

Jupiter's moons became important in another momentous discovery: the fact that light needs time to get from A to B, and a first estimate of the speed of light.



The astronomer was the Danish scientist Ole Rømer and the discovery was made in 1675. Newton used the new information in his "Opticks."

Rømer noted that as E moved away from Jupiter, the observed points of time of Io entering or leaving the shadow of Jupiter were retarded with respect to expectations. As E moved toward Jupiter, the reverse discrepancy appeared.



Ole Rømer (1644-1710)
Rømer, inventor of the transit instrument shown here, determined the velocity of light from observations of the times of eclipse of each Galilean.

The diagram shows Earth's orbit around the Sun. Jupiter is shown at two positions: one when Earth is moving away from it (July 1) and one when Earth is moving toward it (Jan 1). Lines represent the light path from Jupiter to Earth.

The principle of Rømer's method is straightforward.

With E's speed known, the extra distance traveled by the light from Jupiter, between eclipses or occultations, is determined from the difference in observed and expected timing.

Exploration of Jupiter

• Pioneer 10 & 11	fly-bys	1974/75	US
• Voyager 1 & 2	fly-bys	1979	US
• Galileo	fly-by pseudo-orbit probe	1995-2003	US
• Cassini	fly-by	2004	US/Europe
• JIMO	fly-by pseudo-orbit	future	US






Pioneer 10
Voyager 10
Galileo
Cassini



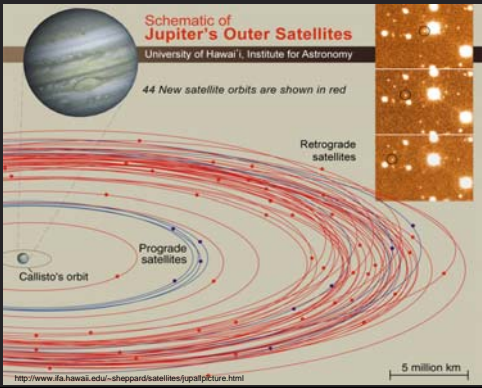
Thanks to the observations by the space probes, we now have some idea about the nature of the Galilean moons, Io, Europa, Ganymede and Callisto.

Io has spectacular volcanoes, powered by tidal action.

Europa has an icy surface, with cracks, and may have an ocean underlying its icy crust.

Ganymede, the brightest of the lot, is probably made of ice and rocks, as is true of the dark and light-weight Callisto, rich in craters. Water may be dominant in this moon.

Jupiter has many satellites besides the Galilean moons (65 and counting)



Schematic of Jupiter's Outer Satellites
University of Hawaii, Institute for Astronomy

44 New satellite orbits are shown in red

Retrograde satellites

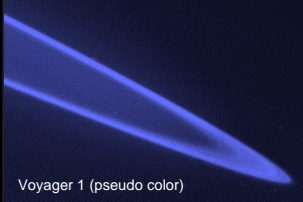
Prograde satellites

Callisto's orbit

5 million km


<http://wwwifa.hawaii.edu/~sheppard/satellites/jupattpicture.html>

Jupiter's Rings



Voyager 1 (pseudo color)

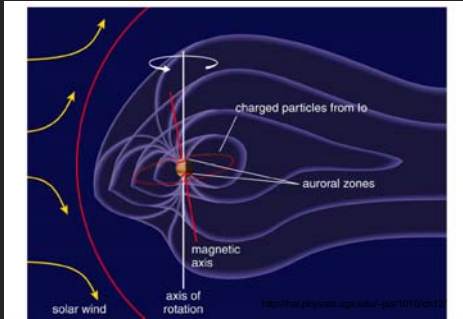
In fact, the number of satellites merely depends on the definition of "satellite." The rings have countless numbers of circling objects.



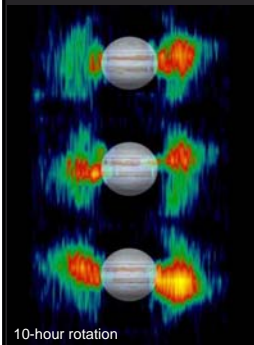
Halo Ring (inner-most)

Jupiter's Magnetosphere

Like Earth, Jupiter has a magnetic field shaped by the solar wind. The origin of the field has to do with rotation of conducting materials in the core, but the details are poorly understood.



Jupiter's Radiation Belts

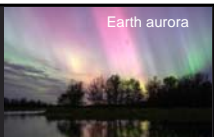


Jupiter's strong magnetic field controls its radiation belt, which emits large amounts of energy in radio frequency.

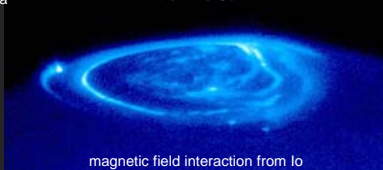
Radio emission, Cassini spacecraft

http://www.jpl.nasa.gov/images/jupiter/jupiter_027102_3_caption.html

Aurorae

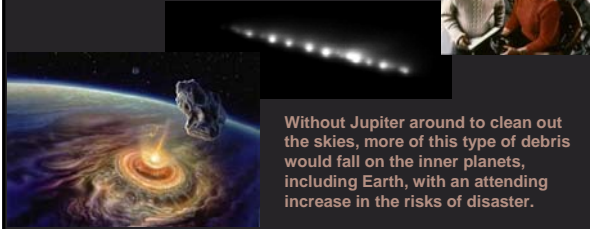


Like Earth, Jupiter has polar lights, generated by electric currents traveling through gas. However, unlike on E, where solar wind delivers the particles generating the auroras, on Jupiter these eerie lights are produced without the help of the Sun.



Cosmic Collisions

In 1994, Jupiter proved its role as the main vacuum cleaner of the solar system, besides the Sun. It captured a comet (Shoemaker-Levy 9), which broke up before hitting the planet, producing a spectacular bombing run.



Without Jupiter around to clean out the skies, more of this type of debris would fall on the inner planets, including Earth, with an attending increase in the risks of disaster.
