Atoms and Nuclei

Impact Parameter, θ = angle of scattering	$b = \frac{1}{4\pi\epsilon_o}\frac{ze^2 \cot\left(\frac{\theta}{2}\right)}{E_K}$

Bohr's Atomic Orbital

Electrons revolve in a stable orbit, forming stationary wave

Angular momentum of the electron is quantised.

Photon or energy is emitted due to transition of electron form higher to stable orbit

Angular Momentum	$L = n\frac{h}{2\pi}$
Velocity	$v = 2.2 \times 10^6 \frac{Z}{n}$
Radius	$r = 0.53\frac{n^2}{Z}$
Frequency	$f = \frac{2}{3} \times 10^{16}\frac{Z^2}{n^3}$
Kinetic Energy	$E_k = \frac{13.6Z^2}{n^2}$

$K.E : P.E : T.E = 1:2:-1$

de-Broglie's Explanations of Bohr's Second Postulate

According to de-Broglie, a stationary orbit is that which contains an integral number of de-Broglie waves associated withrevolving electrons.

For electron revolving in n^{th} orbit of radius r_n

$$2\pi r_n = n\lambda = \frac{nh}{mv_n}$$

$$mv_n r_n = \frac{nh}{2\pi}$$

Emission Spectrum of Hydrogen Atom

$\nu = \frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] \times Z^2$	n_1 & n_2 = *energy levels of transitions* R_H = *Rydberg Cosntant* Z = *atomic number*
Number of Spectrum lines	$\frac{(n_2 - n_1)(n_2 - n_1 + 1)}{2}$

Spectrum Lines of Hydrogen atom

Series	n_1	n_2	Spectral Region
Lyman	1	2,3...	UV
Balmer	2	3,4...	Visible
Paschen	3	4,5...	IR
Brackett	4	5,6...	IR
Pfund	5	6,7....	IR

Nuclei

Radius of nucleus	$R = R_0 A^{1/3}$ $R_0 = 1.1 \times 10^{-15}$m
$r_n = n^2 r_1$	**Relation of radius of n^{th} orbit with 1^{st} orbit**
Rest Mass Energy	$E = m_0 c^2$
Mass Defect	$\Delta M = [Zm_p + (A - Z)m_n] - M$
	The difference between the sum of masses of all nucleons (M) and mass of the nucleus (m) is called mass defect
Nuclear Binding Energy	$E_b = \Delta M c^2$

Radioactivity

Rate of Disintigration where, λ is the decay constant	$-\frac{dN}{dt} = \lambda N$
Number of Nuclei present Undecayed at any instant	$N_t = N_0 e^{-\lambda t}$
Half-life of a Radioactive Element	$T_{1/2} = \frac{0.693}{\lambda}$
Number of Nuclie after n half-life	$N = \frac{N_0}{2^n}$
Equivalent Half-life for two simultaneous Decay	$t_{1/2} = \frac{t_1 t_2}{t_1 + t_2}$

Property	α-particle	β-particle	γ-rays
Nature	Helium nucleus	Fast moving electrons	EM Waves
Charge	+2e	−e	Zero
Rest Mass	6.67×10^{-27} kg	9.1×10^{-31} kg	Zero
Speed	1.4×10^{7} to $2.2 \times 10^{7}\ ms^{-1}$	1 to 99% of c $=3 \times 10^{8} ms^{-1}$	$3 \times 10^{8} ms^{-1}$
Ionising Power	10^4	10^2	1
Penetrating Power	1	10^2	10^4