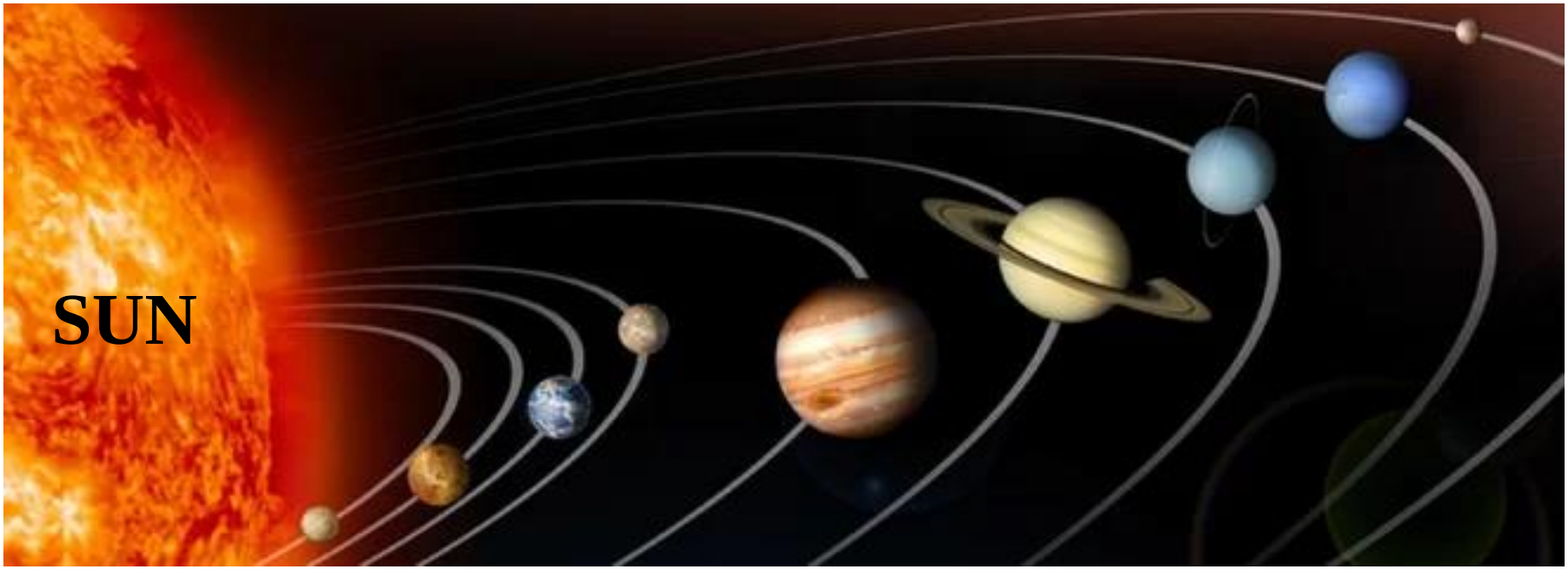
Lesson 07

Part 1

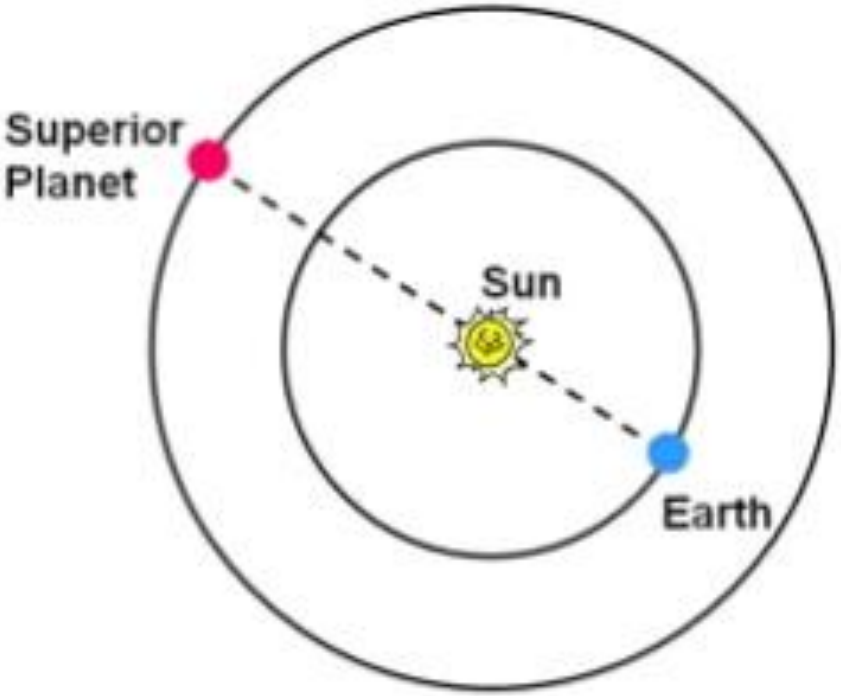
Mercury

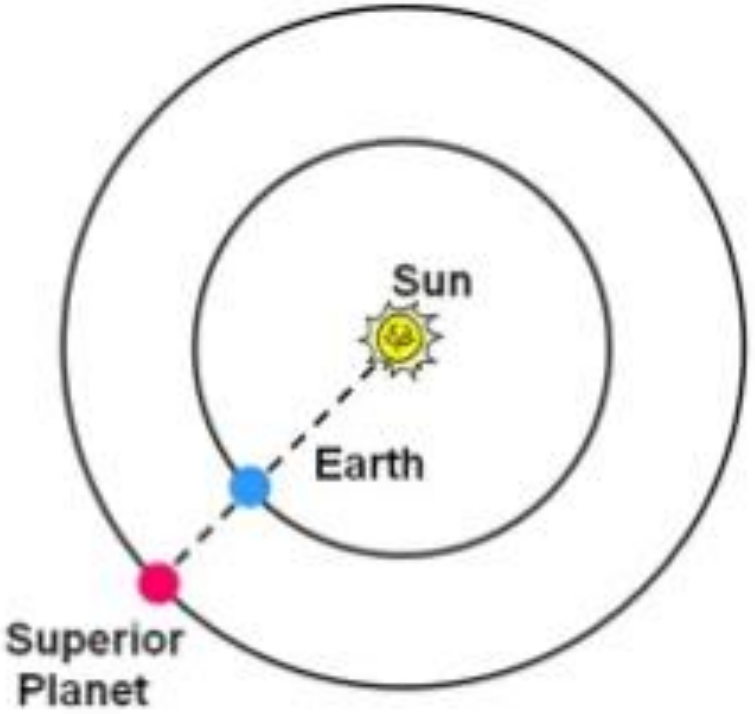
4 **Terrestrial planets**
(small inner planets)

4 **Jovian planets**
(large outer planets)



Additional bodies in the solar system: Moons, comets, asteroids, dwarf planets, and dust.



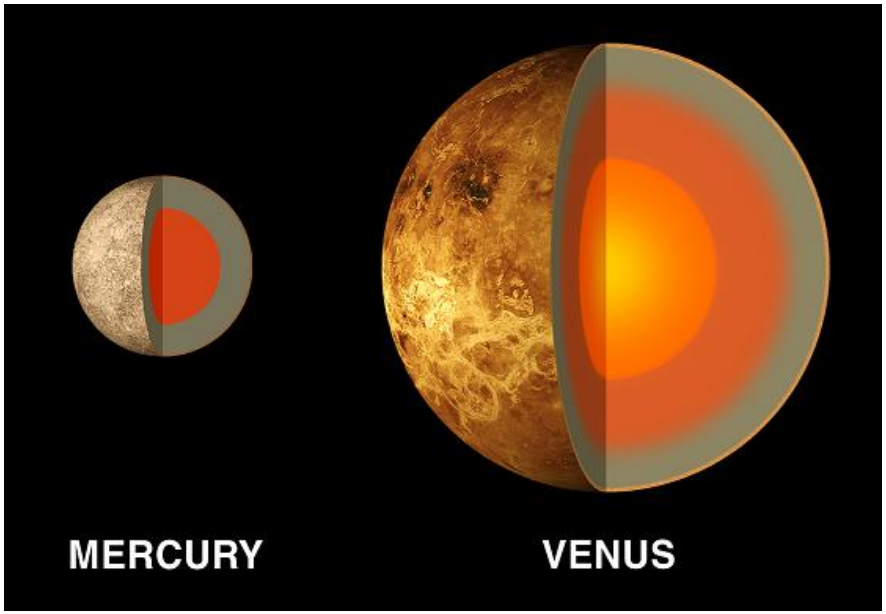


Mercury and Venus are **inferior planets**. **Inferior planets** have orbits that are closer to the Sun than Earth's orbit. The other planets and Pluto are **superior planets**. **Superior planets** have orbits that are farther from the Sun than Earth's orbit.

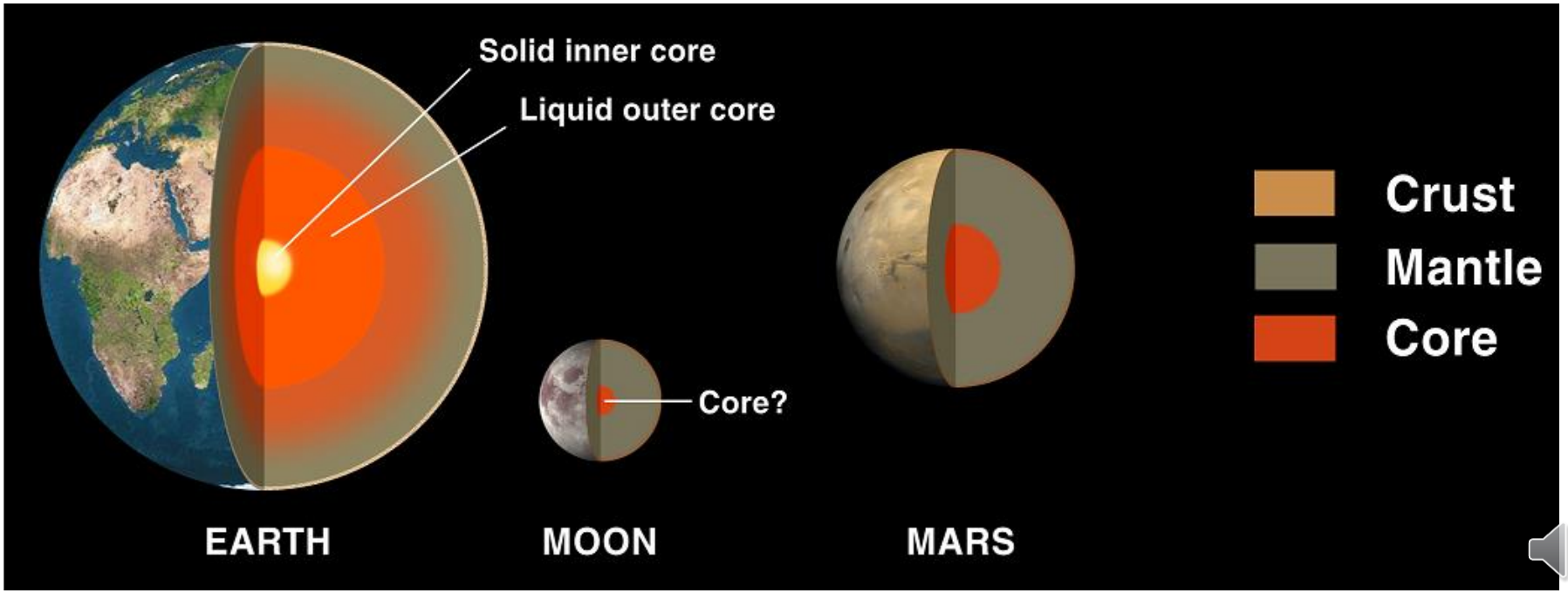
Terrestrial Planets: "Earth-like"

Mercury, Venus, Earth & Mars

- Small in size.
- Inner solar system. Orbit closest to the Sun.
- Made of rock and metal.



Terrestrial Planets have a thin rocky crust, a thicker denser mantle made of rock, and an iron & nickel core. The thicknesses and depths of their mantles and cores vary.

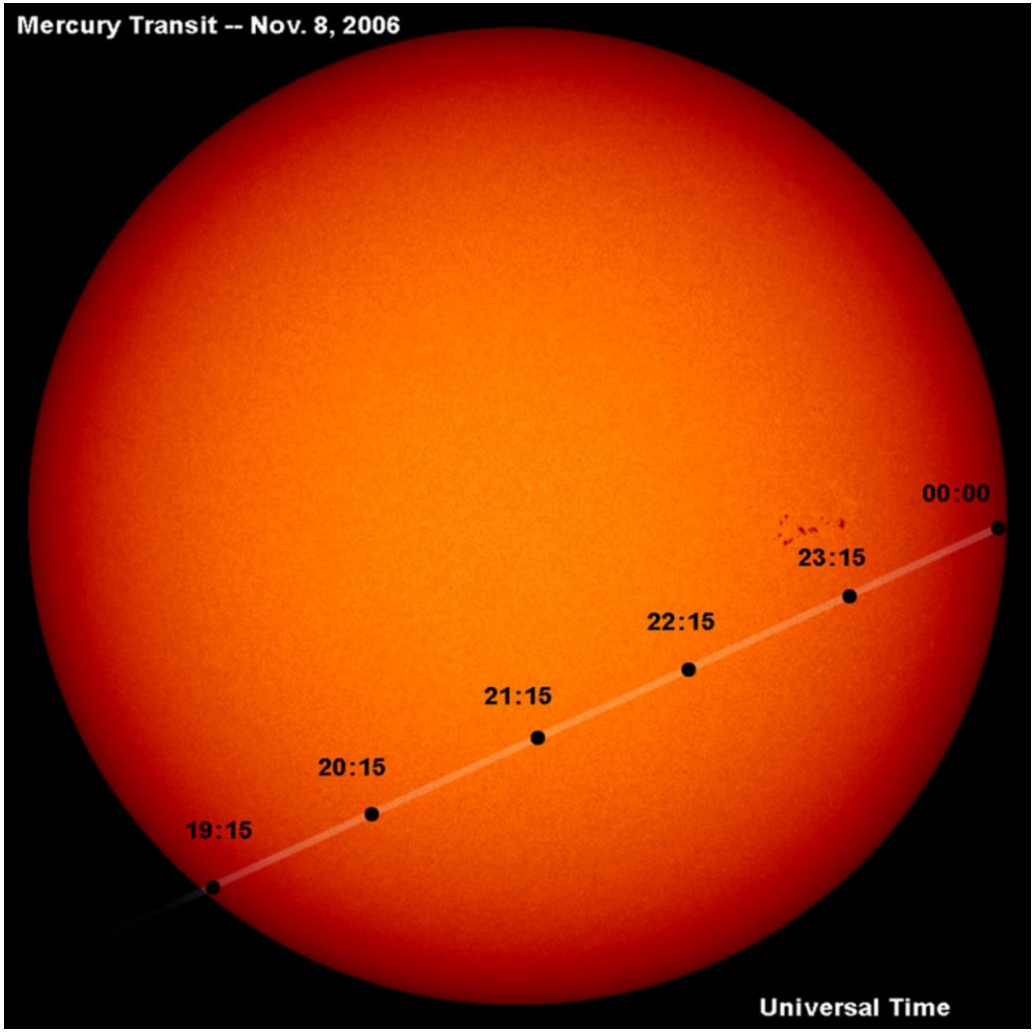


	Atmosphere Composition	Atmosphere Pressure (Atmo)	Avg. Surface Temperature
Mercury	None	None	430ºC Day -180º Night
Venus	96% CO_2 4%N_2 H_2SO_4 clouds	90	460ºC
Earth	78% N_2 21% O_2 H_2O clouds	1.0	15-20ºC
Mars	95% CO_2 3% N_2 H_2O, CO_2 clouds	0.007	-70ºC

MERCURY

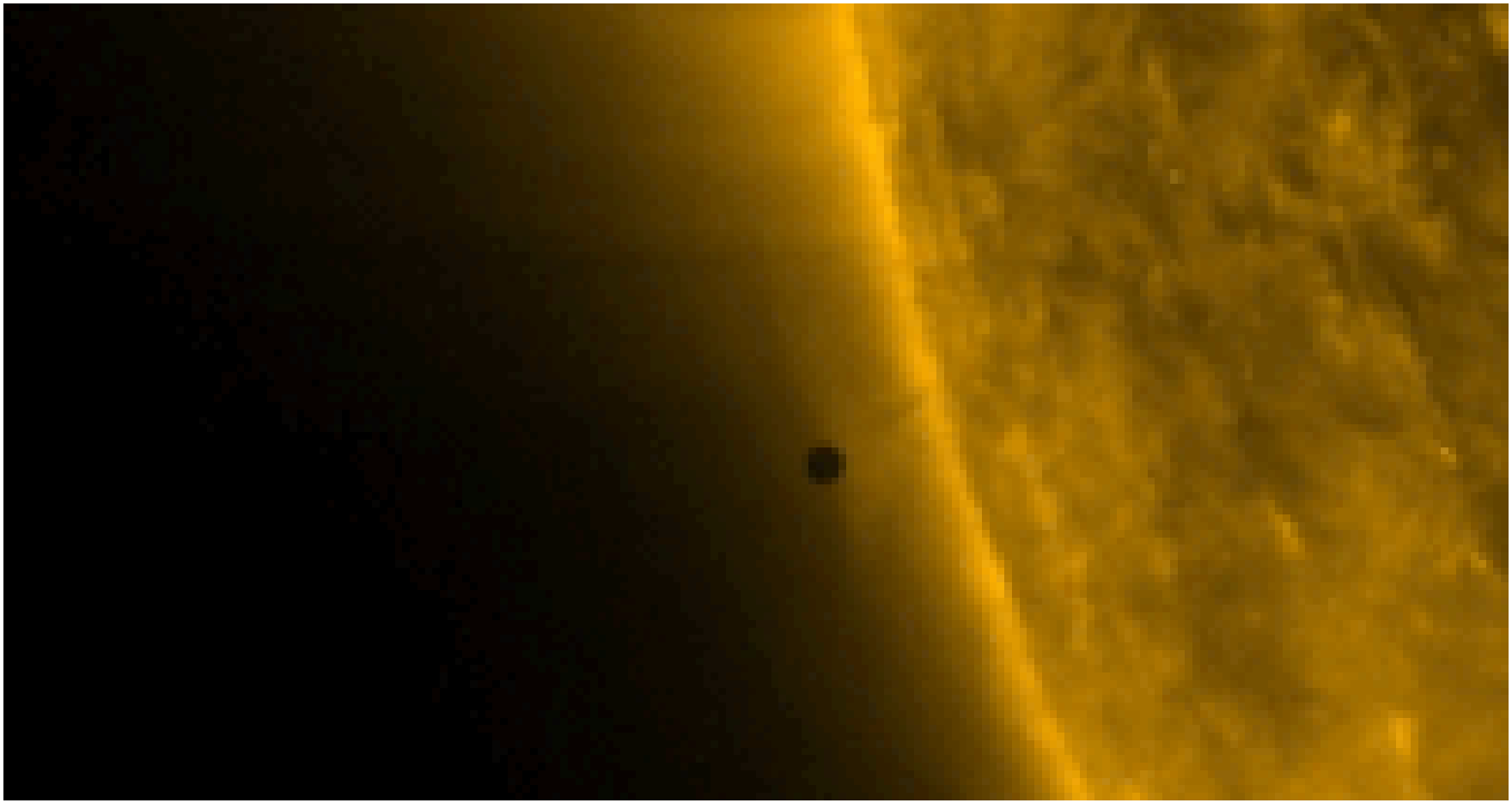
- Equatorial diameter = 4880 km
- Planetary mass = 3.30×10^{23} kg
- Bulk density = 5.43 g/cm^3
- Mean orbital radius = 5.79×10^7 km (0.39 AU)
- Orbital period = 88.0 days (0.24 yrs)
- Rotational period = 58.7 days
- Axial tilt = 0.1º (almost upright)
- No moons
- Atmosphere composition: None.

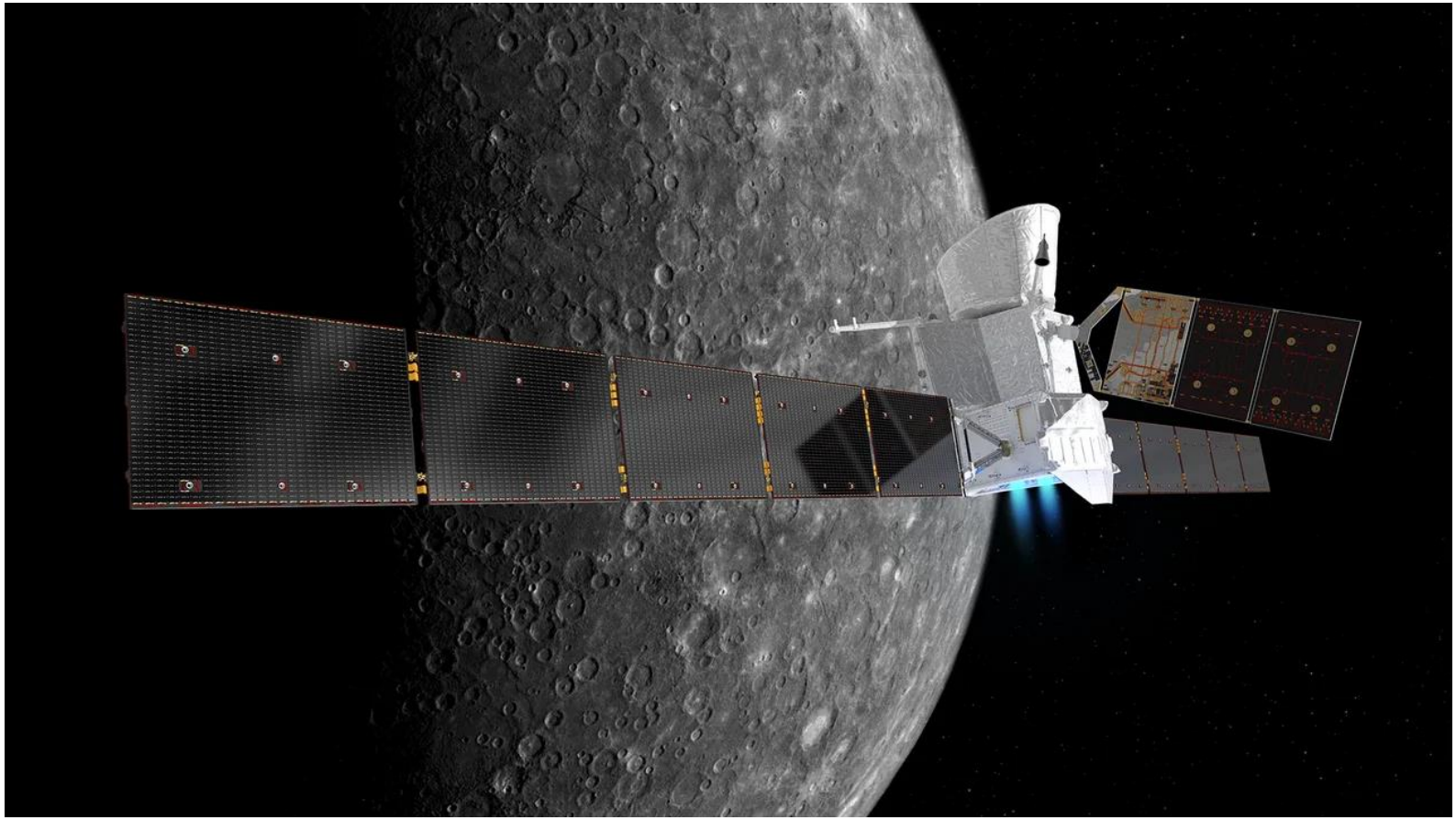
Imaging and photographing Mercury's surface by satellite, and observing Mercury from Earth, are very difficult because of Mercury's close orbit to the Sun.



Time lapse of Mercury in its orbit making transit in front of the Sun.

NASA viewed and recorded the transit of Mercury across the backdrop of the Sun. The corona and chromosphere of the Sun is clearly visible from the edge of the Sun.



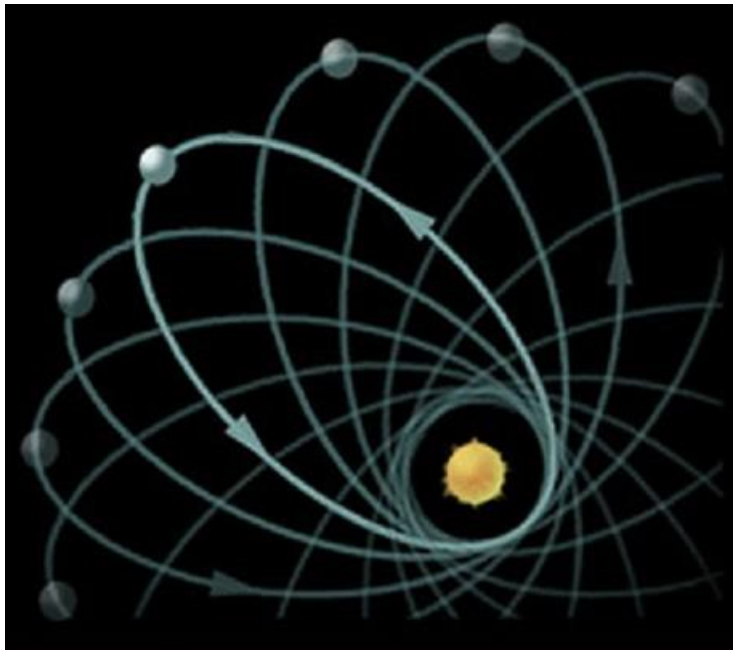


To photograph and image the surface of Mercury, satellites must be between Mercury and the Sun, facing away from the Sun. Mercury also rotates very slowly, so it takes 29 days for the daytime and nighttime sides of Mercury to change positions.

Mercury's orbit is the most elliptical of the 8 planets

- Perihelion = 46,000,000 km
- Aphelion = 70,000,000 km

(diagram is exaggerated)



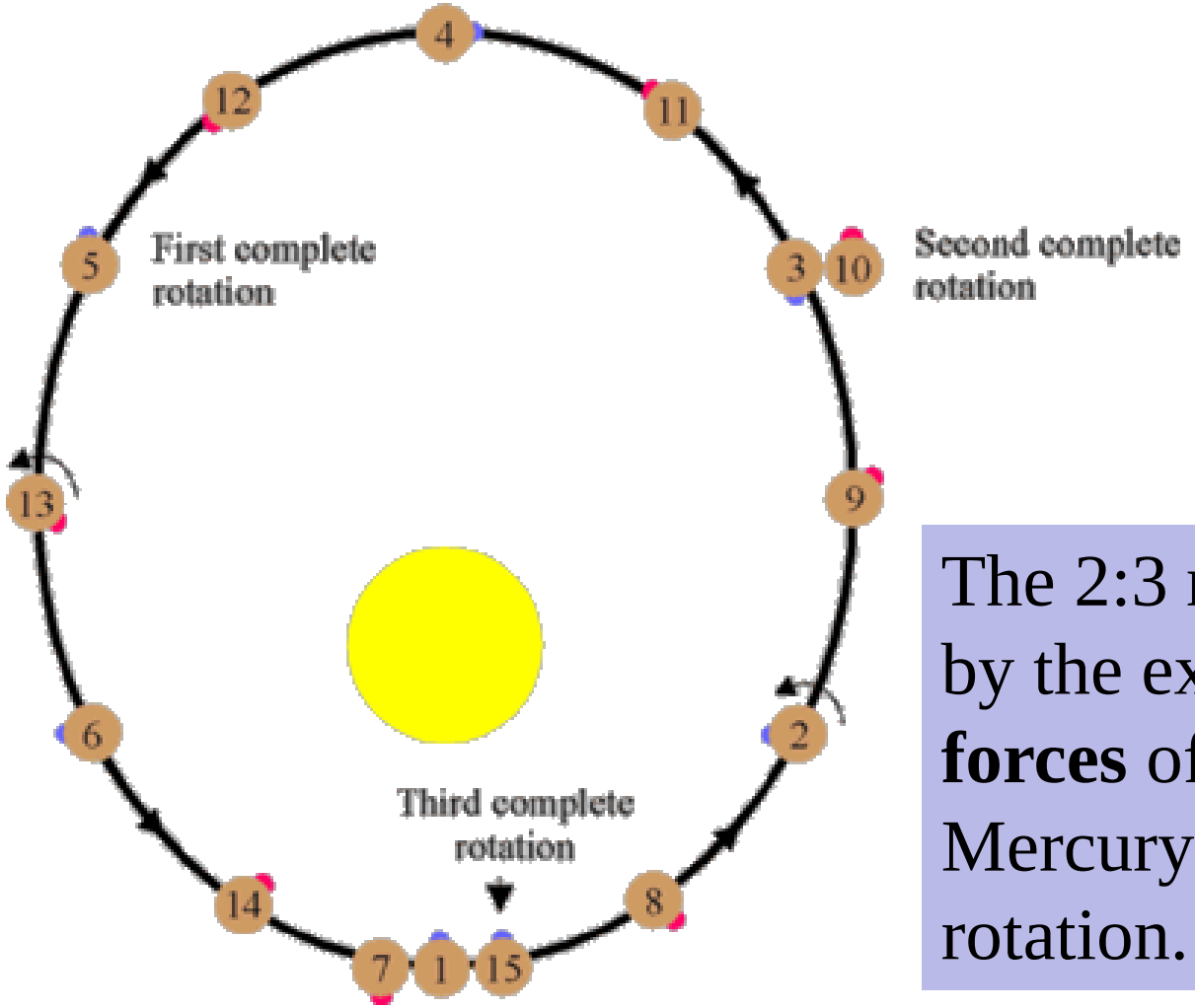
Mercury's orbit is slowly **processing**, or changing orientation. Over time, Mercury's orbit migrates around the Sun in a complete cloverleaf pattern every 23,000 years.

Mercury's day-night cycle (rotation period) is very, very slow at 59 Earth days.

- Each side of Mercury will have 29 consecutive days of daytime and 29 consecutive hours of nighttime.
- There is no atmosphere to regulate or distribute heat at Mercury's surface.
- Average **day side temperature** = 430º C
- Average **night side temperature** = -180º C

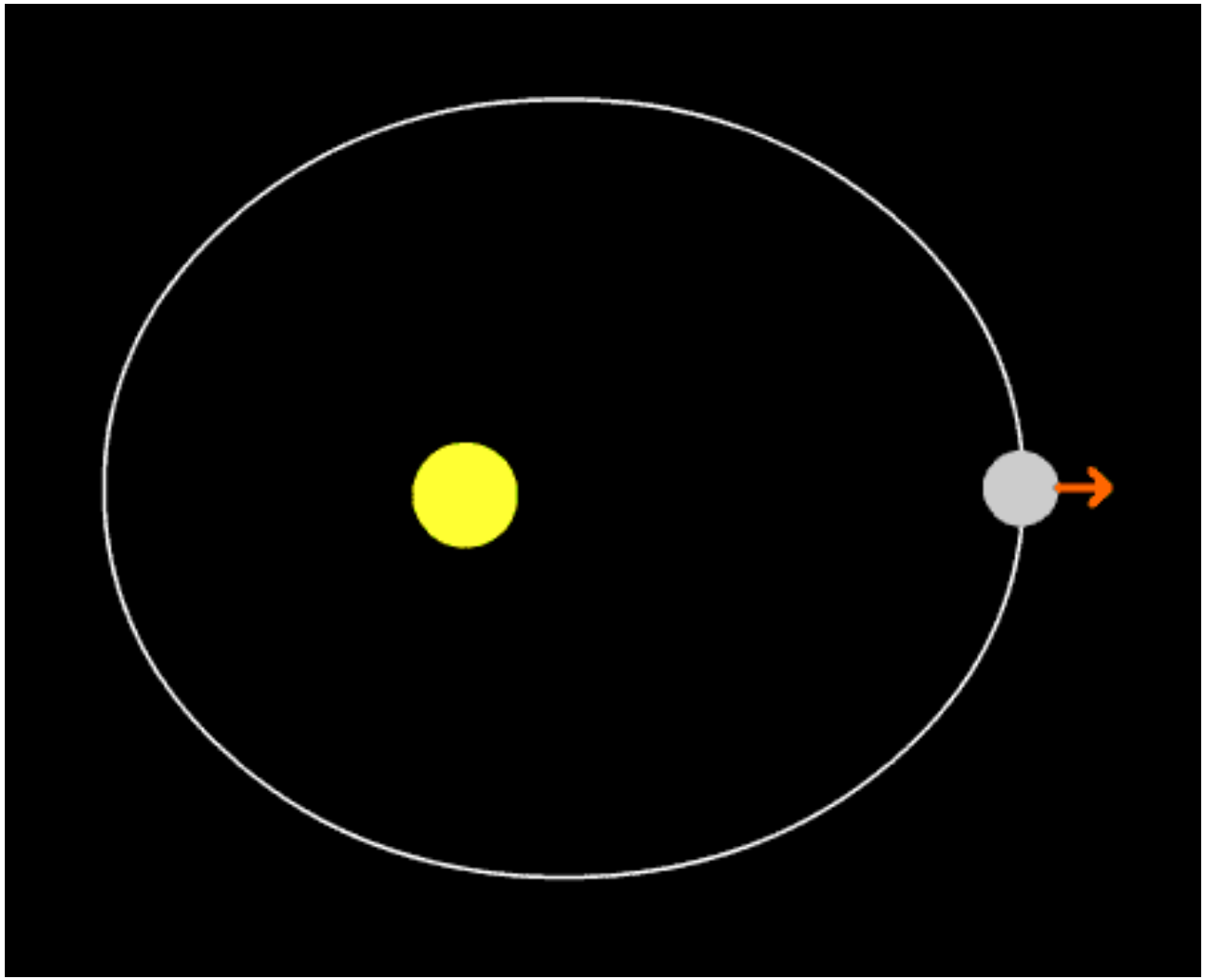
Mercury's year (orbit period) is 88 Earth days. It orbits the sun very fast because it is very close to the Sun.

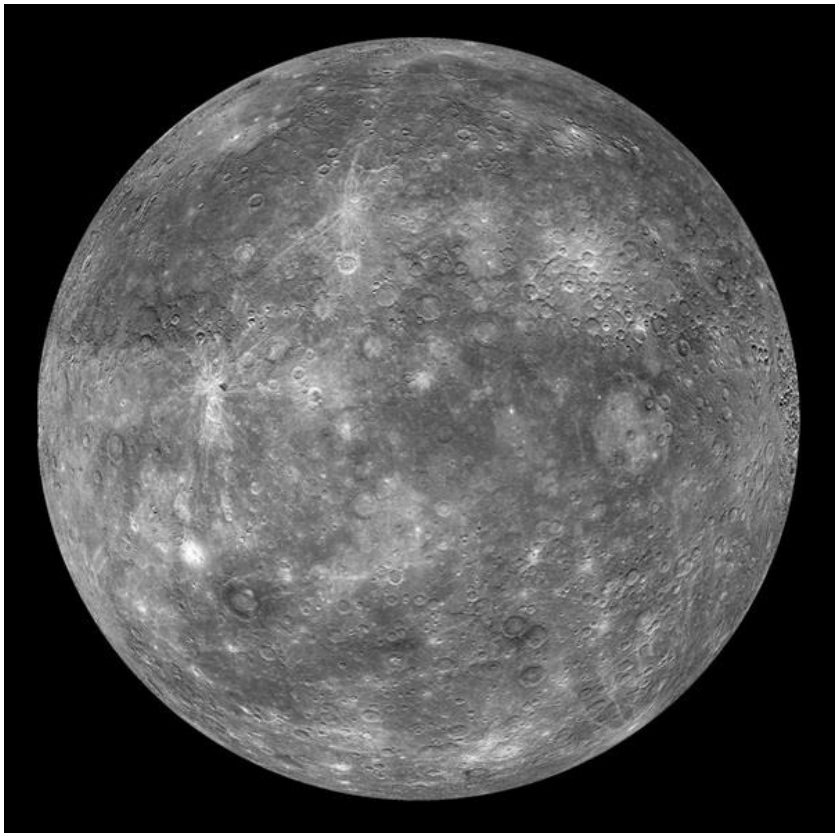
Mercury's orbital period (year) and its rotation period (day-night cycle) are in a **2:3 resonance**. Mercury has exactly 3 rotations for every 2 orbits around the Sun.



The 2:3 resonance is caused by the extremely strong **tidal forces** of the sun pulling on Mercury and slowing its rotation.

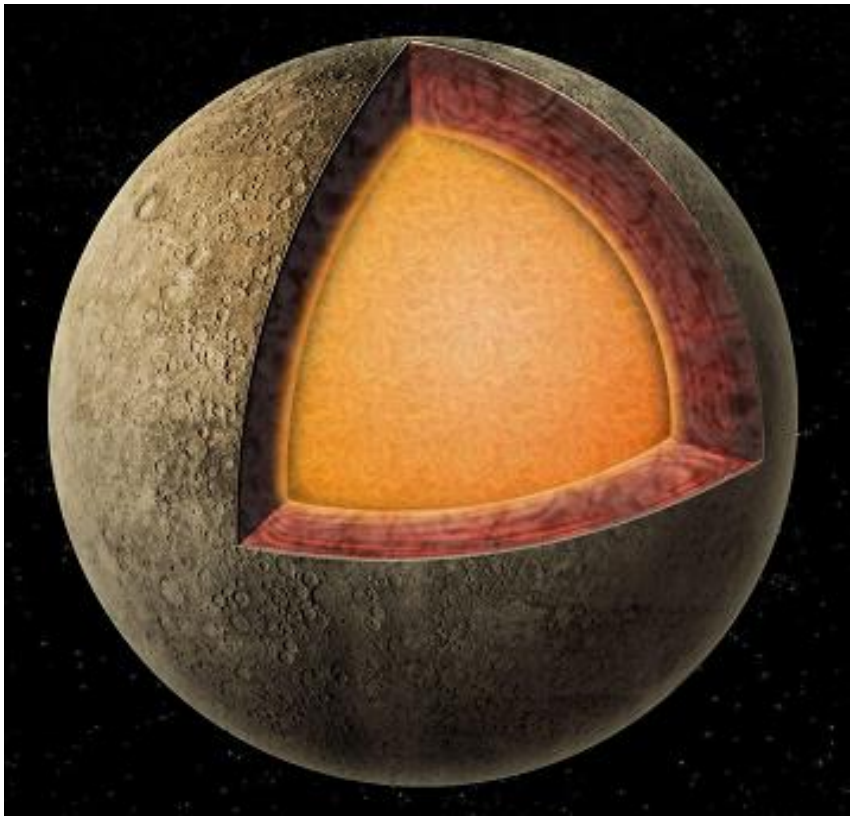
Animation of Mercury's **2:3 resonance**. Mercury has exactly 3 rotations for every 2 orbits around the Sun. The arrow is added for direction reference.





Mercury has no atmosphere because its small size cannot make enough gravity to hold an atmosphere close to its surface. Gases will diffuse into space easily.

Mercury is very, very close to the Sun. The extreme heating of the daytime sky and solar wind would strip any atmosphere away in thousands of years.

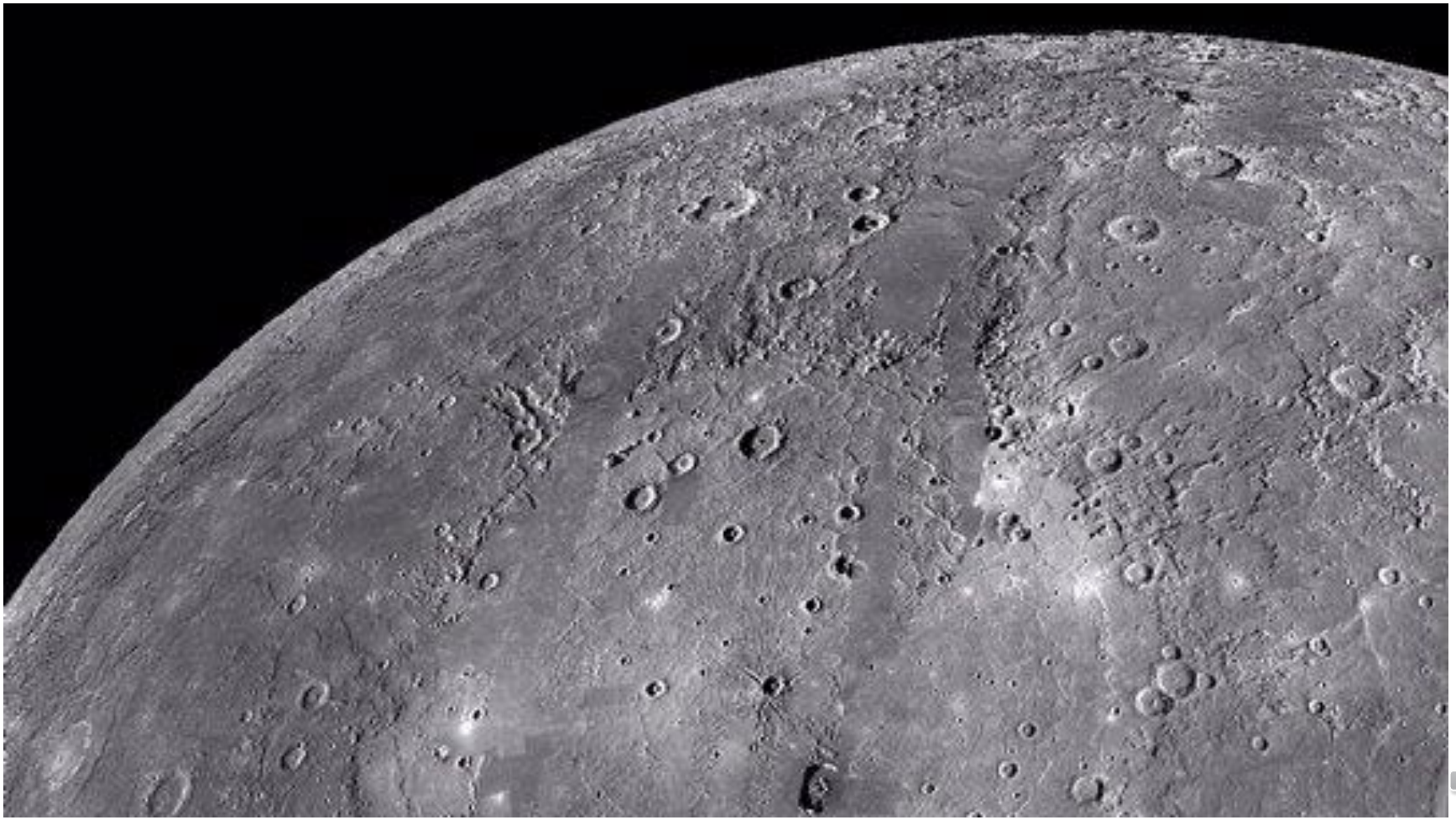


Mercury's iron & nickel core occupies ~70% of Mercury's volume, with a much thinner mantle and very thin crust compared to Earth's structure.

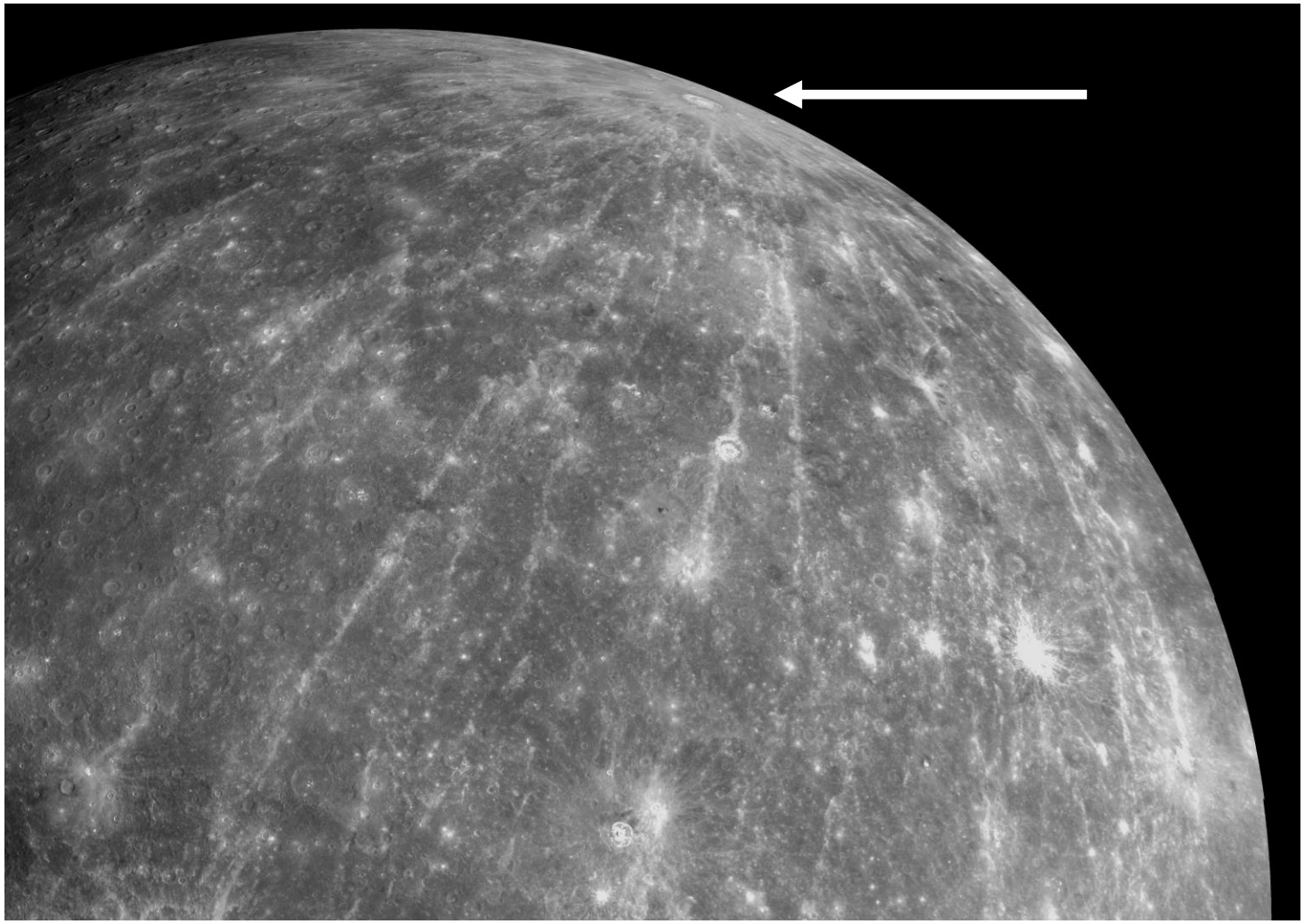
Mercury's core has most likely solidified to a solid sphere (no molten outer core).

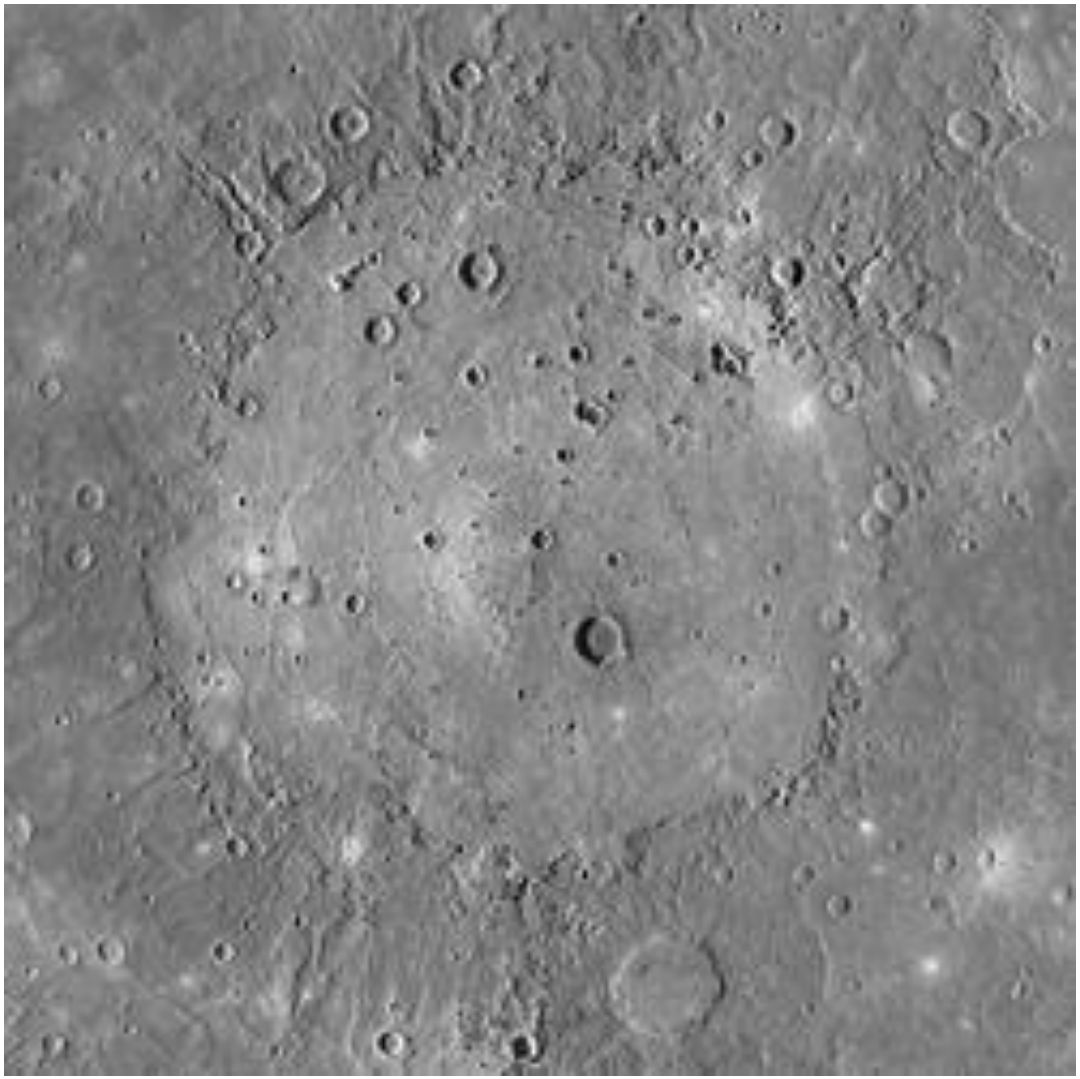
Mercury's interior cooled very quickly, probably in the first 1-2 billion years after its formation. Mercury is so small it could not keep heat in its interior.

Mercury's crust is covered with 100's thousands of **impact craters** and **rays**. There is no indication of recent volcanic activity or plate tectonics. Mercury's surface and size closely resembles Earth's moon.

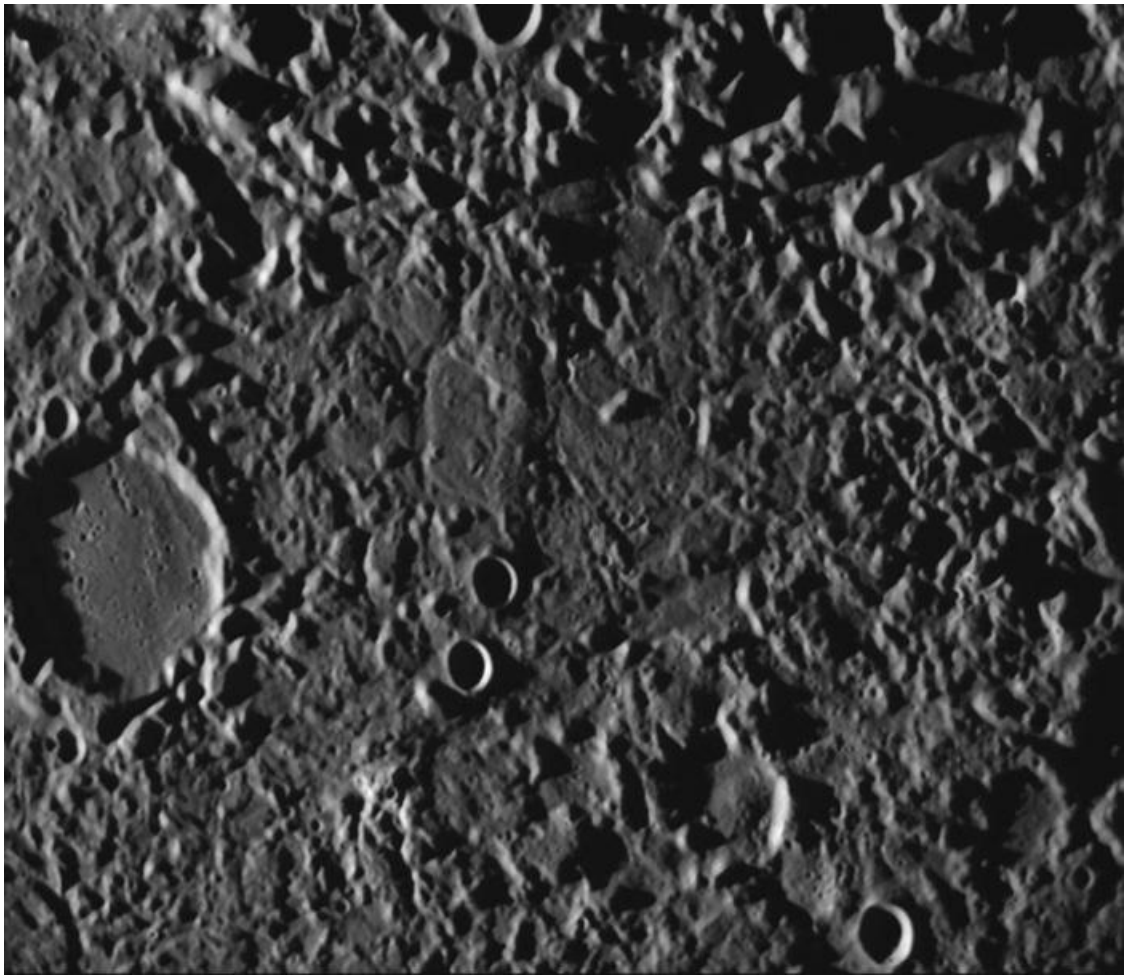


The large impact crater **Hokusai** has an extensive web of rays streaking thousands of km from the crater. The arrow points to the crater. The white linear streaks are the rays.





Caloris Basin is a 1500 km wide impact crater created when a ~100 km diameter asteroid collided with Mercury 3 three billion years ago. The inside of the Caloris Basin is a flat plain with very few asteroid impact craters. It was most likely filled with lava flows immediately after the impact.



Chaotic Terrain (“weird terrain) is an irregular landscape made of fractures, ripples, and irregular hills on the side of Mercury opposite the Caloris Basin.

The force of impact by the Caloris asteroid send shockwaves with astronomical force through Mercury’s interior to the other side of the planet. The forces of the shockwaves broke and crumpled the crust to form the Chaotic Terrain.

Formation of the Caloris Basin and Mercury's Chaotic Terrain.