

# ROAD-TRIPPING WITH THE SOLAR SYSTEM

THE BIG YELLOW  
ONE IS THE SUN

IF YOU GUYS CAN'T GET ALONG, I WILL  
PULL THIS SOLAR SYSTEM RIGHT OVER,  
SO HELP ME!

MERCURY



WE'RE HOOOOOOTTTTT!

VENUS



I'M NOT TOUCHING YOU!  
I'M NOT TOUCHING YOU!

EARTH & MOON



MOM, JUPITER STINKS!

MARS



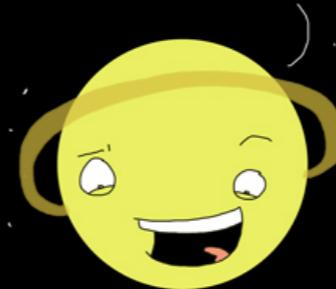
SHUT UP, I FEEL GASSY...

JUPITER



HAHA, I CAN SEE URANUS!

SATURN



HEY! STOP MAKING FUN OF ME!

URANUS



I'M TOO COLLLLD!

NEPTUNE



I FEEL LEFT OUT...

PLUTO

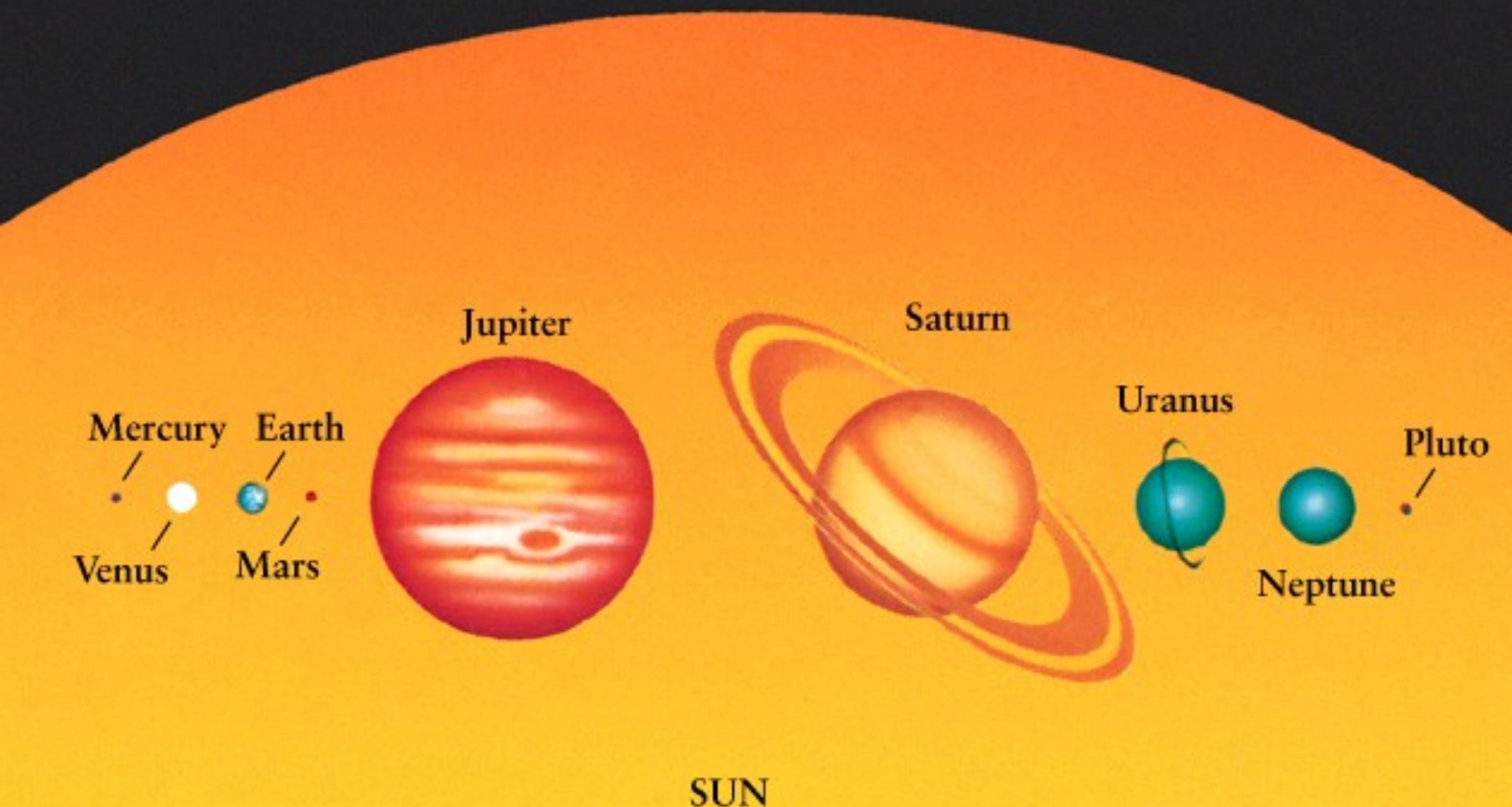


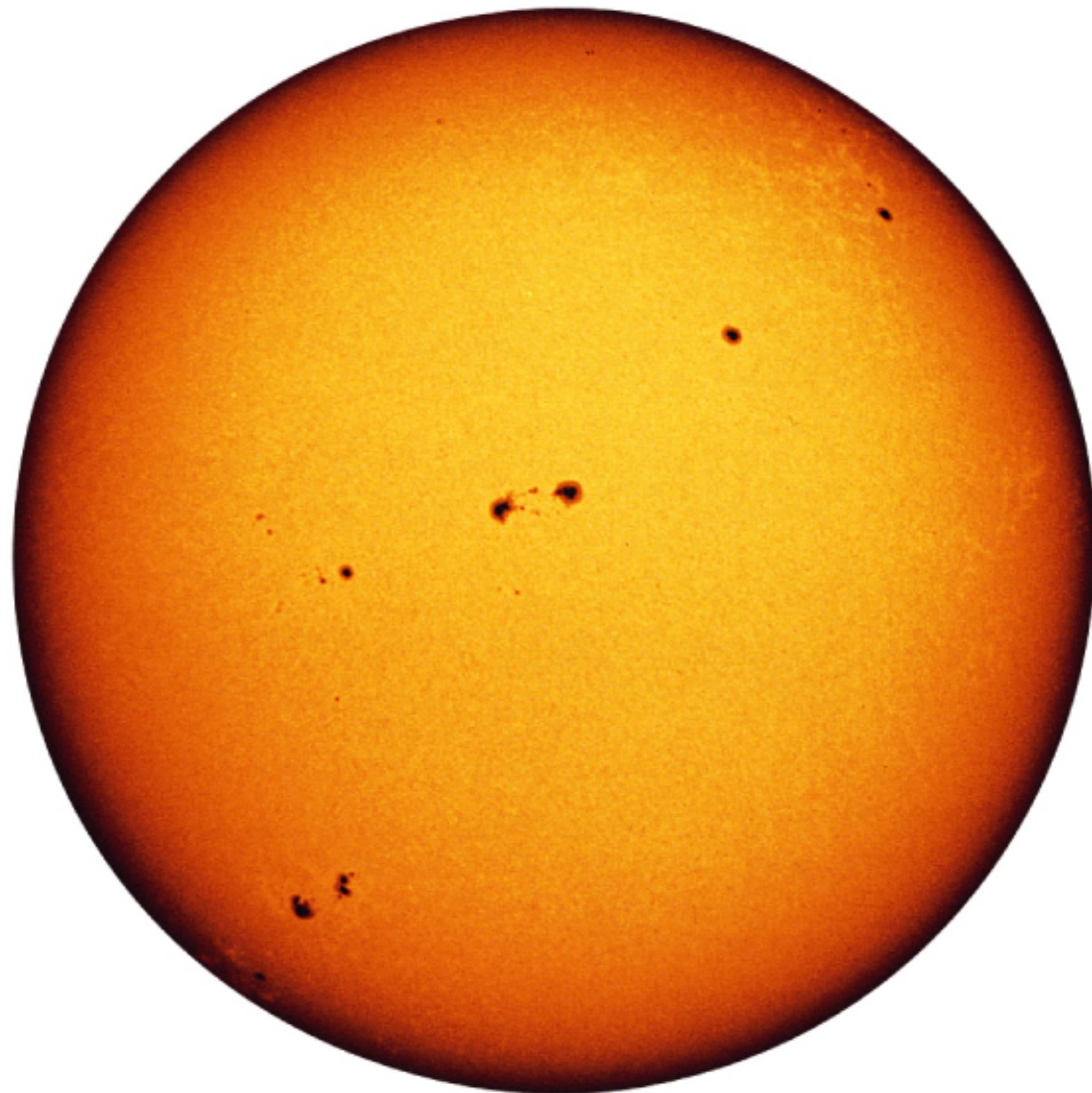
POOR PLUTO...

# The Solar System



# How should we categorize the objects in the Solar System?





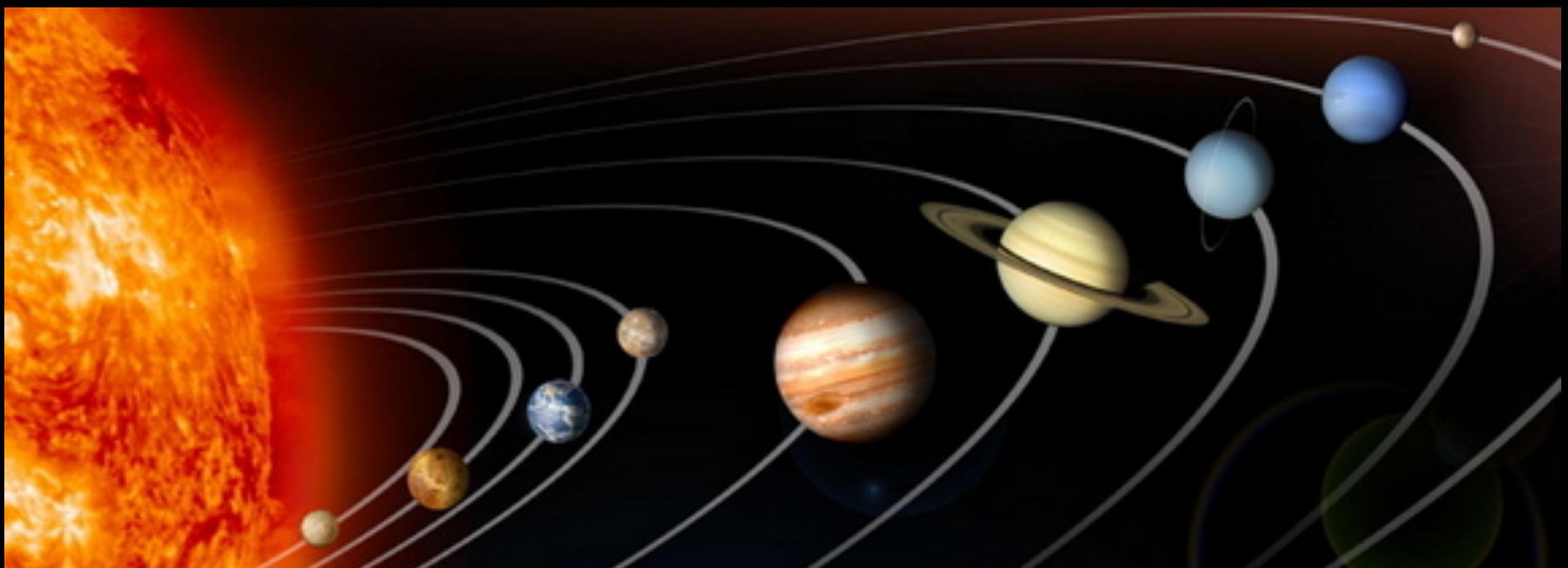
© Addison-Wesley Longman

# The Sun is the Largest Object in the Solar System

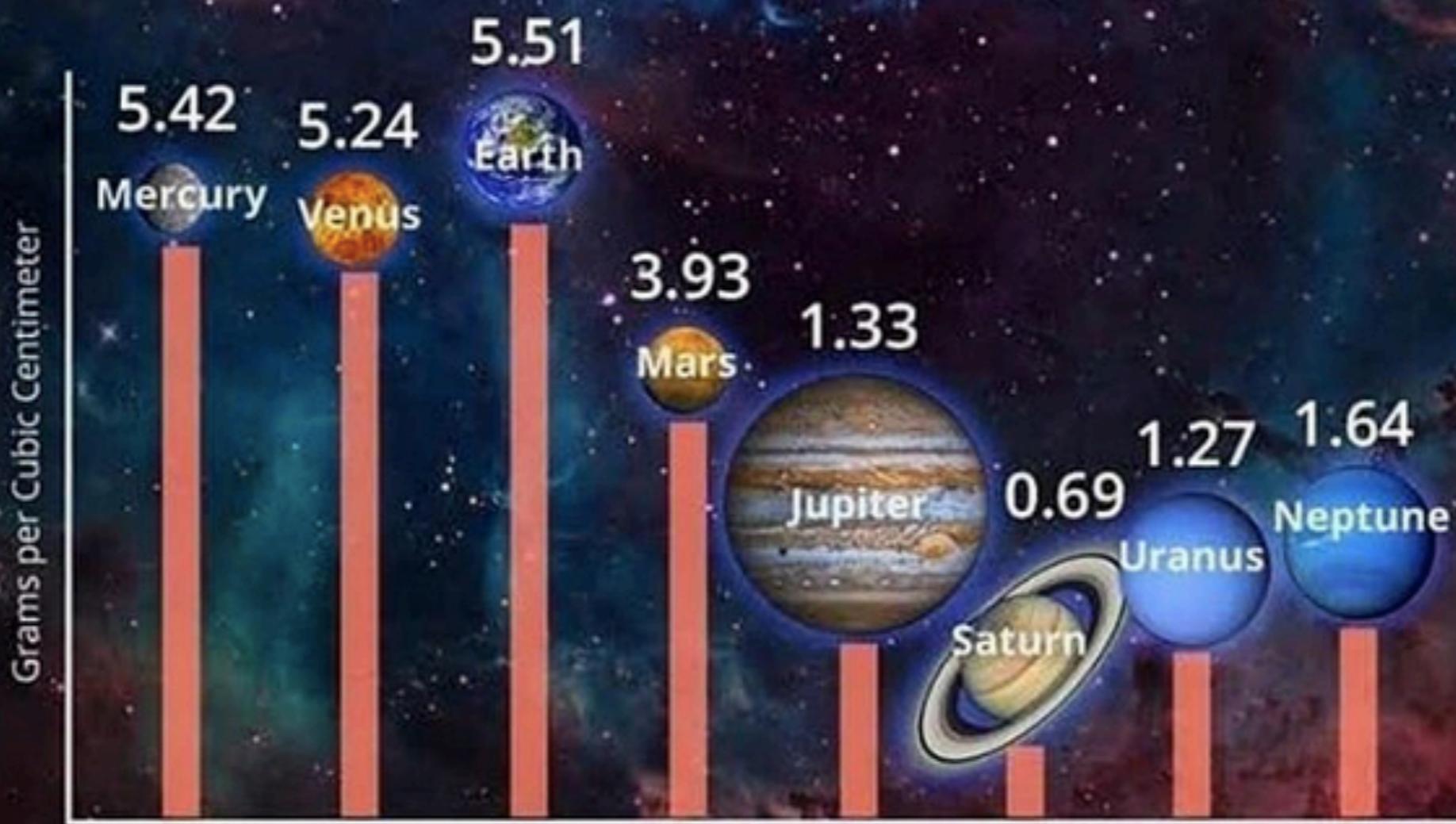
- The Sun contains more than 99.85% of the total mass of the solar system
- If you put *all* the planets in the solar system, they would not fill up the volume of the Sun
- 110 Earths or 10 Jupiters fit across the diameter of the Sun

How big is the Sun?

- The comparison of one planet with another is called **comparative planetology**

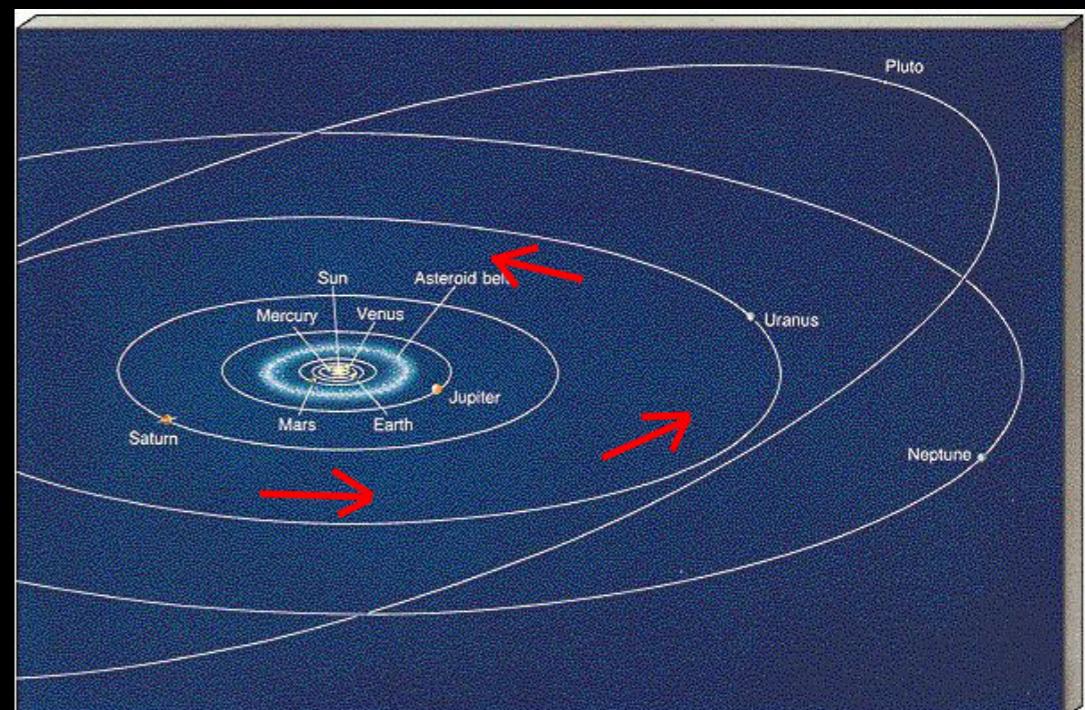


# How dense are the planets?



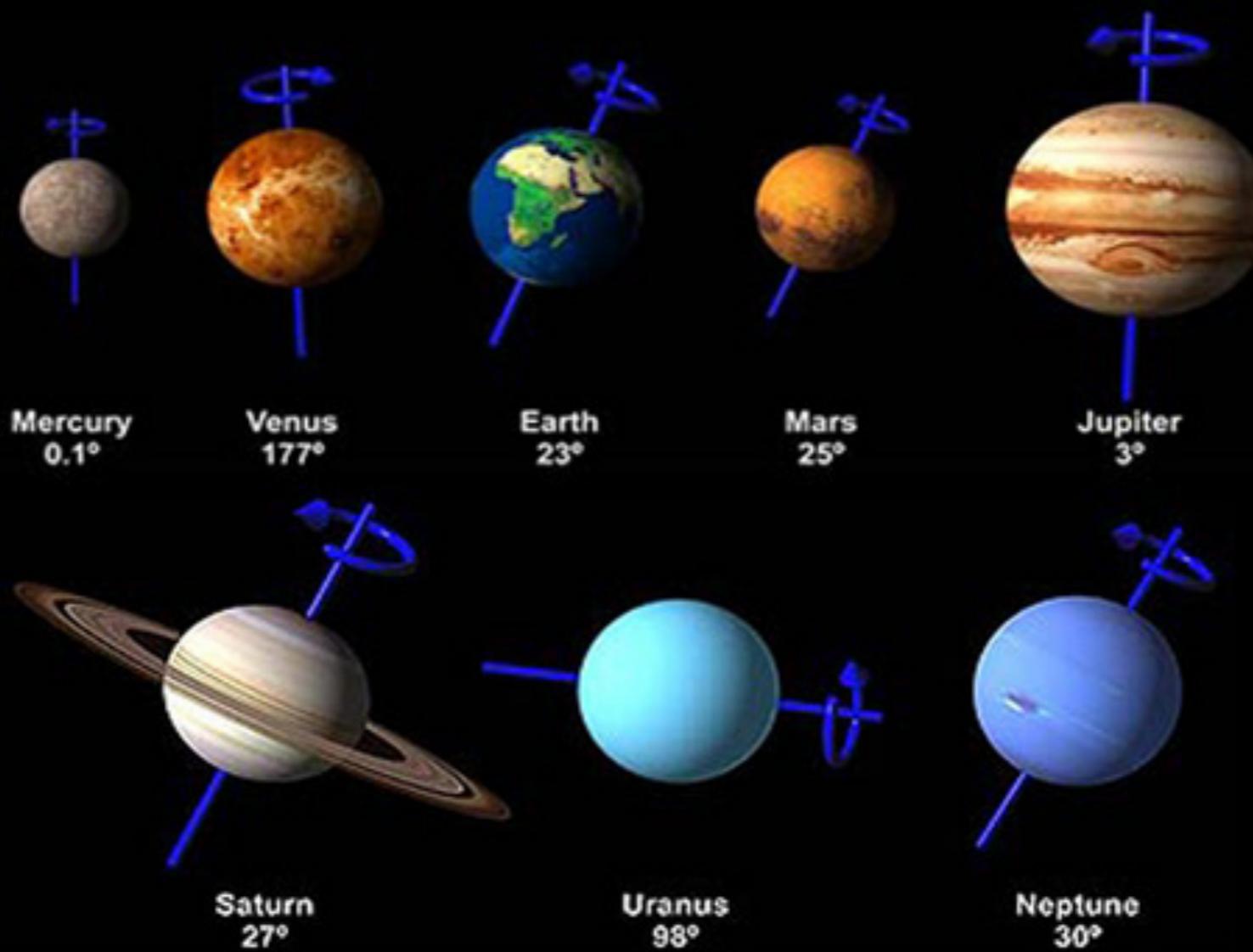
The planets ALL **revolve** around the Sun in the same direction and in orbits that lie close to a common plane.

- The orbit of Mercury, the planet closest to the sun, is tipped  $7.0^\circ$  to Earth's orbit.
- The rest of the planets' orbital planes are inclined by no more than  $3.4^\circ$ .



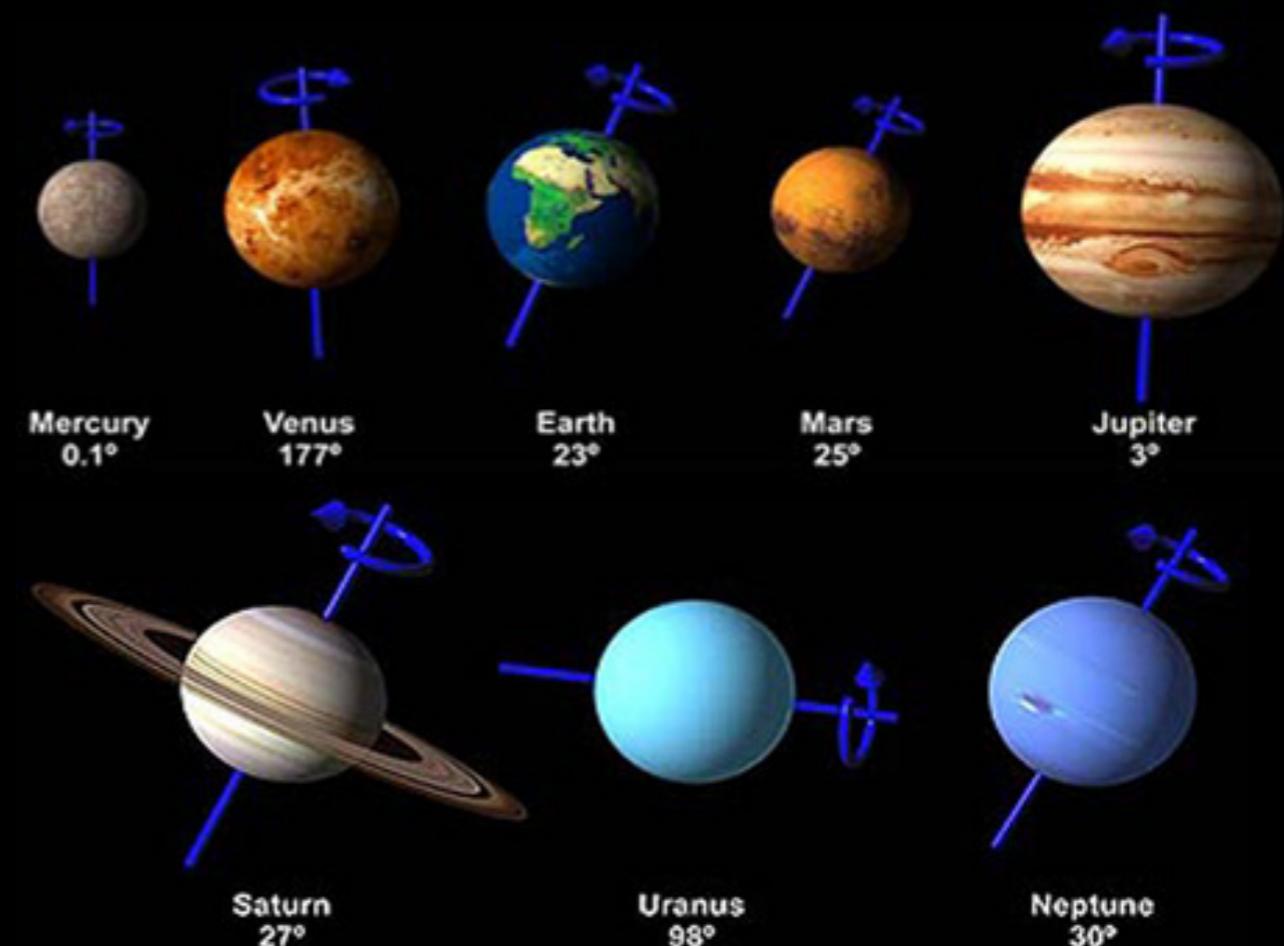
- The rotation of the Sun and planets on their axes also seems related to the same overall direction of motion.

- The Sun rotates with its equator inclined only  $7.2^\circ$  to Earth's orbit.
- Most of the other planets' equators are tipped less than  $30^\circ$

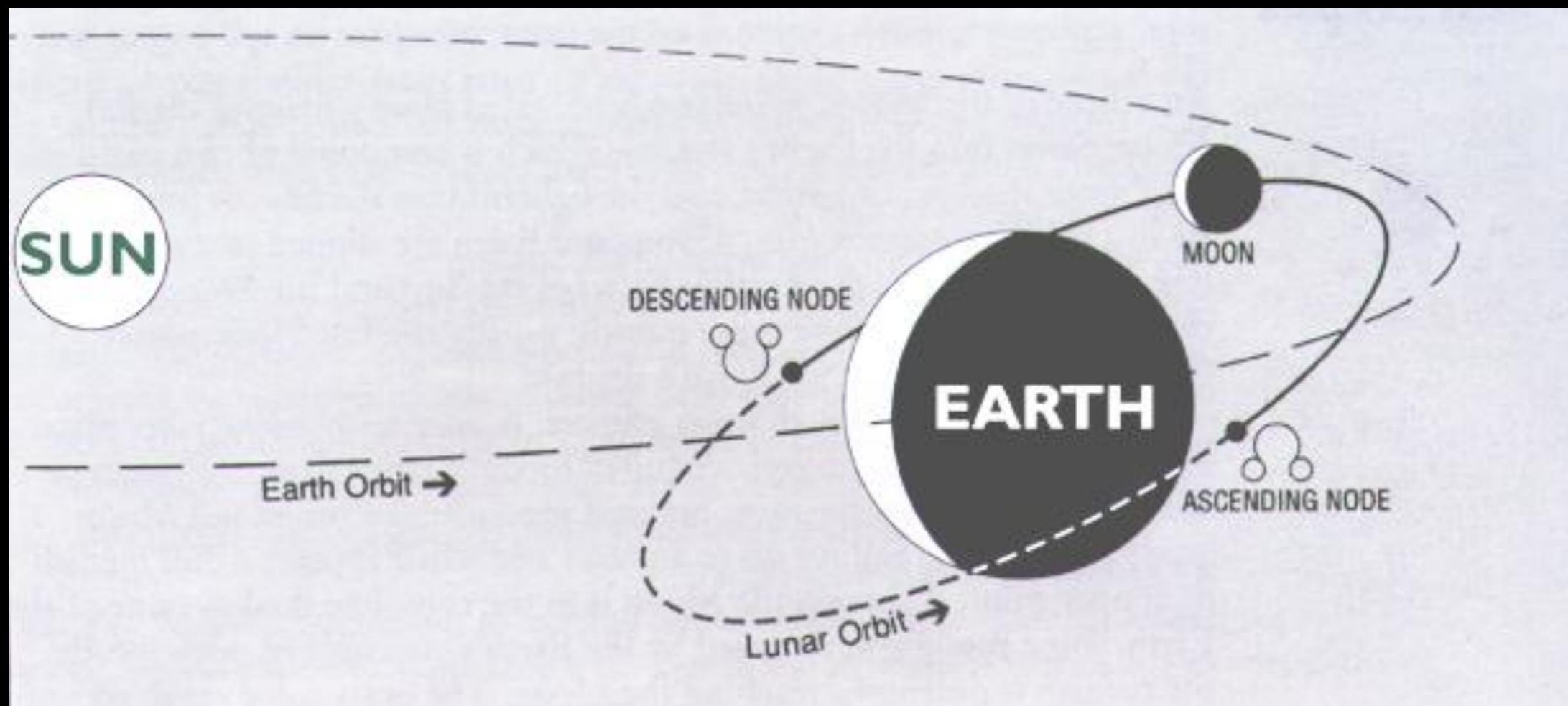


Q: The fact that the rotation axis of Uranus is Tilted nearly 90 degrees means

- a) It will have no seasons
- b) It will have the same seasons as the Earth
- c) It will have more extreme seasons
- d) The tilt of the axis has no effect on its seasons



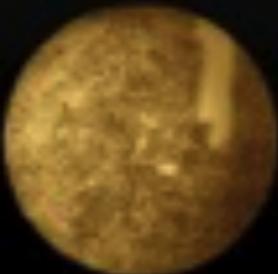
- Nearly all the moons in the solar system, including Earth's moon, revolve around their planets counterclockwise.
  - With only a few exceptions, most of which are understood, revolution and rotation in the solar system follow a common theme - counter clockwise as seen from North pole



# The Inner Planets (Family Portrait)



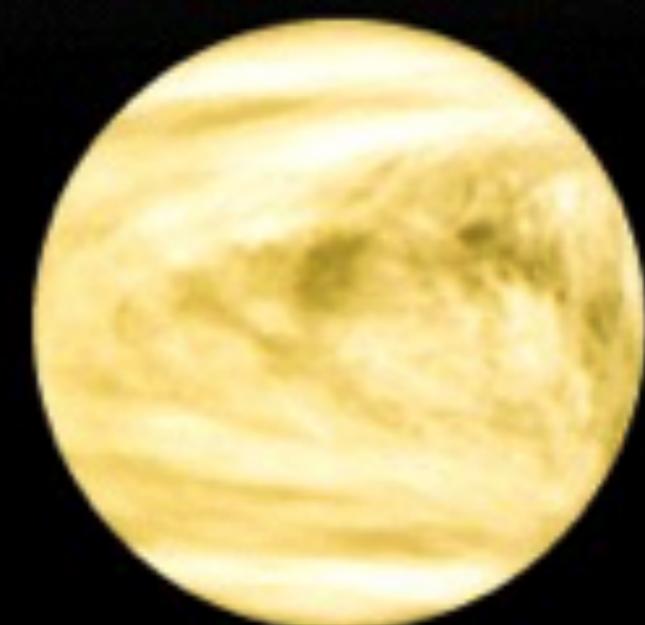
Earth



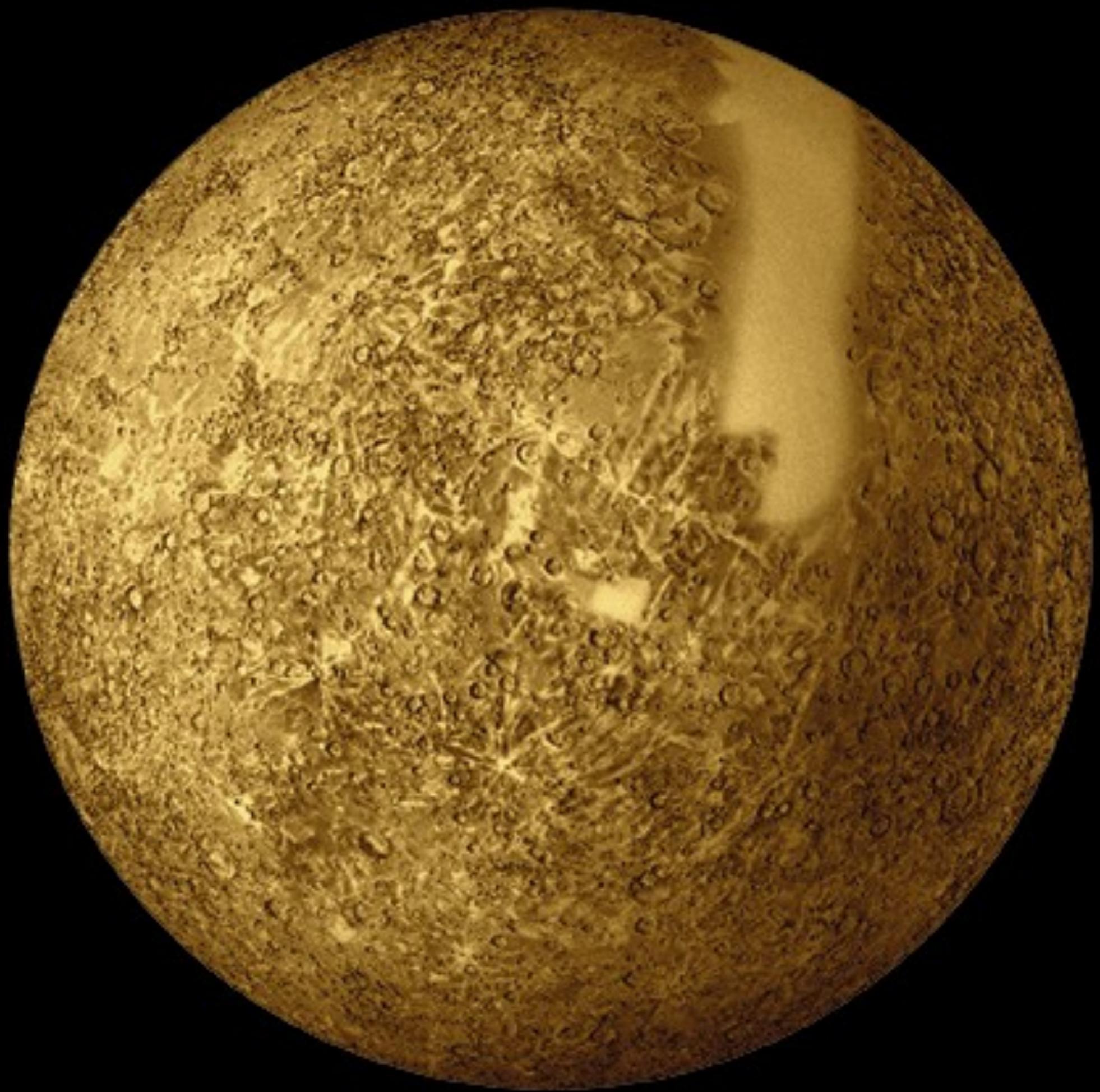
Mercury

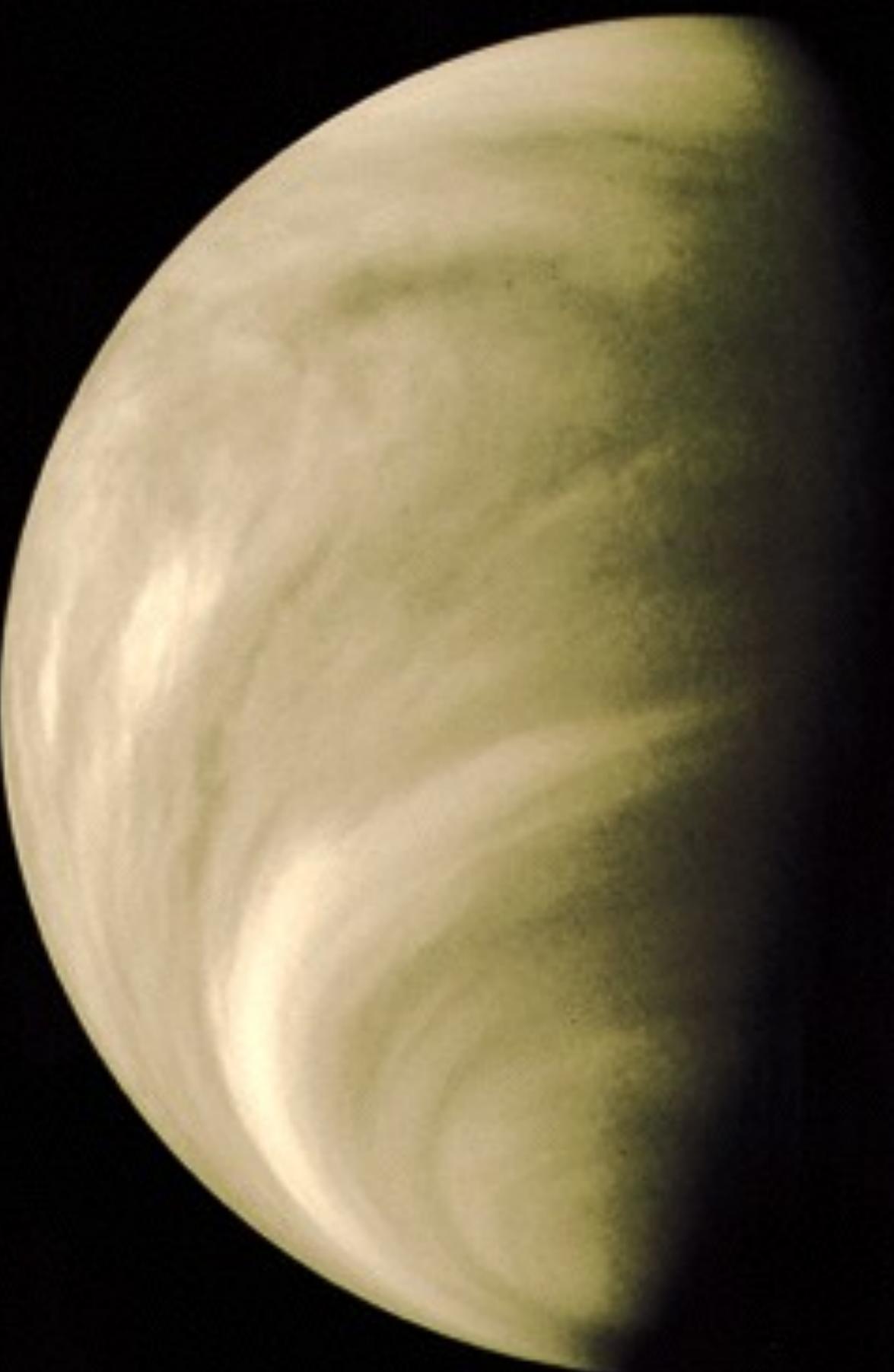


Mars



Venus





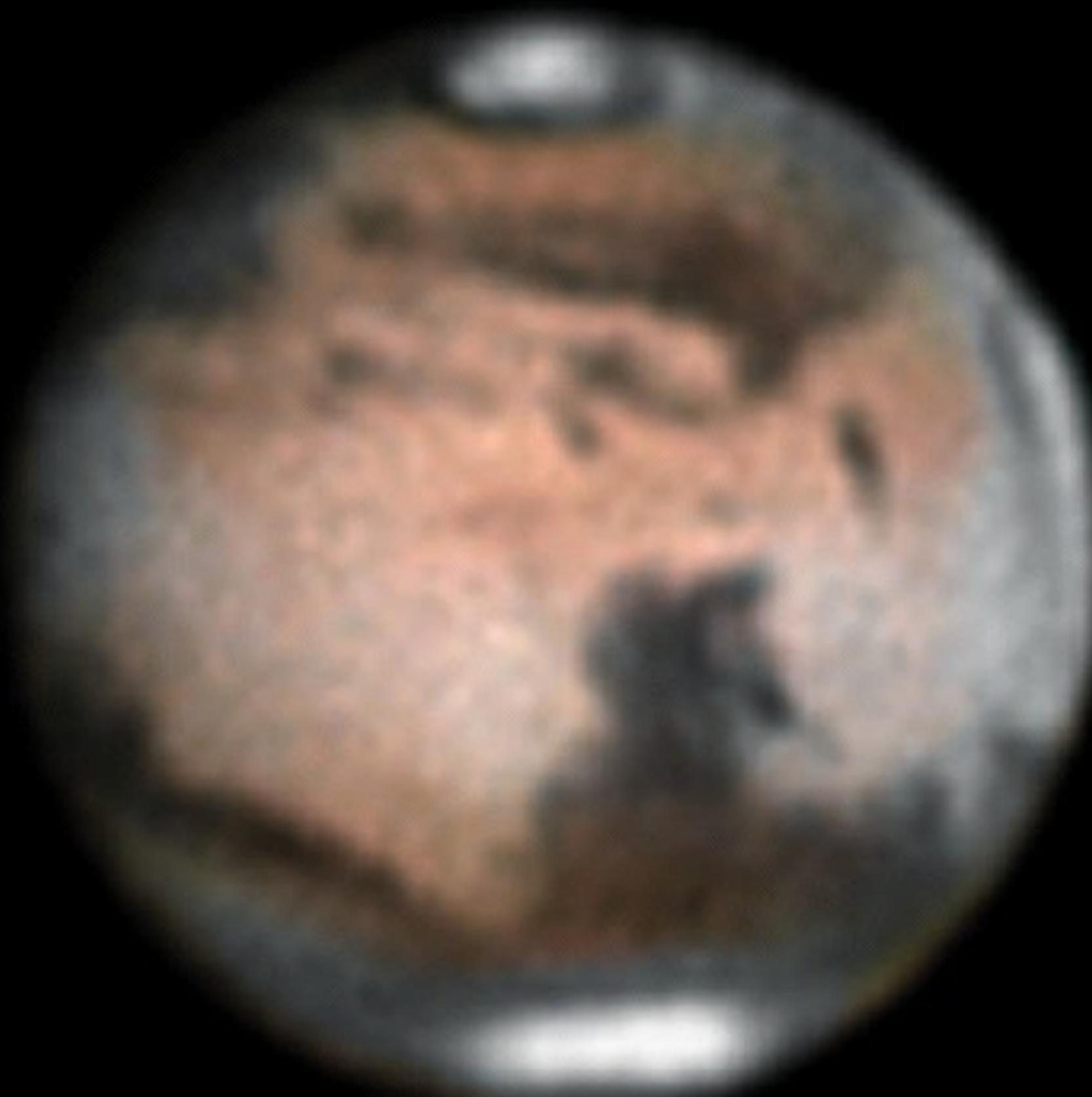
The surface of  
Venus is  
completely  
hidden beneath  
permanent cloud  
cover

# EARTH

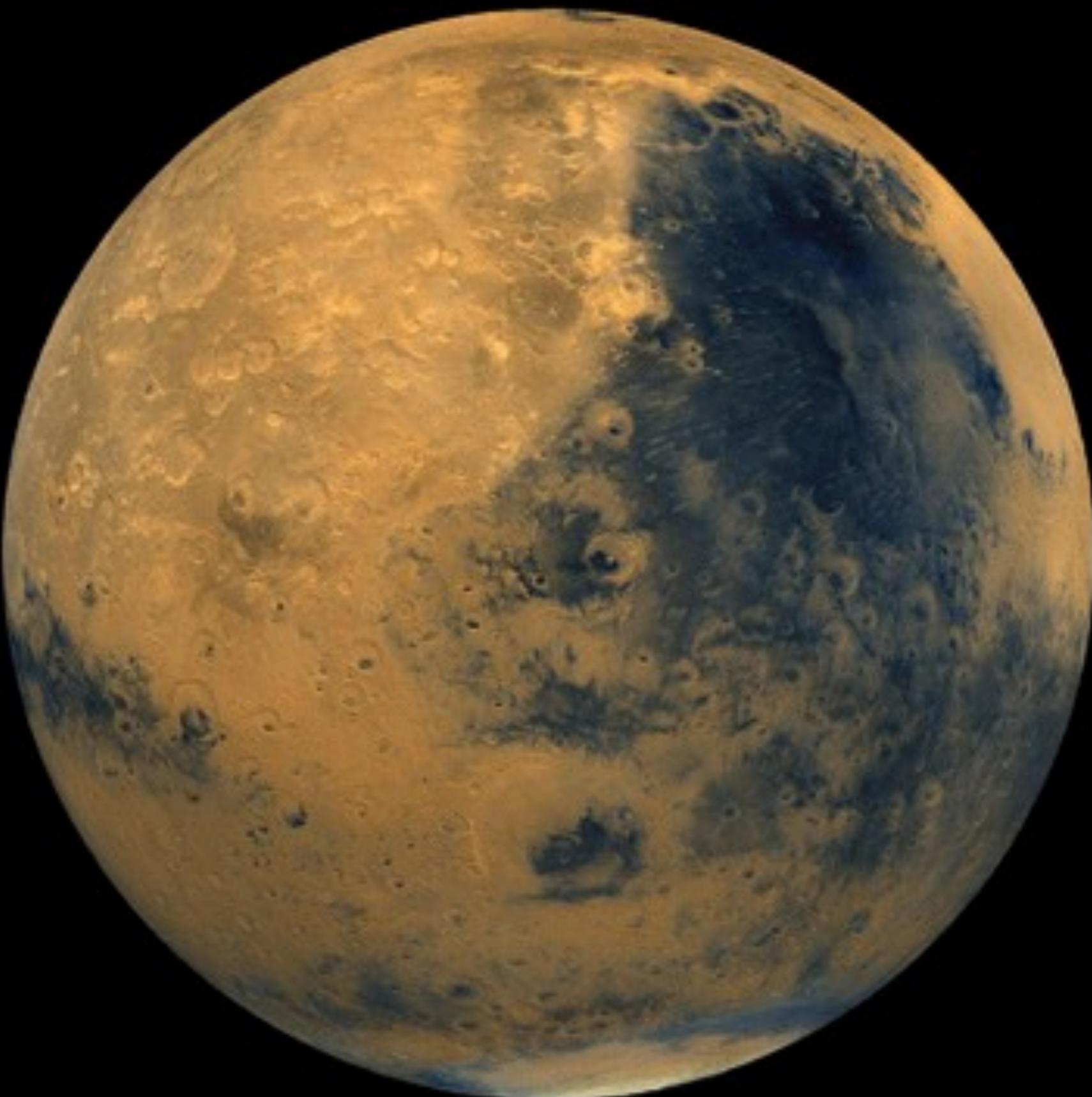
- More on this planet later



# Mars, as seen from Earth



# Mars, as seen from the Hubble Space Telescope



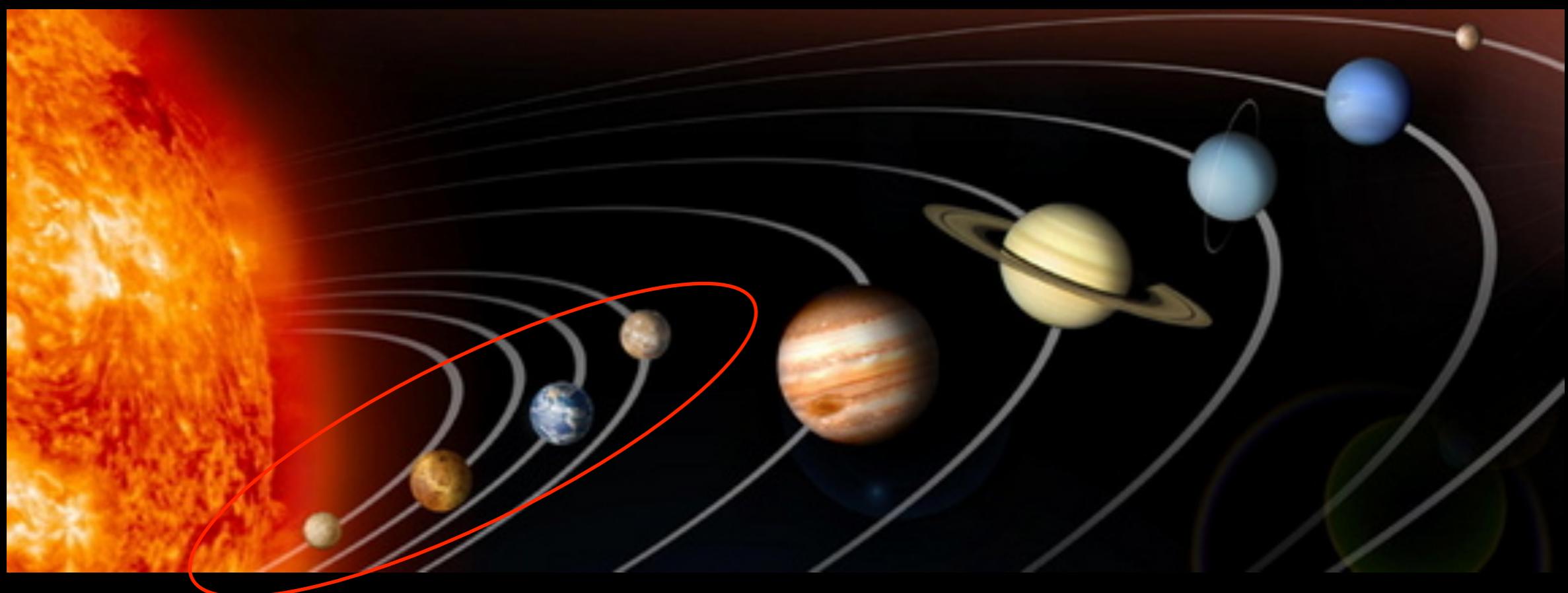
# Inner (Terrestrial) Planets

- Mercury
- Venus
- Earth
- Mars
- Characteristics
  - Small
  - Rocky
  - Very close to the Sun
  - Have few moons
  - Have no rings



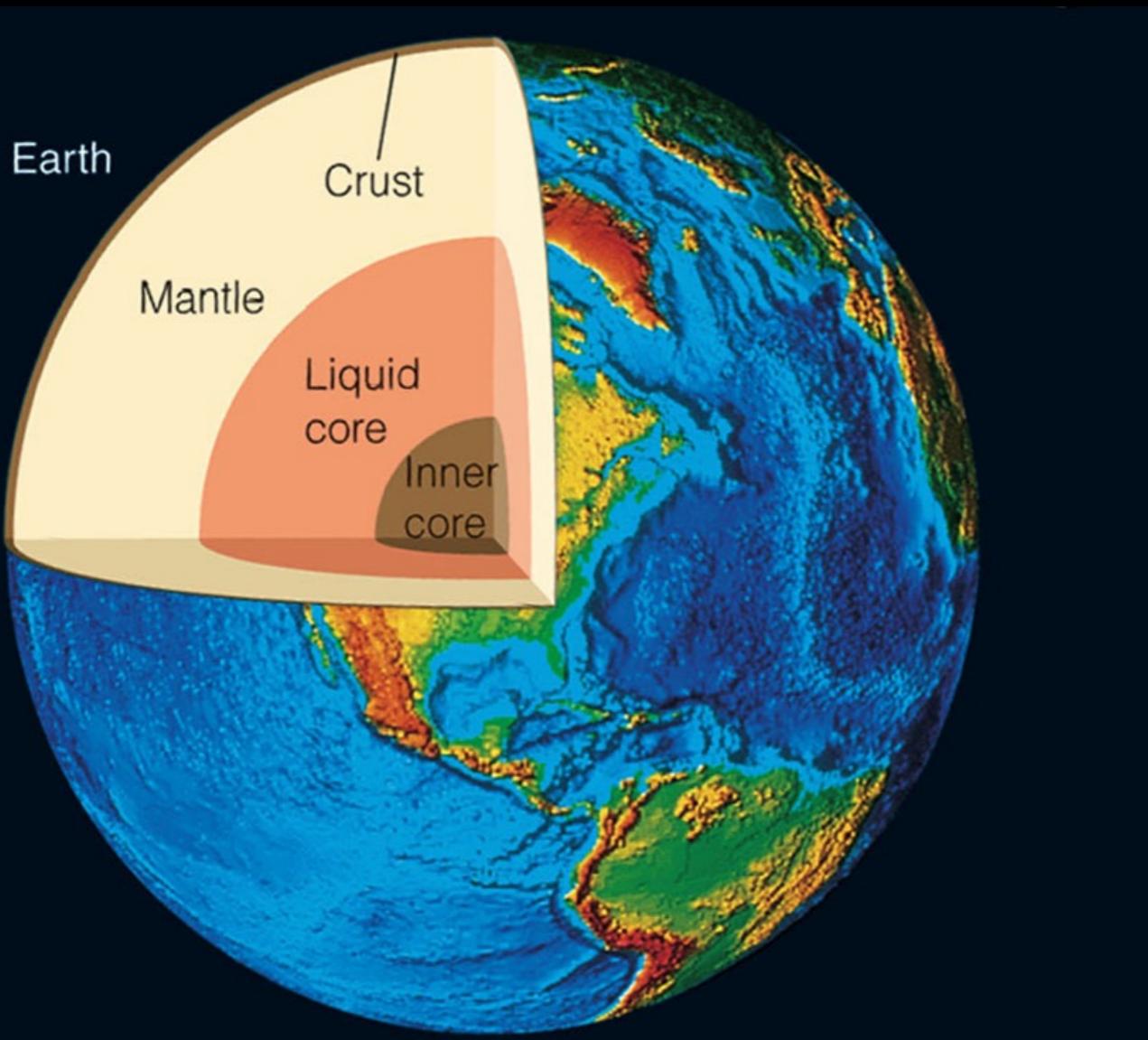
There are multiple aspects of **terrestrial** (or rocky) planets we will focus on

- 1) Interiors
- 2) Surfaces
- 2) Atmospheres
- 3) Magnetic



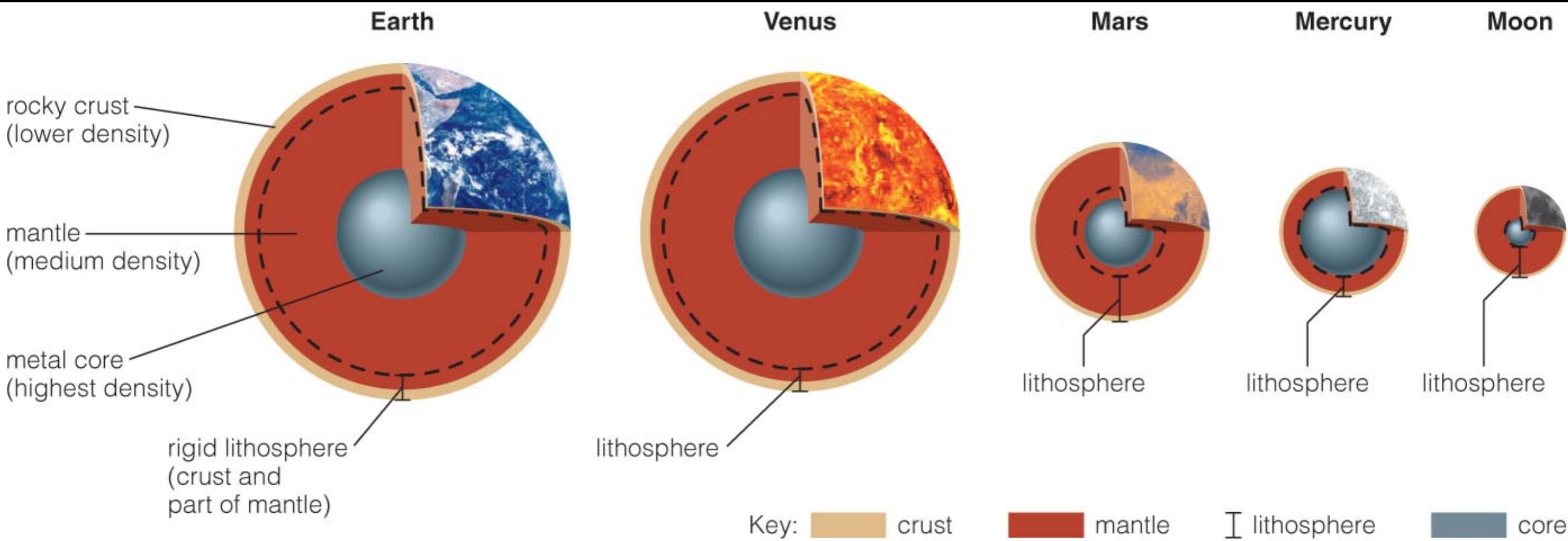
# In general, the **interior** of the Earth has multiple layers

- A metallic core
- A dense rocky mantle
- A thin, low-density crust or lithosphere



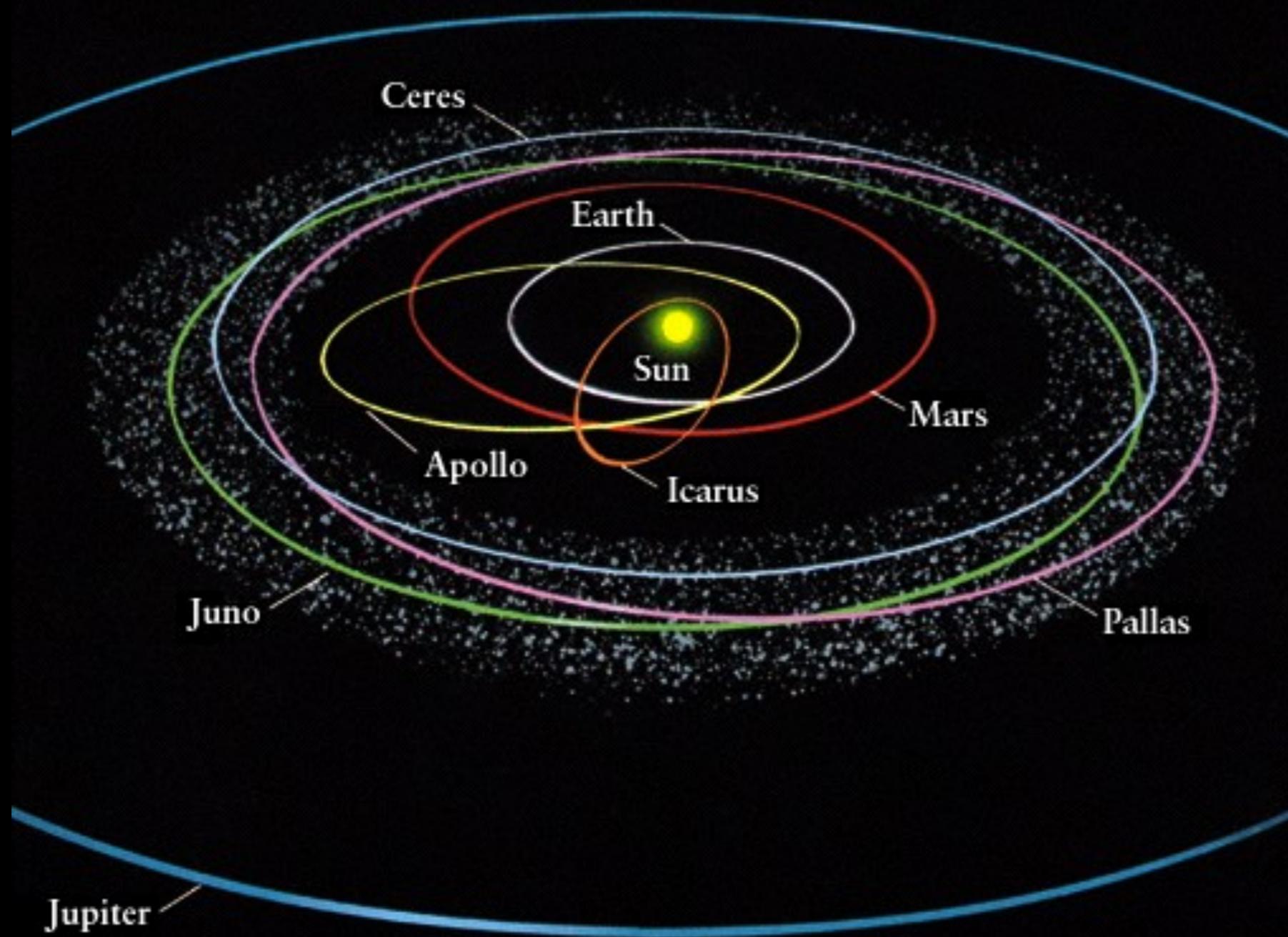
We can study the inside of the Earth from earthquakes

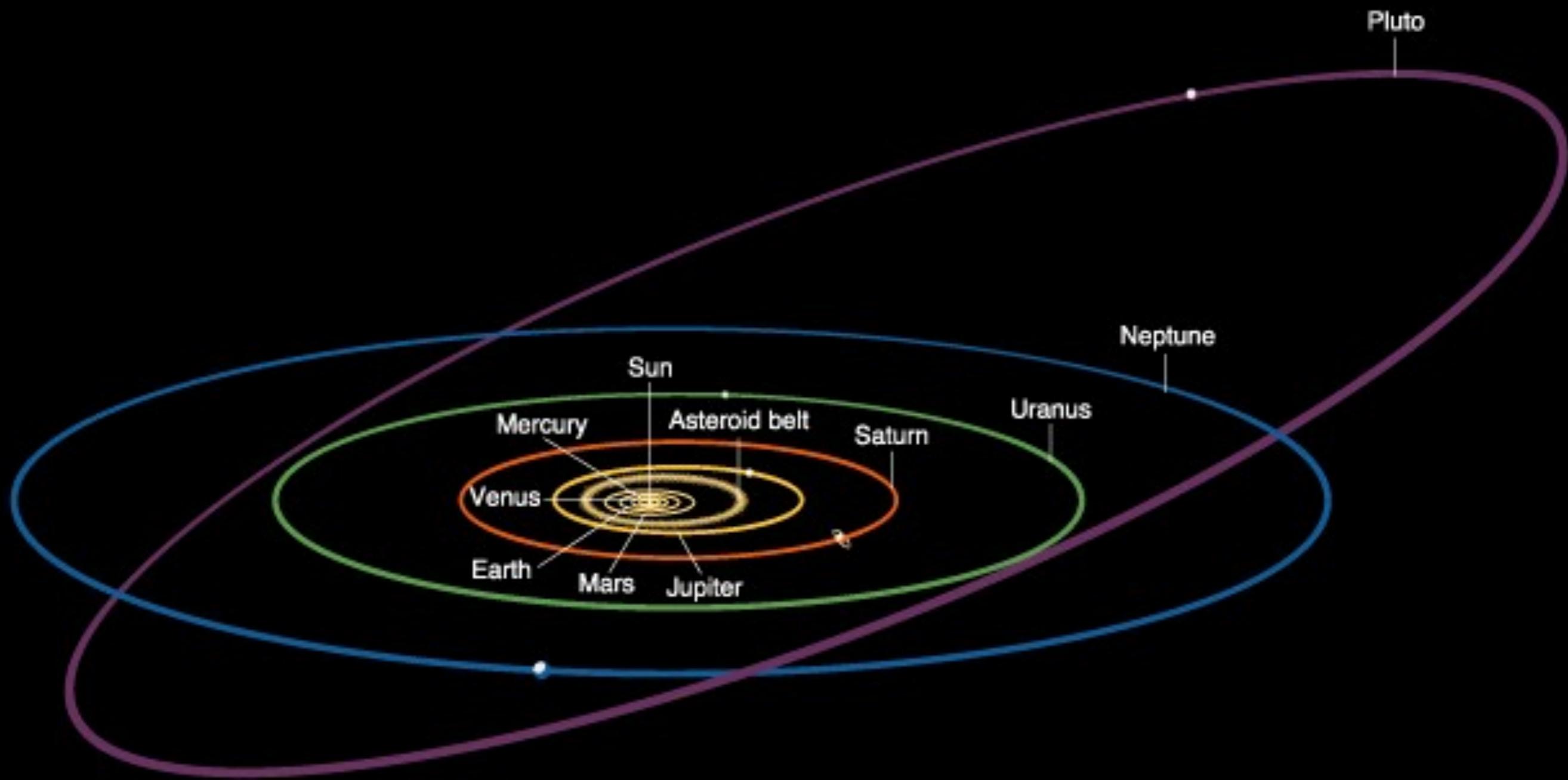
# The size of a terrestrial planet affects its interior



- Smaller worlds cool off faster and harden earlier.
- The Moon and Mercury are now geologically “dead.”

# Most asteroids orbit the Sun between Mars and Jupiter

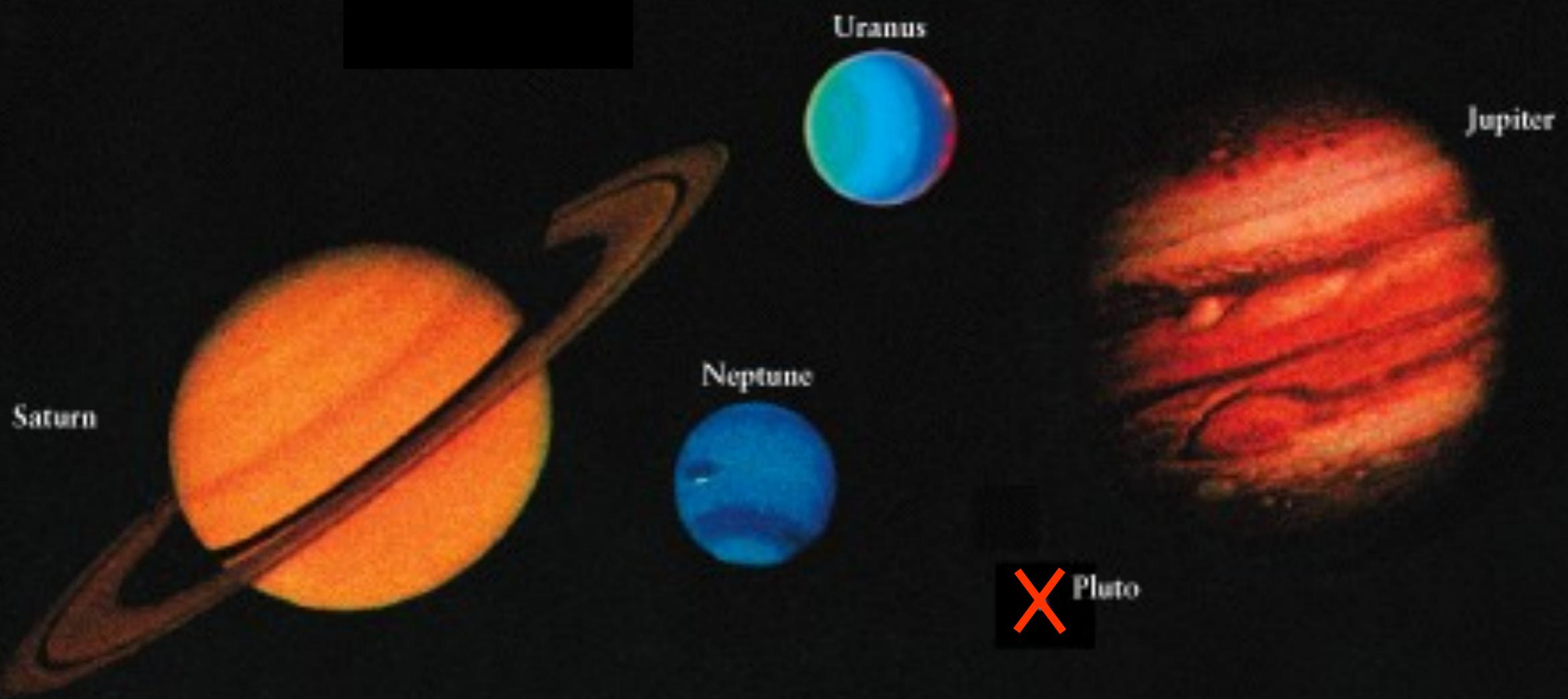




# Outer (Jovian) Planets

- Jupiter
- Saturn
- Uranus
- Neptune
- Pluto
- Enormous
- Gaseous
- Far from Sun
- Separated by large distances
- Have ring systems
- Have many moons

# The Outer Planets (Family Portrait)



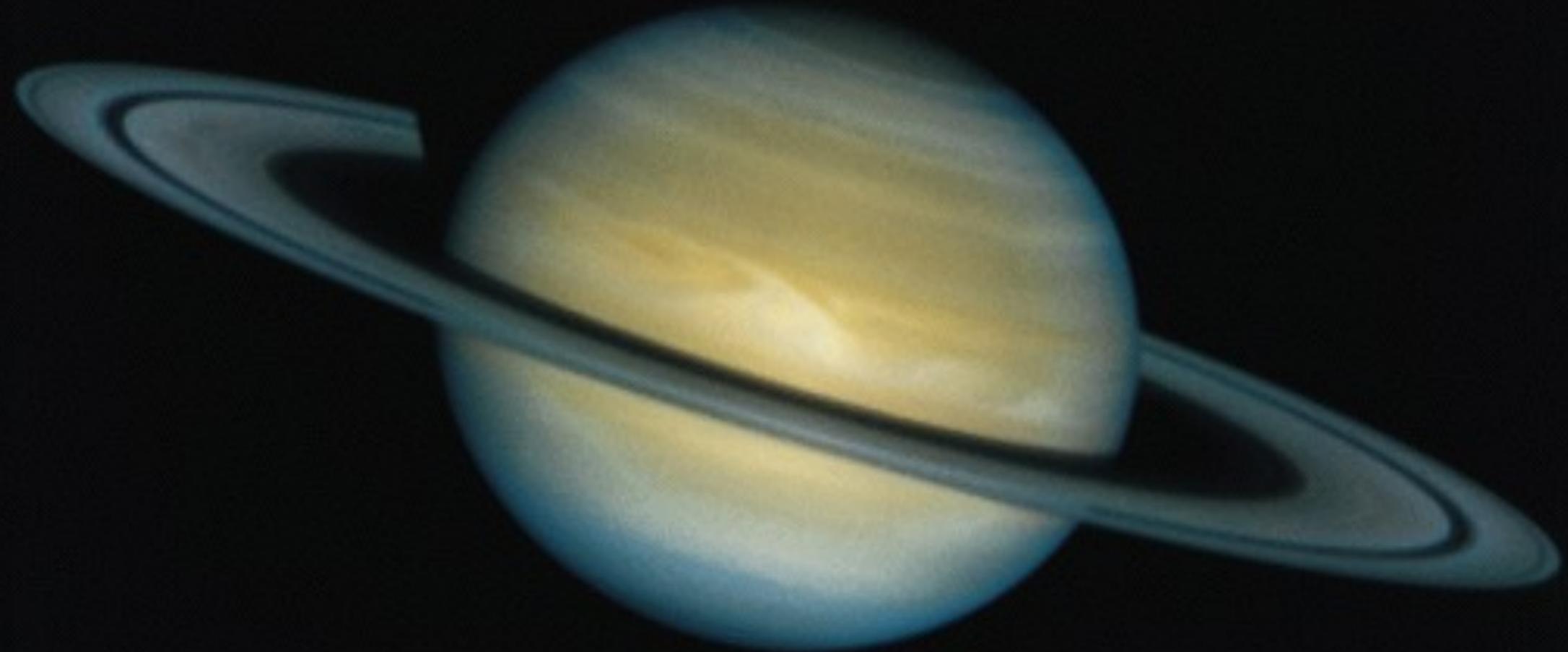
Jupiter is the Largest of the Gas Giant Planets



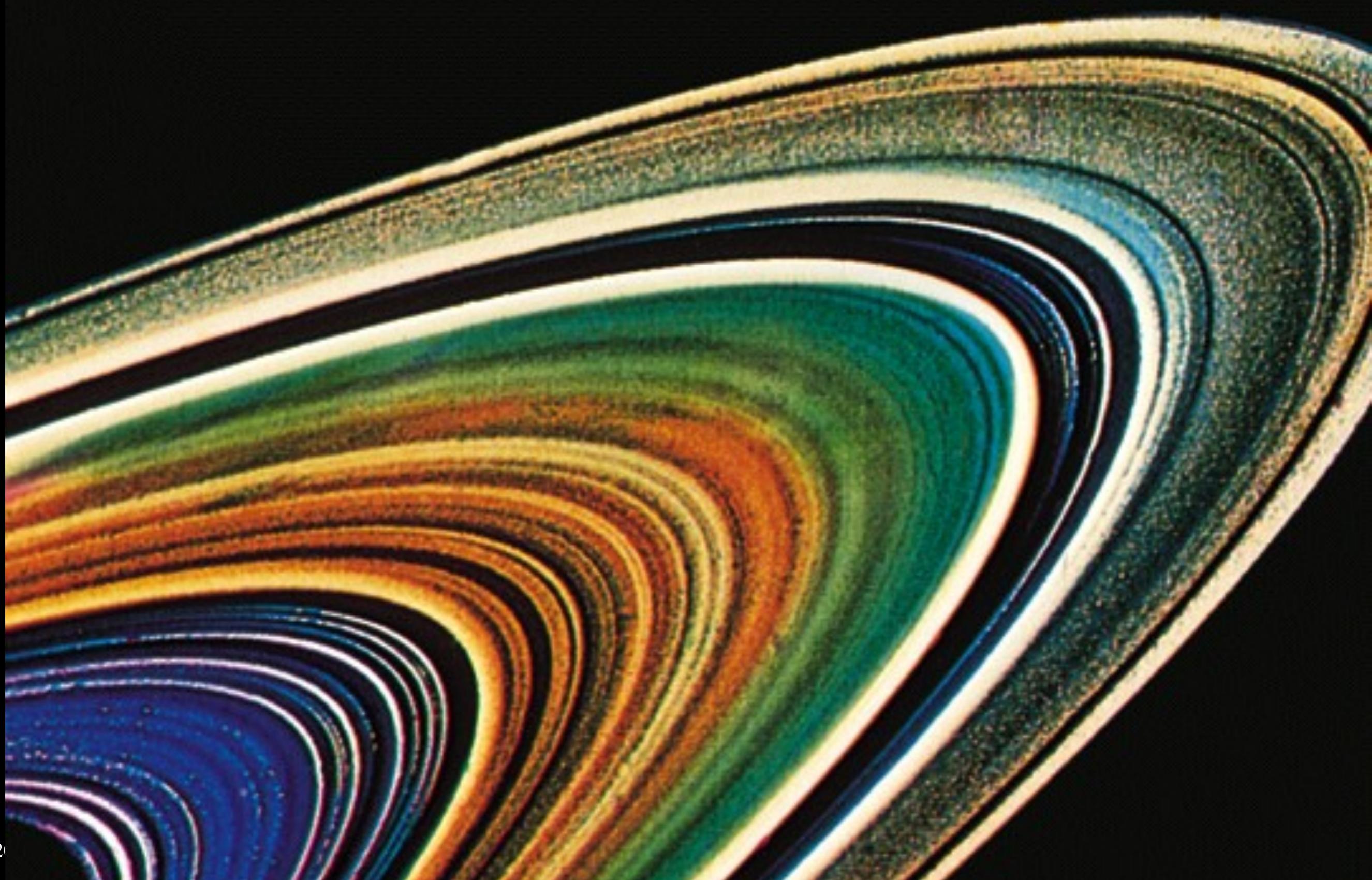


Besides being the largest planet, Jupiter is probably best known for its **Great Red Spot** - a hurricane-like storm that has been observed ever since the invention of the telescope.

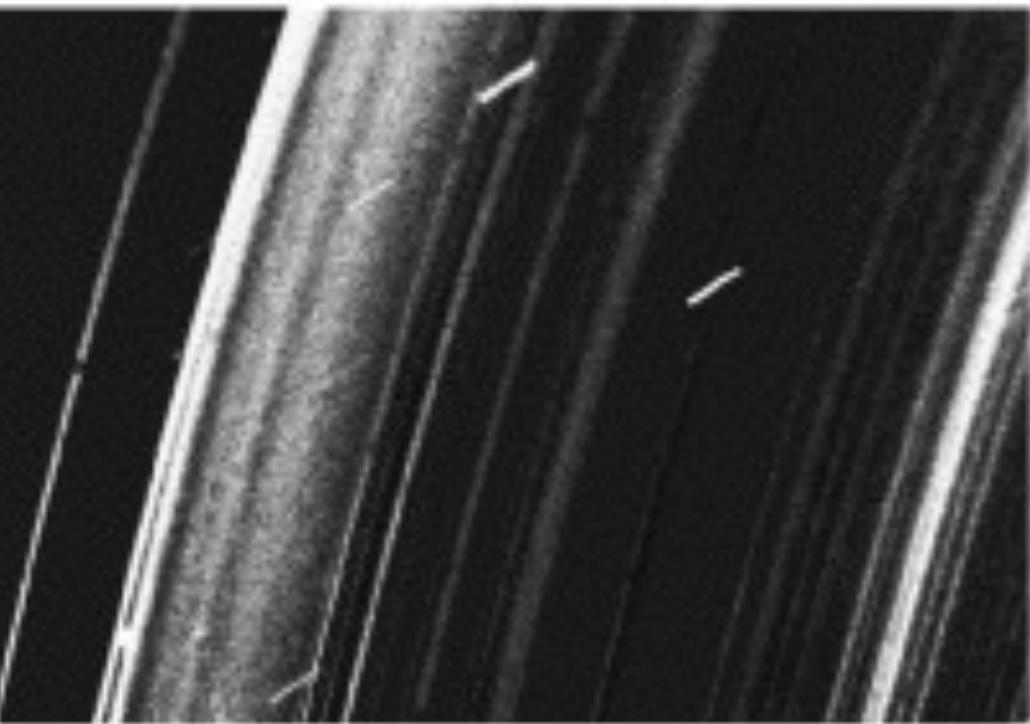
Saturn has the most extensive ring system in the solar system



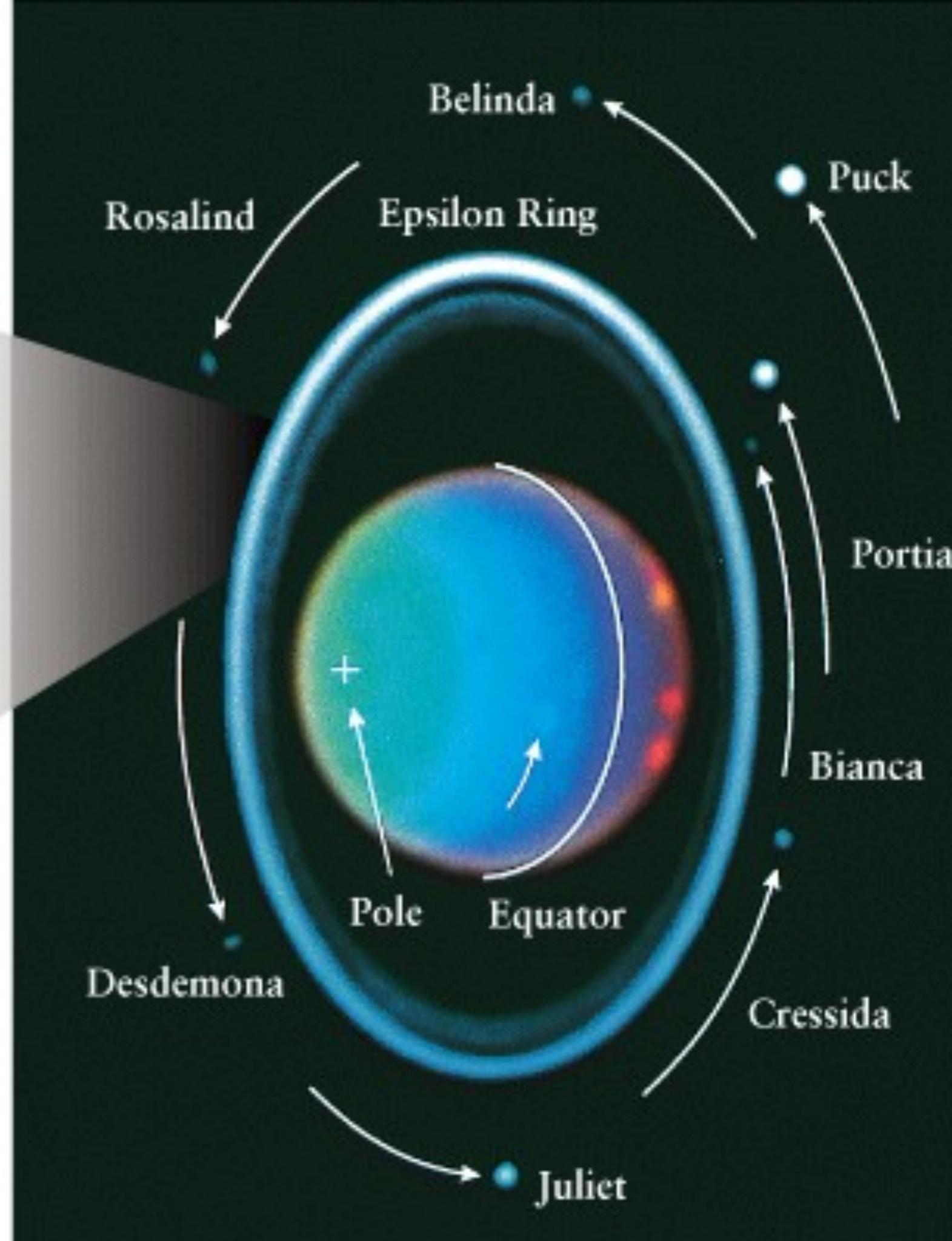
Saturn's spectacular rings are composed of fragments of ice and ice-coated rock



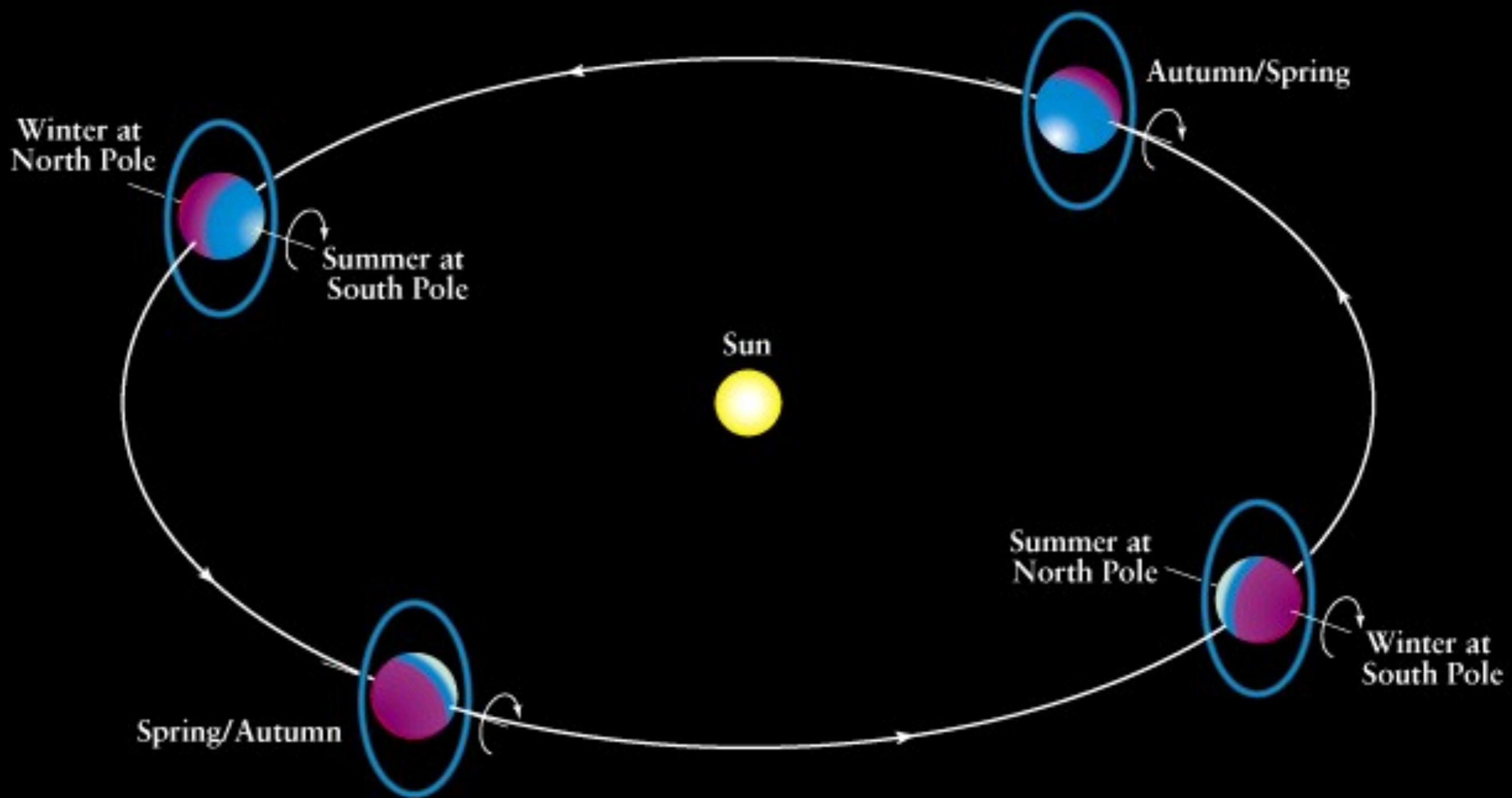
A system of rings and satellites revolves around Uranus



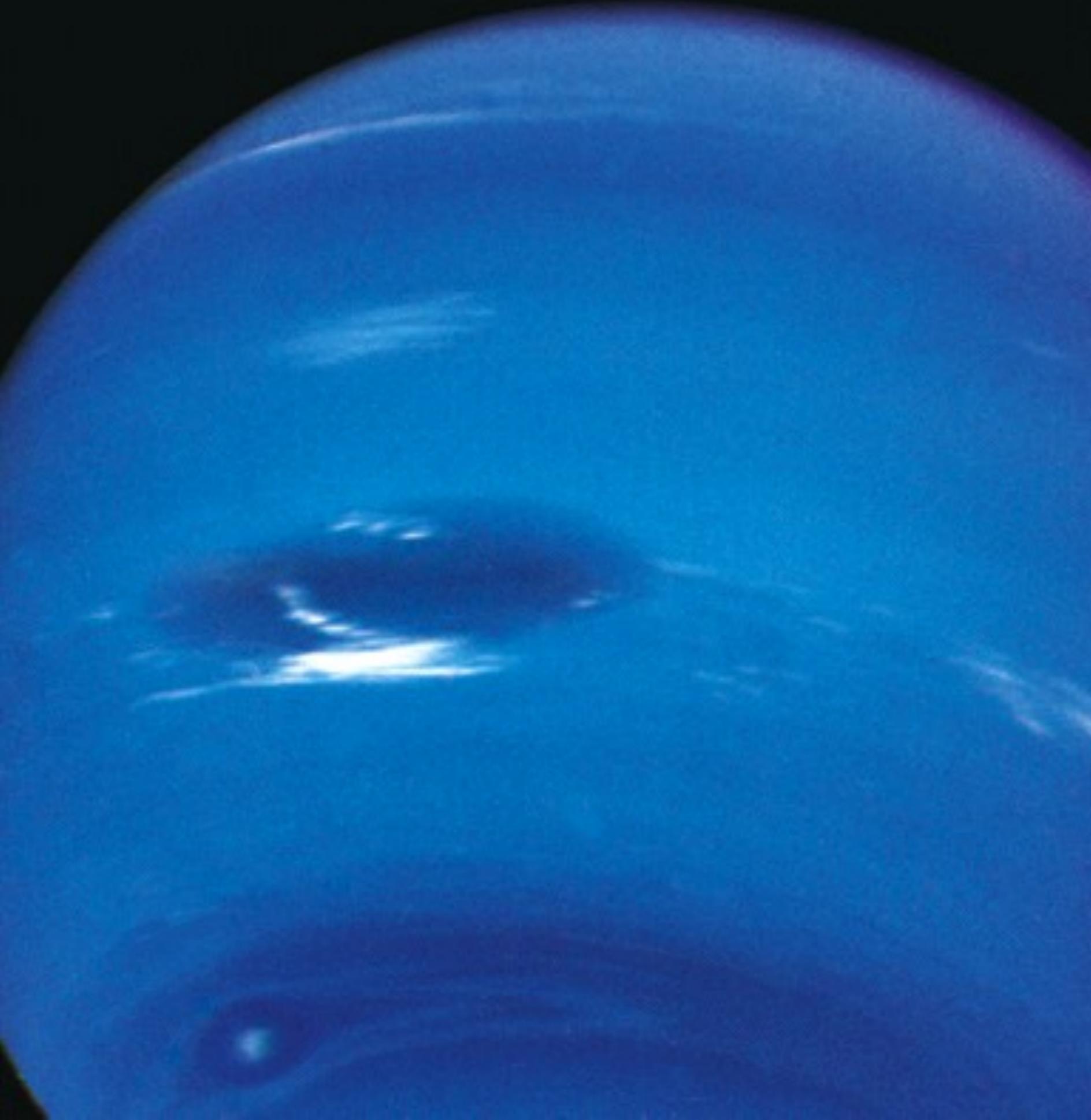
Uranus has a hazy atmosphere with few clouds



# Uranus' tilt gives it very exaggerated seasons



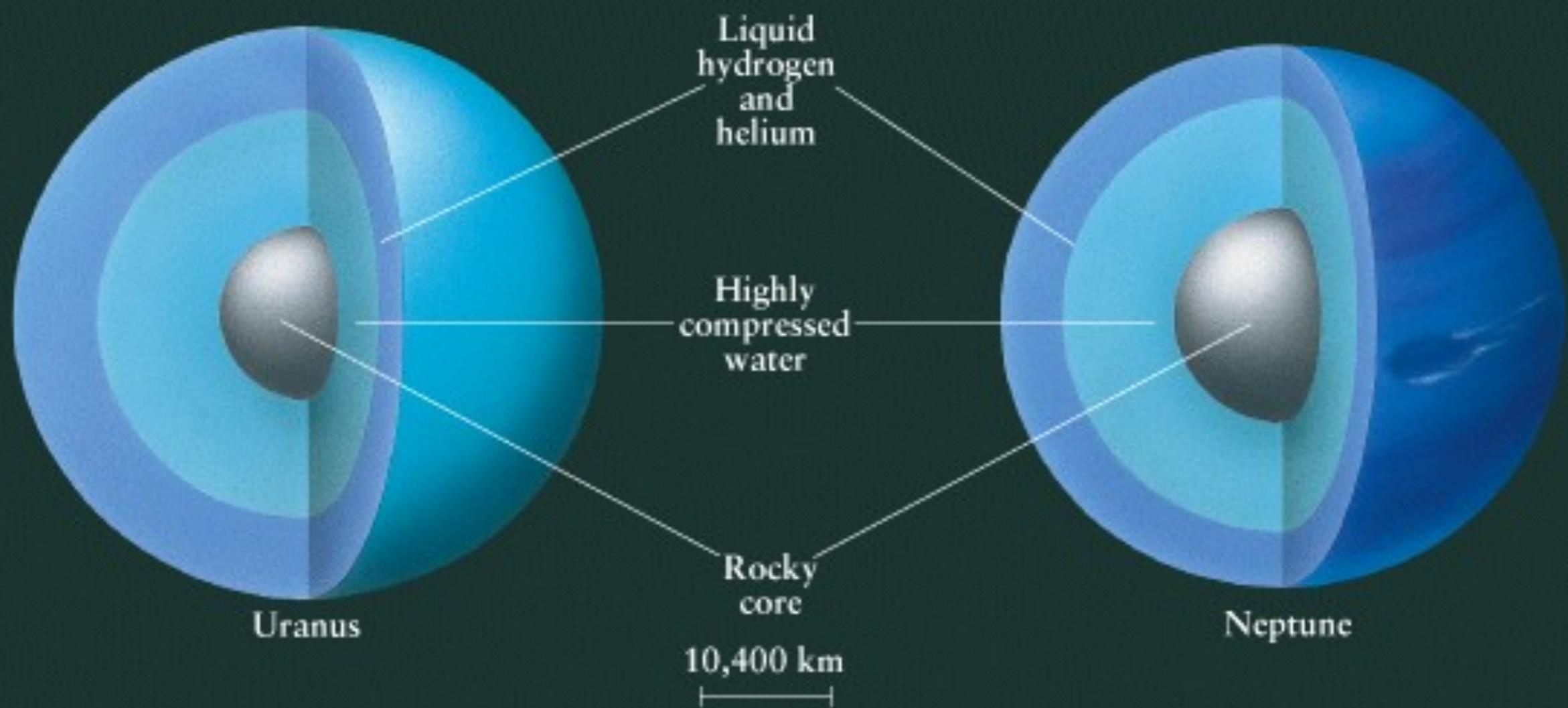
Brilliant blue  
Neptune  
has a giant  
storm too



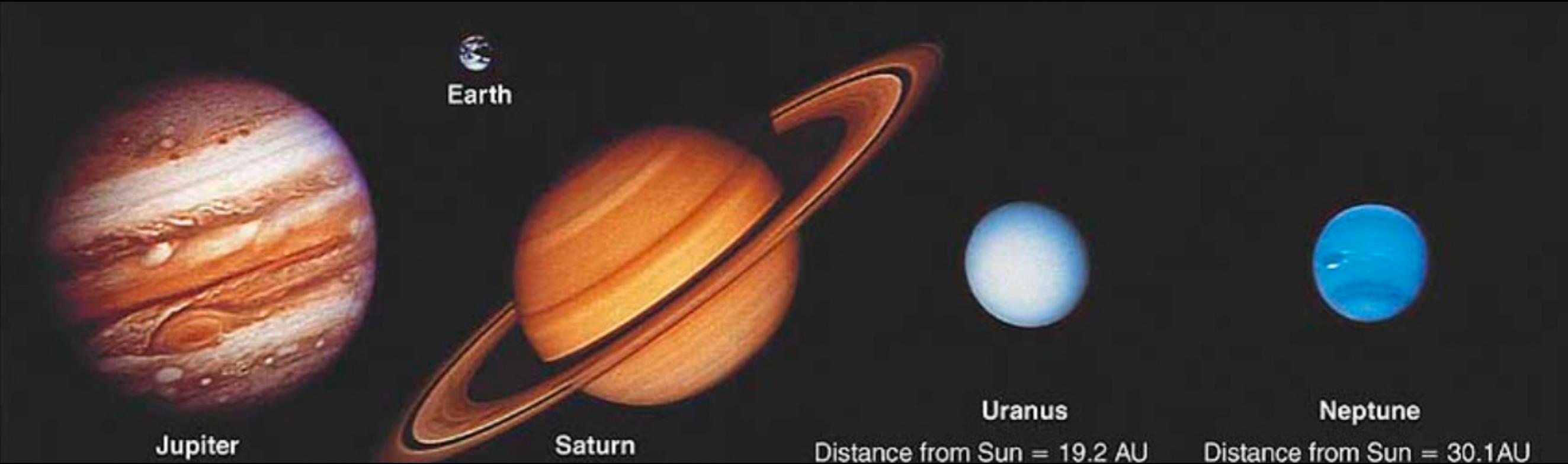


# Neptune's Rings

# Uranus and Neptune have similar interiors

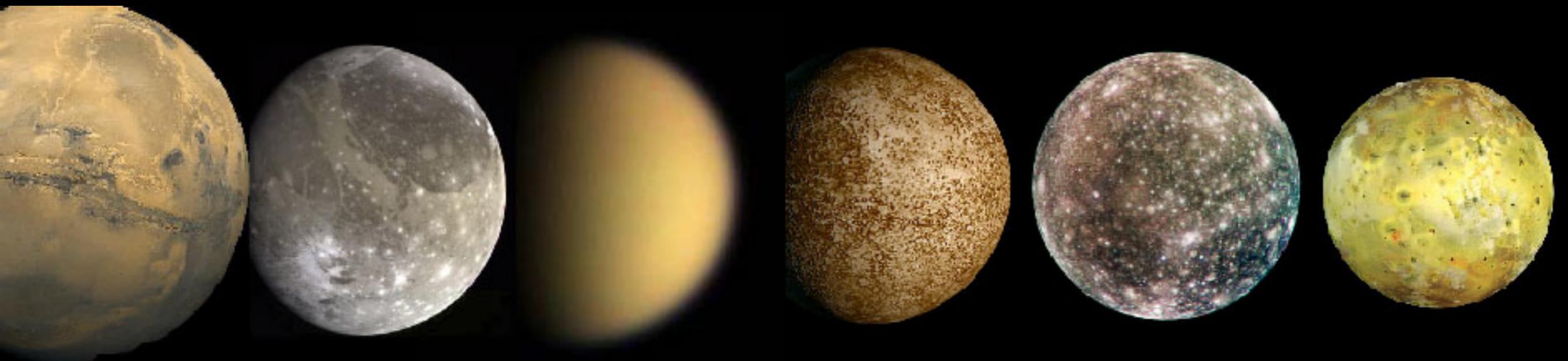


# Comparing the Gas giant planets



<b>Property</b>	<b>Jupiter</b>	<b>Saturn</b>	<b>Uranus</b>	<b>Neptune</b>
<b>Atmosphere</b>	H, He, methane, ammonia, sulfides in different proportions			
<b>Magnetic Field</b>	X	X	X	X
<b>Moons</b>	64 - 4 Galilean			

# Compare all the Moons of the Solar System



Mars  
6804.9 km      Ganymede  
5262 km      Titan  
5150 km      Mercury  
4879.4 km      Callisto  
4821 km      Io  
3643 km



Moon  
3476.2 km      Europa  
3122 km      Triton  
2706.8 km      Pluto  
2390 km      Sedna  
~ 1500 km      Titania  
1578 km      Rhea  
1528 km      Oberon  
1523 km      Iapetus  
1436 km      Quaoar  
1200 km



Charon      Umbriel      Ariel  
1186 km      1169.4 km      1158 km      Dione  
1118 km

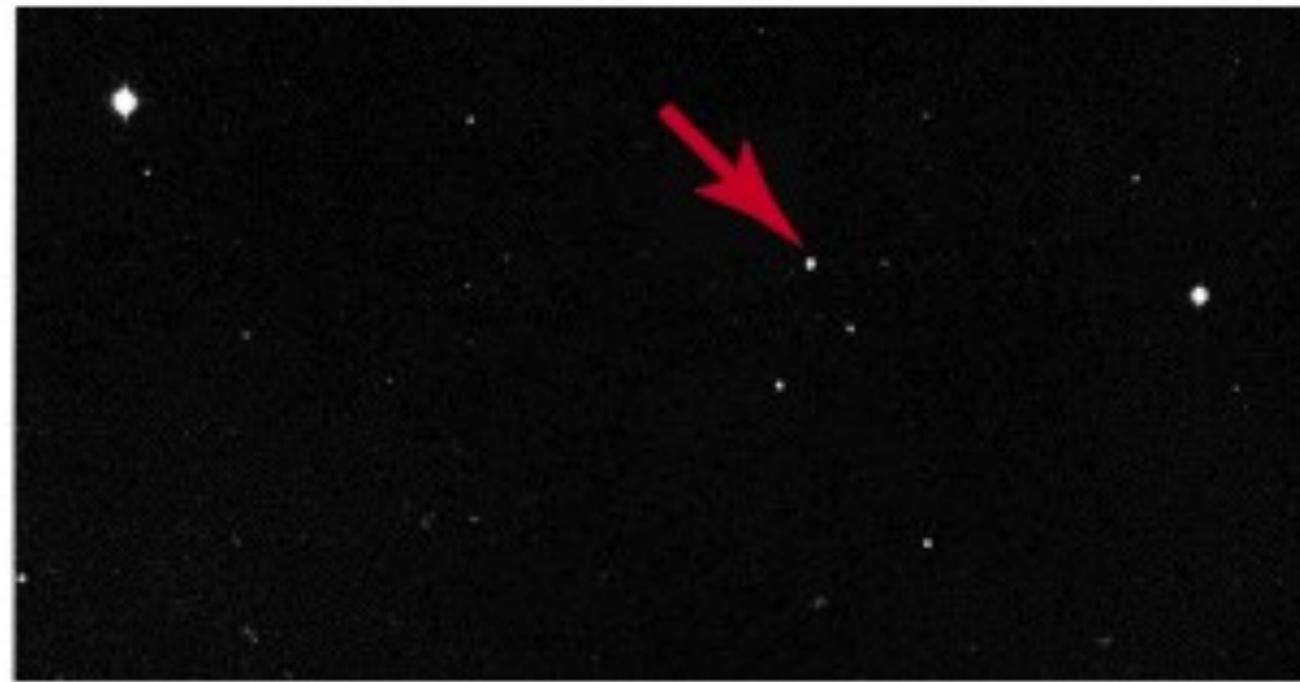
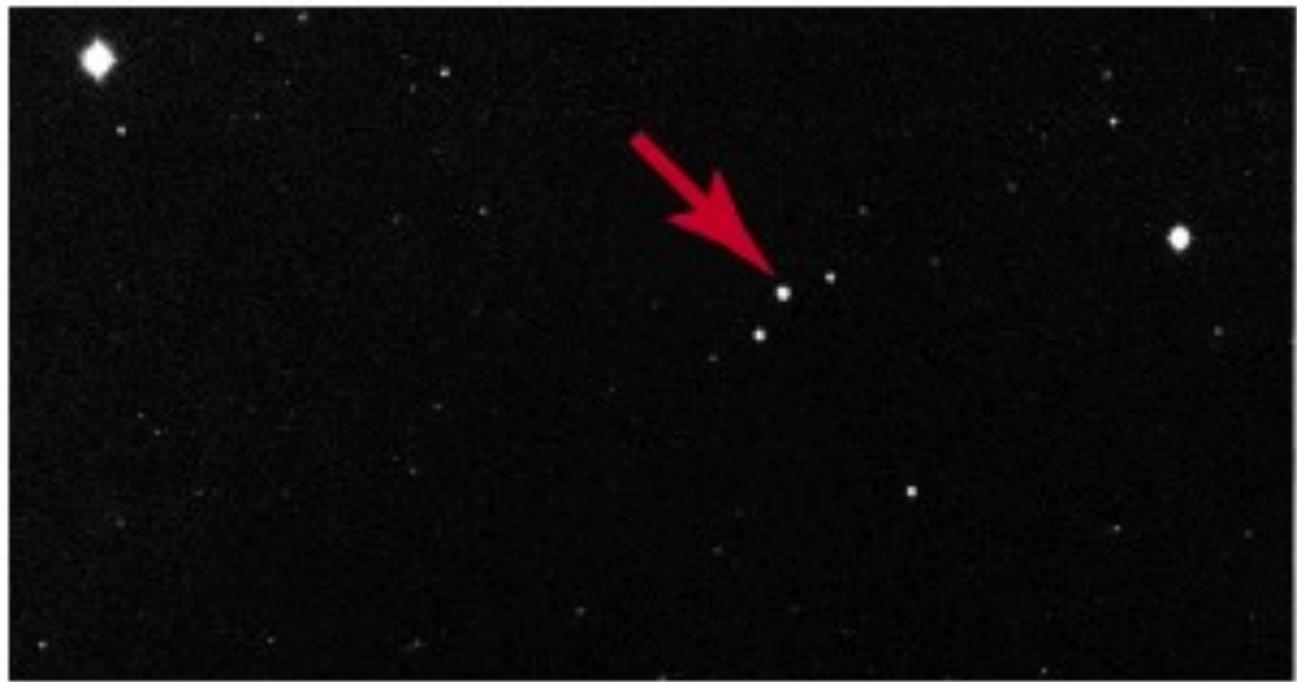


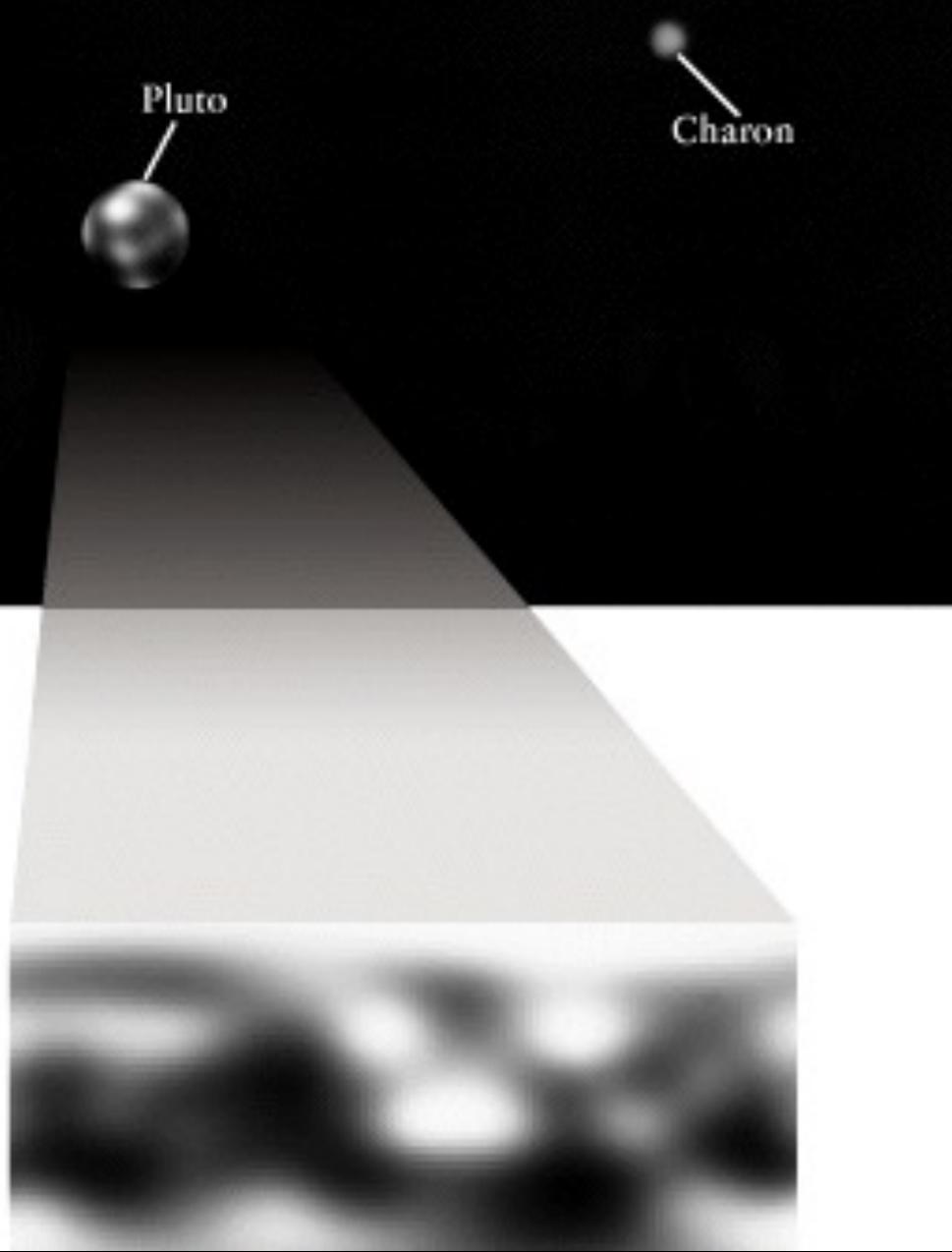
Tethys  
1059 km      Earth  
12,756.28 km

Diameters of the Terrestrial Bodies  
of the Solar System

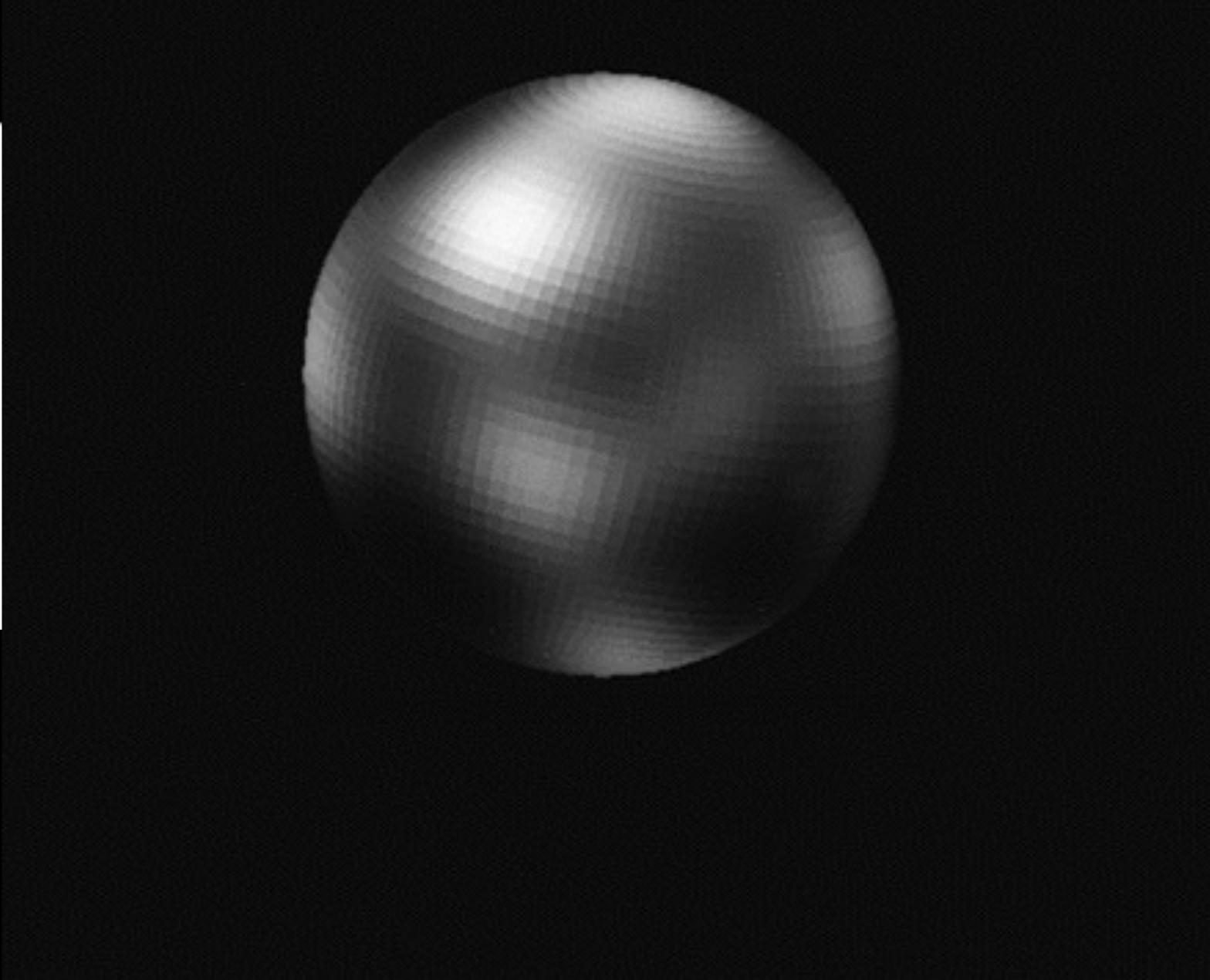
And then, there  
is one planet  
unlike any of the  
others .....

Clyde Tombaugh discovered Pluto in 1930 by comparing photographs taken a few days apart.





Pluto and its moon, Charon,  
are about the same size



# PLANET “X”!!!

- In 2005, after a search of about half of the sky and the discovery of dozens of objects almost the size of Pluto, we found 2003 UB313, the first object larger than Pluto and the largest object found in the solar system since 1848.

# Vagabonds of the Solar System





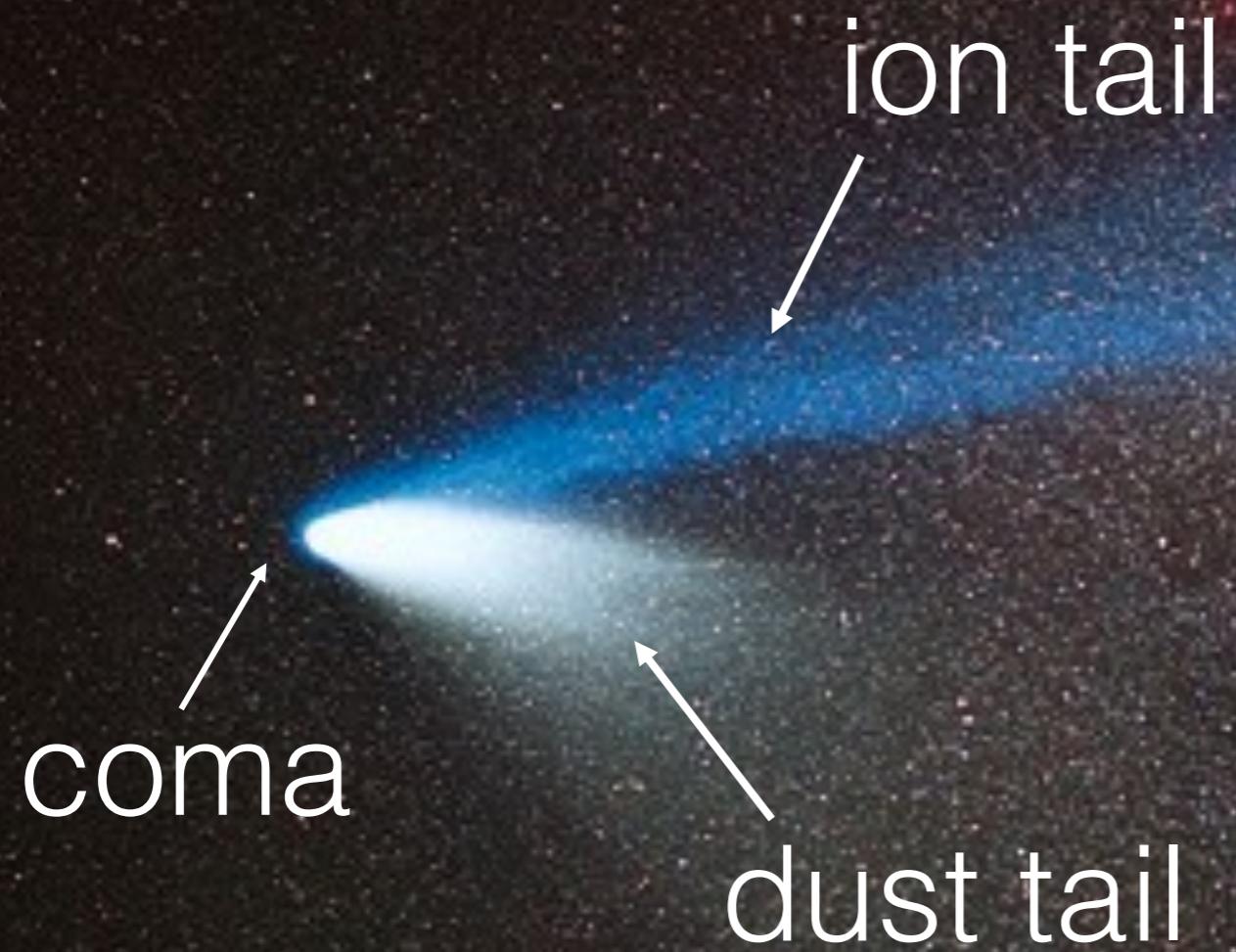
Comet Kohoutek

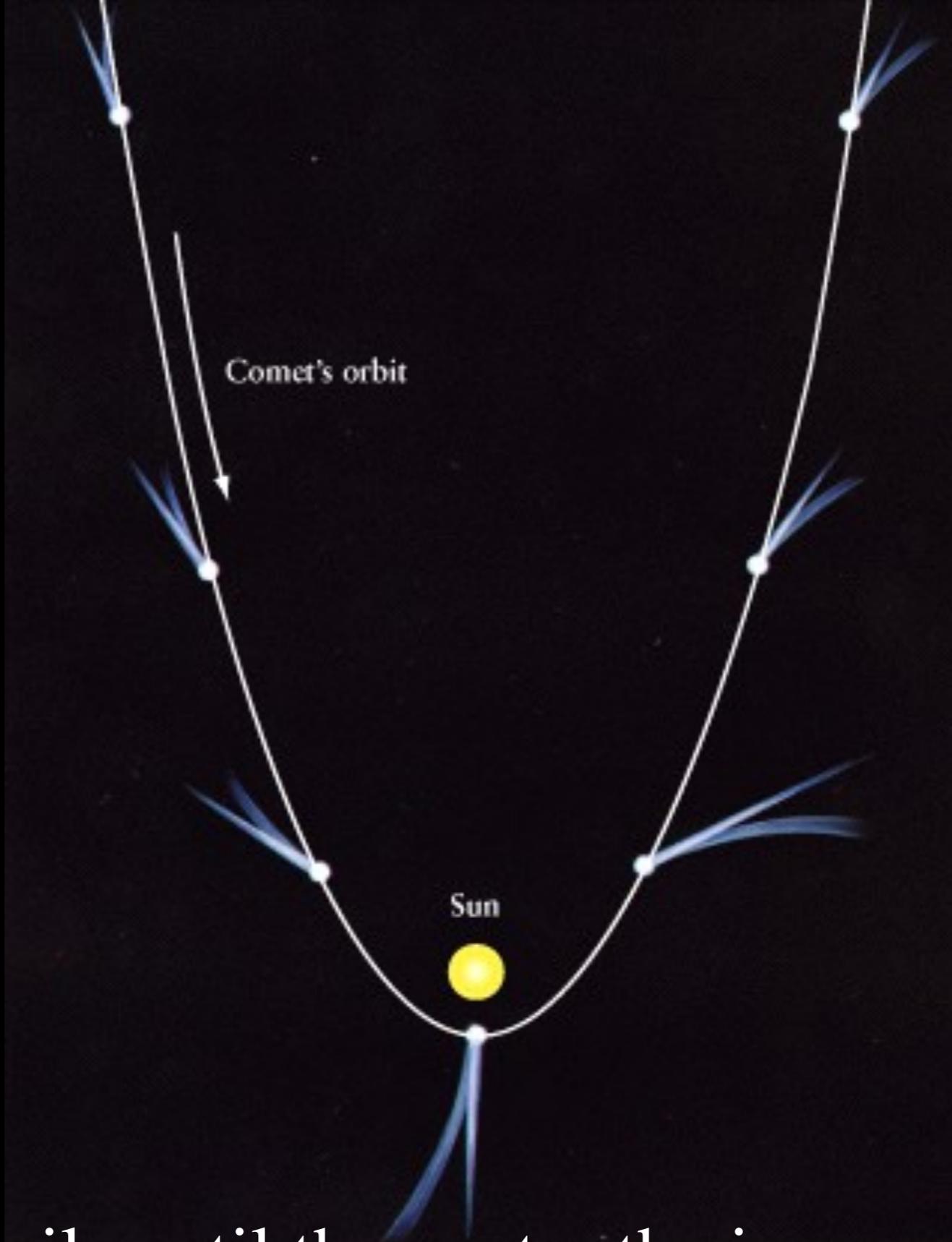


Comets have two tails

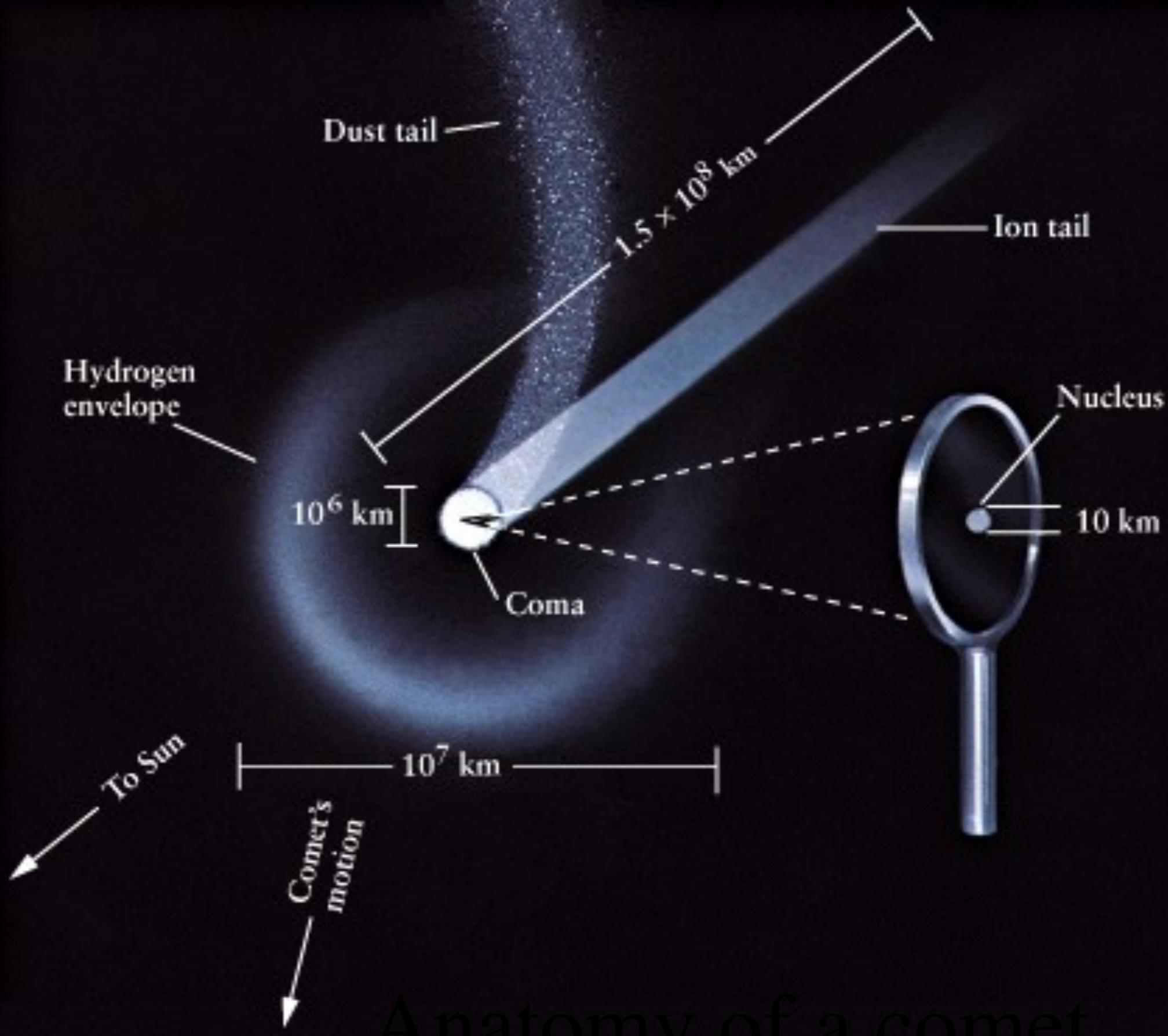


# The anatomy of a comet





Comets lack tails until they enter the inner solar system. A comet's tails always point away from the Sun, no matter which way the comet is moving!





Meteor showers occur when Earth passes through the dusty tail debris left by a passing comet. Dust particles burn up as they enter Earth's atmosphere, like bright light shooting from a single point in the sky.