Class : 12th Physics
Chapter : 13 Nuclei

Nuclei

- **Composition**
  - Nuclei consists of protons and neutrons.
  - Total No. of protons & neutrons in the nucleus is called nucleons
  - $_ZX^A$, A = Z + N = Mass Number
    A = Atomic Number
    N = No. of neutrons
- **Contribution**
  - In 1896, Henri Becquerel discovers Radioactivity.
- **Mass Energy Reaction**
  - Einstein shows that mass is an another form of energy and gives a relation $E = mc^2$
- **Mass Defect**
  - $\Delta M = [Z m_p + (A - Z)m_n] - M$
    m_p = mass of proton, m_n = mass of neutron
    M = mass of nucleus
- **Binding Energy**
  - B.E. = $\Delta Mc^2 = [Z m_p + (A - Z)m_n - M] \times c^2$
  - B.E. per nucleon = B.E/A
- **Nuclear Fission**
  - Splitting of a heavy nucleus into two or more lighter nuclei.
  - $_{92}U^{235} + {}_0n^1 \rightarrow {}_{56}Ba^{141} + {}_{36}Kr^{92} + 3{}_0n^1 + 200$ mev
- **Nuclear Fusion**
  - Combining two lighter nuclei to form a heavy nucleus
  - $^1_1H + ^1_1H \rightarrow ^2_1H + e^+ + \nu + 0.42$ MeV (energy)
- **Types of Nuclei**
  - **Isotones**
    - Atoms whose nuclei having same number of neutron (N)
    - e.g. $_{11}Na^{23}$, $_{12}Mg^{24}$
  - **Isotopes**
    - Same atomic No.(Z)
    - Different mass No.(A)
    - e.g. $_6C^{12}$, $_6C^{14}$
  - **Isobars**
    - Same mass No.(A)
    - Different atomic No.(Z)
    - e.g. $_6C^{14}$, $_7N^{14}$
- **Size of Nuclei**
  - **Nuclear Density**
    - $\rho = \frac{\text{mass of nucleus}}{\text{volume of nucleus}} = \frac{A \times 1.67 \times 10^{-27}}{\frac{4}{3}\pi \times (1.2 \times 10^{-15})^3 \times A} \approx 2.9 \times 10^{17}$ kgm^{-3} (independent of A)
  - **Nuclear Volume**
    - $V = \frac{4}{3}\pi R^3 = \frac{4}{3}\pi R_0^3 A$
    - $V \propto A$ (mass no.)
  - **Nuclear Radius**
    - $R = R_0 A^{1/3}$
    - $R_0 = 1.2 \times 10^{-15}$ **m**
    - A = Mass No.
- **Properties of α, β & γ**
  - **α - Particle**
    - is a heavy doubly ionized helium ion
    - least penetrating power
    - highest ionizing power
    - decay of 1 α particle cause decrease in atomic no. by 2 and mass no. by 4.
  - **β - Particle**
    - is an electron moderate penetrating power (100 times α)
    - less ionizing power than α –particle
    - one β – particle decay cause increase in atomic no. by 1 and mass no. remains unchanged.
  - **γ Rays**
    - A wave having high frequency having no mass,
    - least ionizing power but highest penetrating power
    - No charge in atomic No. and Mass No. on γ decay.
- **Radioactivity**
  - **Disintegration of heavy elements into comparatively lighter elements by emission of α β and γ radiations**
    - **Law of radioactivity**
      - $\frac{-dN}{dt} = \lambda N$
      - $N = N_0 e^{-\lambda t}$
    - **Half life**
      - $t_{\frac{1}{2}} = \frac{0.693}{\lambda}$
      - $N = N^0 \left(\frac{1}{2}\right)^{t/t_{\frac{1}{2}}}$
    - **Mean Life**
      - $\tau = \frac{1}{\lambda} = t_{\frac{1}{2}} / 0.693$

GGSRDN
Educational Services Private Limited
NEET, JEE(Mains/Advanced)
अभ्यास ही सबसे बड़ा गुरु है।