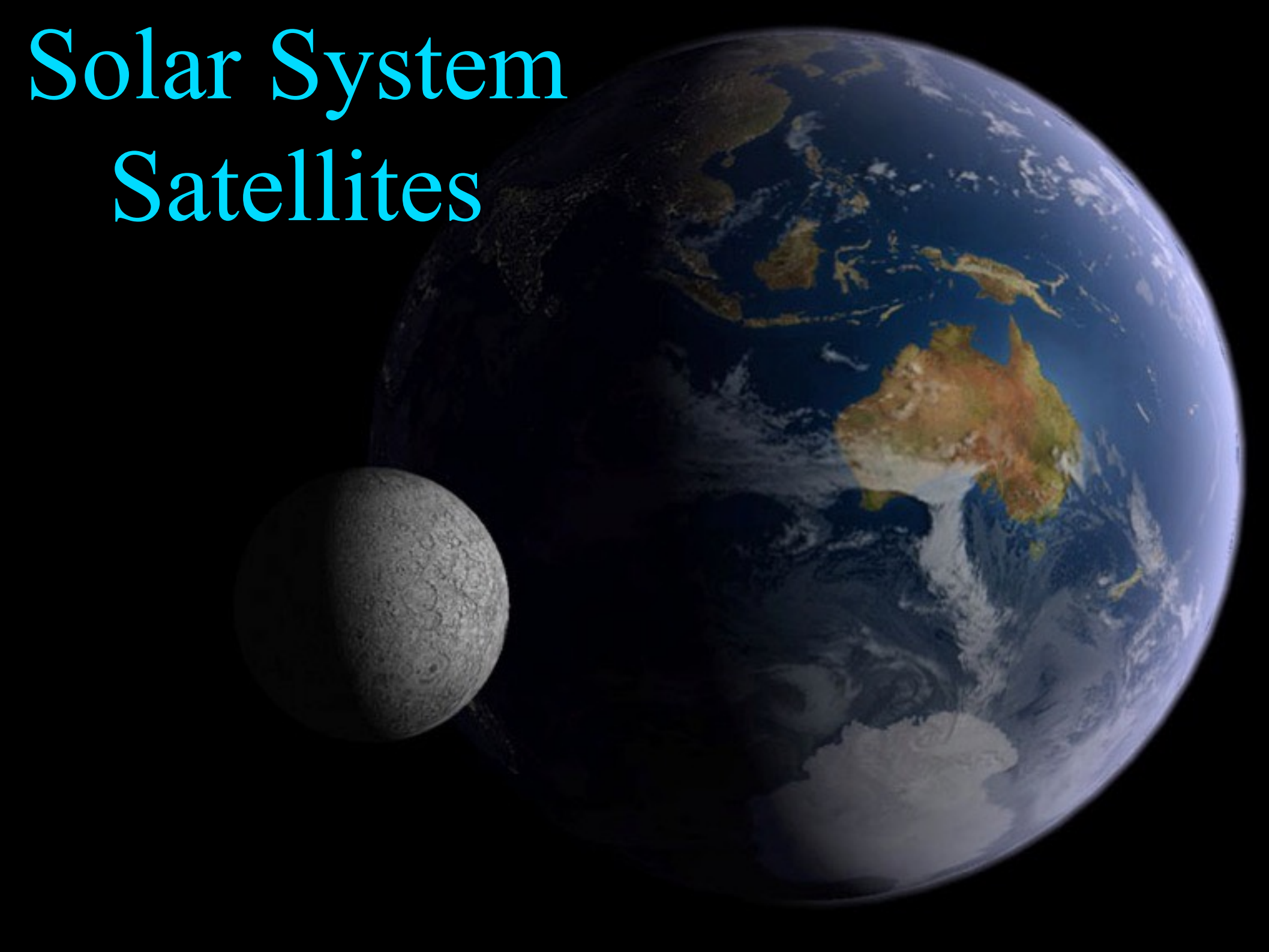
Solar System Satellites



Who can name the most moons?

Mercury:
Venus:
Earth:
Mars:
Jupiter:
Saturn:
Uranus:
Neptune:
Pluto:

Total:

Who can name the most moons?

Mercury: 0
Venus: 0
Earth: 1
Mars: 2
Jupiter: 28
Saturn: 30
Uranus: 21
Neptune: 8
Pluto: 1

Total: 91 (as of 2001)

Who can name the most moons?

Mercury: 0
Venus: 0
Earth: 1
Mars: 2
Jupiter: 60
Saturn: 31
Uranus: 22
Neptune: 11
Pluto: 1

Total: 128 (as of 2003)

Who can name the most moons?

Mercury: 0
Venus: 0
Earth: 1
Mars: 2
Jupiter: 67
Saturn: 62
Uranus: 27
Neptune: 14
Pluto: 5

Total: 178 (as of 2016)

Who can name the most moons?

Mercury: 0
Venus: 0
Earth: 1
Mars: 2
Jupiter: 79
Saturn: 82
Uranus: 27
Neptune: 14
Pluto: 5

Total: 220 (as of 2020)

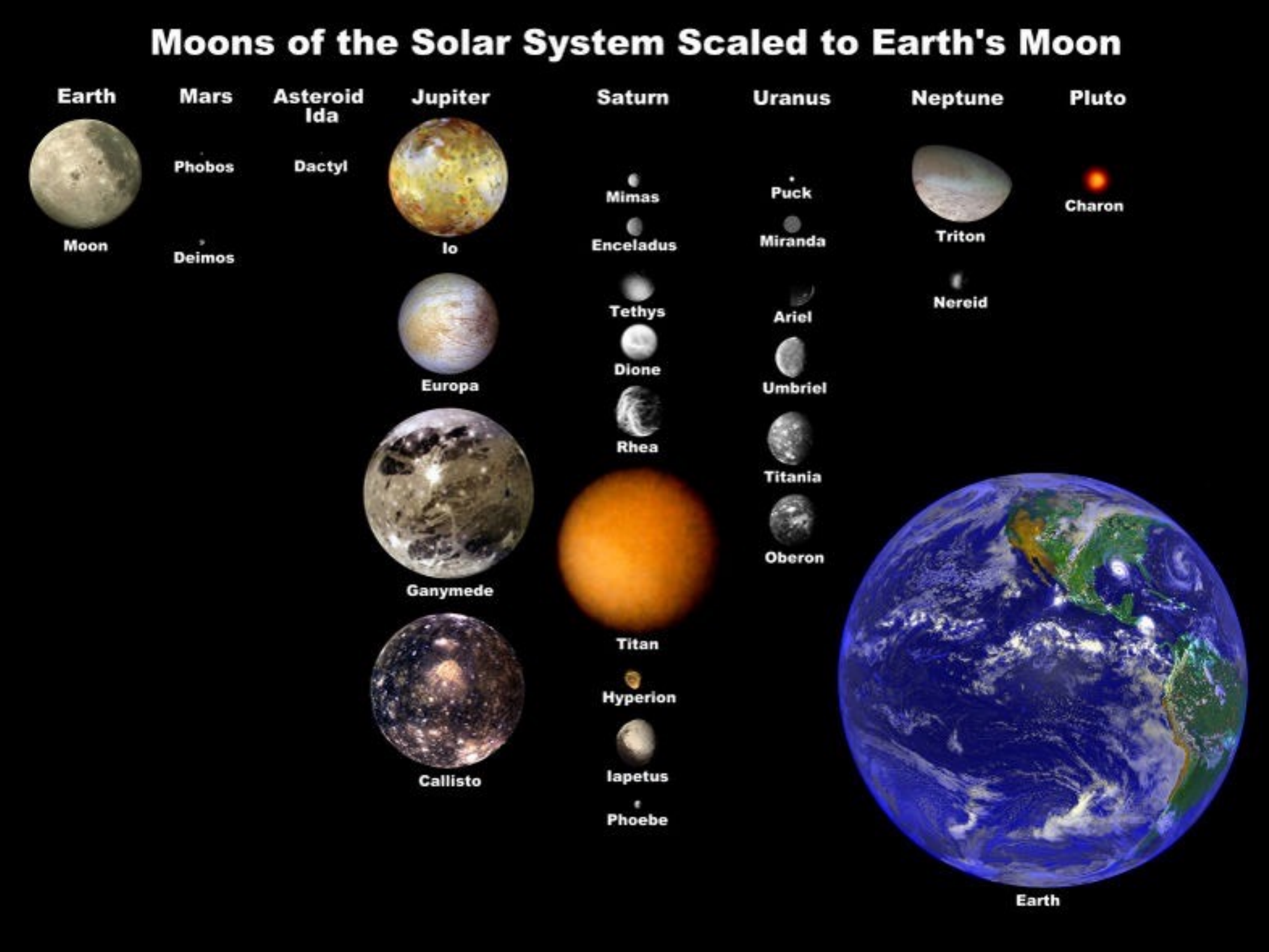
Who can name the most moons?

Mercury: 0
Venus: 0
Earth: 1
Mars: 2
Jupiter: 95
Saturn: 146
Uranus: 27
Neptune: 14
Pluto: 5

Total: 290 (as of 2023)

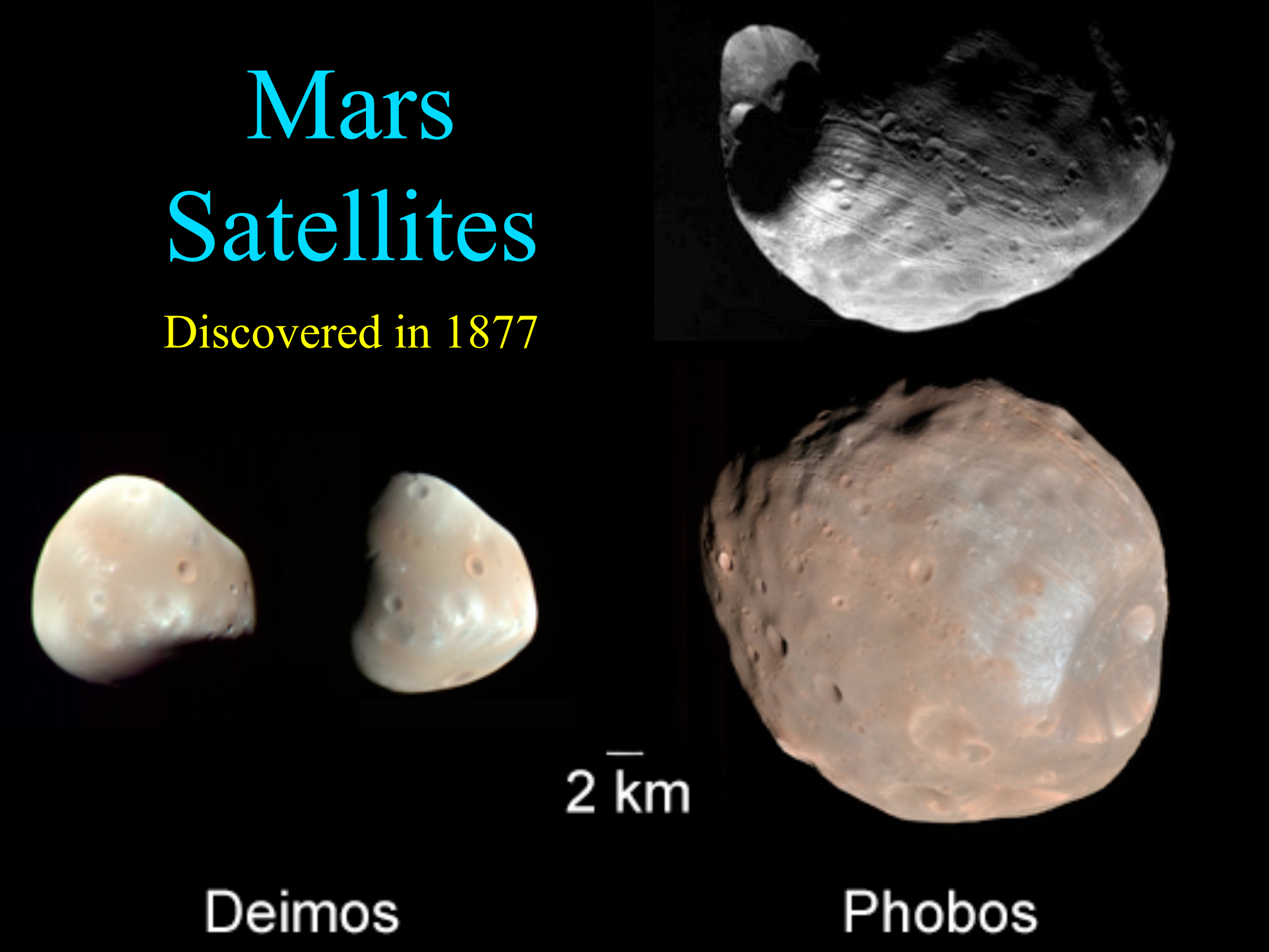
Largest Rocky and/or Icy Objects

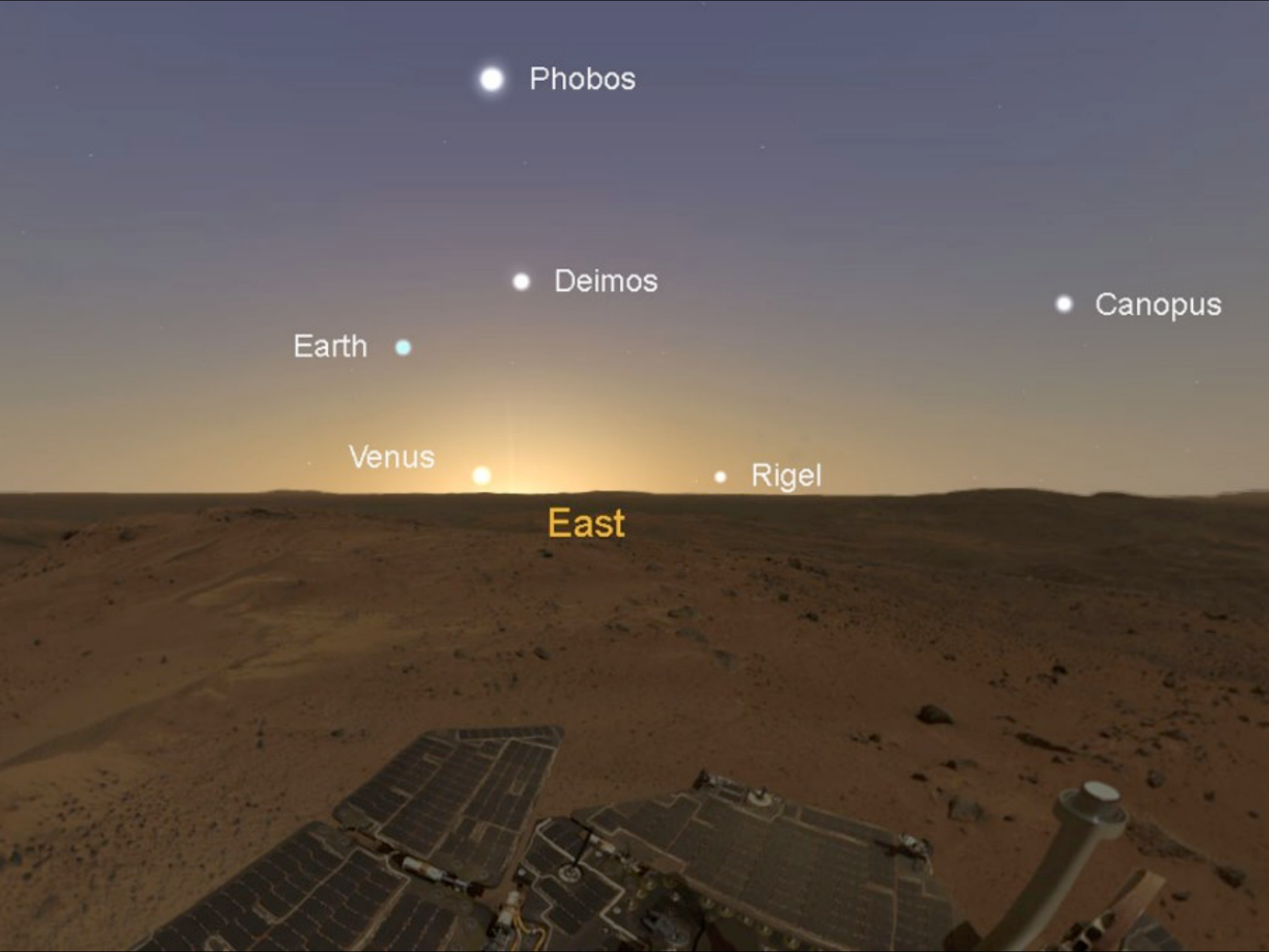
Moons of the Solar System Scaled to Earth's Moon



Mars Satellites

Discovered in 1877




Phobos
Deimos
Canopus
Earth
Venus
Rigel
East

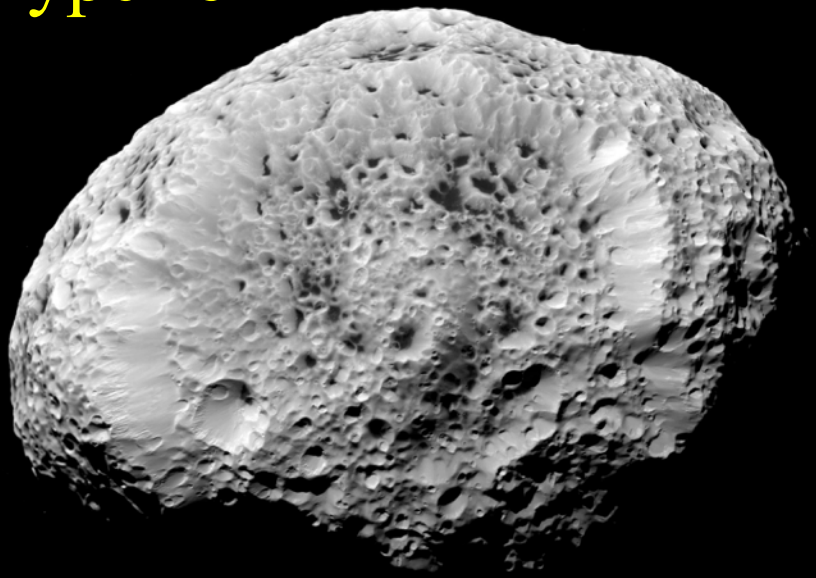
Solar Eclipse on Mars

Jupiter Satellites

Jupiter Satellites

Saturn Satellites

Hyperion

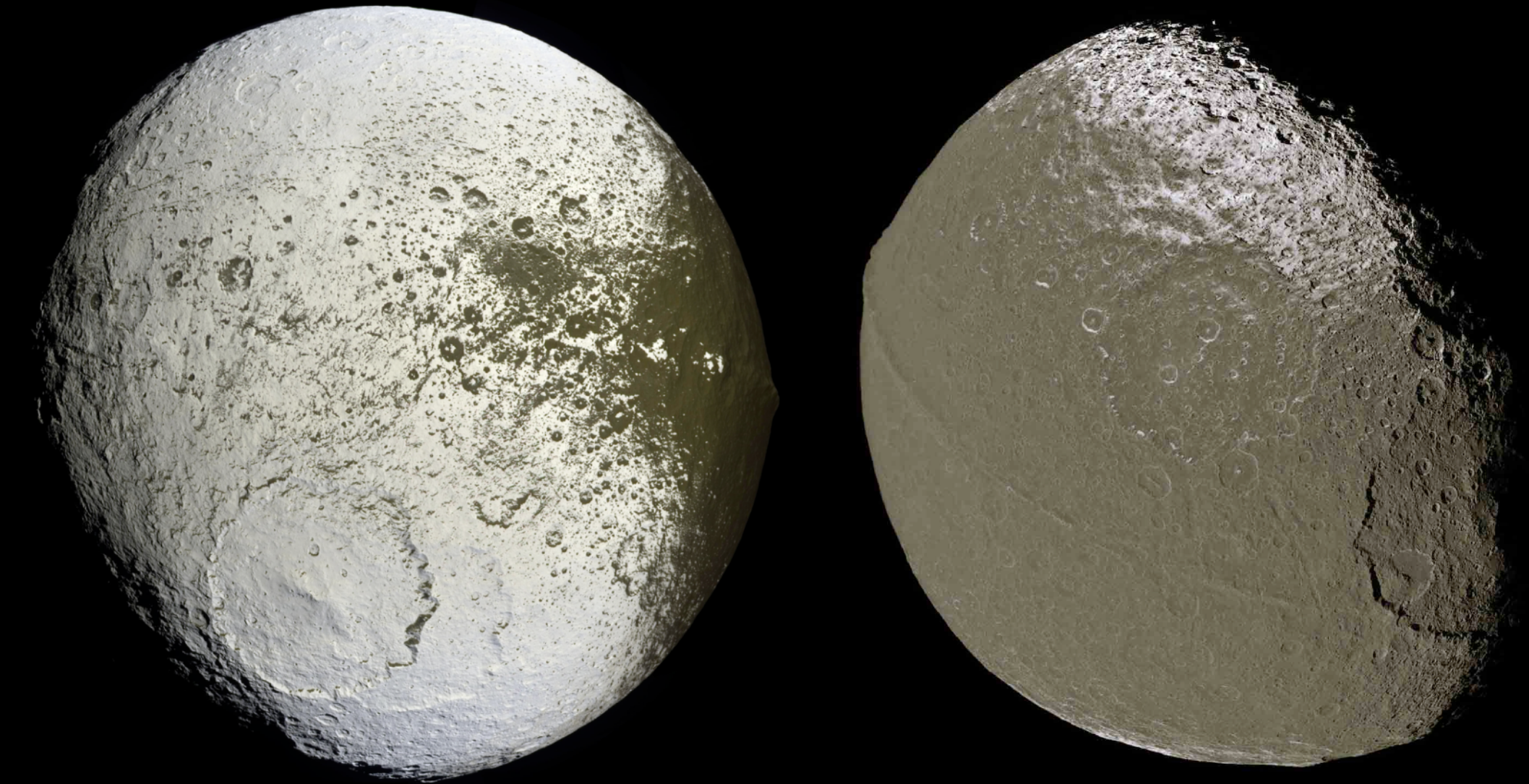


Titan

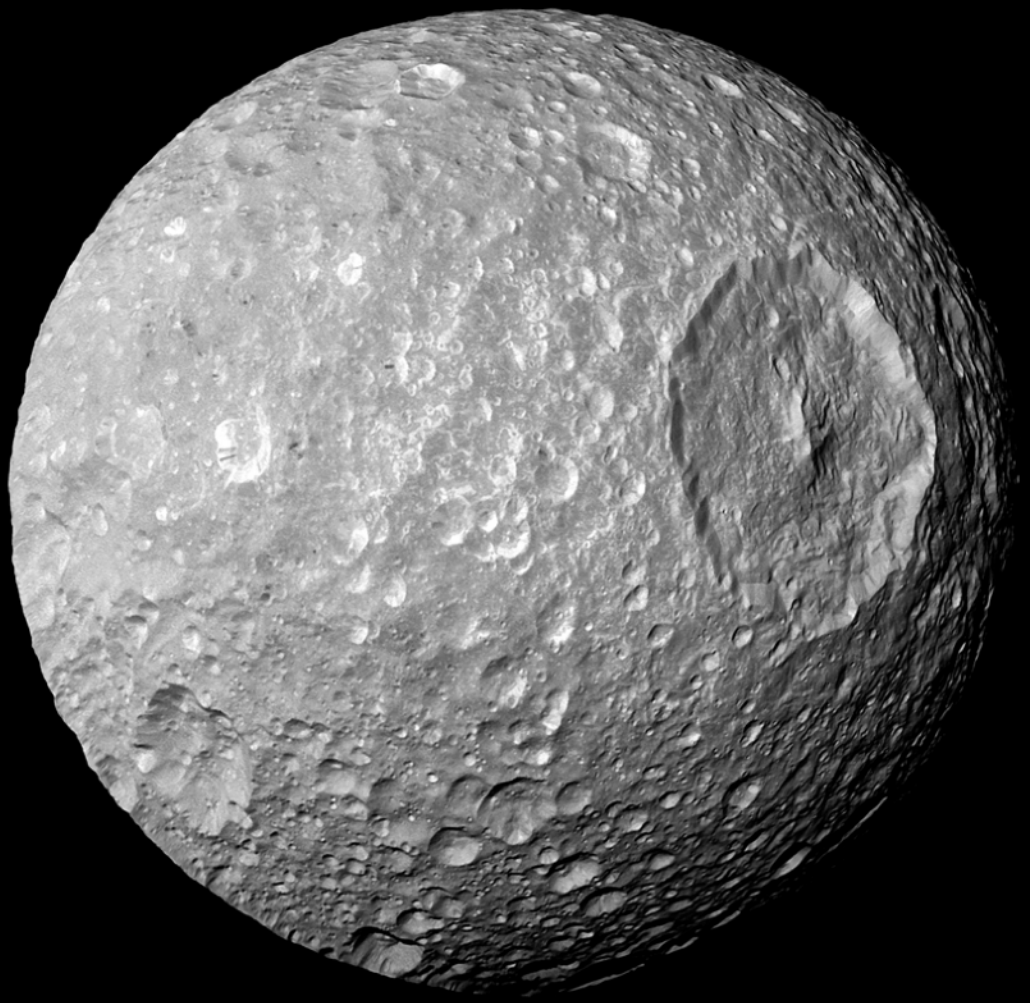
Prometheus

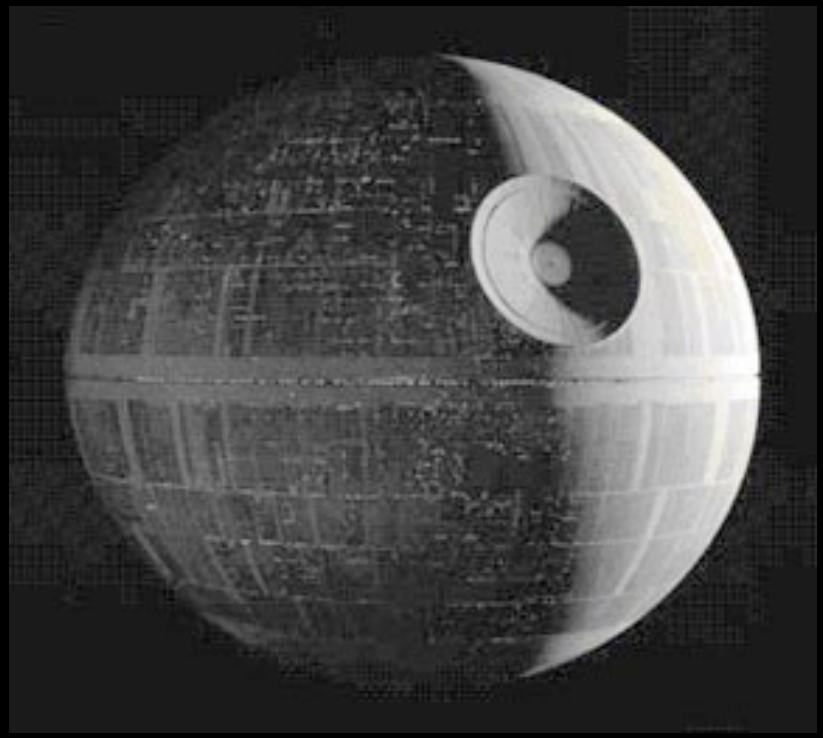
Enceladus

Saturn's Satellite Iapetus



Saturn's Satellite Mimas



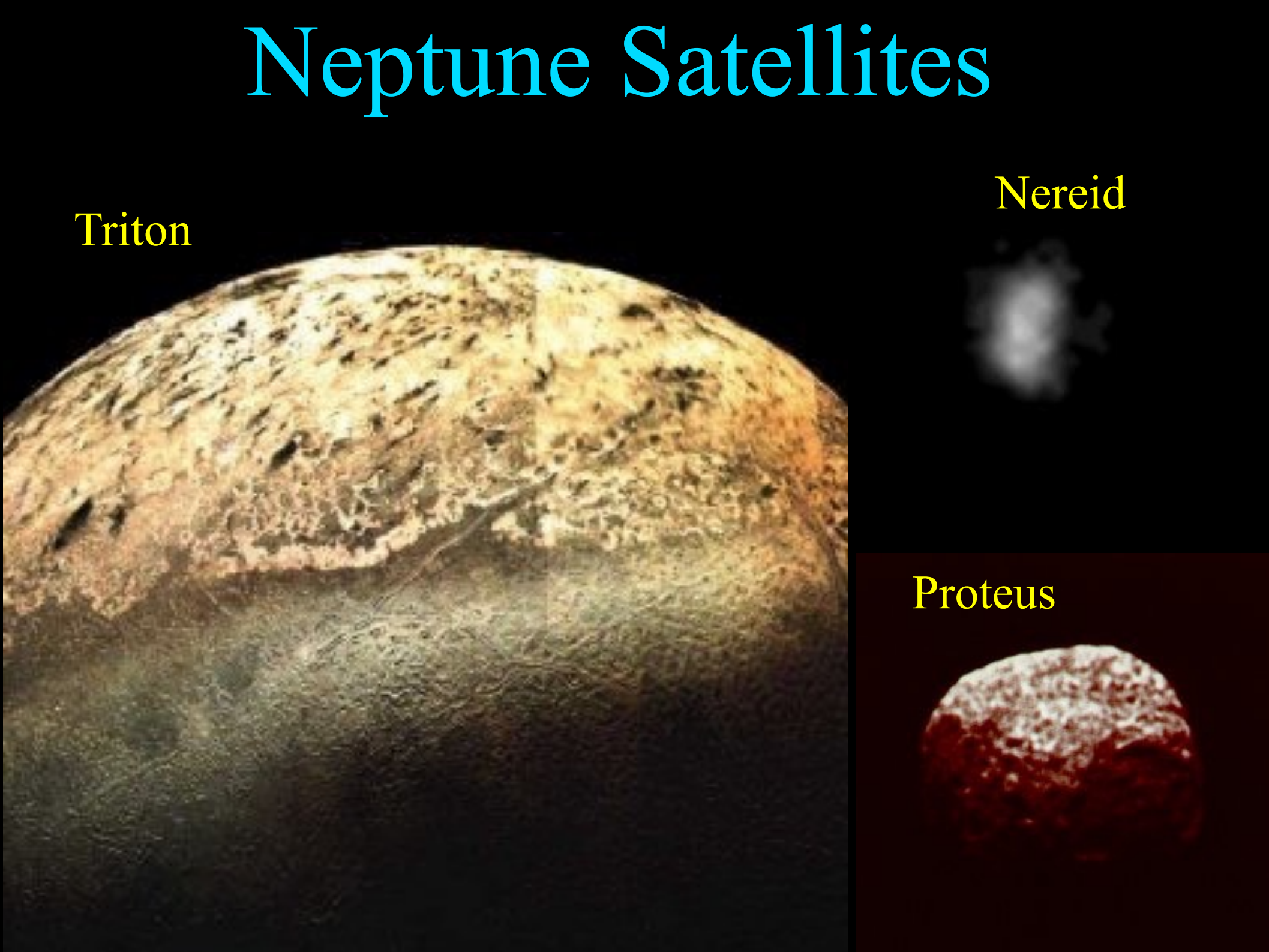


Saturn's Satellite Enceladus

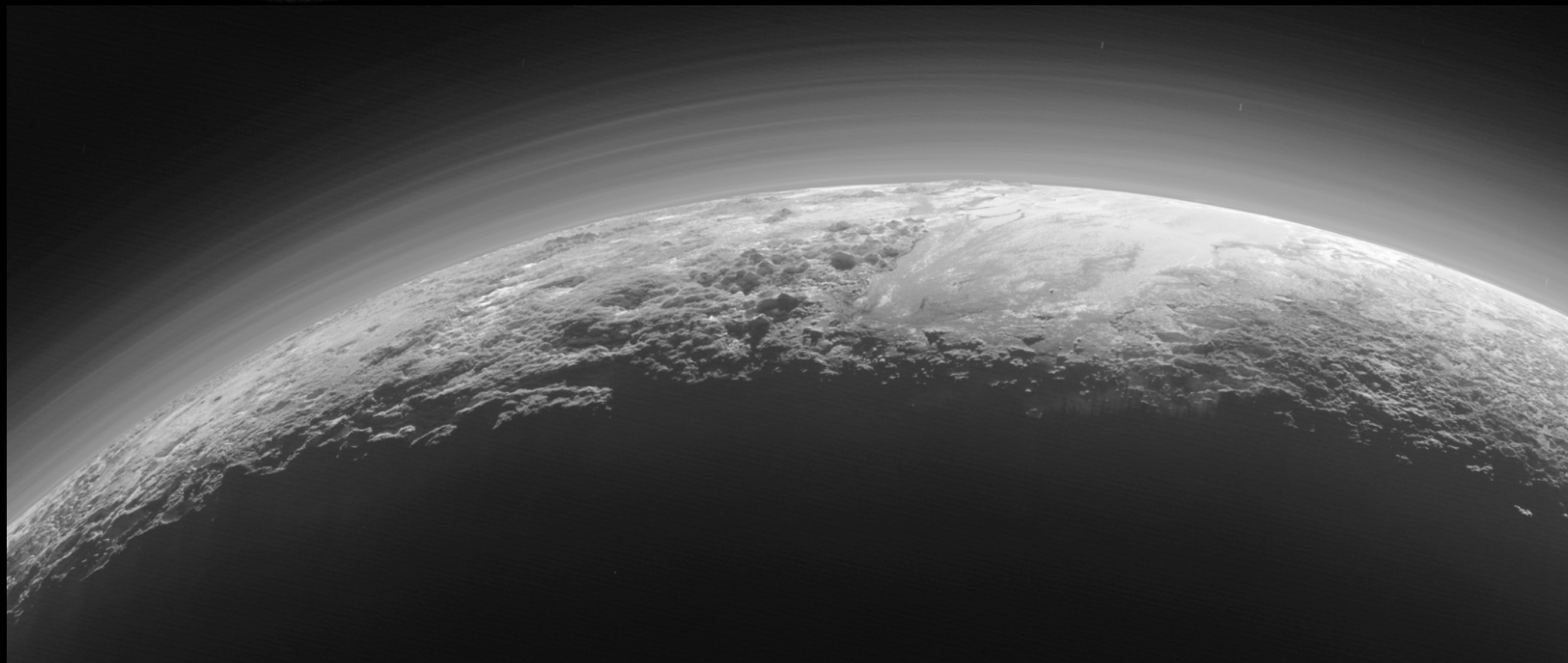
Geysers!

Uranus Satellites

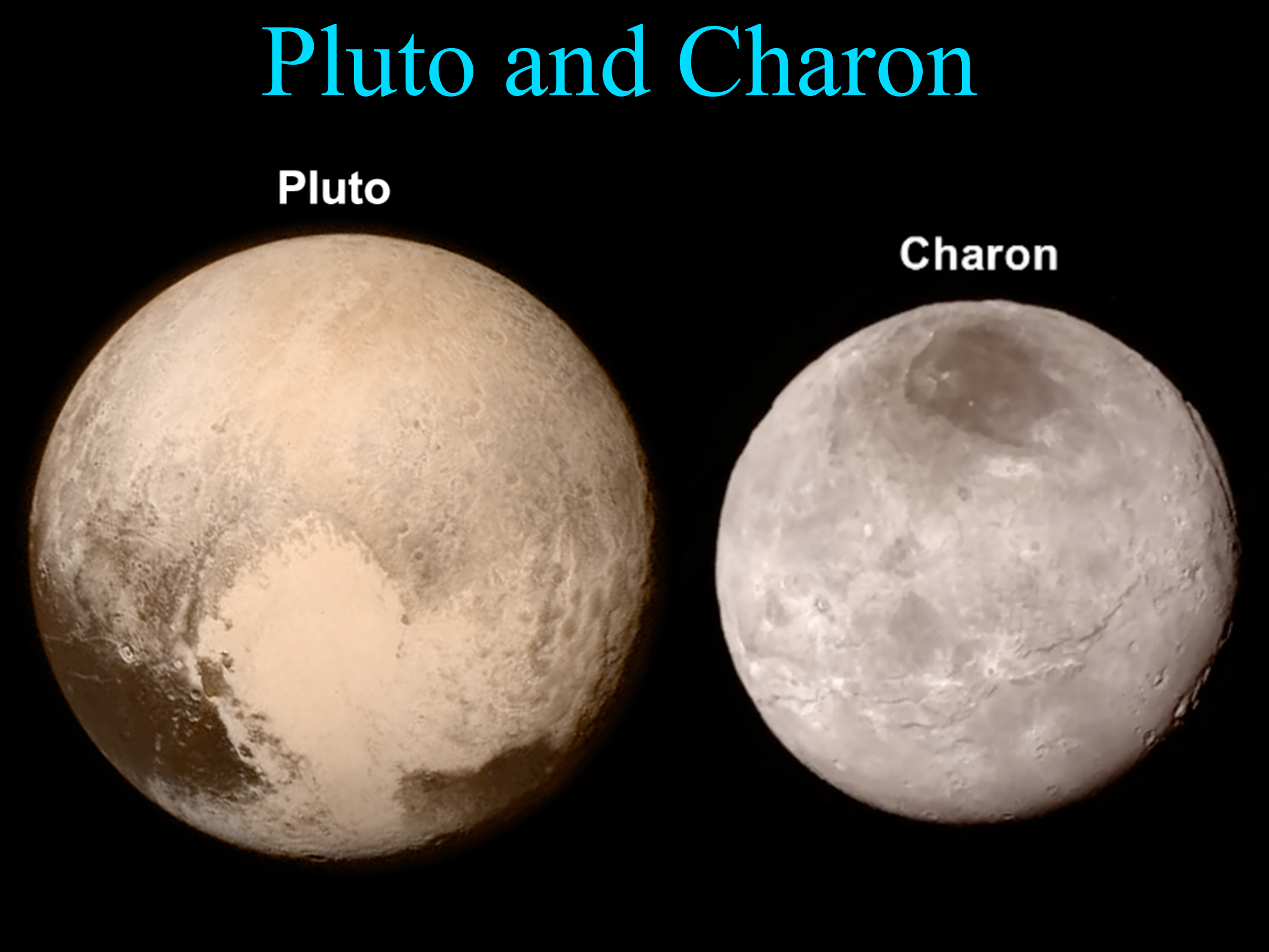
Neptune Satellites



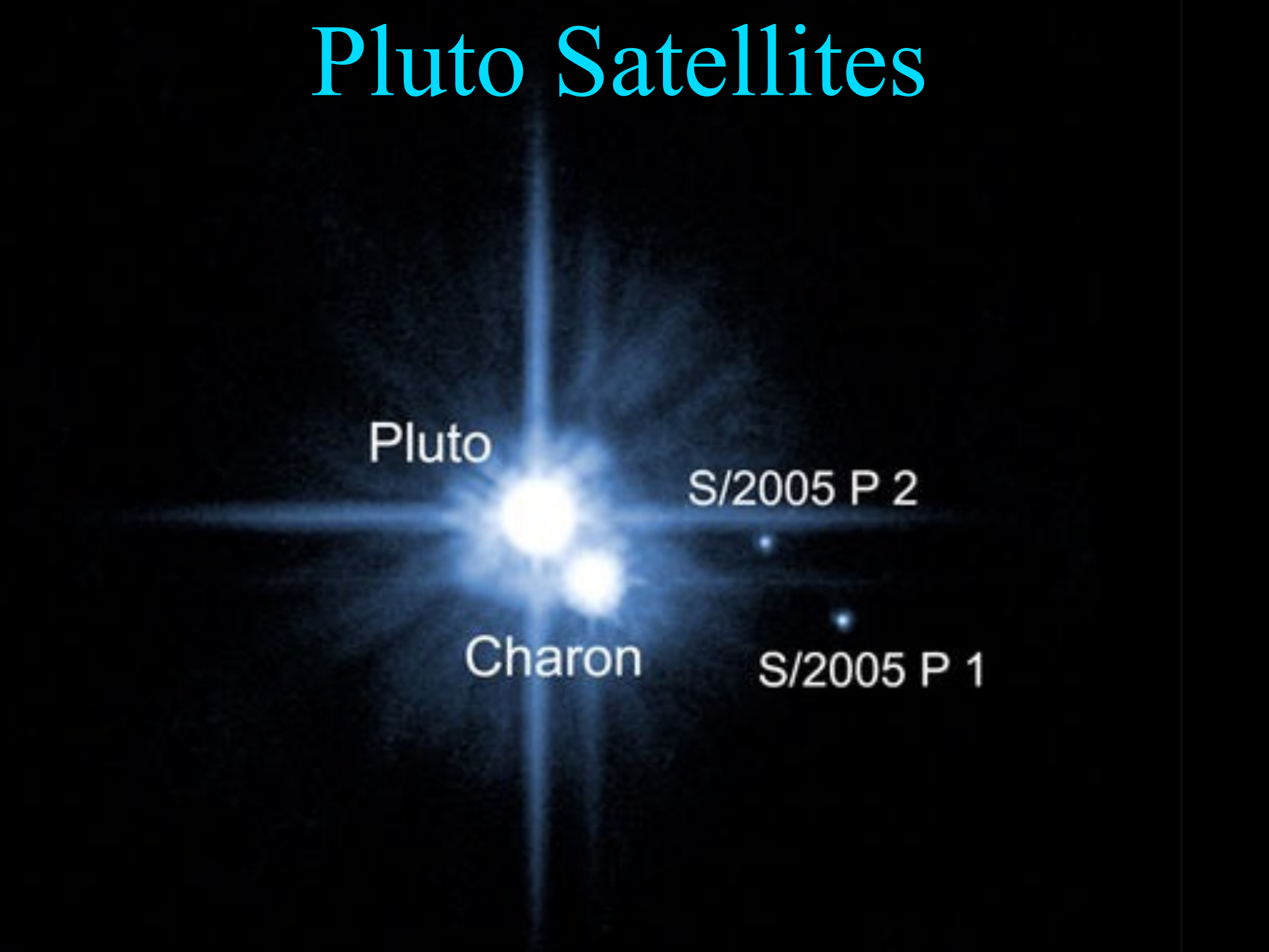
Pluto's Atmosphere



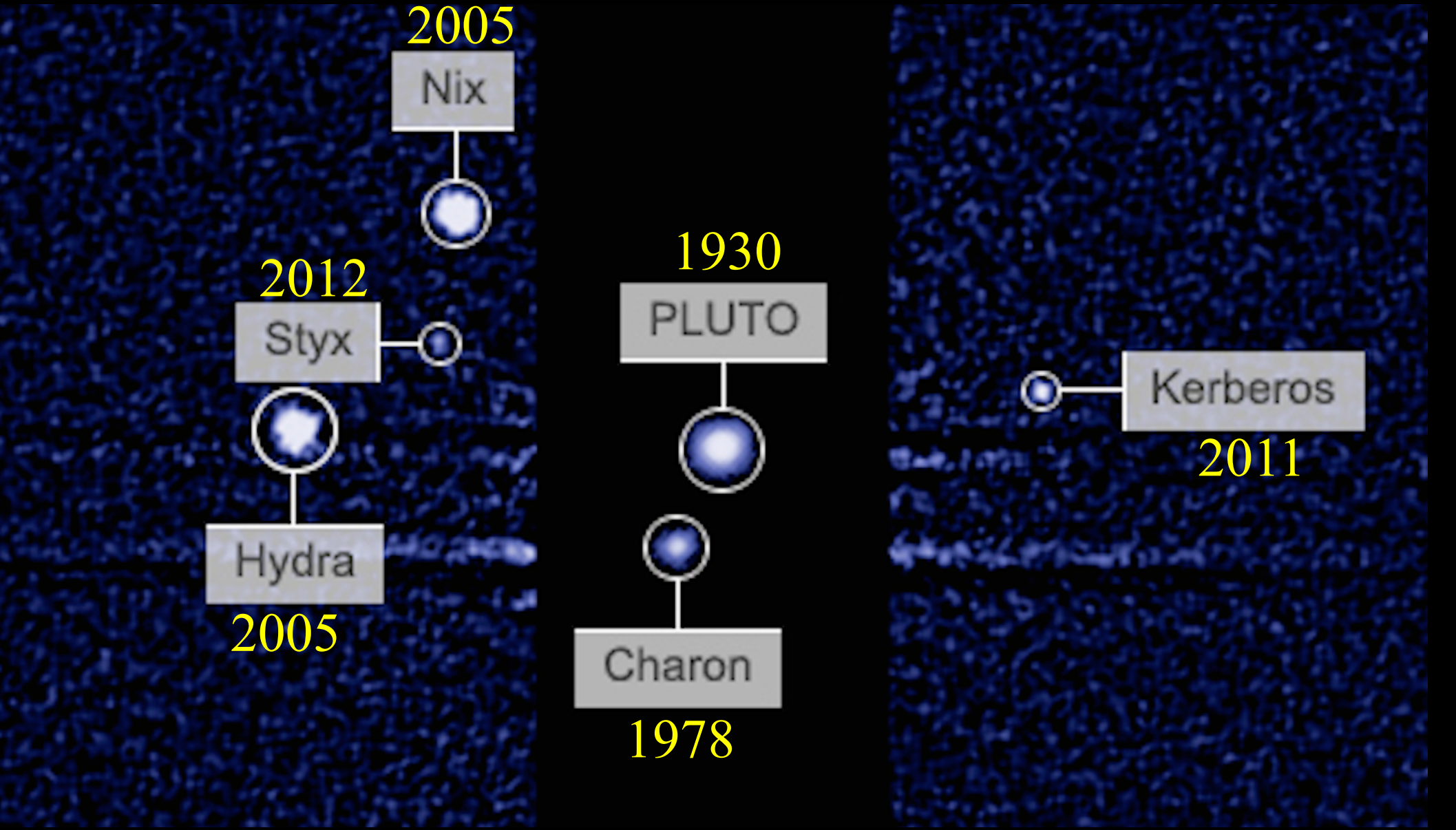
Pluto and Charon



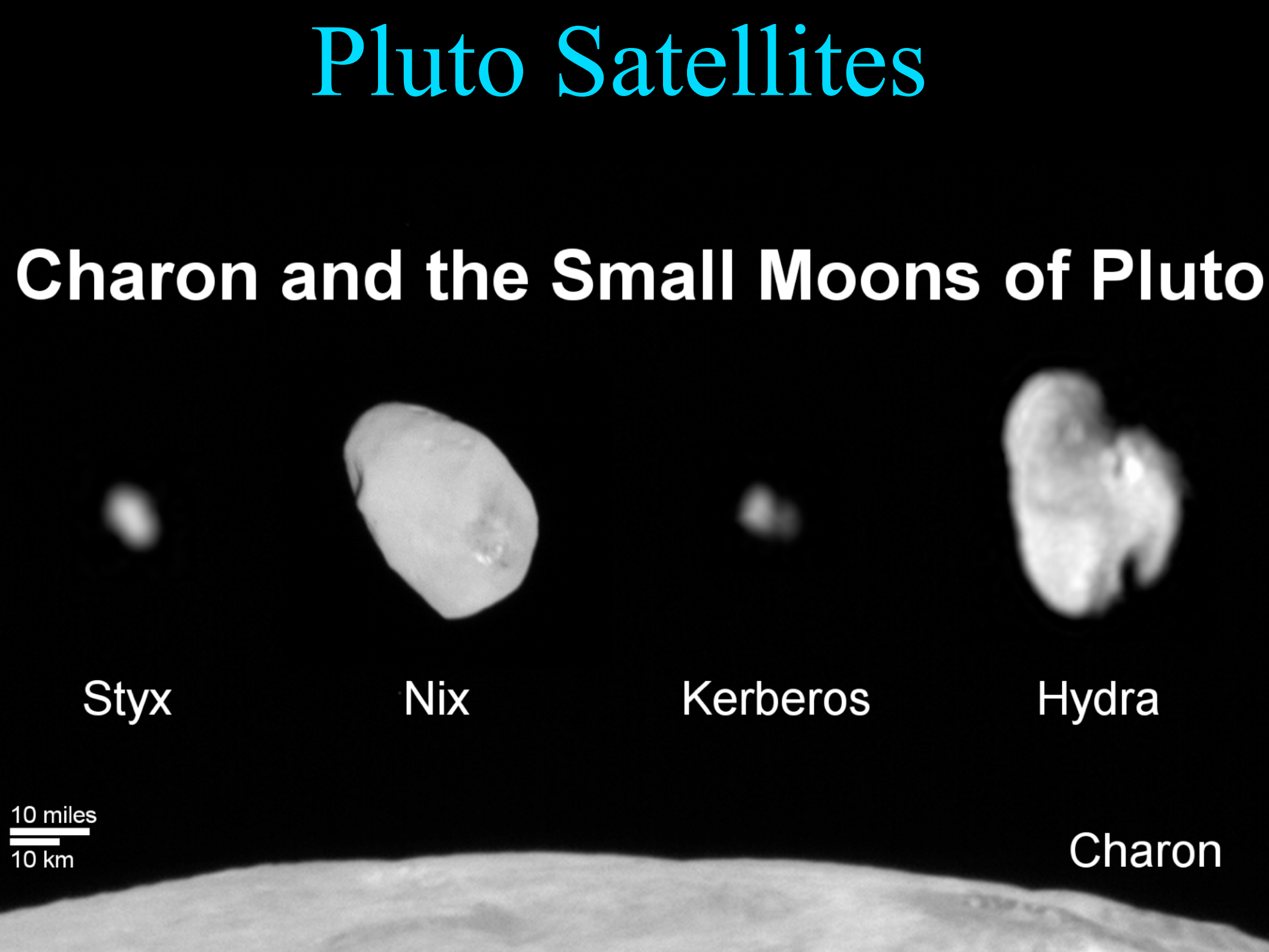
Pluto Satellites



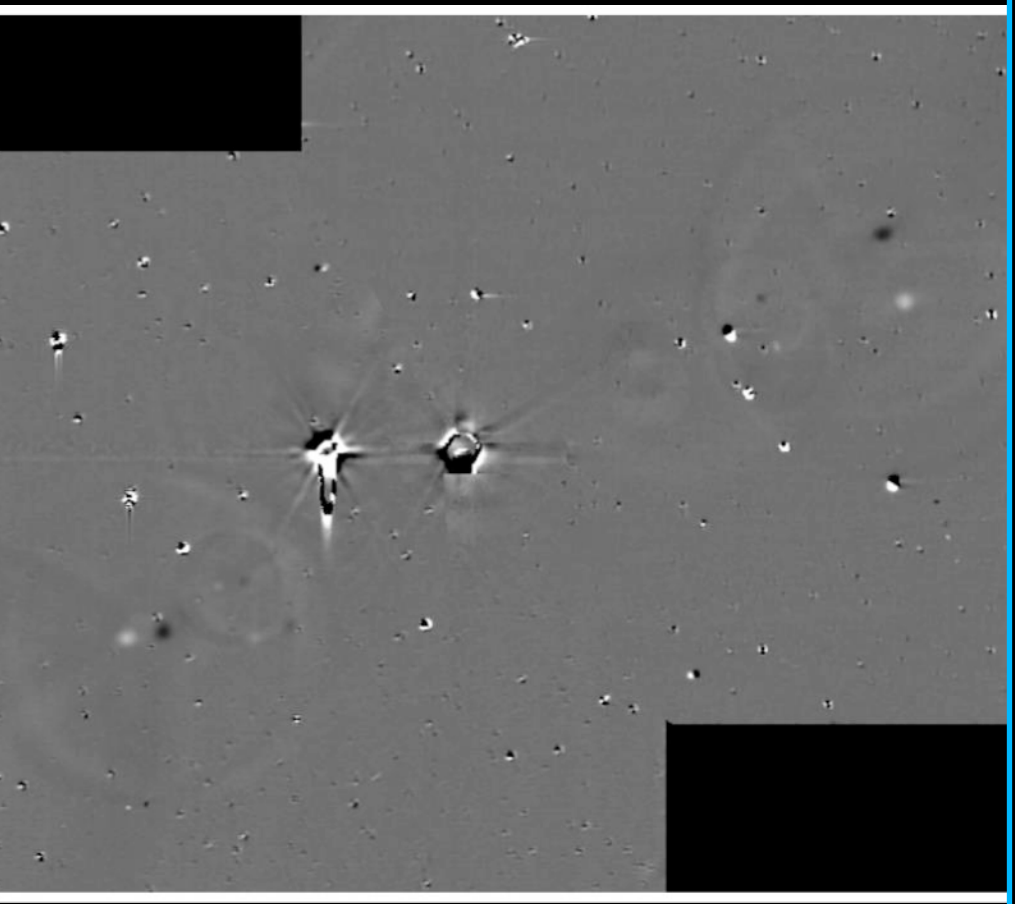
Pluto Satellites



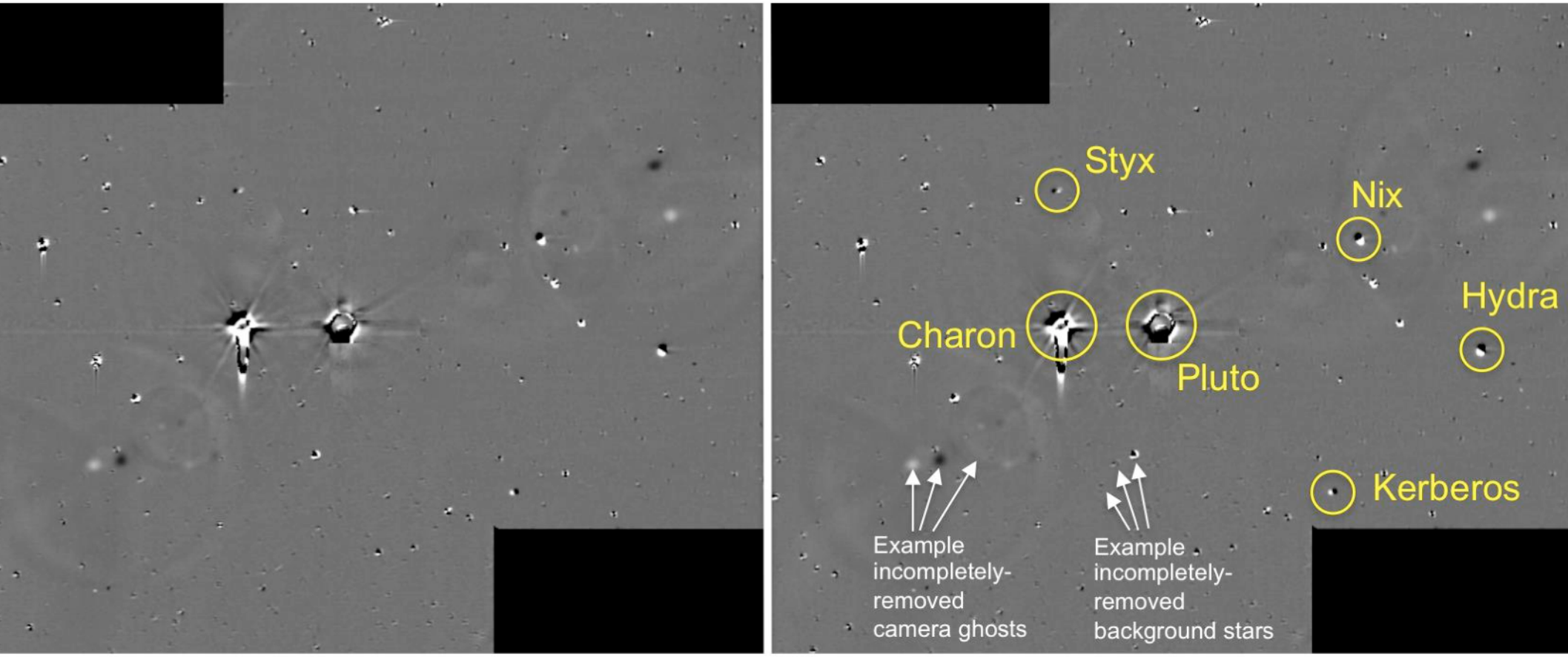
Pluto Satellites

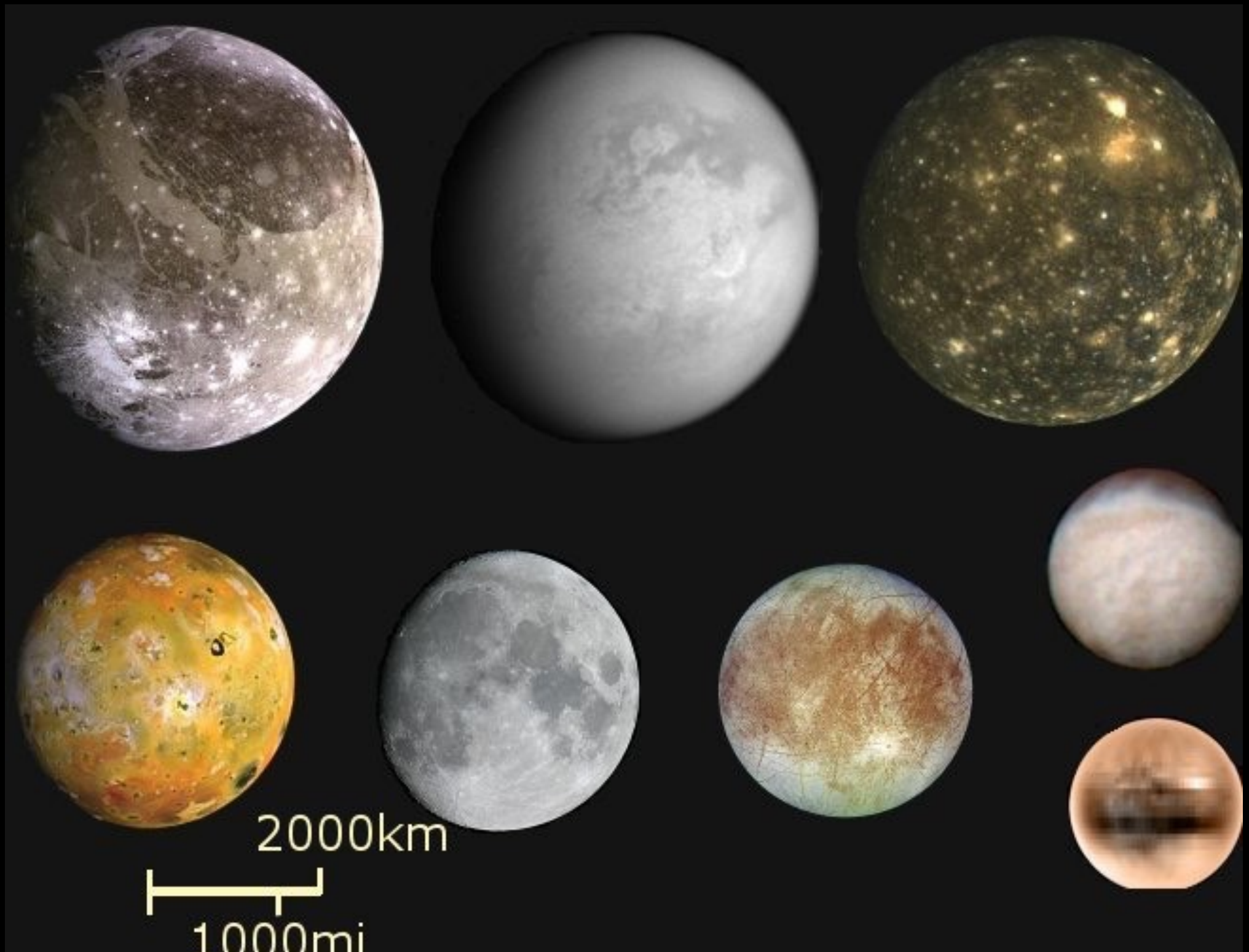


Pluto and Moons from New Horizons



Pluto and Moons from New Horizons



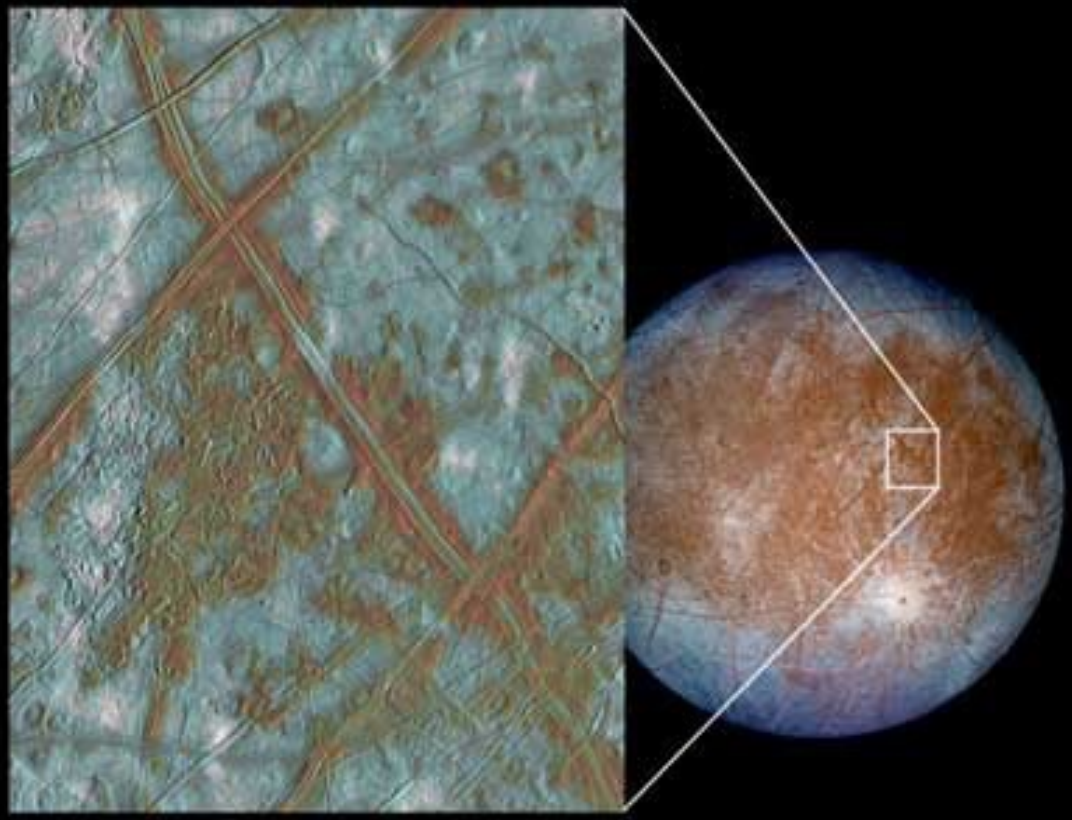

2000km
1000mi


Ganymede
Titan
Callisto
Triton
Io
Moon
Europa
Pluto
2000km
1000mi

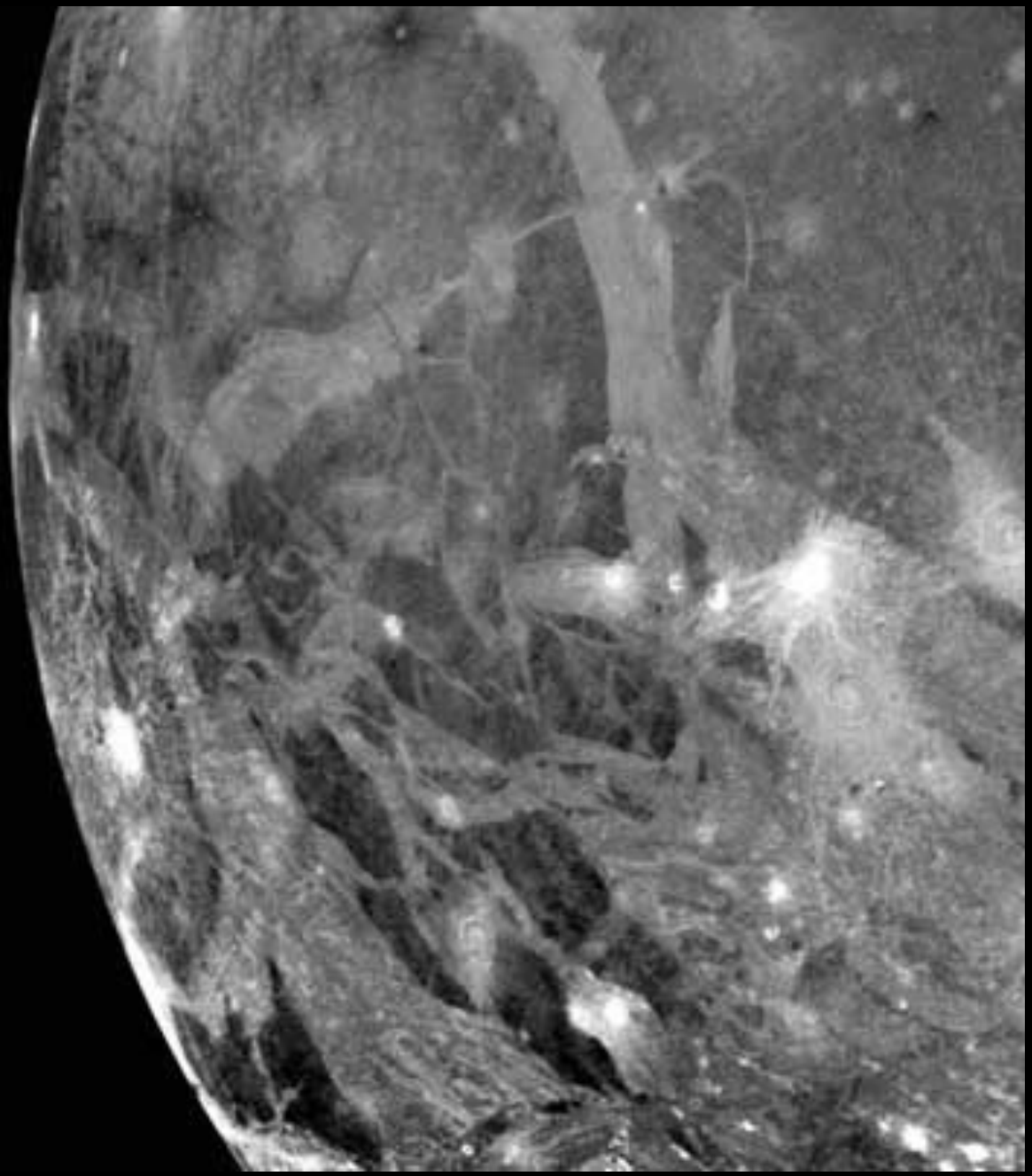
Jupiter Satellites

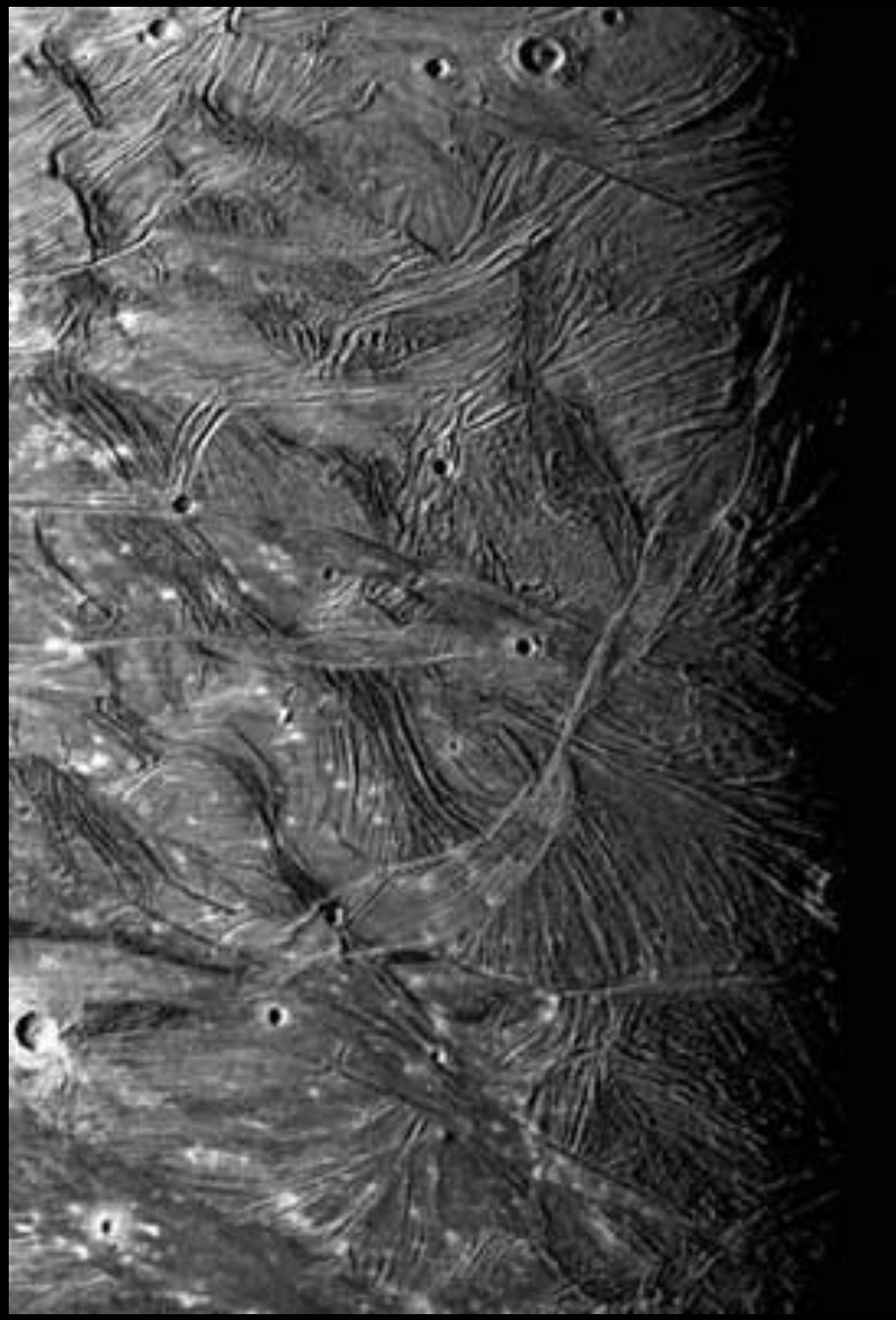
Io - youngest

Europa - next youngest

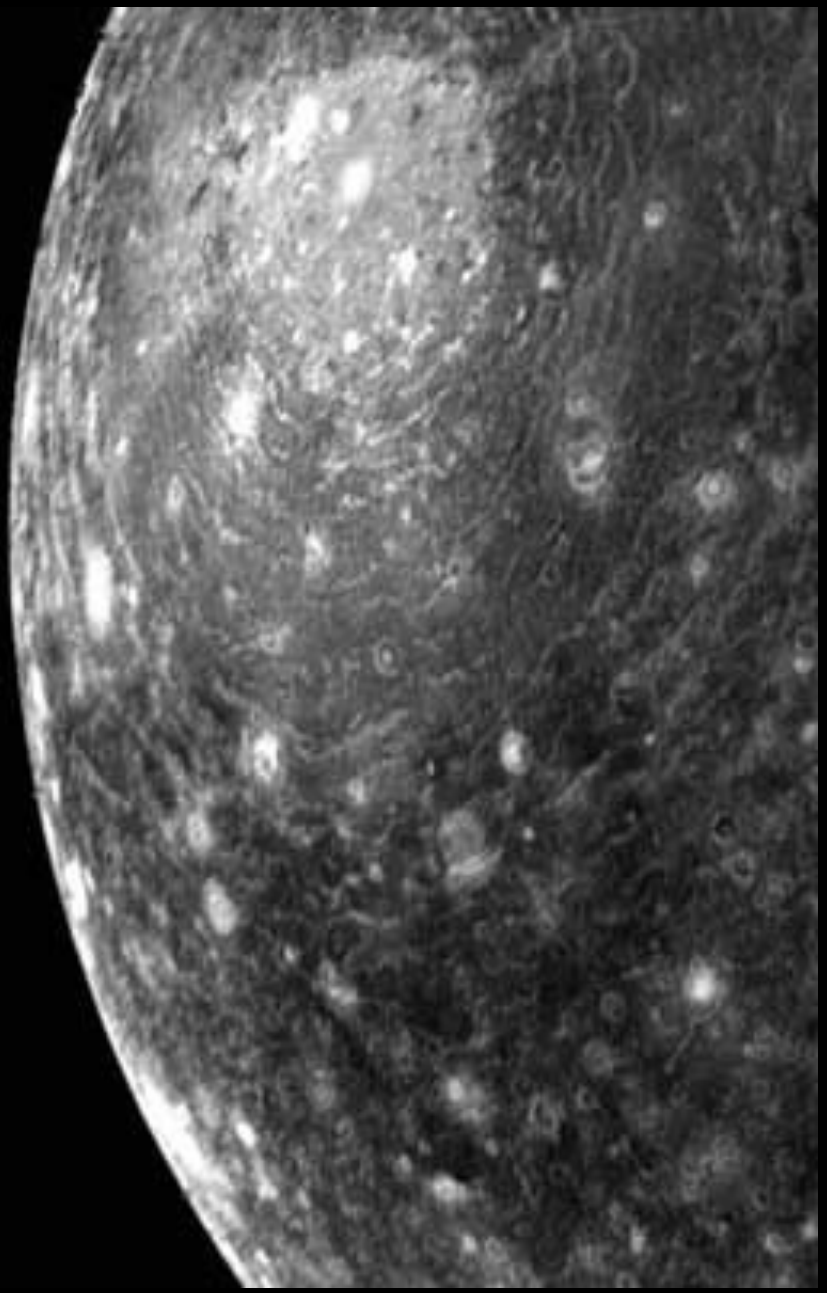


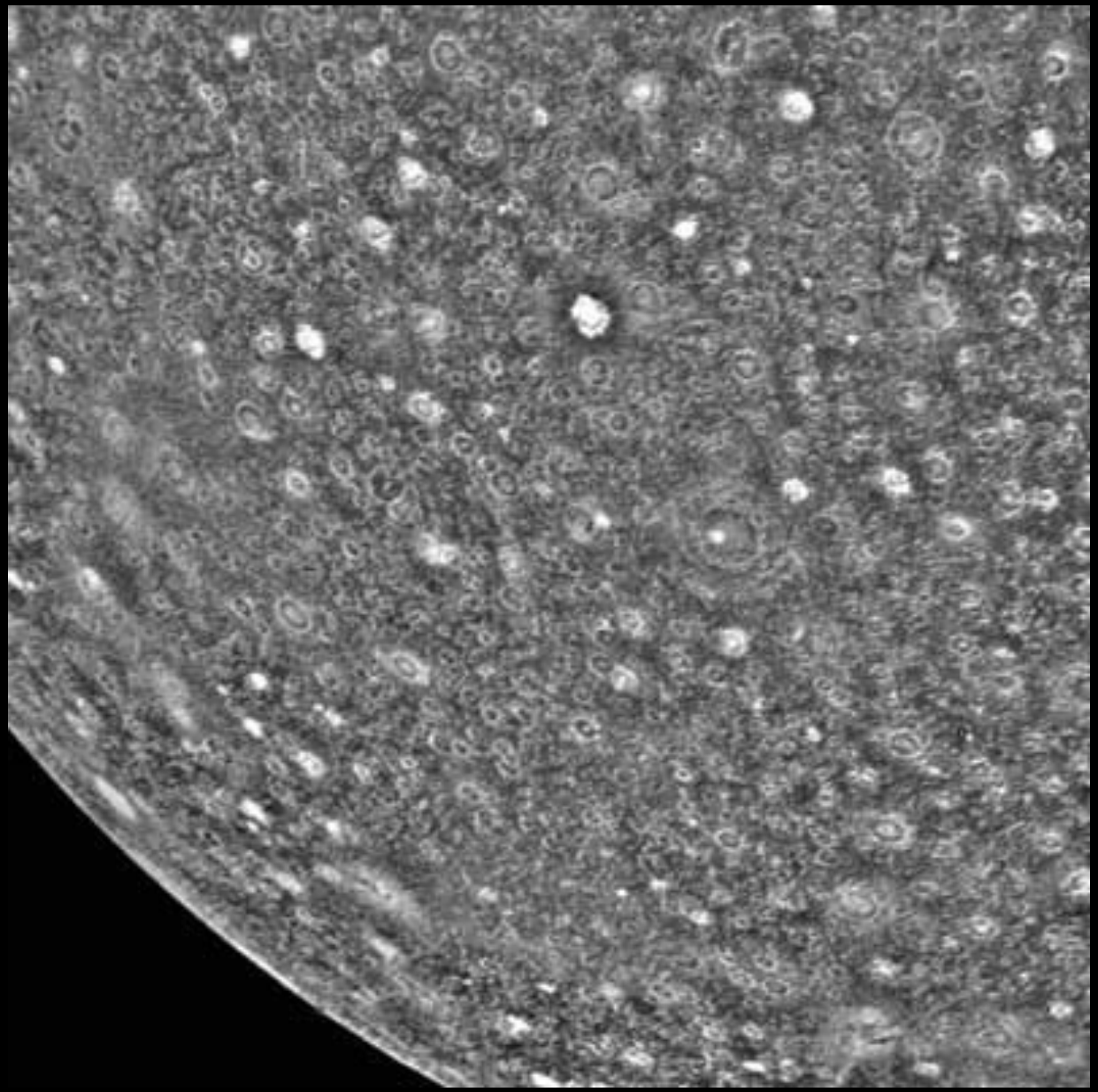
Ganymede - older



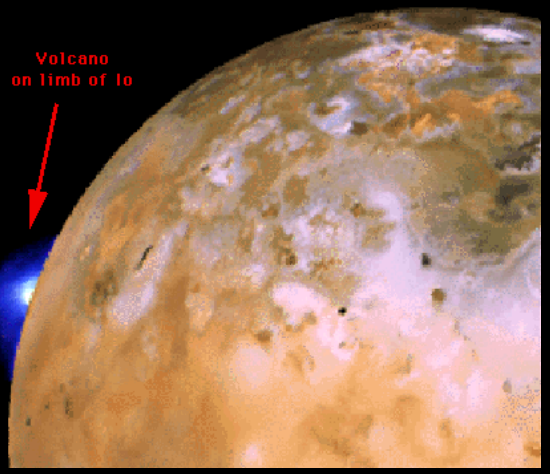


Callisto - oldest

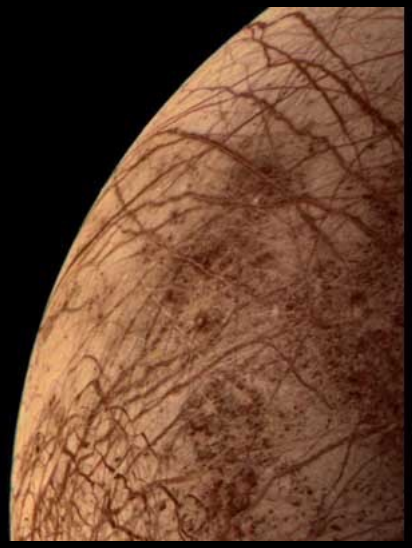




Any Reason to Expect a Correlation with Satellite Size or Distance from Jupiter?

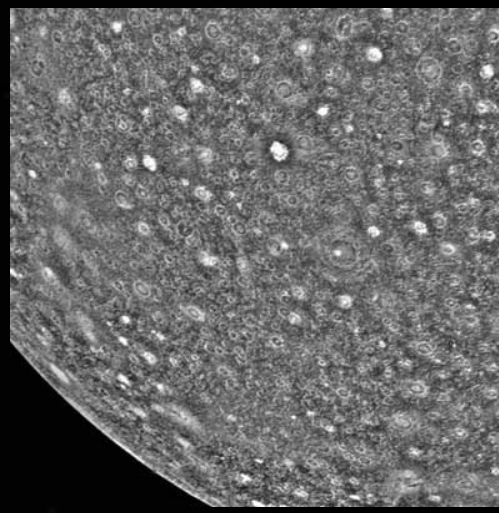


Io



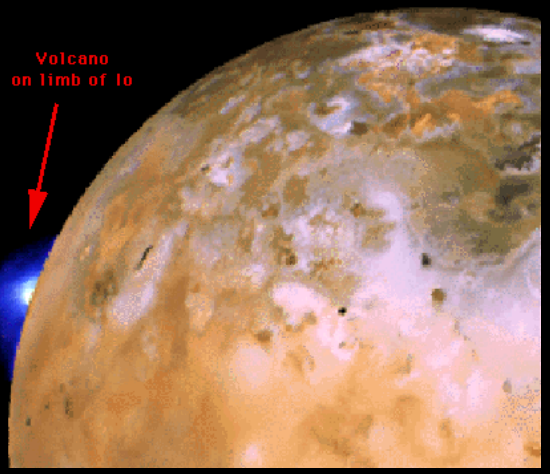
Europa

Ganymede

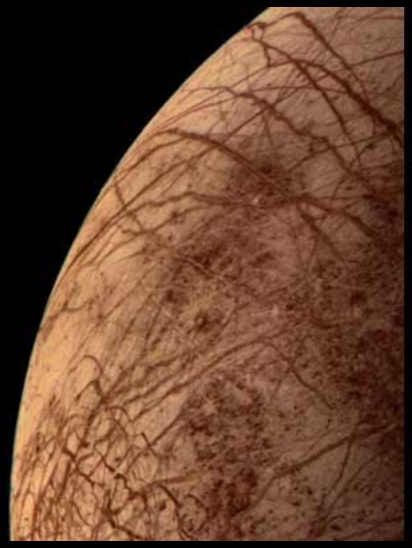


Callisto

Should Activity Correlate with Size or Distance from Jupiter?

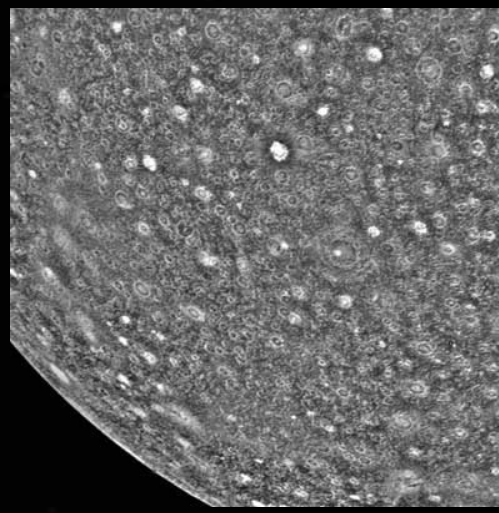


Io



Europa

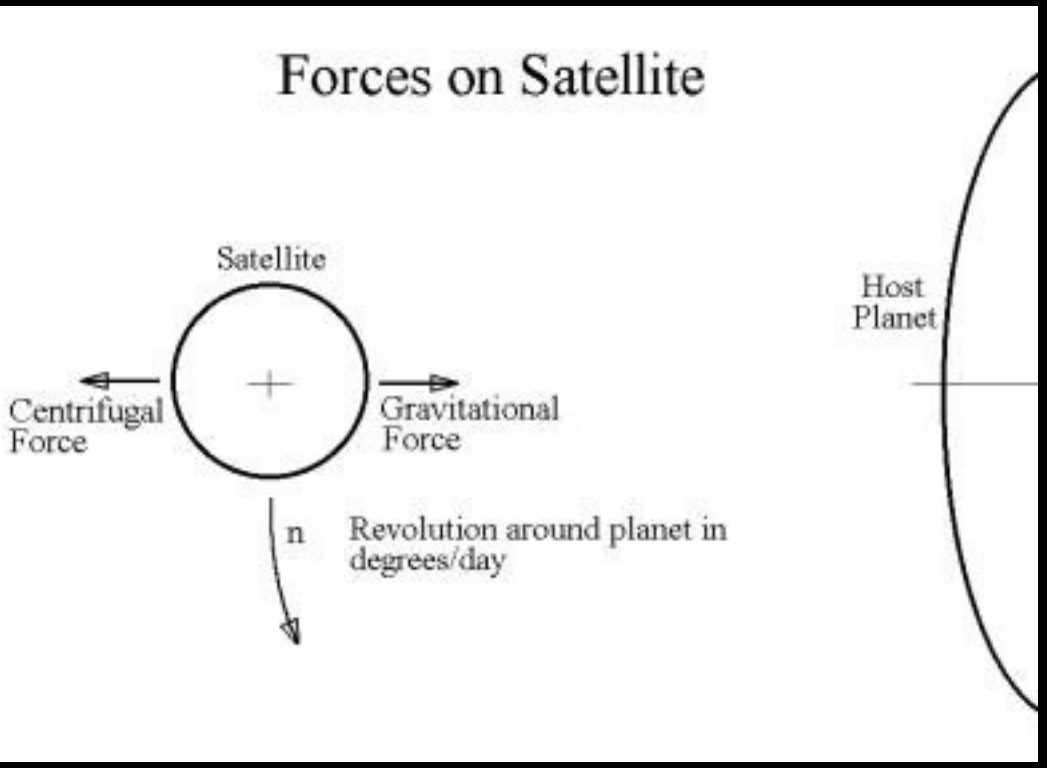
Ganymede

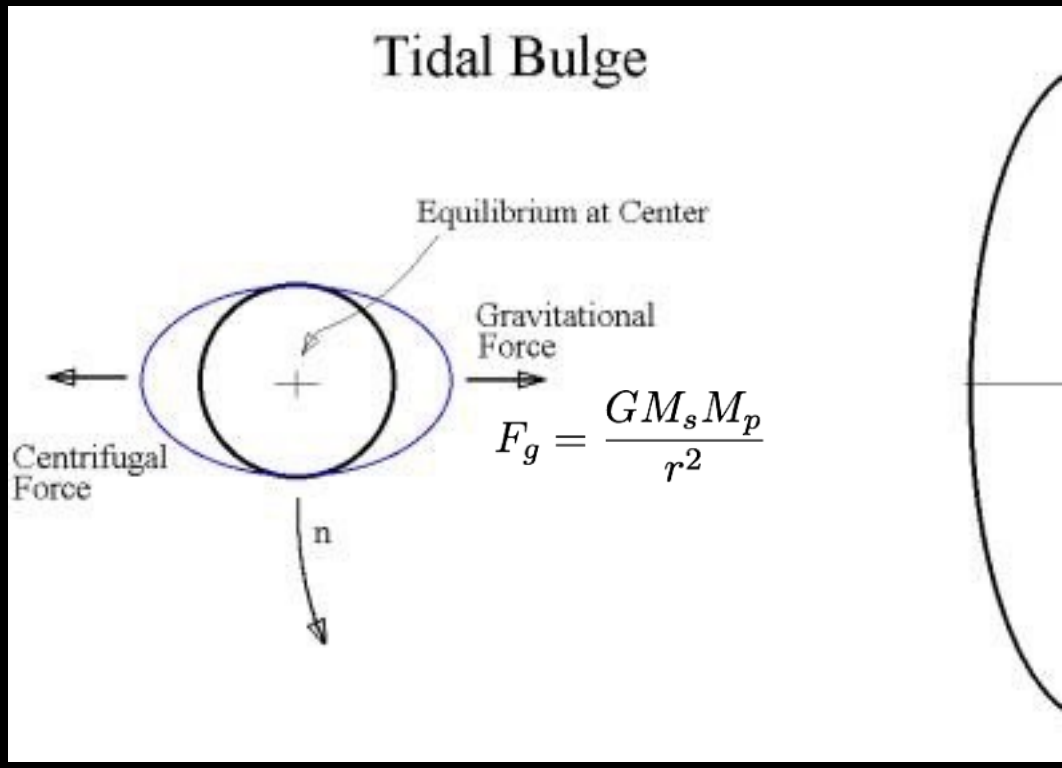


Callisto

Smallest Worlds
are most active!

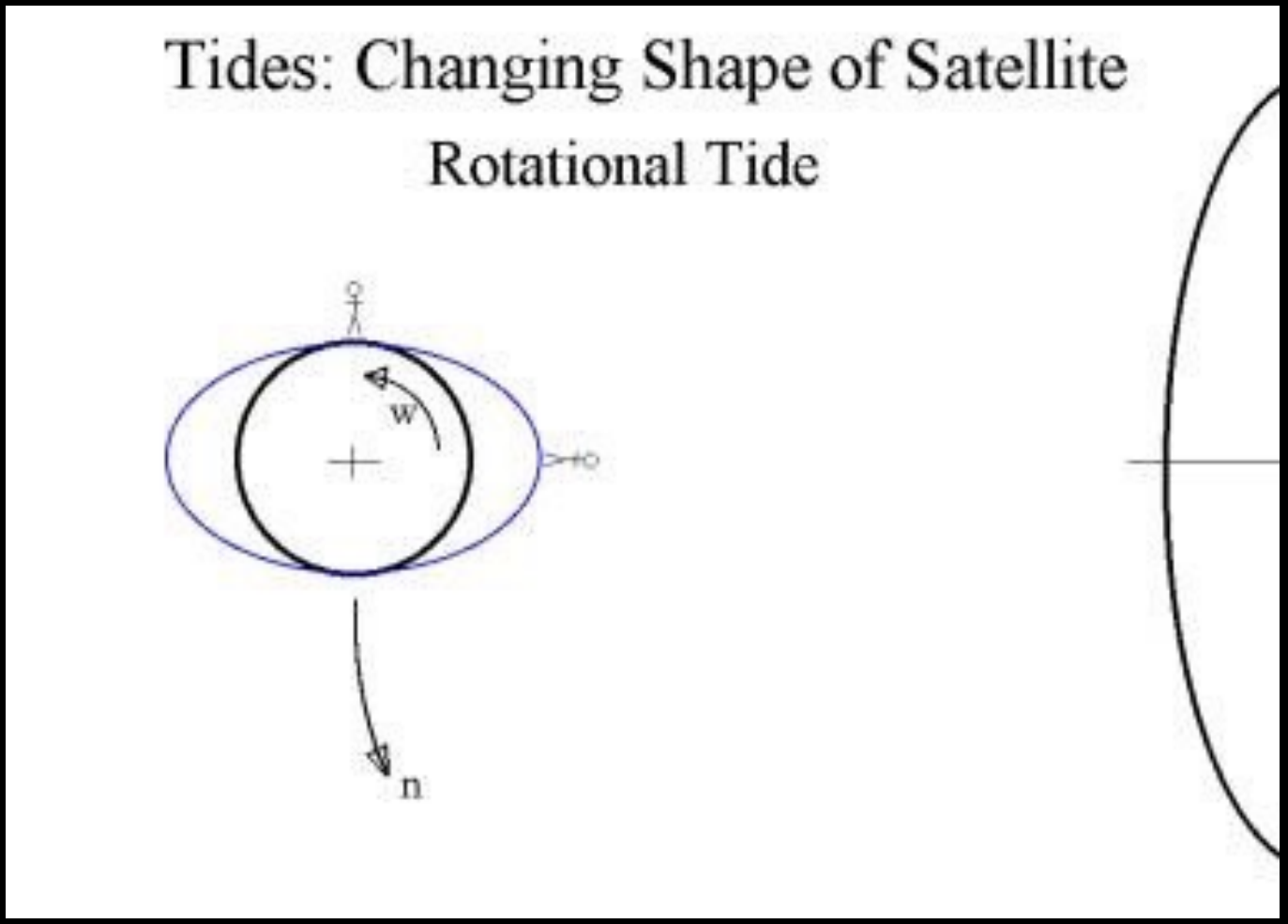
Tidal Evolution





Planets raise tides on satellites, and satellites raise tides on planets. Tides are raised both toward and away from the perturber - why?

Satellite tides

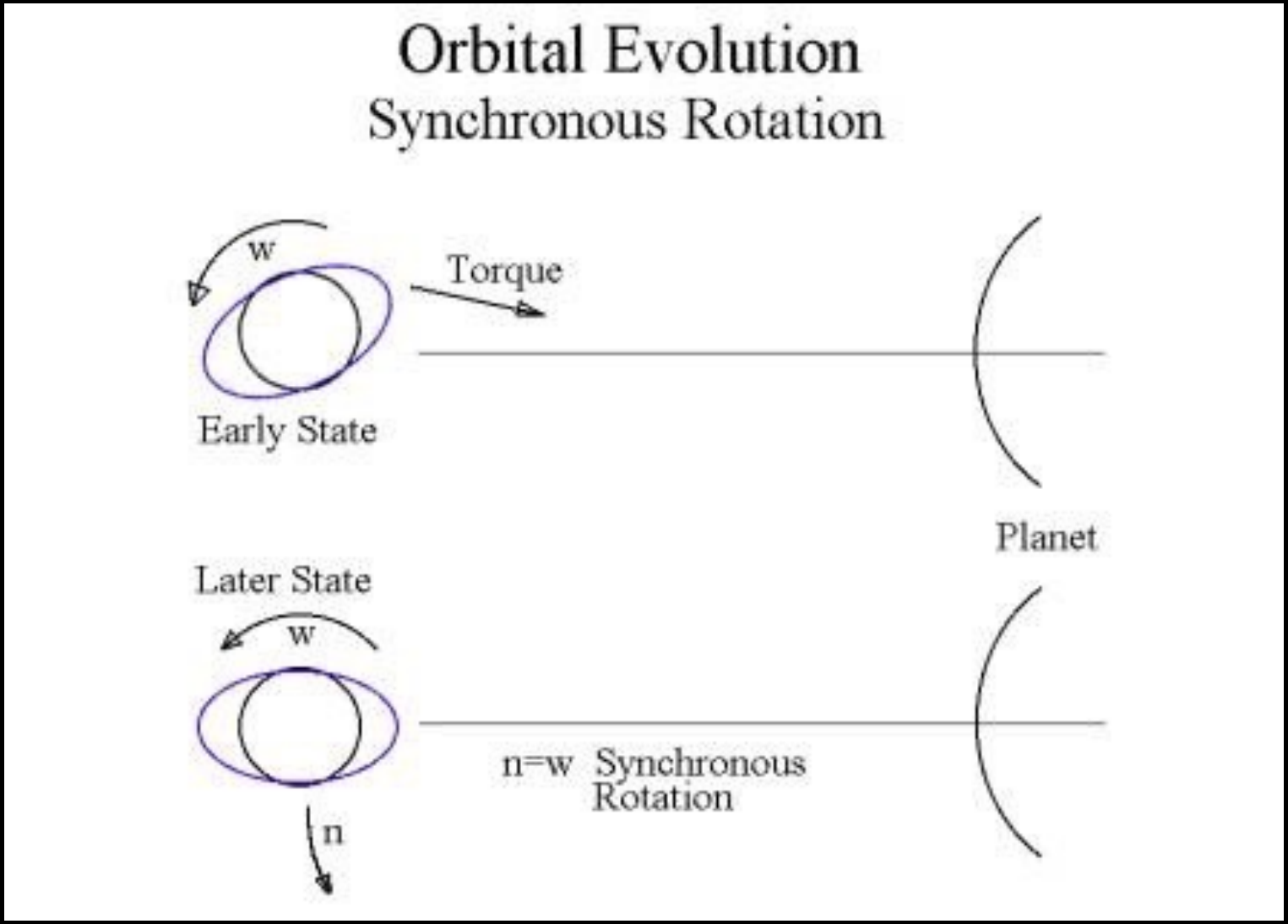


Explain how this causes two high tides a day on Earth.

Sloshing of tides leads to Energy loss - the object's spin slows down.

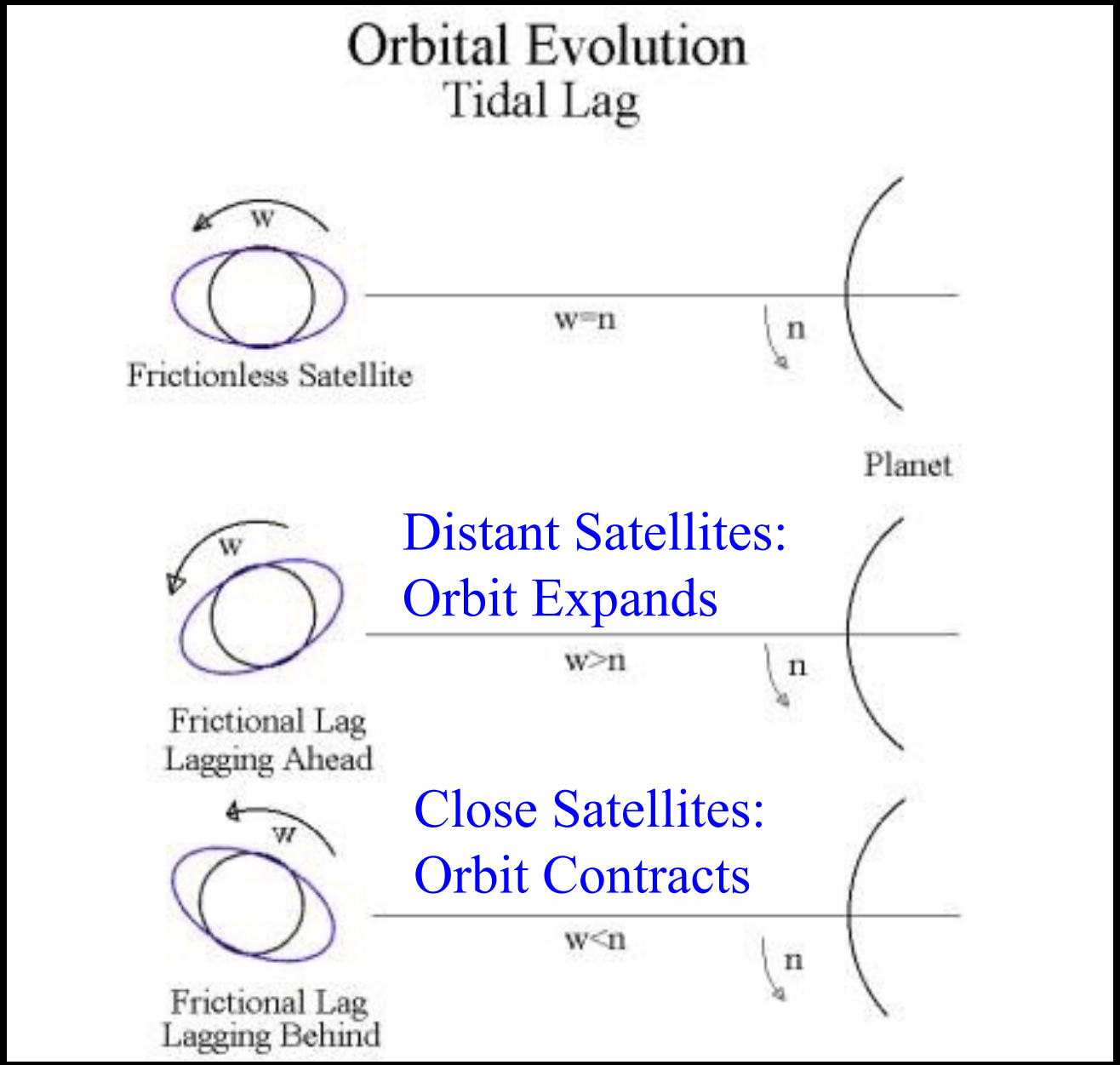
Any energy loss leads to tidal heating!

Most Satellites are Face-Locked



Spindown rate depends on an objects size and distance from its largest neighbors. Spindown is usually very rapid and the end state is synchronous rotation.

Orbital Evolution of Moons

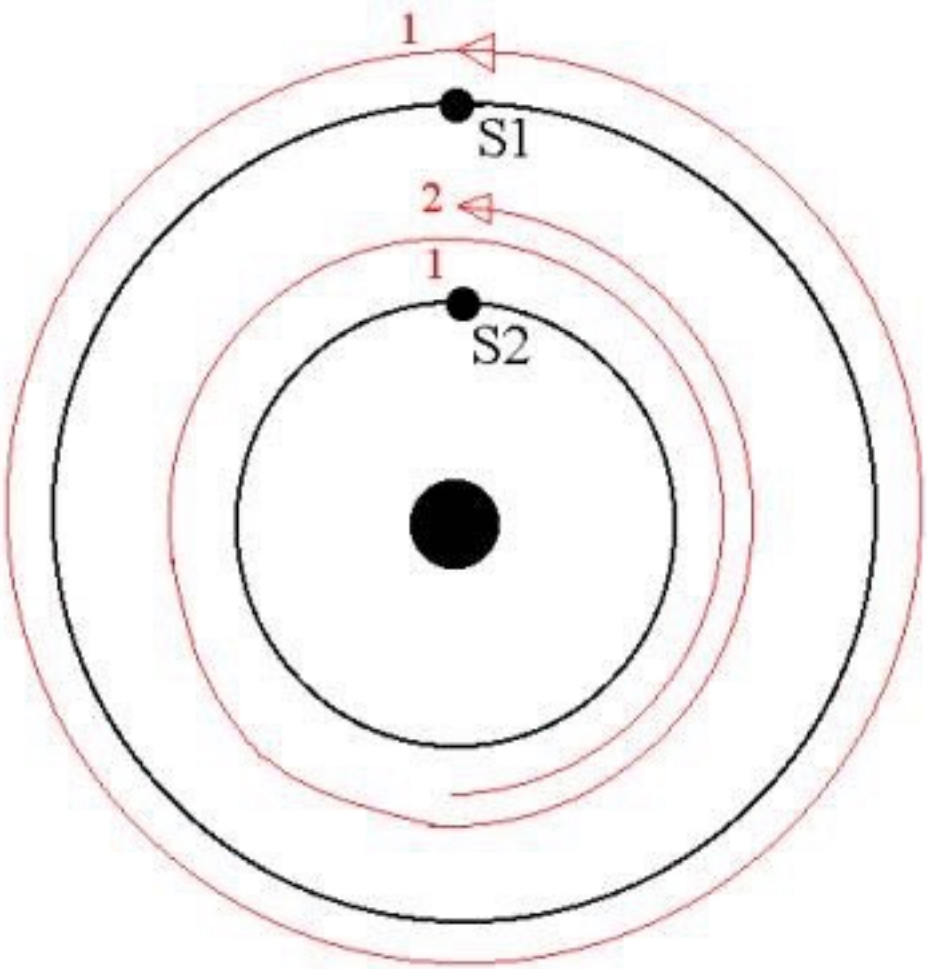


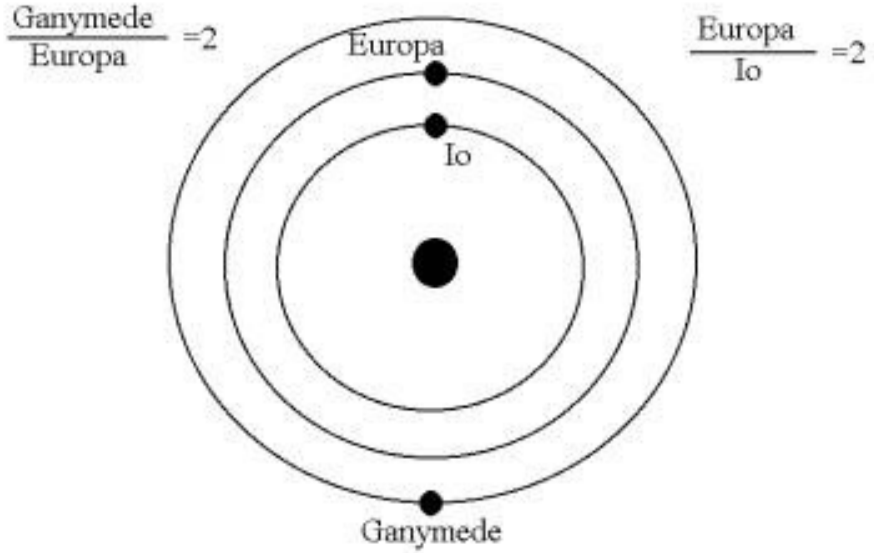
Two Main Effects:

1. Moon with an eccentric orbit. The eccentricity is damped away! (Rapid)

2. Moon on a circular orbit. The size of the orbit increases! (Most Slowly)

Orbital Resonances





Forced/Free Eccentricity

	Free	Forced
Io	.00001	.0041
Europa	.00002	.00101
Ganymede	.0015	.0006

Effects of Tides

1. Satellite spins are slowed. (Very Fast)

2. Satellite orbits are circularized (Fast)

3. Satellite orbits expand/contract (Slowly)

4. Planet spins are slowed (Slowly)

Tides explain:

synchronous rotation states of most satellites

extra heat sources for Io, Europa and other moons

existence of resonances between satellites