LAKSHYA BATCH

JEE

MAGNETISM AND MATTER
GAUSS LAW AND EARTH MAGNETISM

LECTURE - 5

GOALS OF THE DAY

1. GAUSS'S LAW,
2. EARTH'S MAGNETISM
3. RELATION BETWEEN HORIZONTAL COMPONENT, VERTICAL COMPONENT AND ANGLE OF DIP

Gauss law of Magnetostats (Not in Boards).

$$\oint \vec{B} \cdot \vec{dA} = \mu_0 (m_{in})$$

m = Pole Strength.

we donot have monopoles.

$$= \mu_0 (+m - m)$$

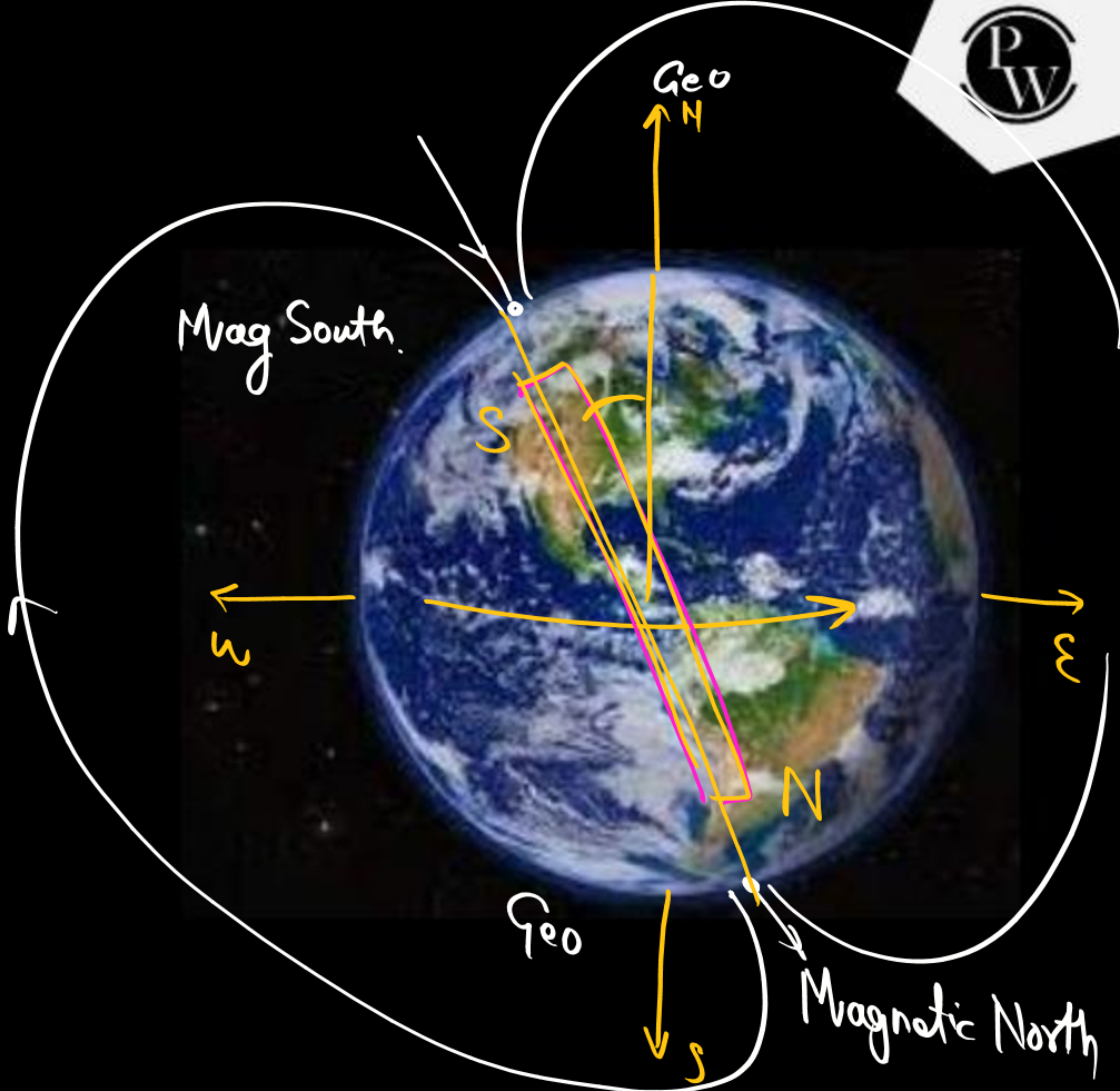
$$\oint B \cdot dA = 0$$

Magnetic flux through a closed Surface is always Zero.

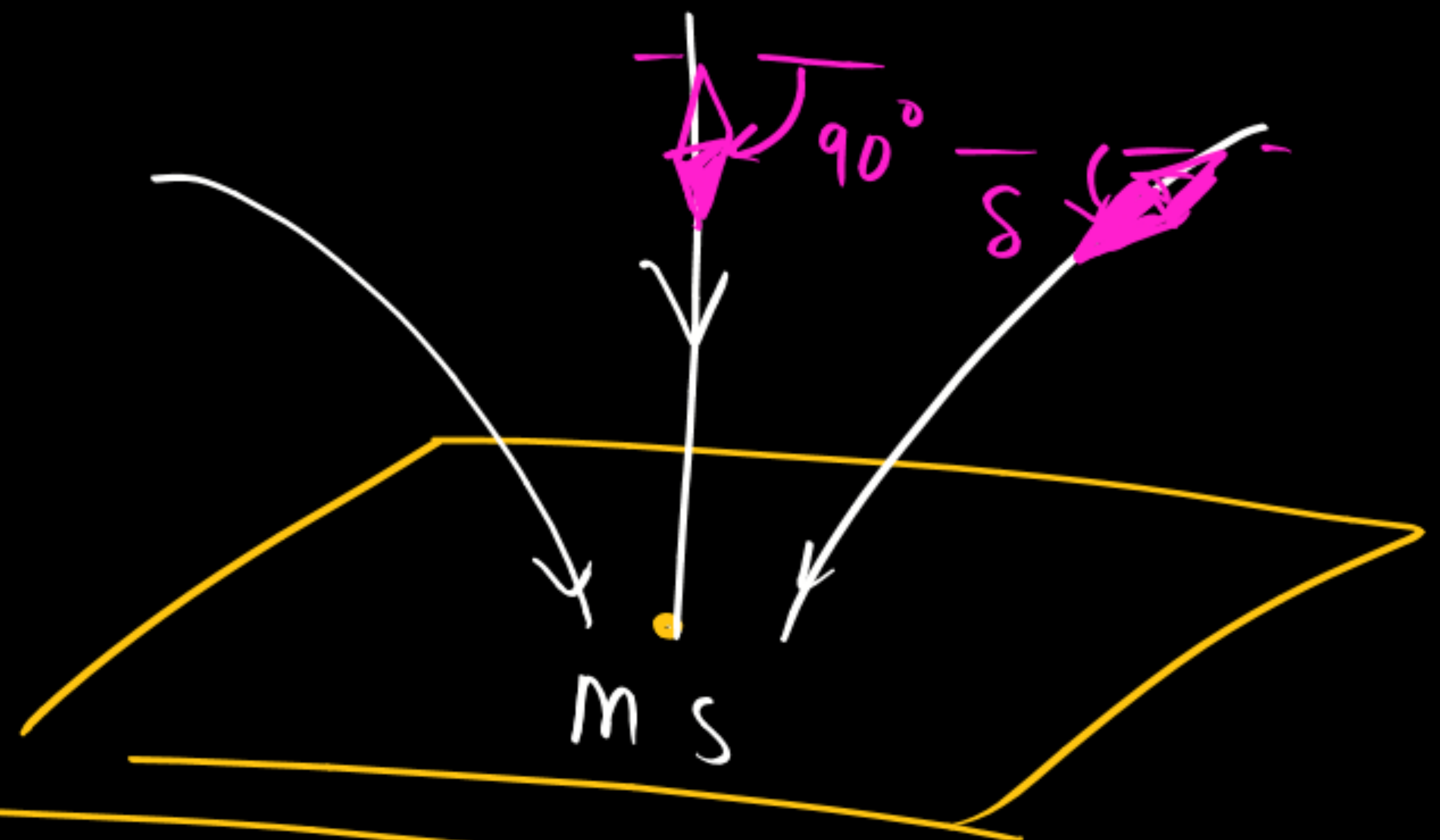
EARTH'S MAGNETISM

Reason :- hypothesis.

due to Rotating Molten Core (free Ions) we assume there is Some Current Inside Core due to which there is Earth Magnetic field

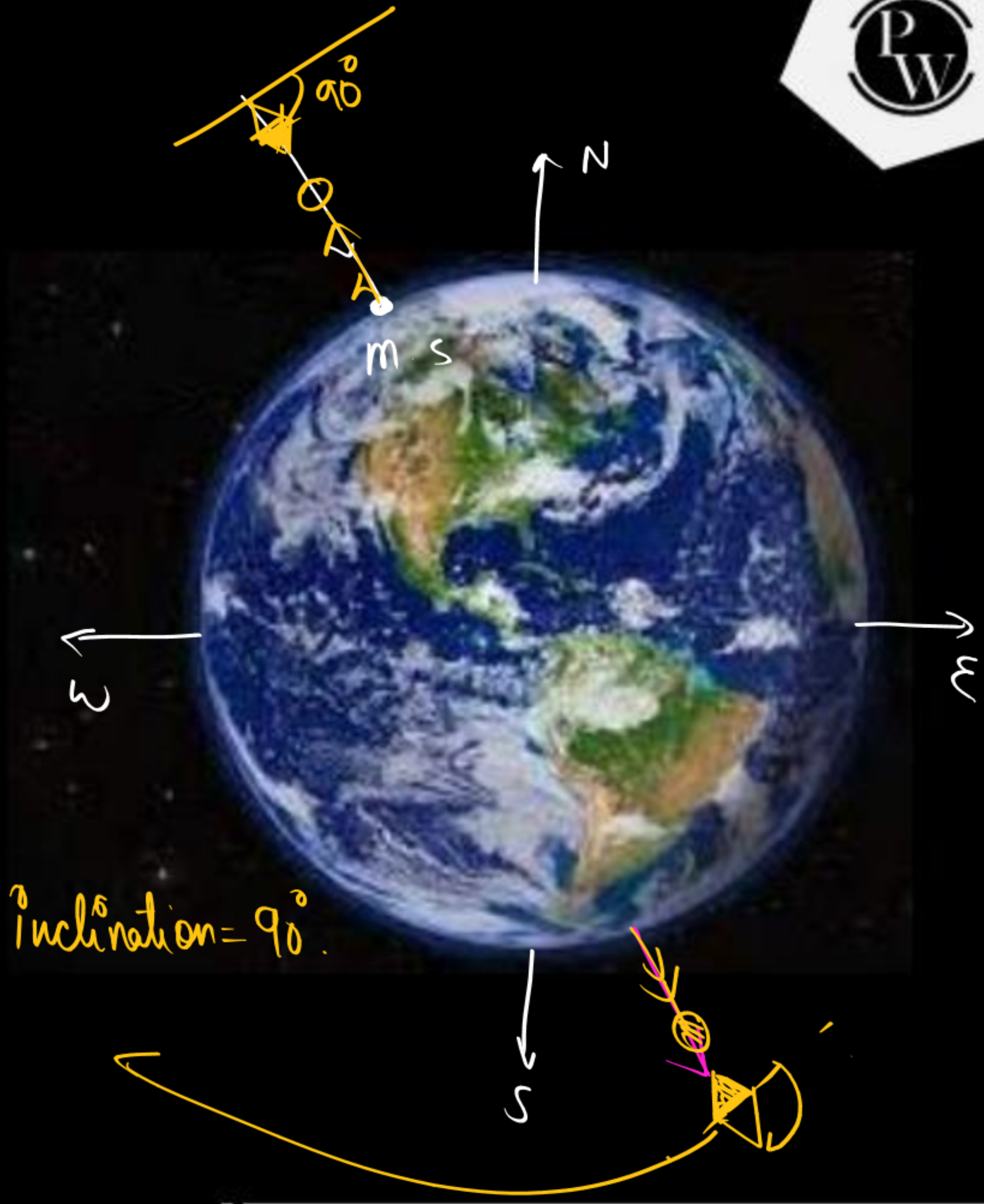


Exactly at Poles



$\delta_{\text{Magnetic Poles}} = 90^\circ$

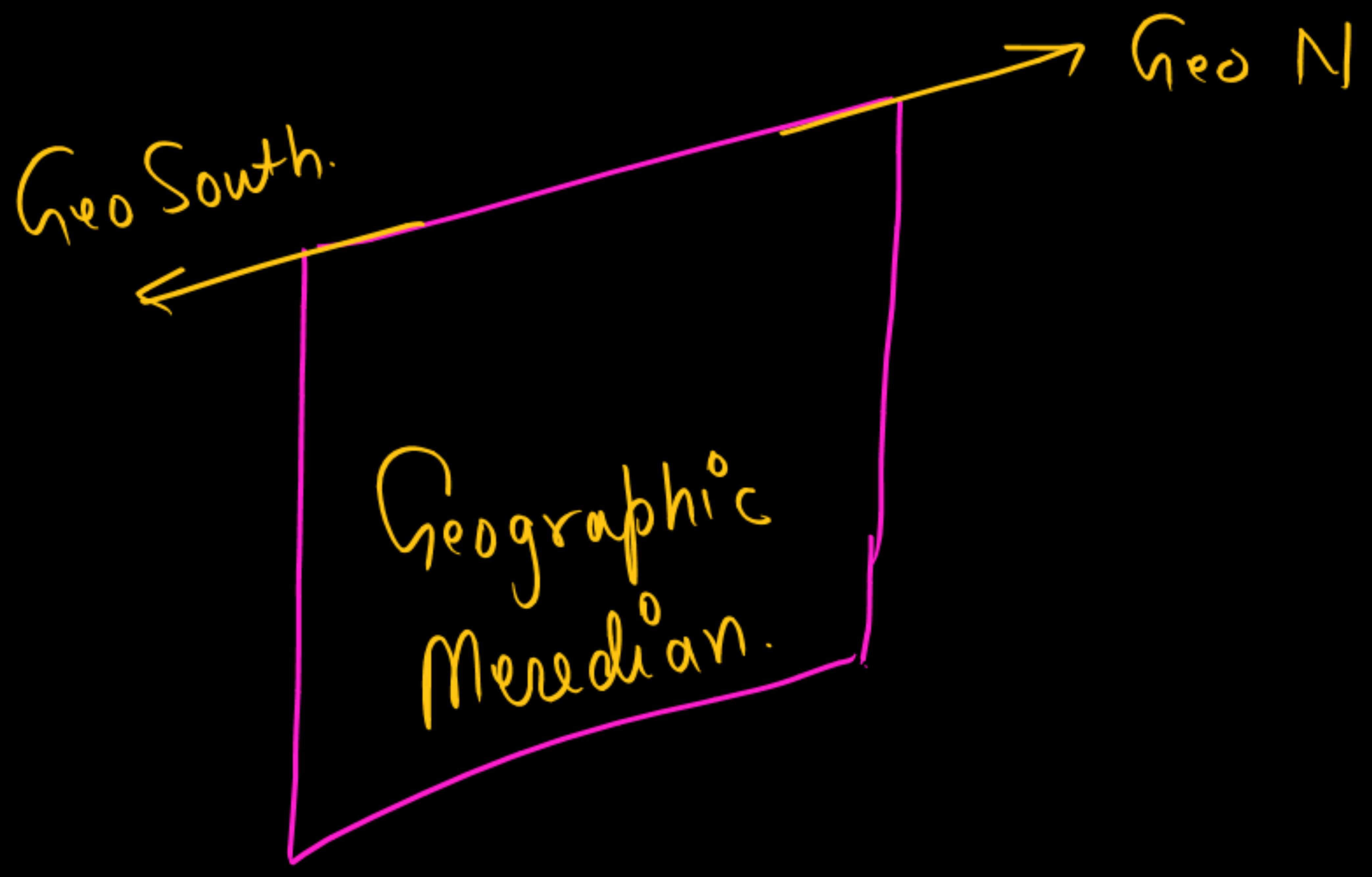
$\delta_{\text{equator}} = 0^\circ$

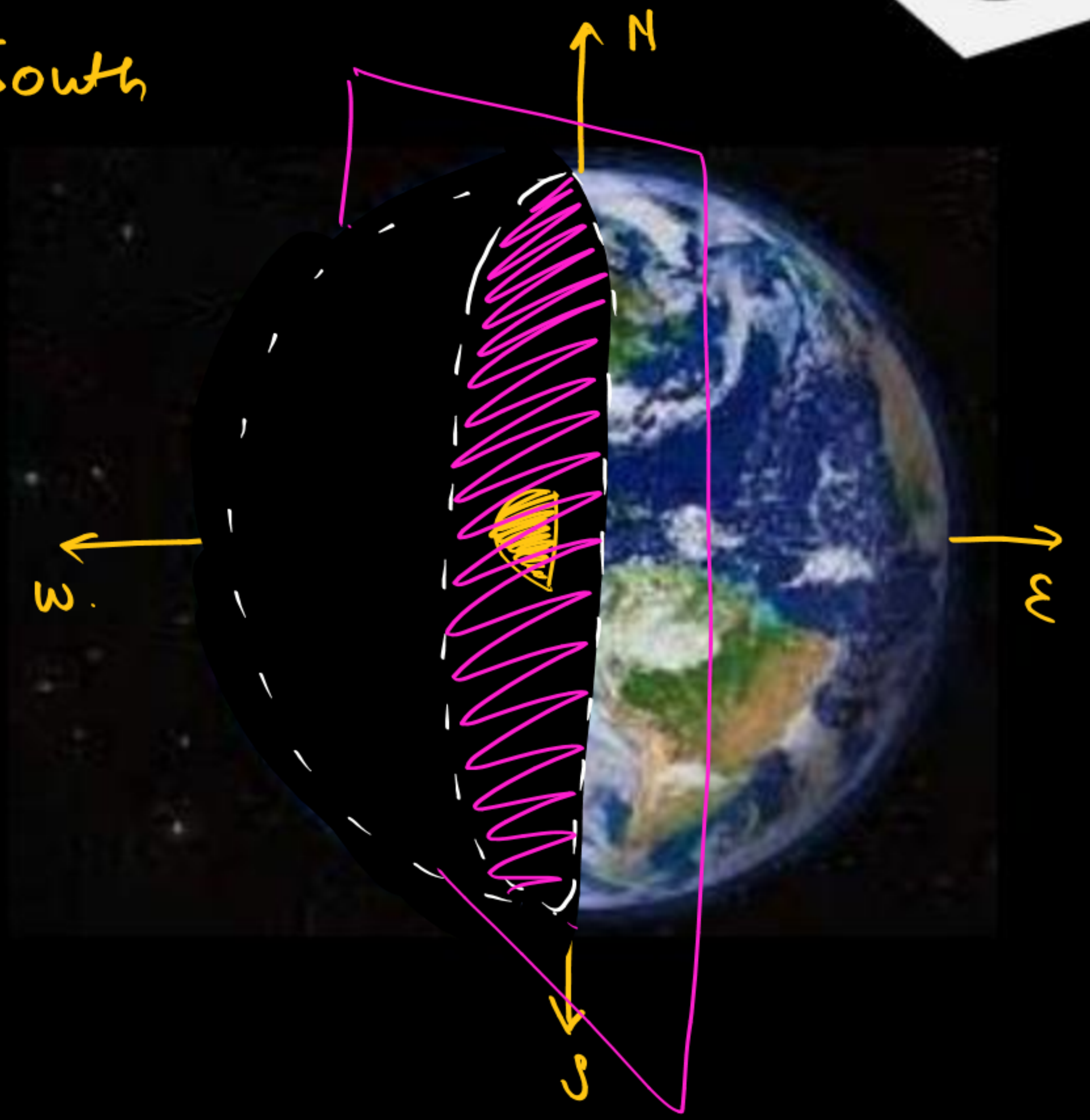


∠ of inclination = 90°.

Geographic Meredian.

The plane which include Geo N & Geo South is called Geographic Meredian





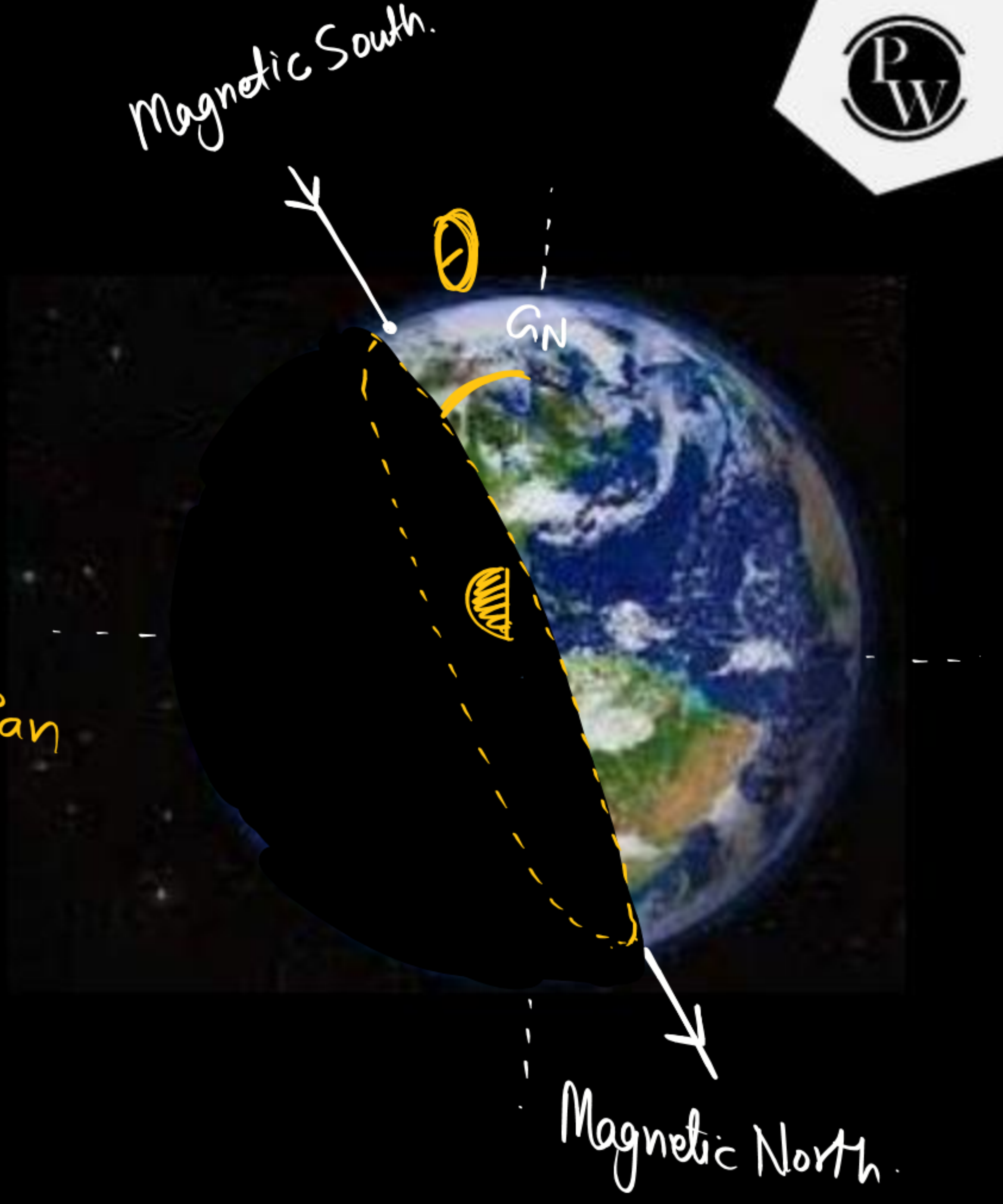
Magnetic Meredian

Plane passing through Magnetic South & North Pole is Called Magnetic Meridian.

θ = Angle between Geographic Meredian & Magnetic Meredian.

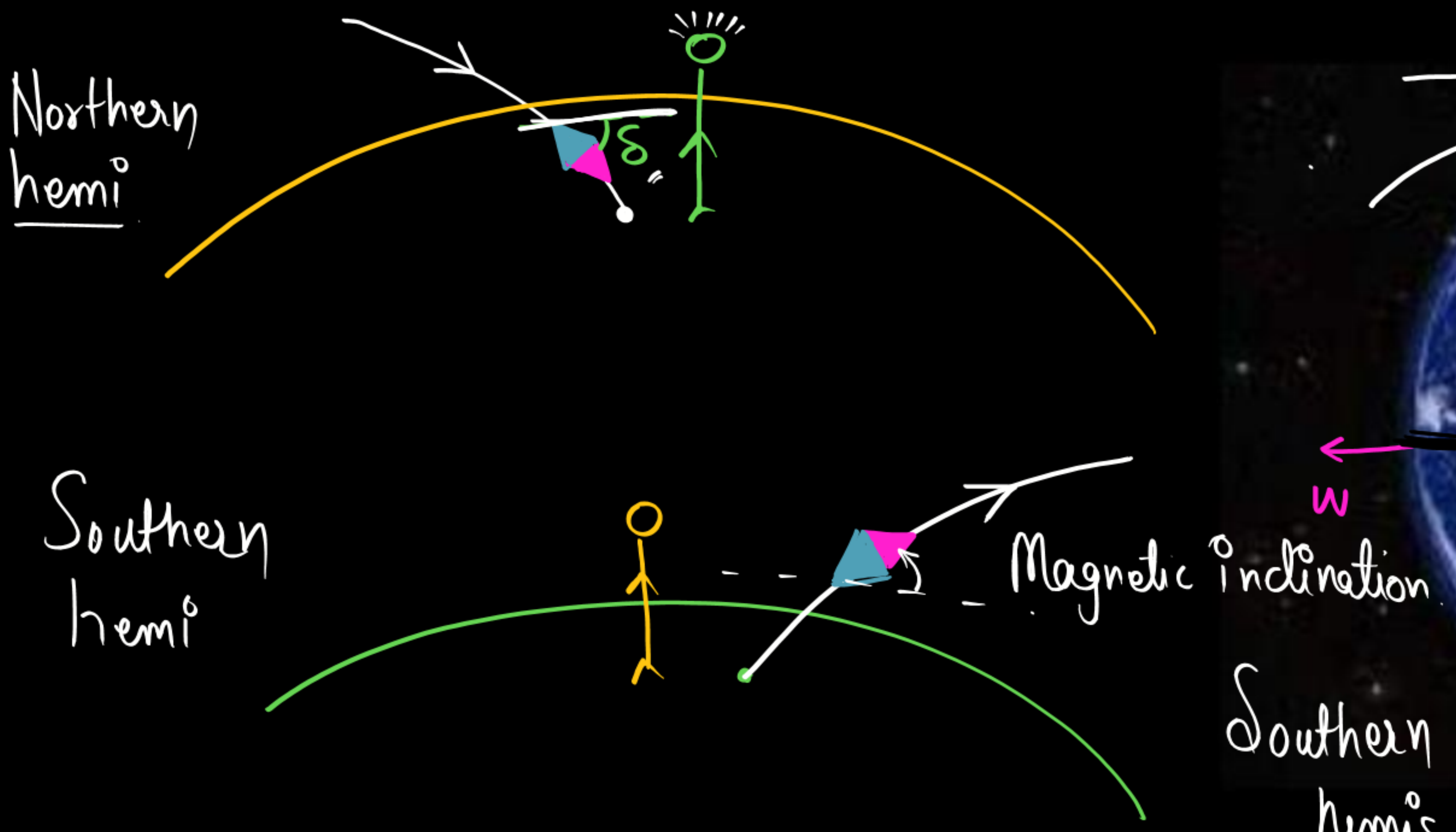
Angle of declination

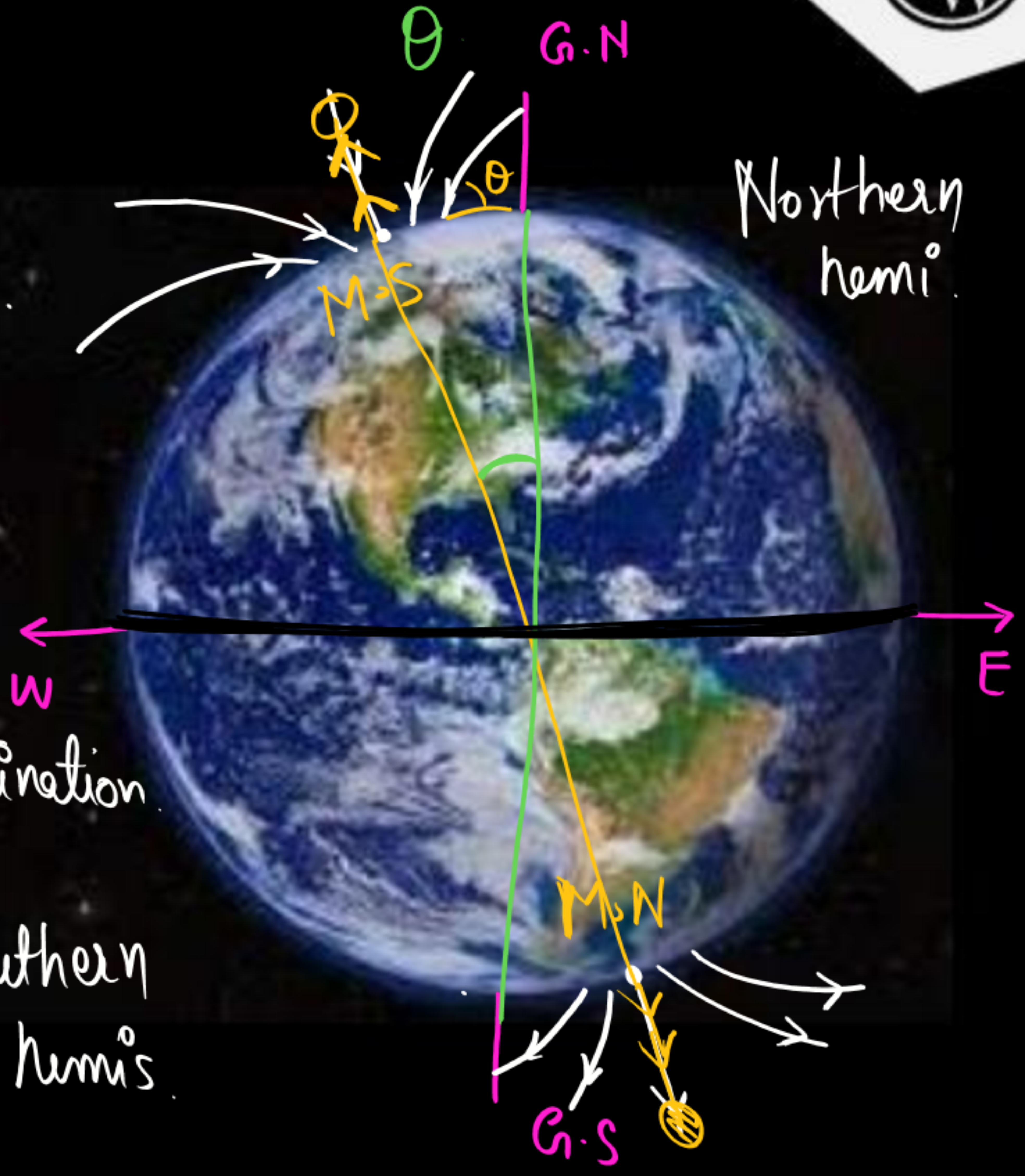
$\theta_{Earth} \approx 11^\circ$



Magnetic Inclination(dip)

Magnetic dip angle





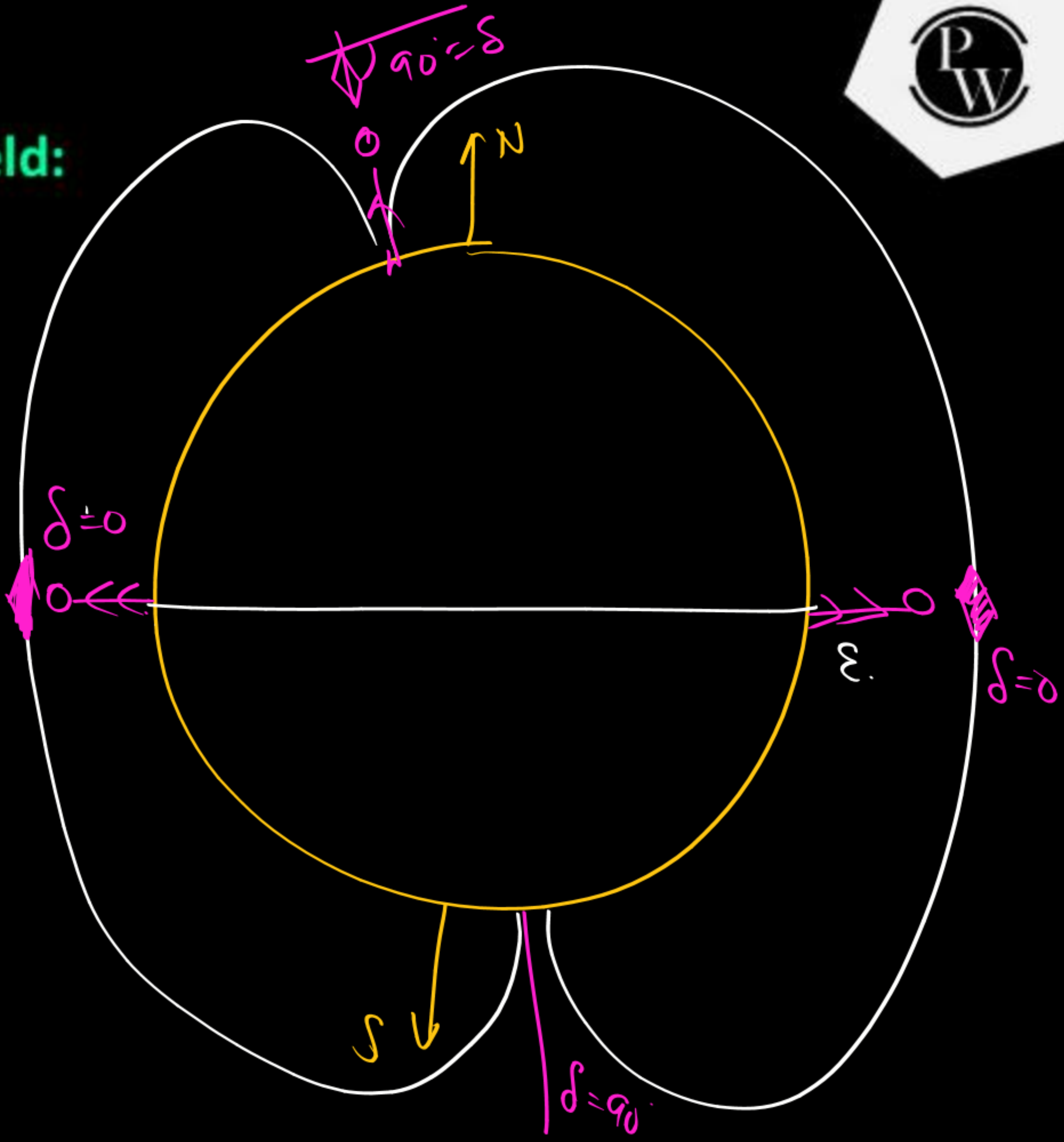
Three components of earth Magnetic Field:

1. Magnetic Declination (θ)

2. Magnetic inclination (Dip)

(Southern hemi) . (Northern hemi)

3. Horizontal component



Three components of earth Magnetic Field:

Magnetic Declination :

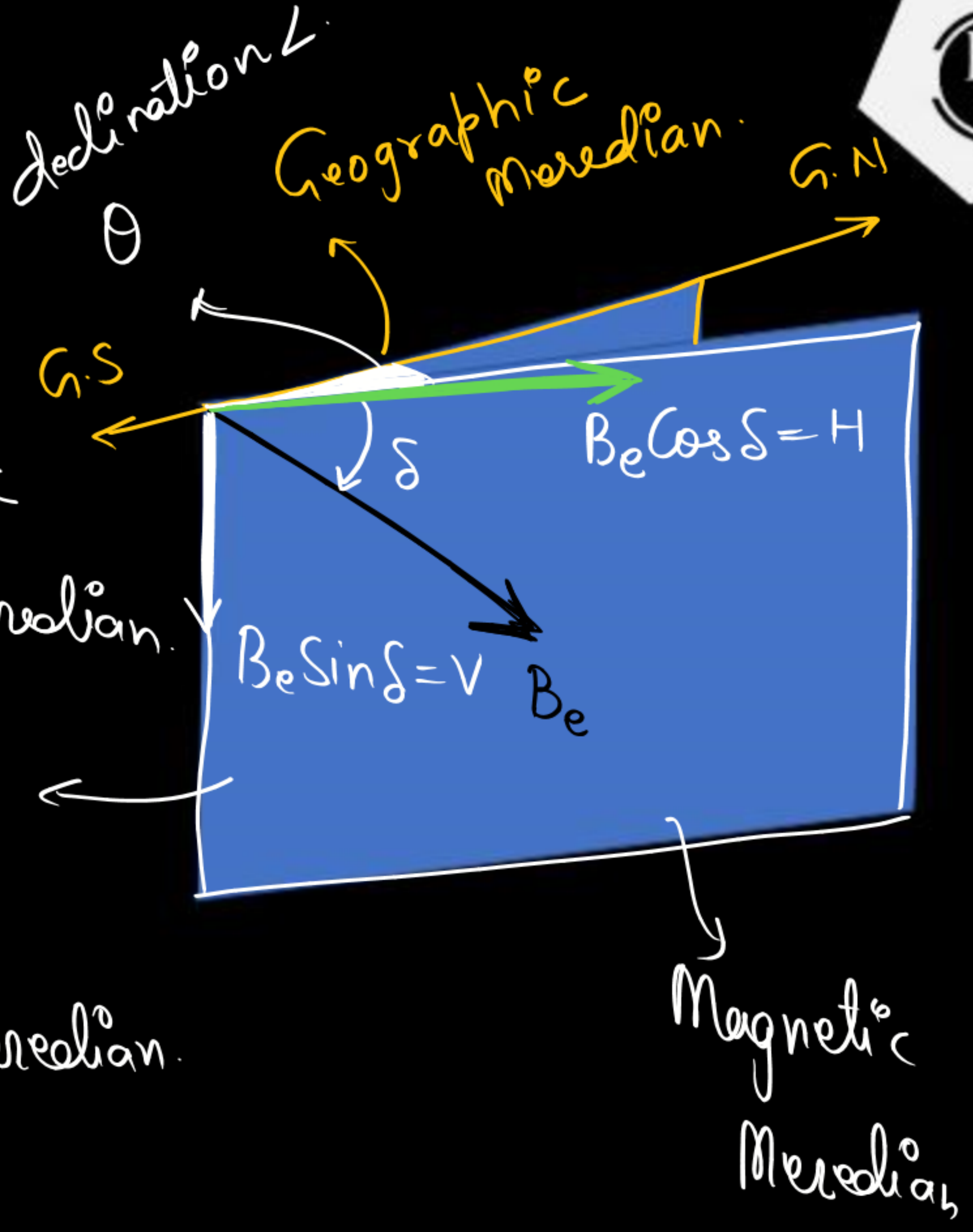
The ∠ between Geographic Meridian & Magnetic Meredian.

Three components of earth Magnetic Field:

Magnetic inclination (Dip) :

The angle made by Earth Magnetic field with horizontal in Magnetic Meredian.

Earth Magnetic field will be Magnetic Meredian.



Three components of earth Magnetic Field:

Horizontal component

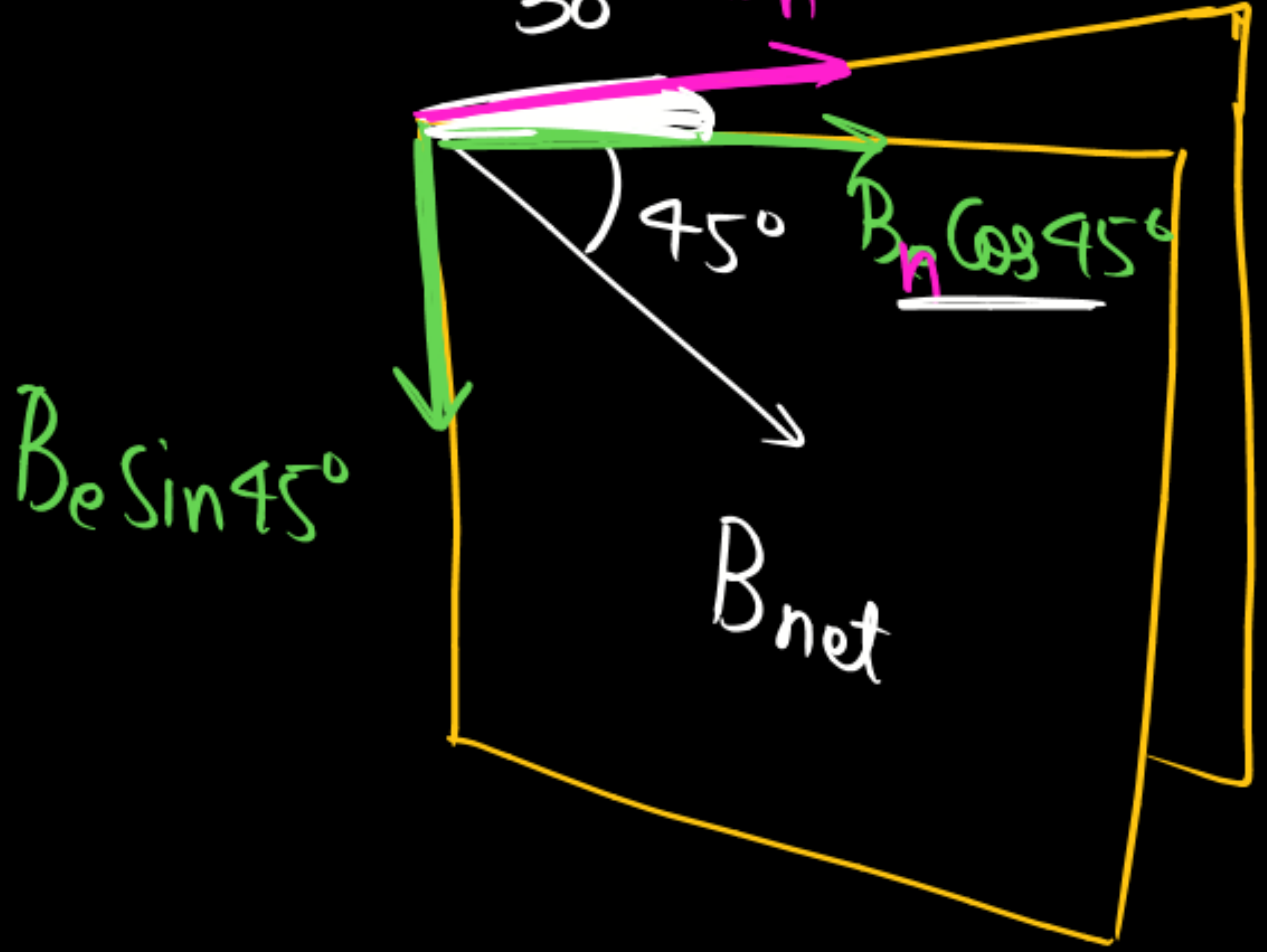
The Component of Earth Magnetic field in horizontal dir is Called Horizontal Component.

- **Isogonic Lines**: The lines on map joining same magnetic declination
- **Aganoic**: the lines which passes through places having zero declination
- **Isoclinic Lines**: These are the lines joining same dip
- **Aclinic Lines**: The lines joining places of zero dip
- **Isodynamic Lines**: The lines Joining the places having same horizontal earth Component

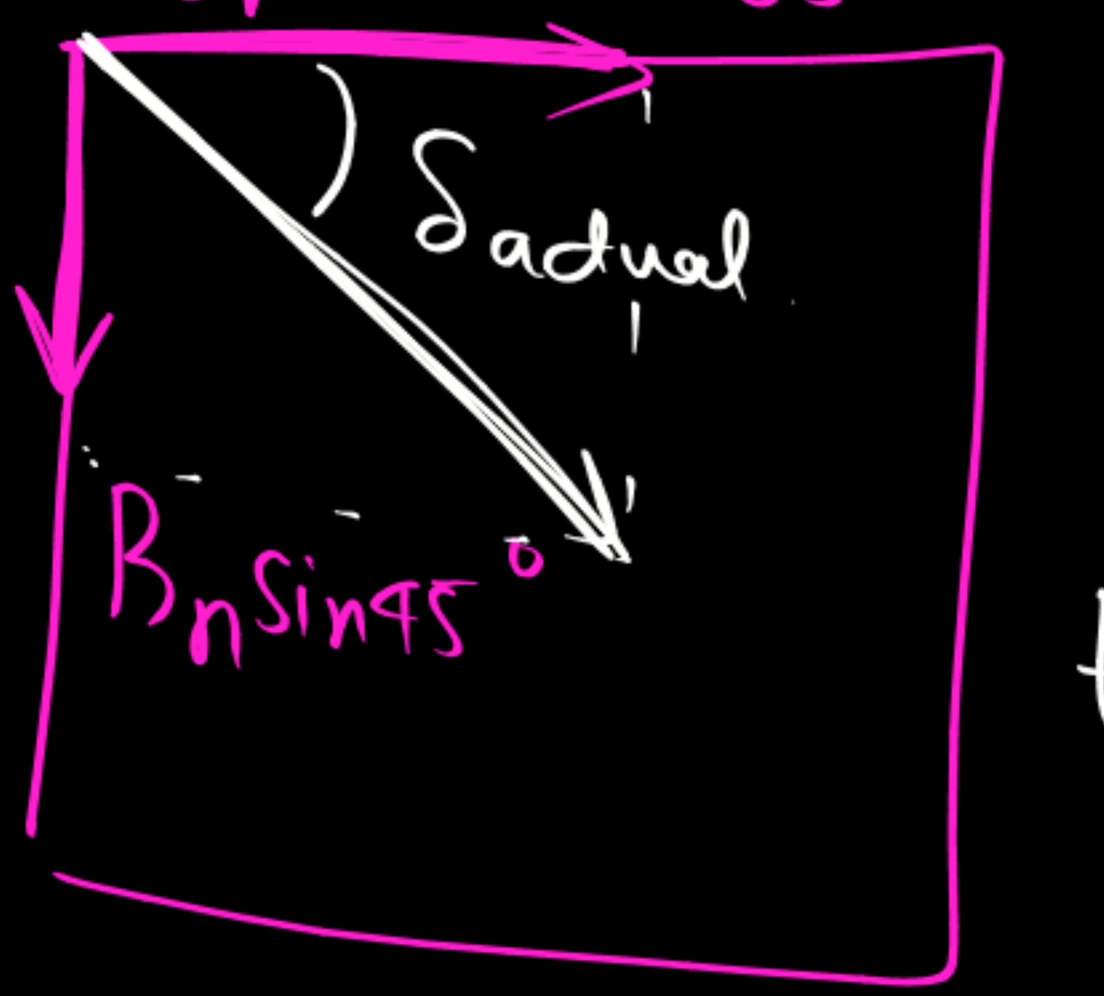
If a magnet is suspended at an angle 30° to the magnetic meridian, it makes an angle of 45° with the horizontal. The real dip is

(a) $\tan^{-1}(\sqrt{3}/2)$ (b) $\tan^{-1}(\sqrt{3})$

(c) $\tan^{-1}(\sqrt{3/2})$ (d) $\tan^{-1}(2/\sqrt{3})$ Ans



Magnetic Meredian. (Real dip will be in Magnetic Meredian)



$$\tan\delta = \frac{P}{B} = \frac{B_n \sin 45}{B_n \cos 45 \cos 30} = \frac{2}{\sqrt{3}}$$

$$\delta_{real} = \tan^{-1}\left(\frac{2}{\sqrt{3}}\right)$$

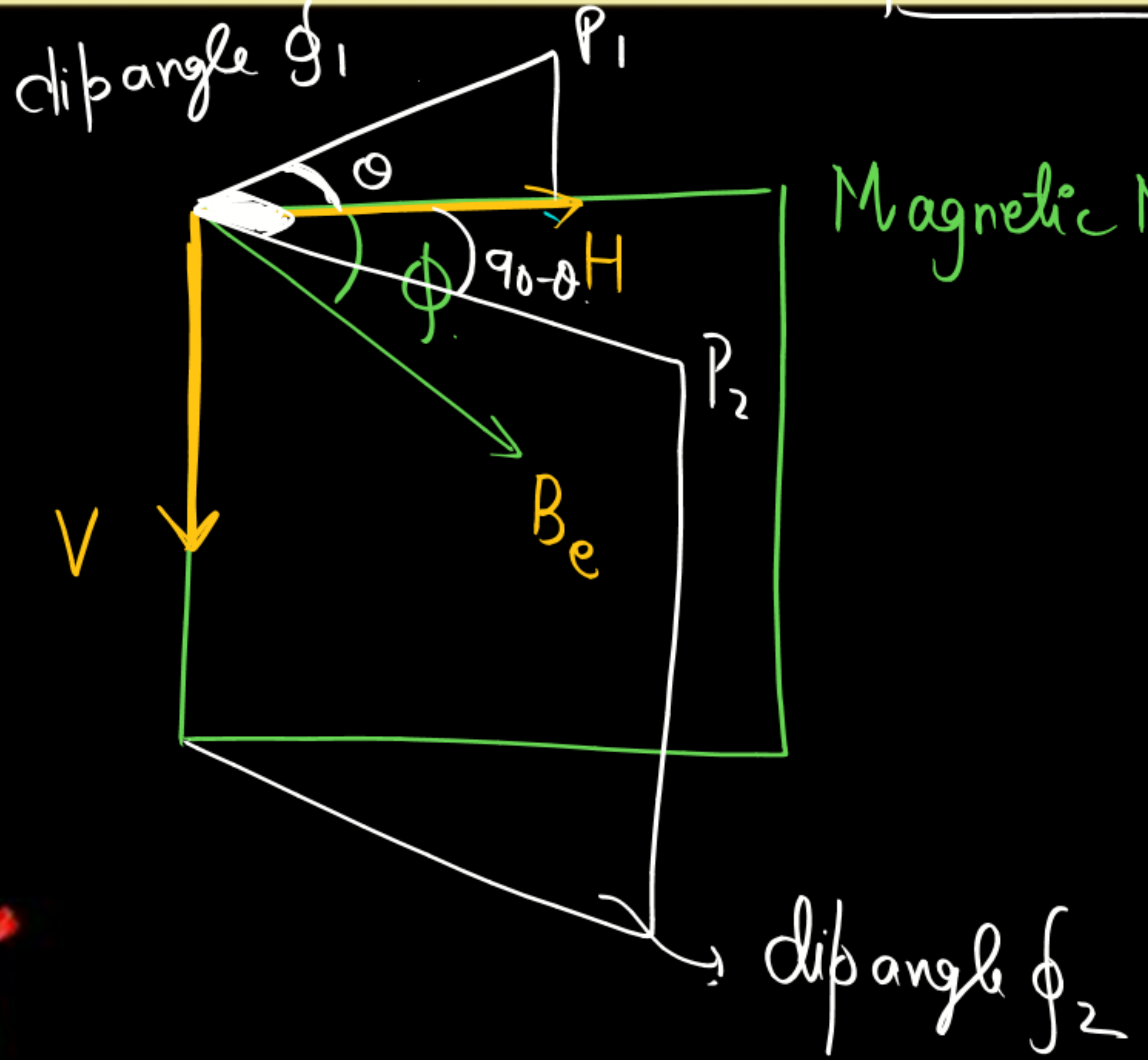
If ϕ_1 and ϕ_2 be the angles of dip observed in two vertical planes at right angles to each other and ϕ be the true angle of dip, then (PYQ).

(a) $\cos^2\phi = \cos^2\phi_1 + \cos^2\phi_2$

(b) $\sec^2\phi = \sec^2\phi_1 + \sec^2\phi_2$

(c) $\tan^2\phi = \tan^2\phi_1 + \tan^2\phi_2$

(d) $\cot^2\phi = \cot^2\phi_1 + \cot^2\phi_2$



P_1 & P_2 are at 90° to Each other

$$\tan\phi_1 = \frac{\tan\phi}{\cos\theta} \qquad \tan\phi_2 = \frac{\tan\phi}{\sin\theta}$$

$$\cos\theta = \frac{\tan\phi}{\tan\phi_1} \qquad \sin\theta = \frac{\tan\phi}{\tan\phi_2}$$

$$1 = \frac{\tan^2\phi}{\tan^2\phi_1} + \frac{\tan^2\phi}{\tan^2\phi_2} \Rightarrow \frac{1}{\tan^2\phi} = \frac{1}{\tan^2\phi_1} + \frac{1}{\tan^2\phi_2}$$

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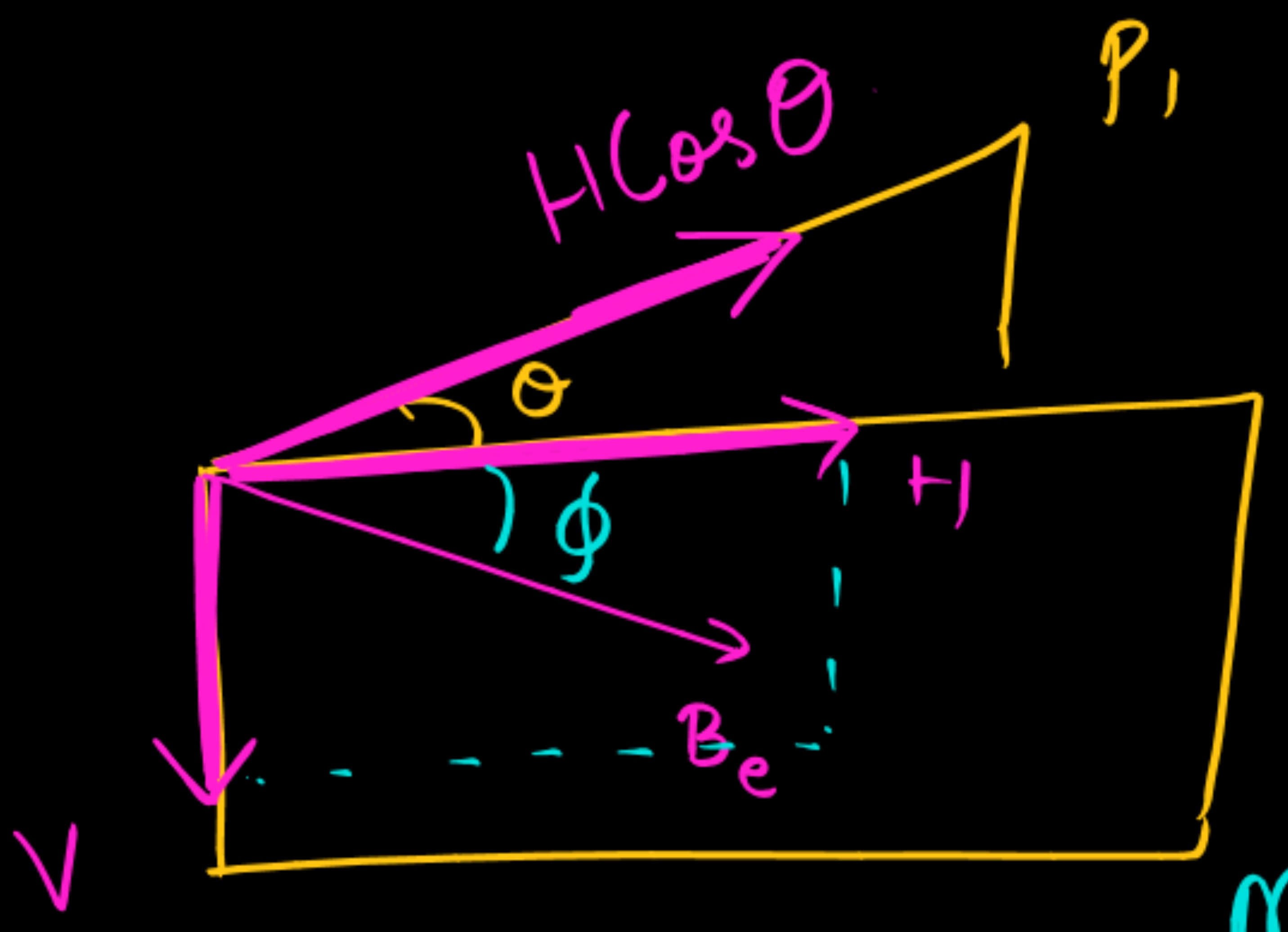
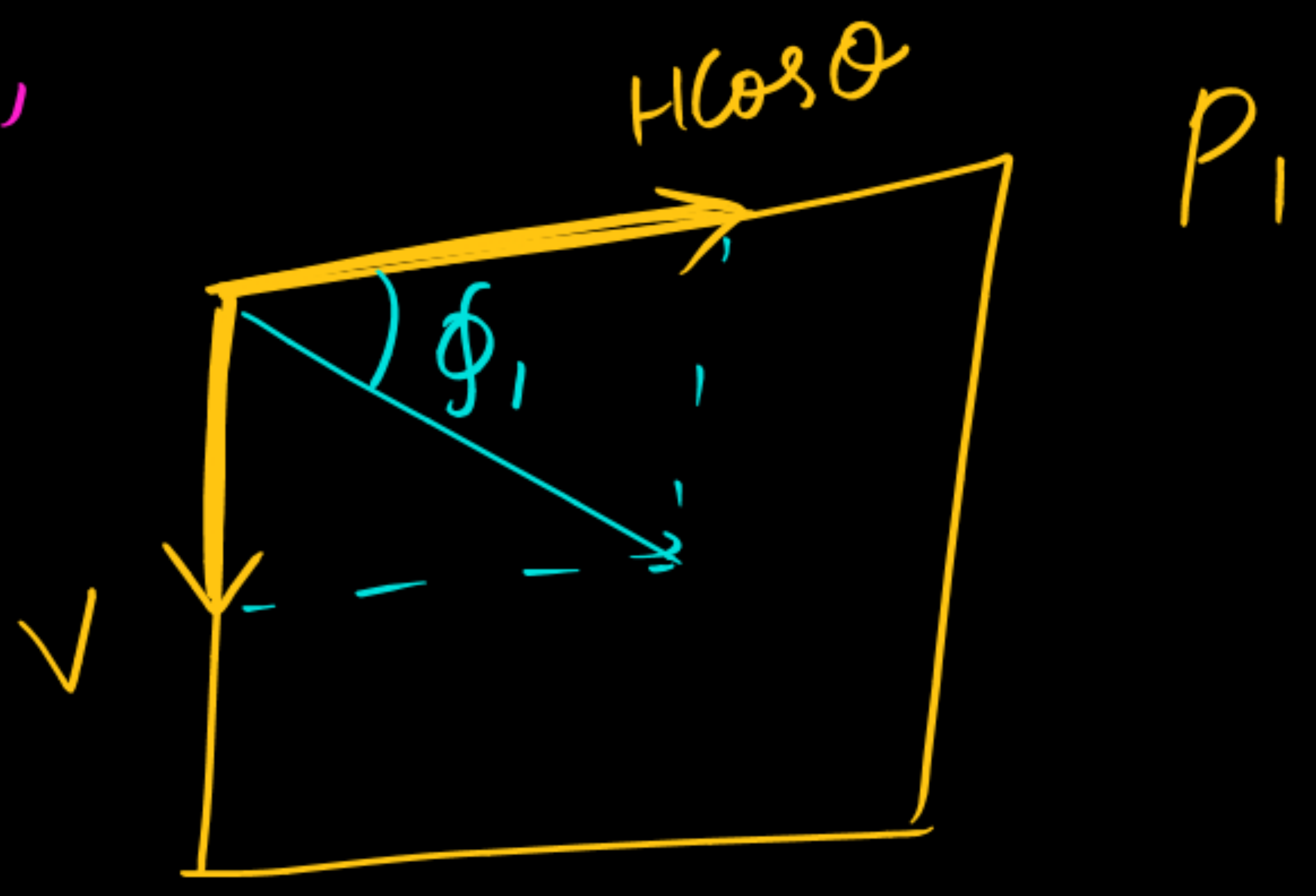
dip angle = ϕ_1



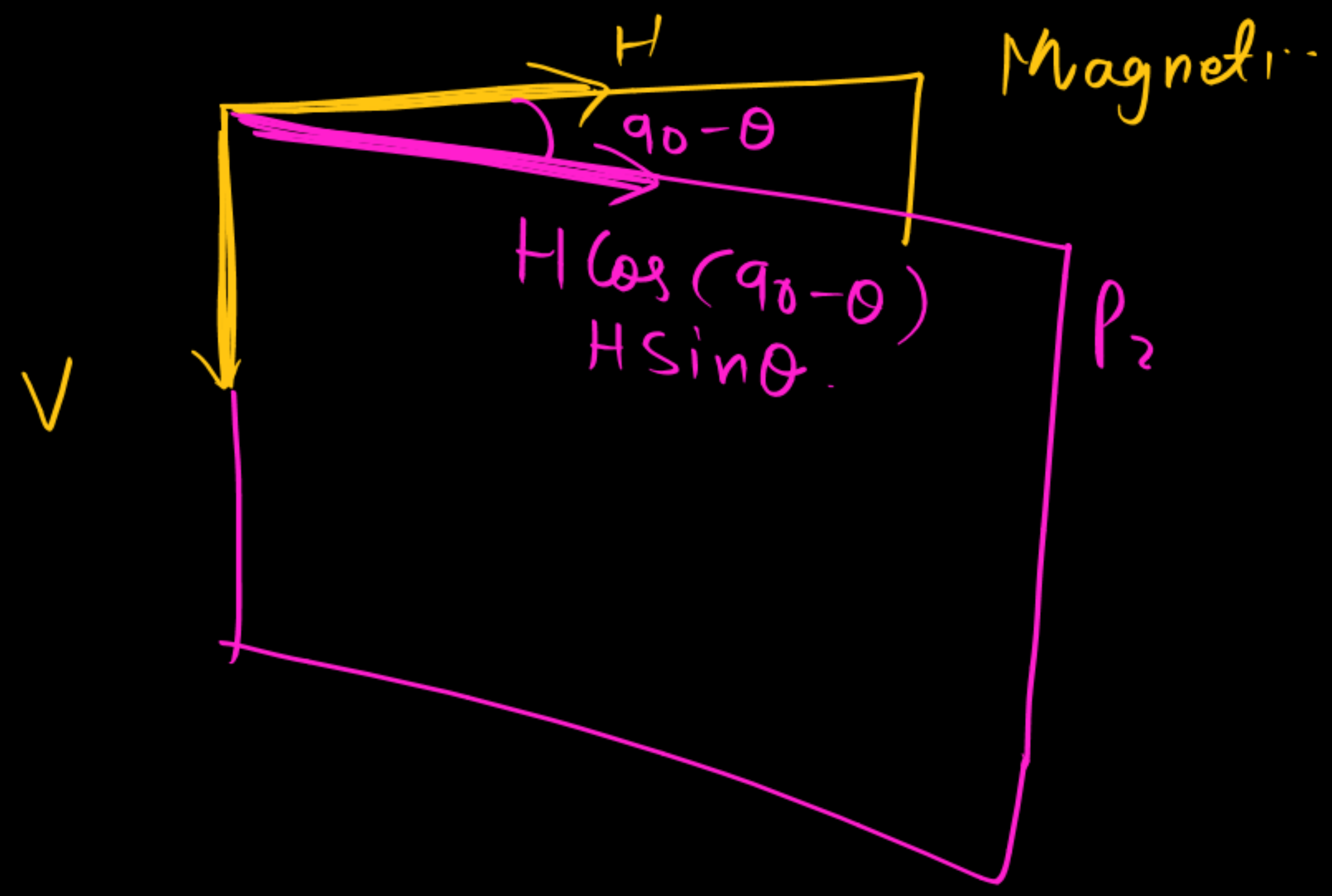
Magnetic Plane.

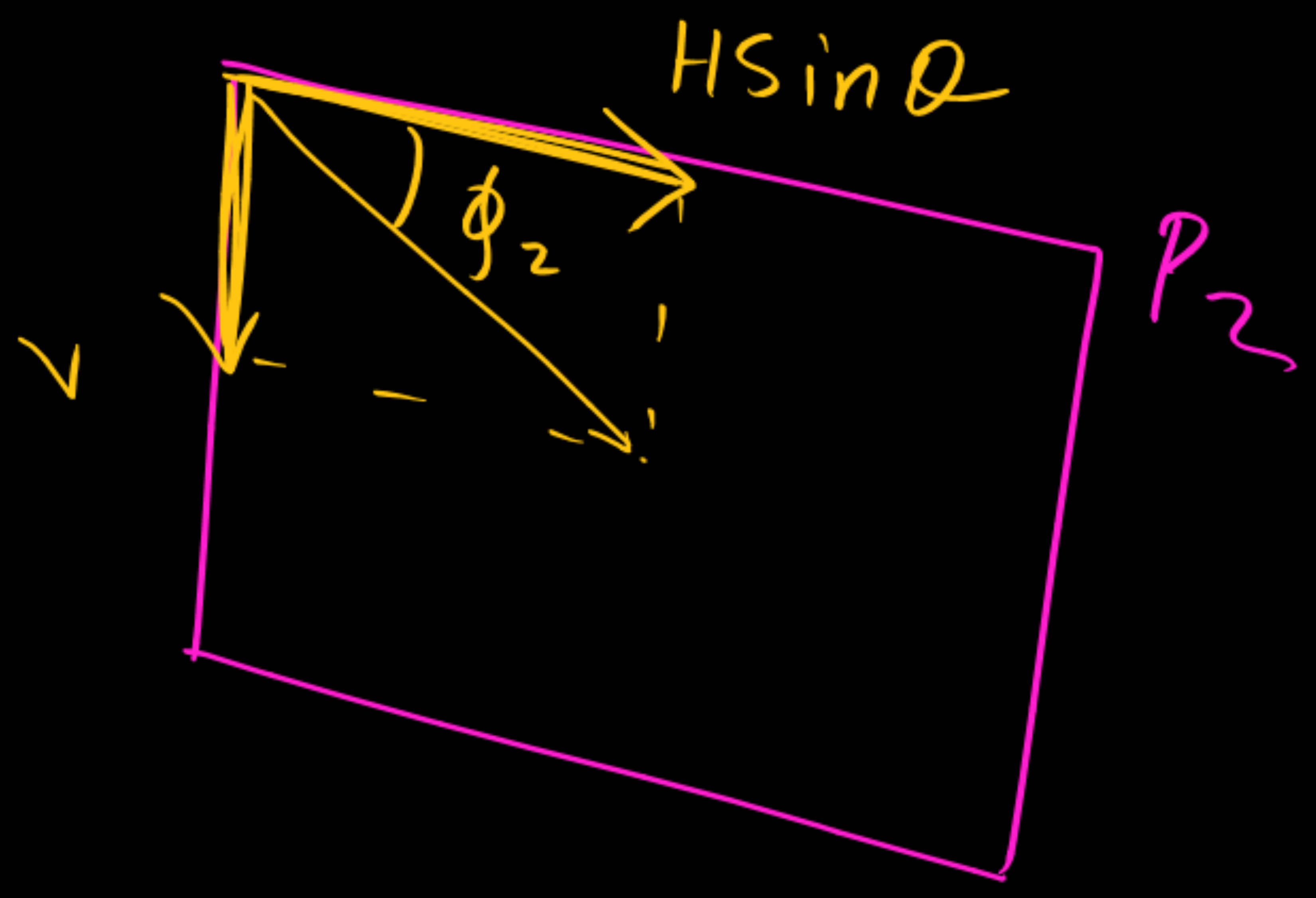
$$\tan\phi = \frac{V}{H}$$



$$\tan\phi_1 = \frac{V}{H\cos\theta}$$

$$\boxed{\tan\phi_1 = \frac{\tan\phi}{\cos\theta}}$$





$$\tan\phi_2 = \frac{V}{H\sin\theta}$$

$$\boxed{\tan\phi_2 = \frac{\tan\phi}{\sin\theta}}$$

Thank You Lakshyians