., Minimum Kinetic energy required to escape the nucleus $\frac{1}{2} m v_e^2 = 2.17987 \times 10^{-18}$.

Substituting the value of m, mass of electron in the equation, we get $v_e = 2187712.94$ m/sec. Therefore, Orbital Velocity, $v_o = \frac{v_e}{\sqrt{2}} = 1546522.39$ m/sec and Kinetic energy of orbiting electron is $\frac{1}{2} m v_o^2 = 1.08936 \times 10^{-18}$. Coulombic attractive force on the hydrogen electron, with a charge of (e/n) will be $F_{centripetal} = k\left(\frac{e^2}{n\,r^2}\right)$. For an electron orbiting around nucleus, this shall be equal to $F_{centripetal} = \frac{m v_o^2}{r}$.

Therefore, $\frac{m v_o^2}{r} = k\left(\frac{e^2}{n\,r^2}\right)$ or Energy, $\frac{1}{2} m\, v_o^2 = k\left(\frac{e^2}{2nr}\right)$. From the previous discussions, we know that the orbital radius of hydrogen atom is $1.05868 \times 10^{-10} (m)$. So, let us calculate the energy when $n = 1$ i.e., $e = e$ then, Energy $E = k\left(\frac{e^2}{2r}\right) = 1.08936 \times 10^{-18}$ (joule). This is exactly equal to the kinetic energy of the hydrogen electron orbiting the nucleus derived above directly from the experimental value of ionization energy. It is necessary to mention that the angular momentum of orbiting electron as calculated is $1.4915 \times 10^{-34}\, kgm/s^2)$ (see Eq 6).

From orbit equation $\frac{m v_o^2}{r} = k\left(\frac{e^2}{n\,r^2}\right)$ or $(m v_o r) v_o = k\left(\frac{e^2}{n}\right)$, and by substituting value of ω we therefore find the $v_o = (1/n)(1.5465 \times 10^6)$.

$$v_e = \sqrt{2}\ v_o = (\tfrac{1}{n})(2.1870 \times 10^6) \qquad (17)$$

and therefore, the Ionization energy of orbiting electron, with the above equation can be calculated as

$$\frac{1}{2} m v_e^2 = \frac{1}{n}(2.17987 \times 10^{-18}) \qquad (18)$$

Let us now calculate the energy difference between $n = 1$ and $n = 2$ .i.e., $e = e$ and $e = (e/2)$ as $E_1 - E_2 = 1.6340 \times 10^{18}\, j$. Converting this to equivalent wave length using equation $E = \frac{hc}{\lambda} = 1.6340 \times 10^{18}$ or $\lambda = 1.2157 \times 10^{-07}\, m$.

This is exactly equal to the wave length of the light released from $n = 2$ to $n = 1$. The above equation can be generalized into $E_f - E_i = 2.17987 \times 10^{-18}\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$.

Now compare this classical equation with the Bohr's formula using Rydberg's constant.

Classical Equation for Energy difference $E_{difference} = 2.17987 \times 10^{-18}\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) = \frac{hc}{\lambda}$ or $\frac{1}{\lambda} = \frac{2.17987\times10^{-18}}{hc}\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) = 1.0972731 \times 10^7\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$, which is the Bohr's formula using Rydberg's constant. Basically, Rydberg constant is the Energy of the electron of Hydrogen atom at ground state $(e = e)$ divided by hc. This means, the Rydberg constant empirically stated by Johannes Rydberg has now another explanation derived from fundaments using classical mechanics without any burden of quantum mechanics.

NEO CLASSICAL ANALYSES OF ENERGY LEVELS OF HELIUM AND HELIUM LIKE ATOM WITH 2 ELECTRONS ONLY (THREE BODY PROBLEM)

Assumption 1. Consider the $2s$ electron is revolving in the opposite side of the nucleus i.e., 180^o degrees from the $1s$ electron. ($1s$ electron will revolve with such speed that it always remains in the same line and relative position with nucleus and $2s$ electron)

Assumption 2. Let the radius of $2s$ electron be r and the $1s$ electron be $0.25r$. i.e., $1.25r$ distance from $2s$ electron. Then the centripetal force acting on $2s$ electron will be the sum of attraction by the protons in the nucleus and repulsion of 1s electron.

Attraction by nucleus, $F_{nucleus} = Zk\left(\frac{e^2}{r^2}\right)$, and repulsion by $1s$ Electron, $F_{1selectron} = -k\left(\frac{e}{1.25r}\right)^2$. Total centripetal force acting on $2s$ electron shall be as;

$$F_{centripetal} = Zk\left(\frac{e^2}{r^2}\right) - k\left(\frac{e}{1.25r}\right)^2$$

Or

$$= k\left(\frac{e^2}{r^2}\right)\left(Z - \frac{1}{(1.25)^2}\right) = (Z - 0.64)k\left(\frac{e^2}{r^2}\right) \qquad (19)$$

As per orbital equation, this can be equated to

$$\frac{mv^2}{r} = (Z - 0.64)\mathrm{k}\left(\frac{e^2}{r^2}\right) \qquad (20)$$

or

$$(mvr)v = (Z - 0.64)ke^2 \qquad (21)$$

As $Z = 2$ for helium atom, $(mvr)v = (1.36)ke^2$. Angular momentum $mvr = 1.4914552147658 \times 10^{-34}$ (Forces are very similar to hydrogenic atom, except there is a repulsion from 1s electron in the same line of attraction of the nucleus). Substituting the values, we will get $v = 2103270.452$ m/sec, $v_e = \sqrt{2}\, v_o$, and $v_e = 2974473.599$ m/sec and therefore the Ionization energy will be 4.02976×10^{-18} joules whereas the experimental value is 3.93772×10^{-18} $(joules)$, which is just 2.3 % error.

This may be due to the eccentricity of the orbit. But the values are getting closer to the experimental values for the $2s$ electrons of atoms with higher atomic number.

Z	(Z- 0.64)	$v = \frac{(z-0.64)ke^2}{mvr}$	$v_e = \sqrt{2}v$	$E = \frac{1}{2}mv_e^2$	E (Experiment value)
2	1.36	2103270.4520	2974473.599	4.02976×10^{-18}	3.93772×10^{-18}
3	2.36	3649792.8430	5161586.539	1.21346×10^{-17}	1.21175×10^{-17}
4	3.36	5196315.2340	7348699.479	2.45969×10^{-17}	2.46541×10^{-17}
5	4.36	6742837.6260	9535812.419	4.14166×10^{-17}	4.15511×10^{-17}
6	5.36	8289360.0170	11722925.360	6.25938×10^{-17}	6.28123×10^{-17}
7	6.36	9835882.4080	13910038.300	8.81284×10^{-17}	8.84333×10^{-17}
8	7.36	11382404.800	16097151.240	1.18020×10^{-16}	1.18434×10^{-16}
9	8.36	12928927.190	18284264.180	1.52270×10^{-16}	1.52817×10^{-16}
10	9.36	14475449.580	20471377.120	1.90877×10^{-16}	1.91572×10^{-16}
11	10.36	16021971.970	22658490.060	2.33841×10^{-16}	2.34712×10^{-16}
12	11.36	17568494.360	24845603.000	2.81163×10^{-16}	2.82241×10^{-16}
13	12.36	19115016.760	27032715.940	3.32842×10^{-16}	3.34174×10^{-16}

Table 6. Ionization Energy of Helium like ions are calculated using classical mechanics and tabulated against the experimental values. Here we used $m_e = 9.109 \times 10^{-31}$ (kg) for mass of electron, v_e as escape velocity, K denoted for kinetic energy and the value of angular momentum $\omega = 1.49146 \times 10^{-34}$ and $ke^2 = 2.30657 \times 10^{-28}$)(Kramida, 2021; T. J. N. Lyman, 1914).

The experimental values are very close to the calculated values and probably the nearest values calculated ever before. After tedious calculations of countless pages, the solutions of wave equation for Helium have never seems to reach nearby this value.

ATOMS WITH MORE ELECTRONS

From the experimental values of the atoms with three electrons Li, Be^+, B^{2+} etc., if we calculated V_e using the formula $E = \frac{1}{2}mv_e^2$ and plotted with atomic number on the x axis we can find the clear linear relation of velocity.

Atom/Ion	Ionization Energy (eV)	Ionization Energy(J)	v_e calculated from $E = 1/2\ (mv^2)$
Lithium	5.391710	8.63752×10^{-19}	1377098.542
Be+	18.21115	2.91743×10^{-18}	2530873.519
B^{2+}	37.93064	6.07649×10^{-18}	3652555.647
C^{3+}	64.49390	1.03319×10^{-17}	4762786.082
N^{4+}	97.89020	1.56820×10^{-17}	5867746.781
O^{5+}	138.1197	2.21268×10^{-17}	6969948.499
F^{6+}	185.1860	2.96668×10^{-17}	8070600.156
Ne^{7+}	239.0989	3.83036×10^{-17}	9170447.839
Na^{8+}	299.8640	4.80382×10^{-17}	10269845.760

Table 7. Escape Velocity of Ions calculated using $E = \frac{1}{2}mv_e^2$

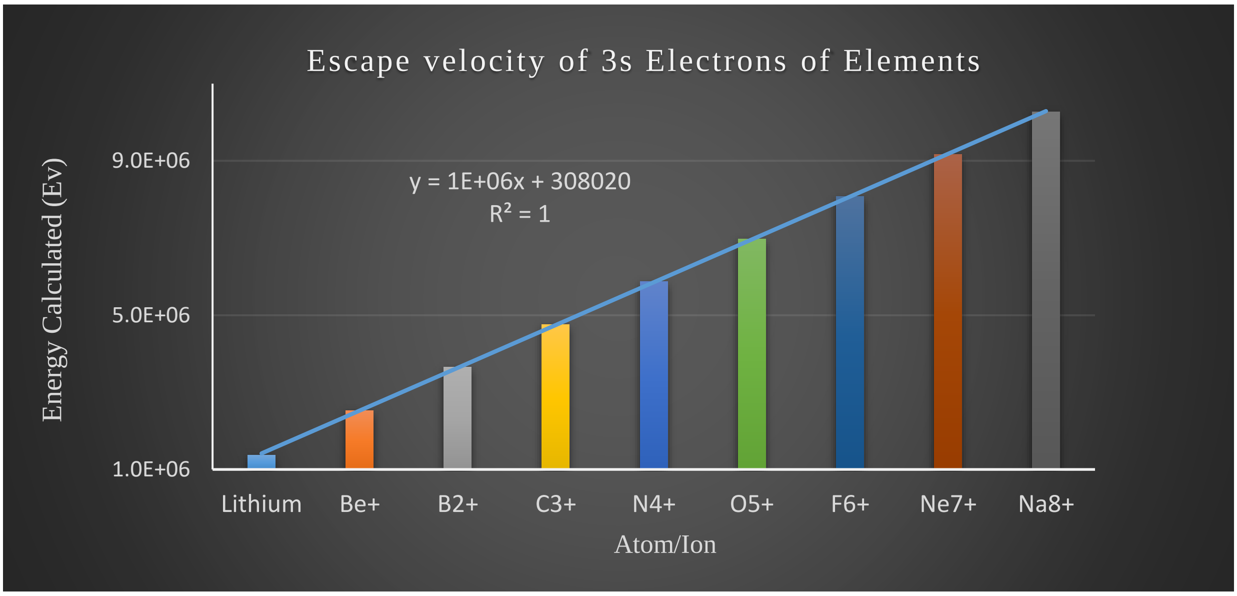

Fig 1. Escape Velocity of 3s electrons plotted, which exhibit a clear linear relation

The above is true with all the higher-level atoms and the energy levels are purely deterministic.

CONCLUSION

The discrete orbit and discrete energy level of atoms are not due to the fact that lights are coming in quantum, but due to the fact that elementary electron charges, when excited, can exist only in discrete values of e/n where $n = 1,2,3 \ldots$ is a positive integer. In contradiction with Bohr's postulate, the further the electron is from the nucleus, the less energy it should have as the KE is inversely proportional to radius. Bohr's assumption that angular momentum of the electron is an integral multiple of reduced Planck's constant, the classical analysis derives the spectral formula from the fundaments of conservation of angular momentum I.e. $mvr = Constant$. Rydberg constant is the Energy of the electron of Hydrogen atom at ground state ($e = e$) divided by hc. i.e. $(2.1787 \times 10^{-18})/hc$. In the above neoclassical theory, the formula for spectrum lines is derived from the fundamental forces using classic mechanics with a clear understanding on why the light of certain wavelengths are only absorbed or emitted by an excited atom. The theory shows that there is a serious flaw in the fundaments of quantum mechanics and the very necessity of quantum theory is being questioned. Why Schrodinger's wave equation has to be solved when the energy levels are calculated by classical mechanics. Moreover, Theory solves the helium like atoms, with two electrons, which is a forward leap from where Bohr and Schrodinger are struck. The neoclassical theory is explained by using a two-dimensional model. The two-dimensional atoms can be combined to form the three-dimensional molecules to build our three-dimensional world. Moreover, the atoms with more than 2 electrons might be forming a 3-dimensional shape keeping their relative position favoring the stability. Hope this will change our way of seeing the microscopic world and the way we perceive light.

REFERENCES

Balmer, J. J. J. A. d. p. (1885). Notiz über die Spectrallinien des Wasserstoffs. *261*(5), 80-87.

Bohr, N. (1913). The spectra of helium and hydrogen. *92*(2295), 231-232.

Bohr, N. (1954). Rydberg's discovery of the spectral laws.

Cotton, S. (2024). *Lanthanide and actinide chemistry*: John Wiley & Sons.

Fricke, B. (2007). Superheavy elements a prediction of their chemical and physical properties. In *Recent impact of physics on inorganic chemistry* (pp. 89-144): Springer.

Griem, H. R., Blaha, M., & Kepple, P. C. J. P. R. A. (1979). Stark-profile calculations for Lyman-series lines of one-electron ions in dense plasmas. *19*(6), 2421.

Hoffman, D. C., Lee, D. M., Pershina, V. J. T. c. o. t. a., & elements, t. (2006). Transactinide elements and future elements. 1652-1752.

Kramida, A. J. P. o. t. I. A. U. (2021). Legacy of Charlotte Moore Sitterly in the Internet Age. *18*(S371), 12-40.

Lincoln, J. (2019). The Lyman and Paschen series of hydrogen–Trying to see invisible light. *57*(5), 348-349.

Lyman, T., & Sciences. (1906). The spectrum of hydrogen in the region of extremely short wave-length. *13*(3), 125-146.

Lyman, T. J. N. (1914). An extension of the spectrum in the extreme ultra-violet. *93*(2323), 241-241.

Mohr, P. J., Taylor, B. N., Newell, D. B. J. J. o. P., & Data, C. R. (2008). CODATA recommended values of the fundamental physical constants: 2006. *37*(3), 1187-1284.

NAGAOKA, H., & MISHIMA, T. (1938). High Terms of Paschen Series in Hydrogen and Deuterium. *14*(2), 53-56.

Suemoto, Z., & Hiei, E. (1959). Balmer series lines of the flare and its structure. *11*, 185.