

Earth-Sun Relations

Earth's Cosmic Address

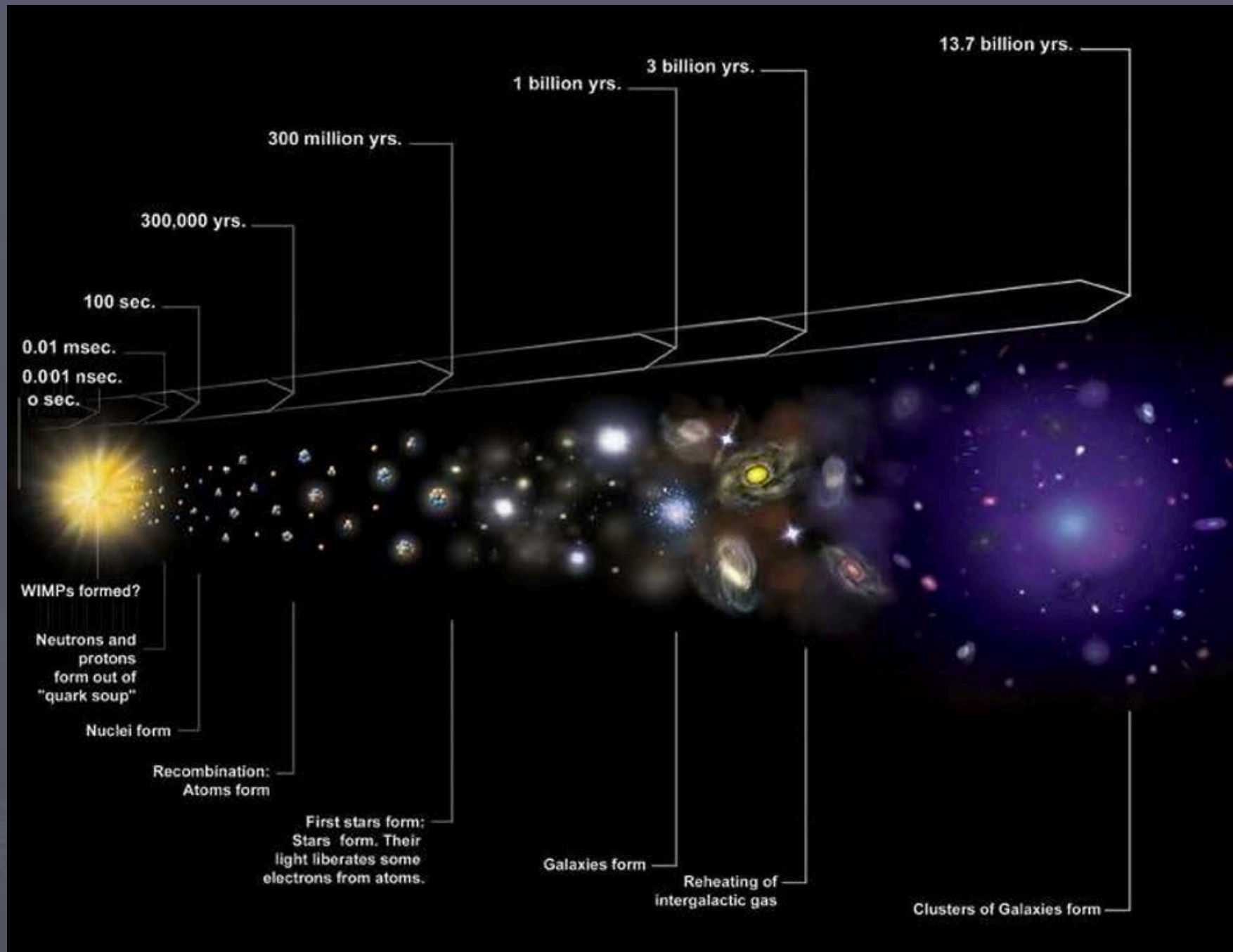
Chapter 2

The Pale Blue Dot



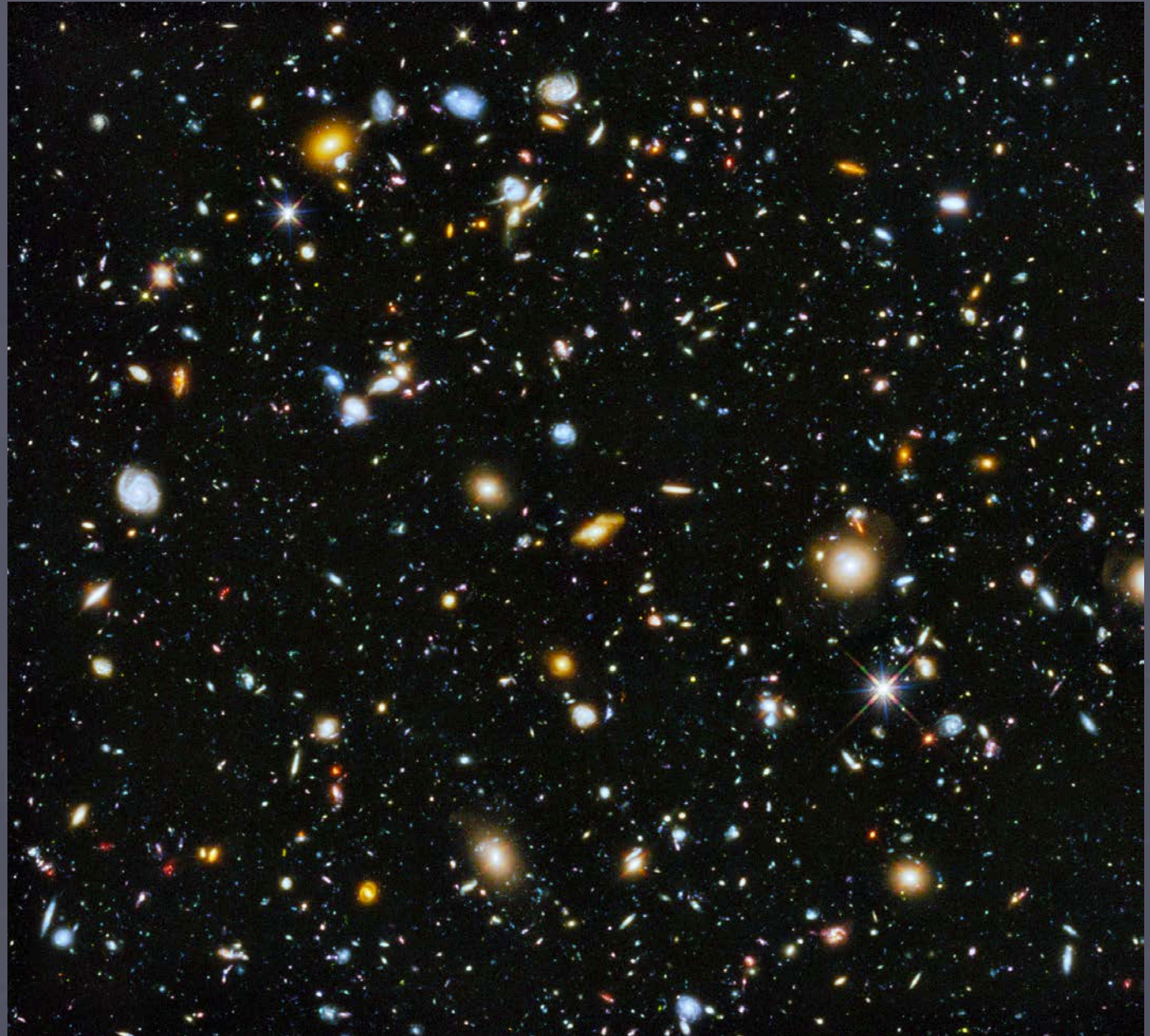
- Carl Sagan Speech - <https://www.youtube.com/watch?v=wupToqz1e2g>

Cosmic Epochs

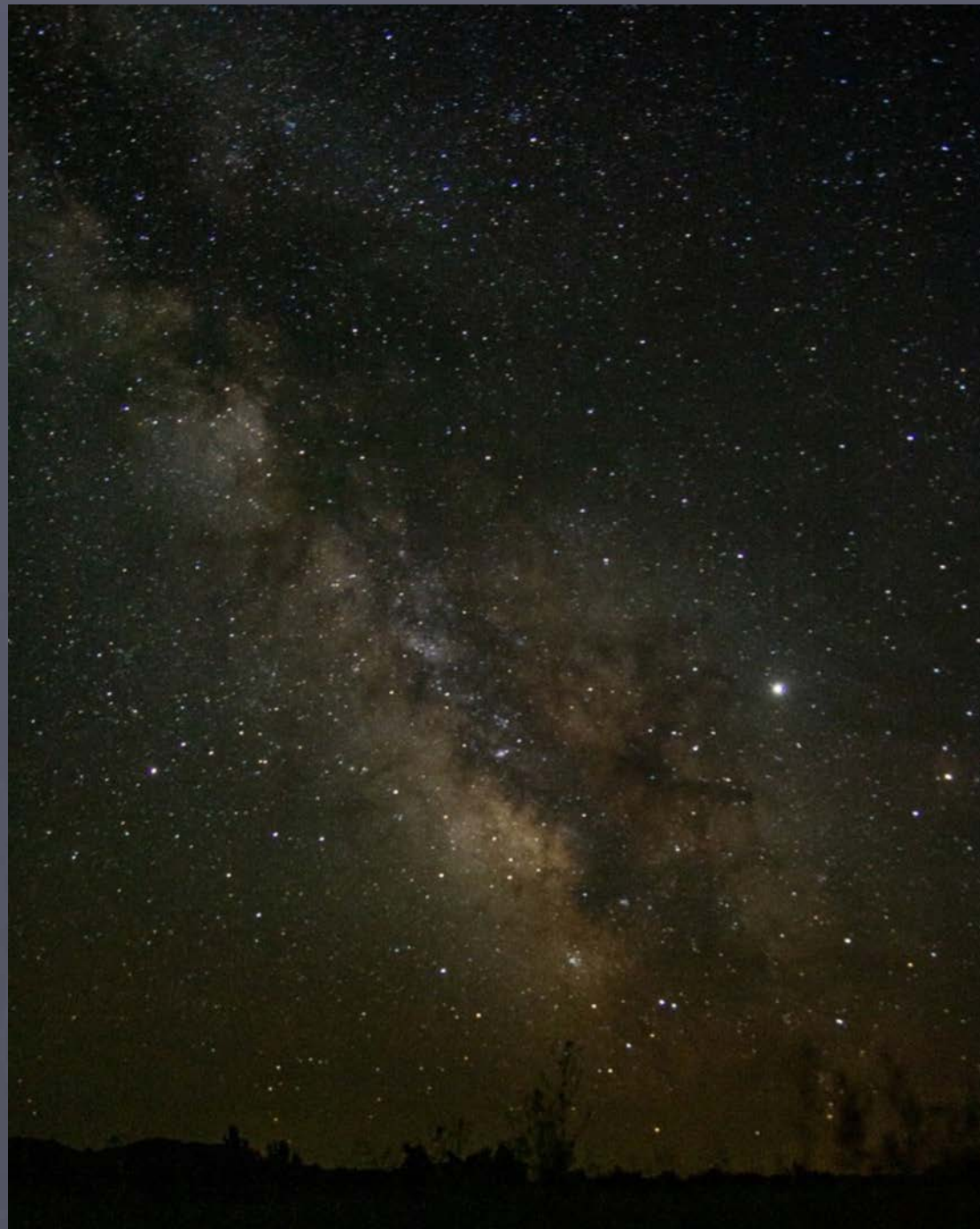


The Universe

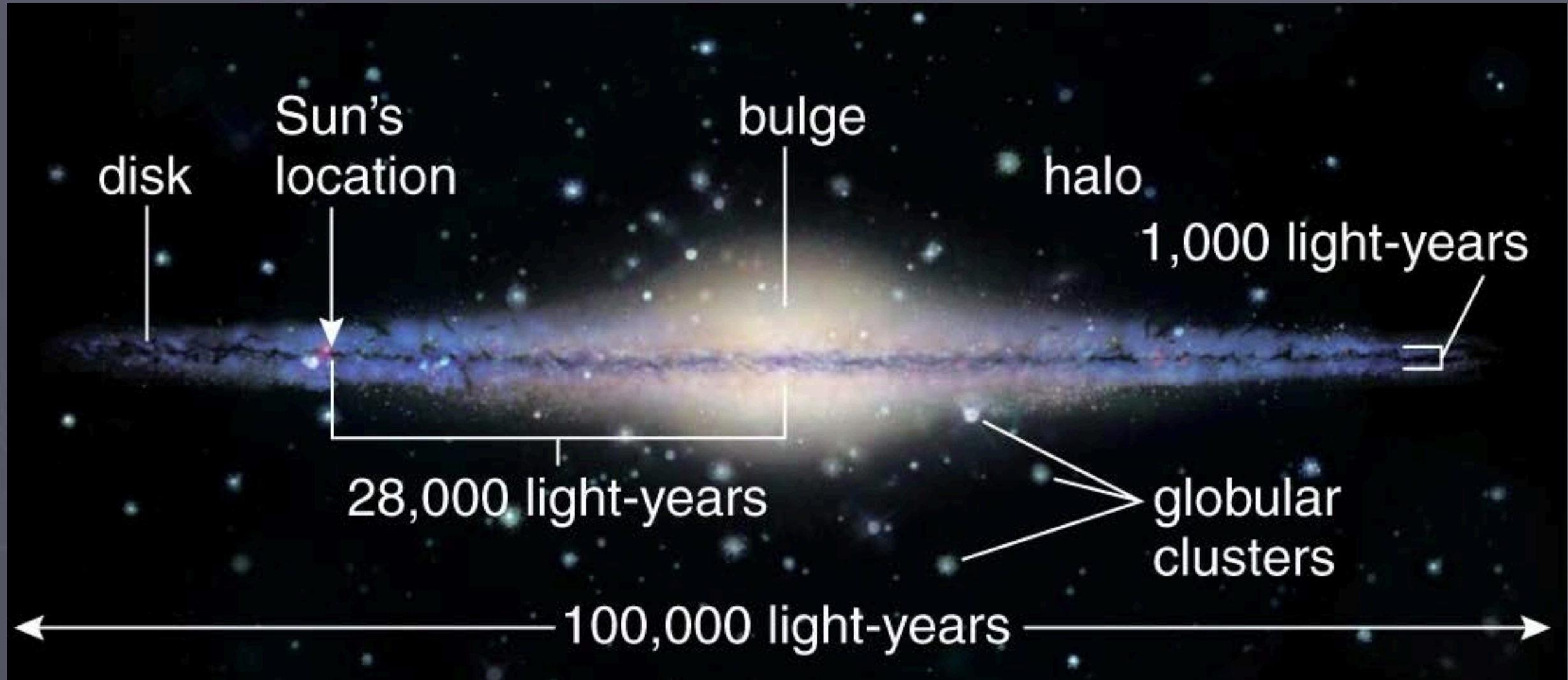
- Universe thought to contain over 125 billion galaxies
 - Each one with millions to billions of their own stars



The Milky Way

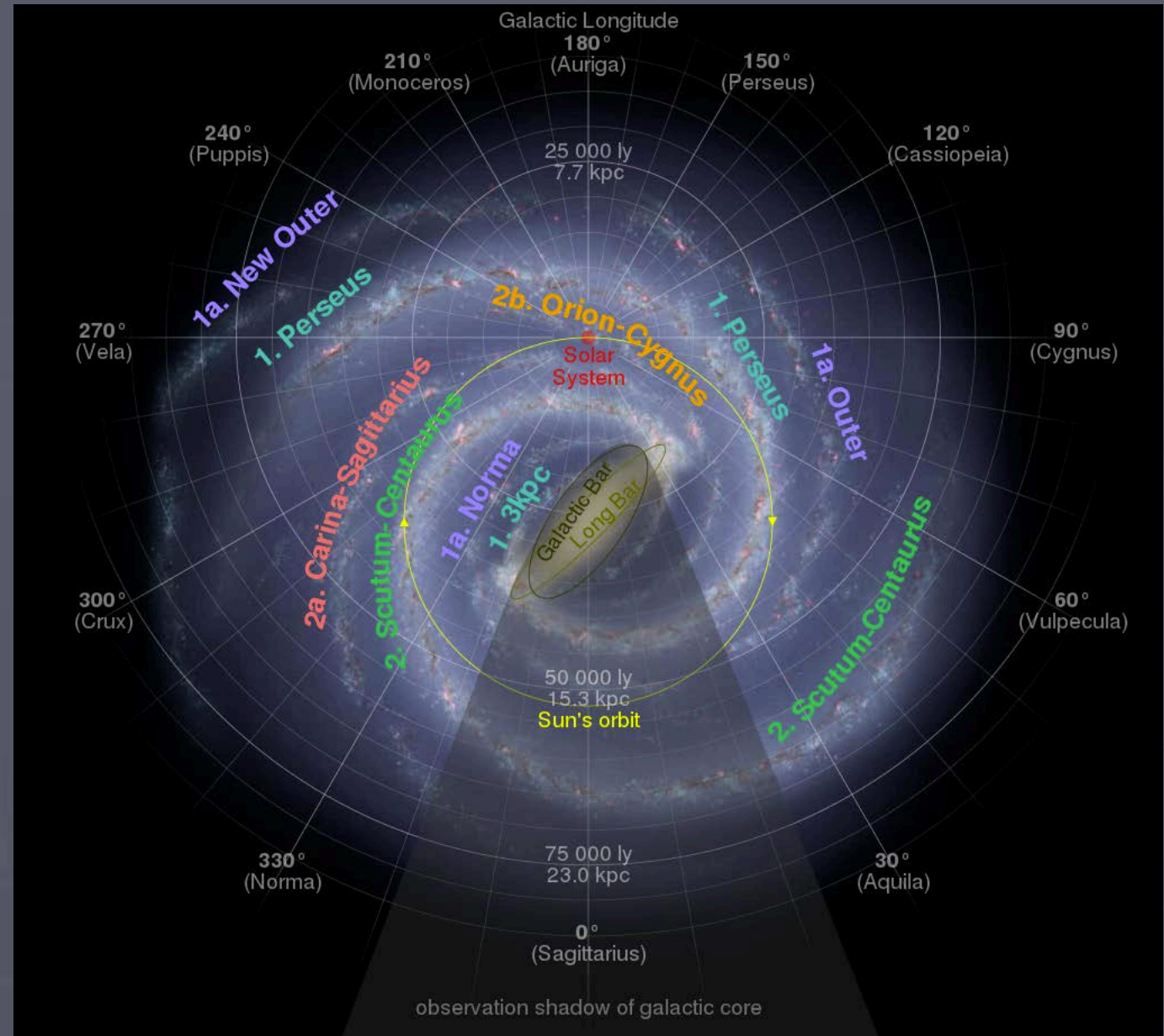


The Milky Way Galaxy

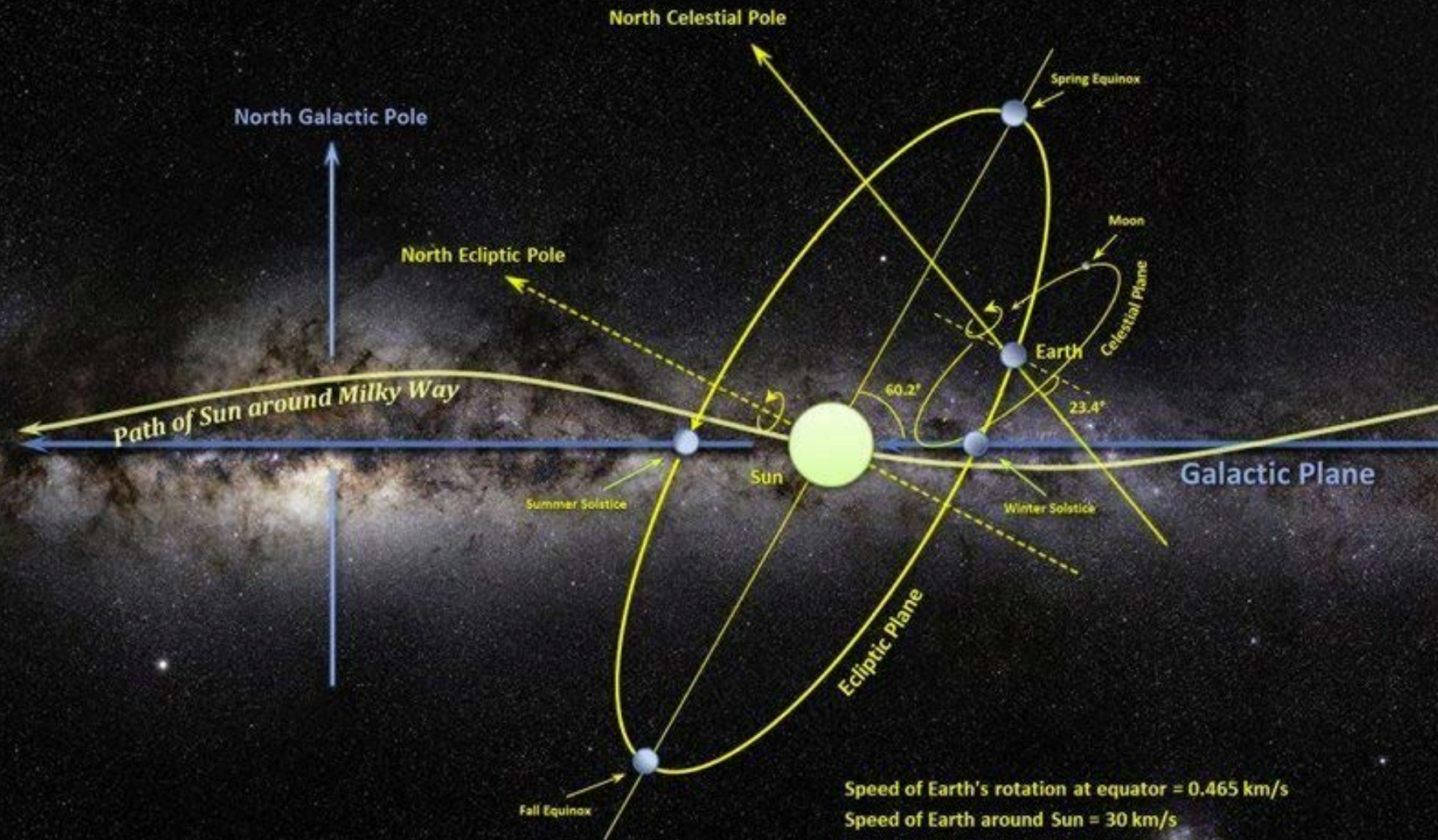


The Milky Way

- Milky Way is thought to contain around 300 billion stars



MOTION OF EARTH AND SUN AROUND THE MILKY WAY

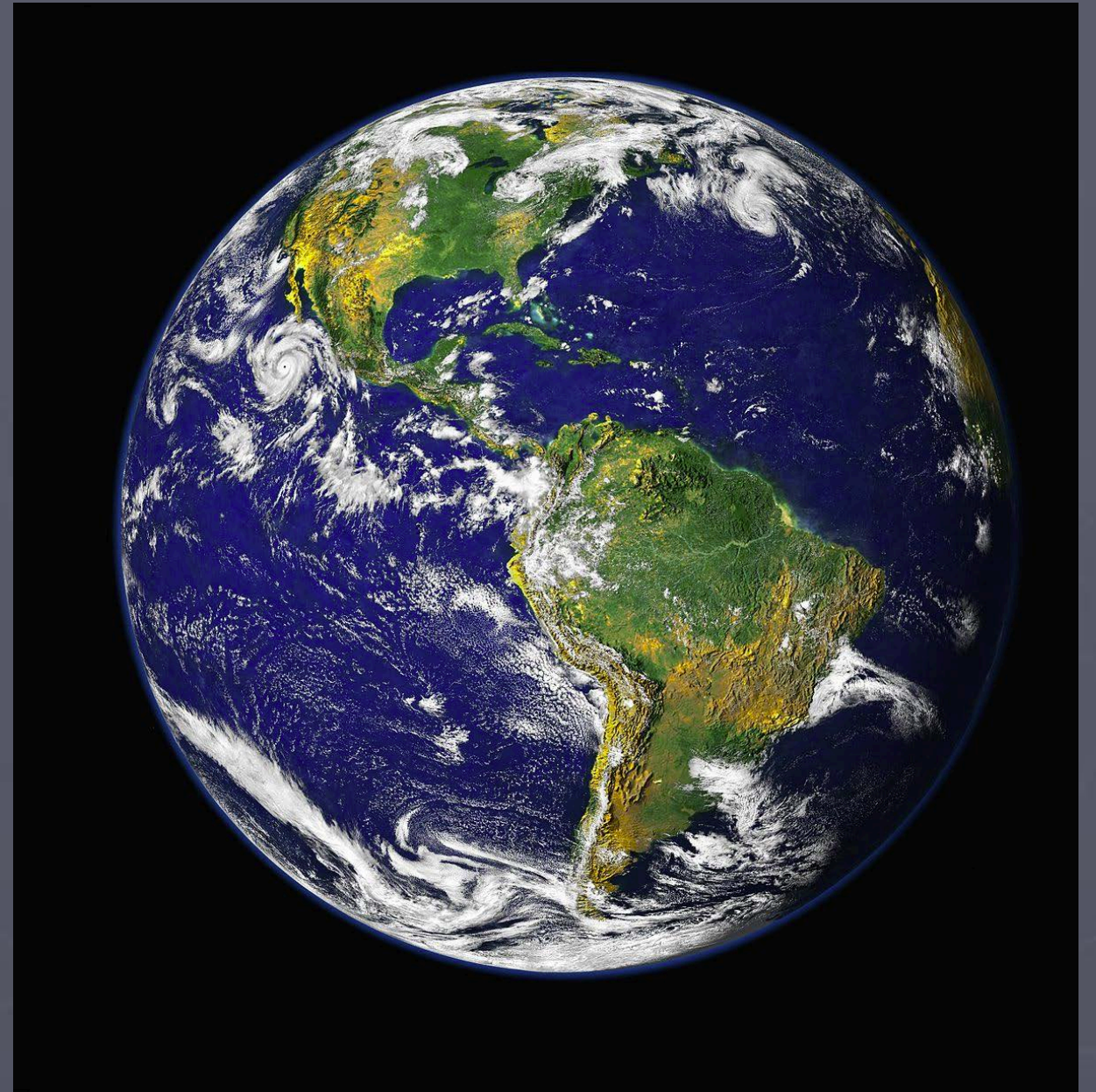


Speed of Earth's rotation at equator = 0.465 km/s
Speed of Earth around Sun = 30 km/s
Speed of Sun around Milky Way = 230 km/s
Sun is approximately 26,000 light years from Galactic Center

Diagram Not to Scale

Our Solar System

- Formed 4.6 to 5 billion years ago
 - Earth thought to be around 4.5 billion years old
- 8 planets revolve around the Sun
 - 4 terrestrial planets
 - 4 gas giants



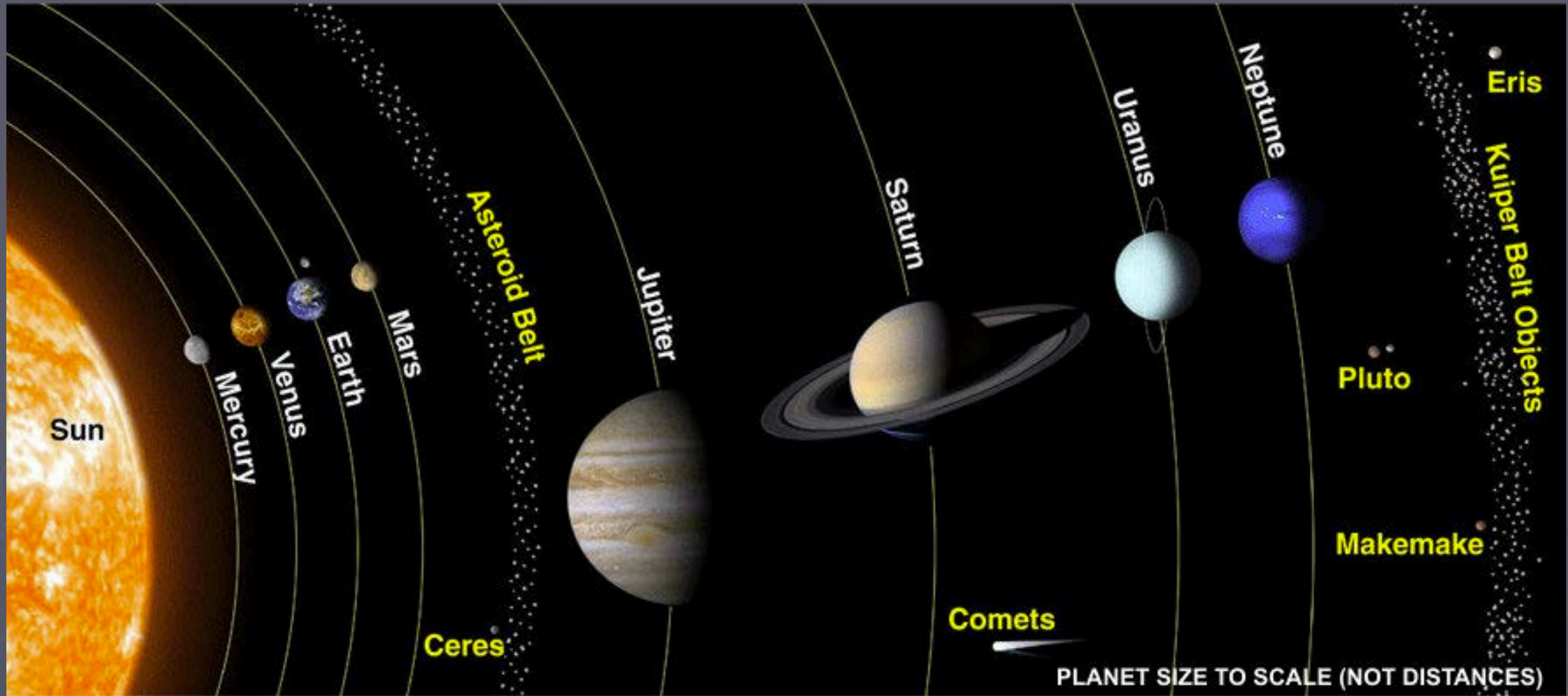
THE SOLAR SYSTEM

— Distances to scale —
— All bodies x1000 —



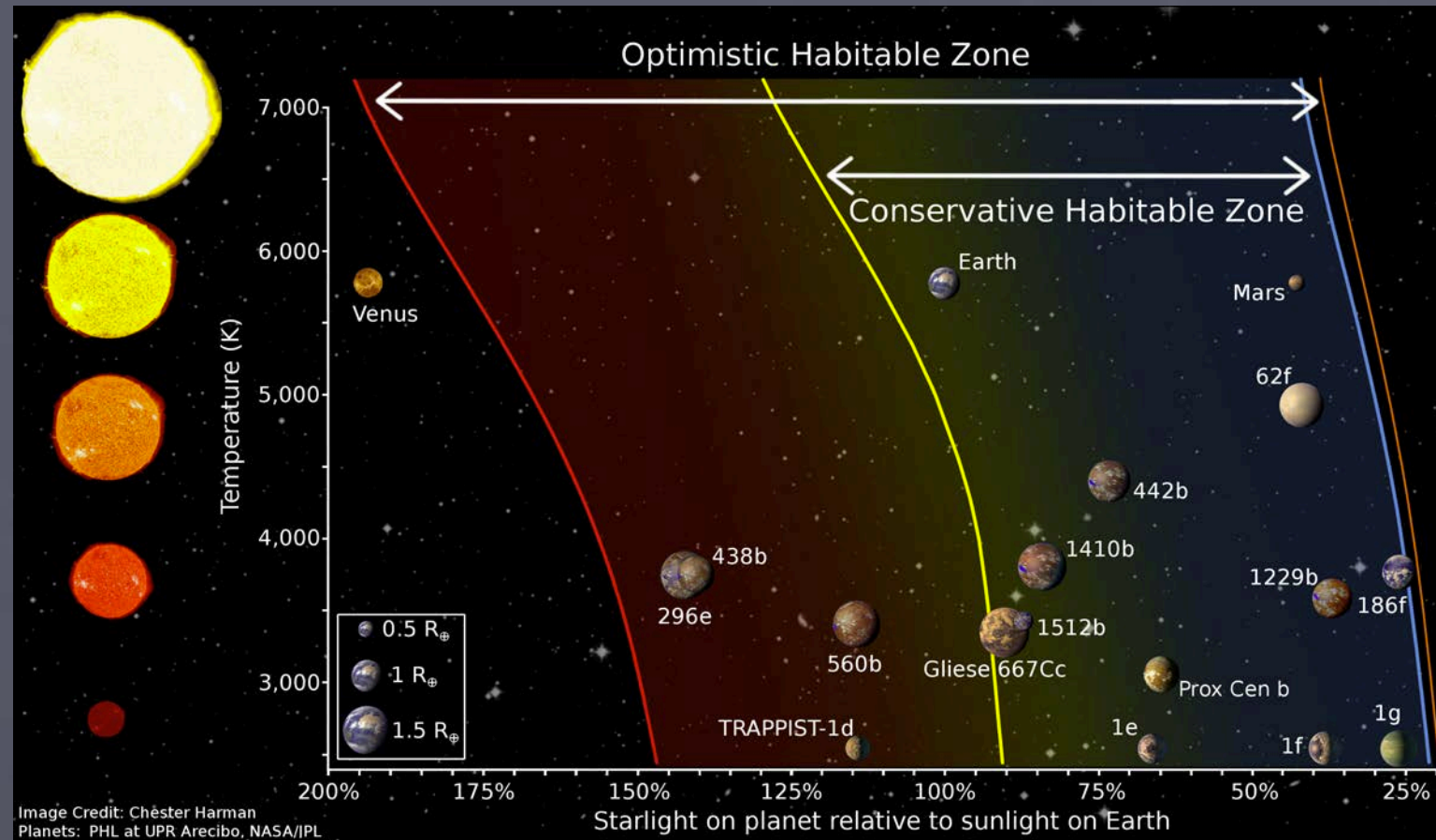
1 Astronomical Unit (1AU) = 149.6 Million km

James O'Donoghue / NASA imagery — T: @physicsJ



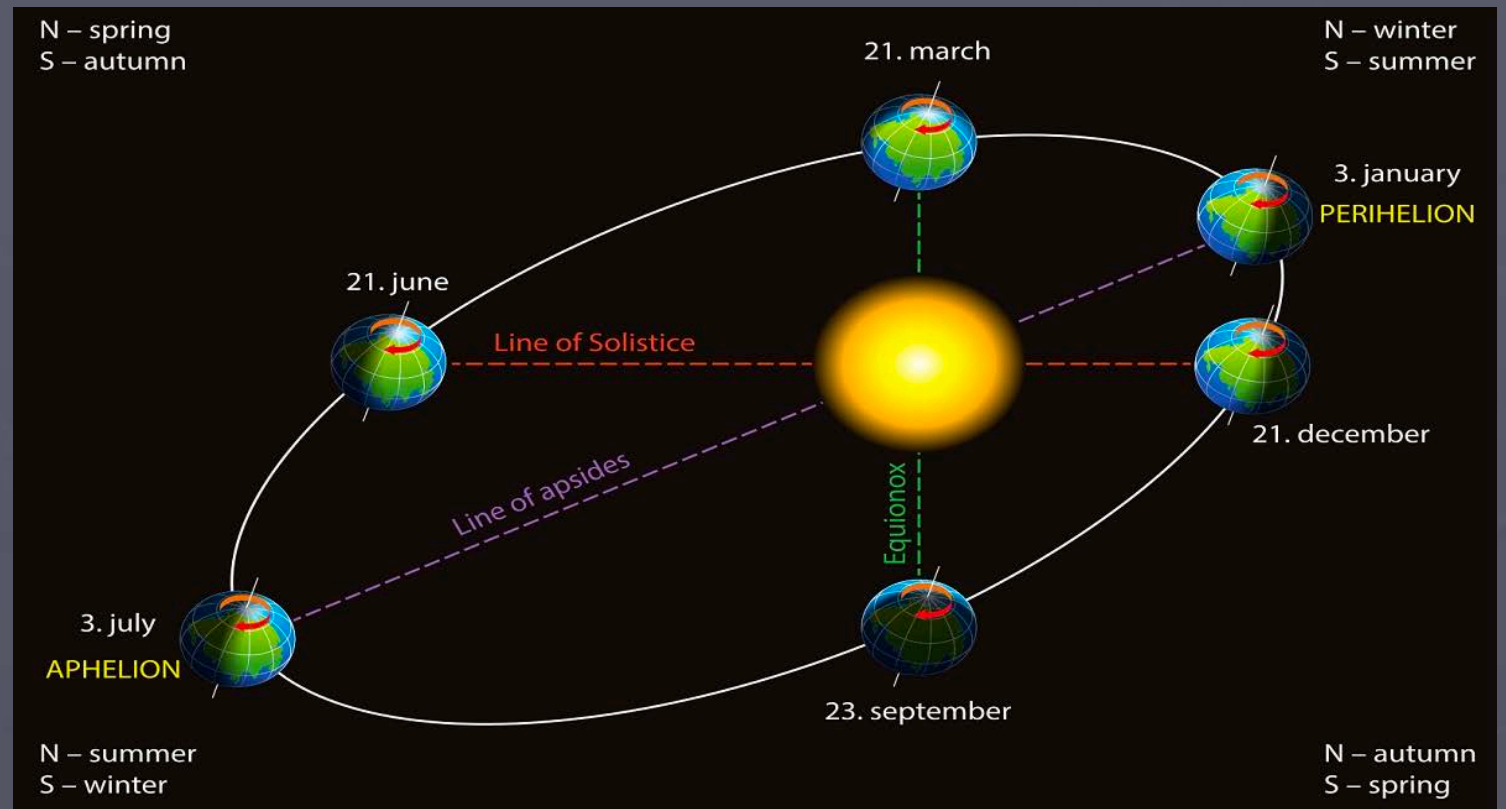
Circumstellar Habitable Zone

- The Habitable Zone (nicknamed the Goldilocks zone) denotes area where life as we know it is possible
- 1953 Hubertus Strughold & Harlow Shapley
- Estimated 1/5 stars have an earth-sized planet in CHZ, meaning upwards of 40 billion



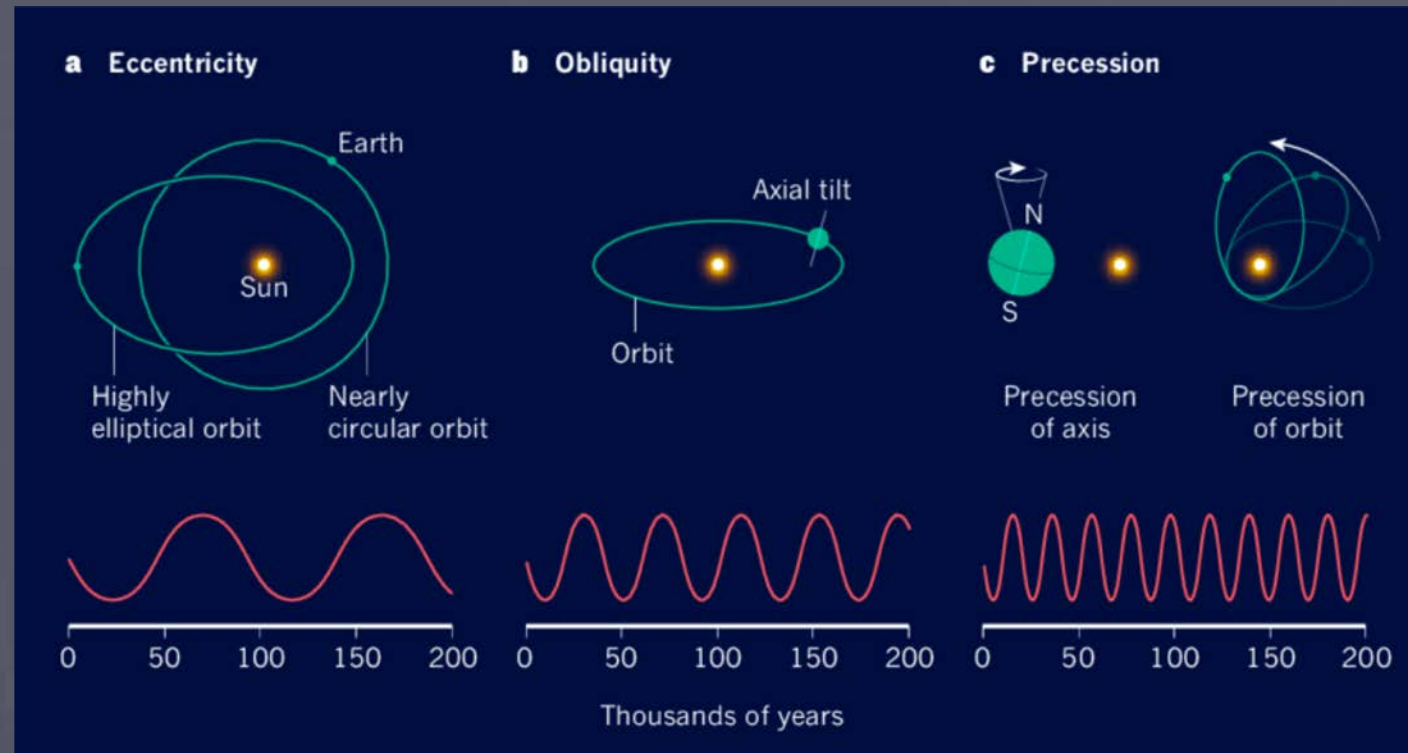
Earth's Elliptical Orbit

- Earth's path around sun not circular, rather it is elliptical
 - Aphelion (152,171,500 km)
 - Perihelion (147,166,480 km)
- Does not significantly factor into seasonal variations in temperature



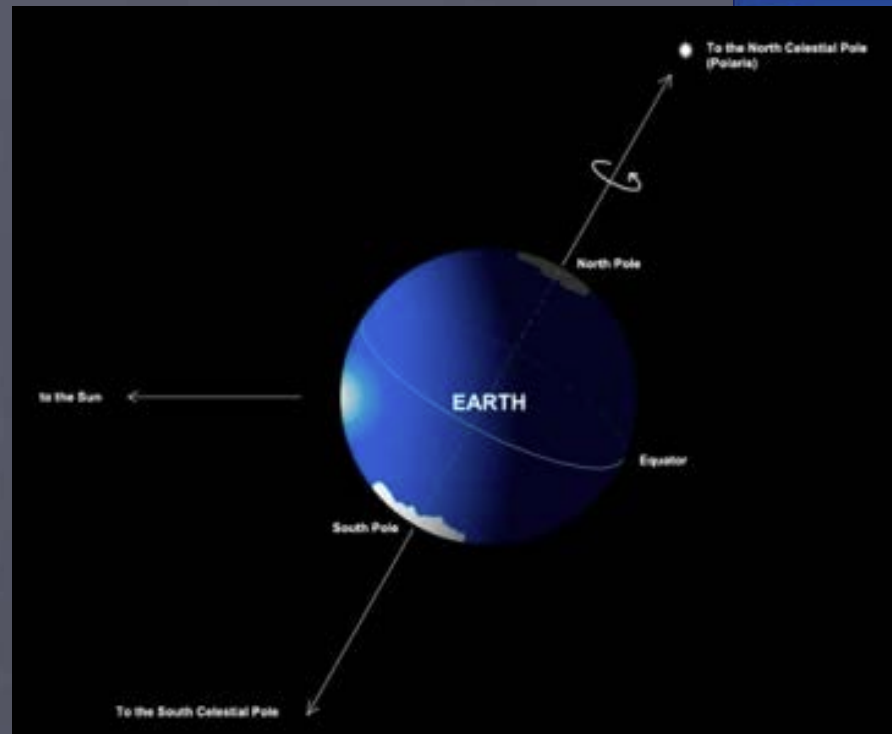
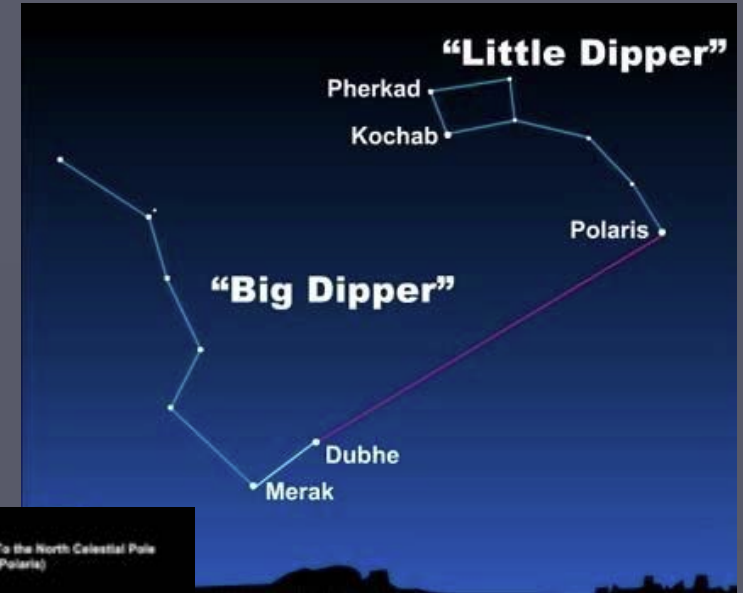
Milankovitch Cycles

- Eccentricity – Changes in Earth's orbit leading to variation in amount of energy
- Obliquity – Minor changes in the tilt resulting in variation at the poles
- Precession – Changes in the orientation of the tilt because of the Earth's wobble due to equatorial bulge



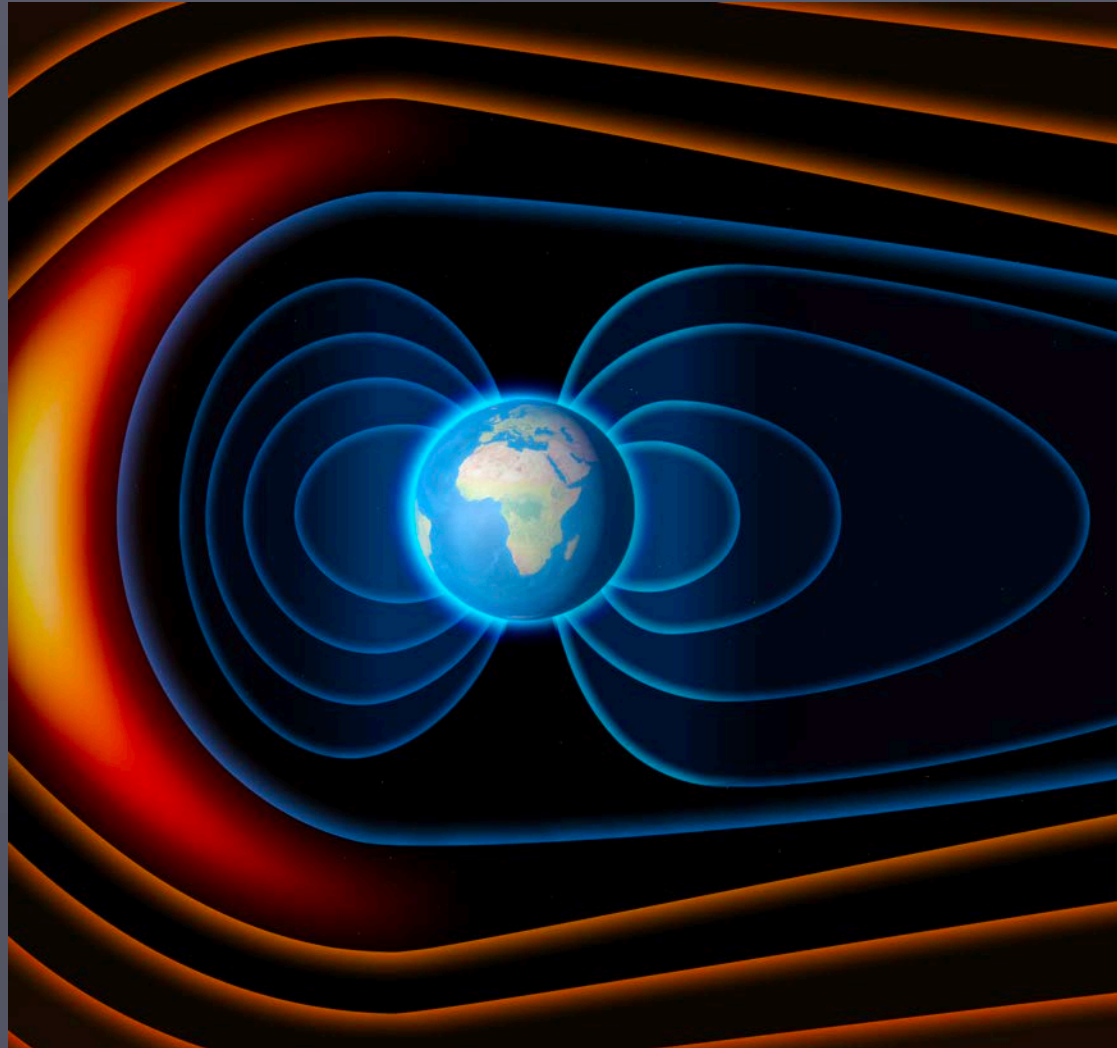
Importance of Polaris

- Constant above North Celestial Pole
- Used to determine latitude
 - 40 degrees North latitude, Polaris is 40 degrees above the horizon



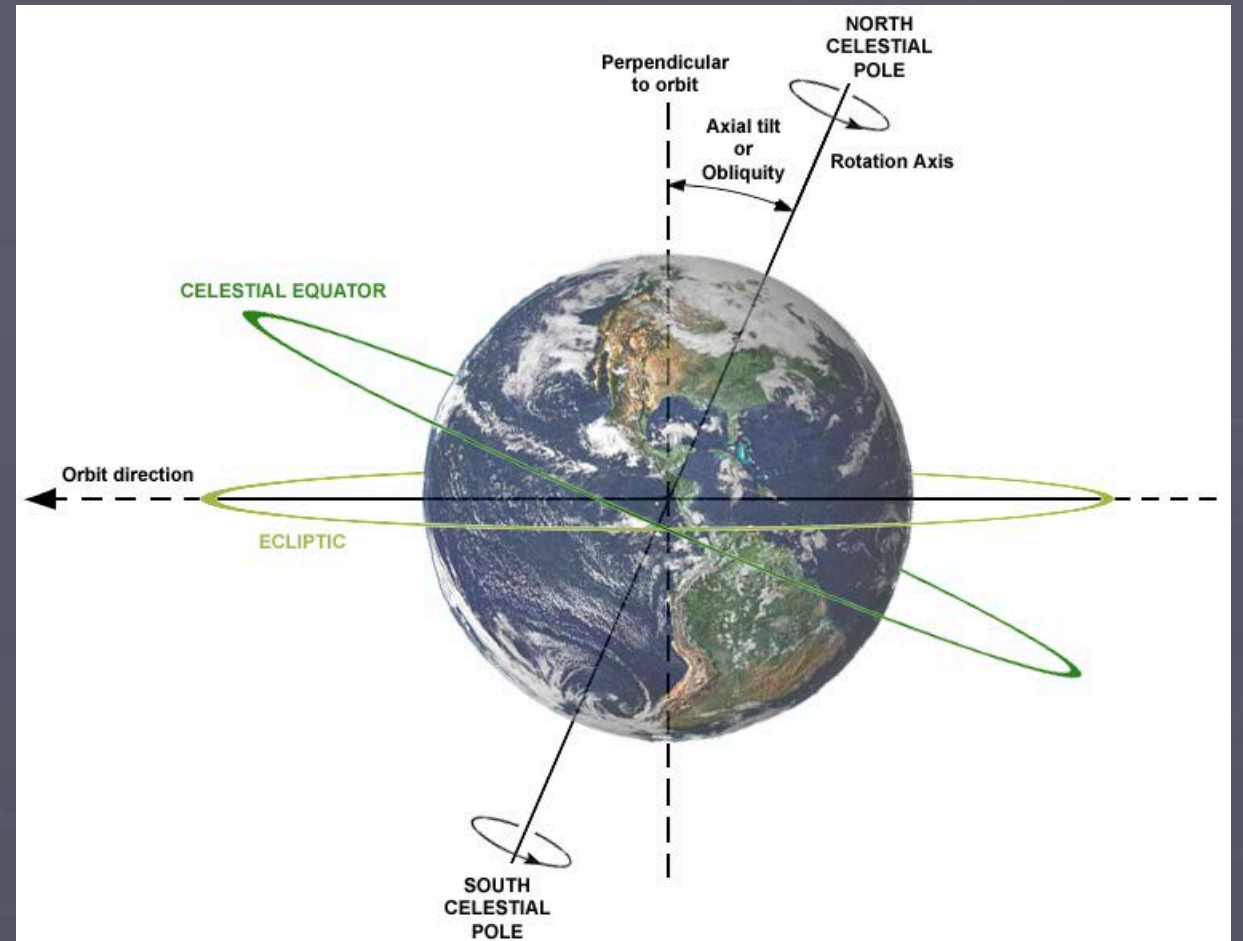
Earth's Magnetic Field

- Magnetosphere create by motion of our planet
 - Protecting us from the majority of the Sun's energy
 - Force compresses sphere on side facing the sun



Magnetic North Pole vs. Celestial North Pole

- Variation between celestial North Pole and Magnetic North pole caused by variation of electric currents near Earth's Core
 - Celestial remains mostly constant while magnetic shifts



Changes in Sun's Behavior

- Sun Spots

- Disturbances on Sun's surface correlated with increased solar radiation

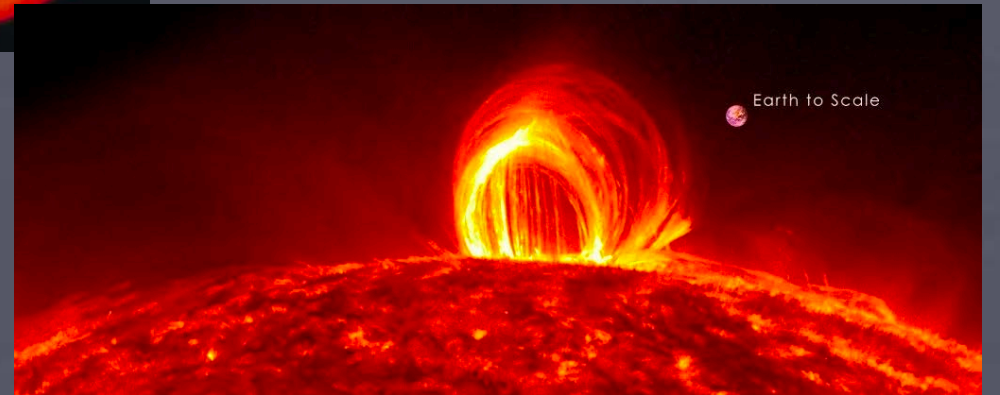


- Solar Flares

- Explosions on the surface resulting in solar wind

- Solar Wind

- Emissions of electrically charged particles
- Magnetosphere directs winds towards poles



The Auroras

- Results from Solar Winds interacting with atmosphere
 - *Aurora borealis* (Northern Lights), *Aurora australis* (southern Lights)

