Modern physics

$R = 1.09 \times 10^7 /m$
$R \simeq 10^7 /m$
$\frac{1}{R} \approx 91\ nm \simeq 90nm$

Atom & Nuclei

① Rutherford model

$k_i + U_i = k_f + U_f$

$k_i = U_f$ $U_F = k_f = 0$

$r_0 = \frac{2kZ_1Z_2e^2}{m V_0^2}$ $r \propto \frac{1}{m}$

m = mass of particle collides on Au

② No. of α-particle scattered (N)

$N \propto 1/\sin^4(\theta/2)$ Imp

③ $E = -13.6\ eV \frac{z^2}{n^2}$

~~$|E| = |K|$~~ = $|E| = K = \frac{|U|}{2}$

④ Absorption spectrum — $(n-1)$

⑤ Emission spectrum — $\frac{n(n-1)}{2}$

(Electrostatic) potential energy pairs form"

⑥ wave no. $= \frac{1}{\lambda} = +RZ^2\left[\frac{1}{n_i^2} - \frac{1}{n_f^2}\right]$

E_1 hydrogen $= E_2\ He^+$
E_2 Hydrogen $= E_4\ He^+$
E_3 Hydrogen $= E_6\ He^+$

$T \propto n^3$

$B = 1/n^5$

⑦ Atomic Recoil.

$P_i = P_f$

$0 = -mV_{recoil} + P_{photon}$

$mV_{recoil} = \frac{h}{\lambda}$ $P_{photon} = \frac{E}{c} = \frac{h}{\lambda}$

eg. → 1st line of Balmer means $n_1 = 2, n_2 = 3$

→ last line / series limit of Balmer $n_1 = 2, n_2 = \infty$

→ first excited state mean $n = 2$

Nuclei

① Radius

$R \propto A^{1/3}$

$R = R_0 A^{1/3}$ (R_0 = 1.2 fm)

② volume : $V = \frac{4}{3}\pi R^3 = \frac{4\pi}{3} R_0^3 A$

③ density

— doesn't depend on (A).

$\rho \approx 2.3 \times 10^{17}\ kg/m^3$ $2.3 \times 10^{17}\ kg/m^3$

⇒ Binding Energy

① $B.E = \Delta m \times 931\ MeV$.

② B.E/Nucleon ⇒ $\frac{B.E.}{A} \propto$ stability

B.E of α (7.2) MeV & Fe (8.8 MeV)

③ Q value $= \Delta m \times 931\ MeV$ (for amu)

α-Decay (A > 210)

① Linear momentum cons.

$_Z^AX \longrightarrow\ V_y \leftarrow\ _{Z-2}^{A-4}Y + {}_2^4\alpha \rightarrow V_\alpha$

$P_i = P_f$

$0 = 4V_\alpha - (A-4)V_y$

$\therefore V_y = \frac{4V_\alpha}{(A-4)}$ $K.E = \frac{p^2}{2m}$

② $K_\alpha = \left[\frac{A-4}{A}\right] Q\ value$ $K_y = \left[\frac{4}{A}\right] Q\ value$

$10^6 \times 1.6 \times 10^{-19}$ ⇒ 1 MeV