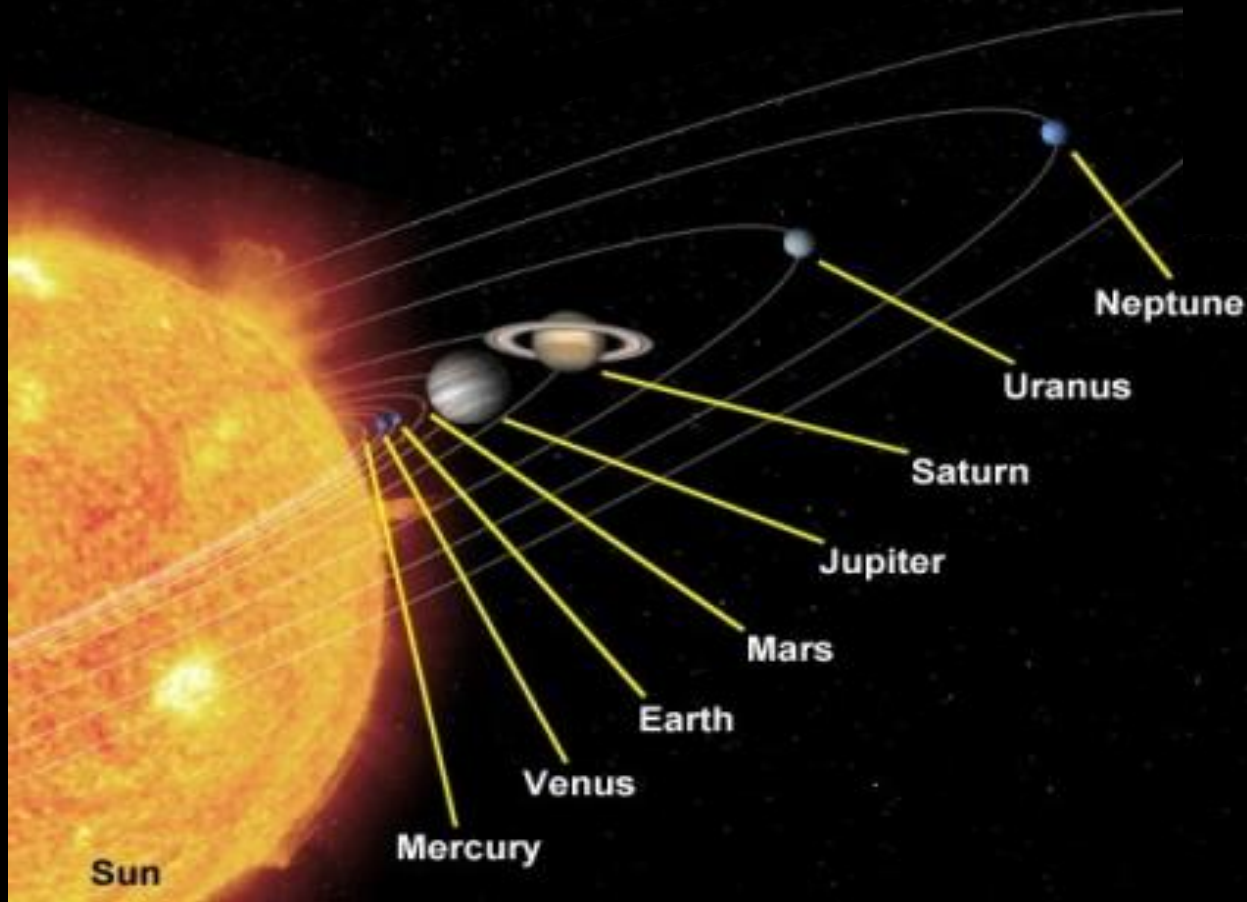
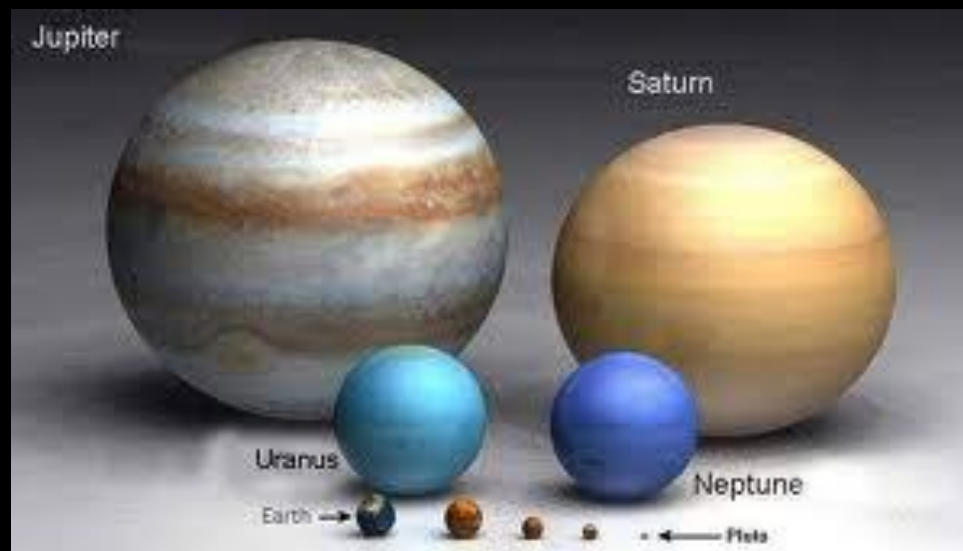
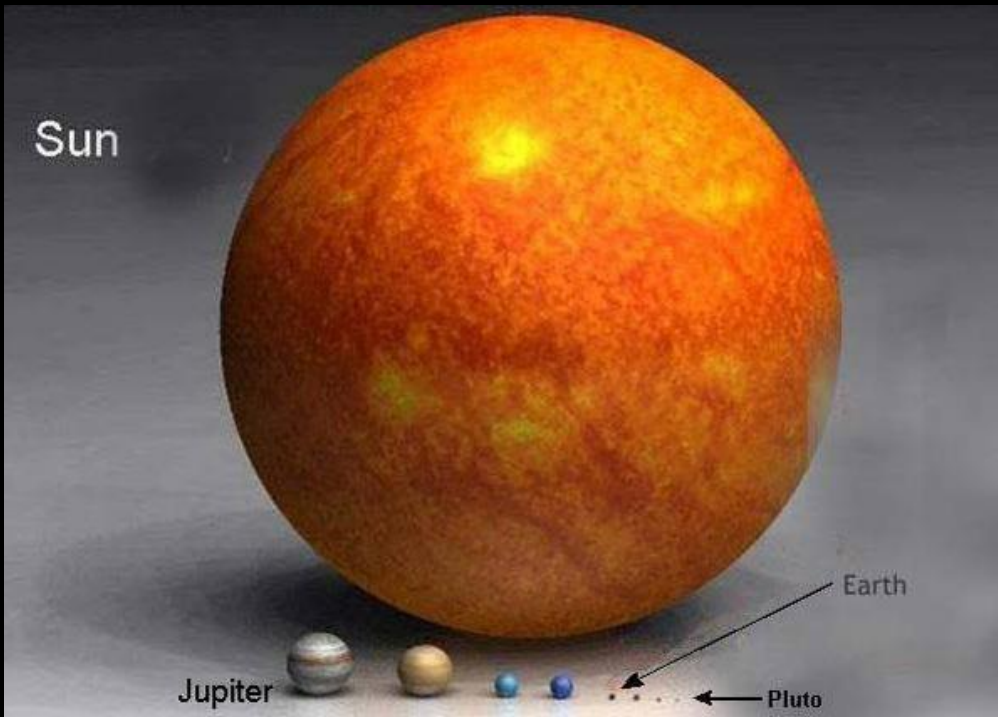


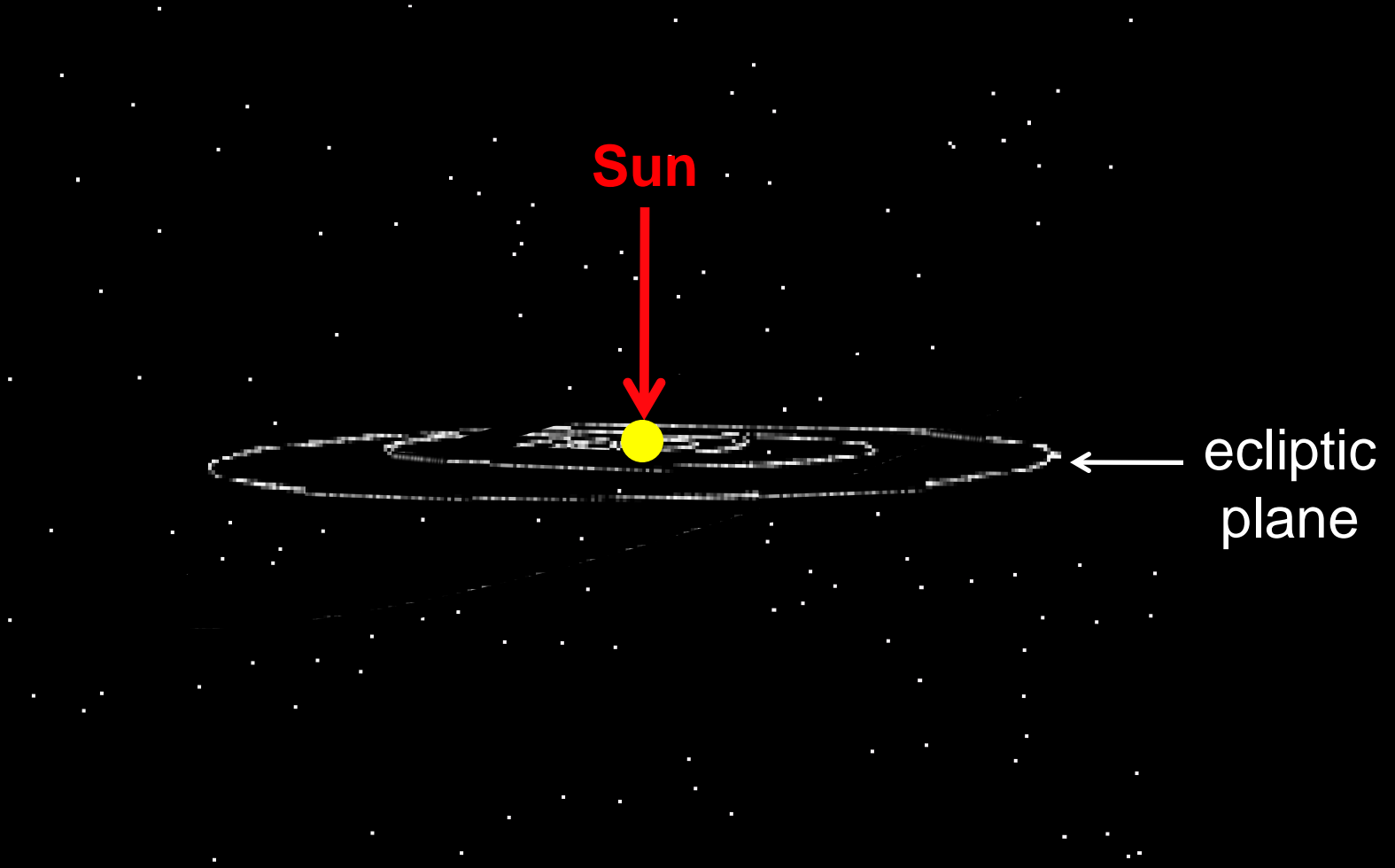
A large, bright yellow sun with a small dark spot on its surface. The sun is centered in the frame, and the text "Our Solar System" is overlaid on it.

Our Solar System

Planets orbit the Sun in a plane known as the **ECLIPTIC PLANE**



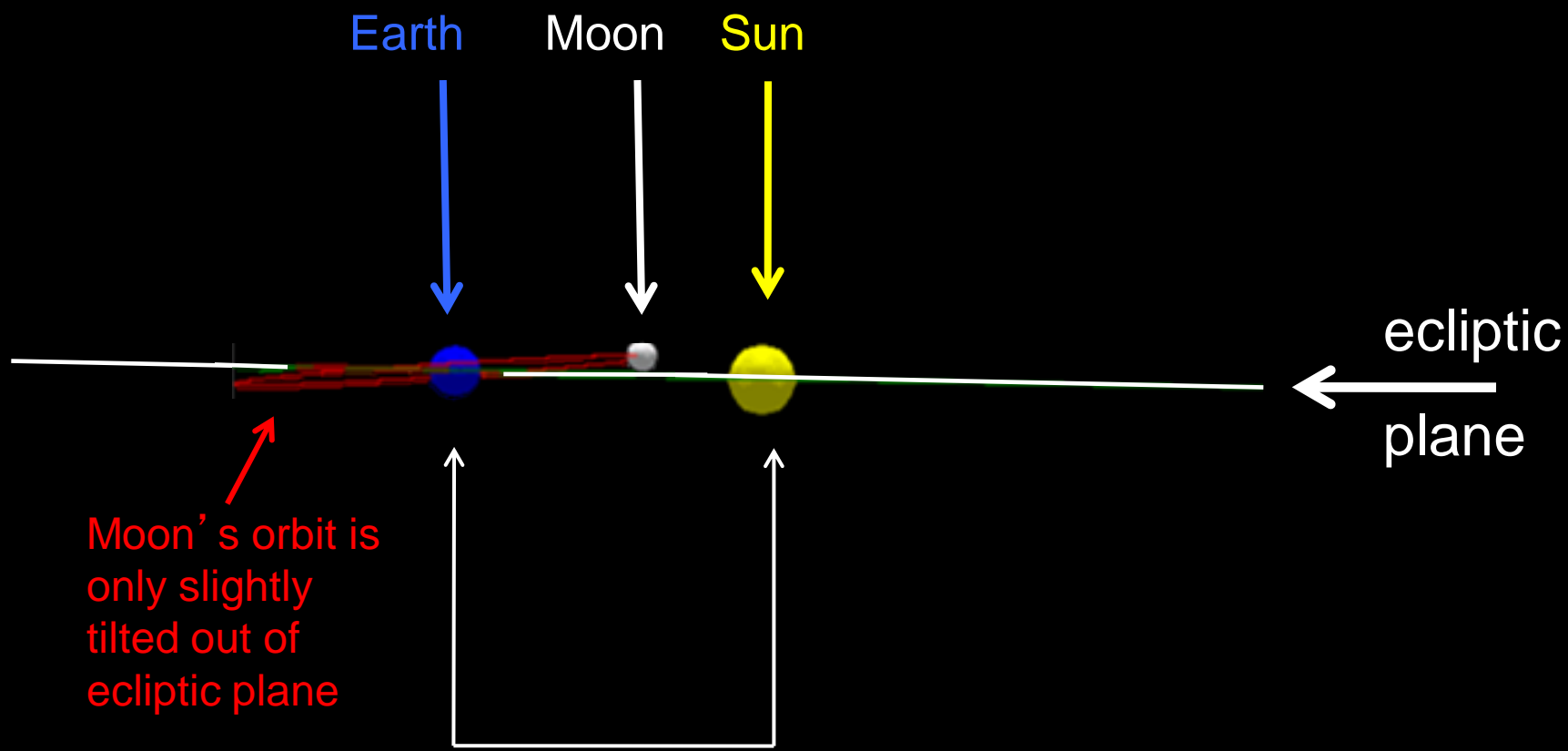




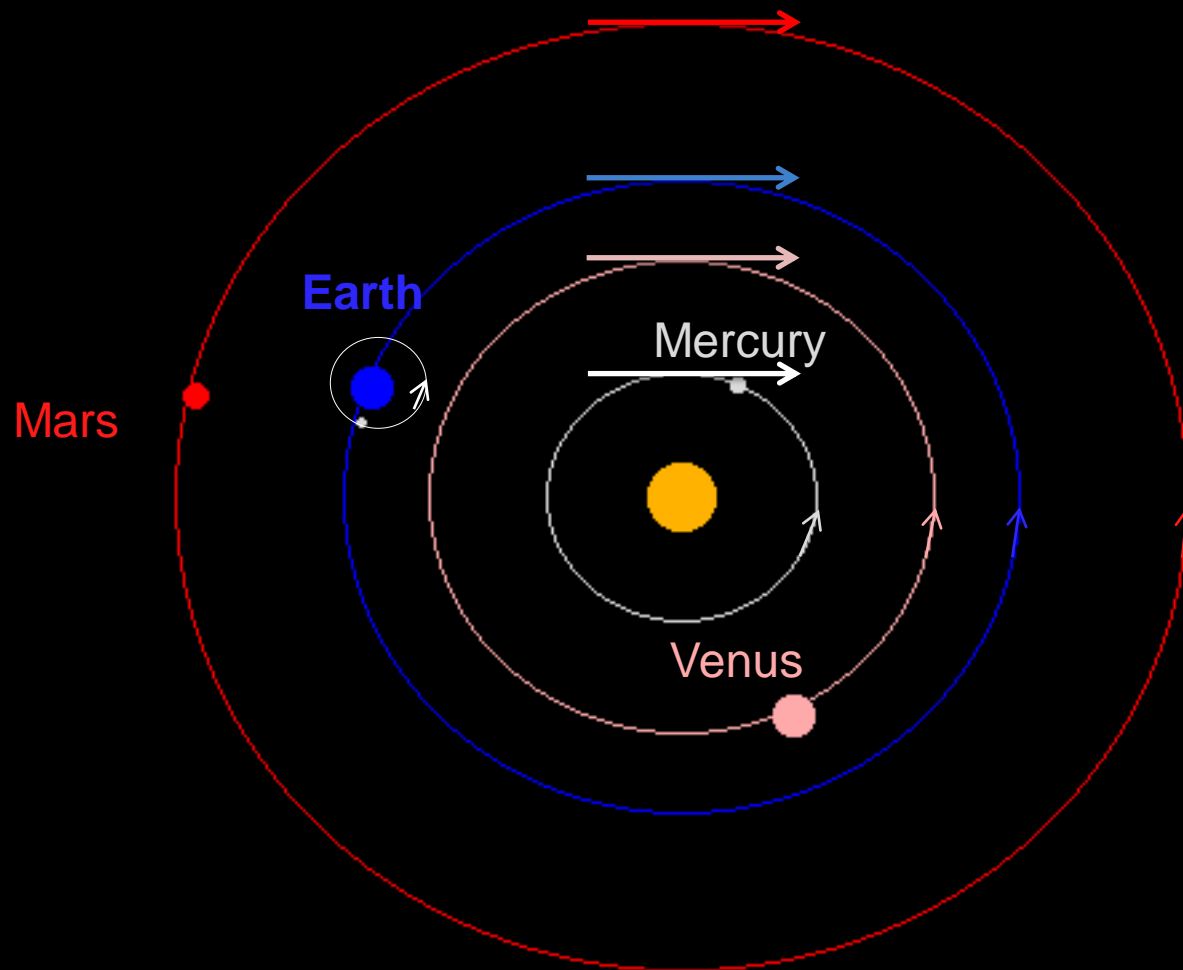
Path of planets around the Sun edge-on view



Jupiter and its moon orbit Jupiter in a flat plane, too. There is a reason the Solar System and Jupiter's moon system orbits are flat — we'll talk about it soon!

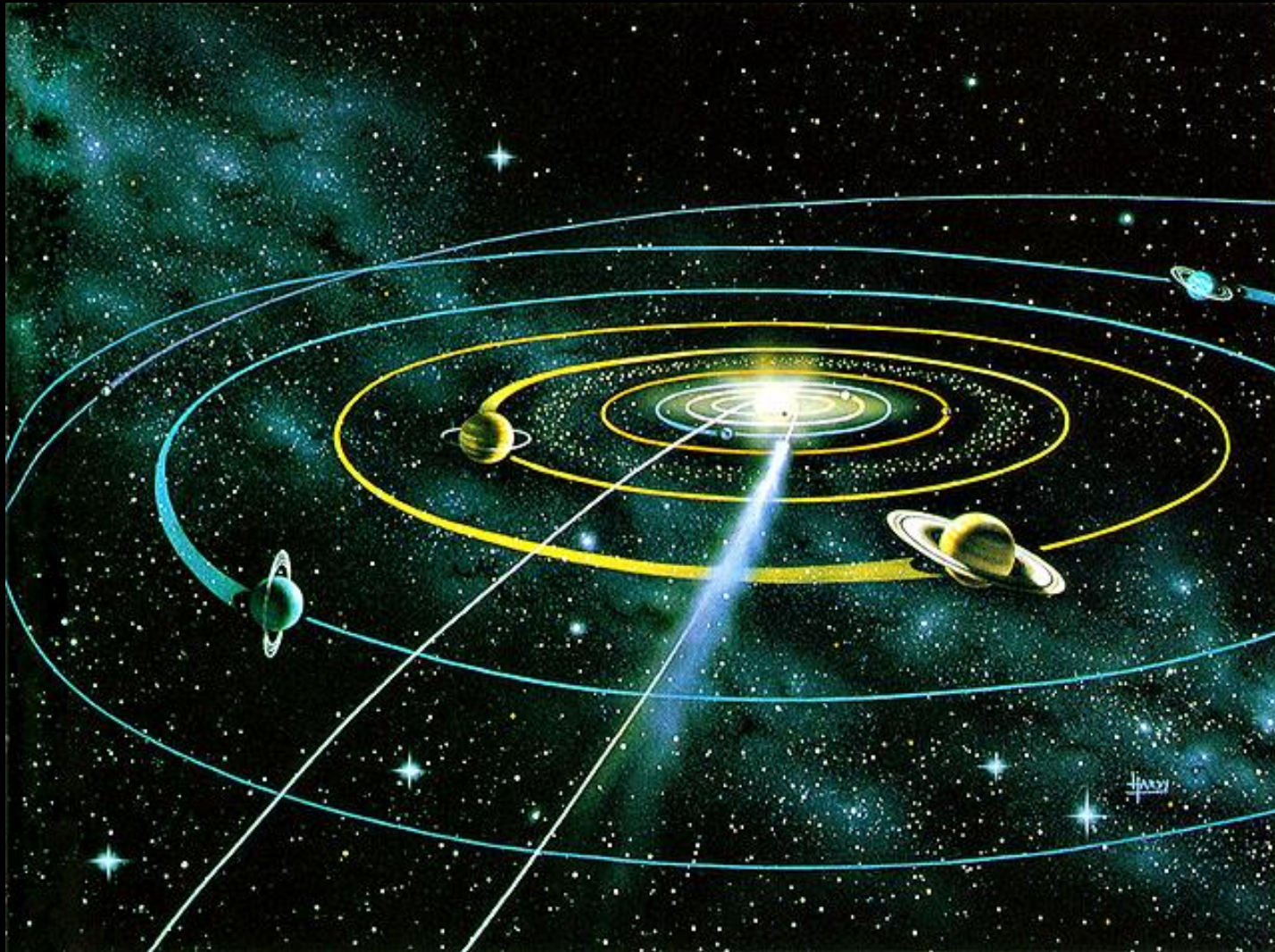


Earth - Sun Distance = 1 Astronomical Unit (AU)



Looking down onto (north) inner Solar System —
all planets orbit Sun counterclockwise

(not to scale)

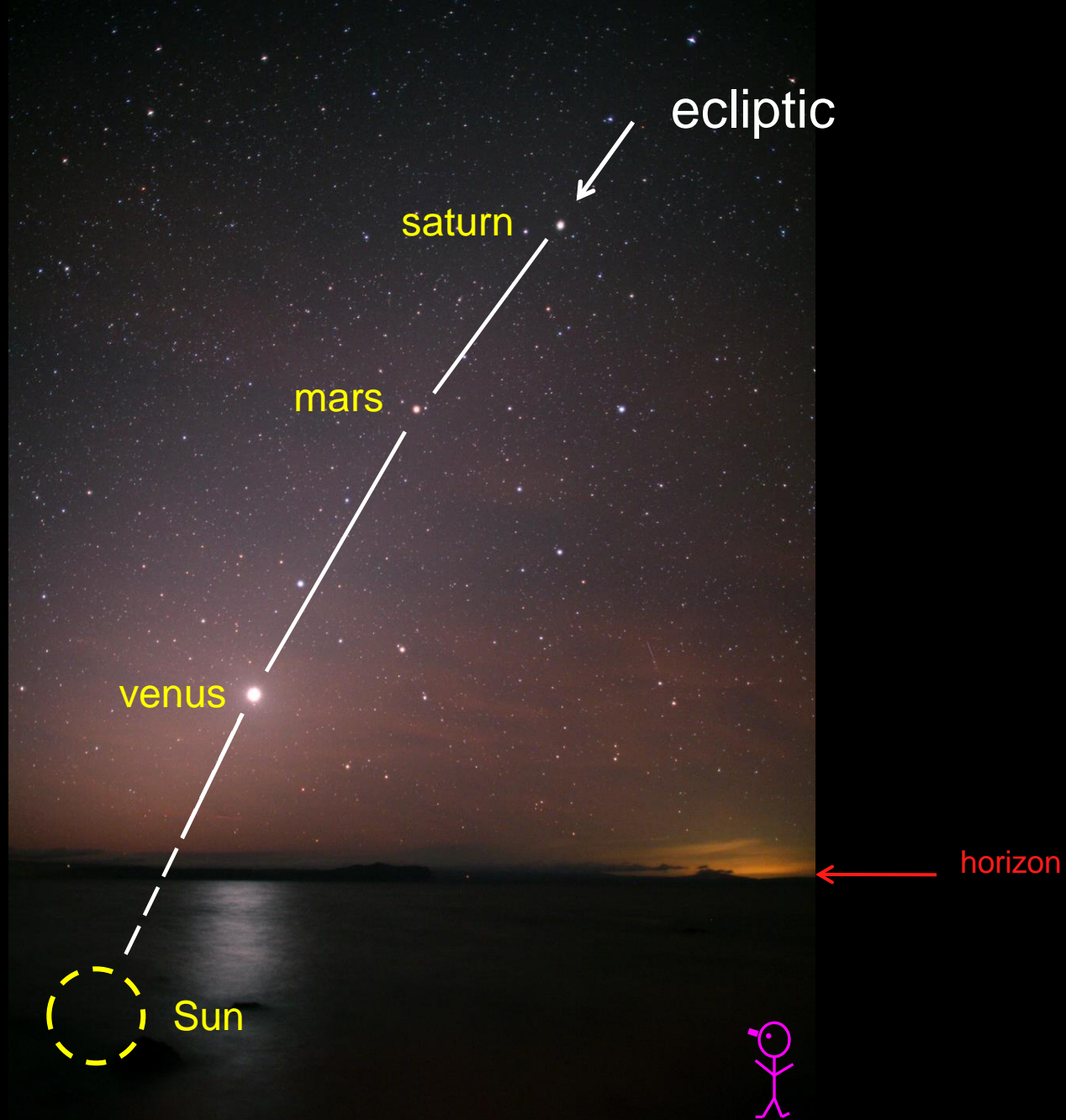


How does being in the ecliptic affect where we see the planets in the sky from the ground, on Earth?



horizon





ecliptic

saturn

mars

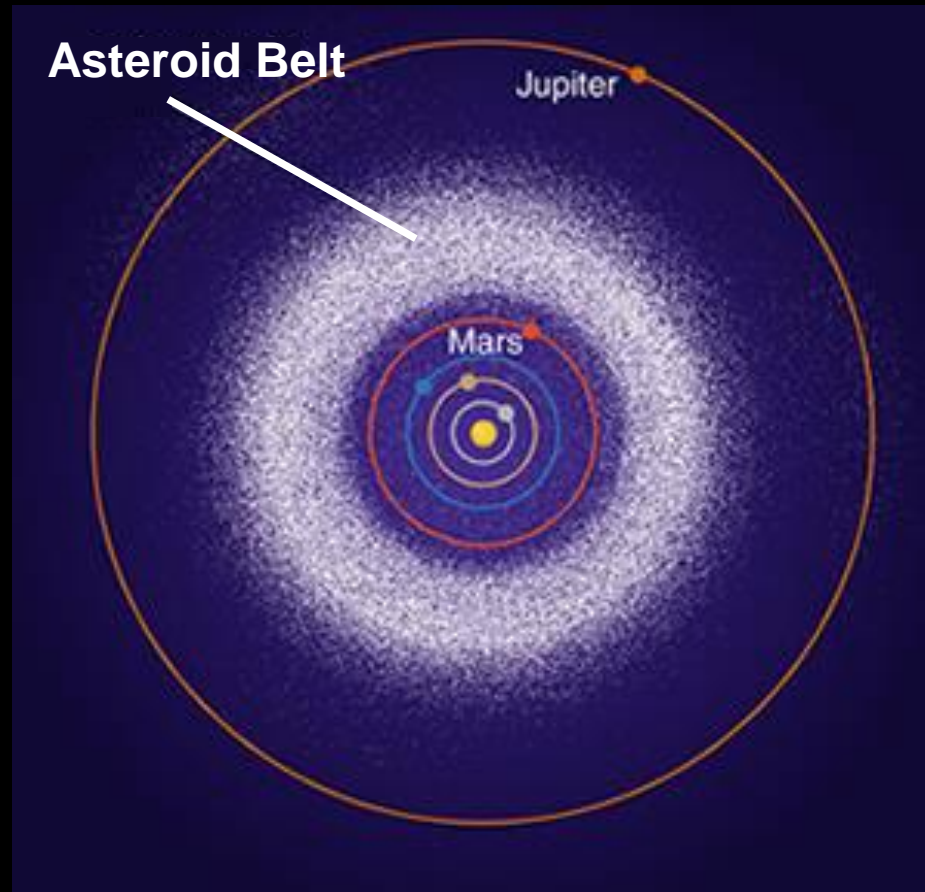
venus

horizon

Sun

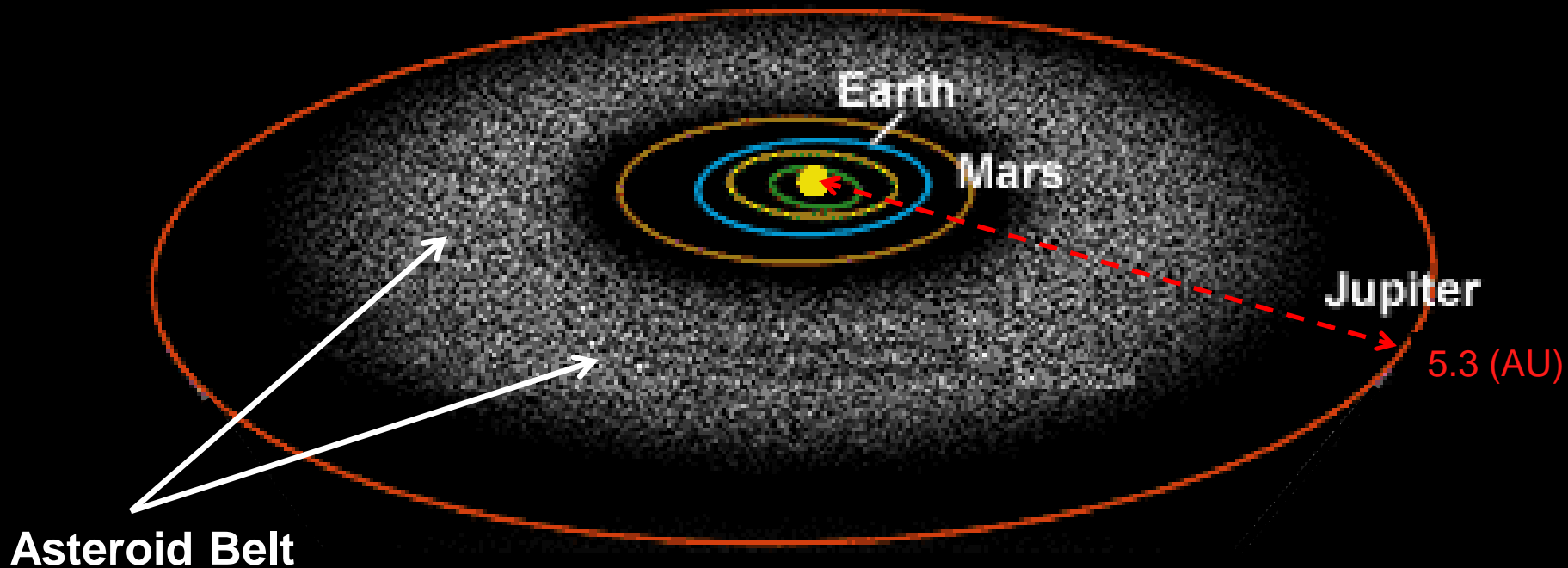
Sun, planets look as if they're in a gentle arc — the ecliptic





there are more than just planets and Sun in the Solar System
in the ecliptic plane — the **ASTEROID BELT**

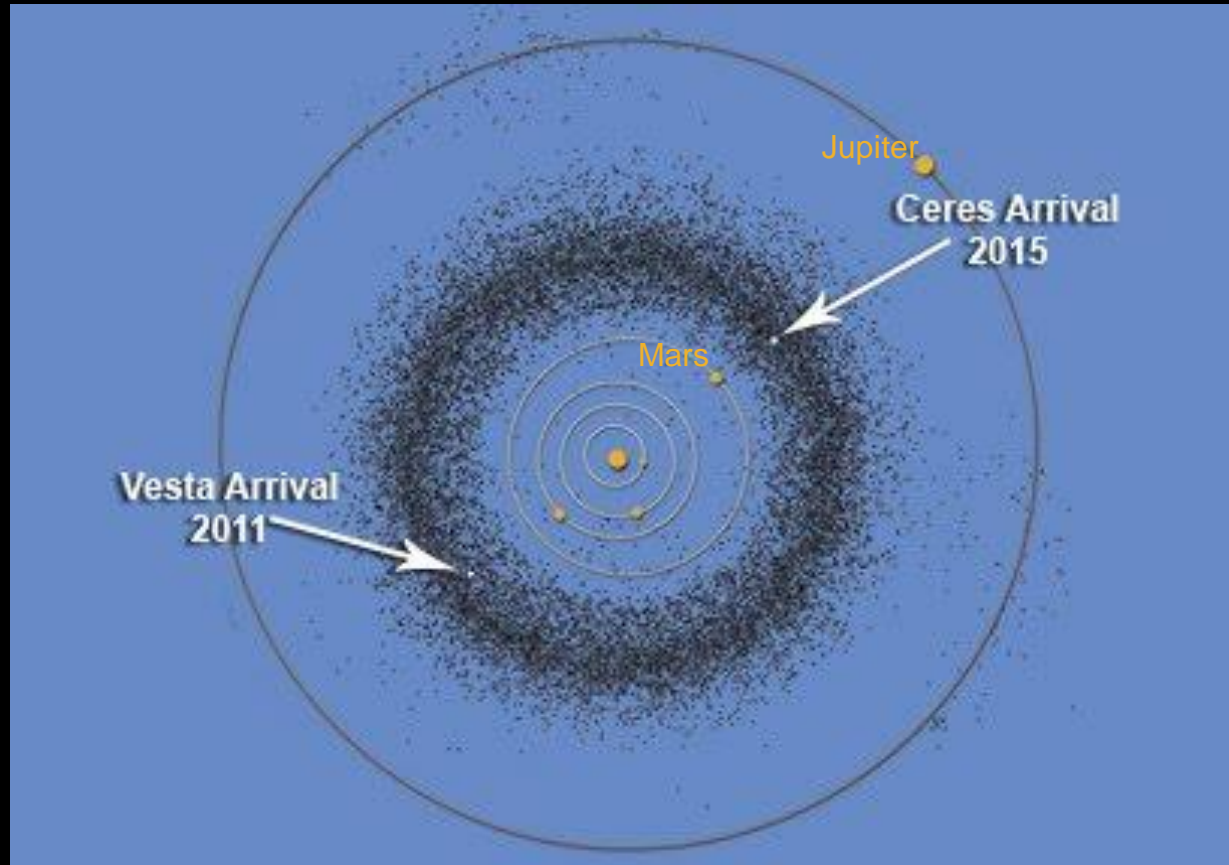
INNER SOLAR SYSTEM, plus Jupiter



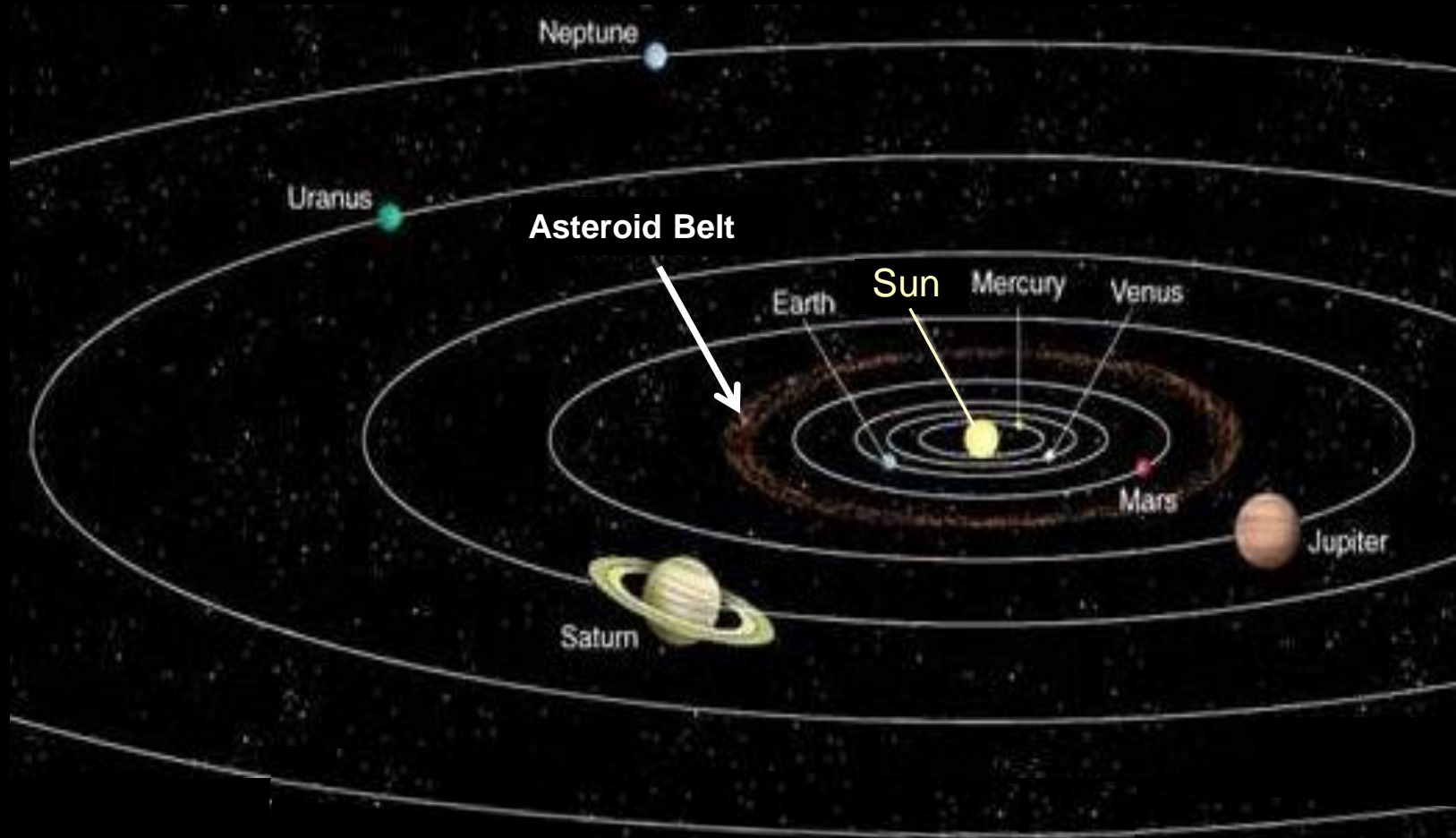
Thousands of asteroids (rocks) — rubble from failed planets

Asteroids that wander to inner Solar System pose great danger to Earth

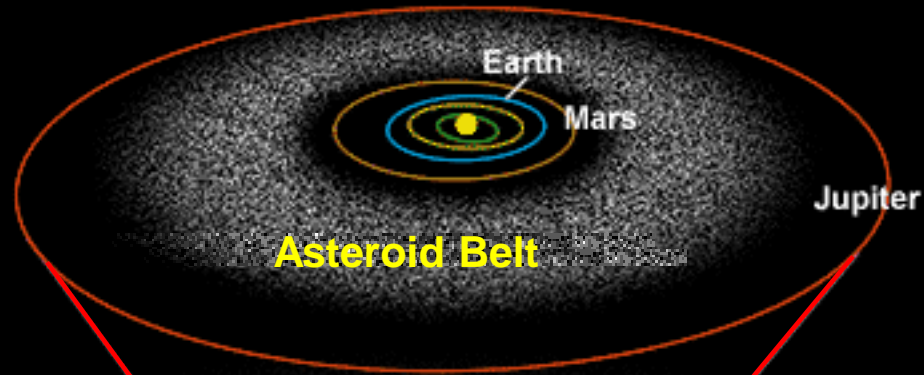
NASA missions arrival dates



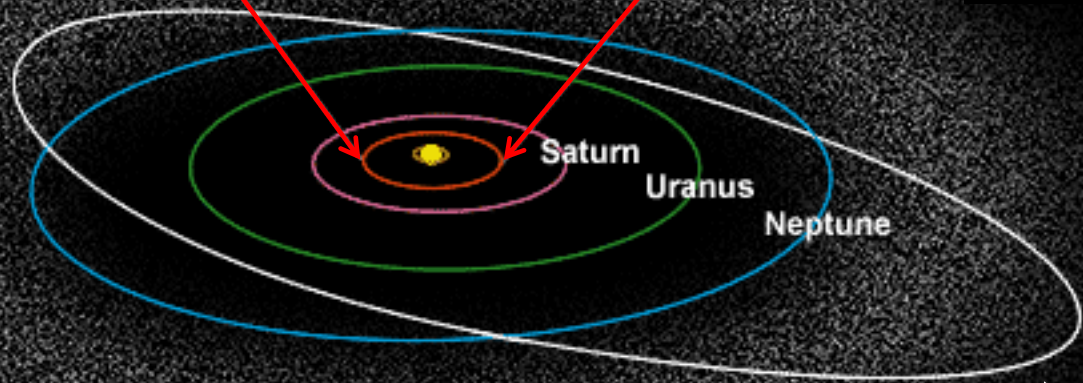
Ceres (900 km) and Vesta (400 km) —
others asteroids from < 1 m to 100 km



INNER SOLAR SYSTEM, plus Jupiter



Asteroid Belt

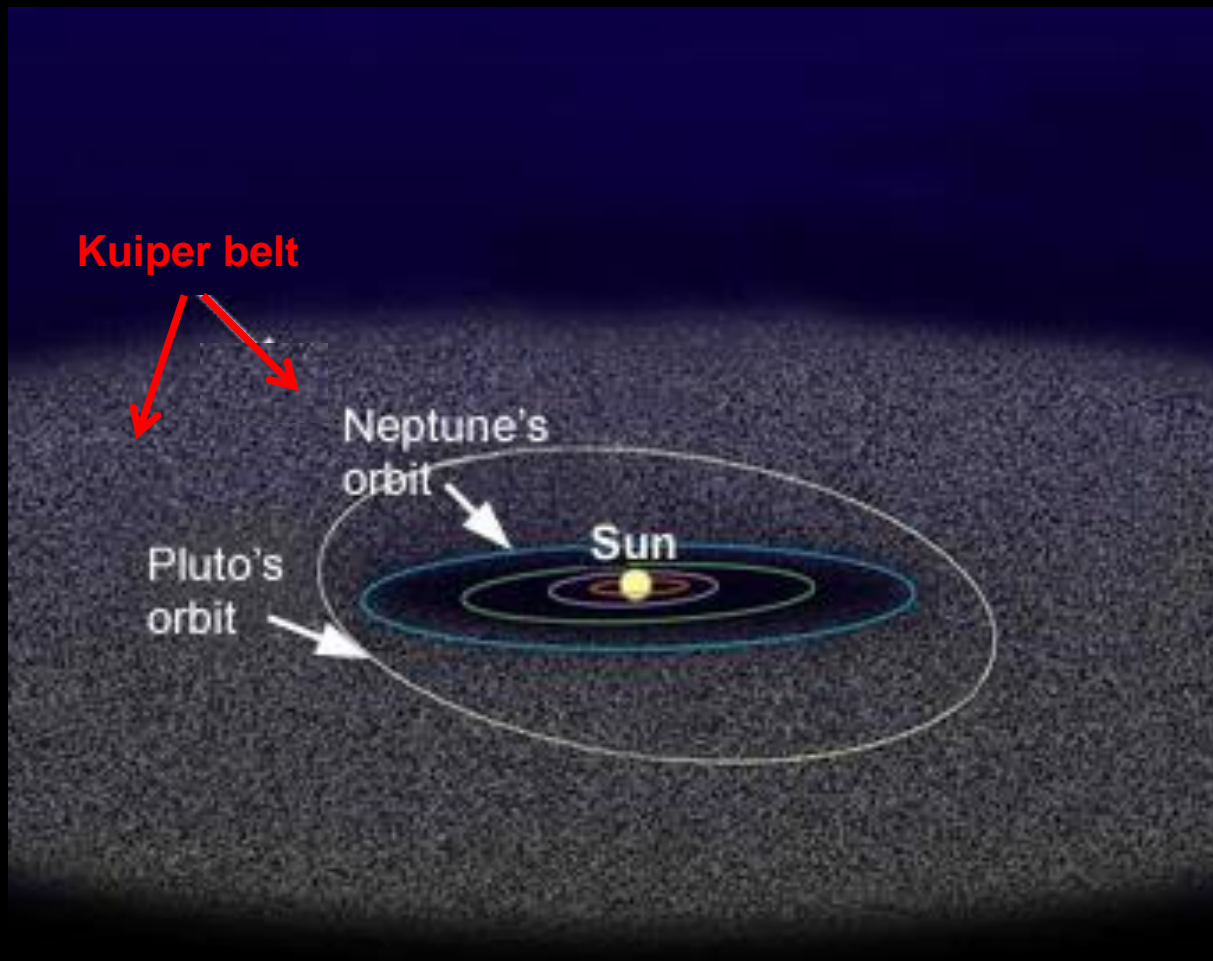


Kuiper Belt

OUTER SOLAR SYSTEM

Pluto's orbit

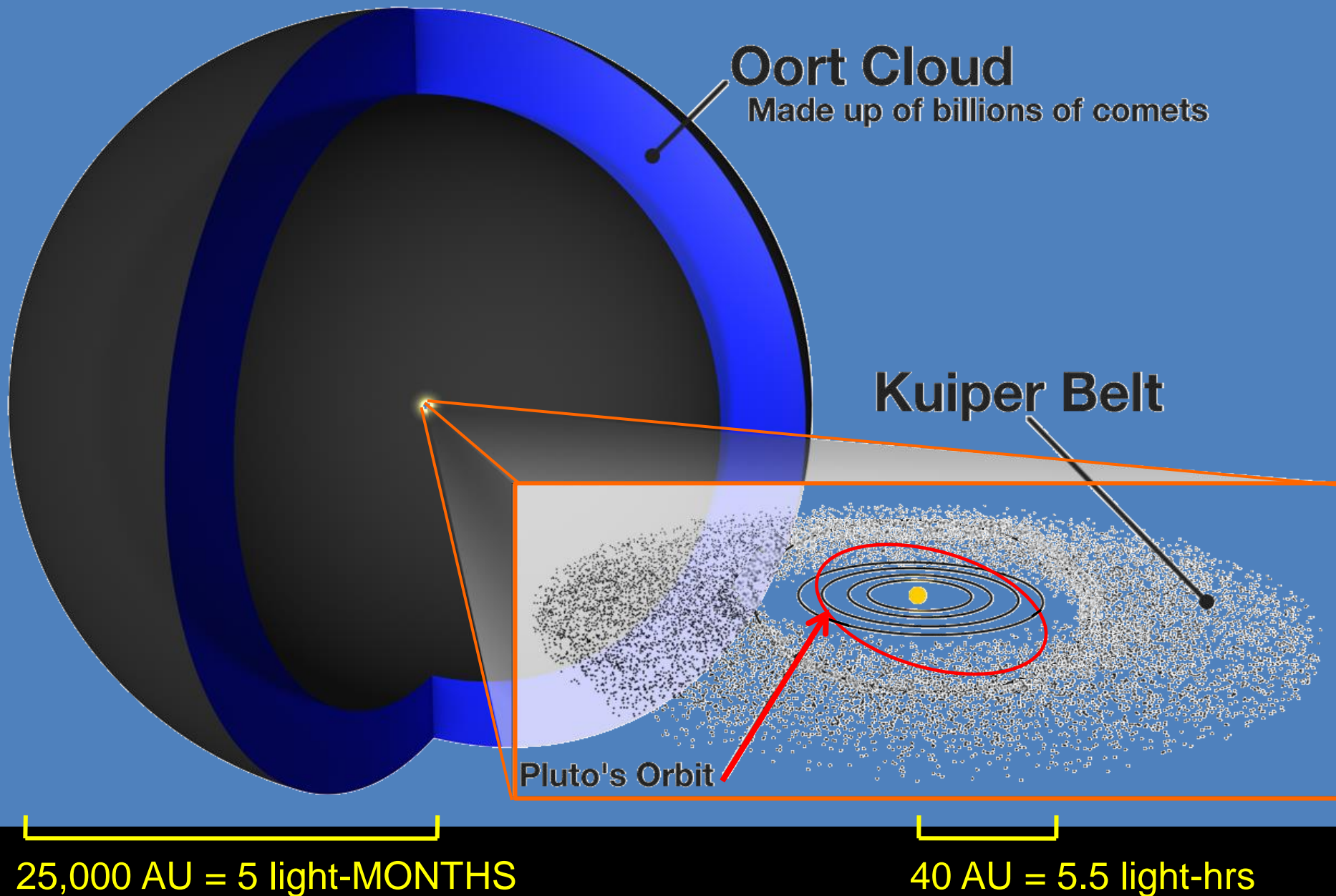
Pluto is from the Kuiper Belt and its orbit is highly inclined to the ecliptic plane

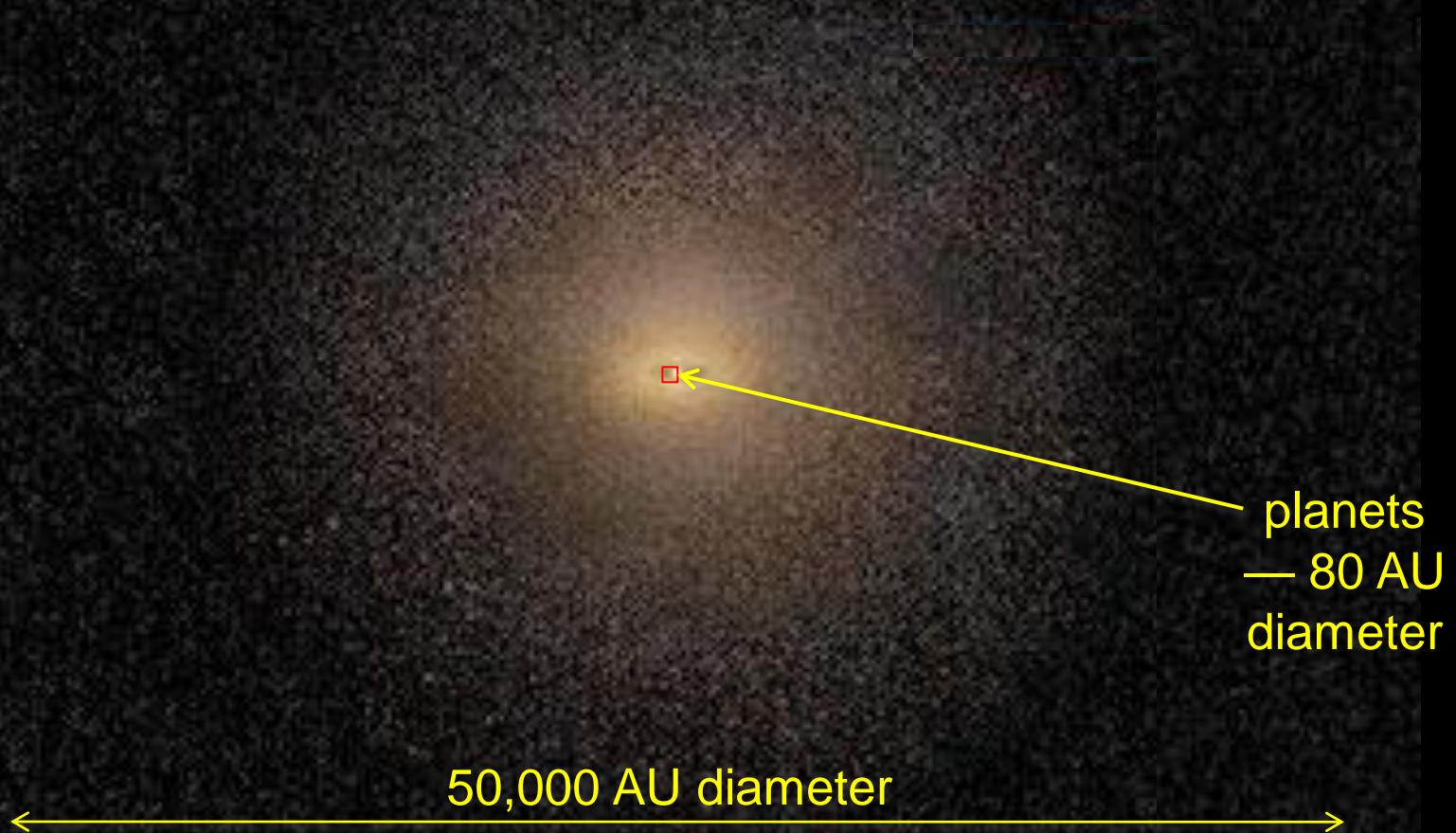


Beyond Neptune's orbit — **Kuiper belt** — asteroids and COMETS

But that is still not the edge of the Solar System....

This is the whole Solar System:

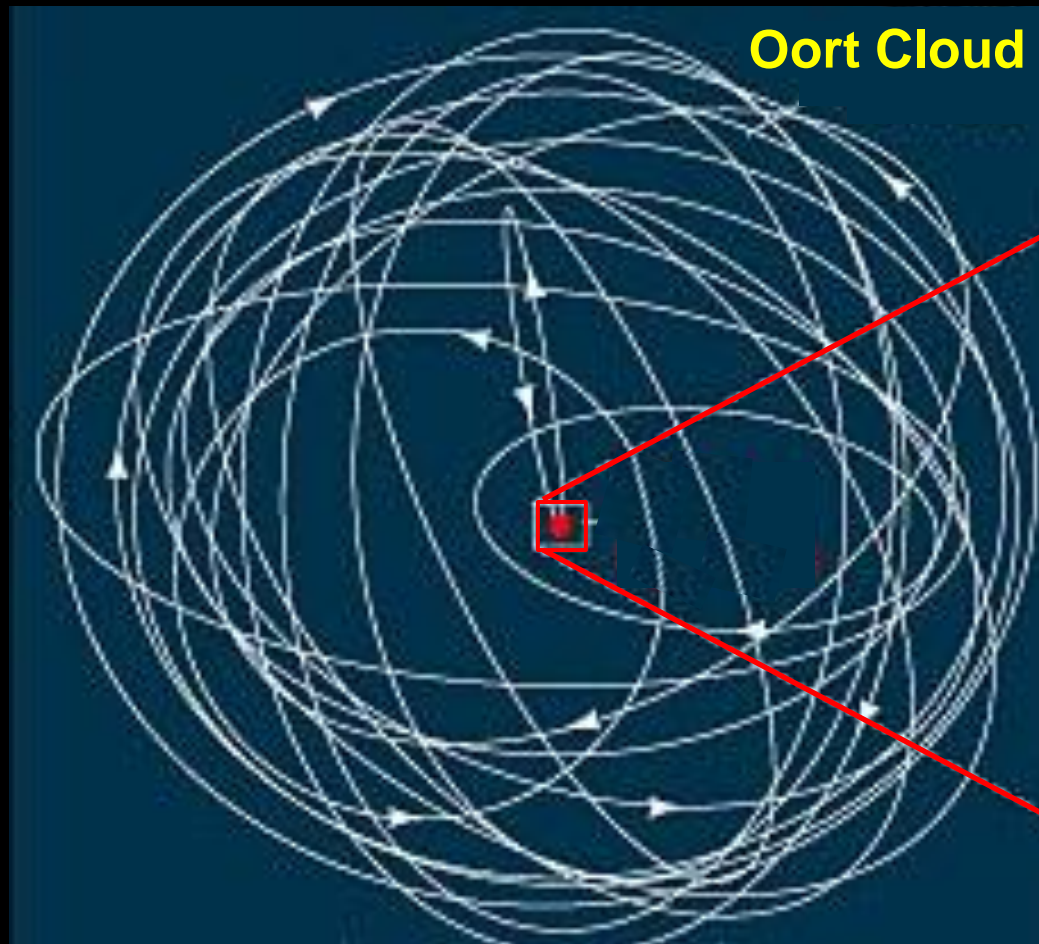




planets
— 80 AU
diameter

50,000 AU diameter

artist's depiction of Oort Cloud —
swarms of comets

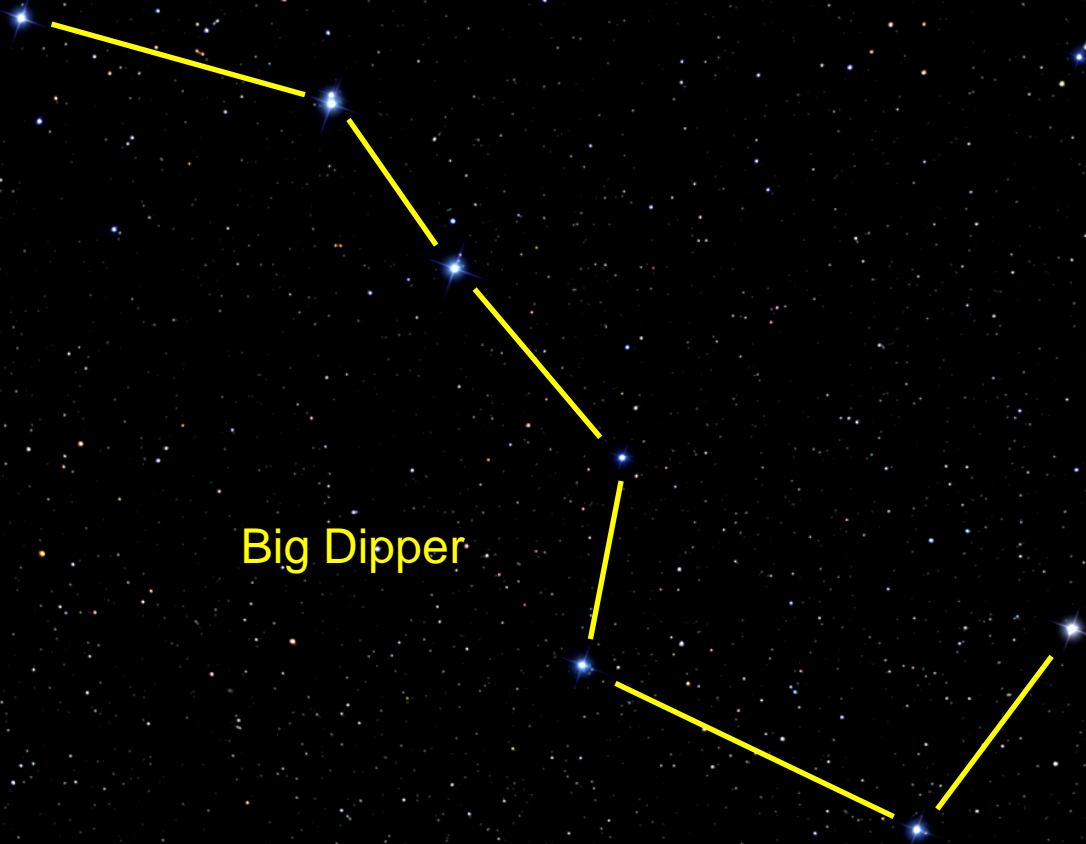


Sun, planets,
Kuiper belt

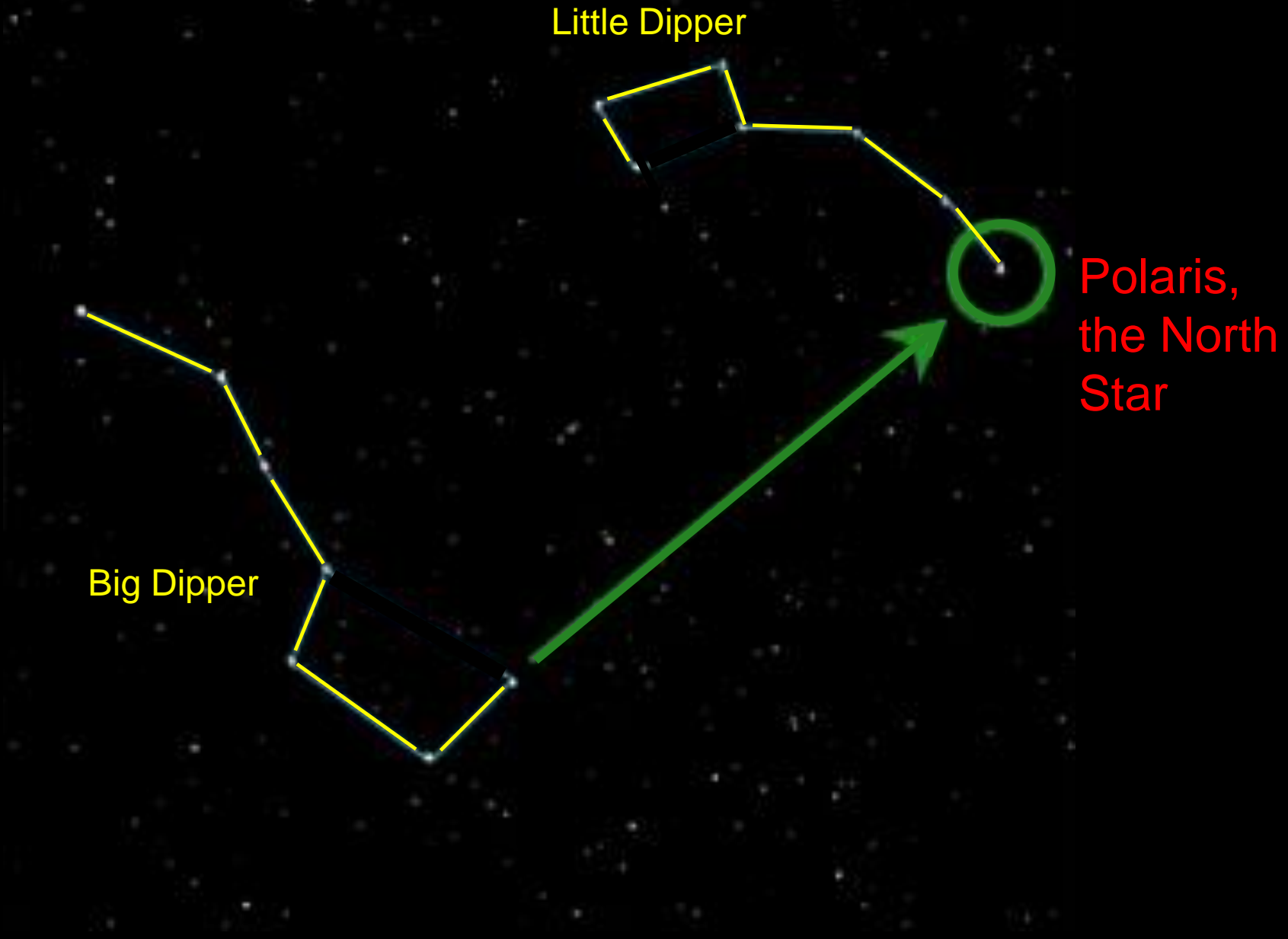
orbits of comets in Oort Cloud are like
bees swarming around a hive



naked eye can see about 6,000 stars in the sky



the brighter ones line up to make pictures — the Constellations

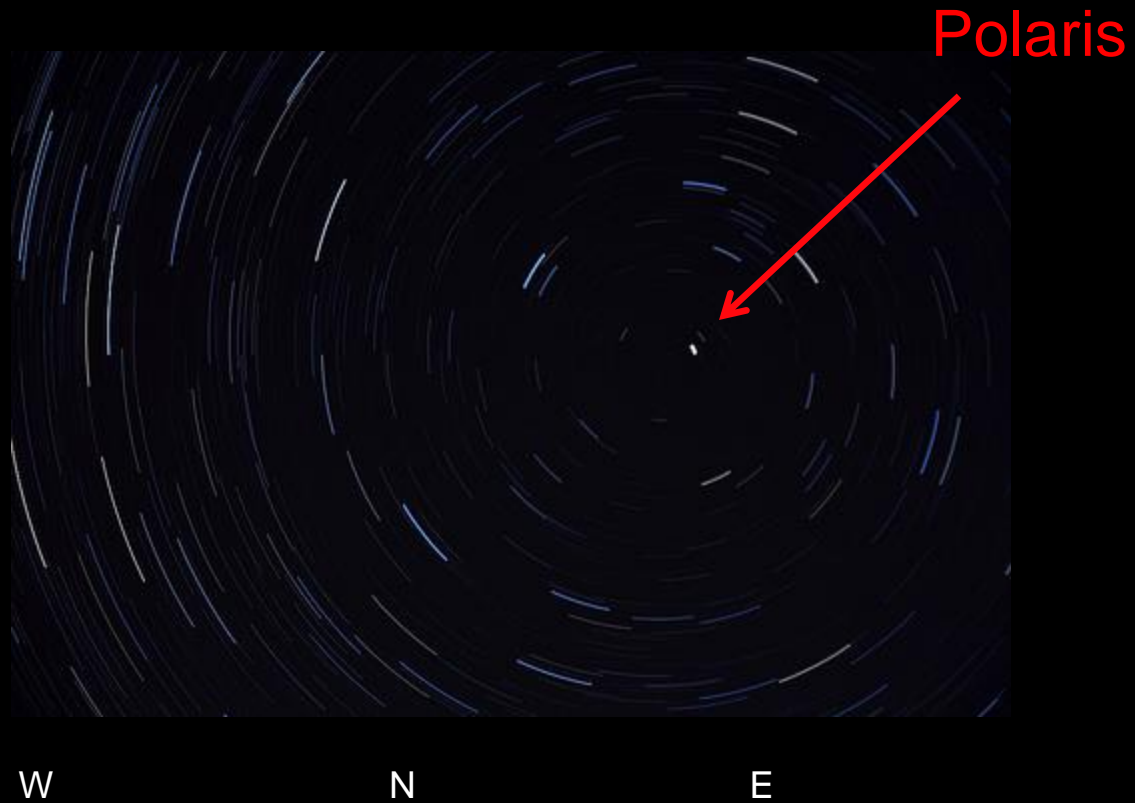


Little Dipper

Big Dipper

Polaris,
the North
Star

from Northern hemisphere, whole sky rotates around Polaris



time-lapse photo — sky turns around Polaris





polaris



polaris



polaris



polaris



polaris



Voyager 1



Pioneer 11



Pluto
New Horizons



Saturn

Uranus

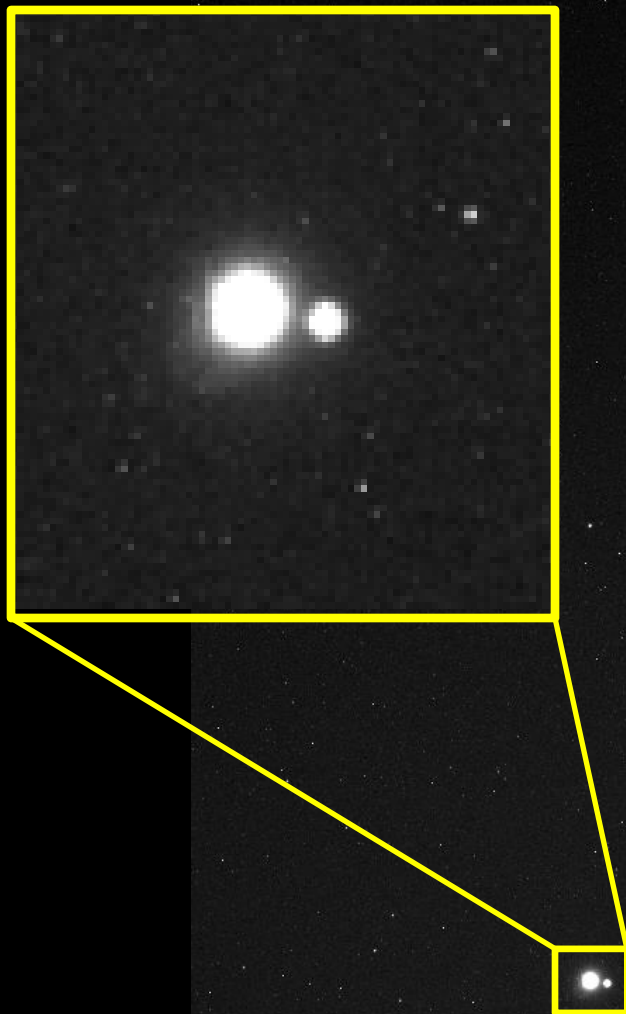
Neptune

Pioneer 10



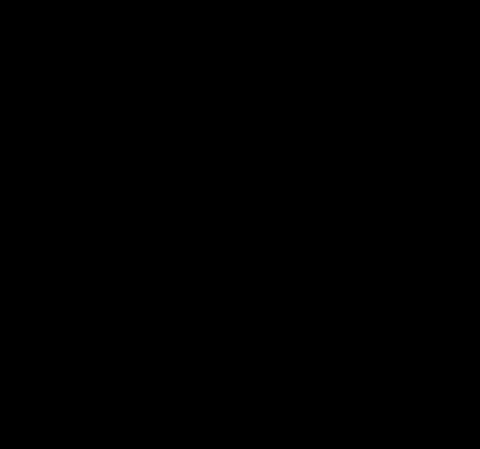
Voyager 2





view of Earth
and Moon from
Mercury
Messenger
Probe







view of Earth
and Moon from
Saturn
Cassini Probe

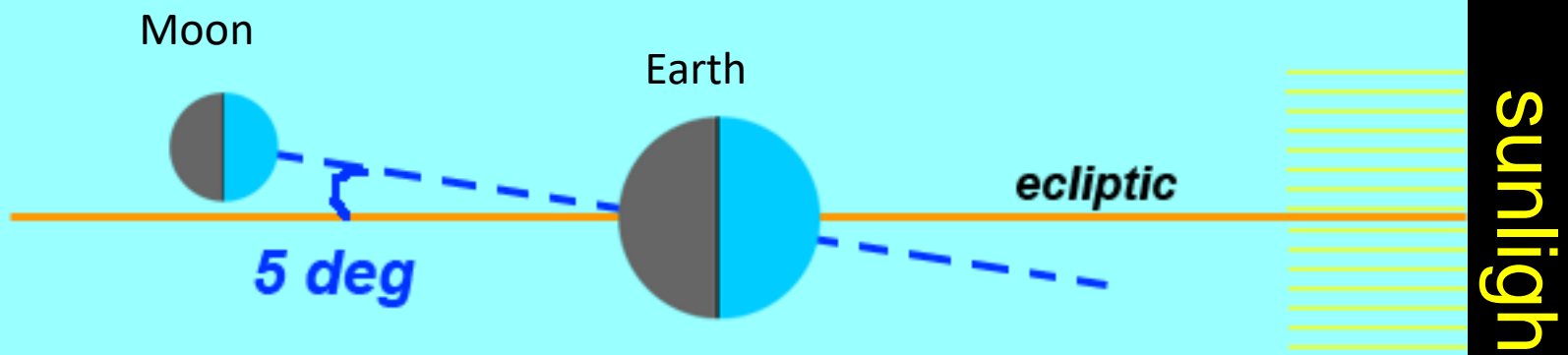


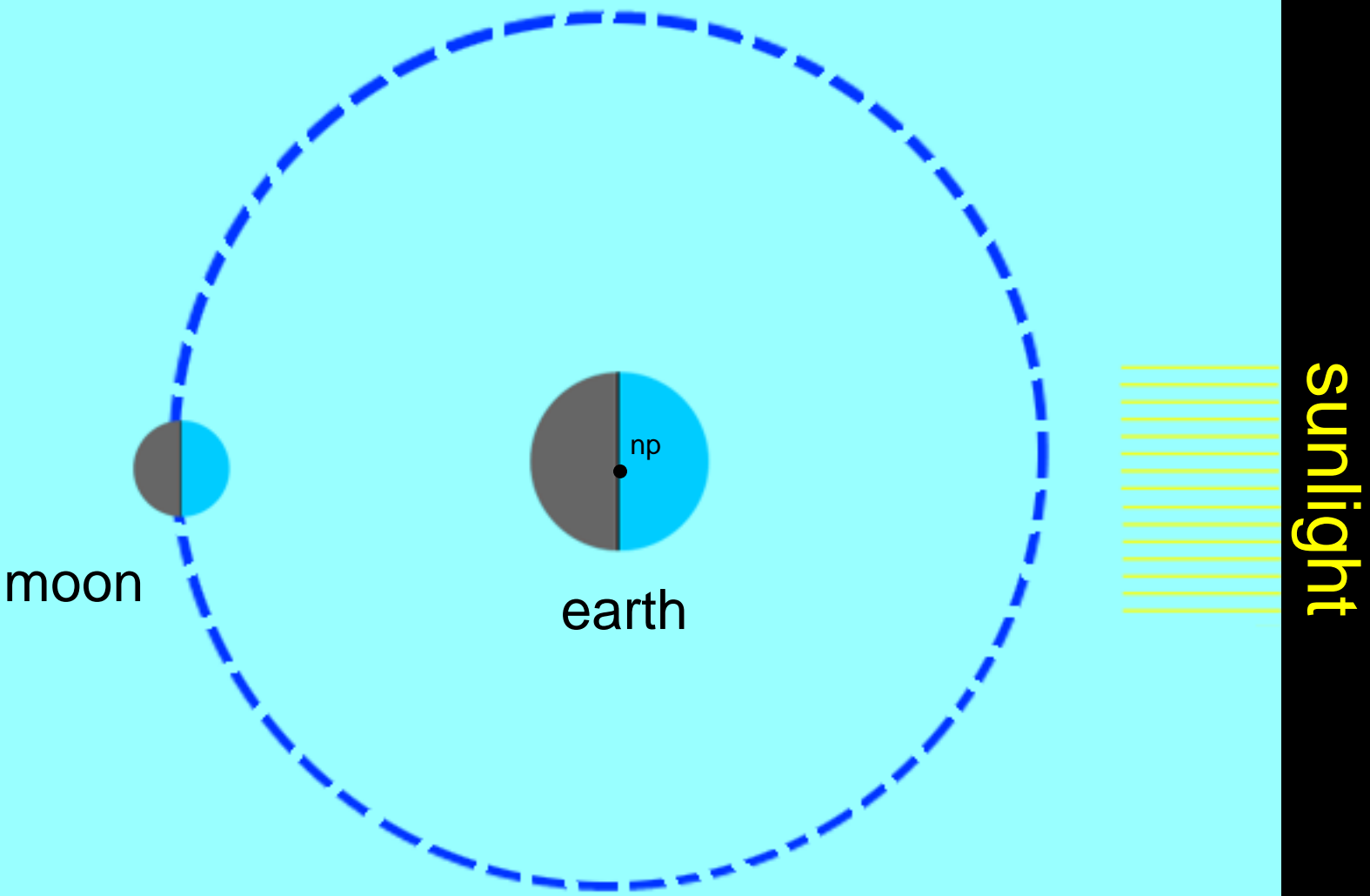
Phases of the Moon

https://www.youtube.com/watch?v=mQwvHn_qkBA



3,400 km = $\frac{1}{4}$ size of Earth!





moon

earth

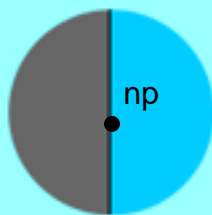
np

sunlight

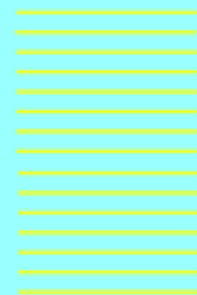
seen from earth



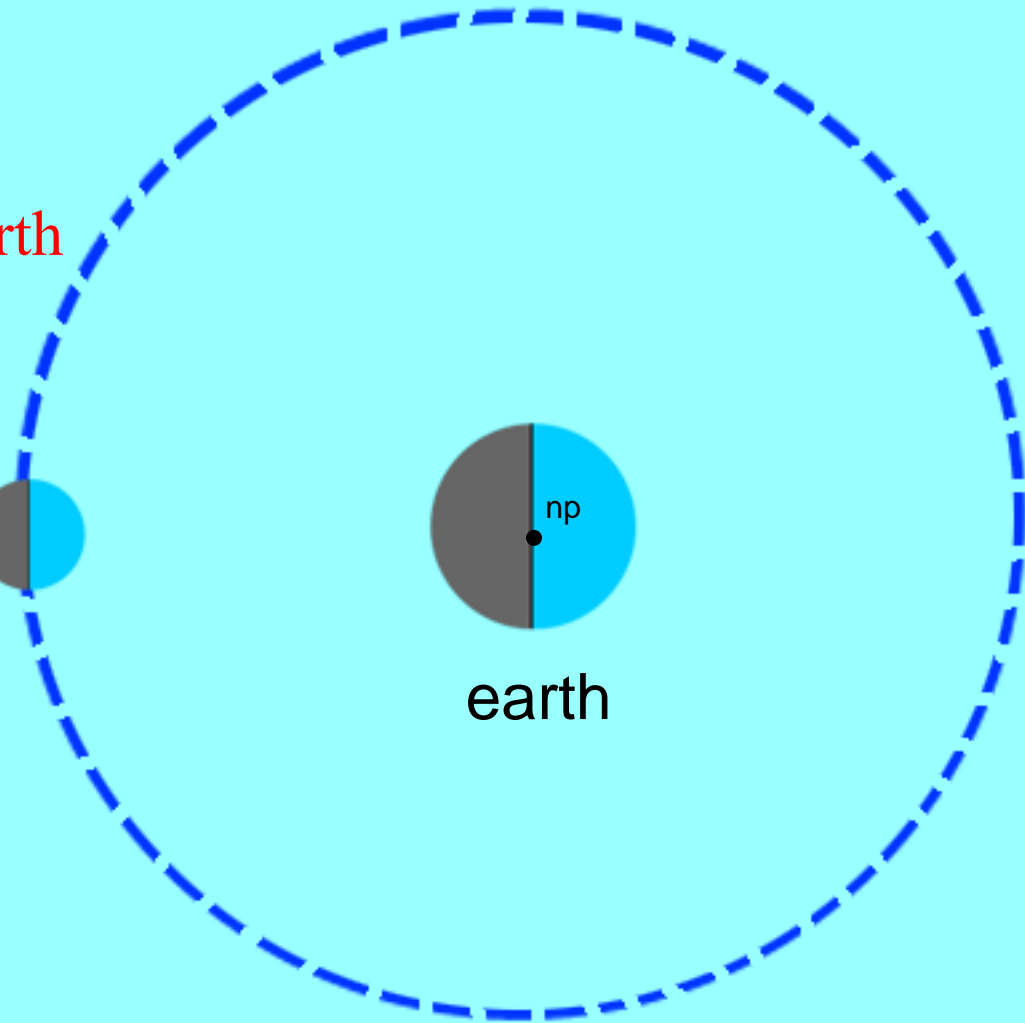
moon

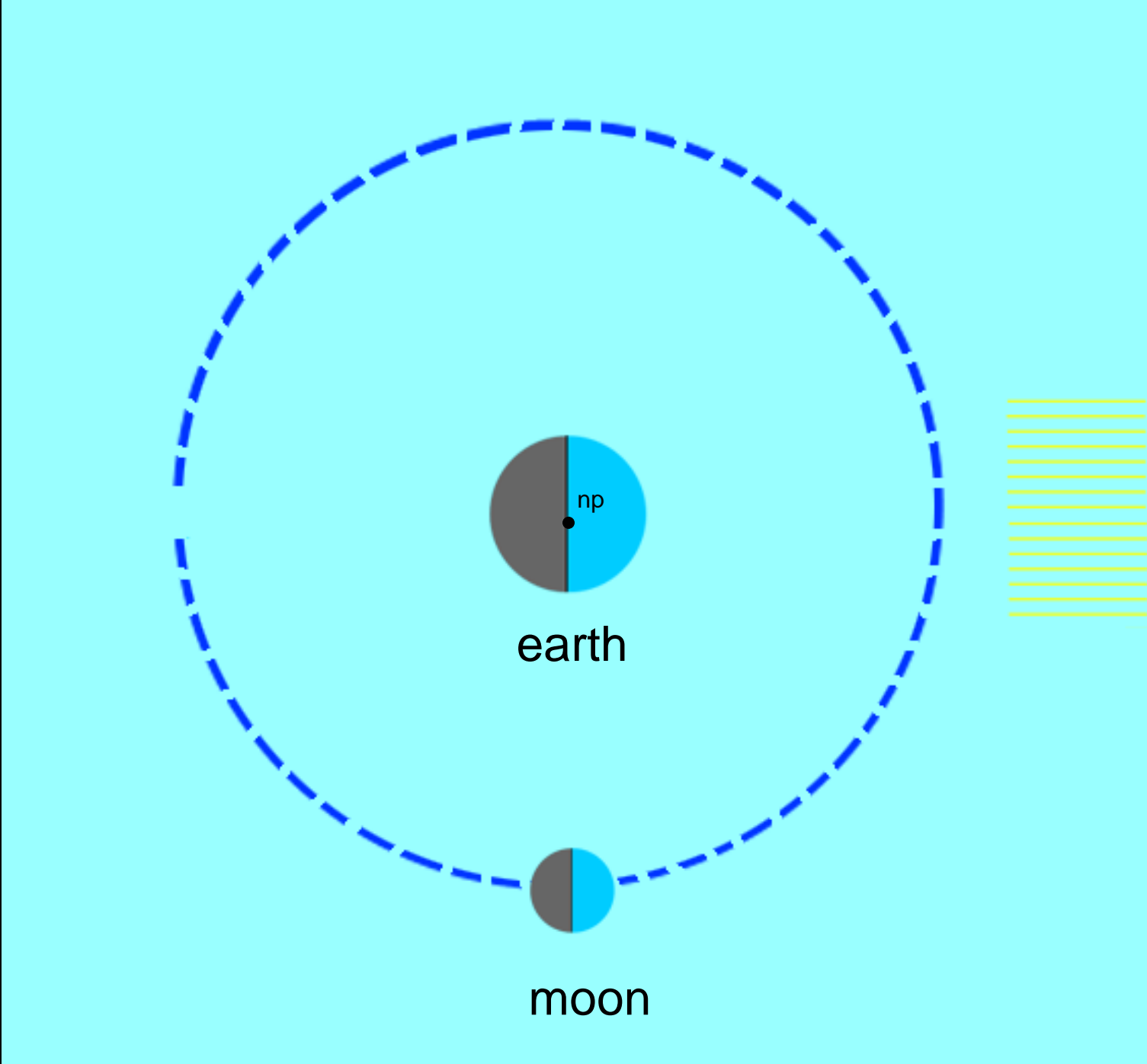


earth



sunlight

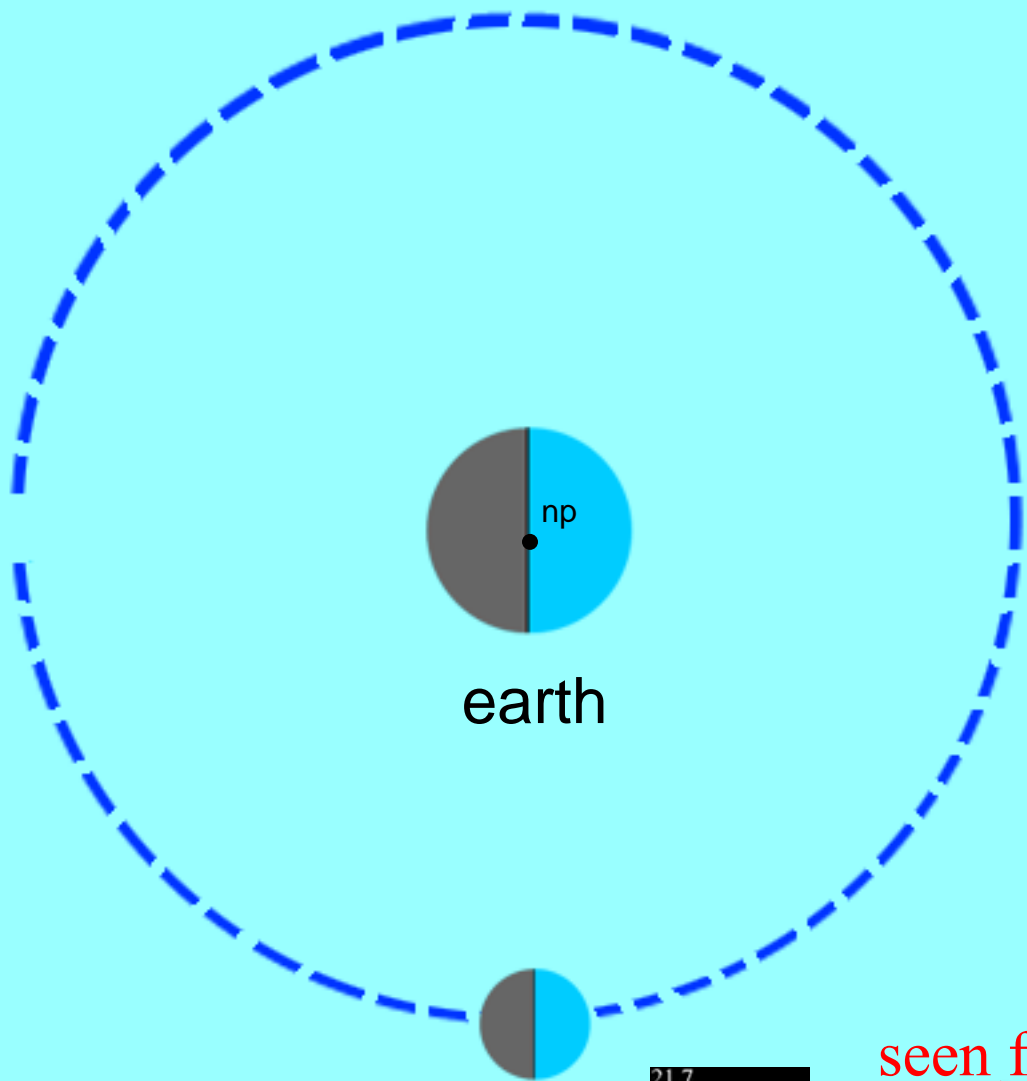




sunlight

earth

moon



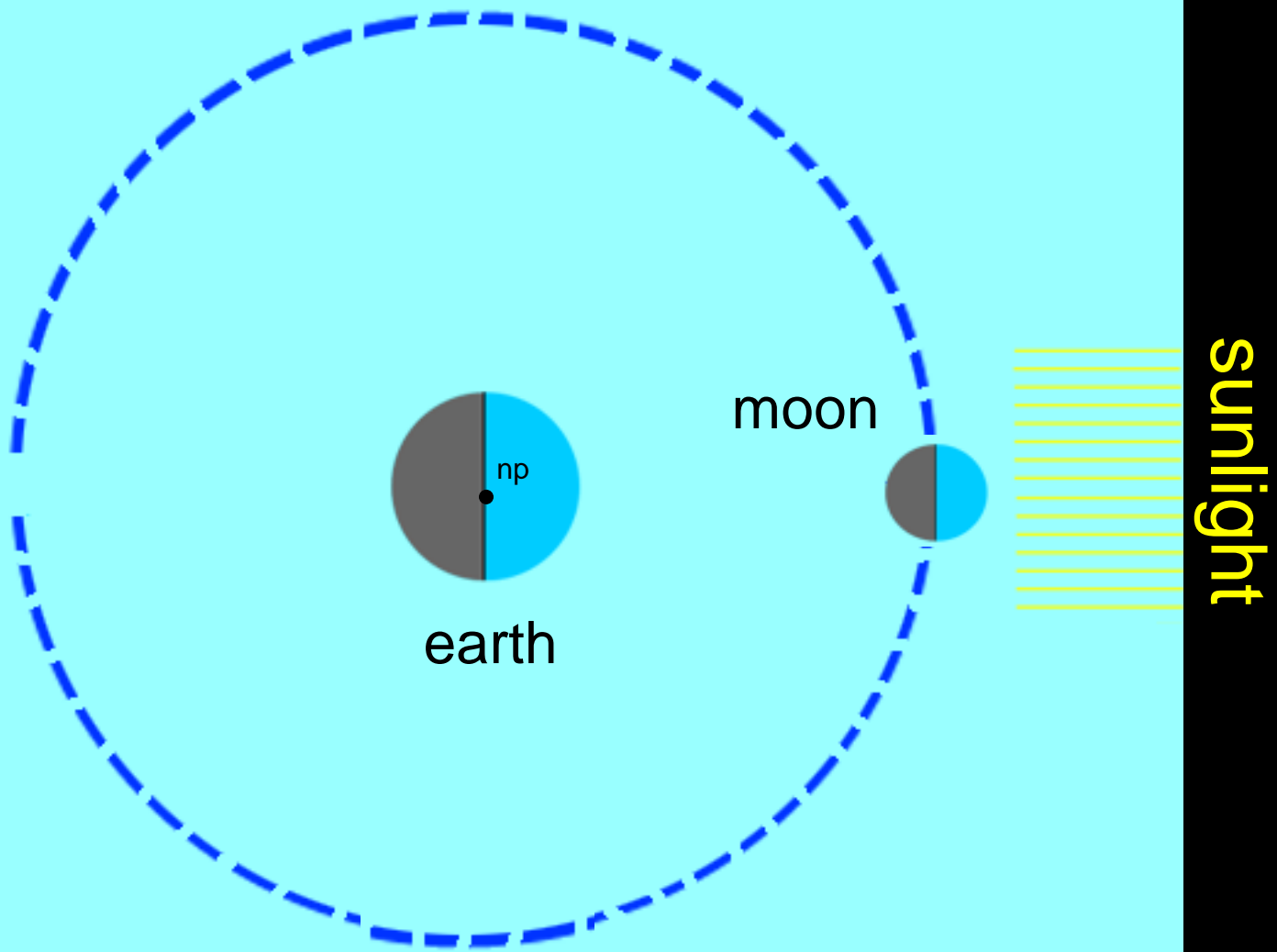
sunlight

earth

moon

seen from earth



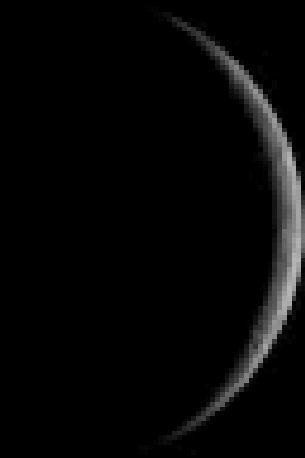


sunlight

We see different parts of the moon illuminated over the course of the month. This phenomenon is referred to as

The Phases of the Moon.















1st quarter

















Full











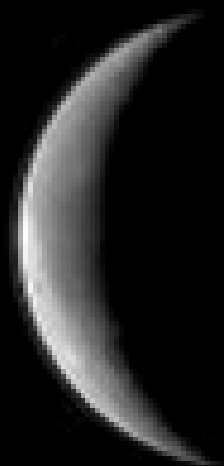


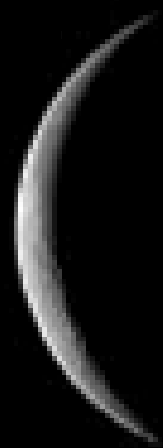
3rd quarter

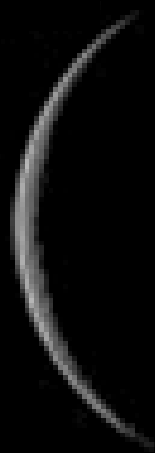






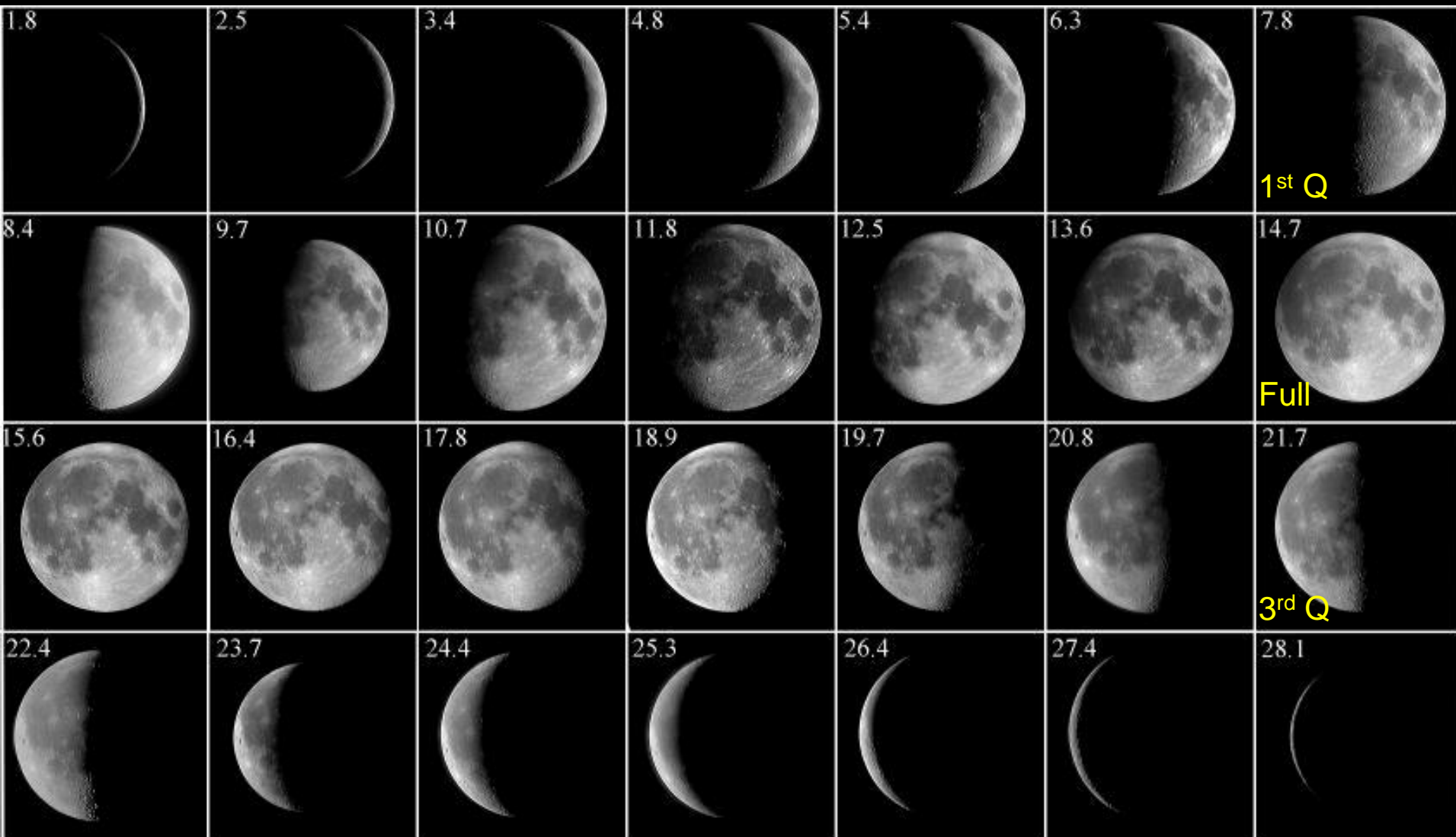






New

Phases of the Moon



1st Q

Full

3rd Q

almost new

Why do we see the moon in phases?

Because it moves between us and the Sun.

Everything that moves between us and the Sun we will see in phases, including other planets.



Moon just before New



Venus



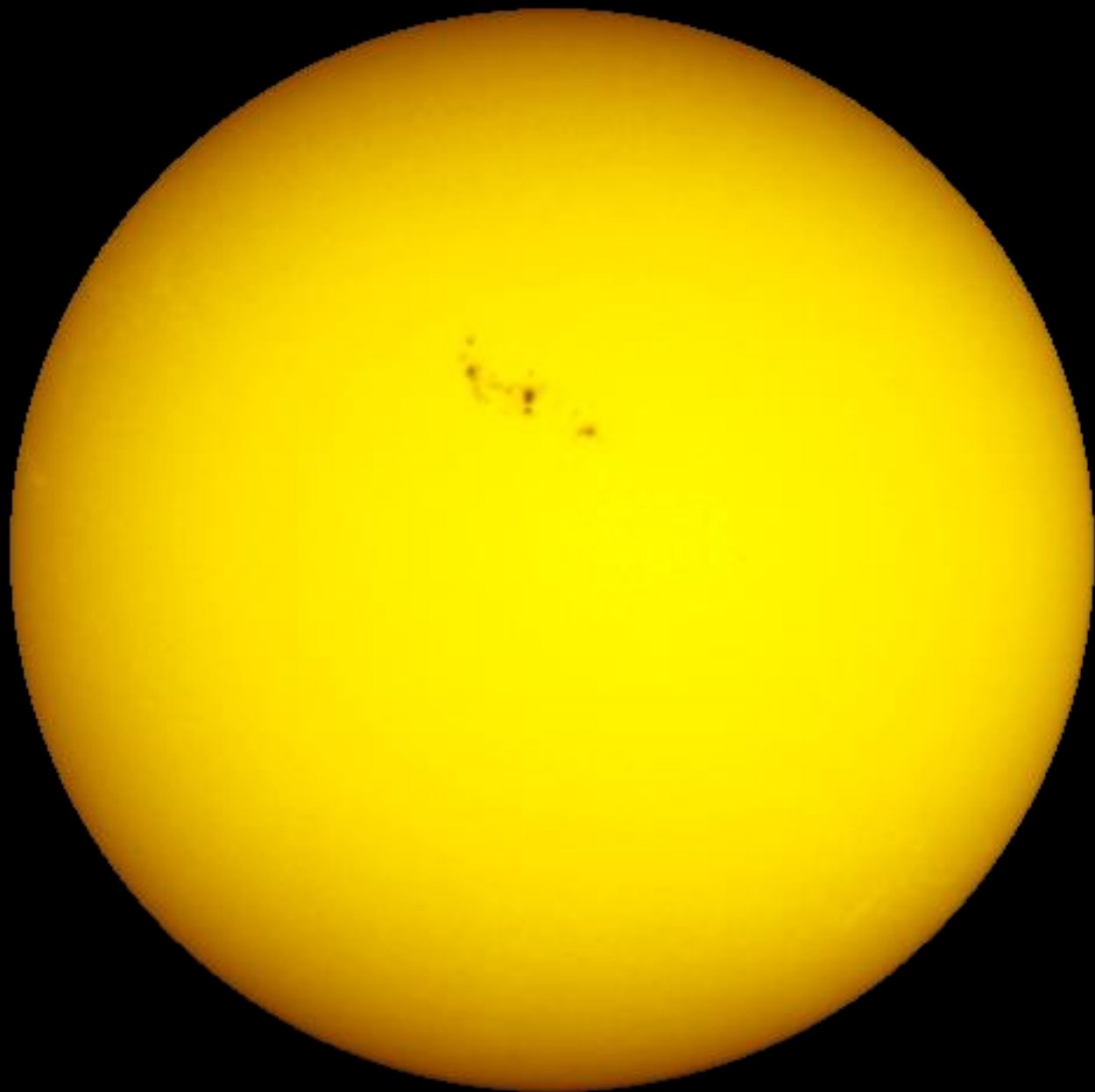
A **SOLAR ECLIPSE** takes place when the new Moon happens to cross the ecliptic when the Sun is right there!



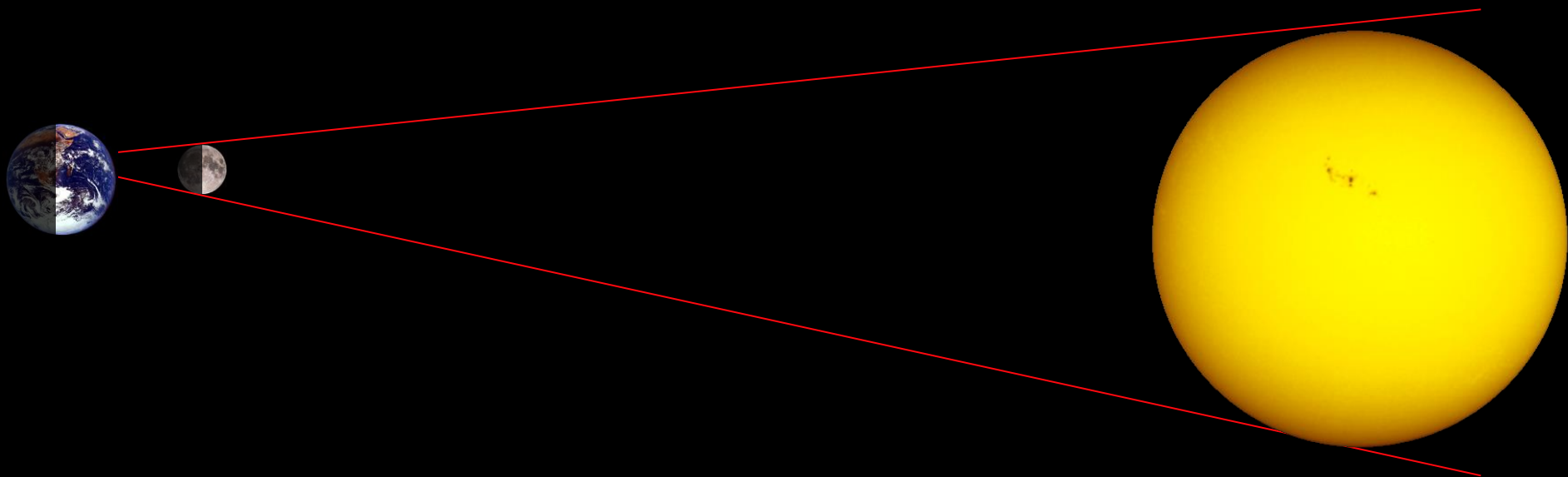
SOLAR ECLIPSE = the Sun is Hidden



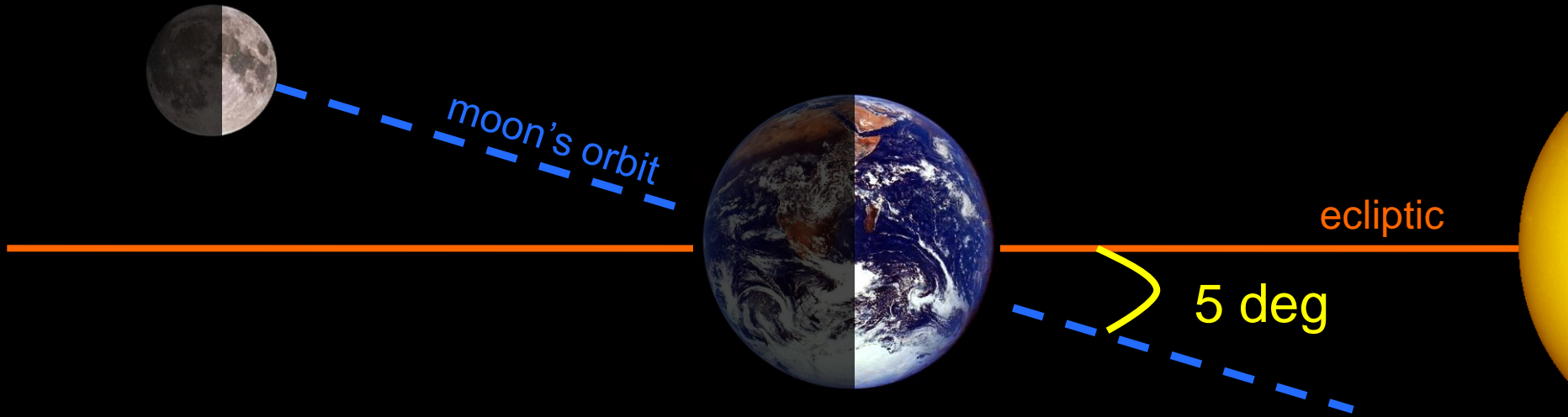
3,400 km



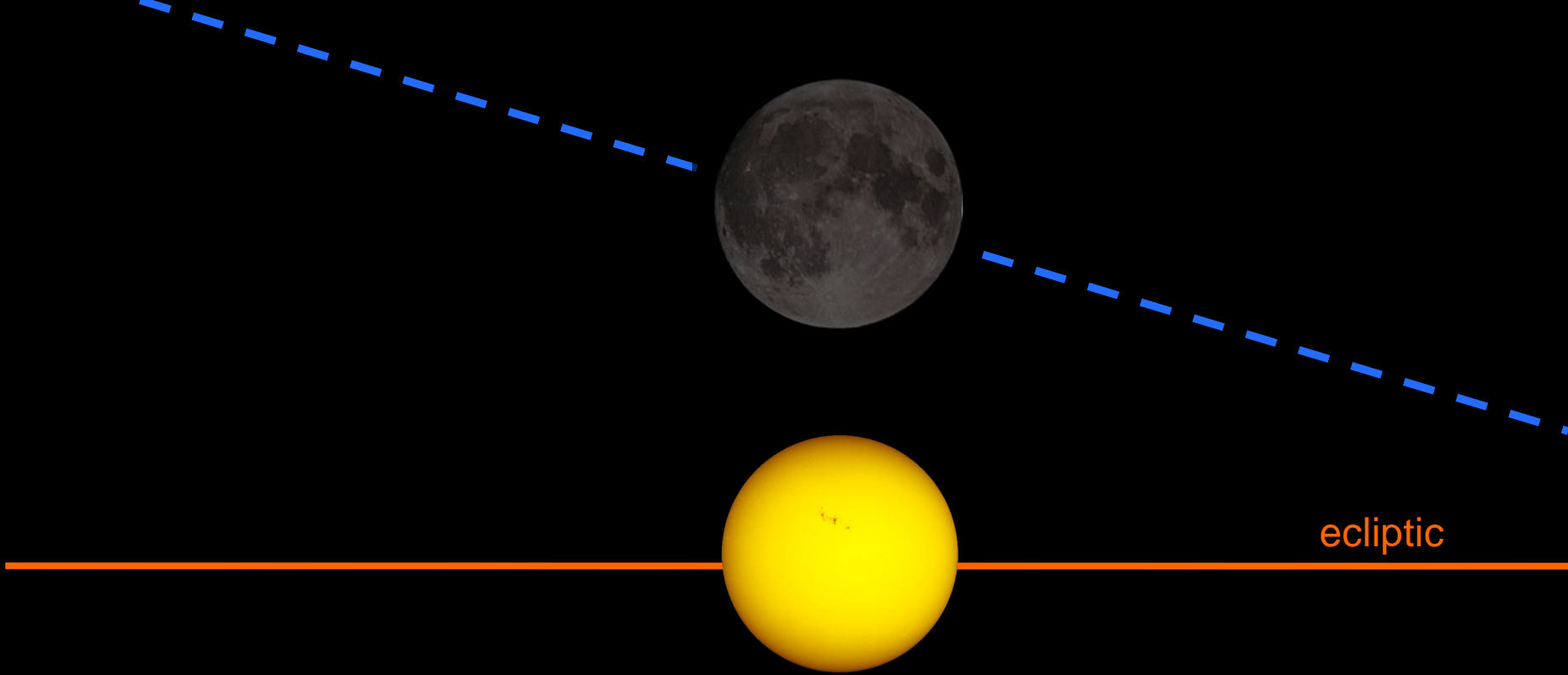
$14 \times 10^5 \text{ km}$



the Moon is the same ANGULAR
SIZE as the Sun



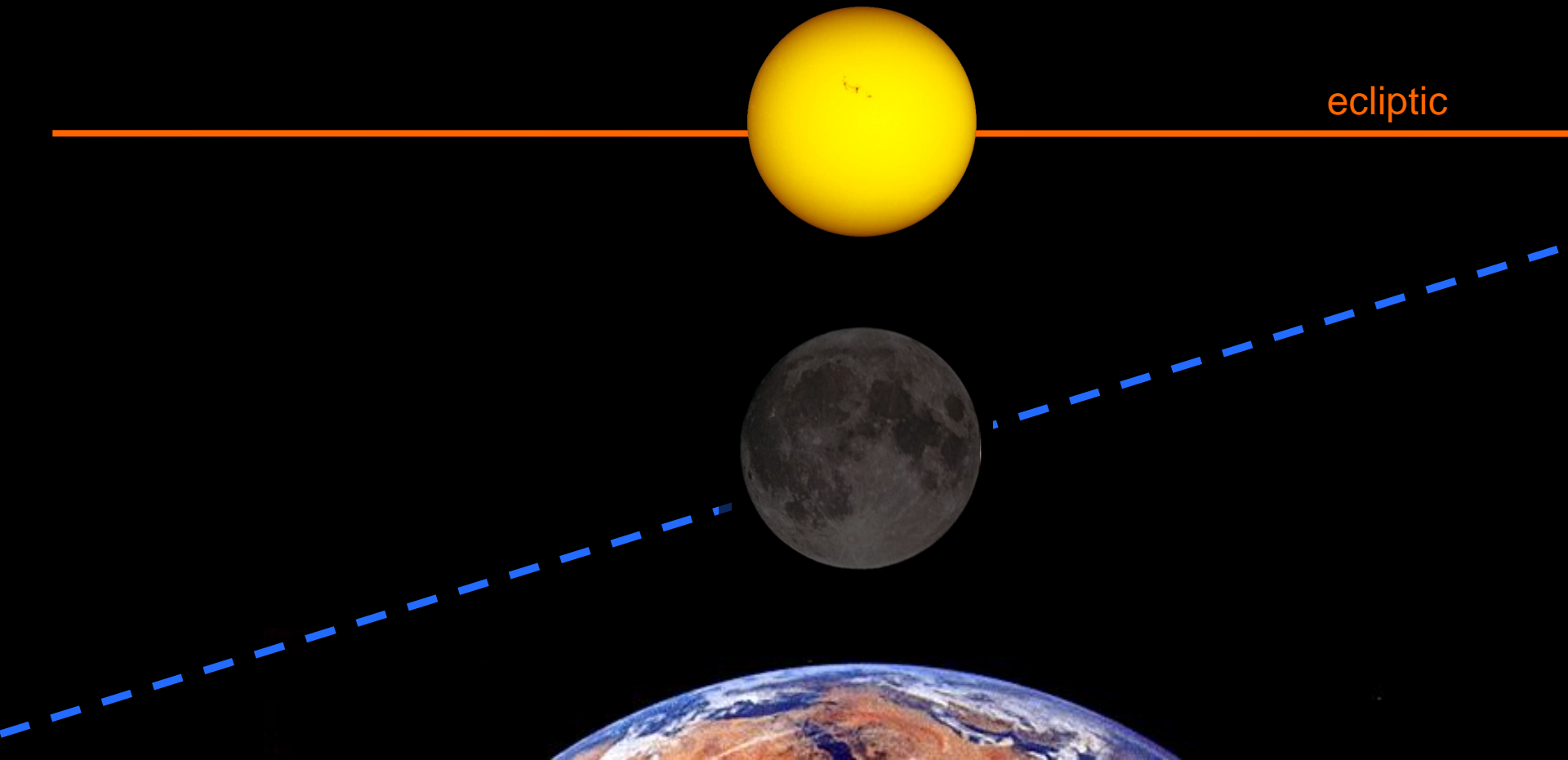
The Moon's orbit is tilted 5 deg
from the ecliptic.



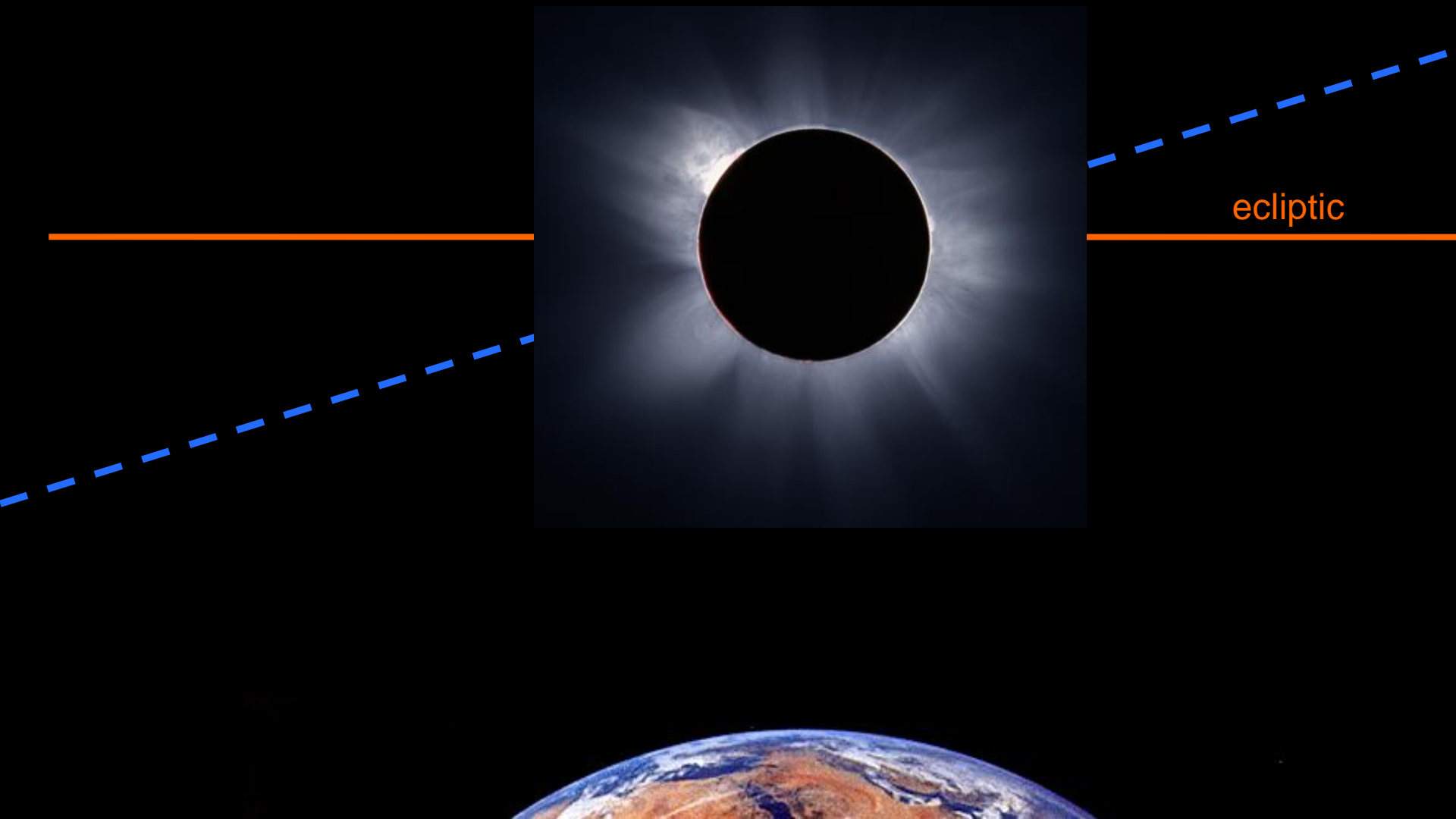
Viewed from Earth, during a new Moon, the Moon passes above the Sun's position or...



... below the Sun's position.

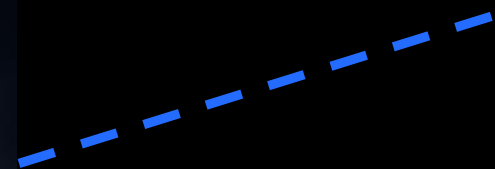


But every now and then, the moon crosses the ecliptic where the sun is, and we are treated to a SOLAR ECLIPSE

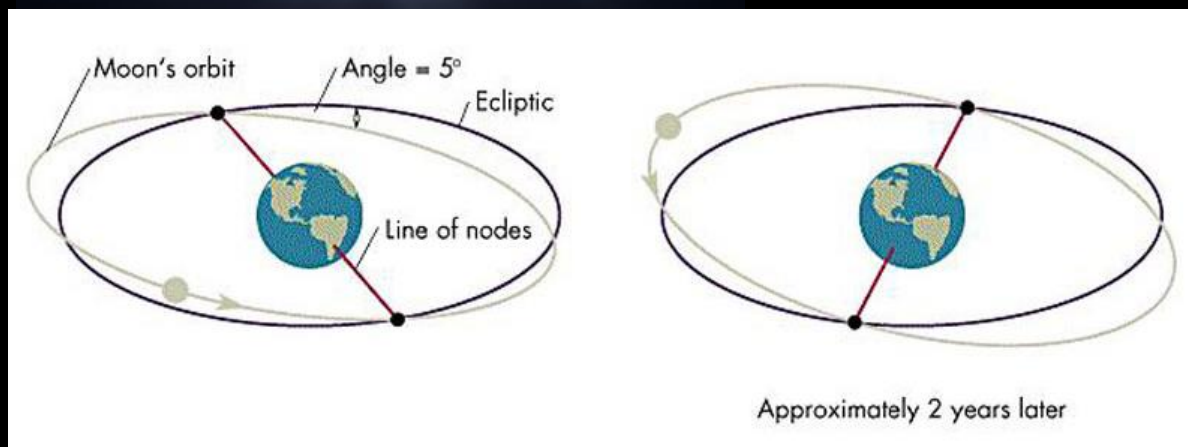


The reason that the Moon changes position as it crosses the ecliptic is that the orbit of the Moon precesses, like a top with the Moon on the rim, with a period of about 18 years.

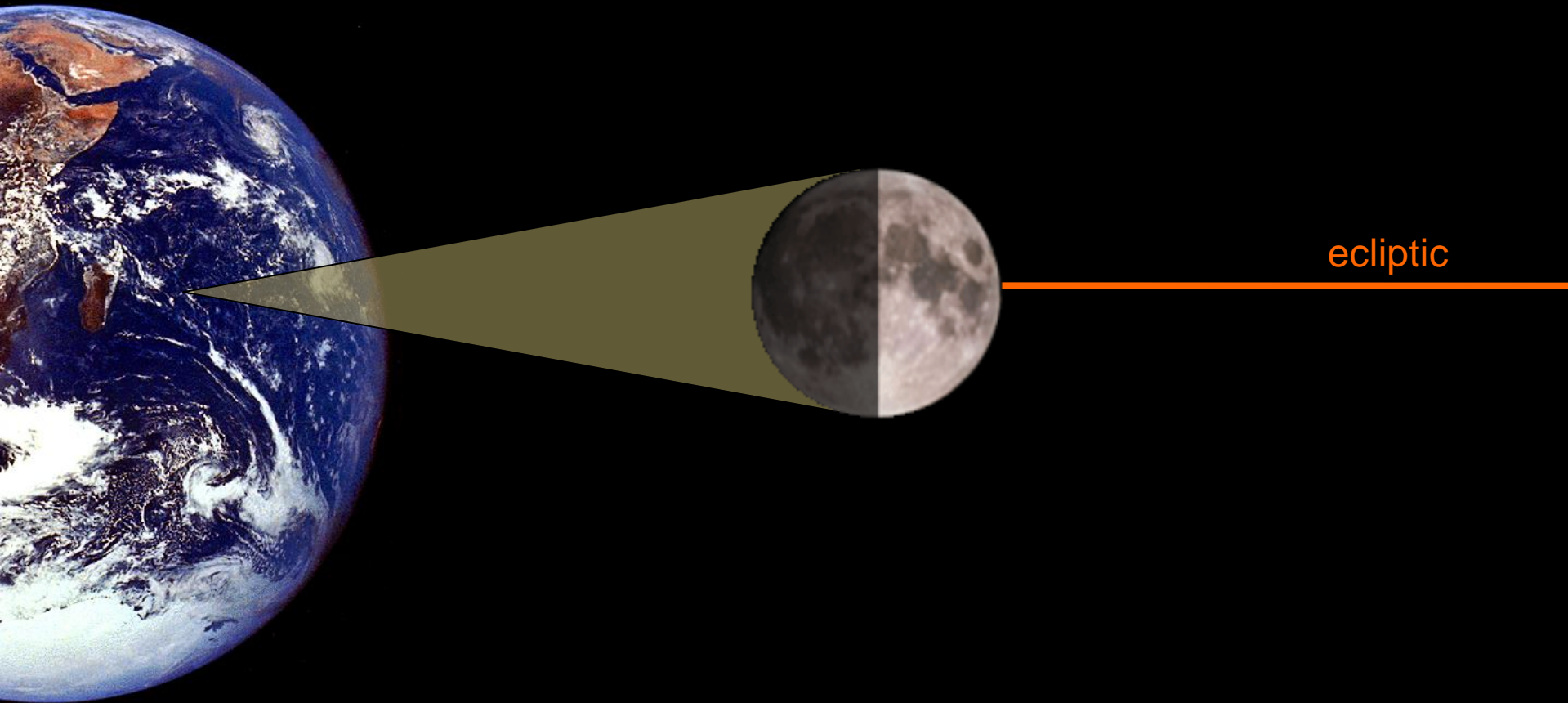
See link: <https://www.youtube.com/watch?v=GnZ3dogED7w>



ecliptic



With a side-view, you can see that the Moon will cast a shadow on a small part of the Earth. People inside the shadow will experience “totality.”





Solar Eclipse — the Moon's shadow on earth



Stages of a Solar Eclipse with Time-stamps









A word about SAFETY:

don't look at the Sun

when it is covered by the Moon it is safe, BUT you don't know exactly when the Sun will peak back out....



... and you can experience PERMANENT damage.

