Simulation of Hydrogen Spectrum Series

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Abstract: ***Transition of hydrogen electron through S-orbits has been studied. Energy levels and frequencies of the emitted spectral lines were computed through new simple atomic model. The equations assume that, the energy and frequency of the emitted lines of six known series are related to enclosed areas of successive orbits and proportionality constants. These constants are strongly related to all spectral lines in all series. The results found from this model will give abroad understanding of quantum mechanics principles.***

Keywords: Atomic model, Rydberg's formula, S-orbits, spectrum series, Proportionality constant

1. Introduction

The frequency of wave of electrons orbiting the hydrogen nucleus at the ground state was calculated (Chen, Jing 2019). The result shows frequency the same as the value of light frequency corresponding to the ground state from the Rydberg's formula. (Dadarao Dhone ,2019) mentioned that, " When an electron is excited by external energy, it reaches to light speed ejecting out the extra energy in the form of light radiations. Light is emitted from excited electron at speed 'c'; hence, the respective electron emitting light; must revolve around its nucleus at speed 'c'. Inside an atom, complete electromagnetic field in between orbiting electrons and the protons in the nucleus, is packed totally inside of an atom". It can be stated that, starting from first principles and reviewing recent researches and results, this should lead to rethinking about atomic models and spectrum frequency in other ways.

In this work, a new approach was followed. The transition of hydrogen electron was considered to be relevant the enclosed areas between S-orbits and the nucleus. The outermost diameter, 1S, is assumed to be one atomic unit length.

2. Methodology

The transition of the electron of the hydrogen atom is considered herein. In this atomic model, it is assumed that the S-orbits are arranged from 1S at the outermost shell with a diameter equals one atomic unit (a. u.). Inner shells with S-orbits, the diameters are assumed to decrease in the following order, table (1).

Table 1: Diameters of S-orbits in hydrogen atomic model

Orbit	1S	2S	3S	4S	5S	6S	7S
Dia. (a. u.)	1	1/2	1/3	1/4	1/5	1/6	1/7

Consequently, the model assumes a series of concentric orbits for which the diameter reduces toward the nucleus axis. In other words, this model different from other models in the literature, as it is completely supposed the atom orbits are confined inside one unit diameter figure (1).

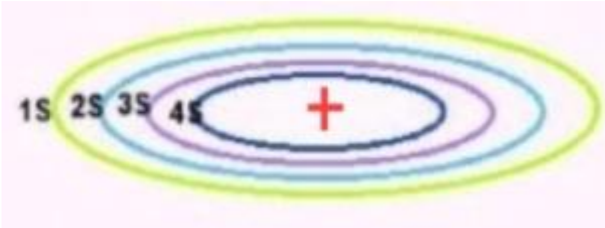

Figure 1: S-orbits Around Nucleus with 1S Outermost Orbit

When the electron is excited, transits from or to the nth s-orbit, it is considered that δA, the enclosed area of the orbit, is the transited area. Consequently, the frequency, f, of the radiated spectrum is assumed to be proportional to the orbit enclosed area δA, with a proportionality constant K_f,

$$f = \delta A.\ K_f \quad .\ .\ .\ . (1)$$

To examine the validity of this formula, the six well known spectrum series were tested. Namely, Lyman, Balmer, Paschen, Brakett, Pfund and Humphreys series (Casey Ray McMahon 2013). The known wave lengths in the series were considered to be dependent on the transition of the electron along the S-orbits. Given that, the relation between the frequency and wave length L, and the speed of light, C, the known equation

$$f = c\ /\ L \quad .\ .\ .\ . (2)$$

Thus, the wavelength

$$L = C\ /\ (\delta A.\ K_f) \quad .\ .\ .\ . (3)$$

$$L = C\ .\ K_L /\ \delta A \quad .\ .\ .\ .\ . (4)$$

Where $K_L = 1/K_f$

Another consideration is that the energy required for spectrum radiation is assumed to be related the charges of electron q^-, and nucleus proton q^+ and, A_s the area of the sphere formed by the orbit and I_o the moment of inertia of that sphere. A constant of proportionality K_e is shown in the proposed formula.

$$E = K_e * (q^+.\ q^-.\ I_o)/\ A_s \quad .\ .\ .\ .\ . (5)$$

The energy to be given in eV, electron volt. TO examine the proposed formula, the energy levels in shells were computed with the corresponding radiated spectrum wave lengths for the previous six series.

3. Results

The proportionality constants K_e and K_f were computed for energy levels and radiated spectrum frequencies in the series with the corresponding orbits enclosed area related to electron transition. The values of K_e, K_L and K_f were found:

K_e = 5.303 x 10^{38} eV/ (sq. a. u. C^2)

K_L= 2.3873 x 10^{-16}sec. (sq. a. u.)= 0.23873 femto second (sq. a. u.)

K_f=4.1889x 10^{15}1/ (sec. (sq. a. u.))= 4.1889 1/ femto seconds (sq. a. u.)

Table (2) summarizes the ranges of model parameters and results computed for 10 S-orbits in the atomic shells, (1S to 10S), in addition to 100S and 1000S orbits using the proposed equations above. Details of model simulation are shown in the appendix.

Table 2: Ranges of model parameters

Parameter	Range
Diameter (a. u.)	1 -1/1000
Energy (joule)	2.180x10^{-18}- 2.180x10^{-24}
Energy (eV)	13.61 - 0.000014
Wavelength (nm)	91.15 -91151857.20
Frequency. (1/sec)	3.291x10^{15}- 3.291x10^{9}

Appendix

Model Simulation Results

Shell No.	1								2			
1/ Diameter (1/a.u.)	1.000	1.010	1.014	1.021	1.033	1.061	1.155	1.414	2.000	2.008	2.087	2.121
Diameter (a.u.)	1	0.990	0.986	0.980	0.968	0.943	0.866	0.707	0.500	0.498	0.479	0.471
Energy (joule)	2.180E-18	2.135E-18	2.120E-18	2.093E-18	2.044E-18	1.938E-18	1.635E-18	1.090E-18	5.450E-19	5.406E-19	5.005E-19	4.844E-19
Energy (eV)	13.61	13.33	13.23	13.07	12.76	12.10	10.21	6.80	3.40	3.38	3.12	3.02
Wavelength (nm)	91.15	93.05	93.75	94.95	97.23	102.54	121.54	182.30	364.61	367.54	397.01	410.17
Orbit Area (sq a.u.)	0.785714	0.769690	0.763946	0.754292	0.736613	0.698473	0.589286	0.392857	0.196429	0.194860	0.180396	0.174607
Frequency (1/s)	3.291E+15	3.224E+15	3.200E+15	3.160E+15	3.086E+15	2.926E+15	2.468E+15	1.646E+15	8.228E+14	8.162E+14	7.556E+14	7.314E+14
Wavelength (nm)	91.15	93.05	93.75	94.95	97.23	102.54	121.54	182.30	364.61	367.54	397.01	410.17
			Lyman Series								Balmer Seris	

4. Conclusion

Hydrogen electron excitation through s-orbits has been studied in addition to energy and frequencies of the spectrum lines were computed through newly developed atomic model in which atom orbits are confined inside one unit diameter. The equations based on the assumption that, the energy and frequency of the emitted spectral lines for the six known series related to enclosed areas by the S-orbits in the hydrogen electron transits. The constants are strongly related to all spectral lines in all series. The equations are quite simple. Energy values and frequencies are easily computed. This result will lead to search for more atomic and nuclear knowledge to investigate the structure of the atom and electron configuration.

References

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2								3					
2.000	2.008	2.087	2.121	2.182	2.309	2.683	2.732	3.000	3.030	3.145	3.181	3.236	3.32
0.500	0.498	0.479	0.471	0.458	0.433	0.373	0.366	0.333	0.330	0.318	0.314	0.309	0.30
5.450E-19	5.406E-19	5.005E-19	4.844E-19	4.578E-19	4.087E-19	3.028E-19	2.920E-19	2.422E-19	2.374E-19	2.204E-19	2.155E-19	2.081E-19	1.976E-1
3.40	3.38	3.12	3.02	2.86	2.55	1.89	1.82	1.51	1.48	1.38	1.35	1.30	1.2
364.61	367.54	397.01	410.17	434.05	486.13	656.27	680.46	820.37	837.02	901.39	922.15	954.66	1005.4
0.196429	0.194860	0.180396	0.174607	0.165002	0.147326	0.109132	0.105251	0.087302	0.085564	0.079455	0.077666	0.075021	0.07123
8.228E+14	8.162E+14	7.556E+14	7.314E+14	6.912E+14	6.171E+14	4.571E+14	4.409E+14	3.657E+14	3.584E+14	3.328E+14	3.253E+14	3.142E+14	2.984E+14
364.61	367.54	397.01	410.17	434.05	486.12	656.26	680.46	820.36	837.02	901.38	922.14	954.66	1005.4
		Balmer Seris								Paschen Seris			

			4					5					
3.321	3.465	3.751	4.000	4.365	4.536	4.619	4.874	5.000	5.102	5.236	5.376	5.525	5.74
0.301	0.289	0.267	0.250	0.229	0.220	0.217	0.205	0.200	0.196	0.191	0.186	0.181	0.17
1.976E-19	1.816E-19	1.549E-19	1.362E-19	1.144E-19	1.060E-19	1.022E-19	9.175E-20	8.720E-20	8.374E-20	7.953E-20	7.542E-20	7.142E-20	6.600E-2
1.23	1.13	0.97	0.85	0.71	0.66	0.64	0.57	0.54	0.52	0.50	0.47	0.45	0.4
1005.41	1094.39	1282.46	1458.43	1736.36	1875.11	1944.69	2165.72	2278.80	2372.76	2498.61	2634.75	2782.33	3010.7
0.071234	0.065442	0.055845	0.049107	0.041247	0.038195	0.036828	0.033070	0.031429	0.030184	0.028664	0.027183	0.025741	0.02378
2.984E+14	2.741E+14	2.339E+14	2.057E+14	1.728E+14	1.600E+14	1.543E+14	1.385E+14	1.316E+14	1.264E+14	1.201E+14	1.139E+14	1.078E+14	9.965E+1
1005.41	1094.39	1282.46	1458.42	1736.35	1875.10	1944.68	2165.71	2278.79	2372.75	2498.60	2634.74	2782.32	3010.6
						Brakett Seris							

	6		7		8		9			10		100	1000
5.747	6.000	6.667	7.000	7.500	8.000	8.050	9.000	9.046	9.524	10.000	11.649	100.000	1000.000
0.174	0.167	0.150	0.143	0.133	0.125	0.124	0.111	0.111	0.105	0.100	0.086	0.010	0.001
6.600E-20	6.055E-20	4.904E-20	4.449E-20	3.875E-20	3.406E-20	3.364E-20	2.691E-20	2.664E-20	2.403E-20	2.180E-20	1.606E-20	2.180E-22	2.180E-24
0.41	0.38	0.31	0.28	0.24	0.21	0.21	0.17	0.17	0.15	0.14	0.10	0.0014	0.000014
3010.70	3281.47	4051.50	4466.44	5127.63	5833.72	5907.21	7383.30	7458.44	8267.74	9115.19	12369.31	911518.57	91151857.2
0.023788	0.021825	0.017677	0.016035	0.013967	0.012277	0.012124	0.009700	0.009602	0.008663	0.007857	0.005790	0.000079	0.000001
9.965E+13	9.142E+13	7.405E+13	6.717E+13	5.851E+13	5.143E+13	5.079E+13	4.063E+13	4.022E+13	3.629E+13	3.291E+13	2.425E+13	3.291E+11	3.291E+09
3010.68	3281.45	4051.48	4466.42	5127.60	5833.69	5907.18	7383.27	7458.41	8267.71	9115.15	12369.26	911514.55	91151454.55
						Pfund Seris				Humphreys Seris			