The angular elevation of Polaris (the Pole Star) and the latitude of the observer
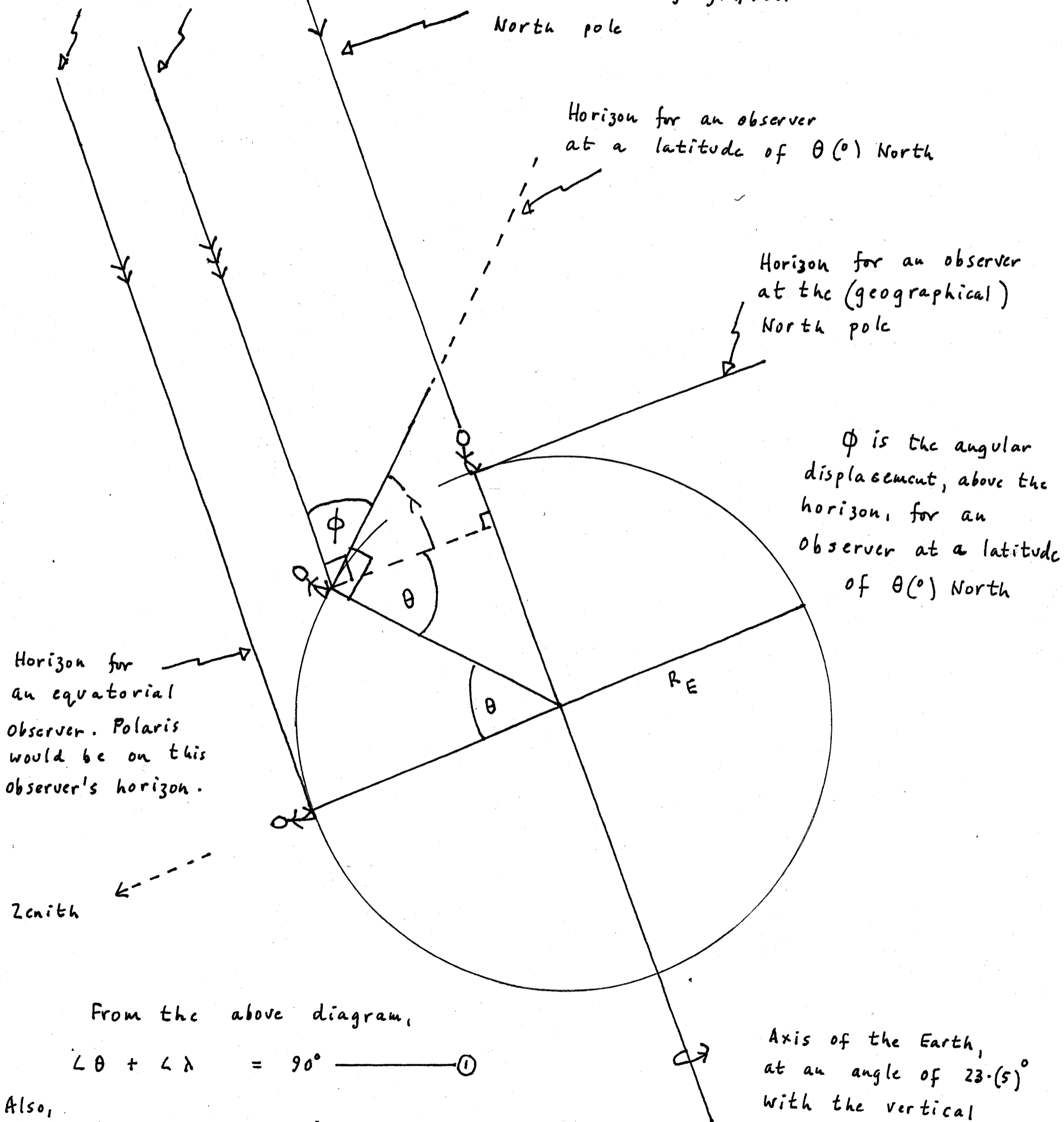
The paths of light from Polaris are practically parallel, because of the large distance of the star

The direction of light from Polaris. The star will be overhead for an observer at the geographical North pole

Horizon for an observer at a latitude of $\theta(°)$ North

Horizon for an observer at the (geographical) North pole

ϕ is the angular displacement, above the horizon, for an observer at a latitude of $\theta(°)$ North

Horizon for an equatorial observer. Polaris would be on this observer's horizon.

ϕ

θ

θ

R_E

Zenith

Axis of the Earth, at an angle of $23 \cdot (5)°$ with the vertical

From the above diagram,

$$\angle\theta + \angle\lambda = 90° \quad\text{———} \quad ①$$

Also,

$$\angle\phi + \angle\lambda = 90° \quad\text{———} \quad ①$$

Combining ① and ②,

$$\Rightarrow \quad \angle\phi = \angle\theta$$

The angle between the observer's horizon and the direction of light from Polaris, is the observer's latitude.