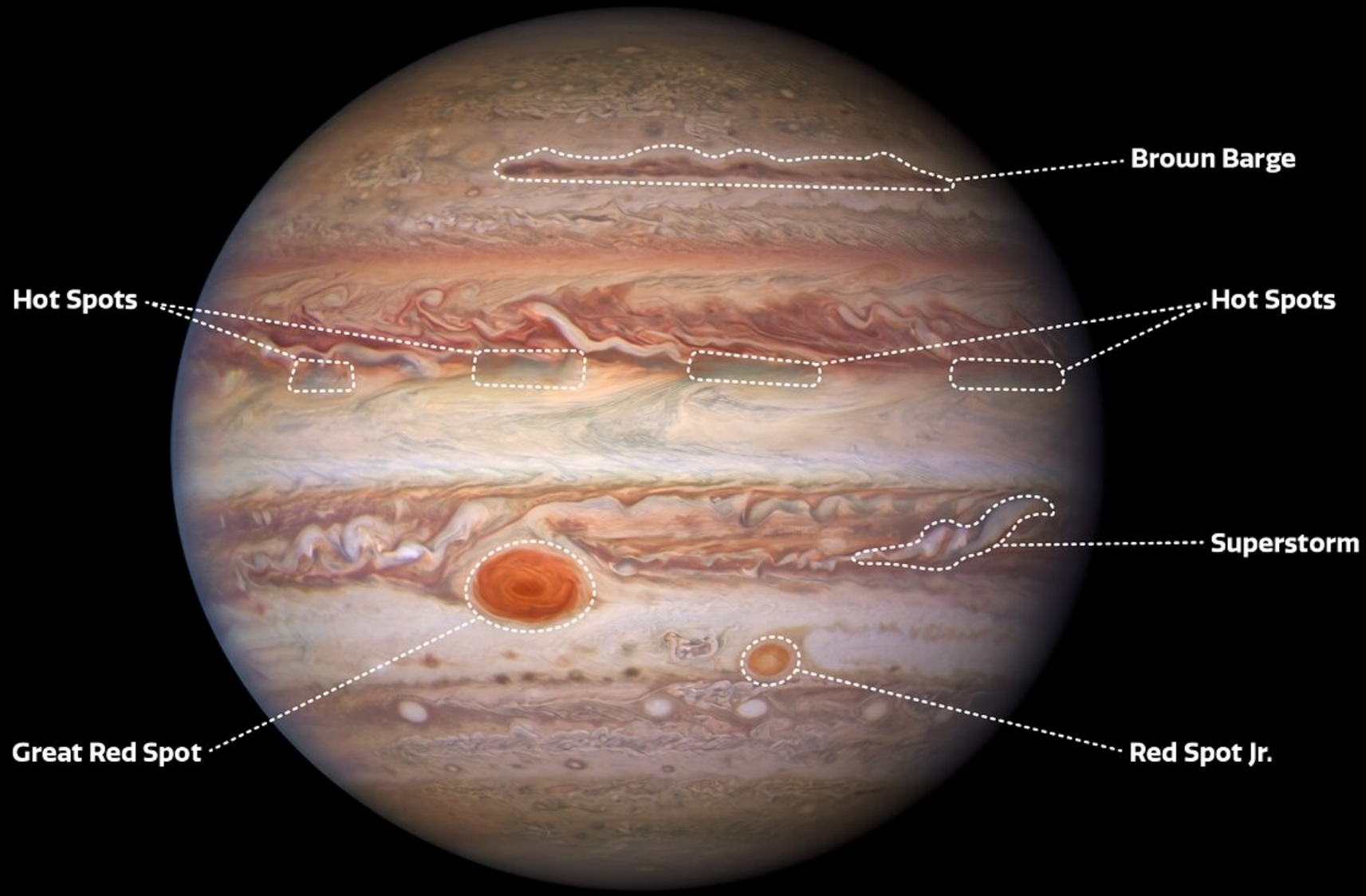
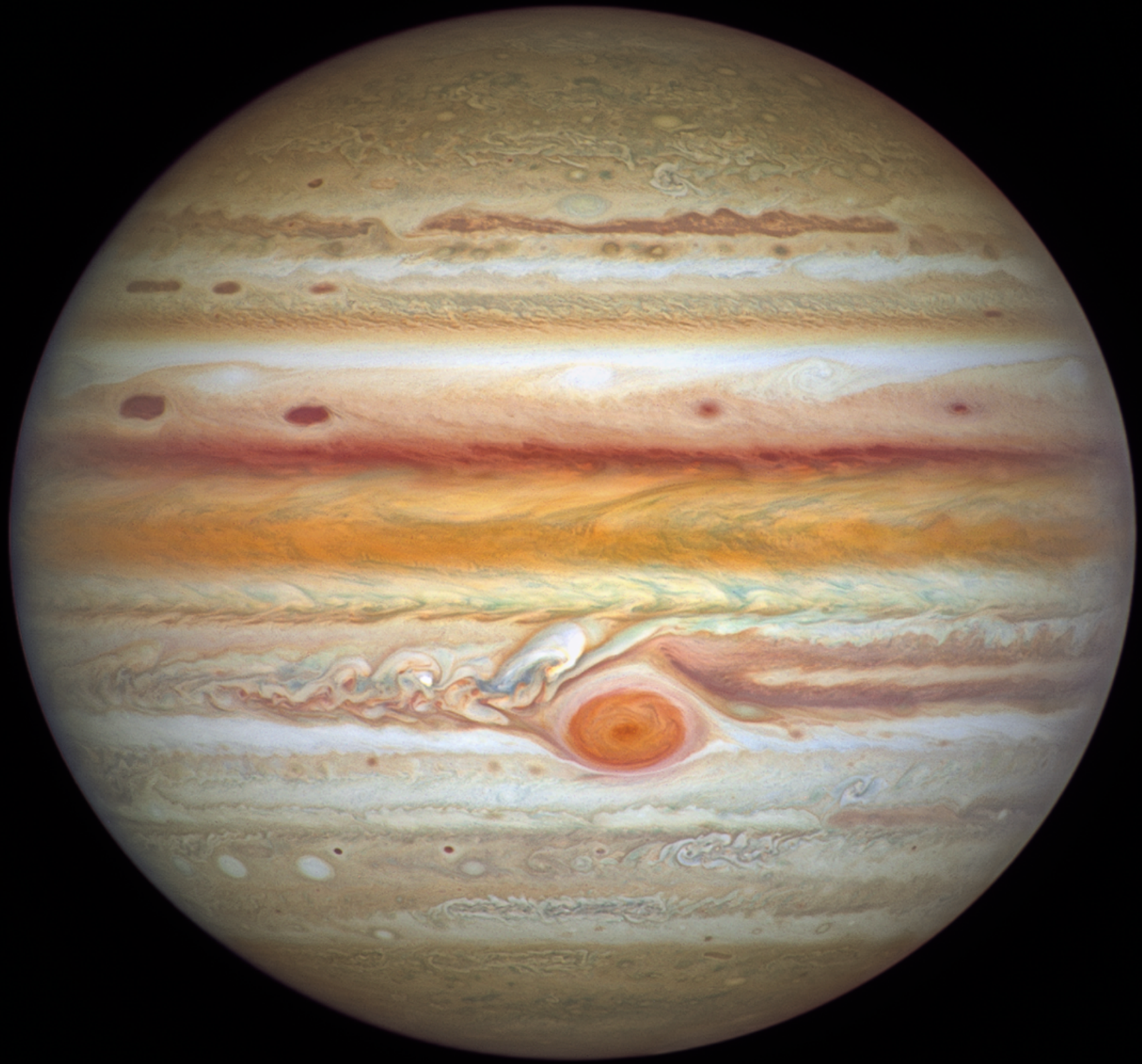
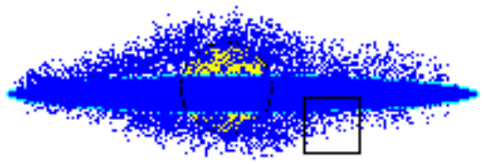


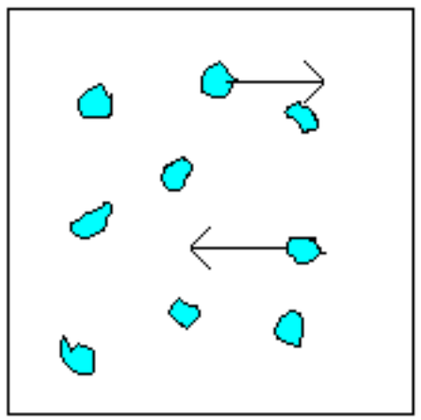
The largest of the planets in our Solar System, the name Jupiter was an accident since the ancient astronomers did not know Jupiter's real size. Its radius is 11.3 Earth radii, its mass is 317 Earth masses. It is composed mostly of hydrogen (90%) and helium (9%) and traces of everything else. Jupiter's mean density is 1.3 gm/cc, close to that of water.



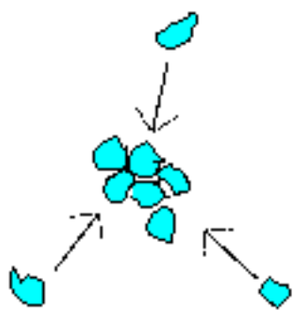
Formation of a Jovian Planet



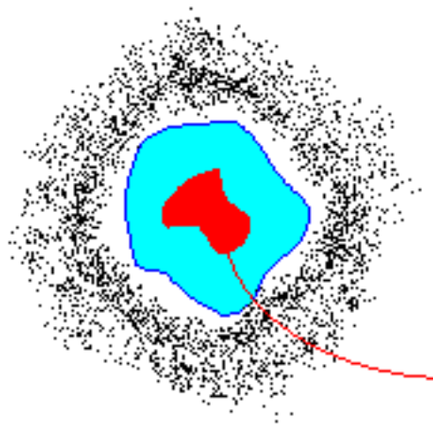
early solar nebula – rich in ice–covered dust in its outer regions



outer regions colder = more volatiles = more mass = large planet mass

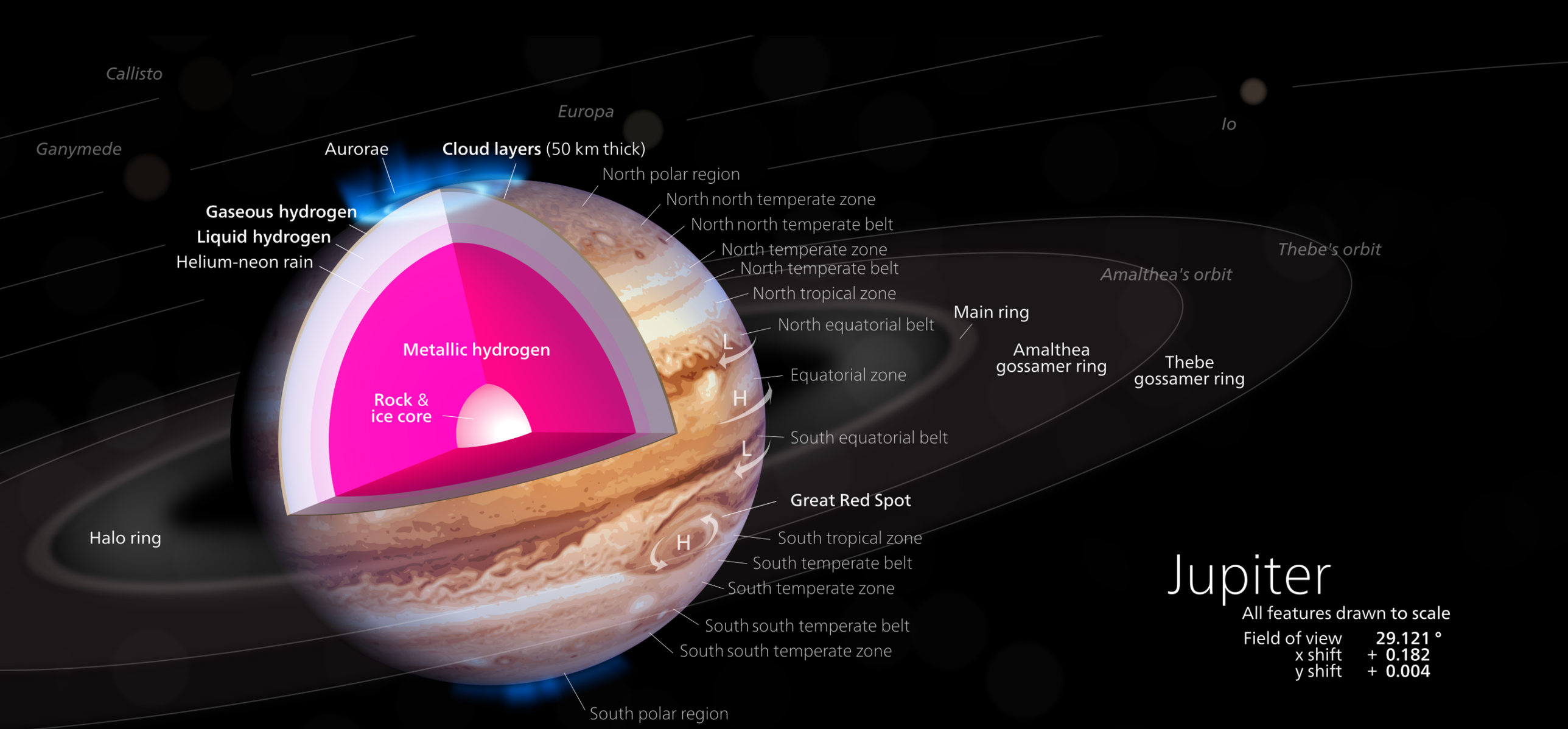


ice/dust accrete = ice "sticks" to other ice particles during collision, mass builds up

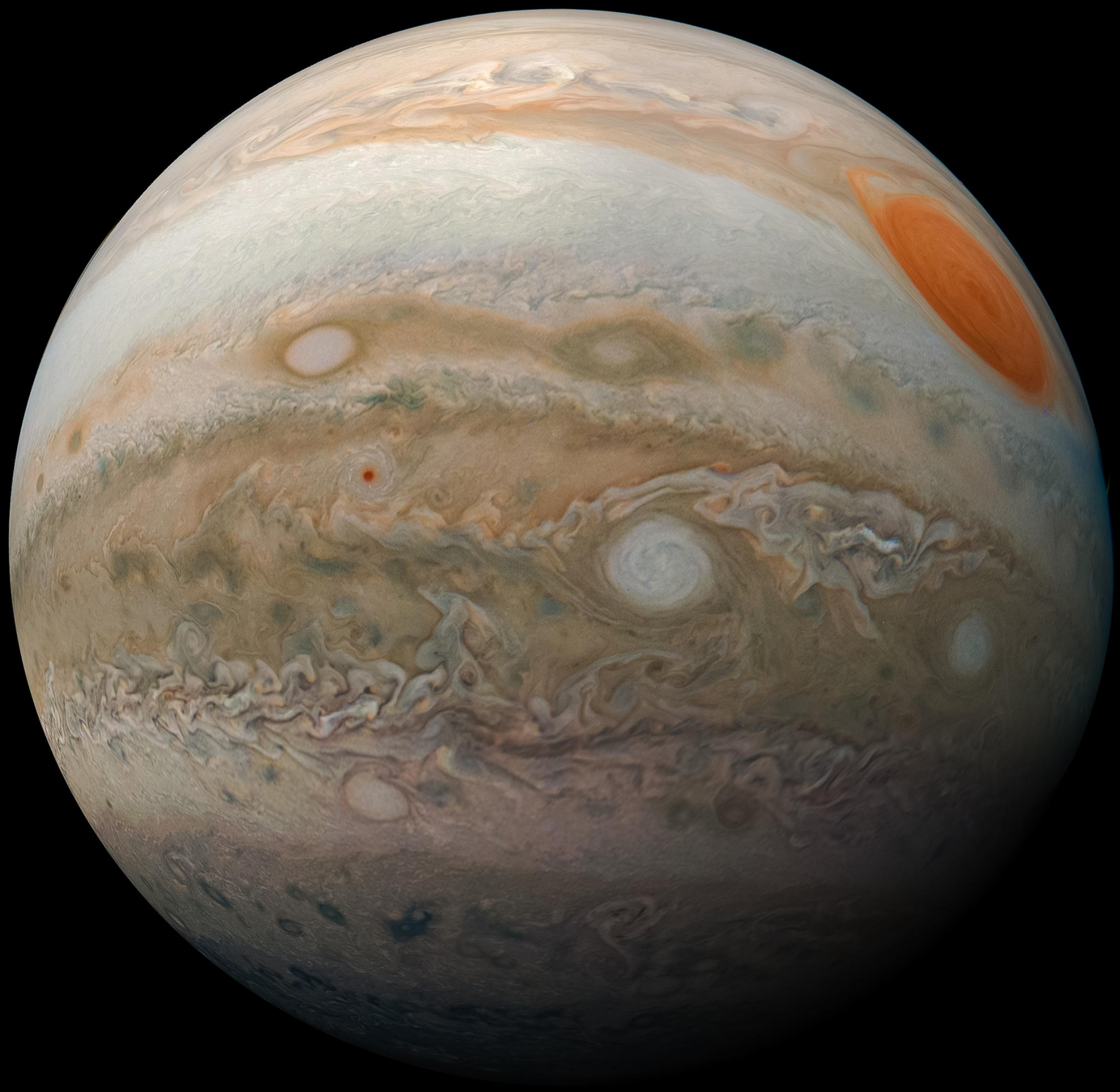


mass = gravity, attracts more dust and gas (hydrogen and helium)

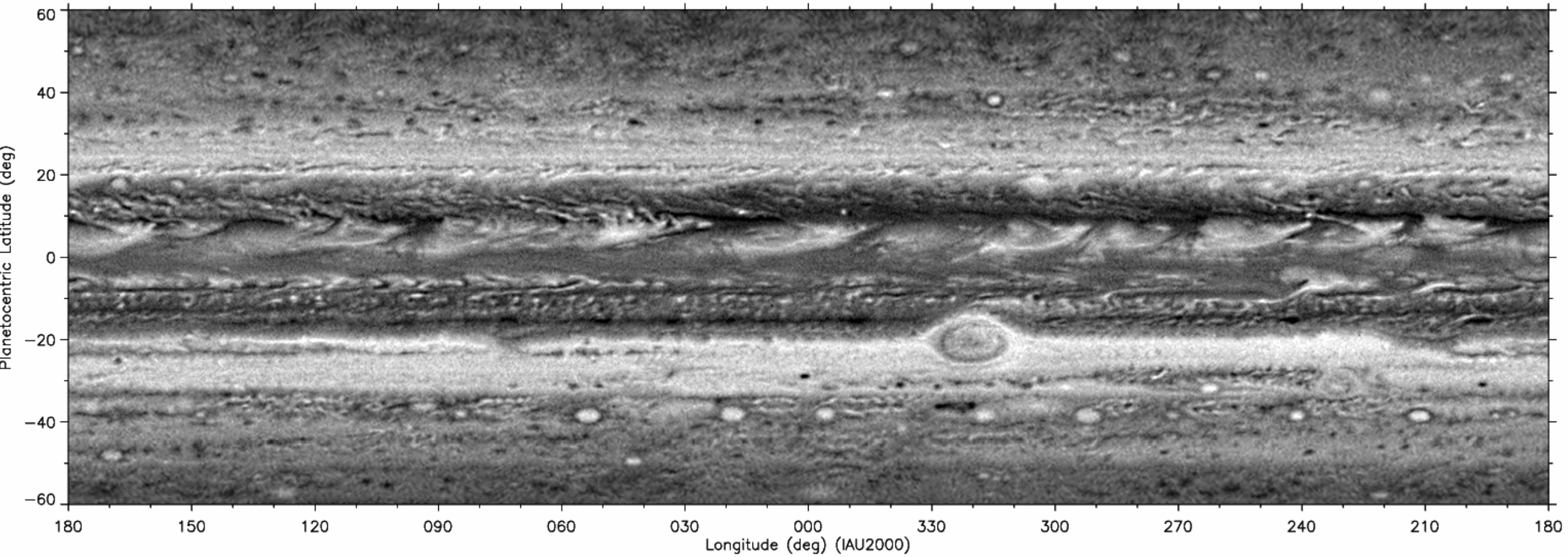
core heats from energy of infalling particles

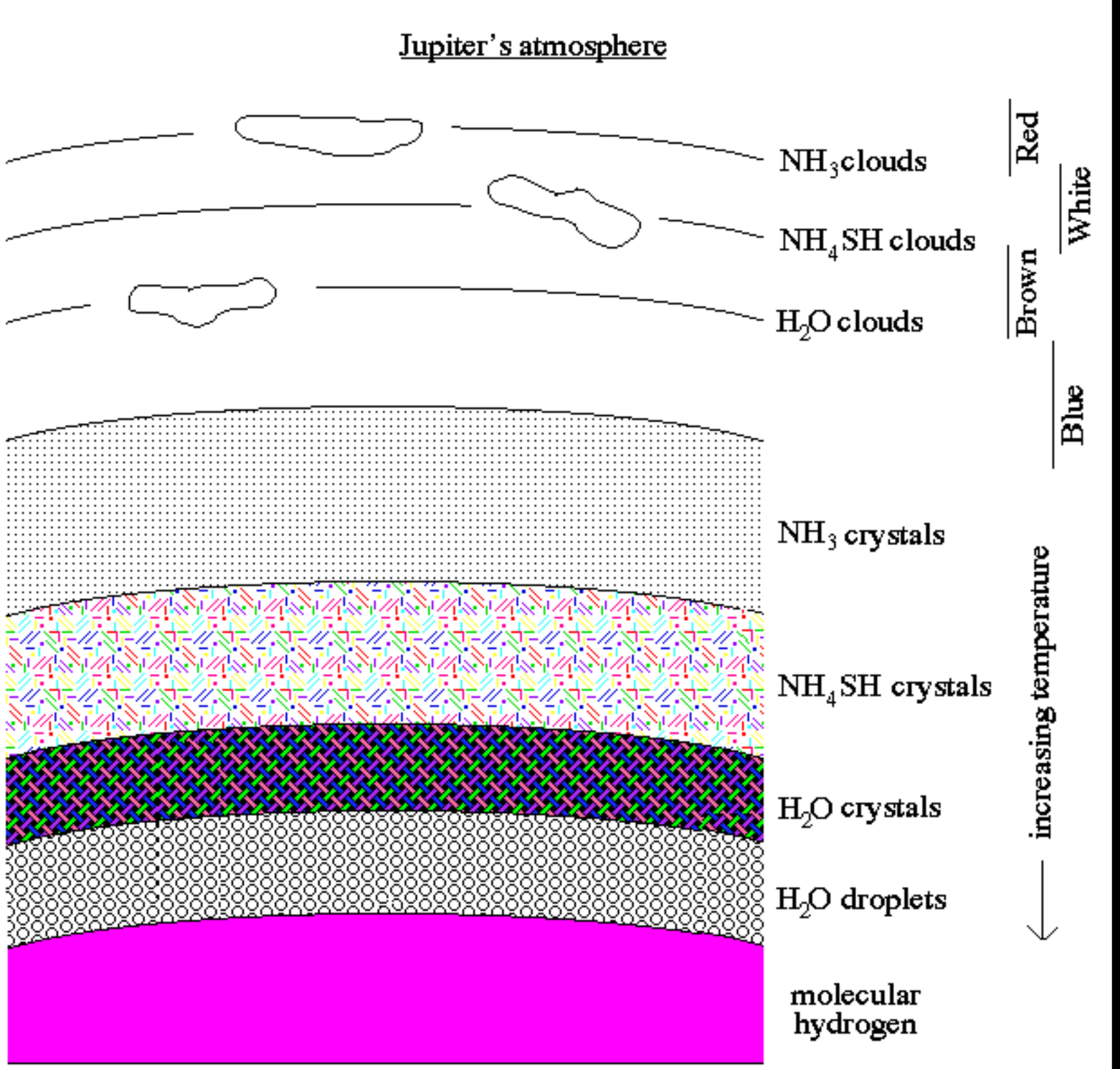


The exterior of Jupiter is noted by its brightly colored latitudinal zones, dark belts and thin bands dotted with numerous storms and eddies. Due to differential rotation, the equatorial zones and belts rotate faster than the higher latitudes and poles

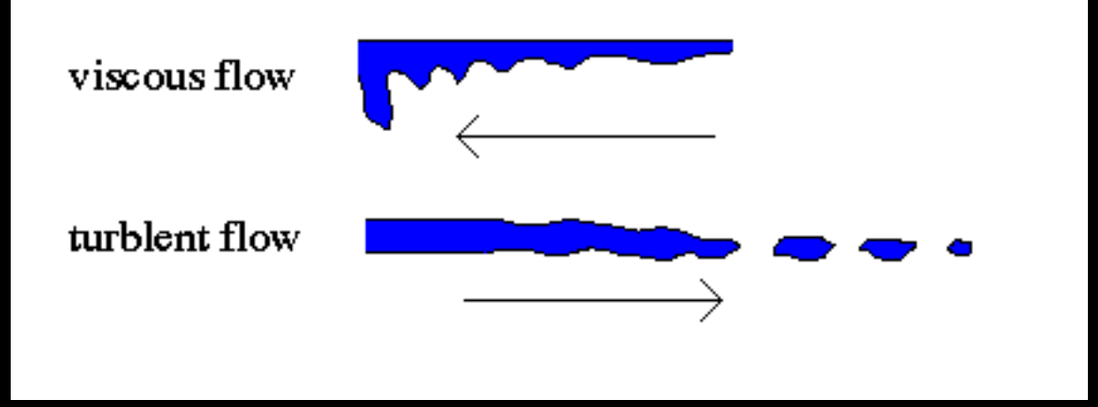


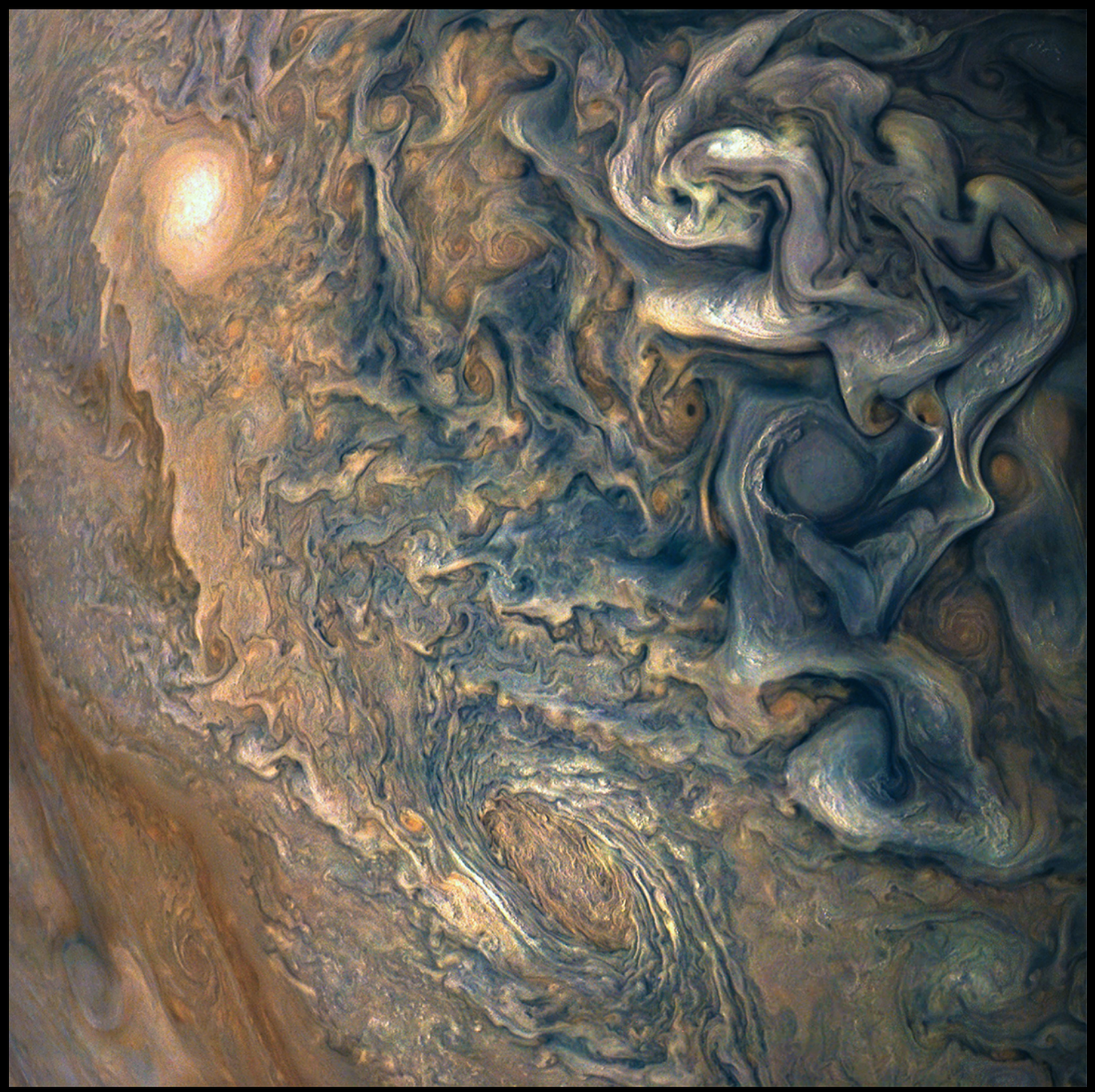
Global map of Jupiter from New Horizons LORRI Image Sequence JObsATM1, 2007 Jan 08





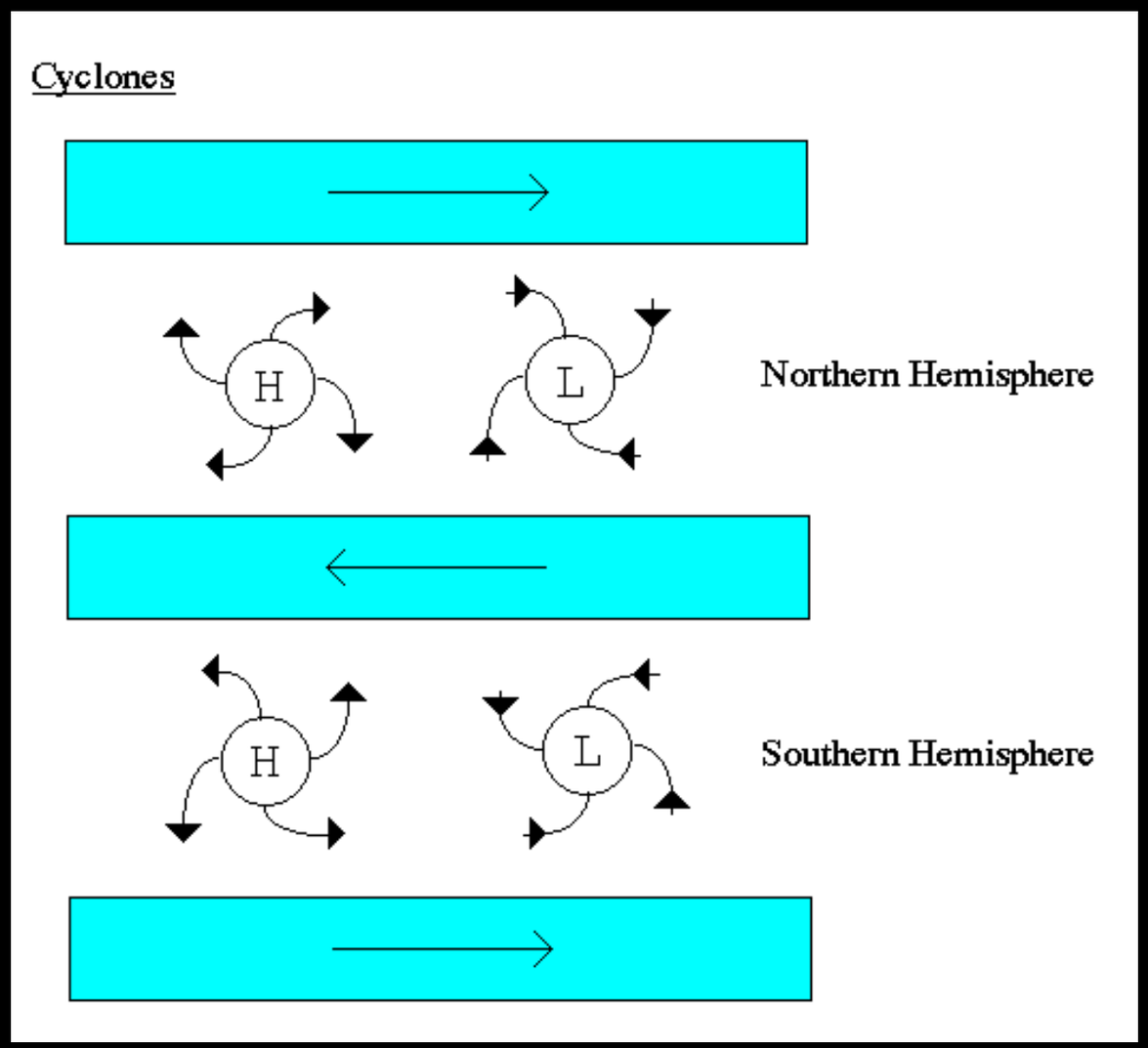
Gas planets do not have solid surfaces, but rather build-up in pressure and density as one goes deeper towards the core. Different colors represent different depths into Jupiter's atmosphere. The colors (reds, browns, yellows, oranges) are due to subtle chemical reactions involving sulfur. Whites and blues are due to CO2 and H2O ices.

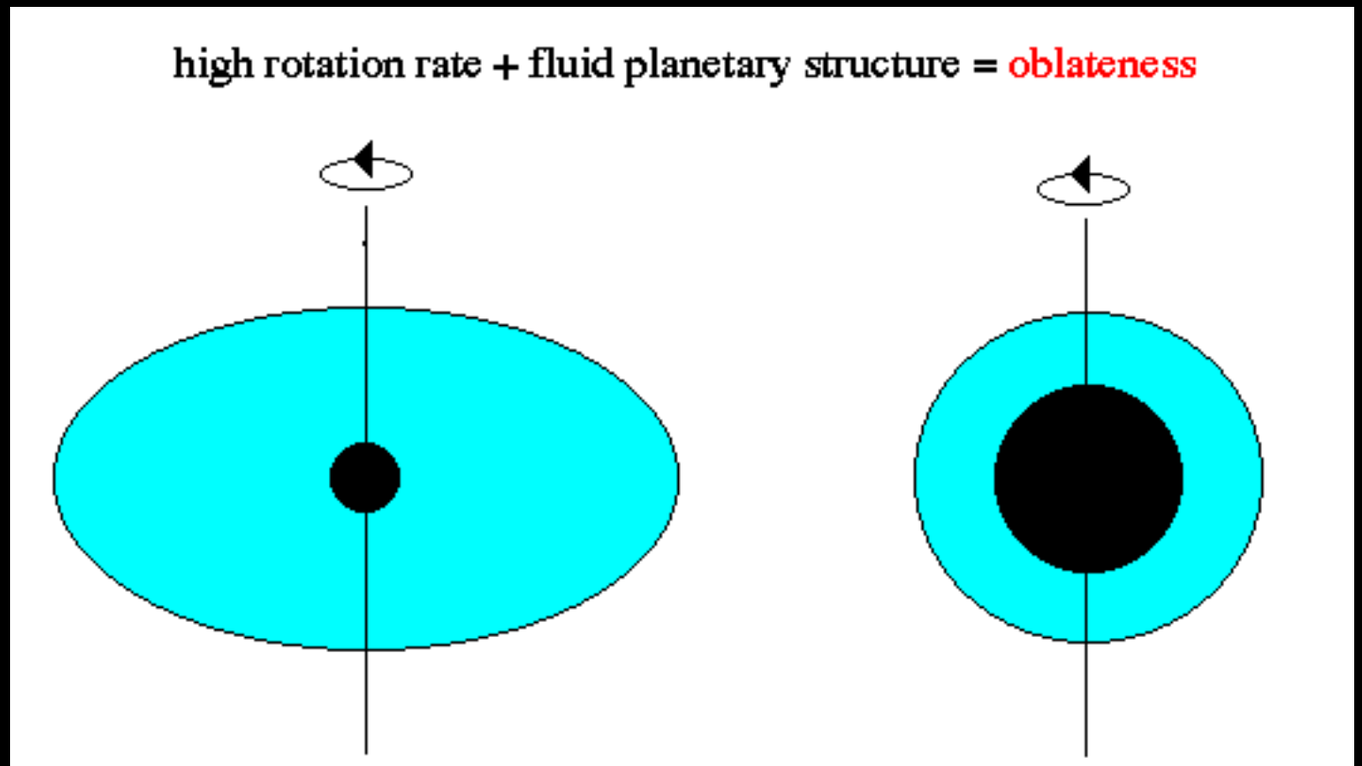




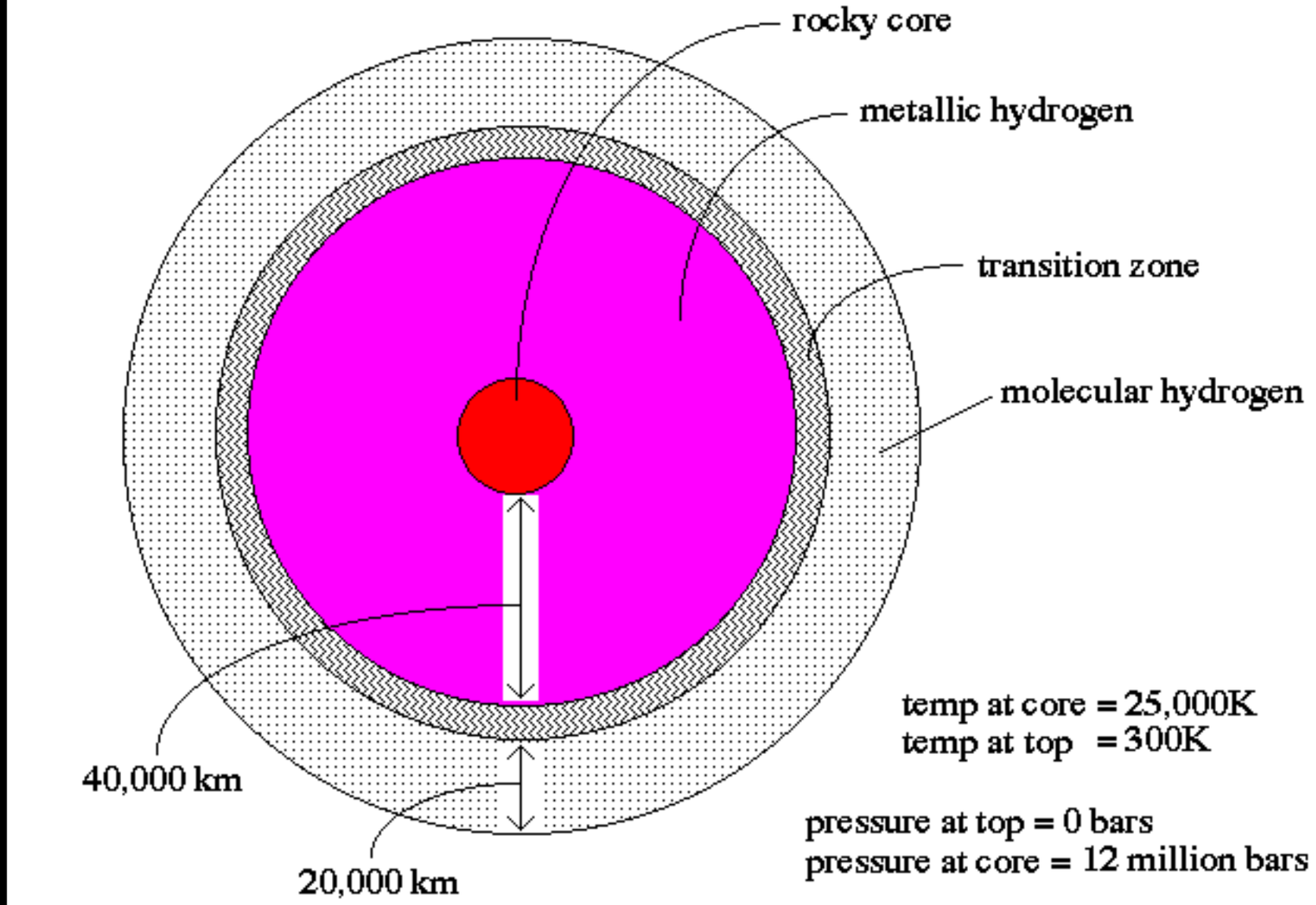
The detailed structure in Jupiter's atmosphere is dominated by physics known as fluid mechanics. Note that the atmosphere of Jupiter is so dense and cold that it behaves as a fluid rather than a gas.

The simplest theories in fluid mechanics predict two types of patterns. One pattern occurs when a fluid slips by a second fluid of a different density. Such an event is known as a viscous flow and produces wave-like features at the boundary of the two fluids. A second pattern is produced by a stream of fluid in a constant medium, called turbulent flow. The stream breaks up into individual elements, called eddies. These eddies can develop into cyclones.

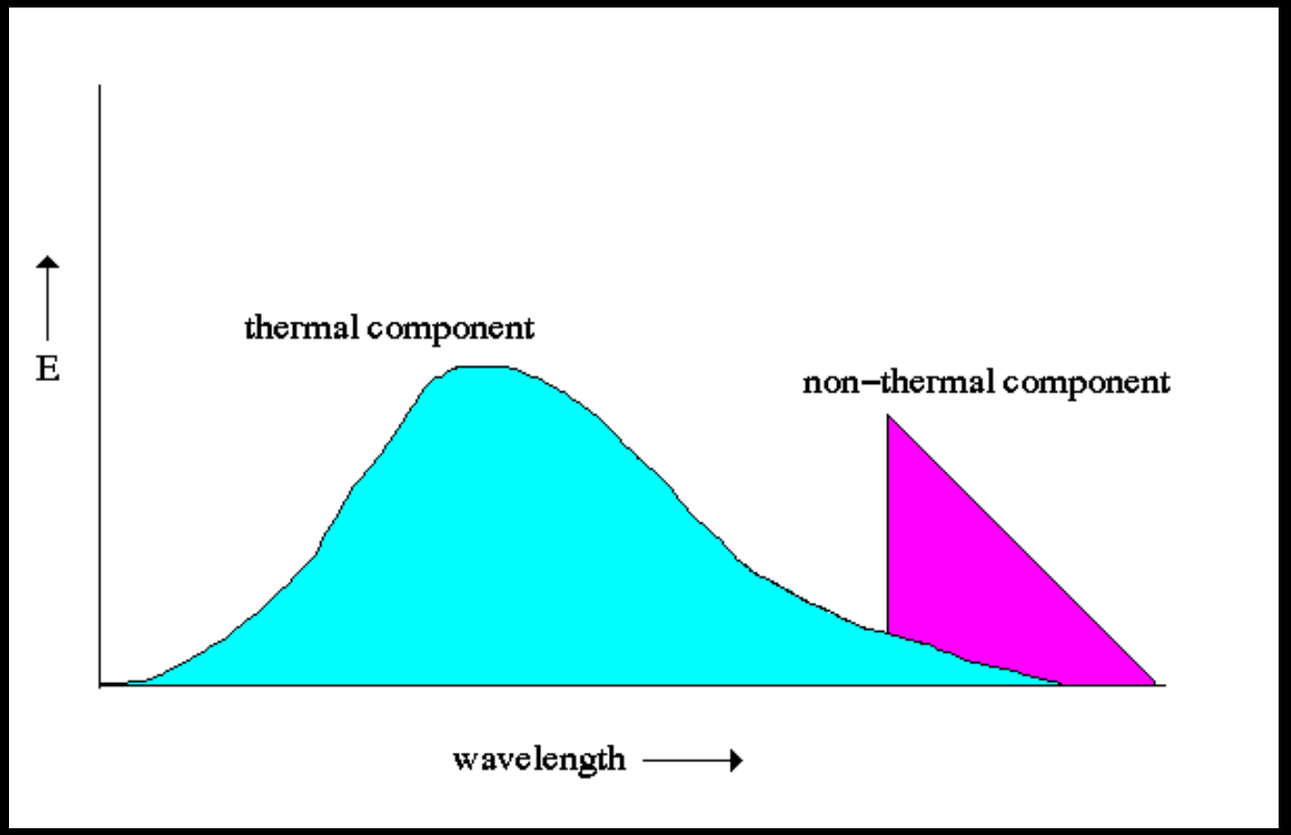




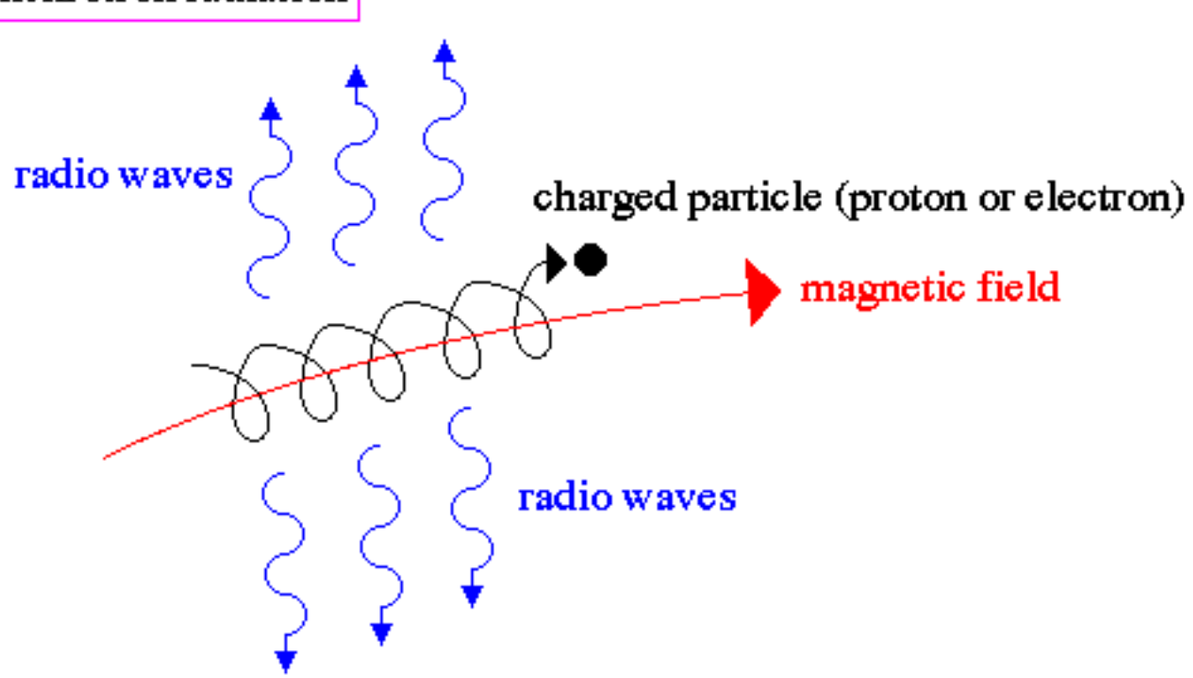
Jupiter is highly oblate (flattened). Plus, Jupiter has a very high rotation rate (once every 9.8 hours). These two facts combine to tell us that Jupiter has a very small solid core.



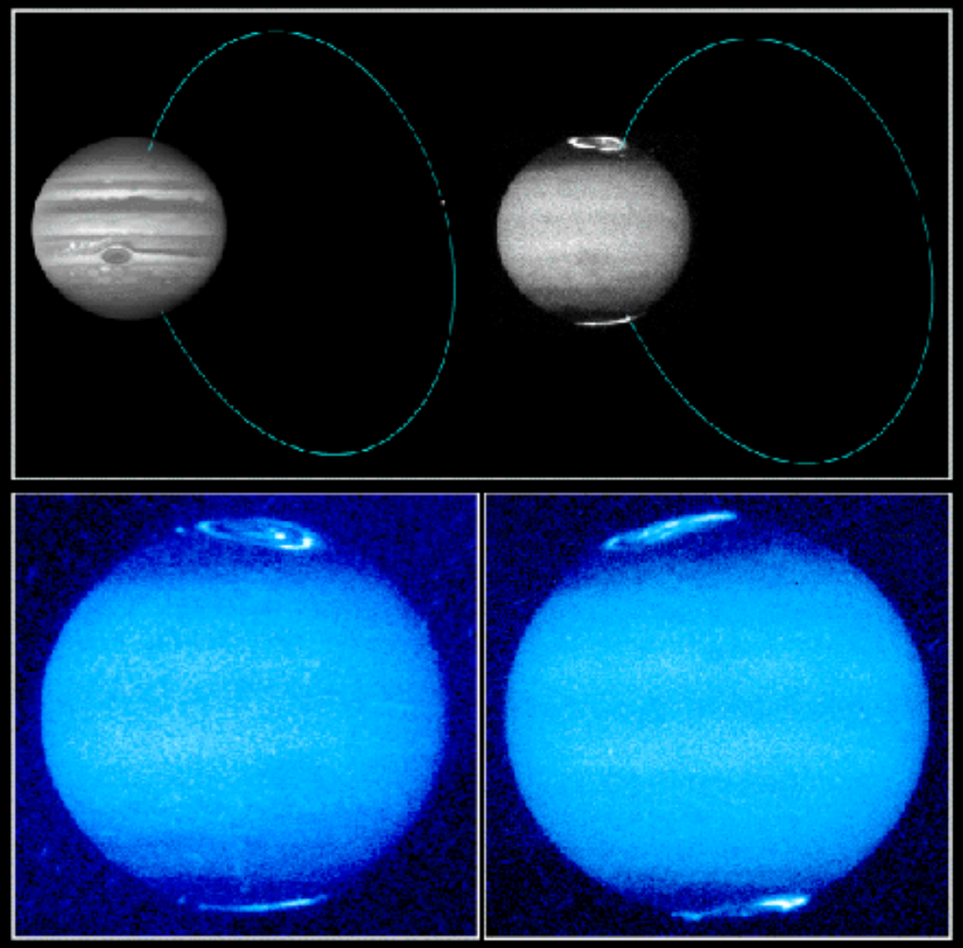
A planet absorbs energy from the Sun in the form of light and converts the energy into heat. The heat is then reradiated back into space (mostly from the nightside of the planet). Based on how much energy Jupiter absorbs from the Sun, then its mean temperature should be 105 K (about -280 F). However, IR and radio measurements of Jupiter show that it has a mean temperature of 125 K, or 20 degrees too warm. In other words, Jupiter radiates about twice as much energy as it receives. Conservation of energy requires that this heat come from someplace and the only reservoir is the core of Jupiter. Thus, this extra heat is leftover energy from the time of Jupiter's formation.



Synchrotron radiation



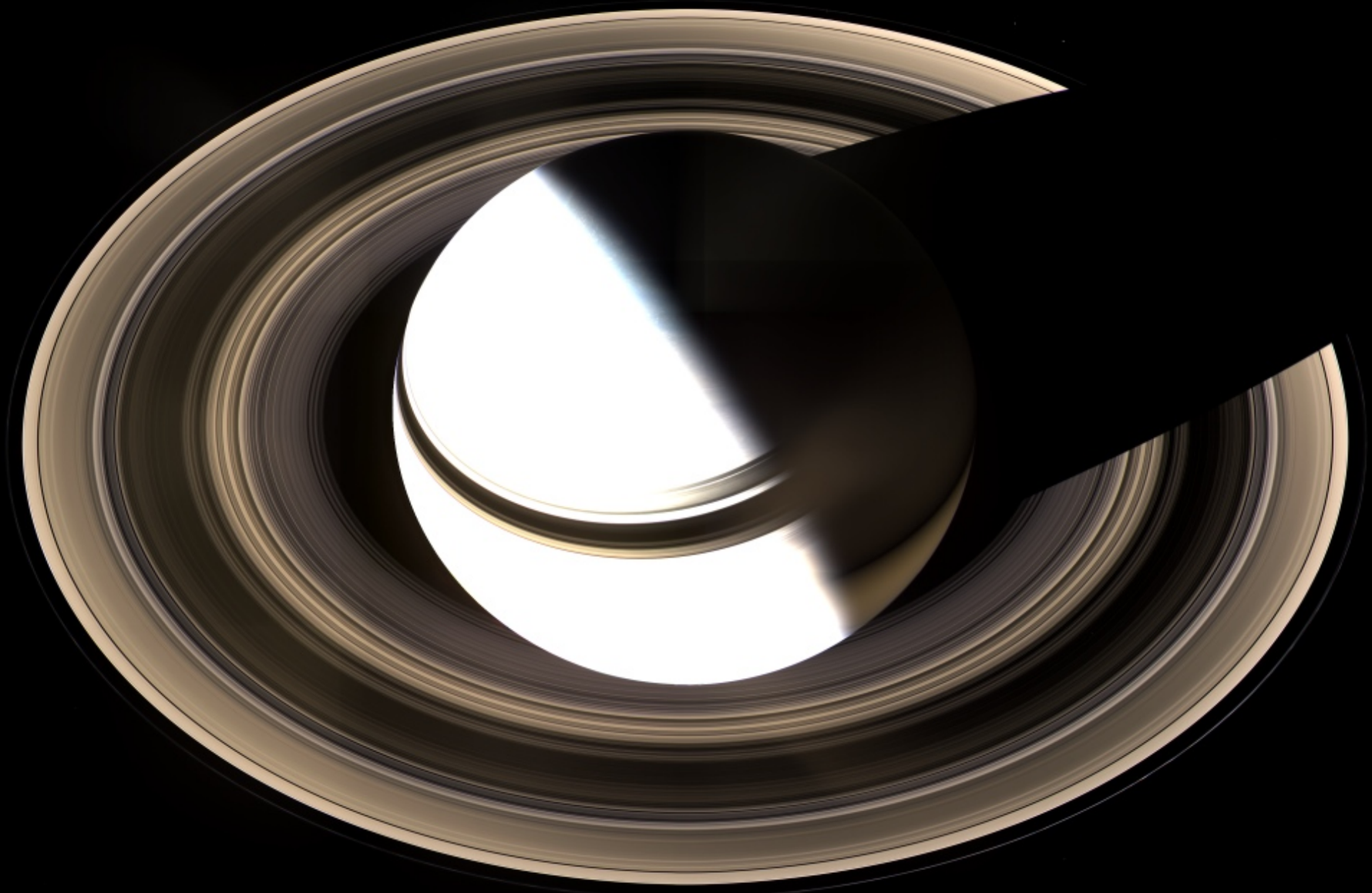
synchrontron radiation occurs when a charged particle encounters a strong magnetic field – the particle is accelerated along a spiral path following the magnetic field and emitting radio waves in the process – the result is a distinct radio signature that reveals the strength of the magnetic field



Jupiter Aurora HST · WFPC2

PRC96-32 · ST ScI OPO · October 17, 1996
J. Clarke (University of Michigan) and NASA

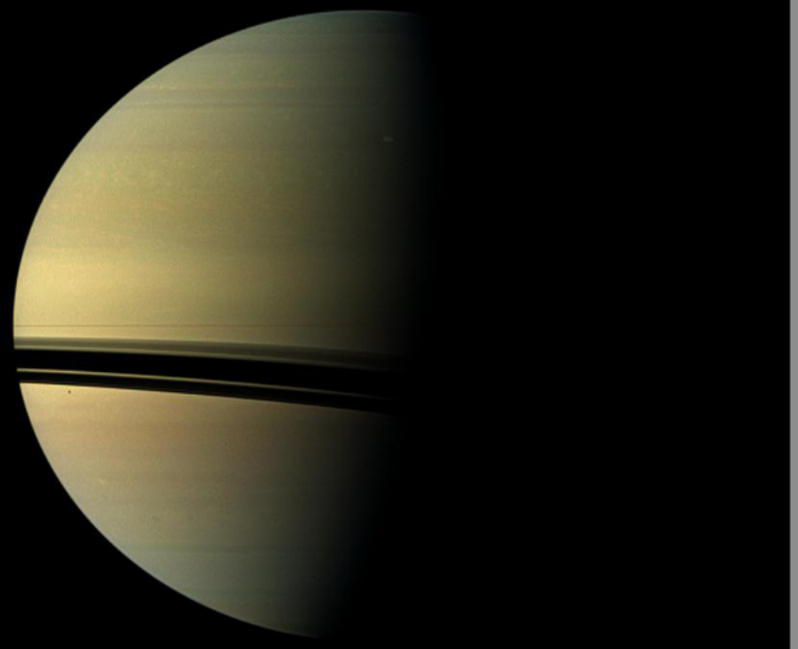
The magnetic field of Jupiter is 19,000 times stronger than the Earth's magnetic field. Even with a large rocky core and high rotation rate, the magnetic field is too strong. The origin of Jupiter (and other Jovian planets) strong magnetic field is the metallic hydrogen shell that surrounds Jupiter's rocky core. Metal is an excellent conductor of electric current and supplies the energy for the generation of an intense and large magnetic field.
A strong magnetic field can capture charged particles from the solar wind (i.e. high speed protons and electrons) and particles ejected from the inner moon, Io. These particles are trapped in the inner magnetic belts and are reflected back and forth between the north and south magnetic poles.



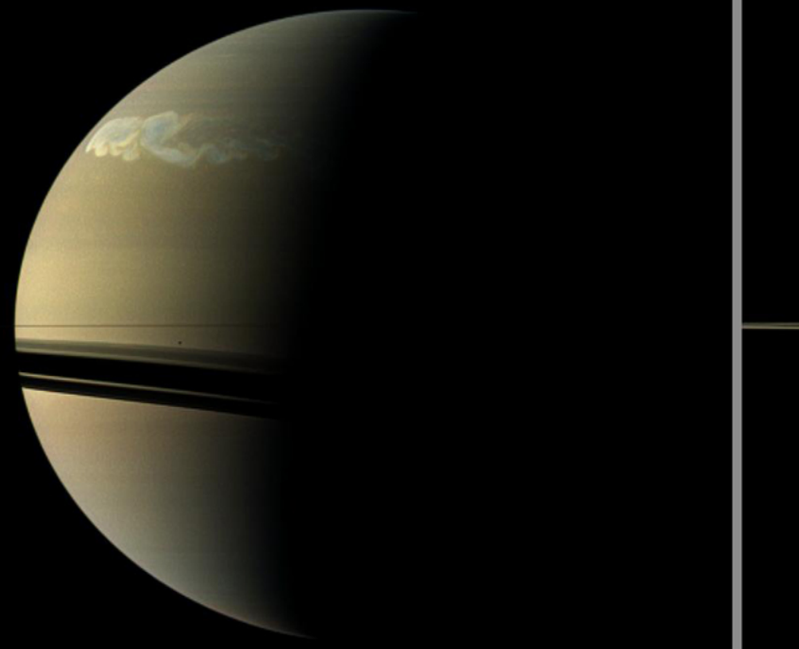
Saturn is the sixth planet from the Sun and is the second largest in the solar system with an equatorial diameter of 119,300 kilometers. Its day is 10 hours, 39 minutes long, and at a distance of 9.5 A.U.'s it takes 29.5 Earth years to revolve about the Sun.

Saturn is 95 Earth masses and has a radius of 9.4 Earth radii. The atmosphere is primarily composed of hydrogen (94%) with small amounts of helium (6%) and methane. Notice that this differs slightly from Jupiter, which is richer in helium (10%).

Dec 5, 2010



Jan 2, 2011



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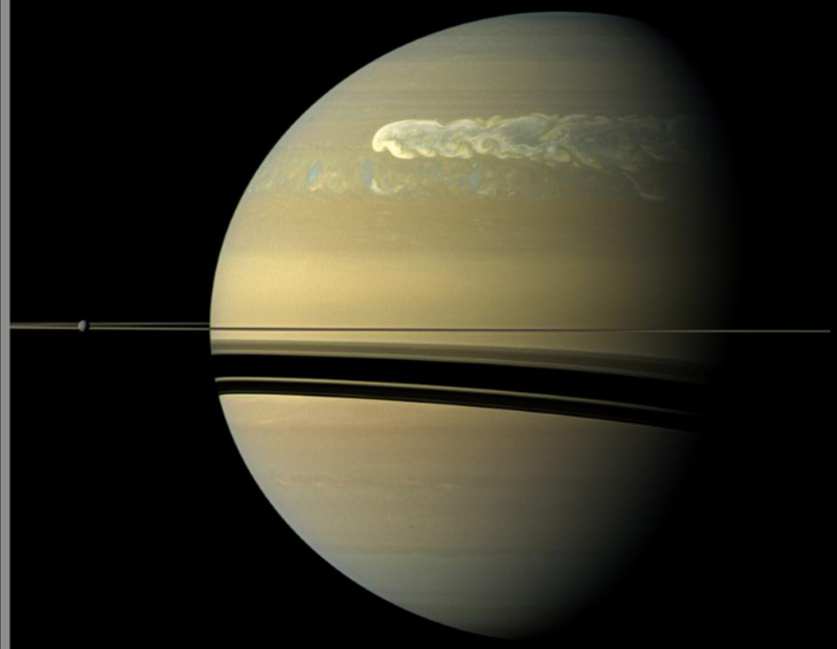
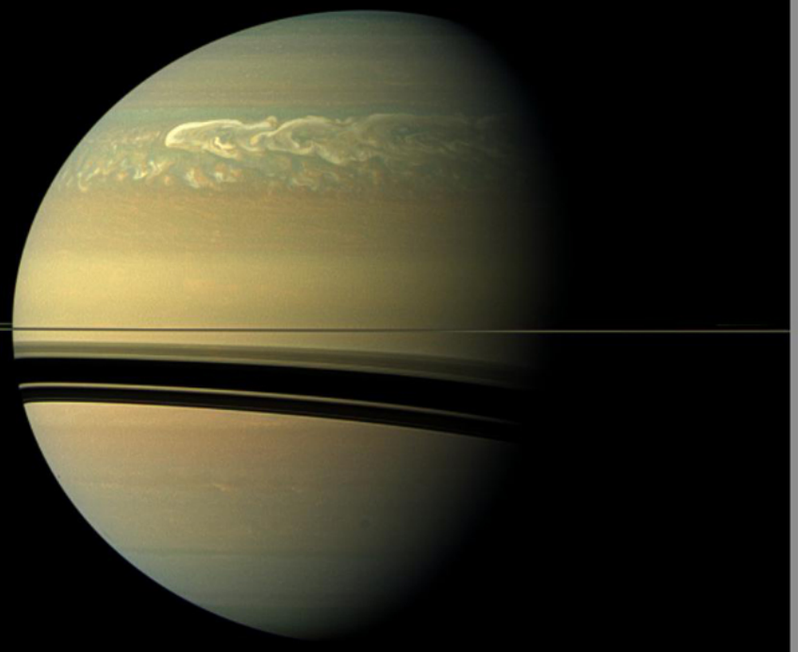


Apr 22, 2011



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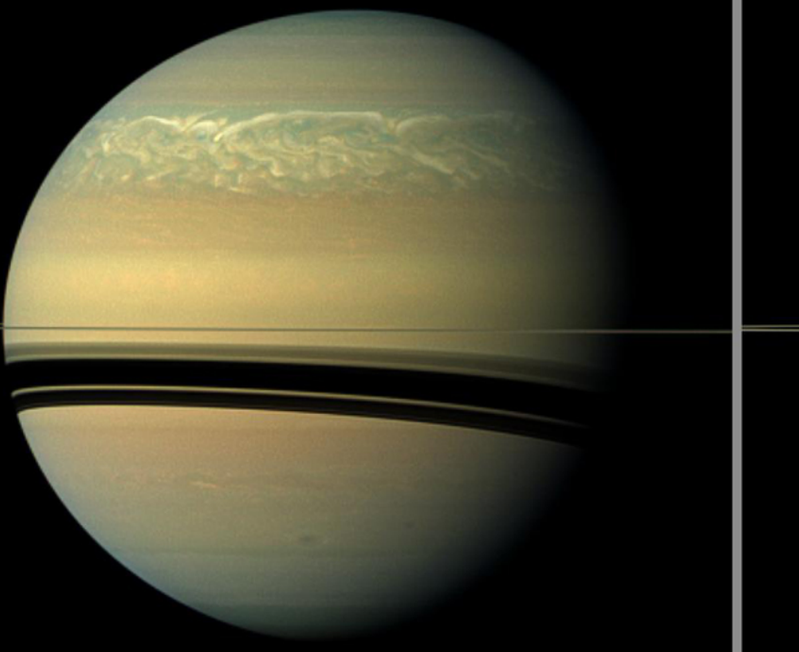

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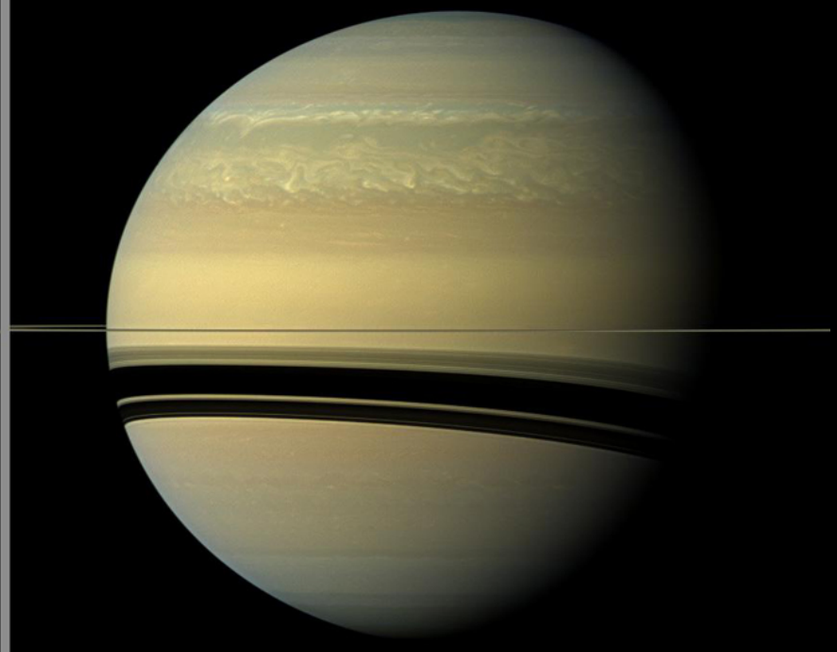
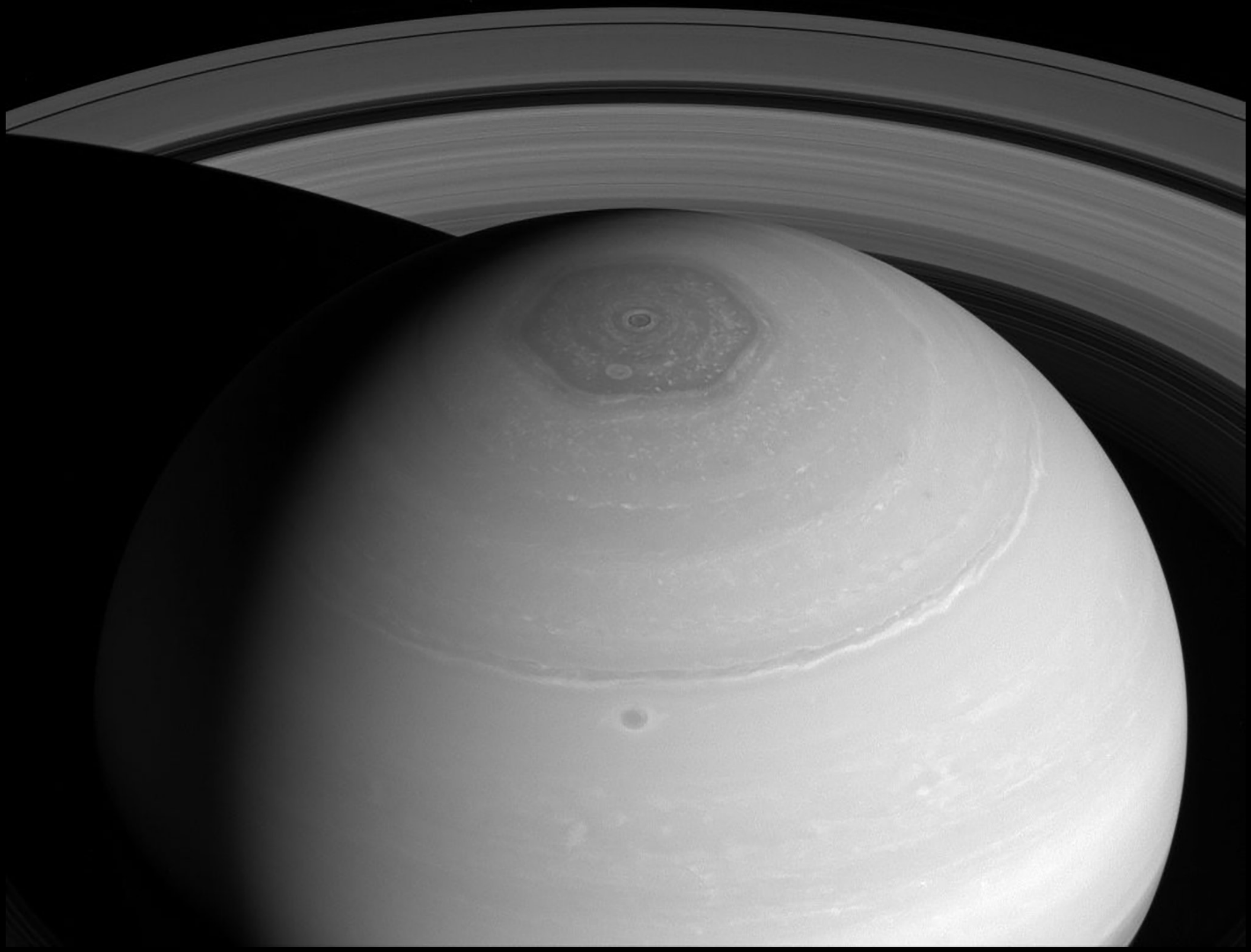
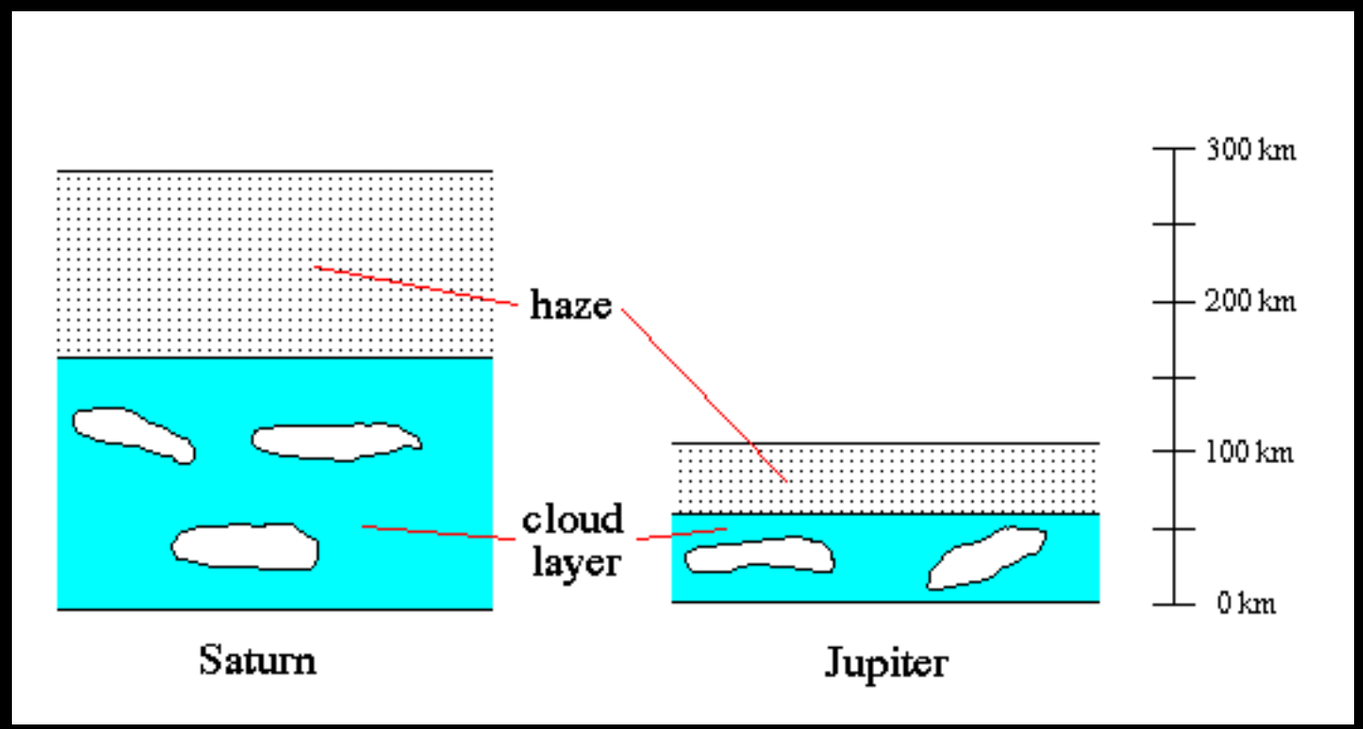
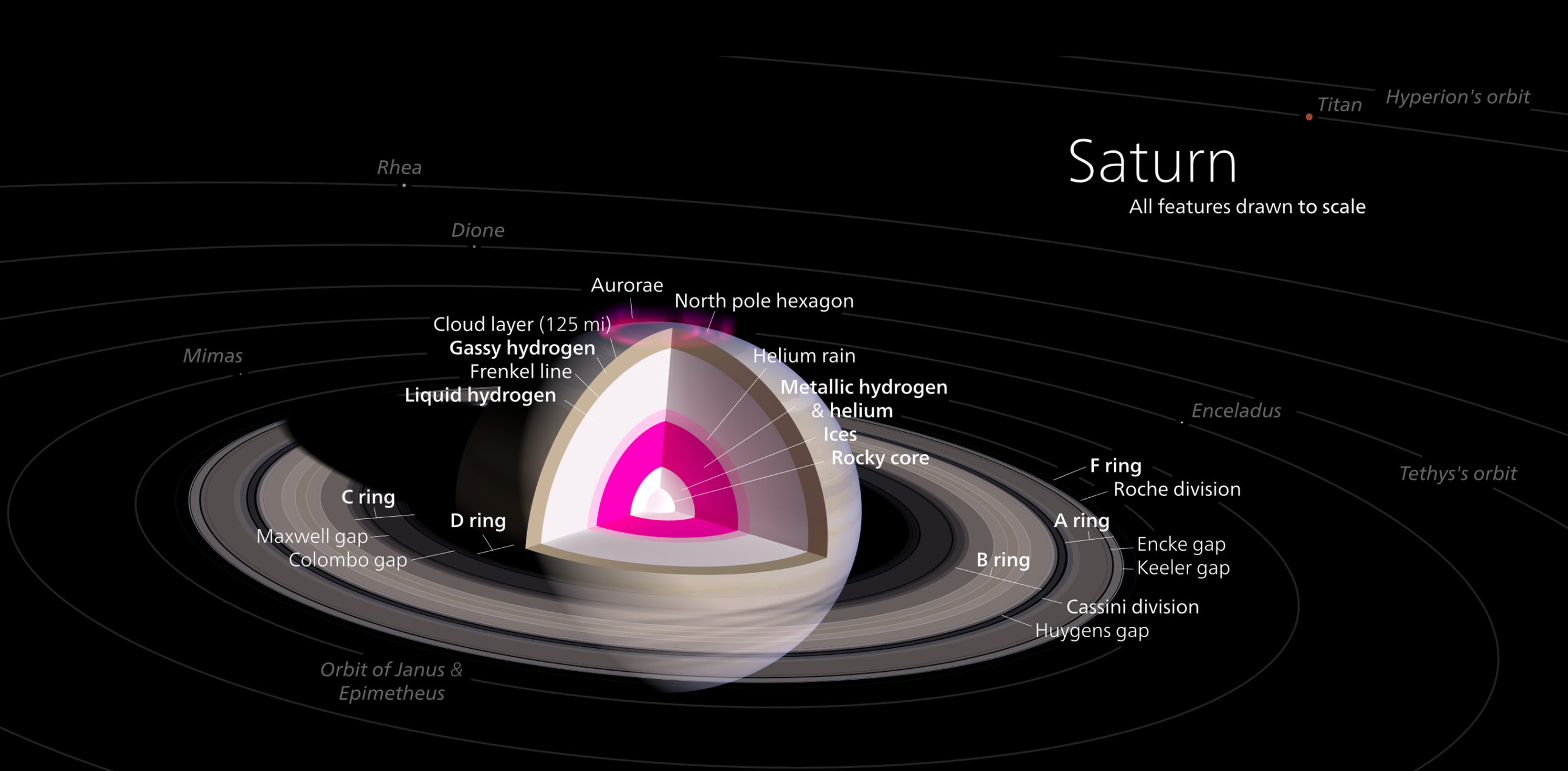




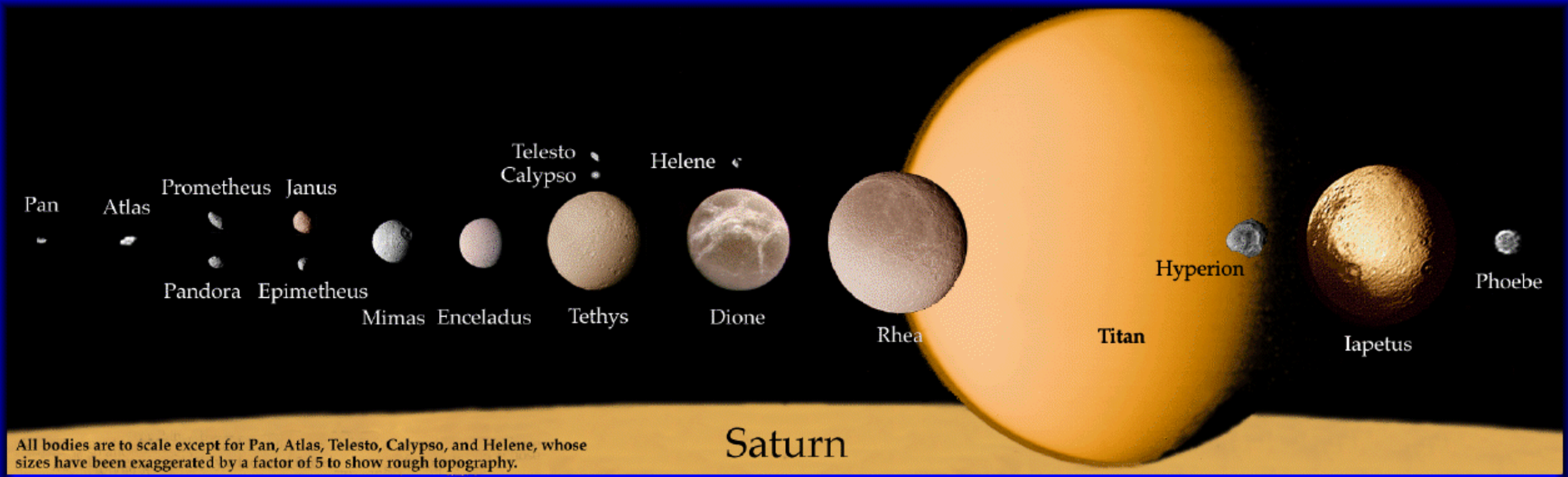


Saturn's features are hazy because its atmosphere is thicker. Jupiters mass is greater than Saturns. Therefore, its gravity is higher and a higher surface gravity compresses the atmosphere to 75 km in thickness. On Saturn, the low mass means less surface gravity and the atmosphere is thicker at 300 km from top to bottom.

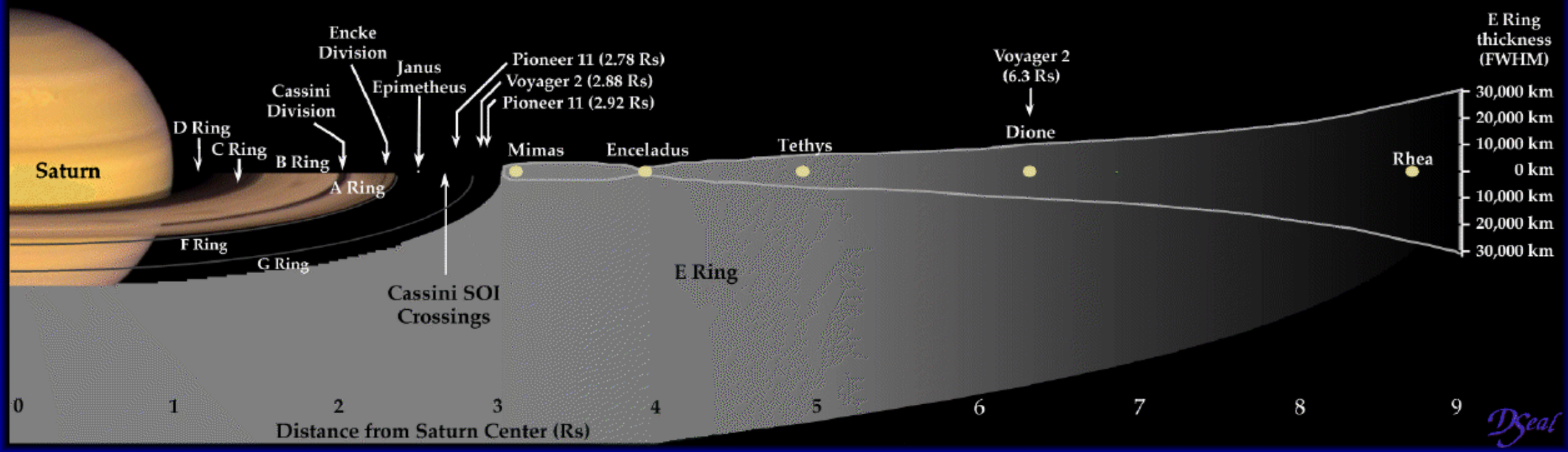


Saturn is the only planet less dense than water (0.7 gm/cc, i.e. it would float). Saturn's hazy yellow hue is marked by broad atmospheric banding similar to, but fainter then, that found on Jupiter. Trace amounts of ammonia, acetylene, ethane, propane, phosphine and methane have been detected in Saturn's atmosphere. The upper clouds are composed of ammonia crystals, while the lower level clouds appear to consist of either ammonium hydrosulfide (NH4SH) or water.

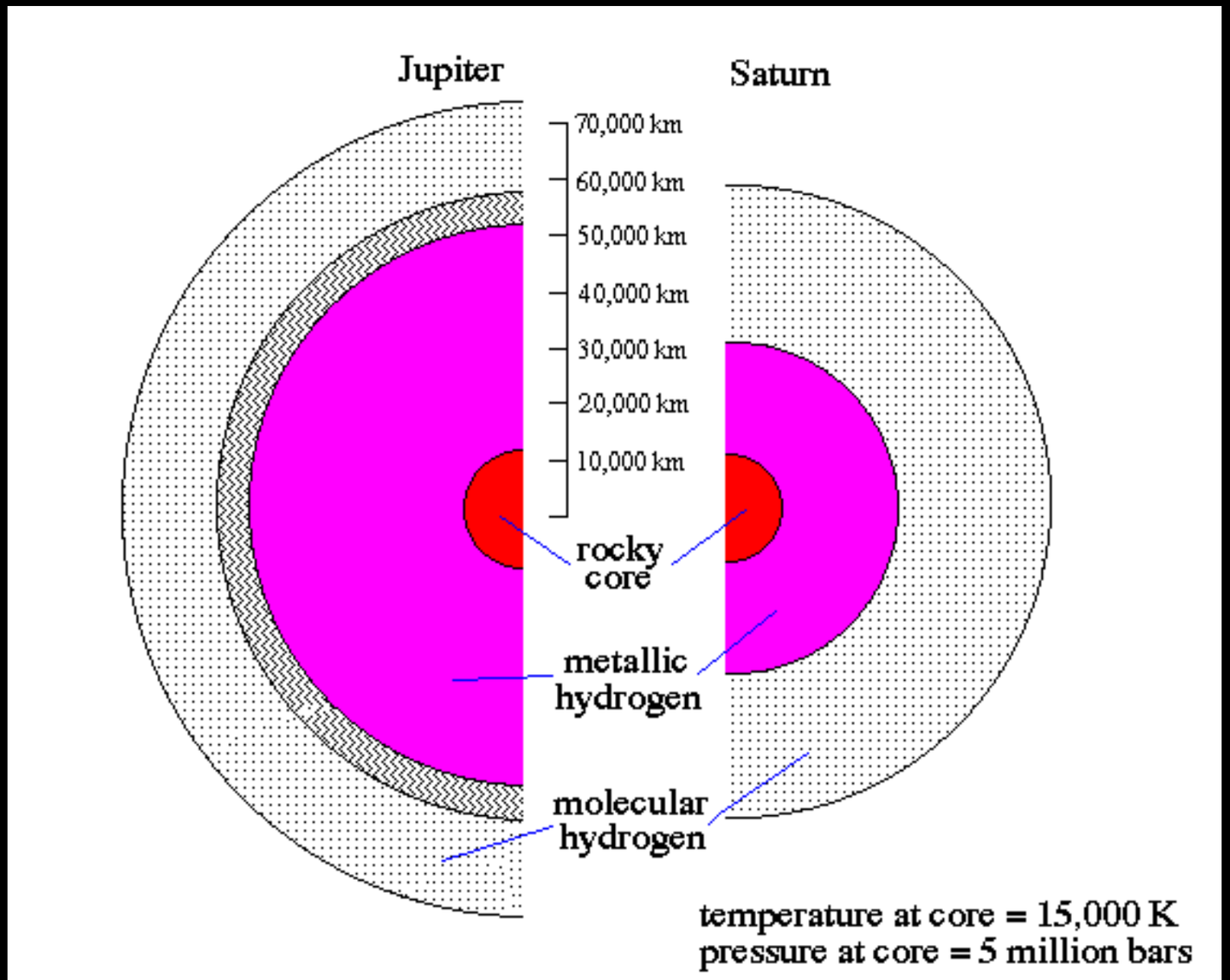
Saturn's Satellites and Ring Structure

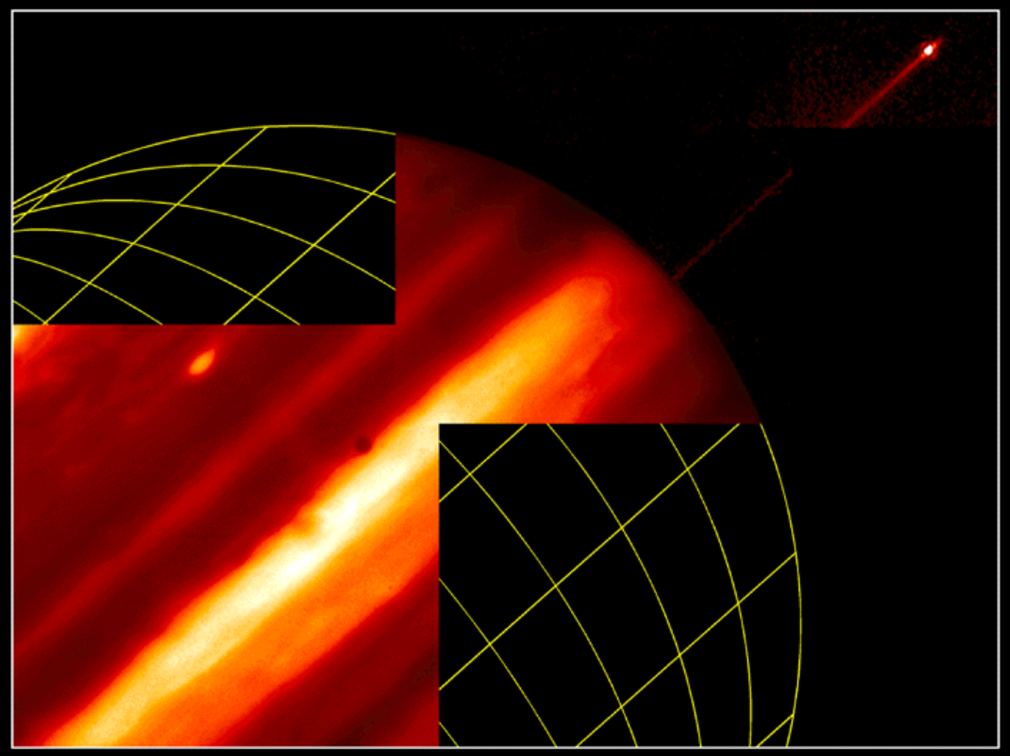


Not shown:	Pan	2.22 Rs	Titan	20.3 Rs
	Atlas	2.28 Rs	Hyperion	24.6 Rs
	Prometheus	2.31 Rs	Iapetus	59.1 Rs
	Pandora	2.35 Rs	Phoebe	214.9 Rs

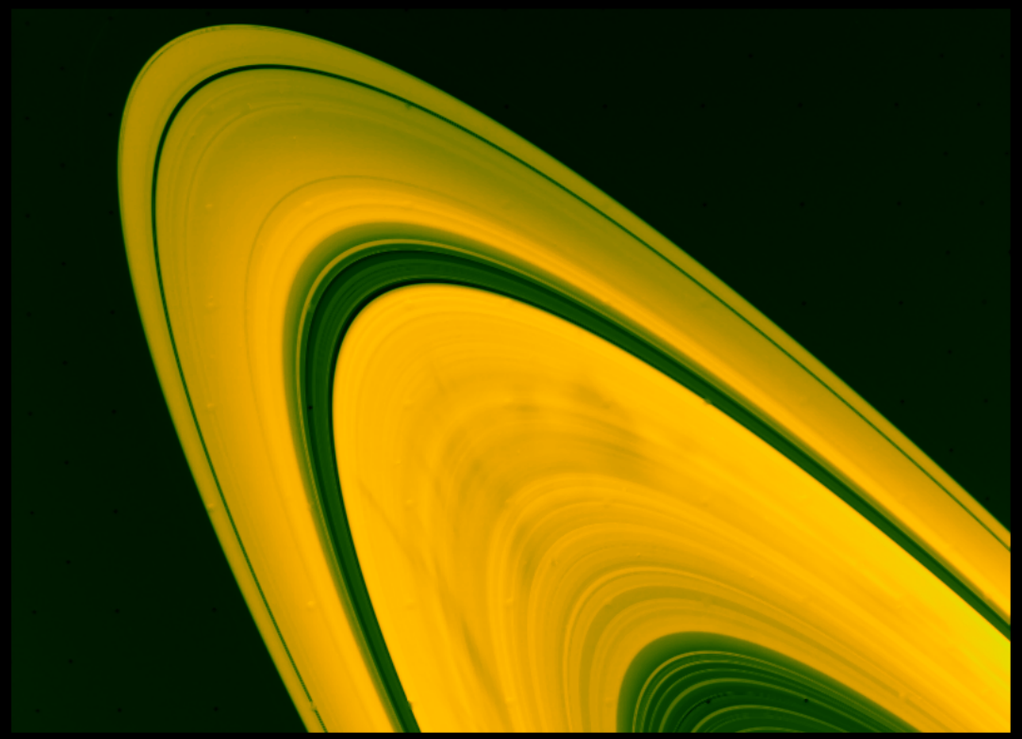


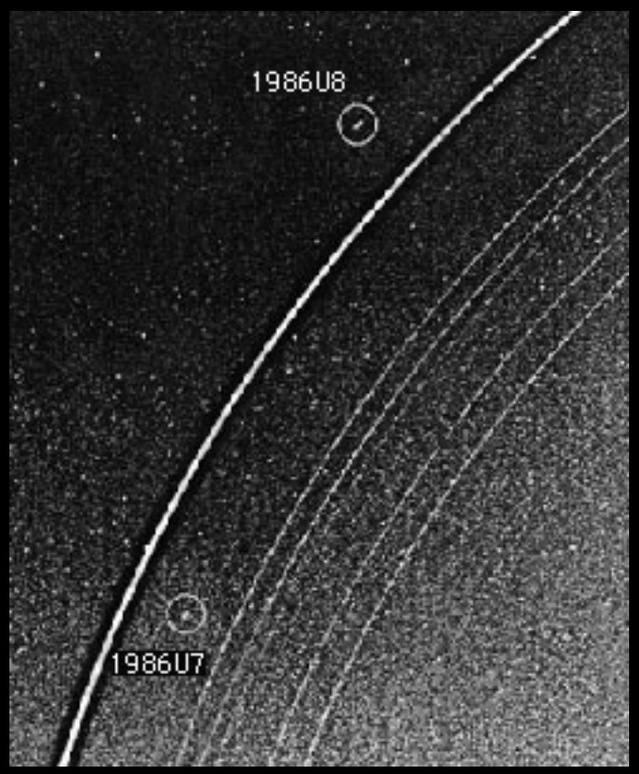
This graphic is available in color if required.

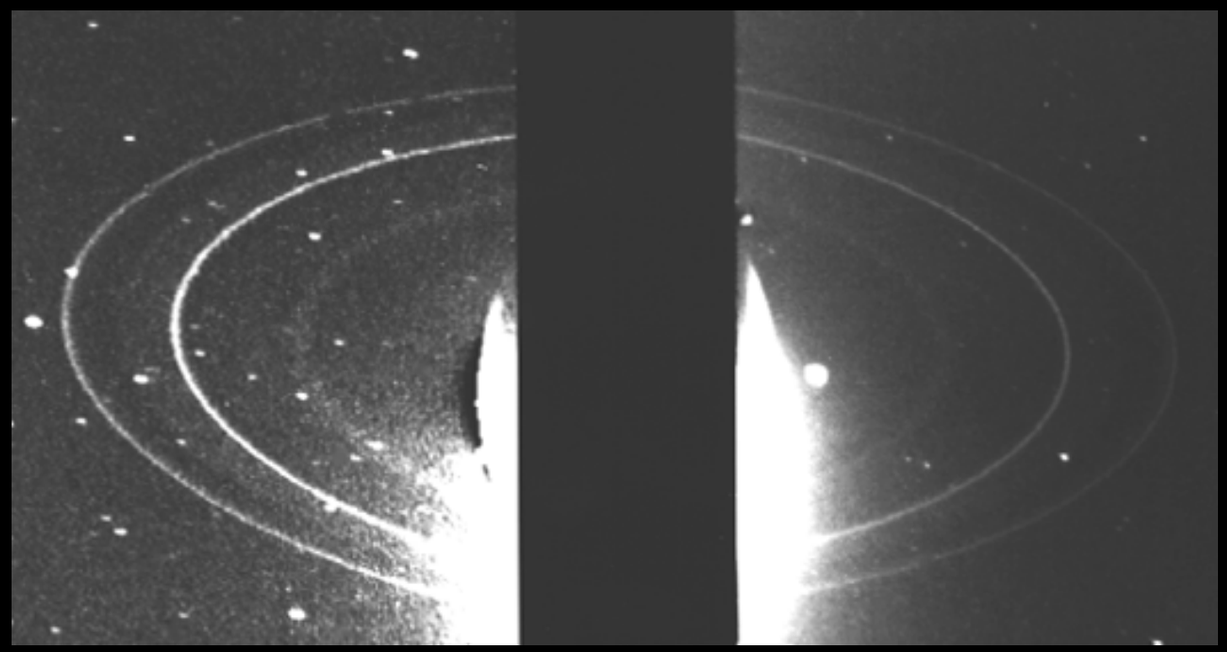

Jupiter
Saturn
70,000 km
60,000 km
50,000 km
40,000 km
30,000 km
20,000 km
10,000 km
rocky core
metallic hydrogen
molecular hydrogen
temperature at core = 15,000 K
pressure at core = 5 million bars

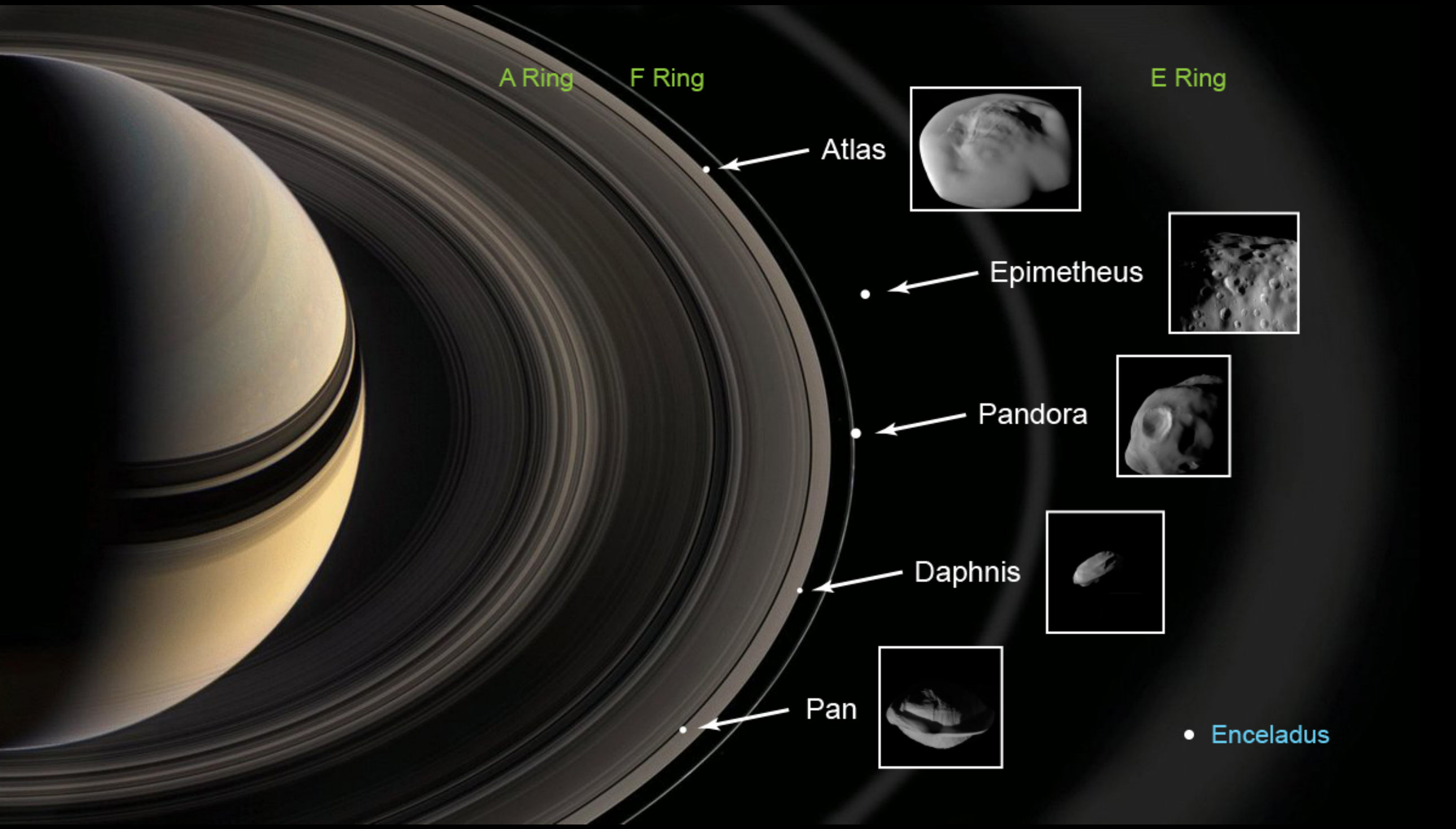


Jupiter • September 17, 1997 HST • NICMOS
PRC97-37 • November 20, 1997 • ST ScI OPO
R. Beebe (New Mexico State University) and NASA

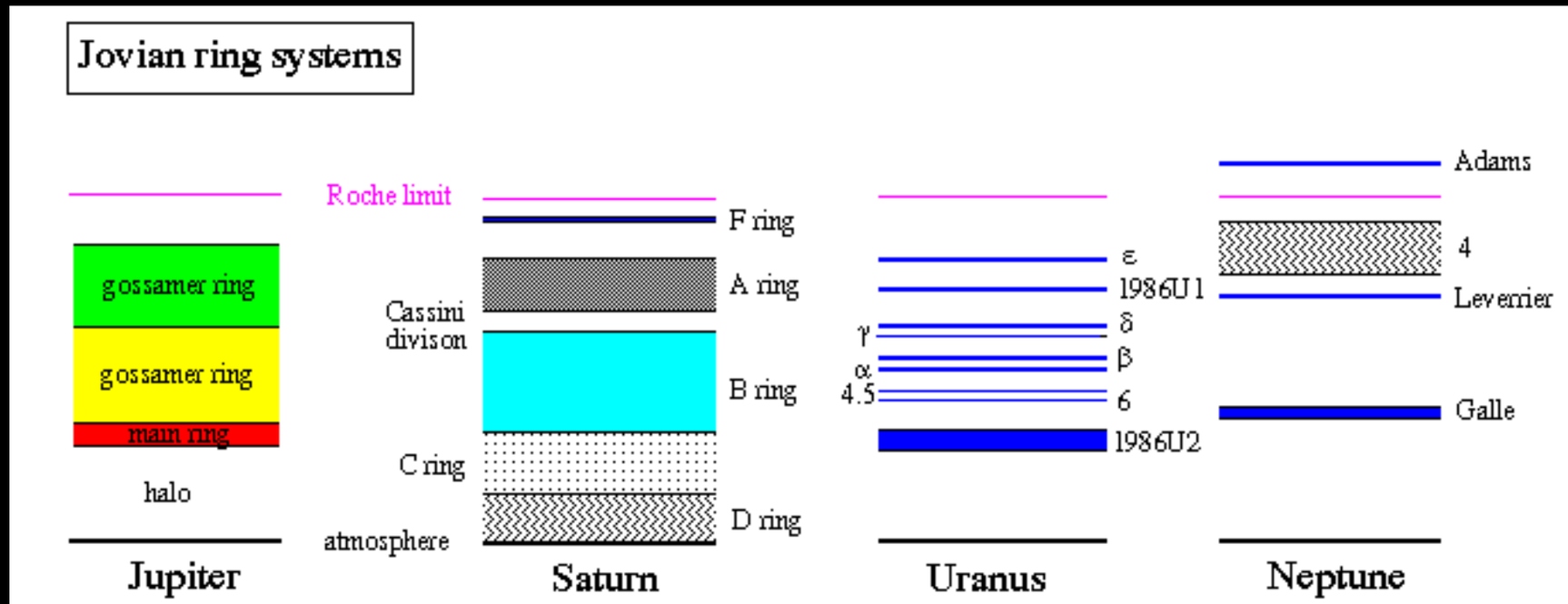


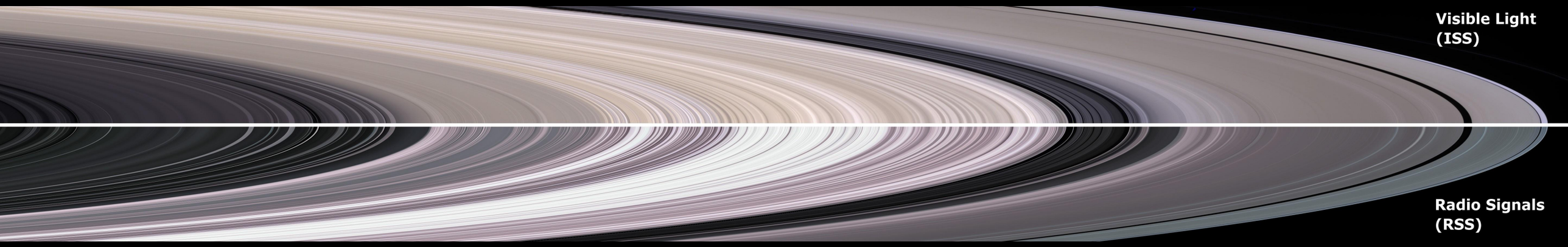


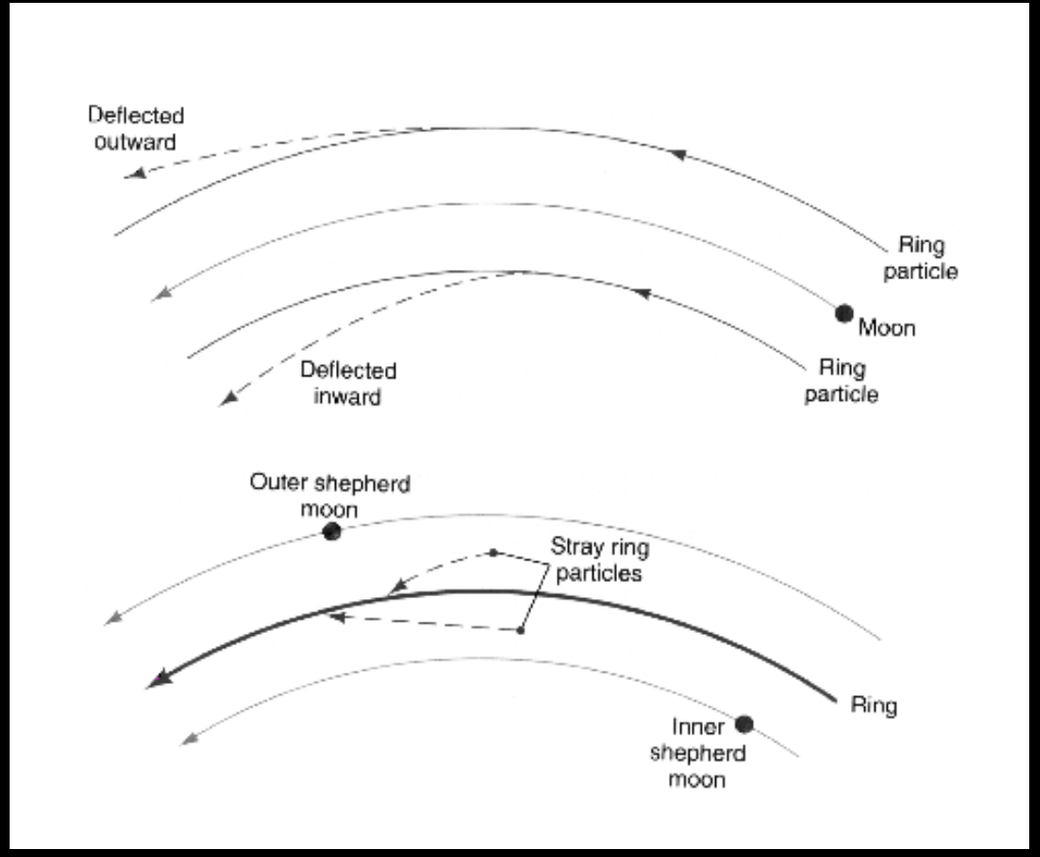



A Ring
F Ring
E Ring
Atlas
Epimetheus
Pandora
Daphnis
Pan
Enceladus

When a moon or comet approaches within the Roche limit of a planet, the tidal forces overcome the internal forces and disrupt the moon/comet. The broken pieces are distributed into a ring shape. We know that that the rings are not solid or liquid since Doppler measurements show that the rings are made of separate particles moving in circular orbits. High albedo means rings are typically made of ice (captured comets?).


Jovian ring systems
gossamer ring
gossamer ring
main ring
halo
Jupiter
Roche limit
F ring
A ring
Cassini
divison
B ring
C ring
D ring
atmosphere
Saturn
ε
1986U1
γ
δ
β
α
4.5
6
1986U2
Uranus
Adams
4
Leverrier
Galle
Neptune


Visible Light
(ISS)
Radio Signals
(RSS)


Deflected outward
Ring particle
Moon
Deflected inward
Ring particle
Outer shepherd moon
Stray ring particles
Ring
Inner shepherd moon