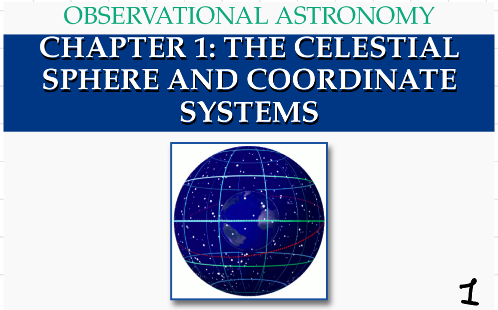
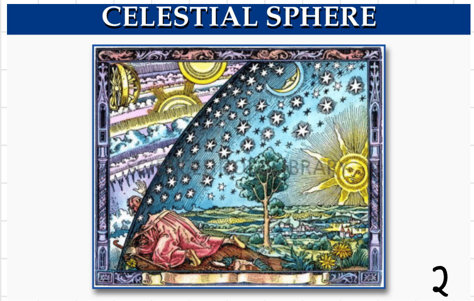
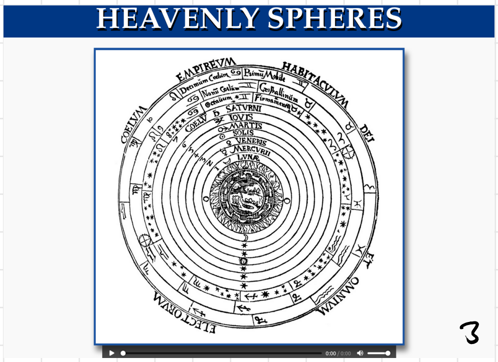
Ch1 Lecture Notes



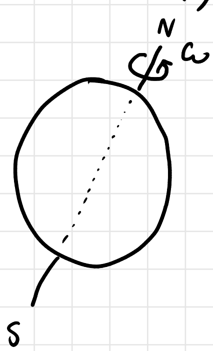




Societies use to think the celestial spheres was the true arrangement of the heavens.

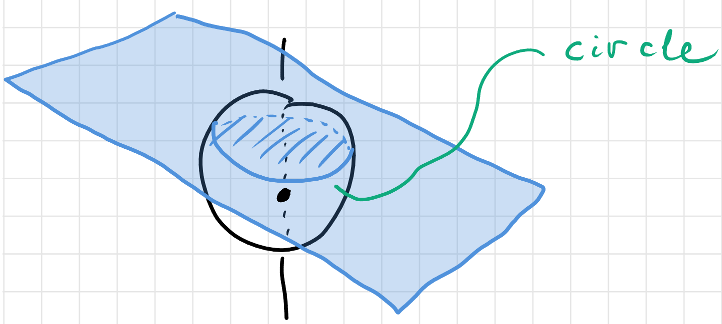
Multiple observations & ideas force astronomy to abandon this model, but the celestial sphere is still a useful tool.

Assume a rotating sphere. The axis of rotation defines the N & S poles

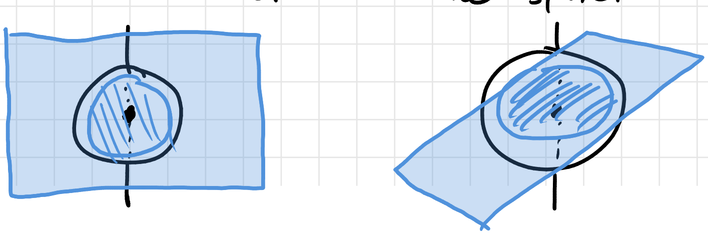


- N pole defined s.t from "birds eye view" sphere rotates CCW

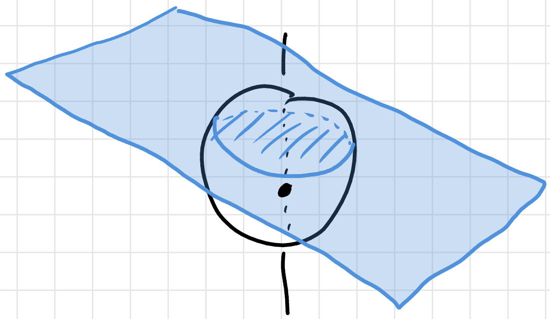
An arbitrary plane can slice through the sphere & trace out a circle



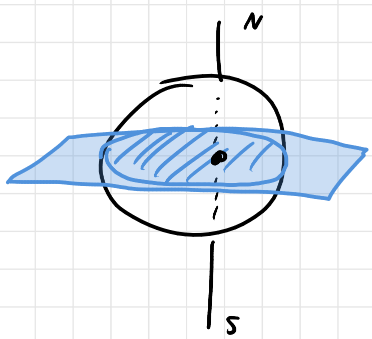
A great circle is created when an intersecting plane encompasses the center of the sphere



A small circle is created when an intersecting plane does not encompass center of the sphere

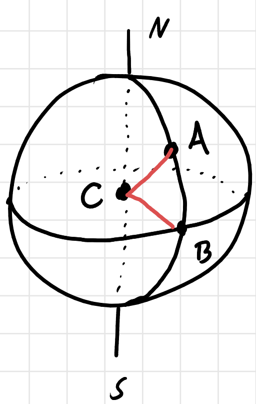


The fundamental plane is the great circle that is perpendicular to the rotation axis



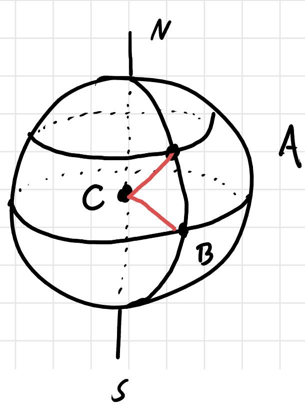
- on Earth we call this the equator
- what we call the fundamental plane will change depending on the coordinate system an astronomer is working with.

Now consider a point A on the sphere by making a great circle that includes the poles



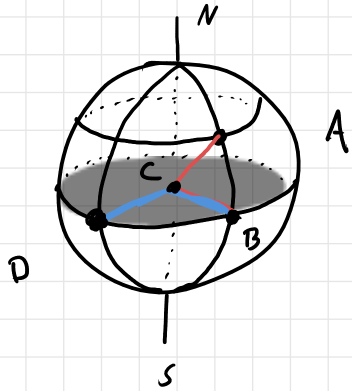
$\angle BCA$ = latitude (on Earth)

Make a small circle // to the fundamental plane & intersects A



- all points on this small circle have the latitude

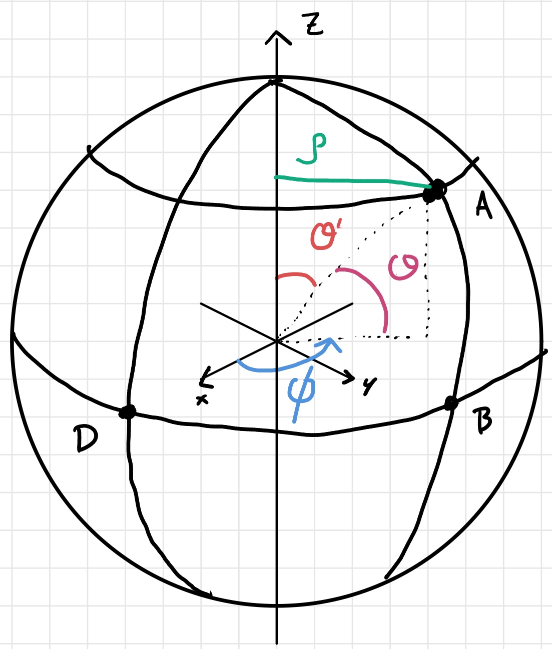
We need one more great circle to get the longitude of A.



$\angle DCB$ = longitude of A

The NDS meridian is the prime meridian. (where $\phi = 0$)

On Earth this is Greenwhich England



ϕ = azimuthal angle

θ = polar angle

note that ϕ & θ labels are opposite by mathematics convention

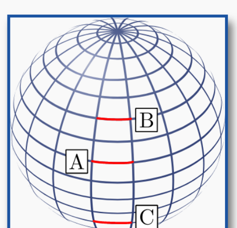
$0 \leq \phi \leq 2\pi$

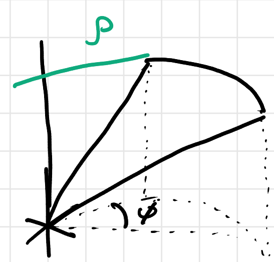
$0 \leq \theta' \leq \pi$ or $-\frac{\pi}{2} \leq \theta \leq \frac{\pi}{2}$

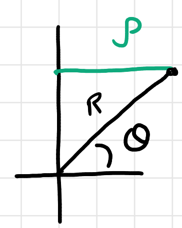
PQ: LONGITUDINAL DISTANCES

The radius of Earth is $R_E = 6378.1\text{km}$. What is the physical distance between two meridians separated by 1° at the following latitudes?

A. At the equator $\theta = 0^\circ$.
B. At Norfolk VA $\theta = 36.88^\circ$.
C. Near Outpost 31 in the Antarctic $\theta = -70.7^\circ$.







s = arclength = $\rho\phi$

$\rho = R\cos\theta$

$s = R\cos\theta \cdot \phi$

A) $s = (6378.1\text{km})\left(1^\circ \frac{\pi \text{ rad}}{180^\circ}\right)\cos(0) = 111.3\text{ km}$

B) $s = (6378.1\text{km})\left(1^\circ \frac{\pi \text{ rad}}{180^\circ}\right)\cos(36.88^\circ) = 89.04\text{ km}$

C) $s = (6378.1\text{km})\left(1^\circ \frac{\pi \text{ rad}}{180^\circ}\right)\cos(-70.7^\circ) = 36.79\text{ km}$

Astronomers use several spherical coordinate systems depending on there needs.

For example: we all know the sun is the center of the solar system, but it is perfectly valid to work in a reference frame where Earth is the center.

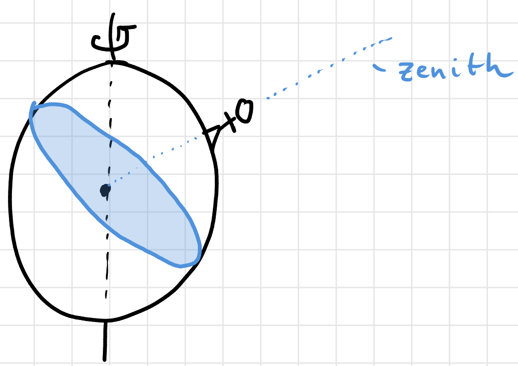
- run Orbital_Transformation.py script from Nick Lucid (Science Asylum)

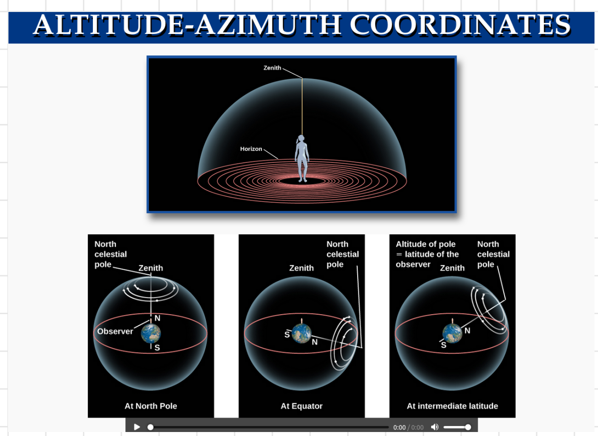
We will discuss 4 coordinate systems in this chapter. Key differences are what is that coordinates fundamental plane.

- Altitude - azimuth
- Equatorial
- Ecliptic
- Galactic equator

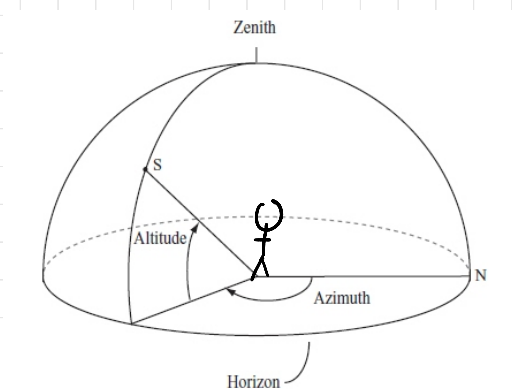
<u>Altitude - azimuth</u> (aka horizon system)

The fundamental plane is the observers horizon





Coordinates: Altitude & Azimuth



go to stellarium & show view at different locations on Earth

Altitude varies from 0 - 90°. An object beneath the horizon has negative altitude.