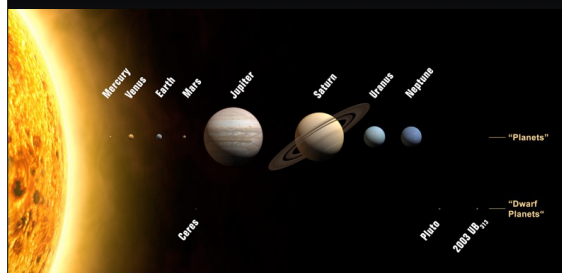


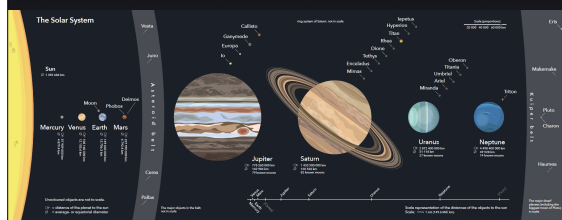
The Solar system - II



Koupelis : chapters 7 & 8
OpenStax : chapters 11, 12 & 13

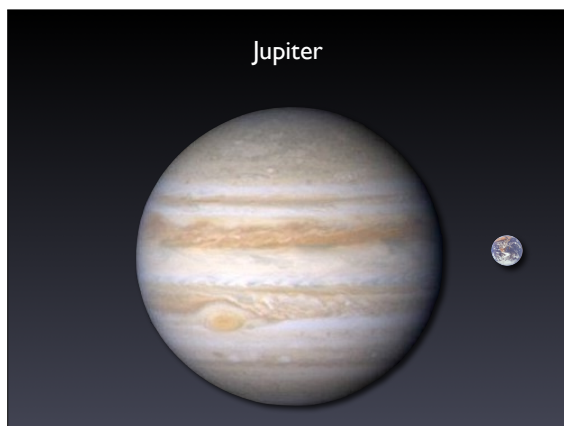
Moons in the Solar system

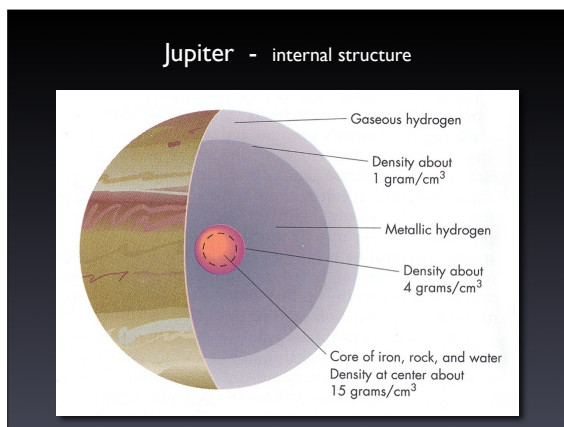
Number of moons: Jupiter: 79, Saturn: 62, Uranus: 27, Neptune: 14



Gas planets

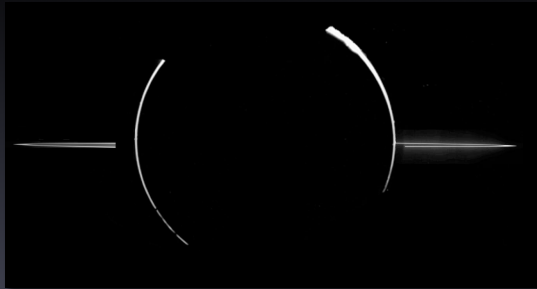




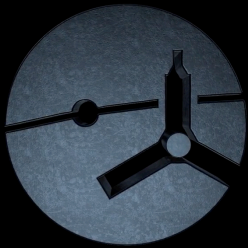




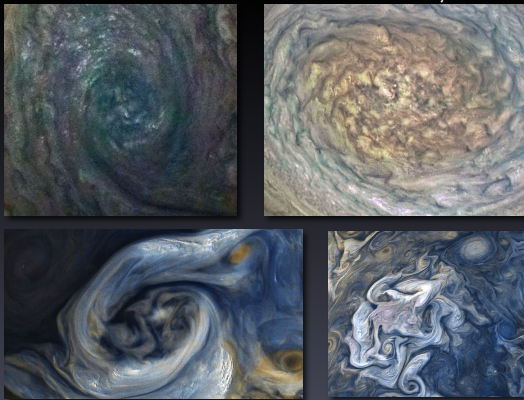
Jupiter - a system of thin rings

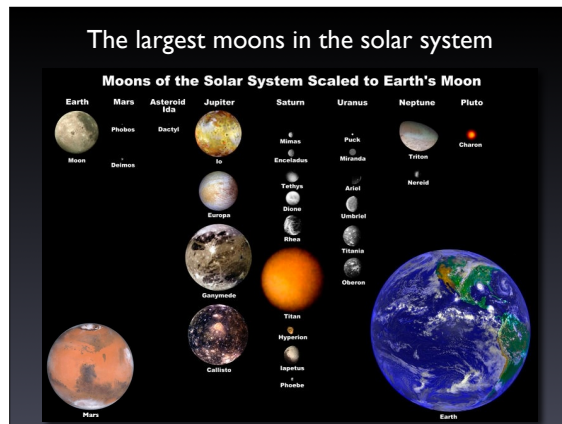
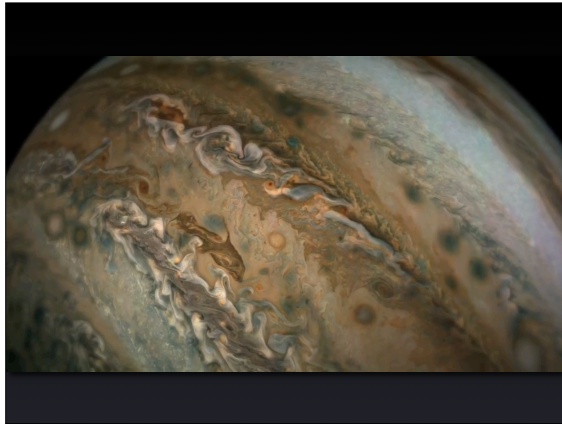


www.missionjuno.swri.edu

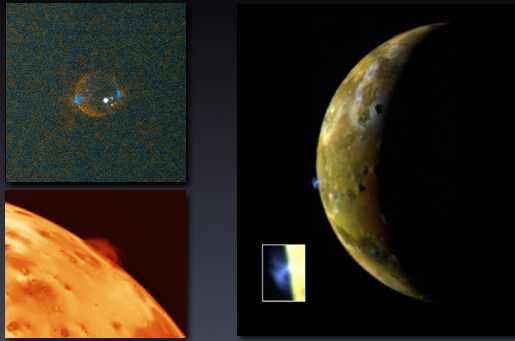


www.missionjuno.swri.edu

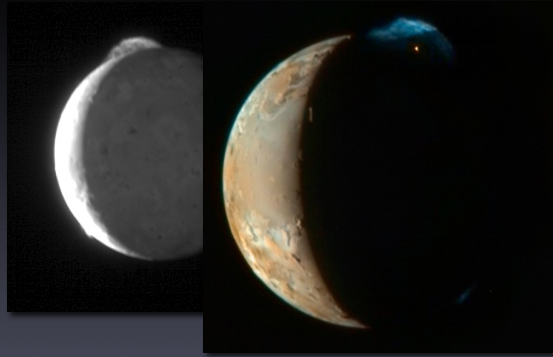




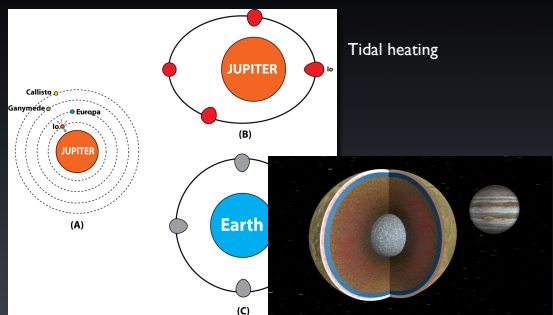
Io - a moon with volcanoes



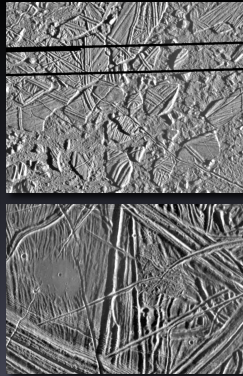
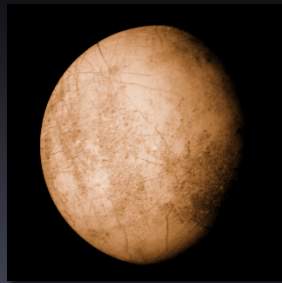
Io - a moon with volcanoes



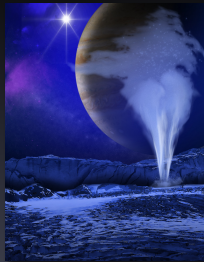
Io - a moon with volcanoes



Europa - ice & water ?

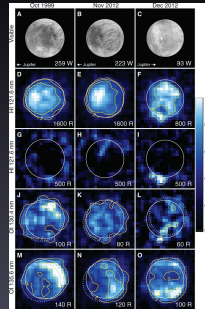


Europa - ice & water ?

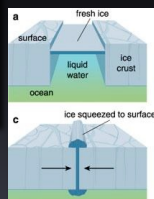
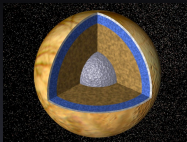


cryovolcanism

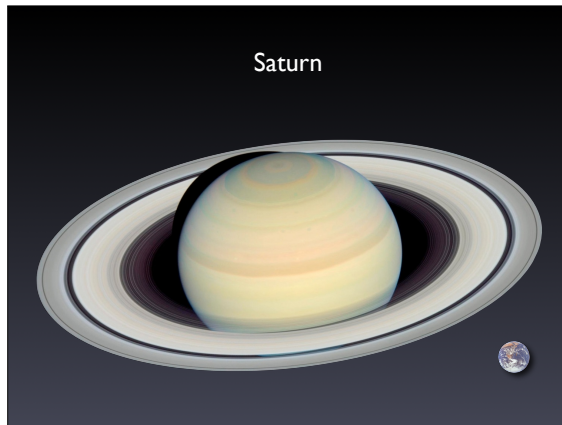
Hubble:
UV observations:
plumes
200 km high
water vapor

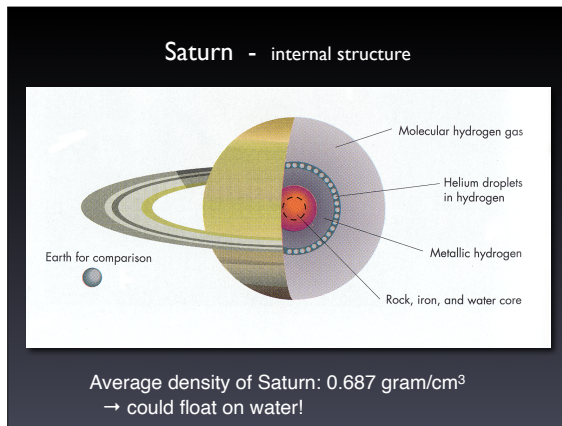


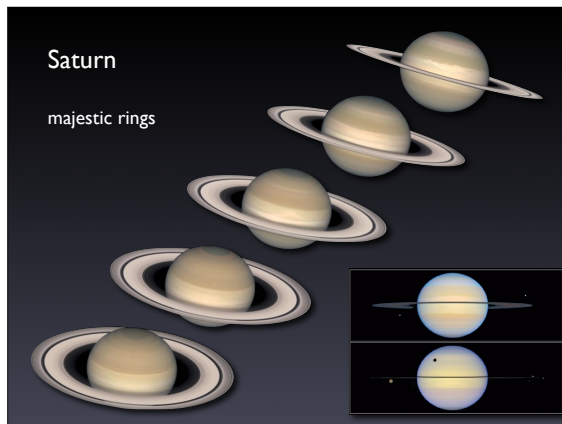
Europa - water & life ?

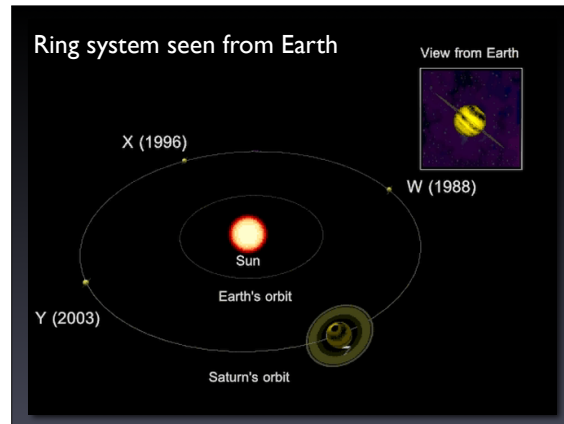


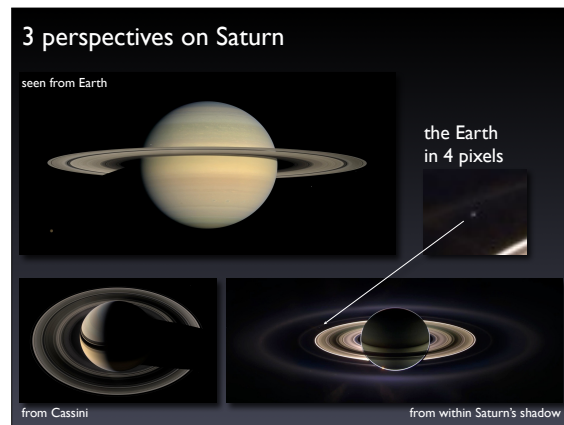
ESA's Cosmic Vision programme:
2023 launch of JUICE mission to Jupiter
Arrival: 2031

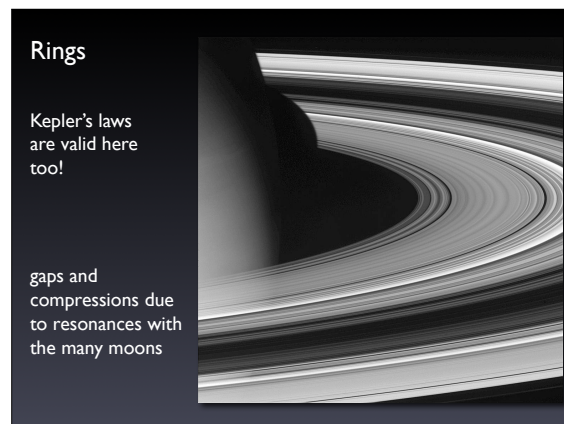


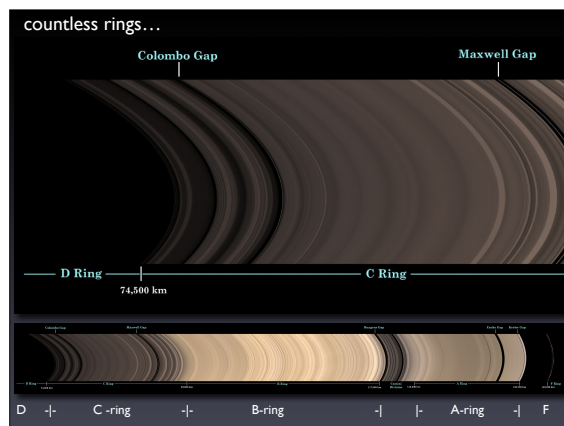




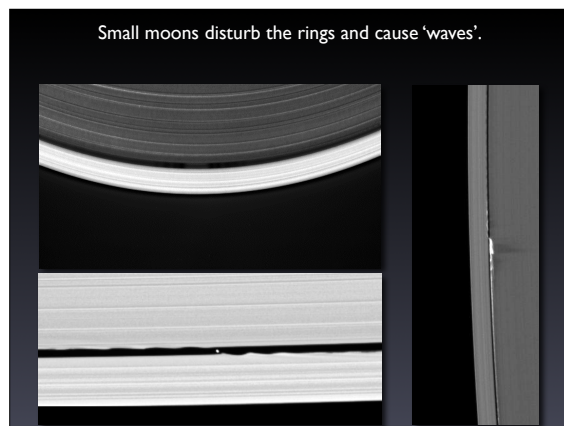




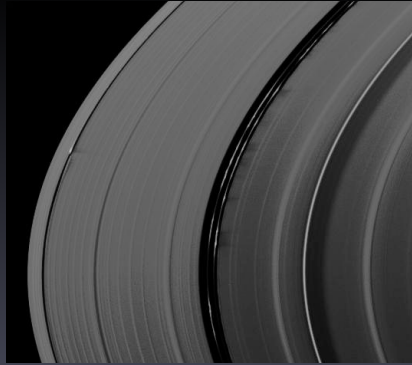






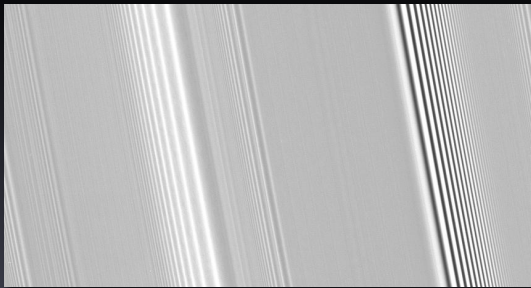


vertical waves cast shadows



two kinds of spiral waves

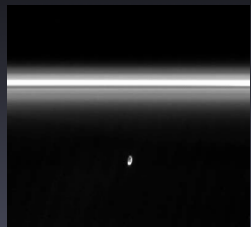
← to Saturn



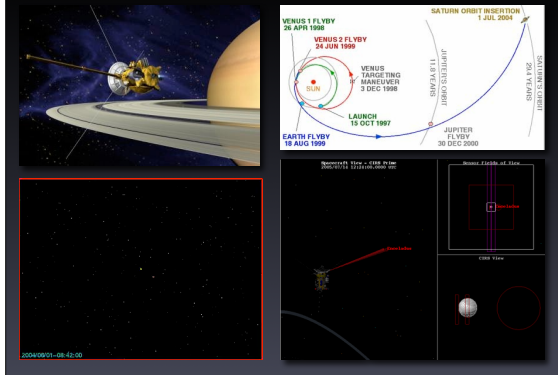
density waves ↑

corrugated waves ↑

Two 'shepherd-moons'
Prometheus & Pandora
maintain and shape
the F-ring.



The Cassini-Huygens mission



Saturn - a variety of moons



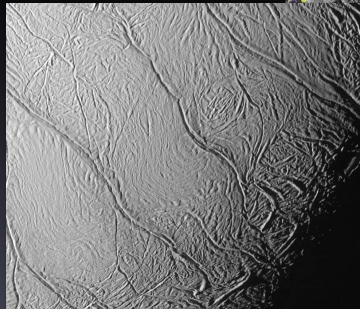
Iapetus - a moon with two faces...



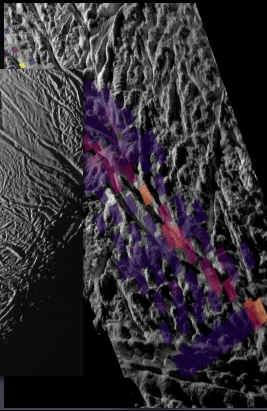
...and an equatorial mountain ridge.

Enceladus

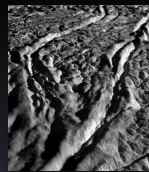
a mysterious ice-moon



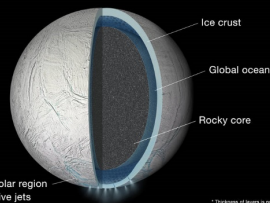
'tiger-strips'



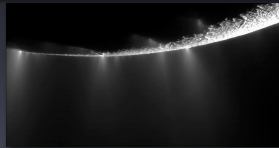
tiger-strips are a source of water vapour and ice-geysers



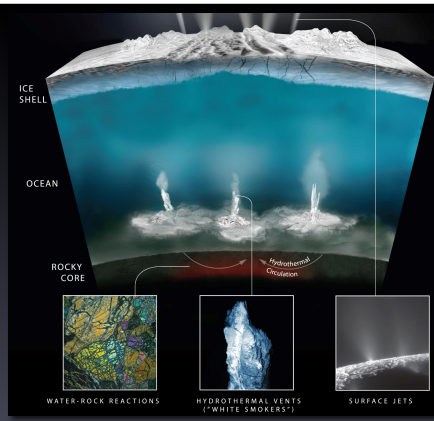
Global Ocean on
Saturn's Moon
ENCELADUS



* Thickness of layers is not to scale



ice-geysers



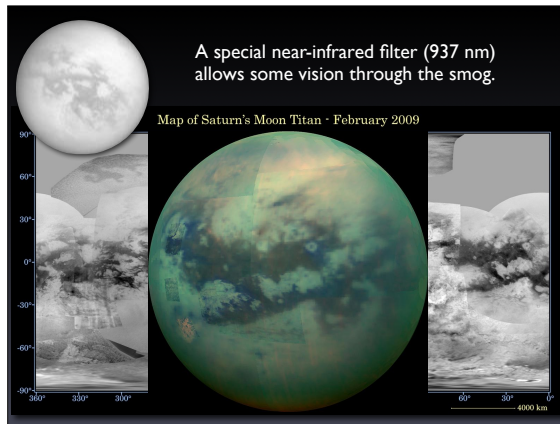


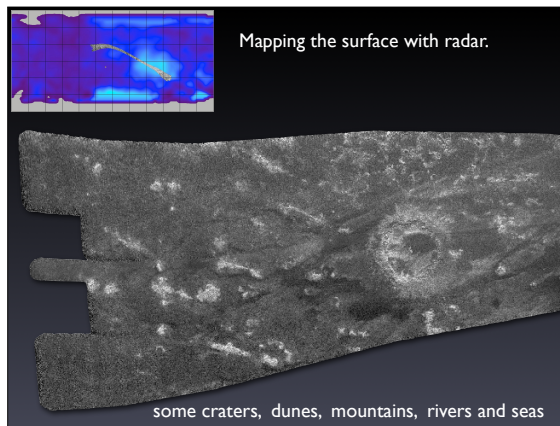
Geysers 'feed' the E-ring

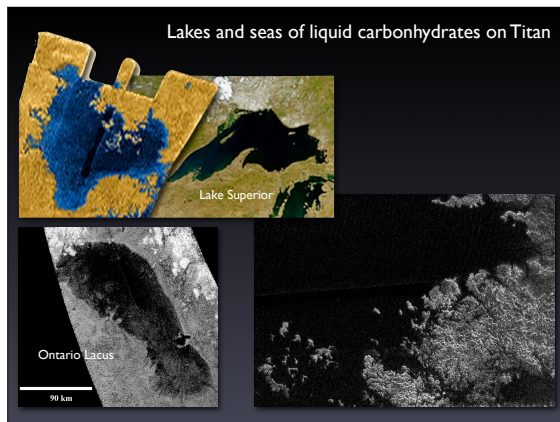


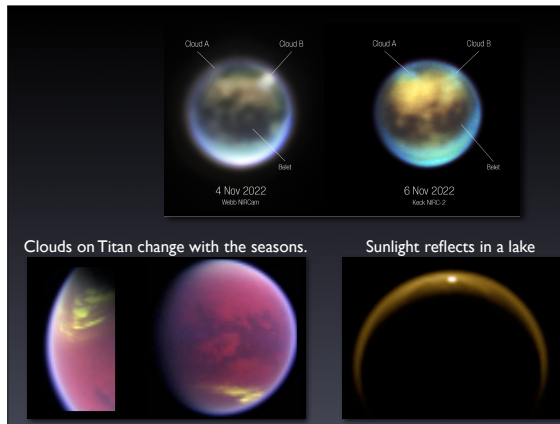
Titan - the largest Moon of Saturn

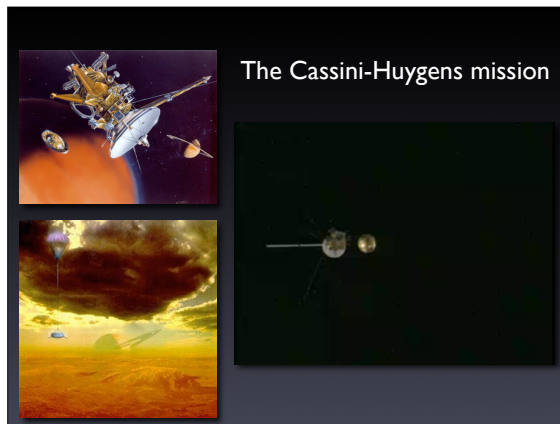
a thick, cold atmosphere filled with smog

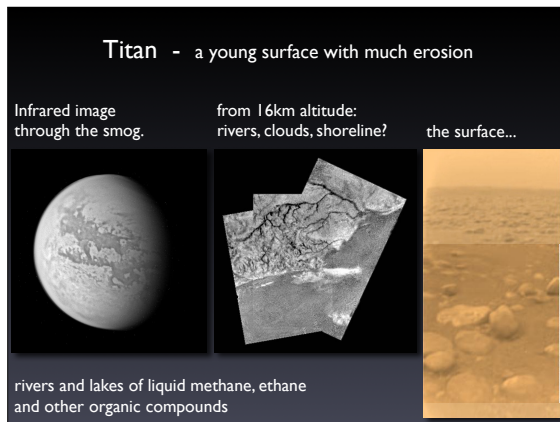












Uranus

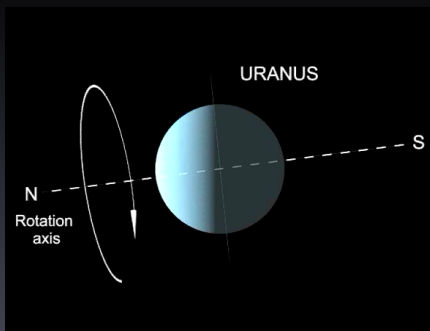


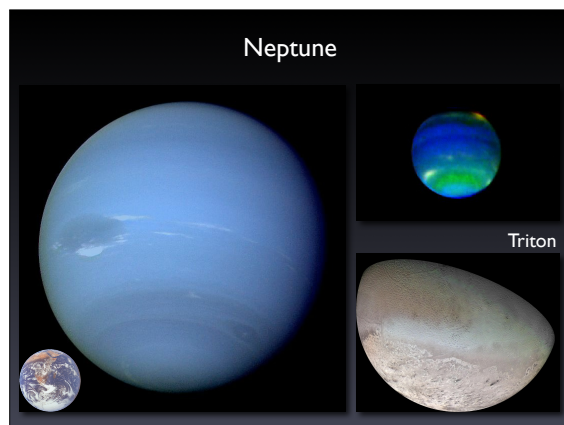
Uranus - a system of rings

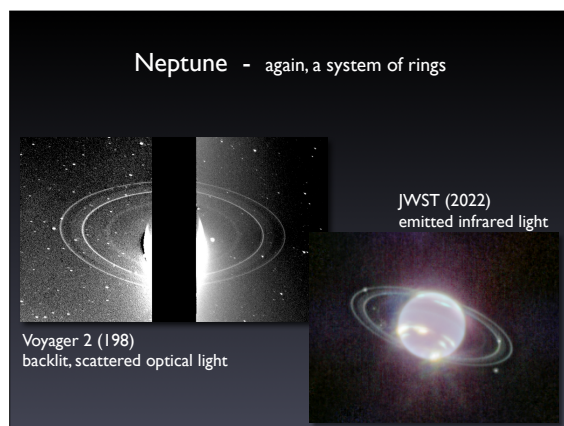
and many moons

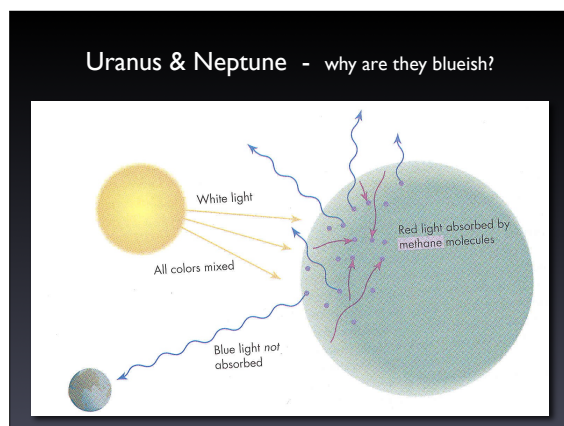
Aug 1
94

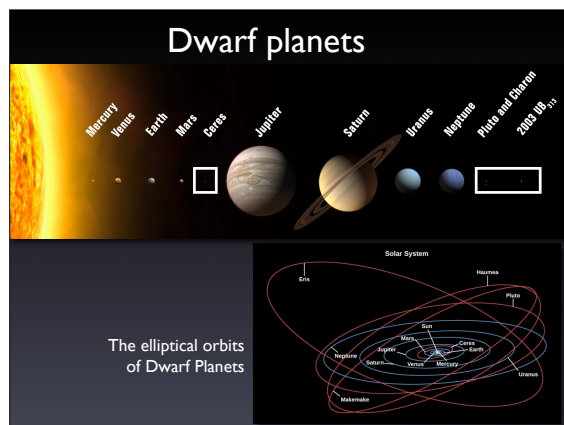
Uranus - extreme obliquity of the rotation axis

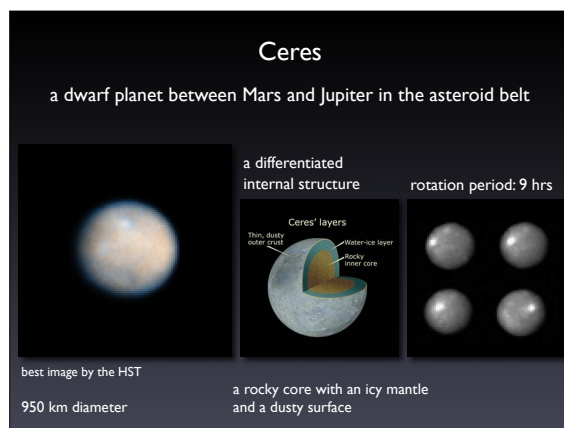


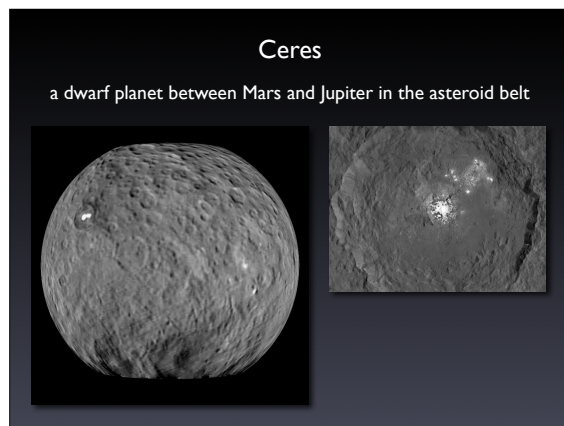












Pluto & Charon

a double dwarf planet

Pluto & Charon with four newly discovered moons

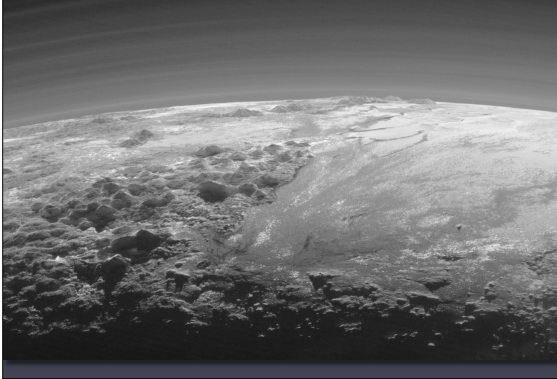
See: *New Horizons* mission to Pluto <http://pluto.jhuapl.edu>

Pluto & Charon

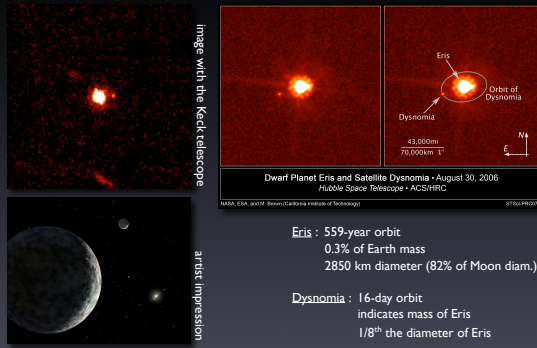
See: *New Horizons* mission to Pluto <http://pluto.jhuapl.edu>

Pluto & Charon

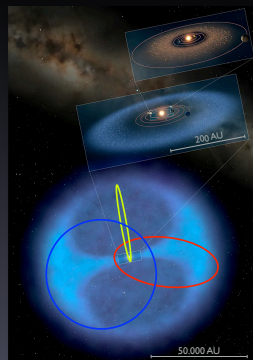
Pluto - a thin, layered atmosphere



Eris and its moon Dysnomia



'Small Solar System Bodies'



Asteroid belt:

Carbonaceous (C-type)
Metallic (M-type)
Silicaceous (S-type)
Ceres (dwarf planet)

Kuiper belt:

TNO's : comets and dwarf planets

Oort cloud:

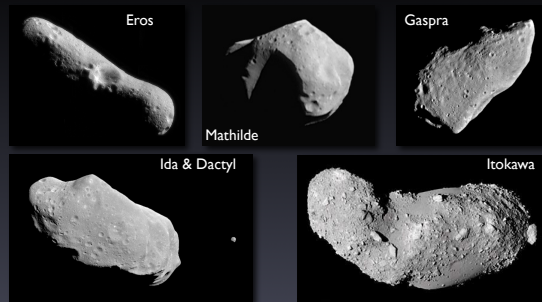
non-periodic comets

'Small Solar System Bodies'

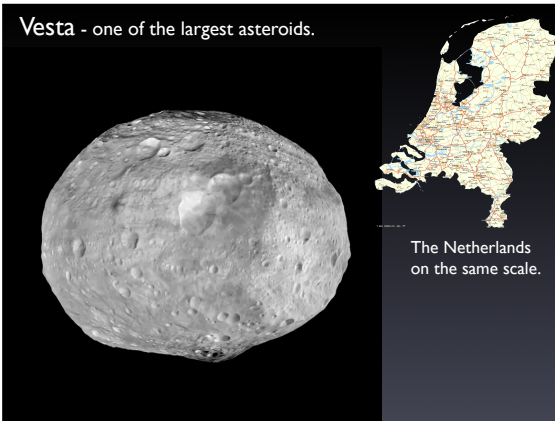
the orbits of asteroids

The animation represents a map of the increased count of all known asteroids in the solar system between Jan. 1, 1999 and Jan. 31, 2018. (Blue represents near-Earth asteroids. Orange represents main-belt asteroids between the orbits of Mars and Jupiter.)

Asteroids



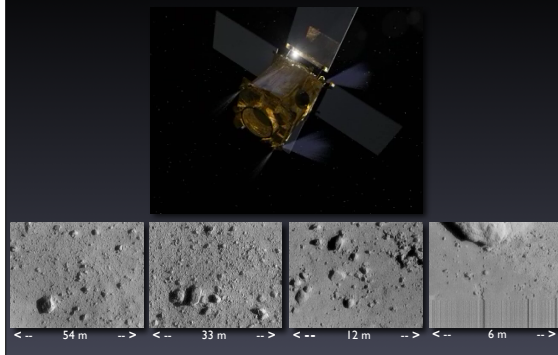
Vesta - one of the largest asteroids.



NEAR spacecraft in orbit around Eros

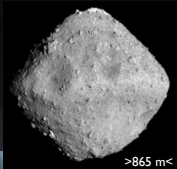


a soft landing on Eros

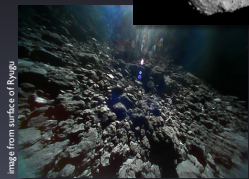
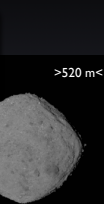


Asteroid sample return missions

Hayabusa-2 at Ryugu



Osiris-Rex at Bennu



DART - Double Asteroid Redirection Test

changing the orbit of asteroid moon Dimorphos

26 September 2022

Orbital period: $11^h 55^m \rightarrow 11^h 23^m$

www.nasa.gov/dart

Arrokoth: the most distant object visited

New Horizons mission time line

- Launch : 19 Jan 2006
- Jupiter flyby : 28 Feb 2007
- Pluto flyby : 14 Jul 2015
- Arrokoth flyby : 1 Jan 2019

35 km

Comets

Wild 2

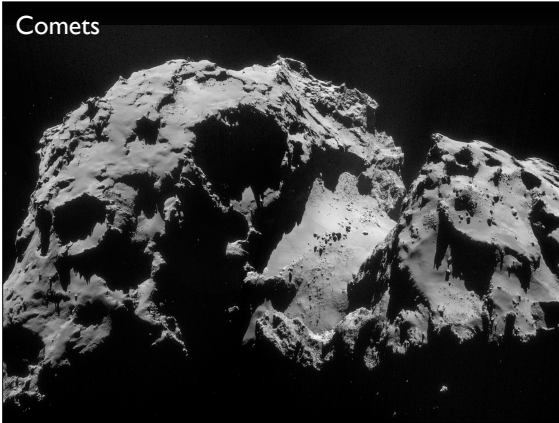
Halley

Tempel 1

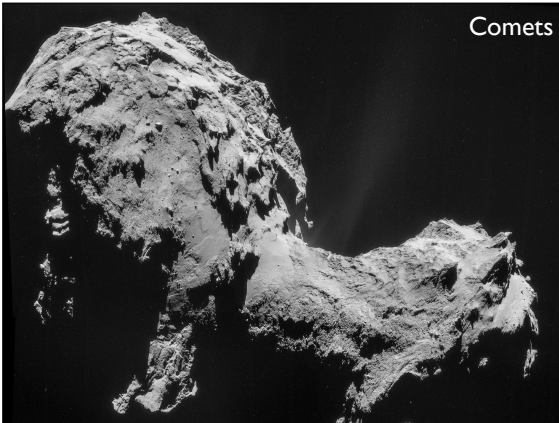
Borrelly

67P-CG

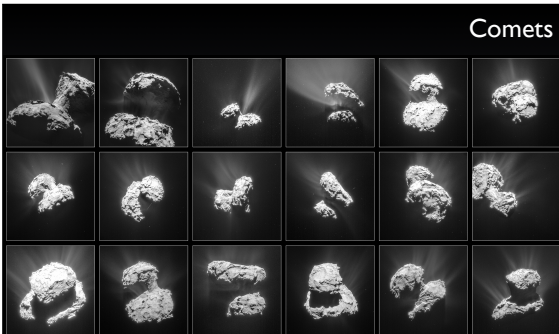
Comets



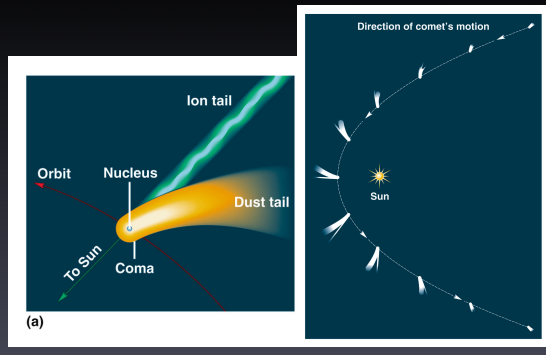
Comets



Comets

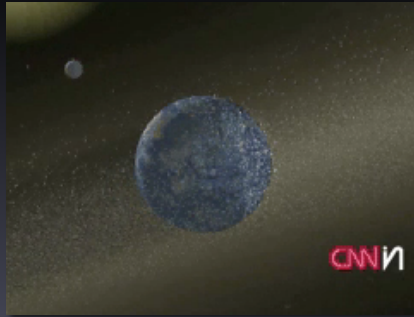


Comets - composition



Comets - a source of meteorites

Perseid meteors (August 11-13):
Earth passing through debris from comet Swift-Tuttle



Next lecture: the Sun & the stars

- Magnetic fields & stellar activity
- Stellar classification
- The Hertzsprung-Russell diagram

