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The electron orbit which considered the Planck constant in the atomic shell

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In this paper, we propose the angular moment of electron is always constant in the atomic shell [1],[2].

The first electron around the n-proton with $Q(=nQ_e)$ charge. Figure 1 shows the image diagram of the orbit of first electron.

We assume the angular moment is the same value as the Planck constant and the orbit is a circle.

(i) By the balance in the circle

$$\frac{m_e v^2}{r} = \frac{k_0 Q_e Q}{r^2} \left(= \frac{n k_0 Q_e^{\,2}}{r^2}\right) \quad \therefore\ m_e r v^2 = n k_0 Q_e^{\,2} \qquad (1)$$

where Q_e is elementary charge, m_e is electron mass, k_0 is Coulomb constant, r is orbit radius, v is speed, n is number.

$$\therefore\ \left(\frac{v}{\mathrm{c}}\right)^2 = \frac{n k_0 Q_e^{\,2}}{m_e r \mathrm{c}^2} = \frac{nR_0}{r} \ , R_0 = \frac{k_0 Q_e^{\,2}}{m_e \mathrm{c}^2} \qquad (2)$$

where c is light velocity, R_0 is minimum radius of charge. It corresponds to the Schwarzschild radius of gravity theory.

(ii) Using the angular moment by the hypothesis.

$$\hbar (= m_e r_1 u_1) \doteqdot m_e r_1 v_1 \quad \therefore\ v_1 = \frac{h}{2\pi m_e r}, u_1 = \frac{v_1}{\sqrt{1-\left(\frac{v_1}{\mathrm{c}}\right)^2}} \qquad (3)$$

where h is Planck constant, $\hbar$ is Dirac constant, u_1 is relativistic speed [1].

By the relation (i),(ii). We can get the Bohr radius and speed.

$$\frac{nR_0}{r}\left[= \left(\frac{v}{\mathrm{c}}\right)^2\right] = \left(\frac{\hbar}{m_e r \mathrm{c}}\right)^2 \quad \therefore\ r = \frac{1}{n}\frac{\hbar^2}{m_e^{\,2}\mathrm{c}^2 R_0} = \frac{1}{n} r_1 \qquad (4)$$

$$r_1 = \frac{h^2}{4\pi^2 m_e^{\,2} \mathrm{c}^2 R_0} = \frac{\hbar^2}{\pi m_e k_0 Q_e^{\,2}} = 5.29166\times 10^{-11} \ ,$$

$$v = \frac{\hbar}{m_e r} = n\frac{\hbar}{m_e r_1} = n v_1 \qquad (5)$$

where r_1 is Bohr radius, v is speed.

Then, the energy E of the electron around the proton is

$$E = m_e \mathrm{c} C_0 = \frac{m_e \mathrm{c}^2}{\sqrt{1-\left(\frac{v}{\mathrm{c}}\right)^2}} e^{-\frac{nR_0}{r}} = \frac{m_e \mathrm{c}^2}{\sqrt{1-\left(\frac{n v_1}{\mathrm{c}}\right)^2}} e^{-\frac{n^2 R_0}{r_1}}$$

$$= m_e \mathrm{c}^2 \left(1 + \frac{1}{2}\frac{n^2 R_0}{r_1} + \cdots\right)\left(1 - \frac{n^2 R_0}{r_1} + \cdots\right) \qquad (6)$$

$$= m_e \mathrm{c}^2 \left(1 - \frac{n^2}{2}\frac{R_0}{r_1} + \cdots\right)$$

Therefore, the formula of the n-th ionization energy $X^{+(n-1)} \to X^{+n}$ is

$$N_A (m_e \mathrm{c}^2 - E)/1000$$

$$= N_A \left(m_e \mathrm{c}^2 - \frac{m_e \mathrm{c}^2}{\sqrt{1-\left(\frac{n v_1}{\mathrm{c}}\right)^2}} \mathrm{e}^{-\frac{n^2 R_0}{r_1}}\right)/1000 \qquad (7)$$

$$= 1312.7 \times n^2$$

where $N_A = 6.02214\times 10^{23}$ is the Avogadro number and X^{+n} means the bare atomic nucleus.

In the case of hydrogen, the orbit shape is an elliptic orbit. The solutions of the “orbit equation” is follow equation:

$$\left(\frac{d\frac{1}{r}}{d\Phi}\right)^2 = -\frac{\mathrm{c}^2}{C^2} + \frac{C_0^{\,2}}{C^2} e^{2\frac{R_0}{r}} - \frac{1}{r^2} \qquad (8)$$

where Φ is relativistic angular, C is the area speed constant, C_0 is the speed constant for energy function. It is calculated that the radius are $r_1 = 5.16491\times 10^{-11}$ (perihelion) and $r_2 = 5.42420\times 10^{-11}$ (aphelion).

Here, $E = m_e \mathrm{c} C_0 = 1312.0/1000 \times N_A$ is an orbit energy and $C = r_1 v_1 = 1.15768\times 10^{-4}$ is a speed of area. Therefore the orbital eccentricity is 0.0244865. Table 1 shows ionization energy (as called I. E.) and calculated I. E. radius.

The electron move on the resonance orbit which is expressed by the angular moment (or Planck constant) of the electric field. Temperature is the frequency of light which has been caused by acceleration amount.

Table 1. Ionization energy and calculated I. E. and radius.

Atom	H	He	Li	Be
I.E. [kJ/mol]	1312.0	5250.3	11814.7	21006.6
Calculated I.E.[kJ/mol]	1312.7	5250.8	11814.3	21003.2
Radius×10^(-11)	5.292	2.646	1.764	1.323

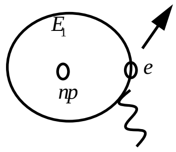

Figure 1 The image diagram of the orbit of first electron.

References

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[2] Y. Takemoto, S. Shimamoto, The Boltzmann constant, the Planck constant and the Temperature, Bull. of NBU, Vol. 44, No.2 (2016 - Oct.), p.p. 55-65.