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Quantization of energy

Discrete spectrum of energy levels in atoms

List of atomic models

- Dalton's atomic model
- Thomson's plum pudding model
- Rutherford atomic model
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- Sommerfeld's non relativistic model
- Sommerfeld's relativistic model
- Vector atomic model

List of drawbacks of rutherford's atomic model

- Could not explain stability of atom
- Could not explain spectral line of hydrogen

Number of postulates in Bohr's atomic model

3

Statement of first postulate of Bohr's atomic model

- Revolution of electron only in those orbits for which angular momentum of electron is an integral multiple of
- $$\frac{h}{2\pi}$$

Magnitude of planck's Constant

$$h = 6.6210^{-34} Js$$

Permitted orbits in Bohr's atomic model

- Orbits at which the angular momentum of electron is
-

$$\frac{h}{2\pi}$$

Statement of second postulate of Bohr's atomic model

- Electron does not emit electromagnetic radiation at permitted orbits

Statement of third postulate of Bohr's atomic model

- Emission of photon on jumping from stationary orbit of higher energy to orbit of lower energy

Expression for frequency of photon on jumping from orbit of higher energy to orbit of lower energy

$$f = \frac{E_i - E_f}{h}$$

Expression for electrostatic force of attraction between the nucleus and the electron in bohr's model of atom

$$F = \frac{1}{4\pi\epsilon_0}\frac{Ze(-e)}{r^2}$$

Expression for relation of electrostatic force with centripetal force in bohr's model of atom

$$\frac{mv^2}{r} = \frac{1}{4\pi\epsilon_0}\frac{Ze(-e)}{r^2}$$

Expression of relation of angular momentum in bohr's first postulate

$$mvr = n\frac{h}{2\pi}$$

Derivation for expression of radius in bohr's atomic model

- $$mvr = n\frac{h}{2\pi}$$
- $$v = \frac{nh}{2\pi mr}$$
- $$v^2 = \frac{n^2h^2}{4\pi^2m^2r^2}$$
- $$\frac{mv^2}{r} = \frac{Ze^2}{4\pi\epsilon_0 r^2}$$
- $$\frac{m}{r}(\frac{n^2h^2}{4\pi^2m^2r^2}) = \frac{Ze^2}{4\pi\epsilon_0 r^2}$$
- $$r = \frac{n^2h^2\epsilon_0}{\pi e^2 Zm}$$

Expression for radius in bohr's atomic model

$$r = \frac{n^2h^2\epsilon_0}{\pi e^2 Zm}$$

Total energy of electron in an orbit in bohr's model

Sum of kinetic energy and potential energy of the electron

Expression for kinetic energy in bohr's model

$$\text{Kinetic Energy} = \frac{1}{2}mv^2 = \frac{1}{8\pi\epsilon_0}\frac{Ze^2}{r}$$

Expression for potential energy in bohr's model

$$\text{Potential Energy} = -\frac{1}{4\pi\epsilon_0}\frac{Ze^2}{r}$$

Derivation for total energy of electron in bohr's model

- $$\text{Total energy} = \text{Kinetic Energy} + \text{Potential Energy}$$
- $$E_n = \frac{1}{8\pi\epsilon_0}\frac{Ze^2}{r} - \frac{1}{4\pi\epsilon_0}\frac{Ze^2}{r}$$
- $$E_n = -\frac{1}{8\pi\epsilon}\frac{Ze^2}{r}$$
- $$E_n = -\frac{me^4Z^2}{8\epsilon_0^2n^2h^2}$$

Expression for total energy of the electron in Bohr's atomic model

- $$E_n = -\frac{me^4Z^2}{8\epsilon_0^2n^2h^2}$$

Derivation for expression of spectral lines in Bohr's atomic model

- $$f = \frac{E_{n_2} - E_{n_1}}{h}$$
- $$f = -(\frac{me^4}{8\epsilon_0^2h^3})\frac{1}{n_2^2} + (\frac{me^4}{8\epsilon_0^2h^3})\frac{1}{n_2^2}$$
- $$f = \frac{me^4}{8\epsilon_0^2h^3}(\frac{1}{n_1^2} - \frac{1}{n_2^2})$$
- $$\frac{c}{\lambda} = \frac{me^4}{8\epsilon_0^2h^3}(\frac{1}{n_1^2} - \frac{1}{n_2^2})$$
- $$\frac{1}{\lambda} = \frac{me^4}{8\epsilon_0^2ch^3}(\frac{1}{n_1^2} - \frac{1}{n_2^2})$$
- $$\frac{1}{\lambda} = R(\frac{1}{n_1^2} - \frac{1}{n_2^2})$$

Expression for spectral lines in Bohr's atomic model

- $$\frac{1}{\lambda} = R(\frac{1}{n_1^2} - \frac{1}{n_2^2})$$

Expression of Rydberg constant in bohr's atomic model

$$R = \frac{me^4}{8\epsilon^2 ch^3}$$

Magnitude of Rydberg constant in Bohr's atomic model

$$R = 1.097 \times 10^7 m^{-1}$$

Name of spectral series at $n_1 = 1$ in Bohr's atomic model

Lyman Series

Name of spectral series at $n_1 = 2$ in Bohr's atomic model

Balmer Series

Name of spectral series at $n_1 = 3$ in Bohr's atomic model

Paschen Series

Name of spectral series at $n_1 = 4$ in Bohr's atomic model

Brackett series

Name of spectral series at $n_1 = 5$ in Bohr's atomic model

Pfund series

Orbit represented by Lyman series in Bohr's atomic model

1

Orbit represented by Balmer series in Bohr's atomic model

2

Orbit represented by Paschen series in Bohr's atomic model

3

Orbit represented by Brackett series in Bohr's atomic model

4

Orbit represented by Pfund series in Bohr's atomic model

5

Location of Lyman series in optical region in Bohr's atomic model

Ultra voilet

Location of Balmer series in optical region in Bohr's atomic model

Visible

Location of Paschen series in optical region in Bohr's atomic model

Near infrared

Location of Brackett series in optical region in Bohr's atomic model

Far infrared

Location of Pfund series in optical region in Bohr's atomic model

Very far infrared