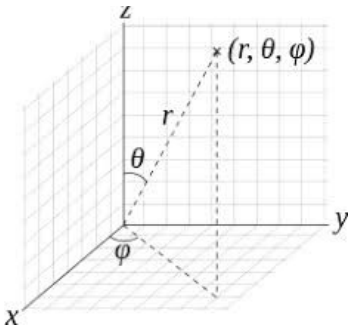
Radio Astronomy: Lesson 4

Celestial Coordinate Systems

How do we describe the positon of an astronomical object in space?

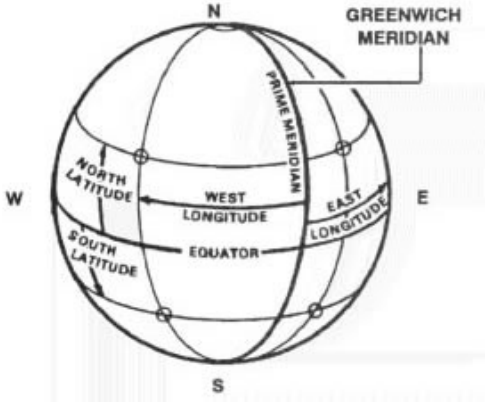
- Celestial bodies are assumed to be on the inner surface of a sphere of infinite radius with the earth at its center.
- Assume the earth does not move, but instead the celestial bodies rotate about it in a predictable manner.

1. Spherical Coordinates:

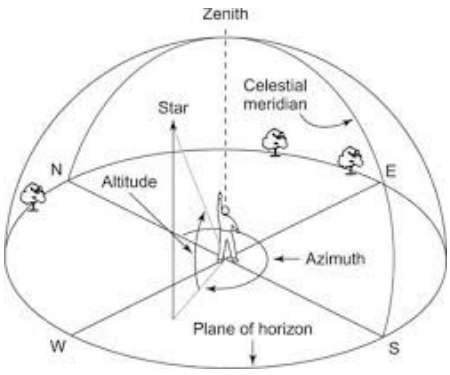


2. Terrestial Coordinates: Longitude and Latitude

The zero point for longitude is the prime meridian which runs through Greenwich.



3. Horizontal Coordinates: Azimuth and Elevation



Zenith: The point vertically above an observer and is 90^{o} from all points on the horizon. The *nadir* is 180^{o} opposite zenith.

The **celestial meridian** is great circle which intersects the zenith, the nadir, and the celestial poles.

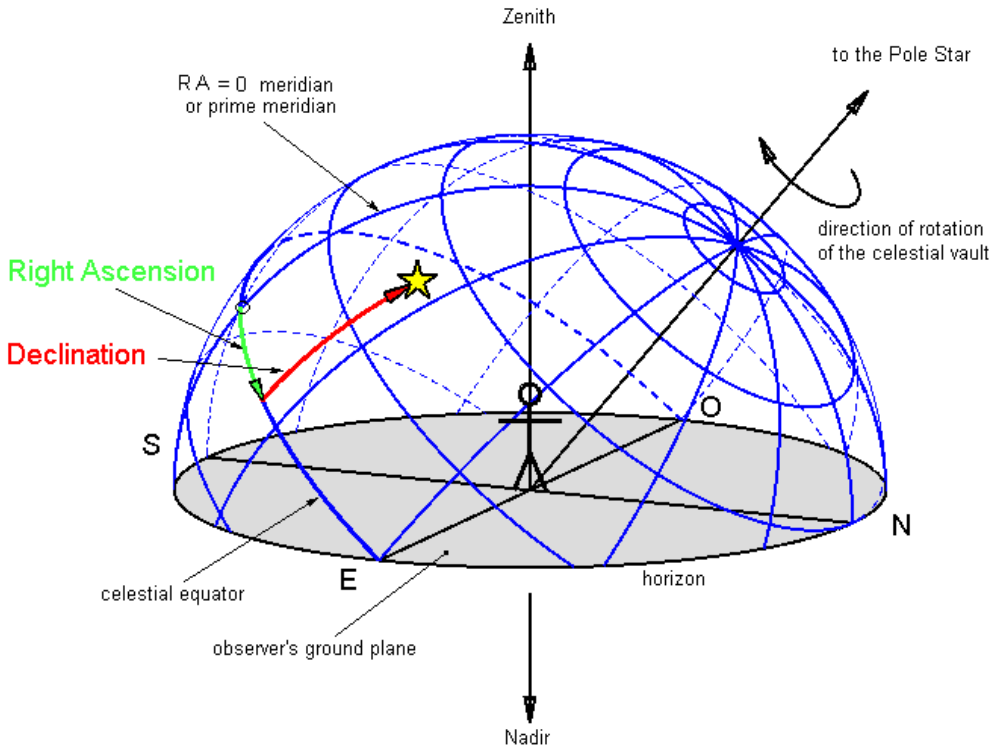
The **astronomical horizon** is a great circle on the celestial sphere which is perpendicular to the zenith-nadir axis.

The coordinates of an object are described by its **azimuth** and **elevation**.

- The **azimuth** is defined in degrees clockwise from due North.
- **Elevation** is defined in degrees above the horizon.

4. Equatorial Coordinates: Right Ascension and Declination

- Most commonly used in astronomy.
- Not tied to observer's location.
- Locations of stars are fixed in the equatorial coordinate system.
- Projection of the terrestial longitudes and latitudes onto the celestial sphere.



Celestial Poles: points vertially above the earth's north and south poles

Celestial Equator: projection of the earth's equator onto the celestial sphere

Right Ascension (RA):

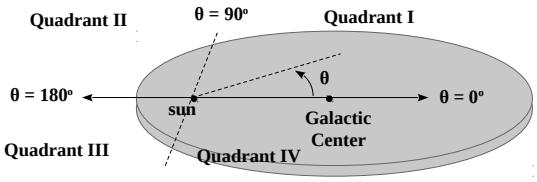
- longitudinal coordinate
- RA = 0^{o} at the prime meridian
- 1 hr of RA = 15^{o}

Declination (Dec):

- latitude coordinate
- Dec = 0^{o} at the celestial equatorial
- North Celestial Pole (NSP) = +90^{o} Dec; South Celestial Pole (NSP) = -90^{o} Dec

5. Galactic Coordinates

- The Milky Way Galaxy is disk-like
- A spherical coordinate system with the sun at its center.
- Describes the positions of objects in the Milky Way Galaxy in relation to the sun (us).
- Galactic longitude rotates 360^o in the plane of the galaxy.
  - galactic longitude $\theta = 0^o$ is toward the center of the galaxy, from the sun's point of view.
  - galactic longitude $\theta = 180^o$ is directly away from the center of the galaxy.
- Galactic latitude rotates 180^o from the galactic north pole to the galactic south pole.



- The galaxy is divided into 4 quadrants using standard trigonometry definitions, as illustrated in the diagram above.

EXERCISES

1. If a person in Charlotte looks straight up, what is the declination of the direction the person is looking?

2. If a star rising in the east and is at an elevation of 30^o, then how much will the RA change when the object is directly overhead?