

Survey of the Solar System

The Sun

Giant Planets

Terrestrial Planets

Minor Planets

Satellite/Ring
Systems



Definition of a dwarf planet

1. Orbits the sun
2. Is large enough to have become round due to the force of its own gravity
3. Is not a satellite
- ~~4. Must dominate the neighborhood around its orbit (cleared its orbital path)~~

Currently there are 5 recognized by the IAU:
Ceres, Pluto, Haumea, Eris and Makemake

Though due to difficulties in confirming KBO roundness there are probably >100 known objects

Minor / Dwarf Planets

The new solar system

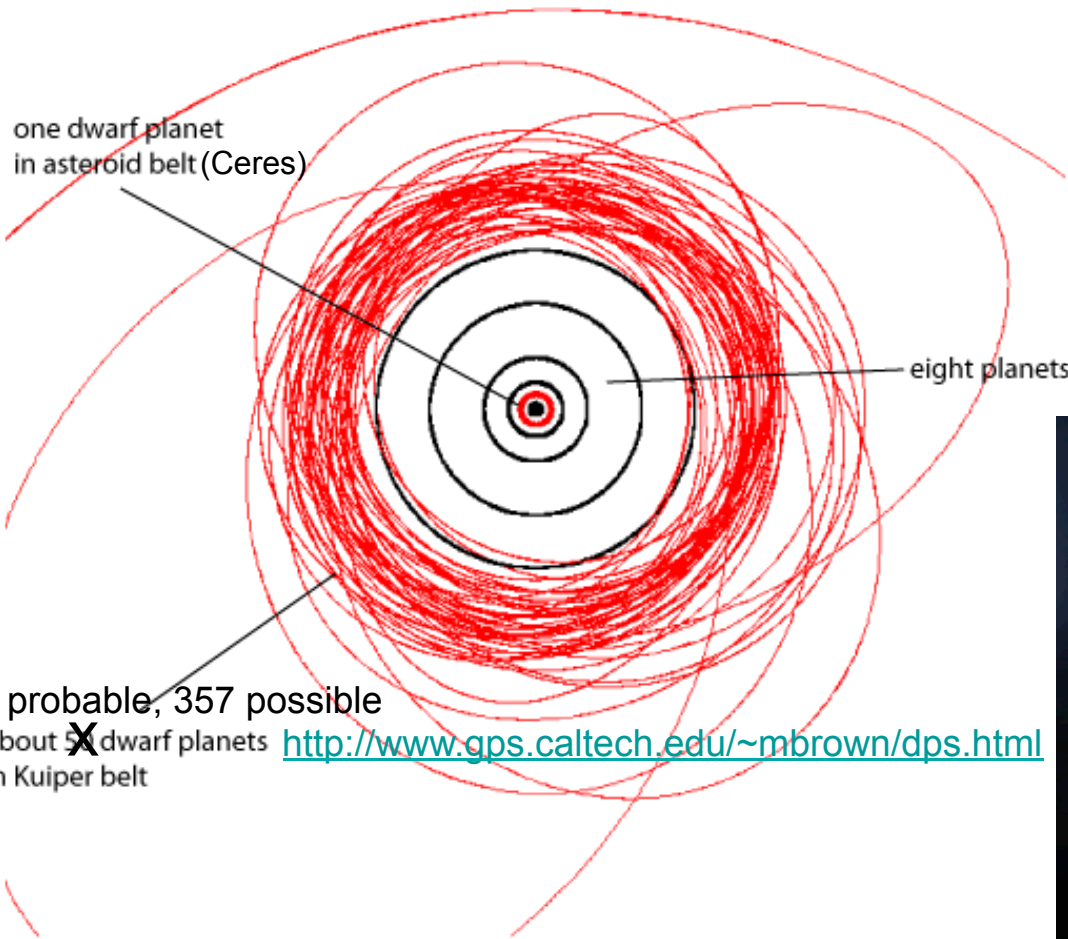


Image credit: M. Brown

Earth For Scale:

Eris

Ceres

Pluto (& Charon)



Image credit: NASA

Asteroids

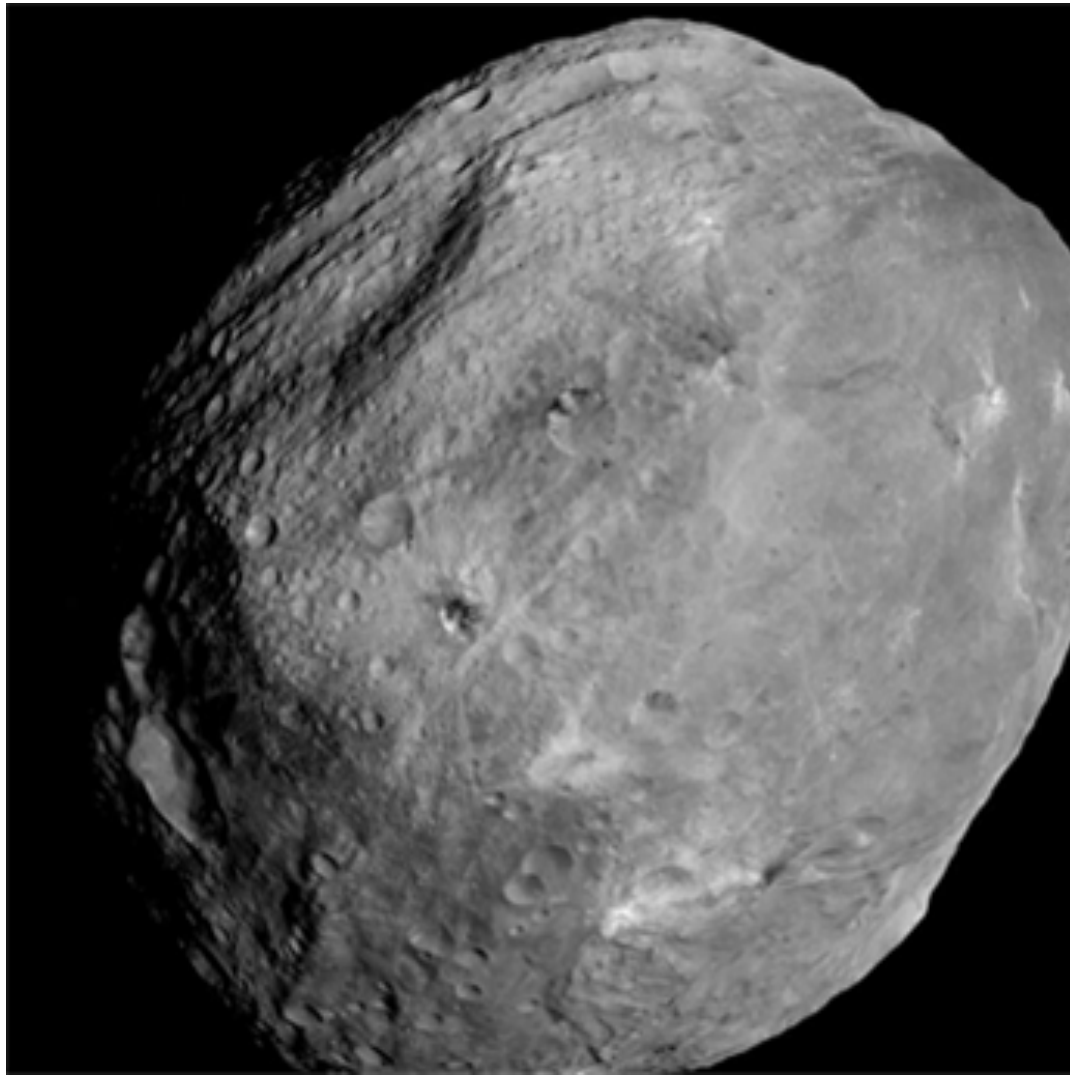
Minor planets with unconfirmed roundness and generally < 500 km in radius.

Most reside in the asteroid belt (2.1–3.3 AU) between Mars' and Jupiter's orbits.

Other populations include centaurs, Trojans, Kuiper belt objects (e.g., Pluto).

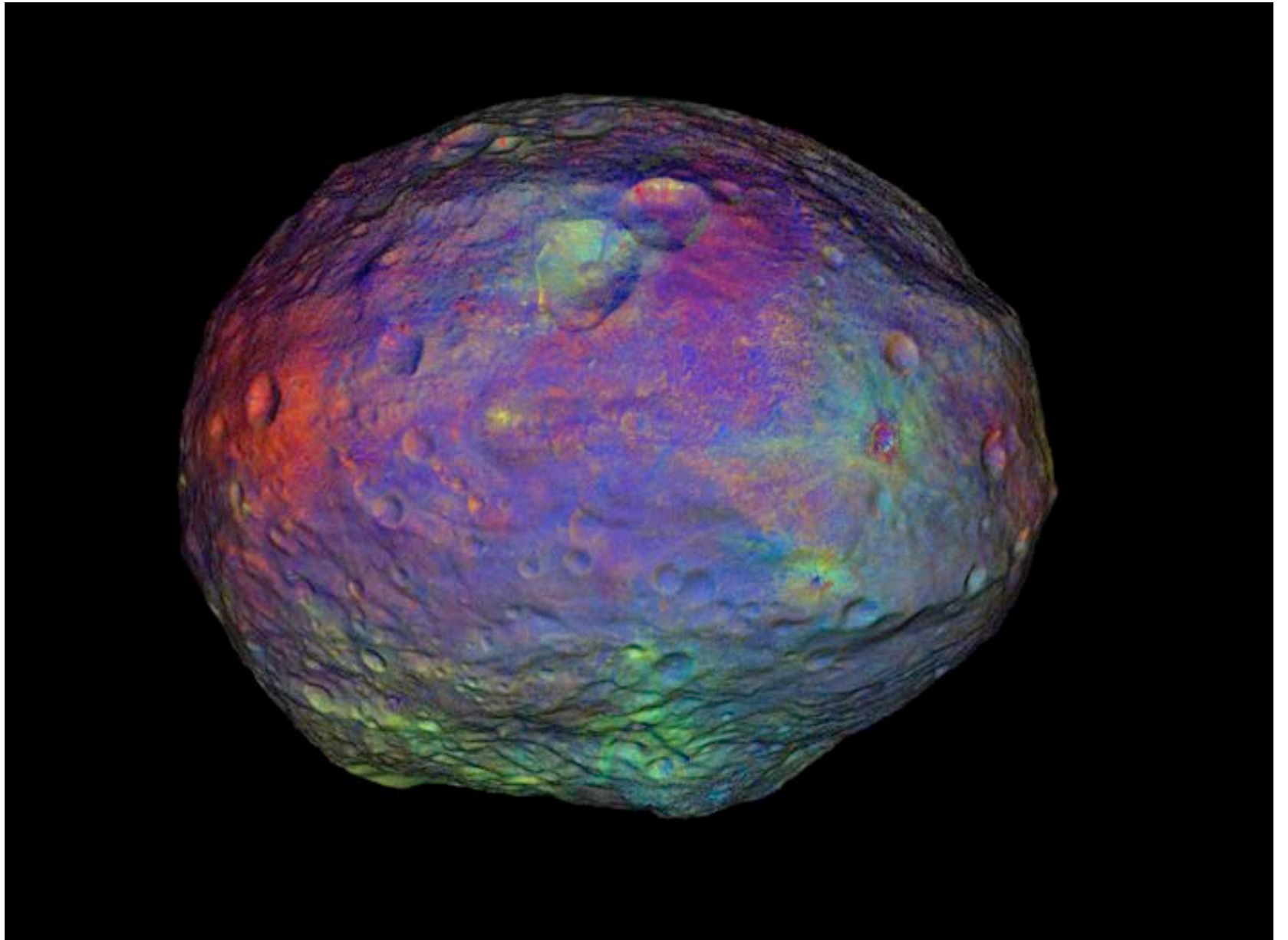
They actually can, and several do, have confirmed satellites.

Vesta

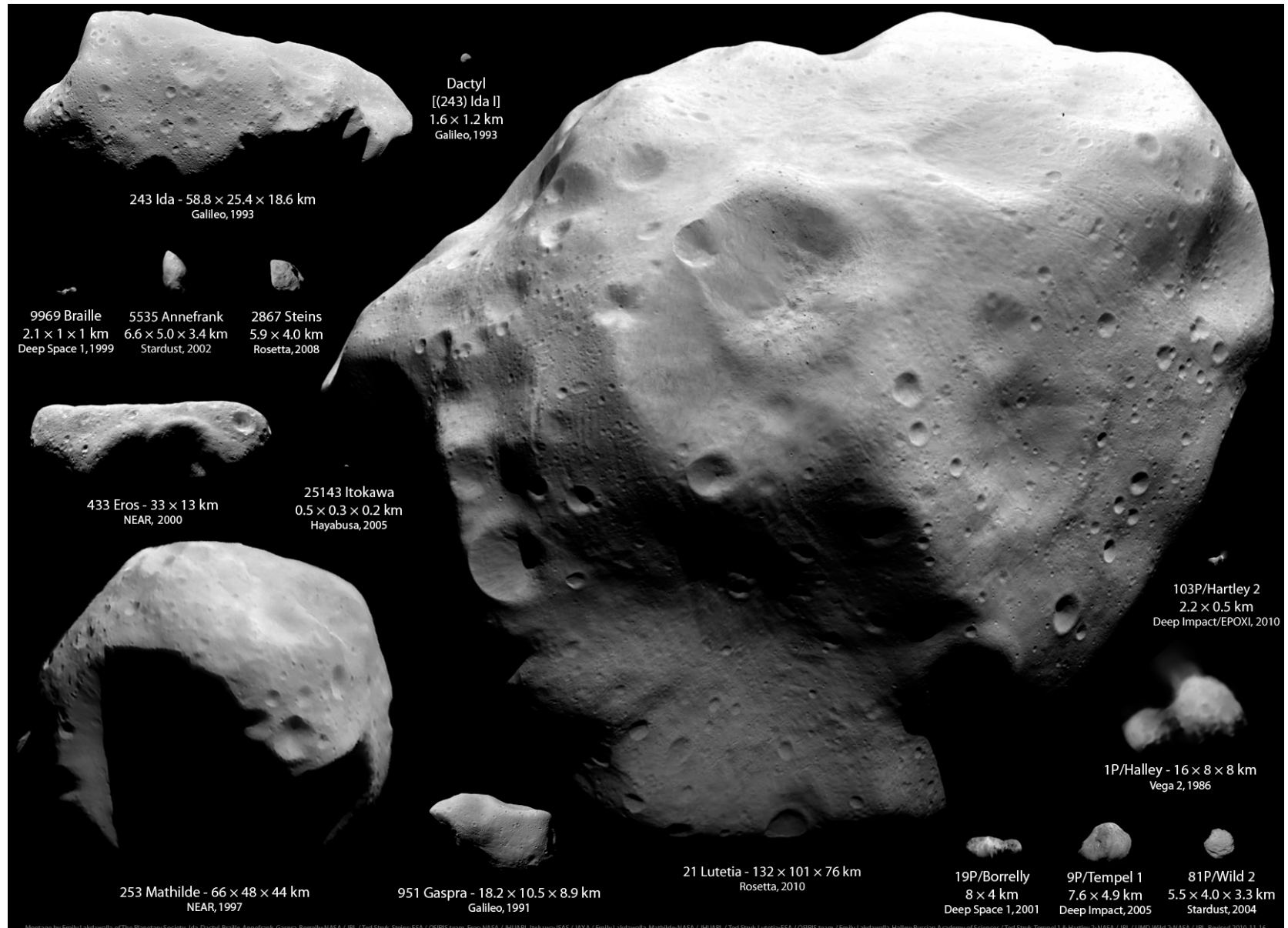


July 24, 2011

Vesta



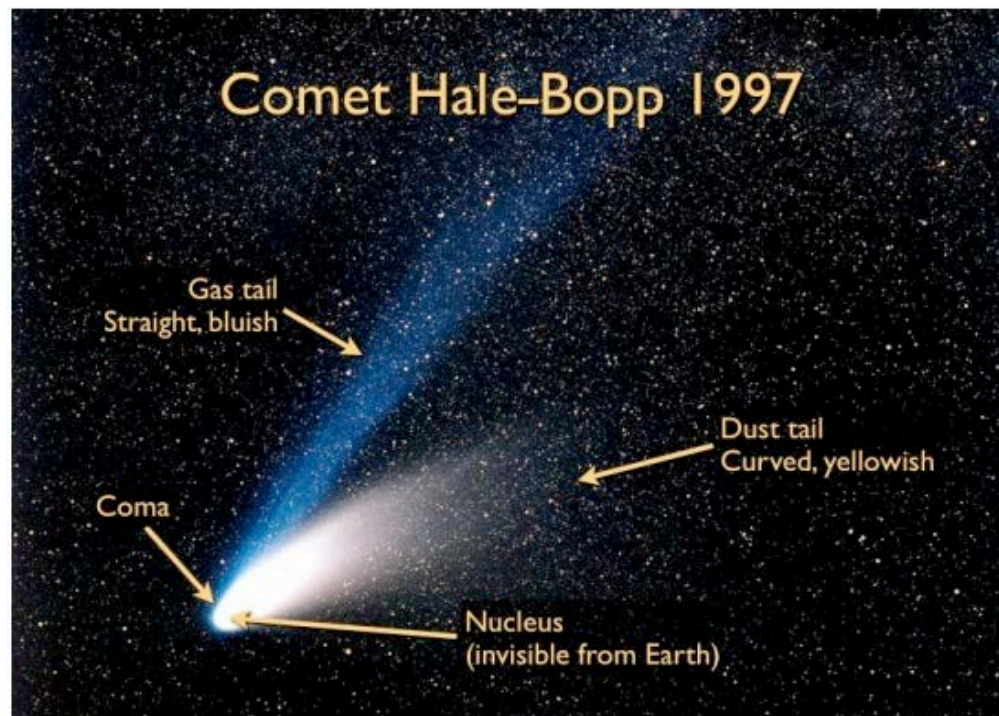
Asteroids and Comets Visited



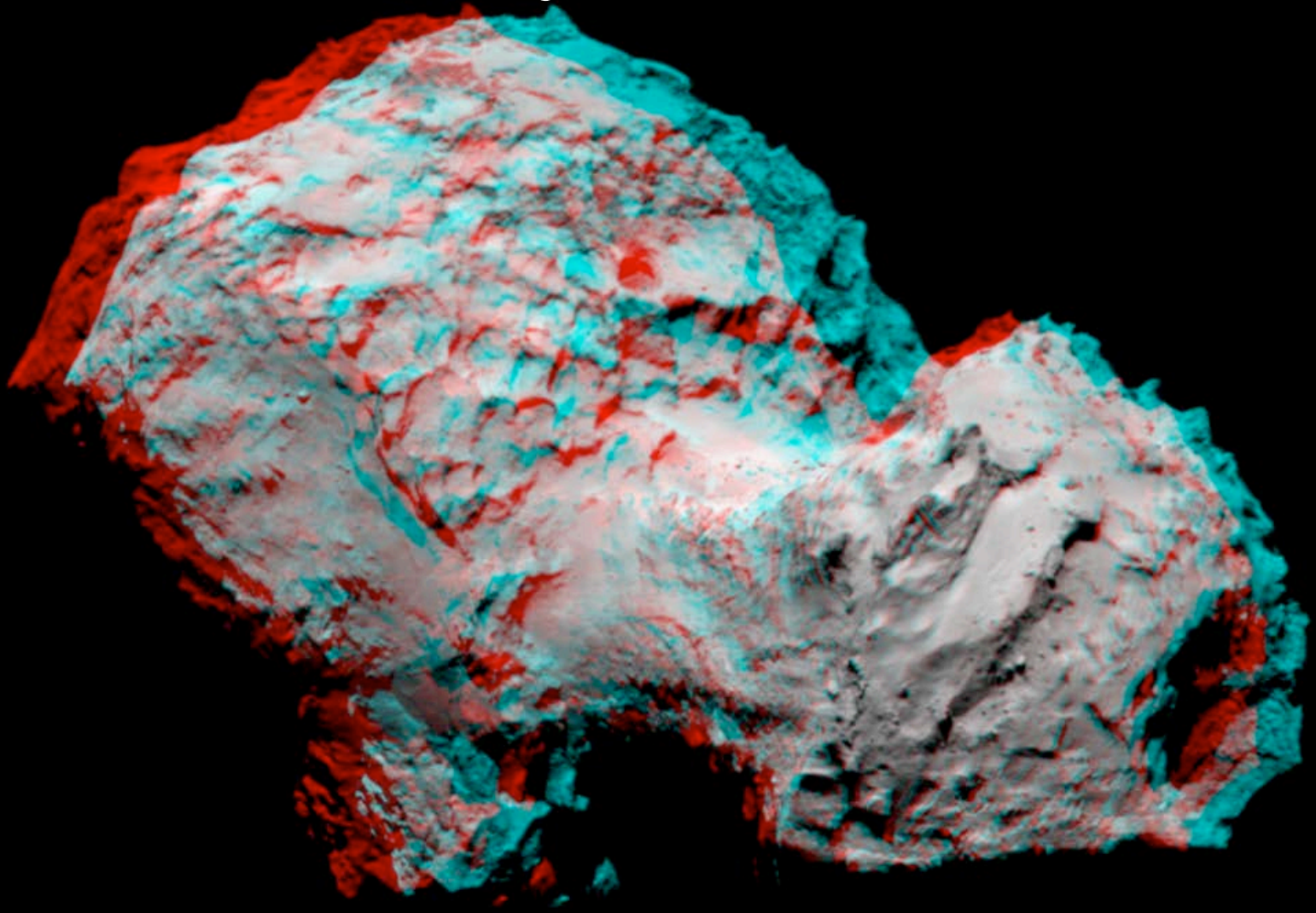
Comets

Ice-rich objects that lose mass in the form of water vapor and ice/dust grains when exposed to sufficient solar heating.

Mostly reside in the Oort Cloud ($1-5 \times 10^4$ AU) and Kuiper Belt region

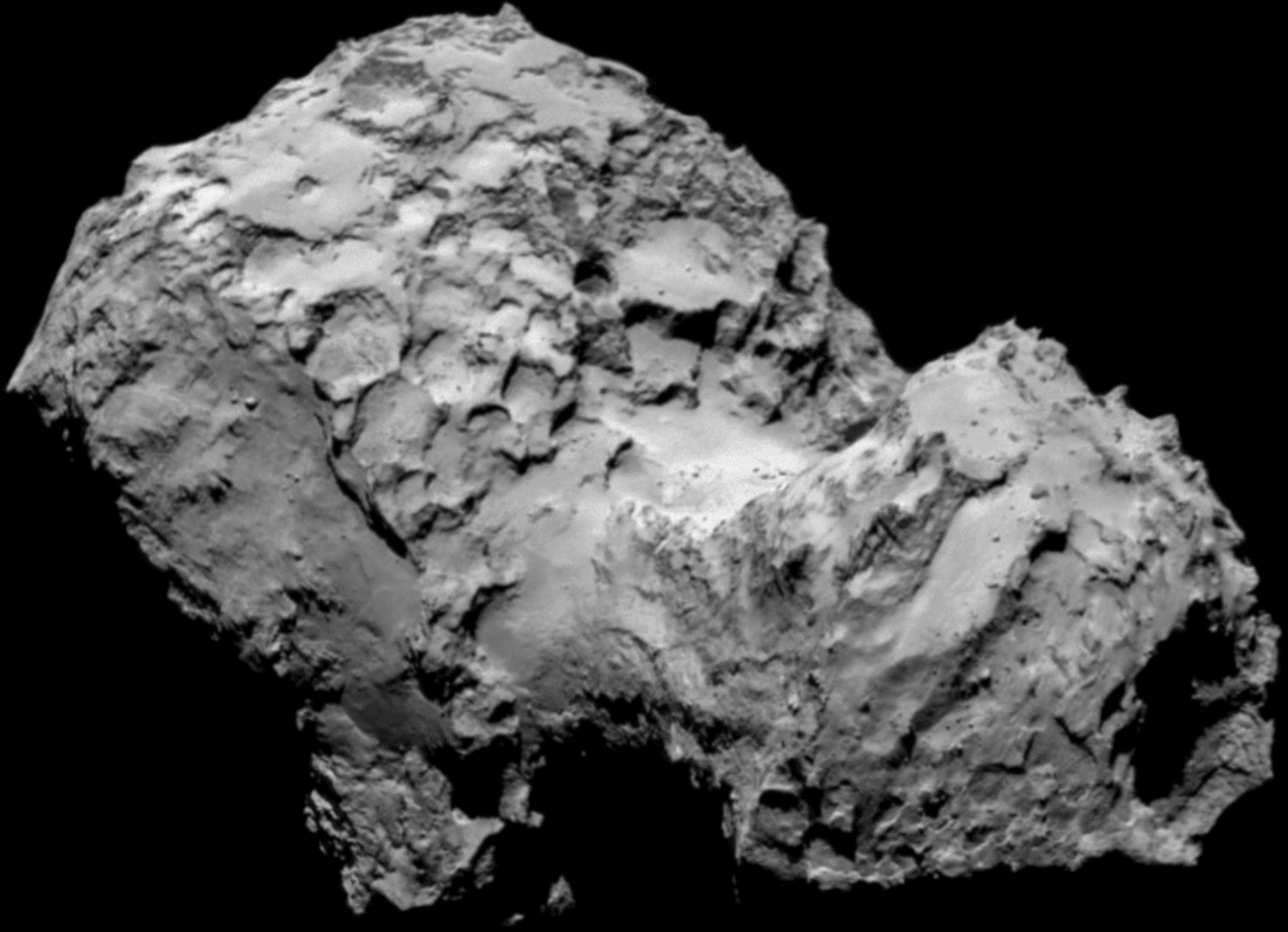


Comets: Churyumov-Gerasimenko



August 3, 2014

Comets: Churyumov-Gerasimenko



August 3, 2014

Comets: Churyumov-Gerasimenko



Survey of the Solar System

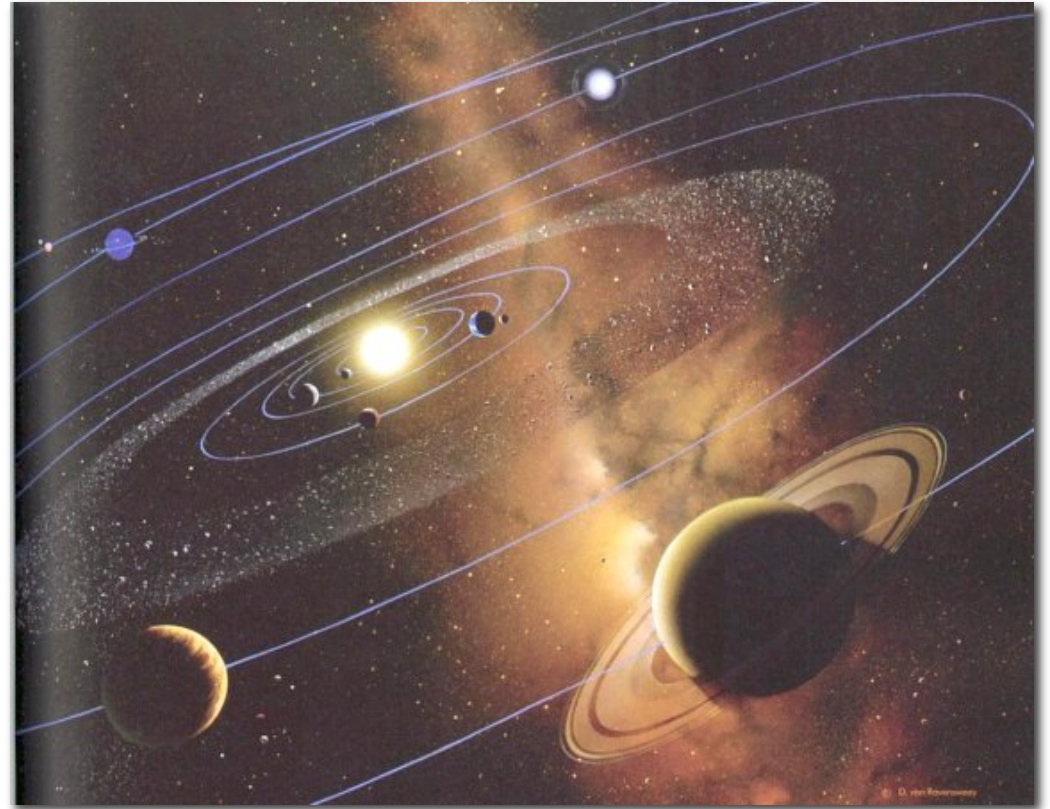
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Satellites

All but two planets (Mercury & Venus) have satellites, as do several asteroids and minor planets

The giant planets have tens of satellites each

Have a broad spectrum of variability



Satellites

Giant Planet Satellite Systems:

Tens of moons (J-67, S-62, U-27, N-14)

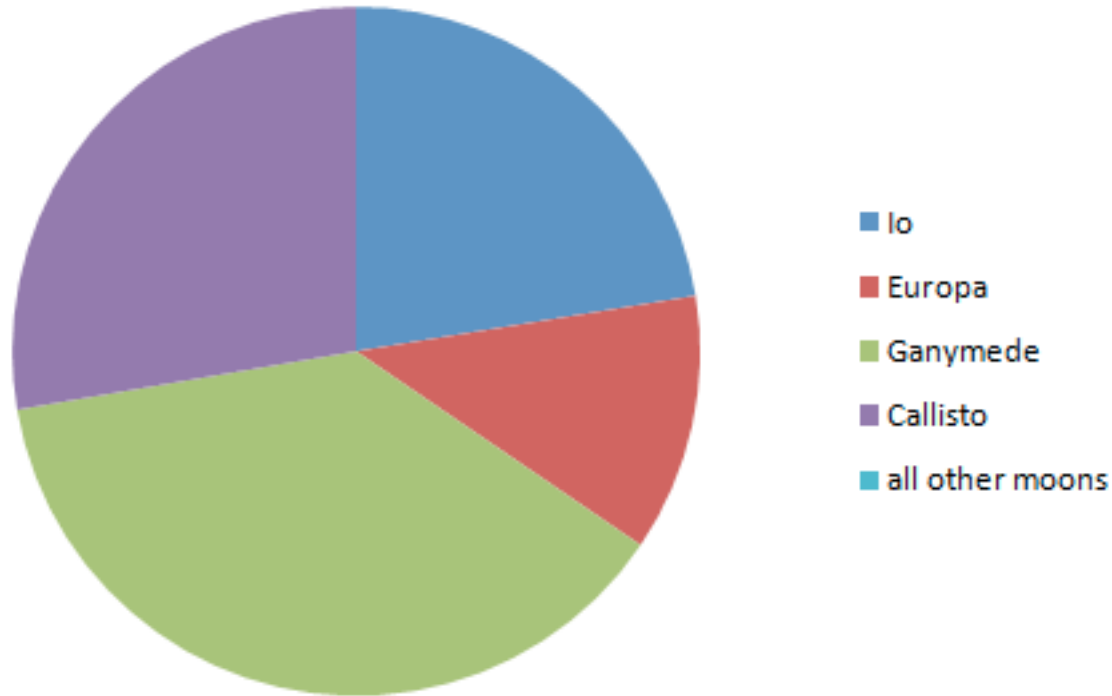
Inner moons in prograde orbits about planet
and close to the equatorial plane with low
eccentricity

Distant moons can orbit in any direction, at
any inclination and with extreme
eccentricity

*Photo by
Jan Sandberg*



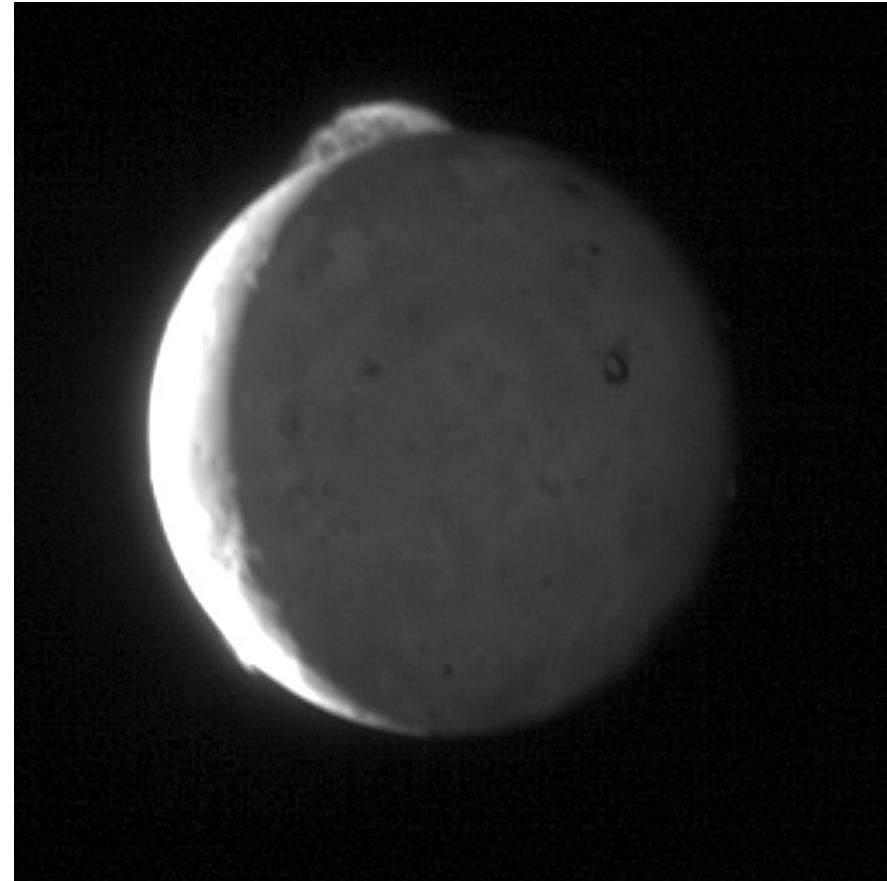
Not all moons carry equal weight...



Satellites

Giant Planet Satellite Systems:

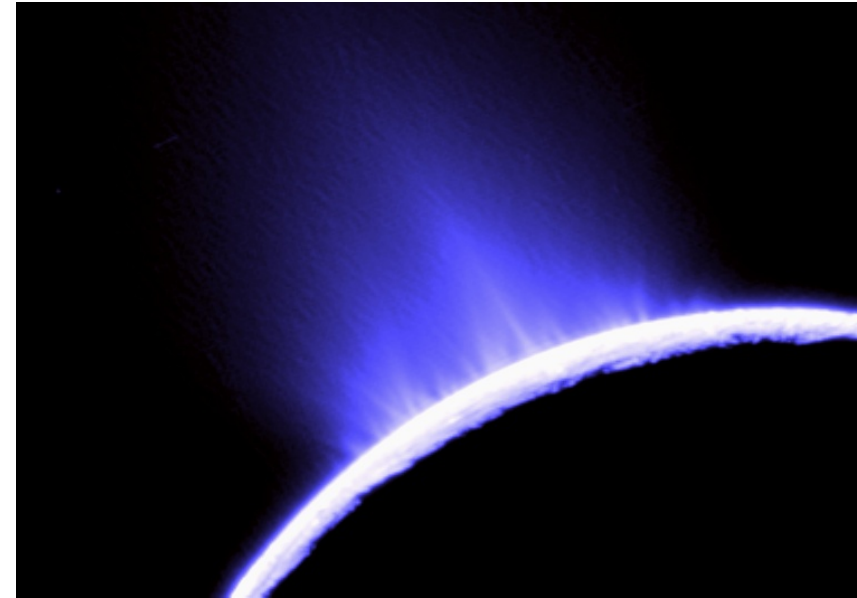
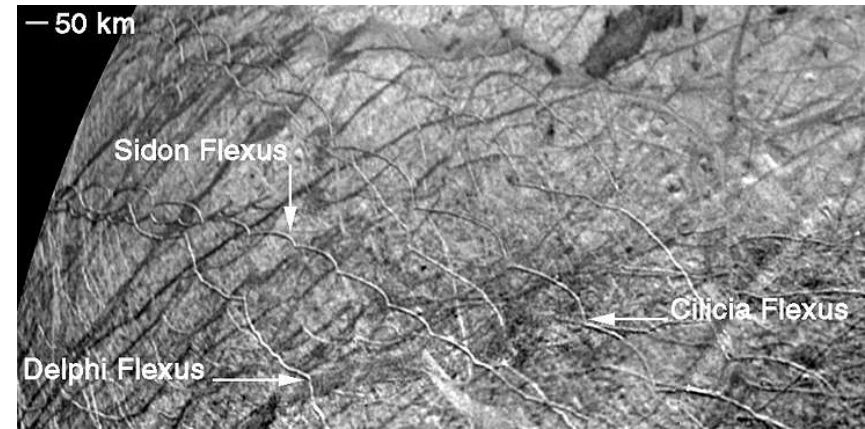
Tidal forces due to orbital eccentricity and changing gravity from other moons can generate significant interior heat for moons



Satellites

Giant Planet Satellite Systems:

Tidal heat could potentially be translated to driving volcanic activity, heating a subsurface layer, etc.

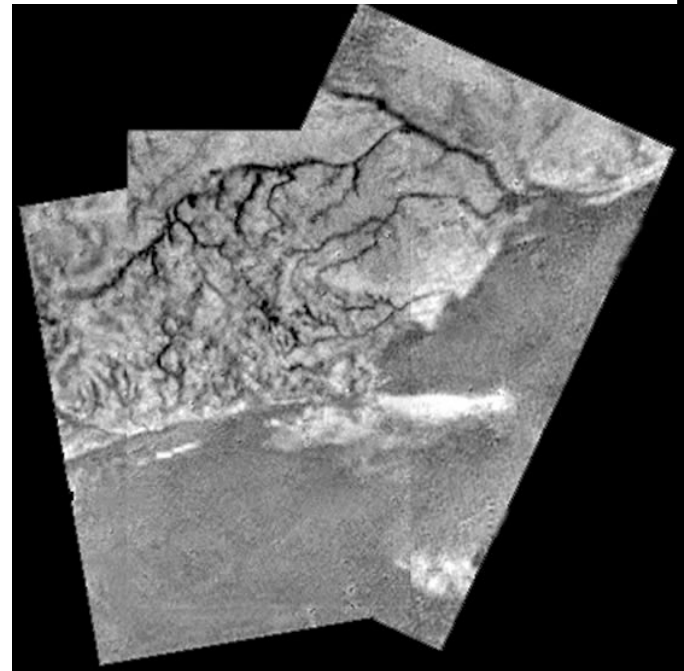
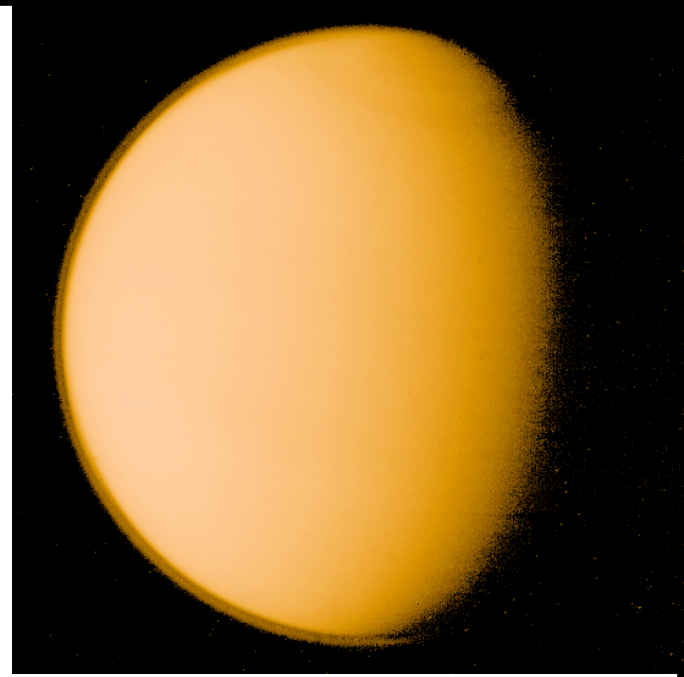


Satellites

Giant Planet Satellite Systems:

Diffuse atmospheres have been detected at several moons, including: Io, Ganymede, Enceladus

Titan's atmosphere is thicker than Earth's



Satellites

Terrestrial Moons:

Earth's moon thought to be from a large impactor early in the solar system's history

Mars's two moons appear to be captured asteroids likely from the nearby asteroid belt.

*Deimos & Phobos
from MRO*



Satellite Sizes

Pluto and Earth have largest moons relative to their size; both are likely formed from the impact of secondary planetesimals

Ganymede and Titan are larger than Mercury

Smallest moons are
~ km in size

*Earth and Moon
from Messenger spacecraft*



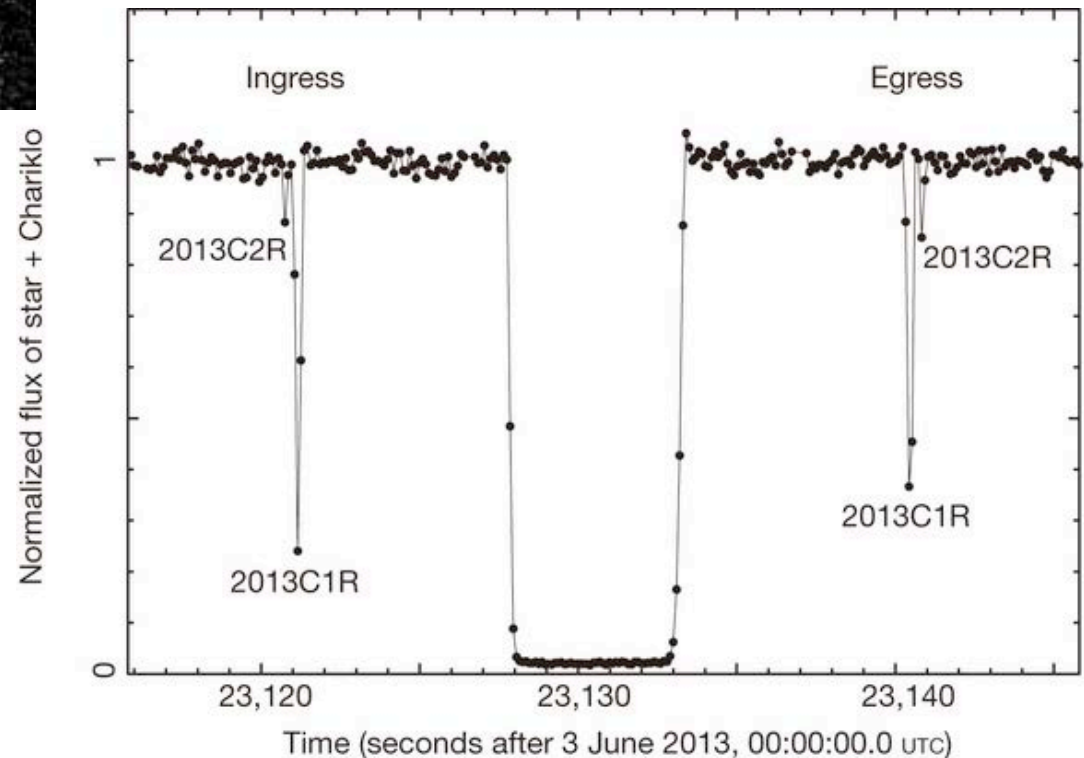
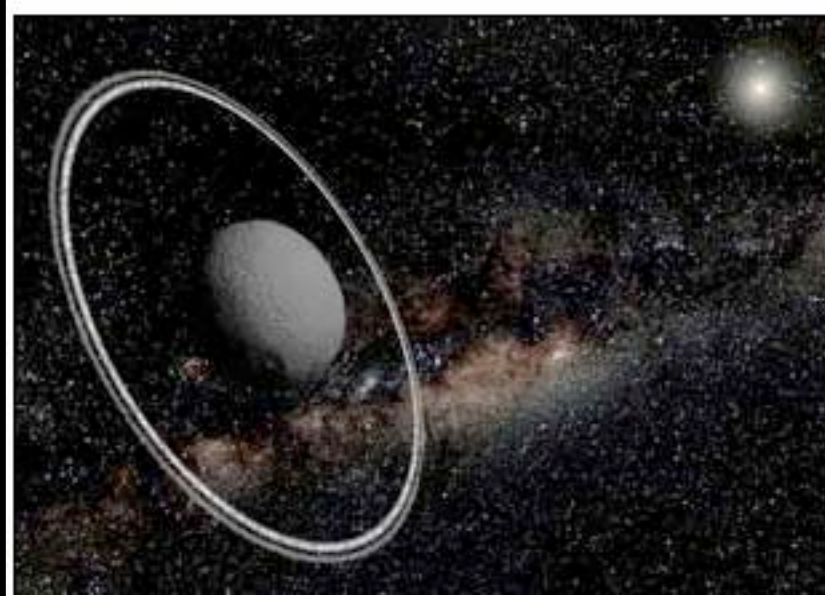
Ring Systems

Only giant planets* have confirmed ring systems **and asteroid Chariklo*

Generally thought to reside within a few radii of the planet (but recent observations show otherwise!)

Characteristics are quite variable between systems (e.g., Neptune arcs), raising many questions with respect to ring formation, life expectancy, and evolution.

Ring Systems – Chariklo! (largest centaur)



Ring Systems

Saturn:

Most observed and dynamic of the ring systems

Ring particles are made nearly entirely of water ice, with some dust and other chemicals

*Sun eclipsed by Saturn
from Cassini*

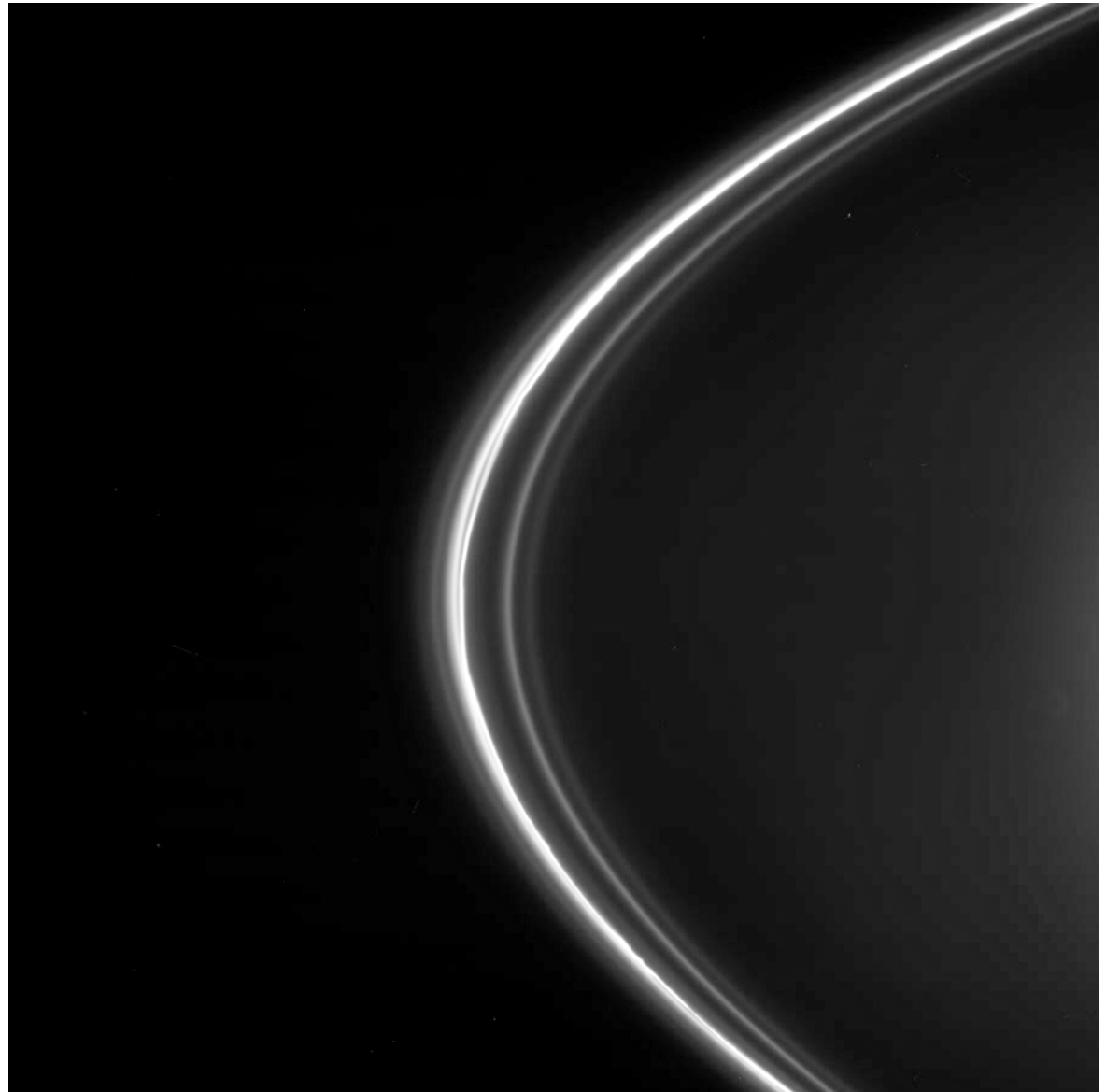


Ring Systems

Saturn:

Rings

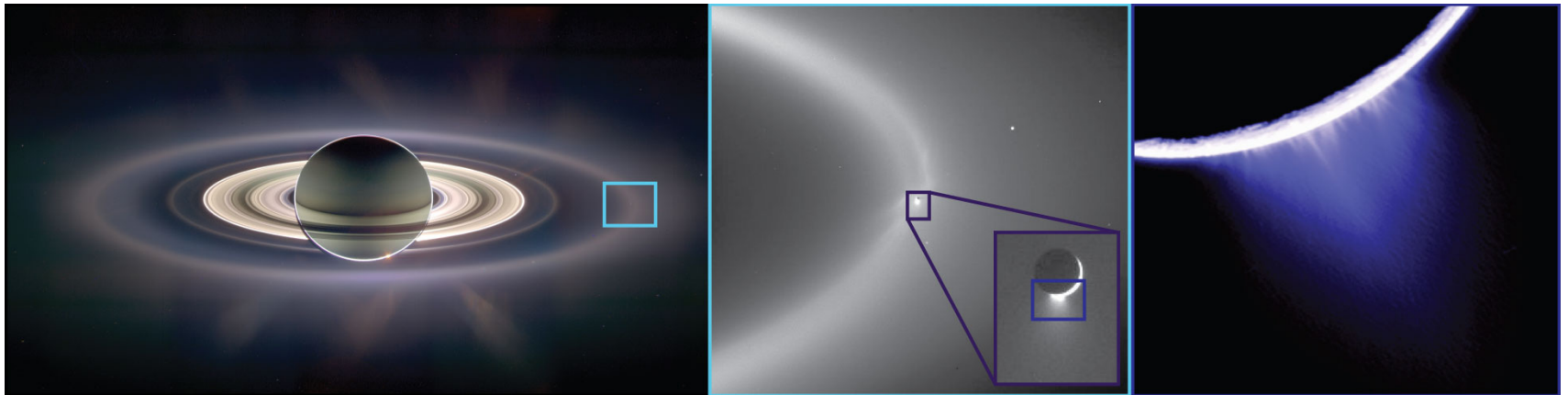
dynamically
shaped by
moons
causing
waves,
channels,
gaps, etc.



Ring Systems

Saturn:

E Ring sourced
from
cryovolcanism
on the moon
Enceladus



Ring Systems

Saturn:

Latest ring discovery
by Spitzer Space
Telescope: ring
orbiting at $100 R_s$
and tilted 27° from
inner ring plane

Corresponds to orbit
of irregular moon
Phoebe

