Review for Test #2 Oct 11

Topics:

- The Solar System and its Formation
- The Earth and our Moon
- The Terrestrial Planets
- The Jovian Planets
- Moons, Rings, Pluto, Comets, Asteroids, Dust, etc.
- The Sun

Methods

- Conceptual Review and Practice Problems Chapters 5 – 8 and 10
- Review lectures (on-line) and know answers to clicker questions
- Try practice quizzes on-line

•Bring:

- Two Number 2 pencils
- Simple calculator (no electronic notes)

Reminder: There are NO make-up tests for this class

Test #2 Review

How to take a multiple choice test

1) Before the Test:

- Study hard
- Get plenty of rest the night before

2) During the Test:

- Draw simple sketches to help visualize problems
- Solve numerical problems in the margin
- Come up with your answer first, then look for it in the choices
- If you can't find the answer, try process of elimination
- If you don't know the answer, Go on to the next problem and come back to this one later
- TAKE YOUR TIME, don't hurry
- If you don't understand something, ask me.

Test #2 Useful Equations

Kepler's laws, including: $P^2 \ \alpha \ a^3$

Gravitation:

$$F = \frac{G\, m_1\, m_2}{R^2}$$

Equivalence of Matter and Energy:

$$E = mc^2$$

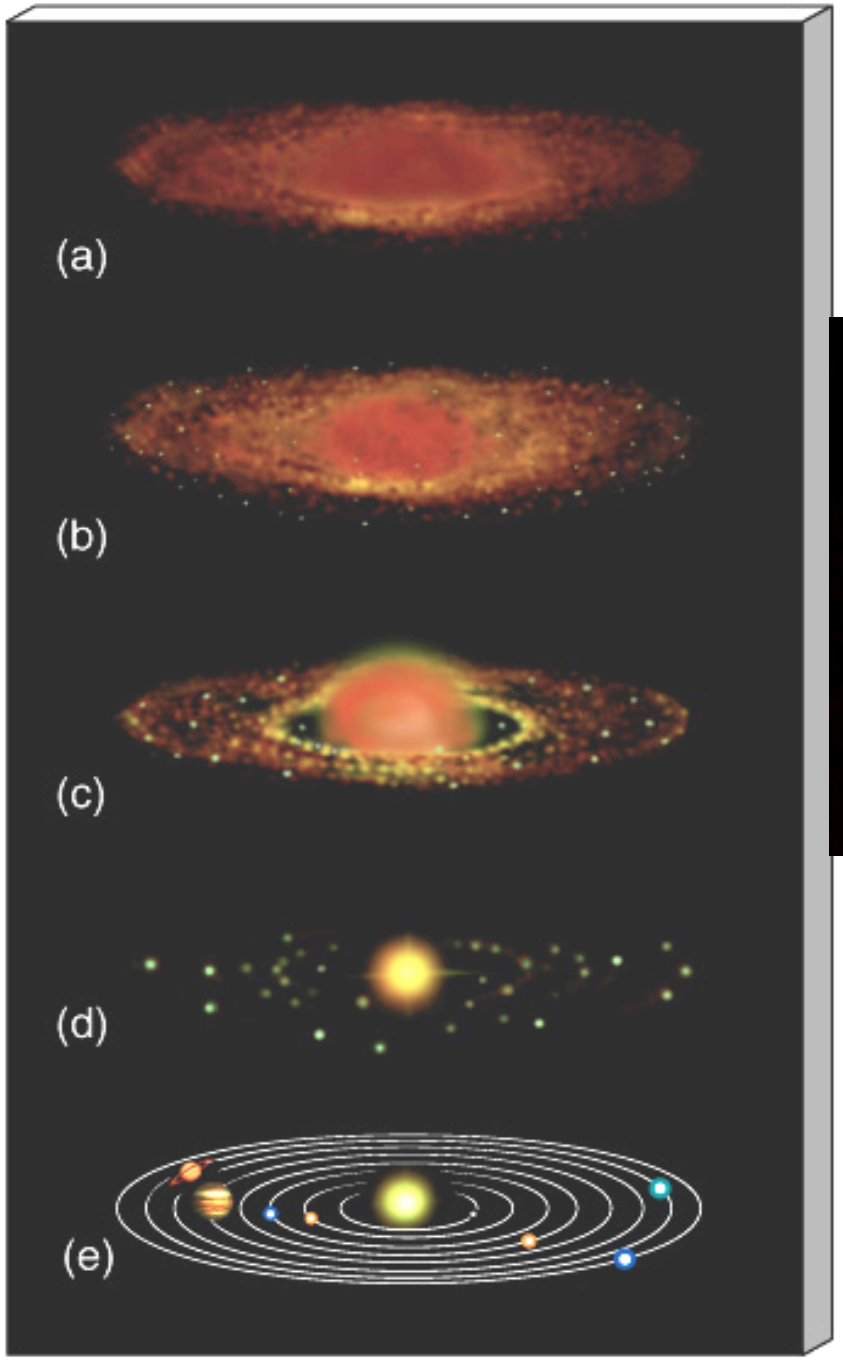
initial gas and dust nebula

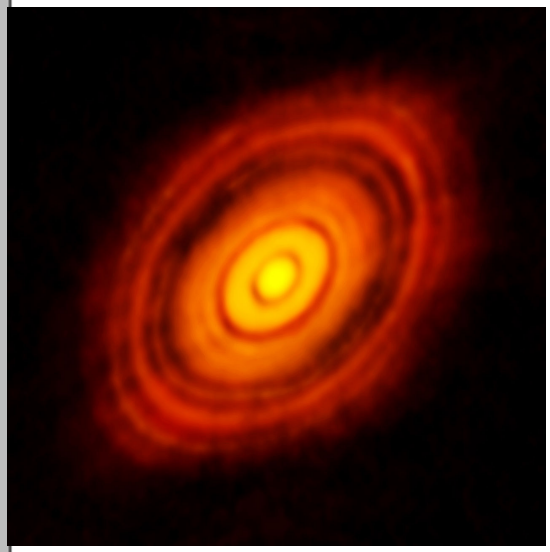
dust grains grow by accreting gas, colliding and sticking

continued growth of clumps of matter, producing planetesimals

planetesimals collide and stick, enhanced by their gravity

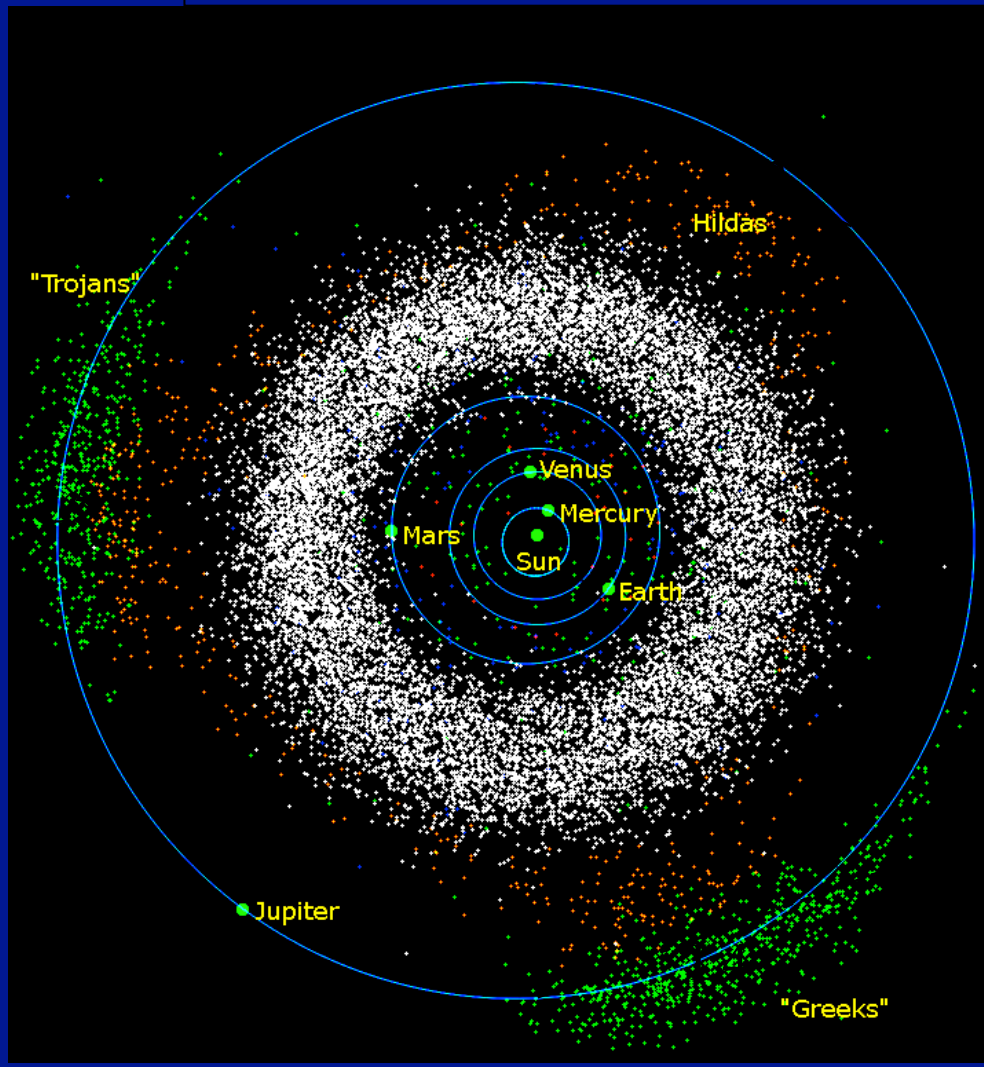
result is a few large planets



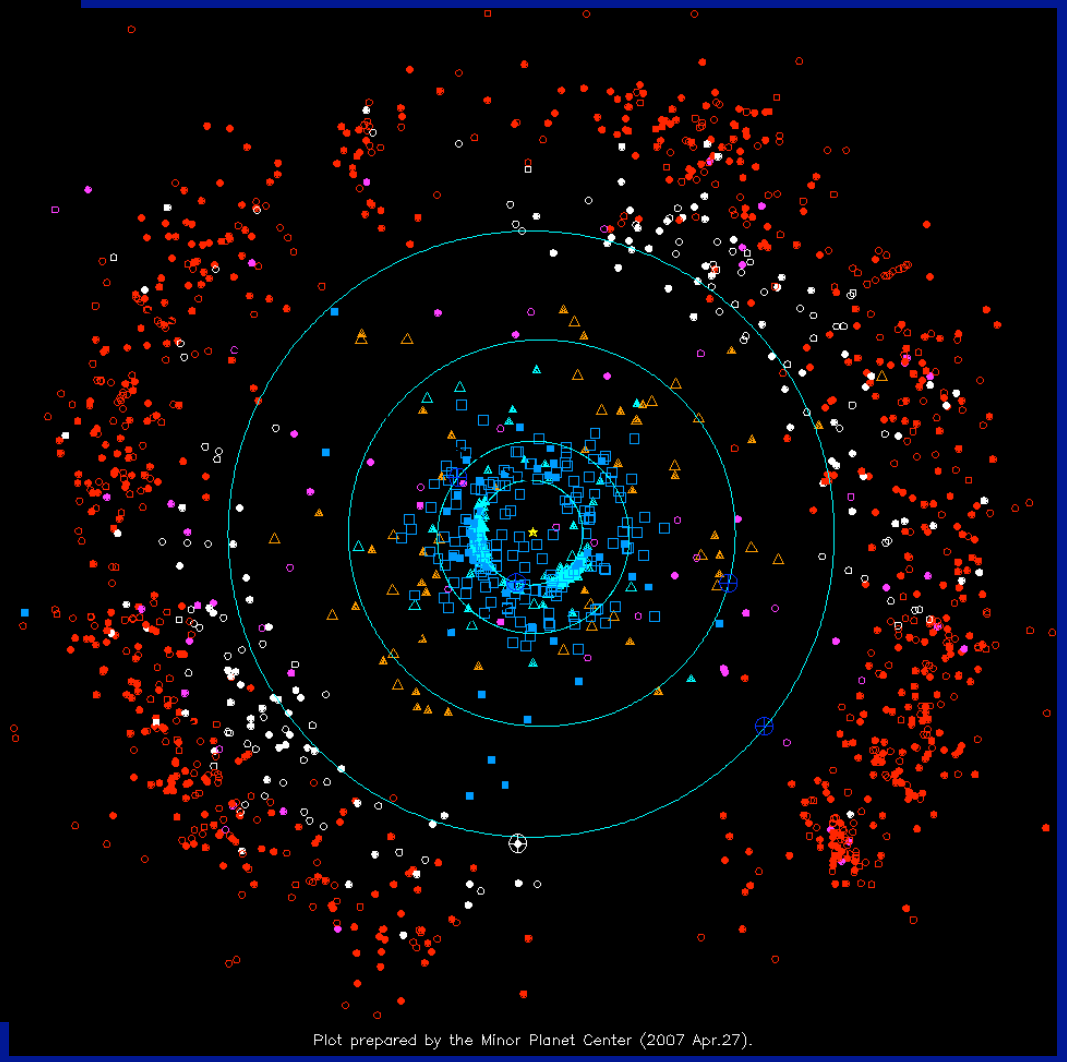


ALMA mm image of HL Tau showing a disk around a young star with ring structure. Unseen planet sweeping out gaps?

The Structure of the Solar System

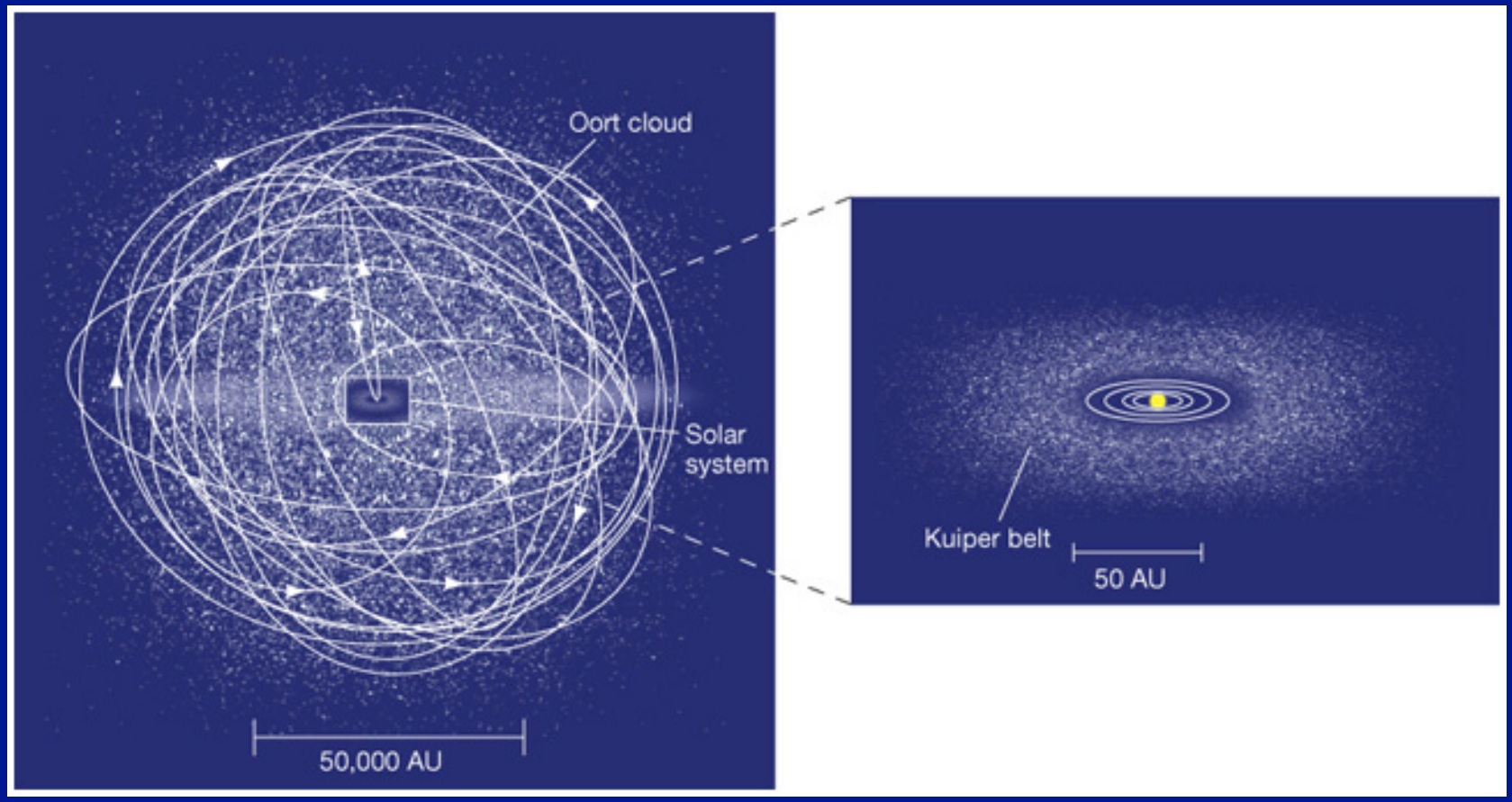


~ 5 AU



~ 45 AU

Oort Cloud is a postulated huge, roughly spherical reservoir of comets surrounding the Solar System. ~10^8 objects? Ejected planetesimals.

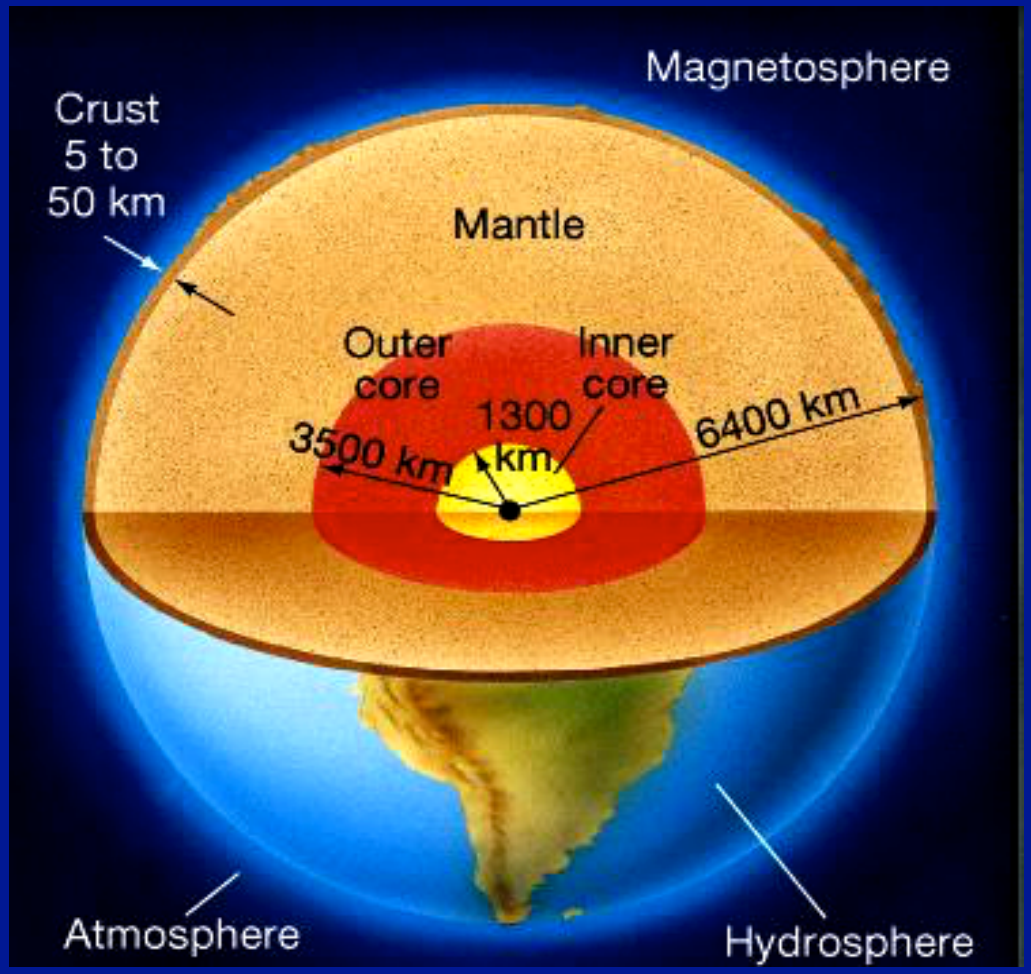


A passing star may dislodge Oort cloud objects, plunging them into Solar System, where they become comets.

If a Kuiper Belt object's orbit takes it close to, e.g., Neptune, its orbit may be changed and it may plunge towards the inner Solar System and become a comet.

Earth's Internal Structure

How do we know? Earthquakes. See later



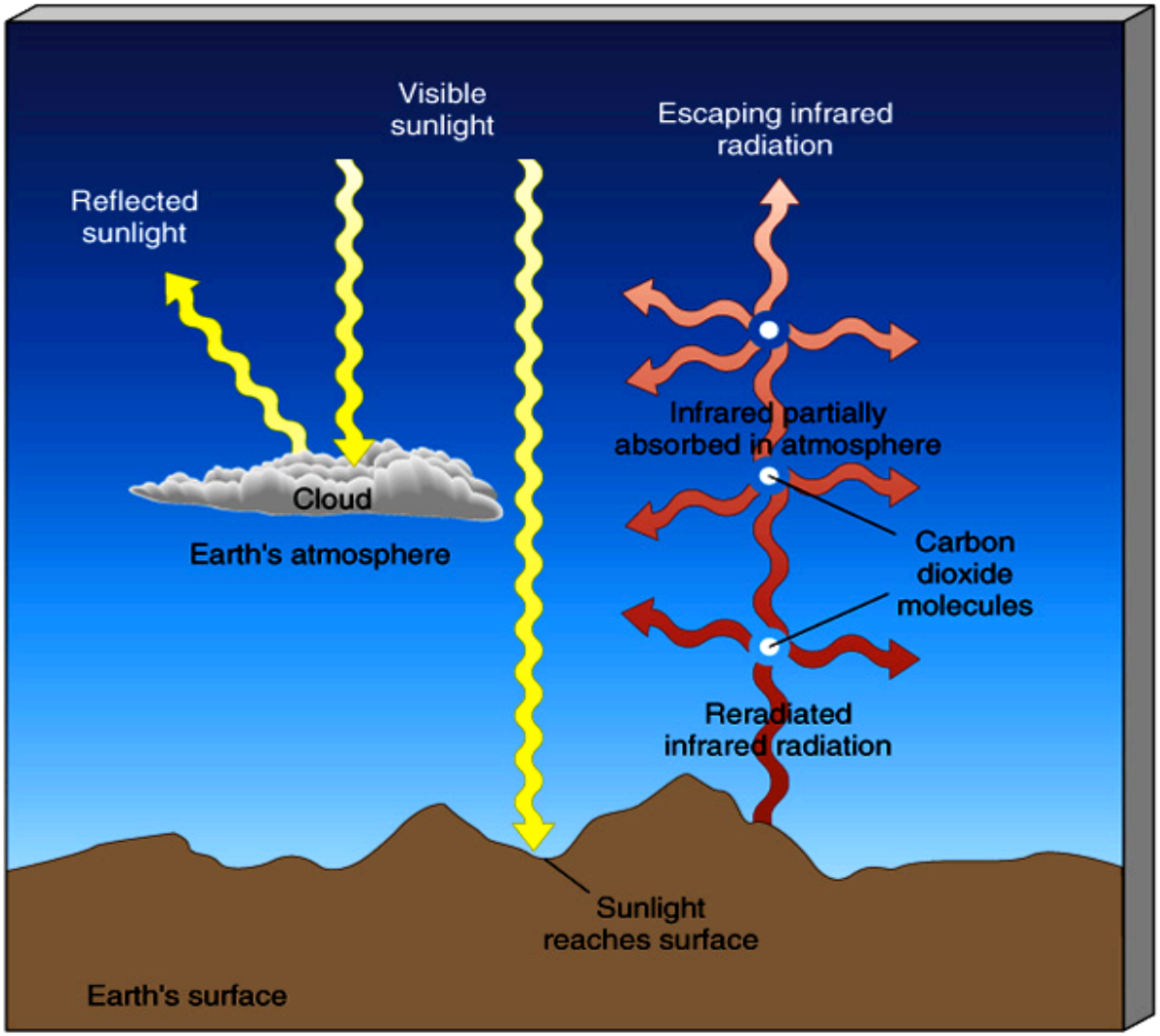
Crust: thin. Much Si and Al (lots of granite). Two-thirds covered by oceans.

Mantle is mostly solid, mostly basalt (Fe, Mg, Si). Cracks in mantle allow molten material to rise => volcanoes.

Core temperature is 6000 K. Metallic - mostly nickel and iron. Outer core molten, inner core solid.

Atmosphere very thin

The Greenhouse Effect



Main greenhouse gases are H_2O and CO_2.

If no greenhouse effect, surface would be 40 °C cooler!

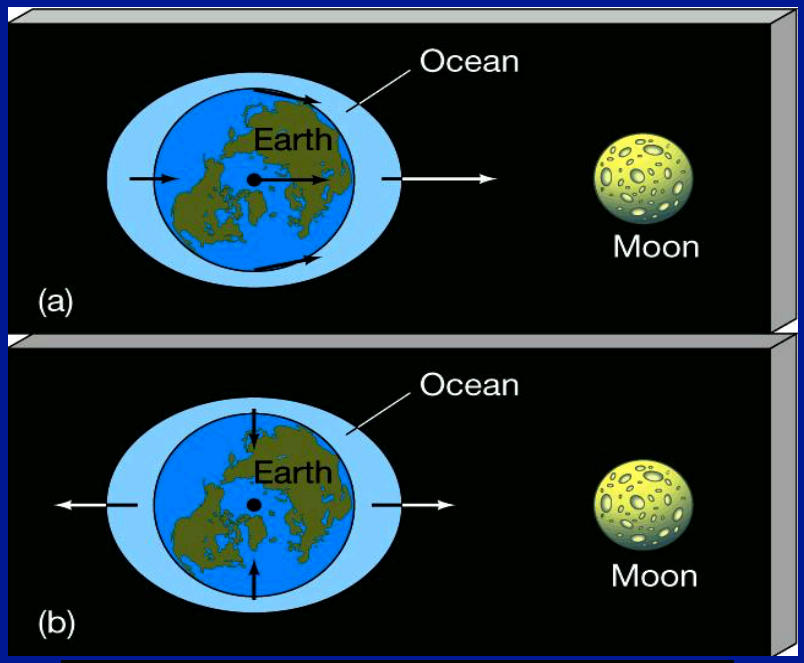
The Moon

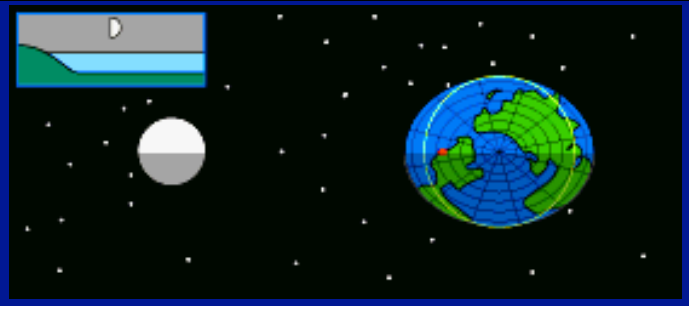
Tides

A feature of oceans (but solid material has small tides too).

Two high and two low tides per day.

Tides are due to Moon's gravitational pull being stronger on side of Earth closest to it (Sun causes smaller tides).

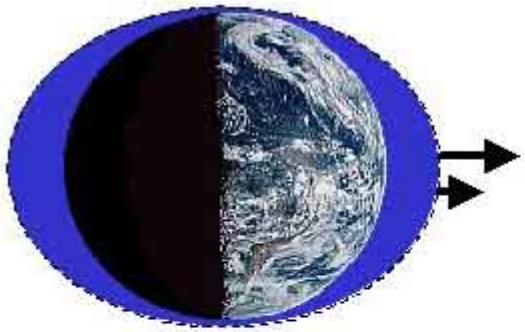




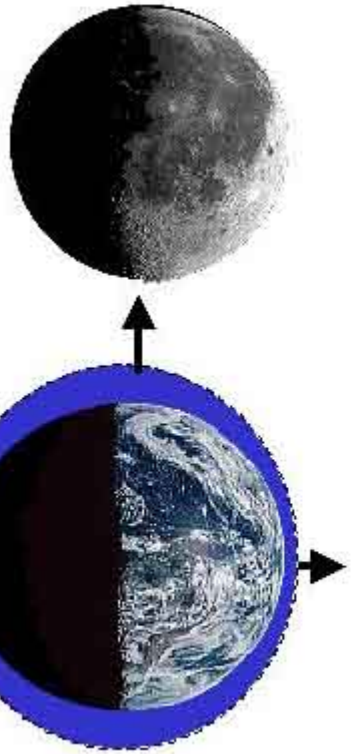
Earth-Moon gravity keeps them orbiting each other. But side of Earth closest to Moon has slightly stronger pull to Moon => bulges towards it. Other side has weaker pull => bulges away compared to rest of Earth.

The Earth spins once a day while the bulge always points towards and away from the Moon => high and low tides.

Tides

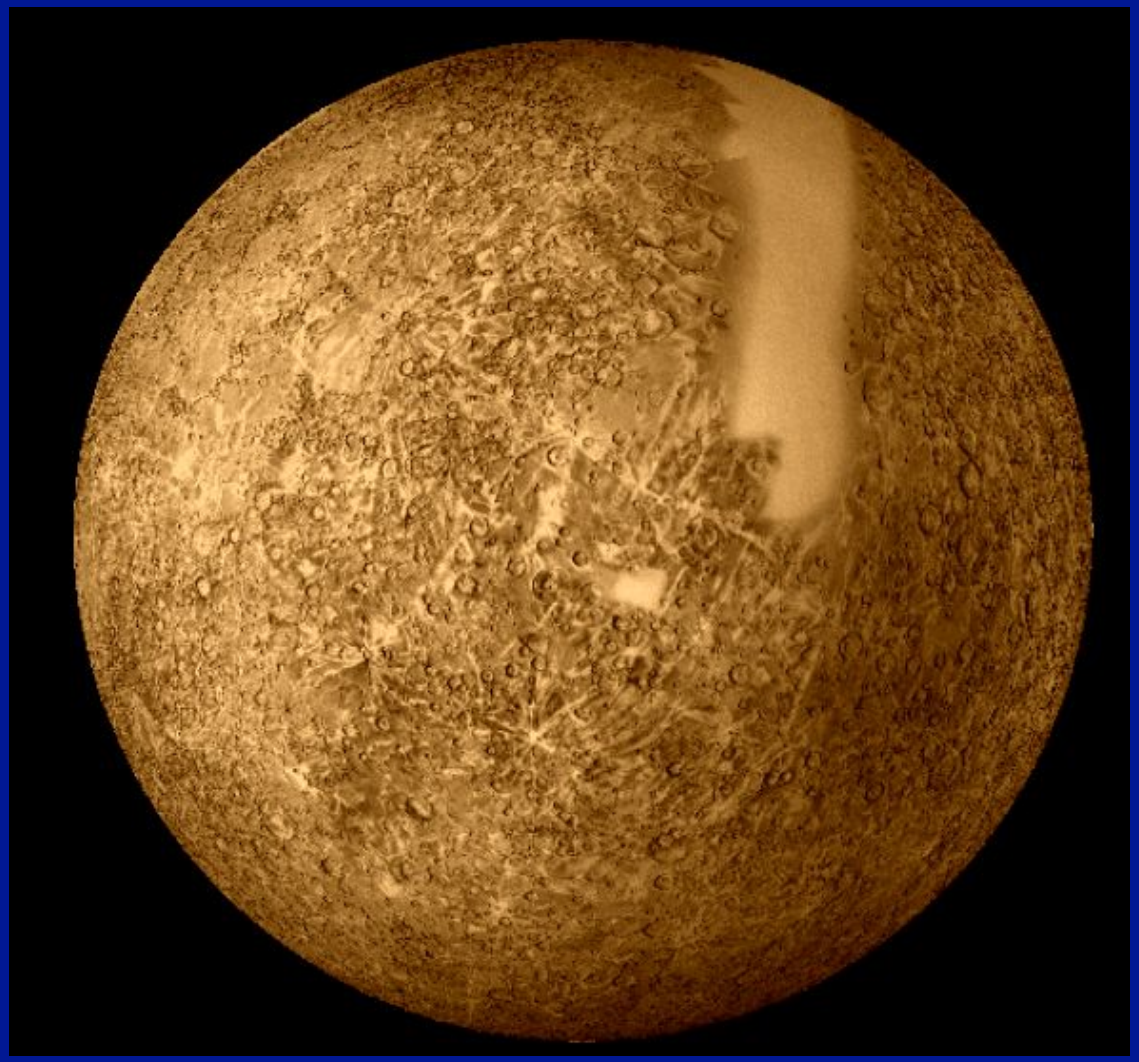


Spring tides at new and full phase are large because the gravity of the moon and sun pulls in the same direction.



Neap tides at first and third quarter phase are weak because the gravity of the sun pulls at right angles to that of the moon.

Mercury

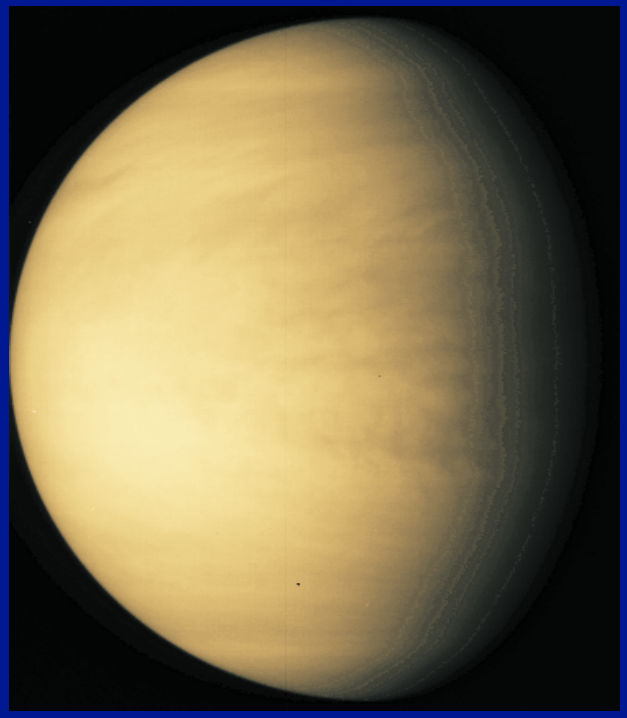


Mass = 3.3×10^{26} g
= $0.055\ M_{Earth}$

Radius = 2439 km
= $0.38\ R_{Earth}$

Density = $5.4\ g/cm^3$

Semimajor axis = 0.39 AU



Venus

Mass = 0.82 M_{Earth}

Radius = 0.95 R_{Earth}

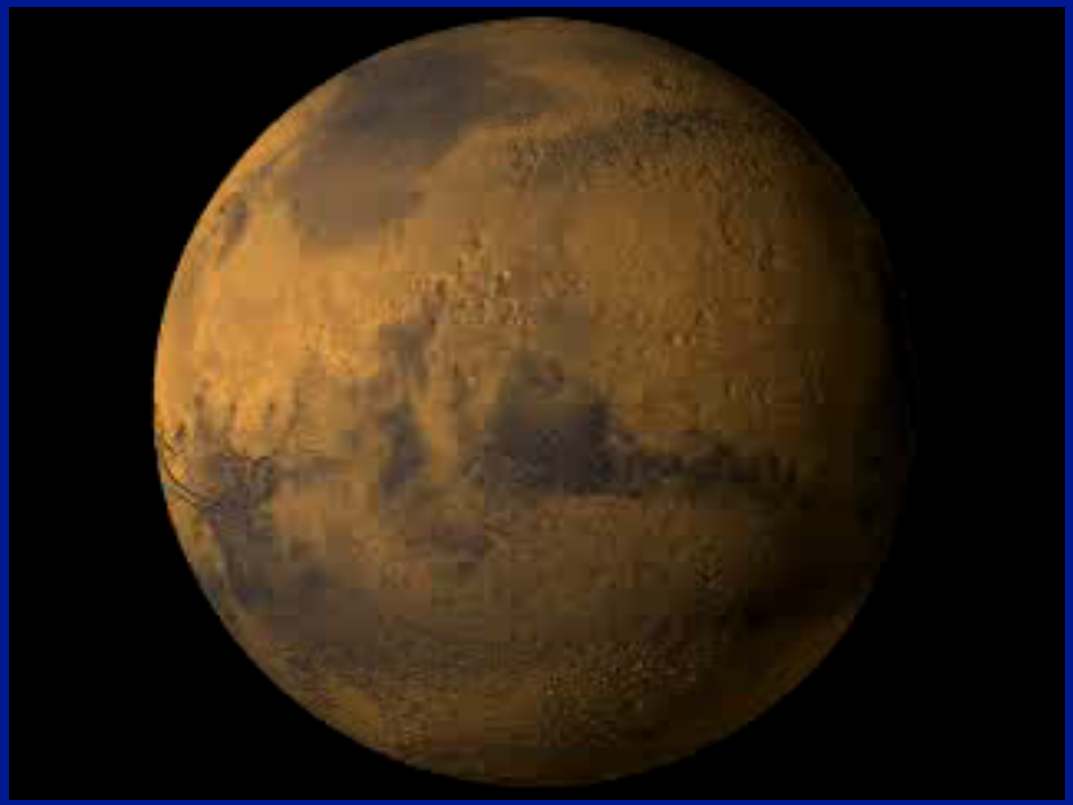
Density = 5.2 g/cm^3

Average distance from Sun = 0.72 AU

Orbital period = 225 days

Rotation period = 243 days (longer than orbital period, and retrograde!)

Mars



Mass = 0.11 M_{Earth}

Radius = 0.53 R_{Earth}

Density = 3.9 g/cm^3

Average distance from Sun = 1.52 AU

eccentricity = 0.093

Range in distance from Sun = 1.38 - 1.66 AU

Rotation Period = 24.6 hours

Orbital Period = 687 days

The Jovian Planets (Gas Giants)

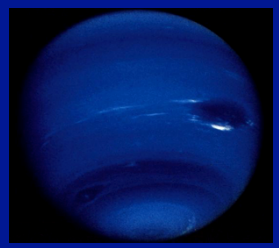
Jupiter

Saturn

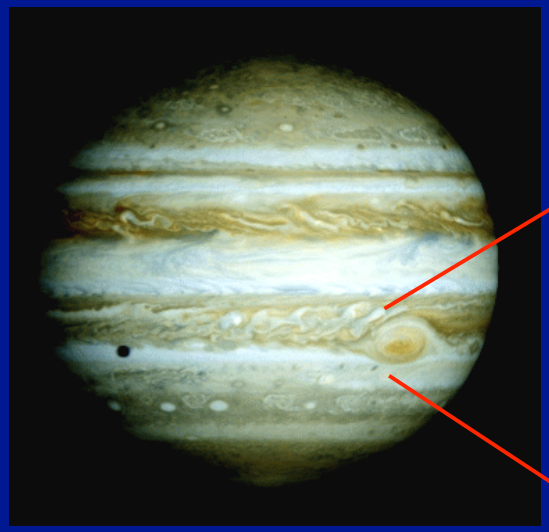
Uranus

(roughly to scale)

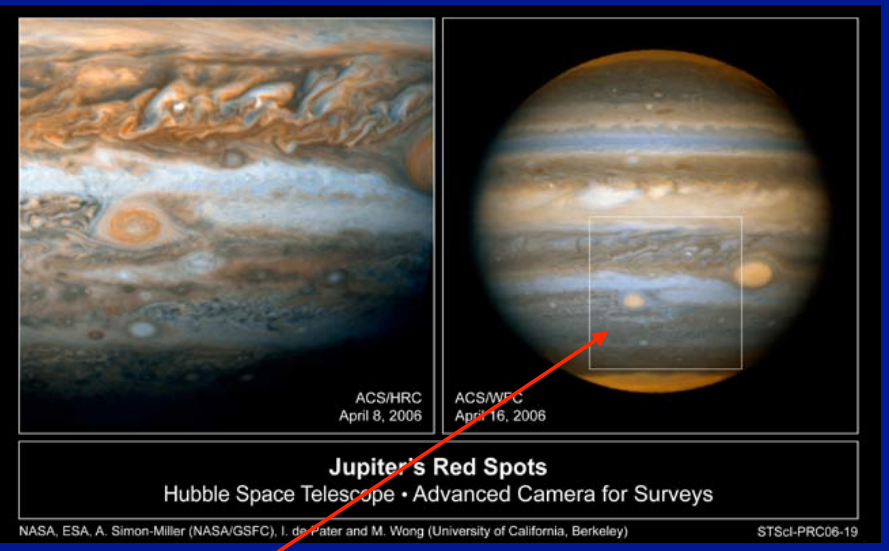
Neptune



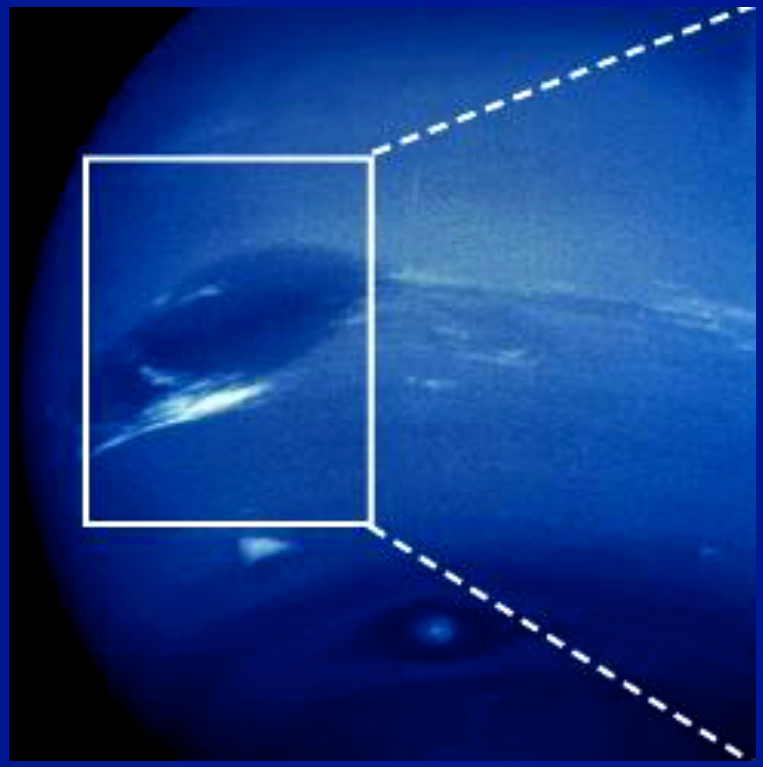
Storms on Jovian Planets

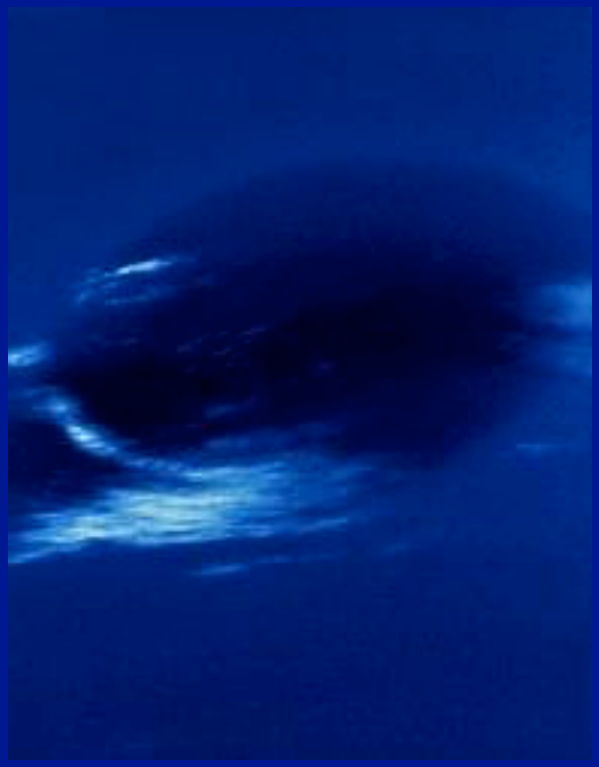


Jupiter's Great Red Spot: A hurricane twice the size of Earth. Has persisted for at least 340 years.



New storm "Oval BA"





Neptune's Great Dark Spot: Discovered by Voyager 2 in 1989. But had disappeared by 1994 Hubble observations. About Earth-sized.

Why do storms on Jovian planets last so long?

On Earth, land masses disrupt otherwise smooth flow patterns. Not a problem on Jovian planets.

The Galilean Moons of Jupiter

(sizes to scale)

Closest to Jupiter

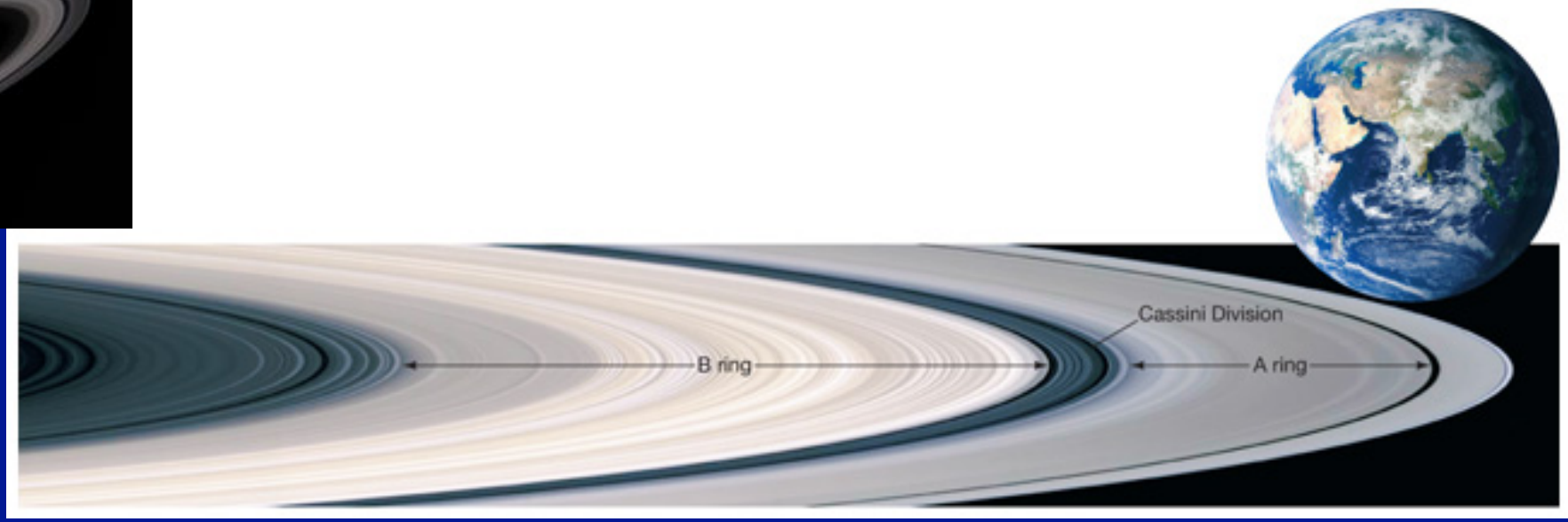
Furthest from Jupiter

Radii range from 1570 km (Europa, slightly smaller than our Moon), to 2630 km (Ganymede - largest moon in Solar System).

Orbital periods range from 1.77 days (Io) to 16.7 days (Callisto).

The closer to Jupiter, the higher the moon density: from 3.5 g/cm^3 (Io) to 1.8 g/cm^3 (Callisto). Higher density indicates higher rock/ice fraction.

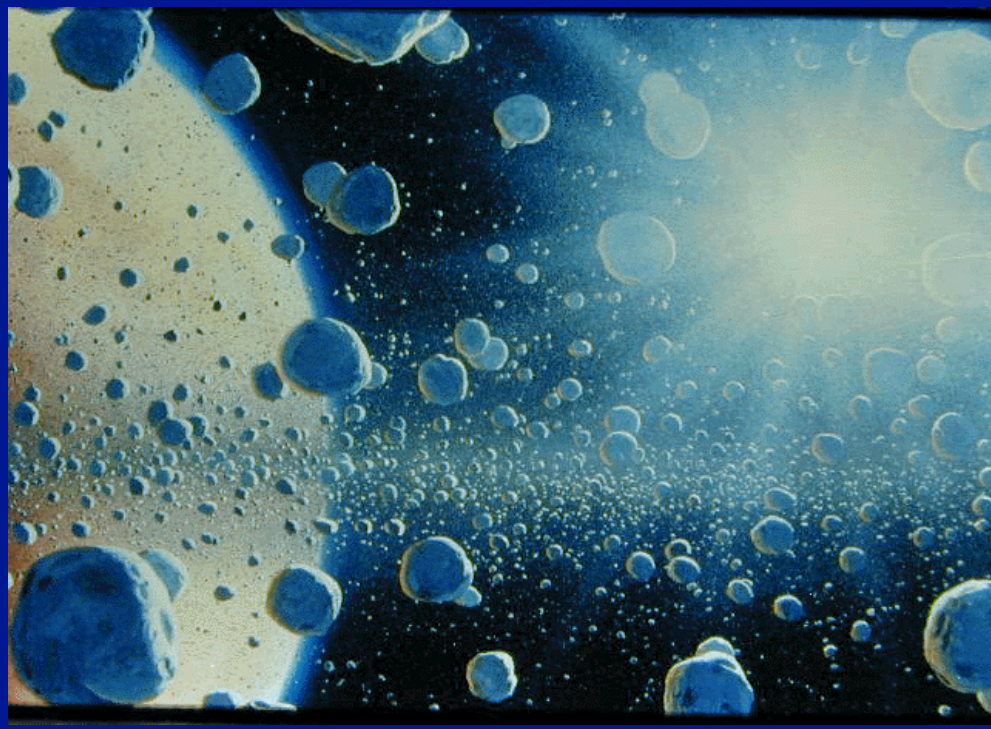
Saturn's Rings (all Jovians have ring systems)



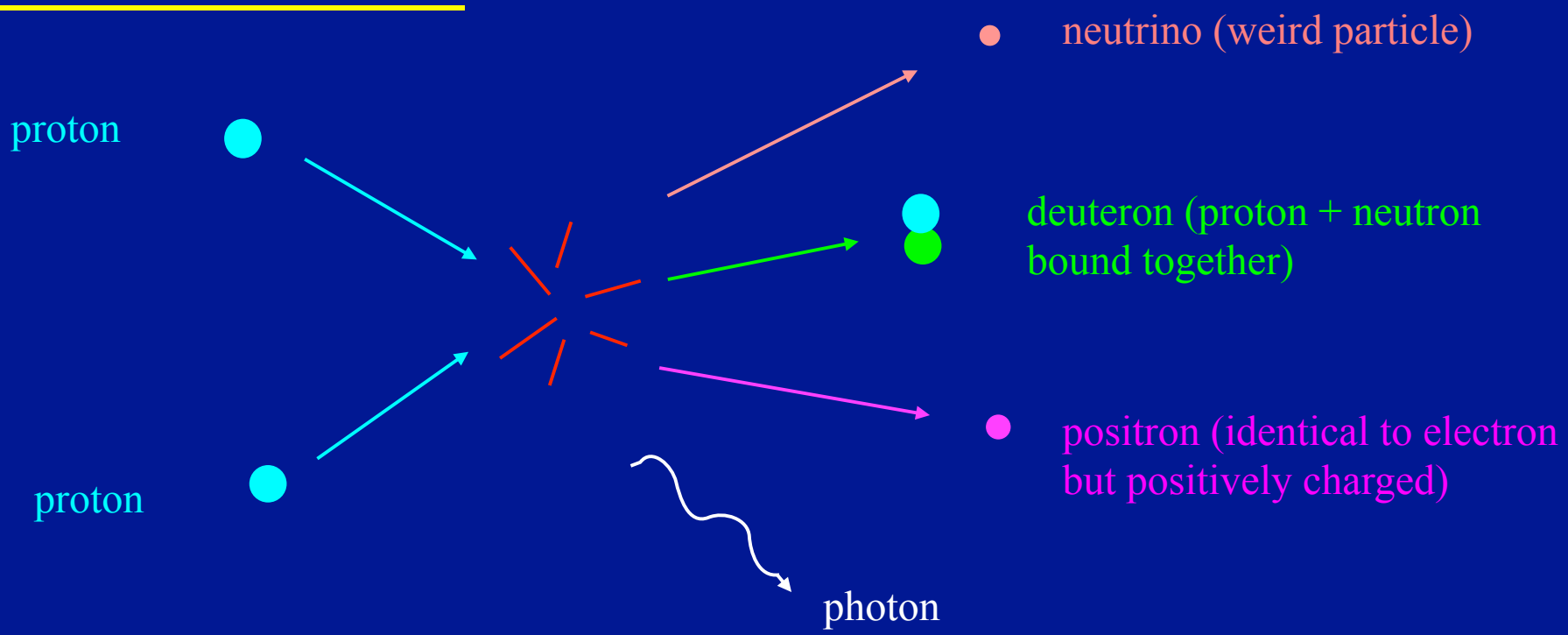
- Inner radius 60,000 km, outer radius 300,000 km. Thickness ~100 m!

- Composition: icy particles, <1 mm to >10m in diameter. Most a few cm.

- A few rings and divisions distinguishable from Earth.



In the Sun's Core...

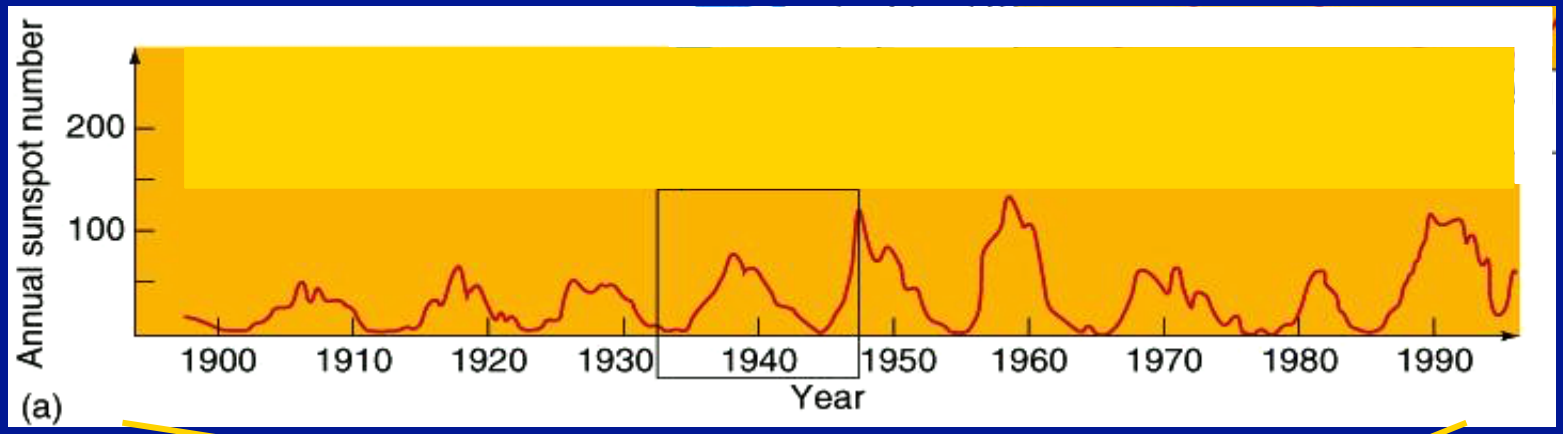


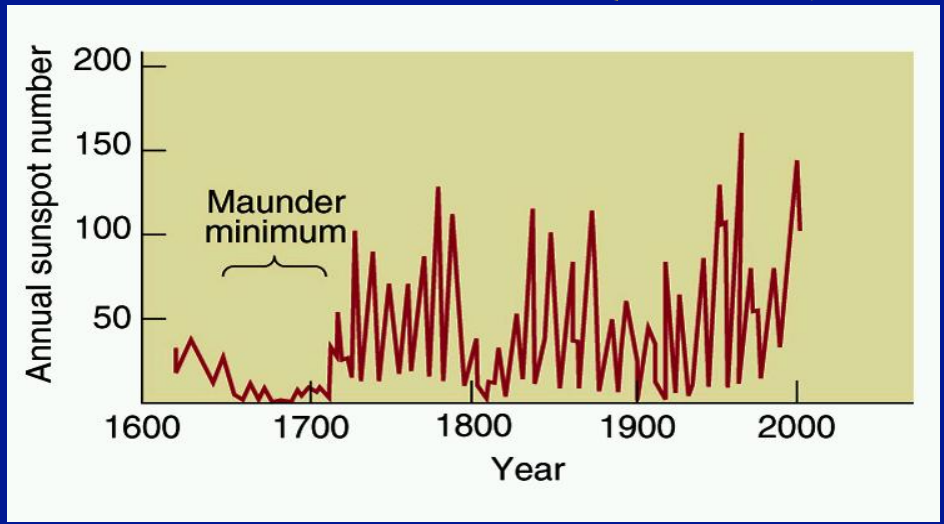
1) proton + proton → proton+neutron + neutrino + positron

(deuteron) (heavy hydrogen)

\+ energy (photon)

Sunspot numbers vary on a 11 year cycle.





Study hard and do well!