MIND MAP

Nuclear Physics

Radius of a Nucleus

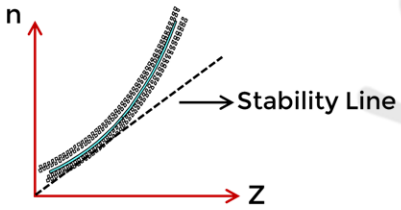
$$R = R_0 A^{\frac{1}{3}}$$

Density of Nucleus (ρ) =

$$\frac{\text{Mass}}{\text{Volume}} = \frac{\text{Mass of 1 Nucleon} \times A}{\frac{4}{3}\pi R^3 = \frac{4}{3}\pi R_0^3 A}$$

Nuclear Force Theory

Nuclear force is a force which holds the Nucleons together.



For atomic number < 20, most stable Nuclei have n : p ratio nearly 1 : 1

For n/p ratio > 1.52, Nucleus is unstable.

For atomic number > 83, there are no stable nuclei.

Mass Defect

The difference (Δm) between mass of constituent nucleons and the nucleus is called mass defect of nucleus.

$$\underbrace{{}^{m}p}_{m_1} + \underbrace{{}^{n}n}_{m_2} \longrightarrow \underbrace{{}^{m+n}X}_{m_3} + \text{Energy (BE of nucleus)}$$

Q-value

$$\underset{m_A}{A} + \underset{m_B}{B} \longrightarrow \underset{m_C}{C} + \underset{m_D}{D} + \text{Energy}$$

Reactants ⟶ Products + Q-Value

If BE products > BE reactants then energy will be released

Q value = |BE products − BE reactants|

$$\text{Q-value} = [(m_A + m_B) - (m_C + m_D)]c^2$$

$$\text{Q-value} = (KE_C + KE_D) - (KE_A + KE_B)$$

Representation of atom ${}_zX^A$

A = Mass number z = Atomic number

Atomic mass unit(amu)

$$1 \text{ amu (u)} = \frac{1}{12}(\text{Mass of Carbon} - 12 \text{ atom})$$

$$1 \text{ amu} \equiv 931.5 \text{ MeV}$$

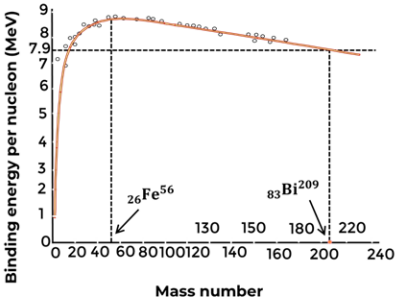
Binding Energy of Nucleus

Binding energy of nucleus is energy released when constituent nucleon are bought from infinity to form nucleus.

$$2p + 2n \longrightarrow {}^{4}_{2}He + \text{Energy}$$

Binding energy of nucleus $= \Delta mc^2$

$$\text{B.E. per nucleon} = \frac{\text{B. E.}}{\text{No. of nucleons}}$$



Nuclear binding energy is maximum for mass number 50–60.

Mass and Energy

Mass m of a particle is equivalent to energy given by $E = mc^2$.
It is also kown as rest mass energy.

mass defect $= \Delta m = (m_1 + m_2) - m_3$

$BE = (\Delta m)c^2$