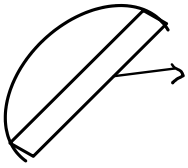
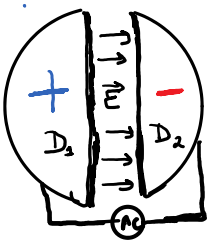
CYCLOTRON

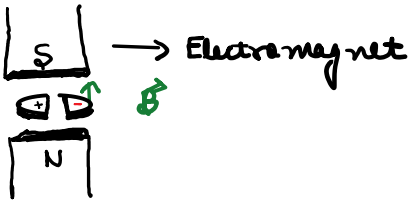
Developed By E. O. Lawrence

- Used to accelerate proton and neutron By passing them through electric field multiple times with the help of magnetic Field.



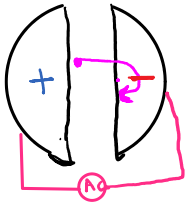
two hollow conducting Discs D_1 and D_2





→ Electromagnet

- Proton is released Between the two hollow Discs. it Accelerates in the direction of Electric field and aquires a velocity $\vec{v_1}$
- On reaching the hollow Disc the speed of the proton stops increasing due to shielding effect. But due to Magnetic Field the path is semicircular inside the disc.



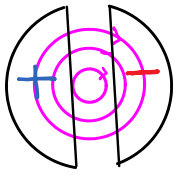
Time period of charge
$= t/2 = \frac{2\pi R}{v \times} = \frac{\pi R}{v}$
$\Rightarrow \frac{\pi R}{q B R} \times m = \frac{m\pi}{qB}$
$\therefore$ Frequency of AC $= \frac{1}{T}$
$= \frac{qB}{\pi m}$

- When it comes out of the D. The polarity of the D's changes due to AC voltage thus the charge accelerates Further to velocity $\vec{v_2}$

We know $\vec{v_2} > \vec{v_1}$

and $r = \frac{mv}{qB}$

$\therefore \quad \vec{r_2} > \vec{r_1}$



- A point comes when the charge goes out of the D, And it thrown out of the window with a high acceleration.

KE of the charged particle $= 1/2mv^2$

$v = \frac{qBR}{m}$ (R = Radius of the Disc)

$$KE = \frac{1}{2}m\left(\frac{qBR}{m}\right)^2$$

$$KE = \frac{q^2B^2R^2}{2m^2} \times m$$

$$KE = \frac{q^2B^2R^2}{2m}$$

Applications of cyclotron

- Magnetron waves, device for producing high frequency radio
- For radiation therapy in the treatment of cancer
- Cyclotrons are used for nuclear transmutation