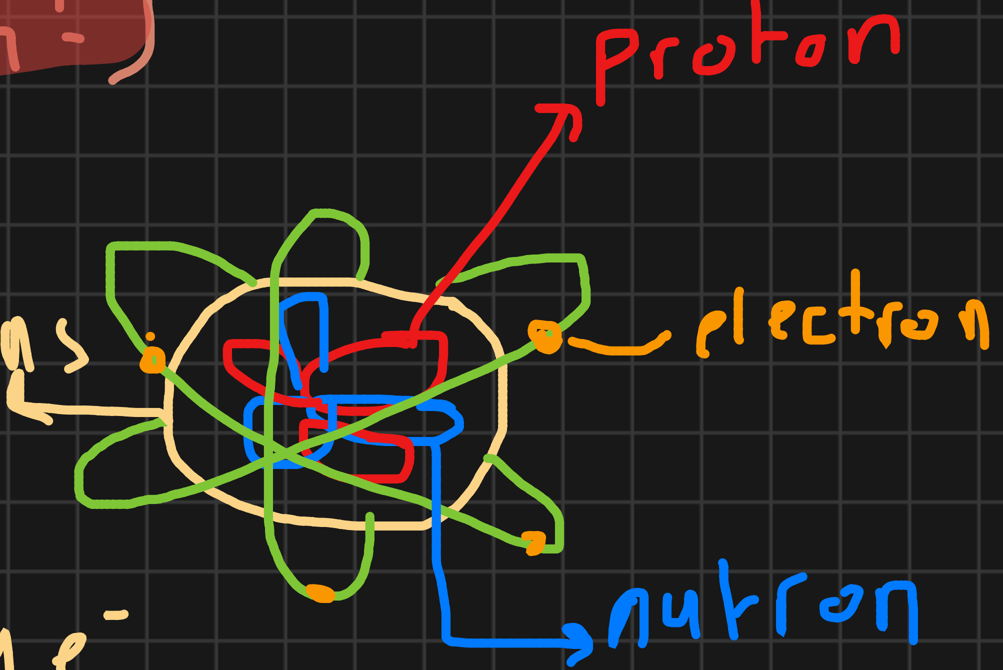
Chapter 30

رب أشرح لي صدري و يسر لي أمري و احلل عقدة من لساني
يفقه قولي بسم الله الفتاح ، اللهم لا سهل ألا ما جعلته سهلا و
انت تجعل الحزن اذا شئت سهلا يا ارحم الراحمين...

The atom made up of electrons and nucluse and nucluse made up of $(p^+, n^{\pm})$



Atom

$m_{p^+} \simeq m_{n^{\pm}} > m_{e^-}$

charg $p^+ = -$ charge e^-

A: Mass number

$$A = Z + N$$

$$^{A}_{Z}X_{N}$$

Z: proton number

N: nutron number

A neutral atom has the same number of p^+ and $n^{\pm}$.

No net charg

isotopes: → same number of p^+
different number of $n^{\pm}$

isotones: → same no. ($n^{\pm}$) different no. (p^+)

isobars: Same mass number

$^{40}_{18}Ar = {}^{40}_{19}K$

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to calculate the radius of nucluse

$$R = 1.2 \times 10^{-15} \sqrt[3]{A}$$

$$10^{-15} = fe \equiv fermi$$

NOTE :→

→ Density of Nuclear is 10^{15} times greater than the density of normal matter

→ Radus of atom is 10^5 times greater than the radus of nucluse.

→ $mass_{atom} \simeq mass_{nucluse}$

$$\frac{mass_{atom}}{mass_{nucluse}} \simeq 1$$

The atomic mass unit is (u)

$1u = 1.6605 \times 10^{-27}$ kg

we can also measure the mass by unit of energy

By Einsteins equation

$E = mc^2$

(m: mass; c: constant; E: energy)

$m = \frac{E}{c^2}$

How much 1u in unit of eV?

1u in kg

$E = (1.66 \times 10^{-27}) \times (2.9979 \times 10^{8})^2$ → in Joule

1 eV → 1.6×10^{-19} J

$\frac{(1.66 \times 10^{-27})(2.99 \times 10^{8})^2}{1.6 \times 10^{-19}}$

$= 931.5 \times 10^{6}$ eV

931.5 MeV

(m → u)

$mc^2 = 931.5$ MeV

$1u = 931.5 \frac{MeV}{c^2}$

unit of mass in eV

Radioactivity

unstable nuclei → emit ($n^{\pm}$, p^{+}, e^{-}, α, γ, β, xray) → stable nuclei

radio activty

- **natural radio activity**
  like: U^{235}_{92} , U^{238}_{92}
- **artifical radioactivity**
  like: (californium)

Alpha (α) particles: $2p^{+}$ and $2n^{\pm}$

$$\alpha \equiv {}^{4}_{2}He^{++}$$

can be stopped by paper

$\beta^{\pm}$ particles:
- → β^{-} is e^{-}
- → β^{+} is e^{+}

can be stopped by using few mm of alumium

γ - radiation: very high radation

can be stopped by several cm of lead.

radio active decay law

$$N = N_0 e^{-\lambda t}$$

N: the remaing number of radioactive nuclei at (t)

N_0: inital number of radio active nuclei at $t = 0$

λ: decay constant

$$\left\{ \lambda = \frac{\ln 2}{t_{\frac{1}{2}}} \right\}$$

$$t_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$$

Larg λ → small $t_{\frac{1}{2}}$ → fast decay

Small λ → larg $t_{\frac{1}{2}}$ → slow decay

$$N = N_0 e^{-\lambda t}$$

after $t_{1/2}$ $N = \frac{N_0}{2}$

$$\frac{N_0}{2} = N_0 e^{-\lambda t_{\frac{1}{2}}}$$

$$\ln \frac{1}{2} = \ln e^{-\lambda t_{\frac{1}{2}}}$$

$$\ln \frac{1}{2} = -\lambda t_{\frac{1}{2}}$$

$(\ln 1 - \ln 2) =$

$(0 - \ln 2) = -\ln 2$

$$-\ln 2 = -\lambda t_{\frac{1}{2}}$$

$$t_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$$

Activity: number of decay per second.
"rate of decay"

$$A = \lambda N_0 e^{-\lambda t}$$

$$A = \lambda N \quad (1)$$

$$A = \lambda N_0 e^{-\lambda t}$$

$$A = A_0 e^{-\lambda t}$$

A_0 → initial activity

Mean life ($\bar{T}$): average life time of all the radioactive nuclei of a given radioactive element

$$\bar{T} = \frac{1}{\lambda} = \frac{t_{1/2}}{\ln 2}$$