Galileo Mission to Jupiter

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Nearly 400 years after the Italian astronomer Galileo Galilei discovered Jupiter's major moons, the Galileo spacecraft was successfully inserted into Jupiter's orbit on December 'i', 1995, and began its 23-month exploration of the planet and its moons. The spacecraft was designed, built and operated by NASA Jet Propulsion Laboratory to investigate Jupiter's atmosphere, moons, and the surrounding magnetosphere. Its value? According to NASA Associate Administrator Dr. Wesley "l'. Huntress, "In many ways, Jupiter is like a miniature solar system in itself. Within Jupiter's constellation of diverse moons, its intense magnetic field, and its swarms of dust and charged particles, the Galileo mission should uncover new clues about how the Sun and the planets formed, and about how they cent inue to interact and evolve."

Galileo is the first dual-spin planetary spacecraft (Fig. 1). The rotor (the spinning section) normally spins at 2.9 rpm to maintain the spacecraft stability and allow the science/magnetometer boom to sweep about for magnetosphere experiments. The stator (the despun section) is normally kept stationary to provide inertial pointing of the camera and other instruments. Also mounted on the rotor are the nigh-Gain Antenna (HGA), two low-gain antennas, two Radioisotope Thermoelectric Generators (RTG), the propulsion module (developed by Germany), the star scanner, instruments for measuring fields and particles, and most of the computers and control electronics. Besides the camera system, the stator also carries the instruments for atmospheric and moon surface chemical analysis, studying the gases, and measuring the radiation energy. 'l'he Radio Relay Antenna (RRA) and the atmospheric probe arc also attached to the stator.

Galileo was launched on October 18, 1989, onboard the space shuttle Atlantis. A two-stage Inertial Upper Stage (1 US) booster then pushed it out of 1 Earth orbit and the spacecraft began its Venus-Earth-Earth-Gravity-Assist (VEEGA) trajectory. Along this interplanetary trajectory using gravity assists of the planets, about 30 small maneuvers were performed by firing the 10-newton thrusters for trajectory correction. These planet flybys provided scientists with great opportunities for scientific observations. The spacecraft arrived at Venus on February 10, 1990. Lightning at Venus was confirmed and the first views of the mid-level clouds of Venus were obt aincd. The Earth flybys occurred on December 8, 1990 and December 8, 1992, respect ivel y.

in addition to many Earth observations, Galileo also observed the north pole of the Moon. The VEEGA trajectory also led the spacecraft fly through the Asteroid Belt twice, letting it closely encounter asteroids Gaspra and lda (on October 29, 199] and August 28, 1993, respectively). Accidentally, it found a small moon (1.2x 1.4 x 1.6 km, later named Dactyl) circling around Ma. As a bonus, Galileo's imaging instruments directly captured the impact of the fragment W of Comet Shoemaker-1.cvy 9 with Jupiter in July, 1994.

The main telecommunication equipment onboard the spacecraft is the High-Gain Antenna. Unfortunately, it failed to open complete] y during the first try on April 11, 1991, Tremendous efforts had been put in to free the HGA ever since, yet unsuccessful (the last attempt will be made in March, 1996). Communication burden then fell on the low-gain antenna whose data rate is substantiality lower than that of the HGA. However, engineers and scientists have successfully upgraded the onboard software anti the ground telecommunication hardware so that at least 70 percent of the original science objectives can be achieved.

On July 13, 1995, the spacecraft spun up to 10.5 rpm for more gyroscopic stability and released the atmospheric probe, aiming toward its Jupiter entry. Following the probe release, the spacecraft fired its 400-newton main engine for the first time to deflect its trajectory for its own Jupiter Orbit Insertion (JOI). The probe descended into Jupiter's atmosphere on December 7, 1995, and Transmitted valuable science data as the temperature, pressure, chemical composition, lightning and radiant energy of Jupiter's atmosphere back to the spacecraft. The spacecraft then fired its 400-newton engine for 49 minutes (again at the spin rate of 10.5 rpm) to slow down and was successfully captured by Jupiter's gravity into Jupiter's orbit. For the following 23-month orbital tour, Galileo will travel in 11 different elliptical orbits around Jupiter. It will encounter Jupiter's satellite Ganymede four times, Callisto three times, and Europa three times to perform close observations. It will also gather valuable data of Jupiter's magnetospheric and dust environment.

Galileo mission to this largest planet (about 1,400 times the size of Earth) in the solar system will advance the know] edge in the fields of meteorology, geochemistry, geology, geophysics, atmospheric science and space physics as well as our understanding of the formation and evolution of our solar system.

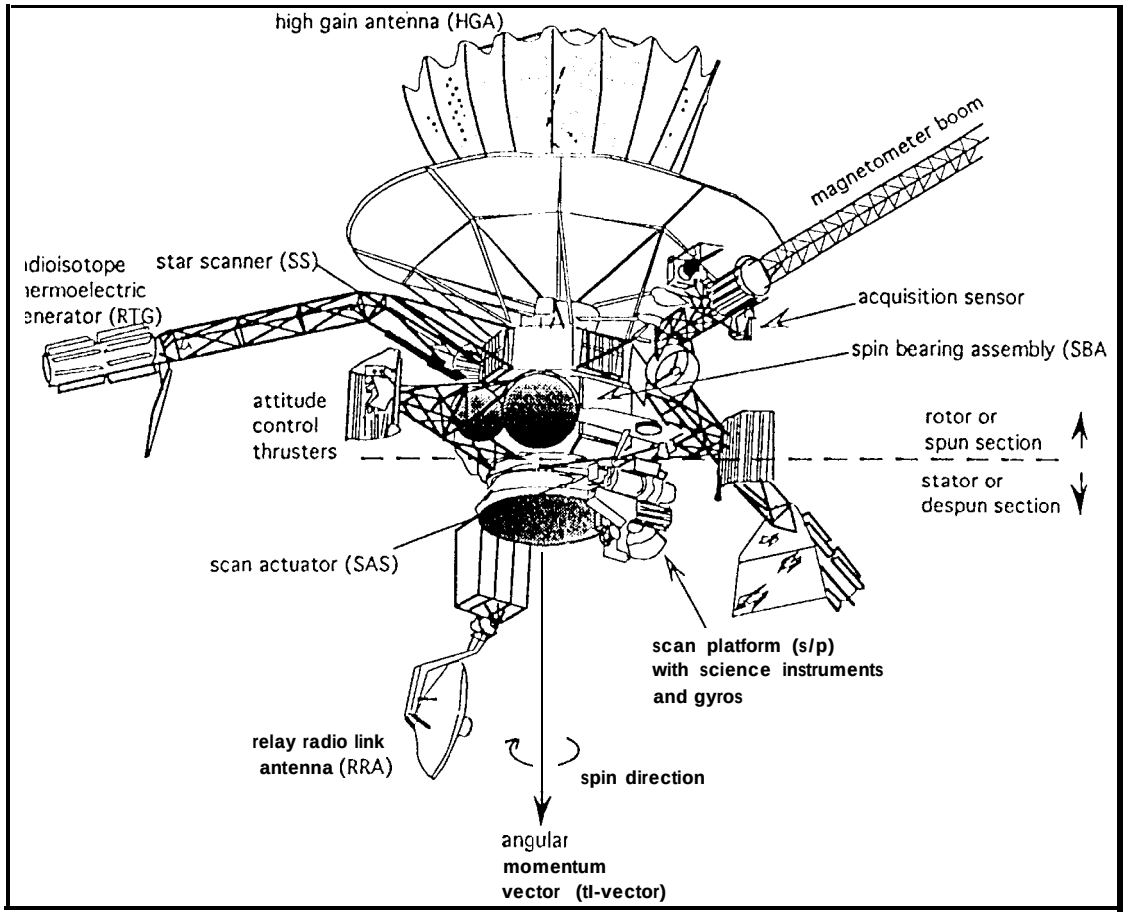

Figure 1. Gal ilco Spacecraft