PROJECT GALILEO: FINAL MISSION STATUS

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After a 14-year odyssey, the historic Galileo mission to Jupiter ended on September 21, 2003 when the spacecraft entered the atmosphere of the giant planet it had studied for almost seven and a half years. The planned destruction of the orbiter was necessary to satisfy planetary protection concerns about Europa, a prime target in the search for extraterrestrial life.

Almost 11 months earlier, on November 5, 2002, the spacecraft flew about 71,500 km above the planet's cloud-tops, sampling the inner magnetosphere and the Gossamer ring. The trajectory took Galileo by Amalthea to obtain the first density estimate for a small inner moon of Jupiter. The Amalthea encounter presented challenges both in preparing for this risky flyby and in recovering from this traverse deep within the radiation belts. By limiting the observations to two primary experiments, radio science and fields and particles, the flight team was able to simplify sequence design and facilitate a robust strategy to continue data acquisition in the event of an anomaly. Based on previous experience, changes were made to onboard fault protection routines to either facilitate recovery or keep Galileo from entering safe mode (and subsequently canceling the science command sequence).

Not unexpectedly, two new types of hardware problems were manifested during this perijove passage. About 16 minutes after Amalthea closest approach, the extreme radiation environment caused erratic behavior in the Command and Data Subsystem phase lock loops. This resulted in multiple swaps of the timing chains and entry into spacecraft safe mode. An autonomous science recovery sequence designed to continue recording fields and particles data was initiated but did not run to completion because of the specific type of hardware anomaly. High-energy protons encountered by the orbiter for the first time caused displacement damage in optical electronics that control the tape recorder motor. By applying current to the circuit, this damage was annealed sufficiently to enable playback of the unique continuous sample of the inner magnetosphere.

Designed to withstand 150 krads inside a 2.2 g/cm^2 shell, the spacecraft is remarkably healthy after sustaining about 650 krads but is showing some age and radiation damage. Radiation affected the spacecraft via damage to electronic parts in the attitude control subsystem, the computer memory, the tape recorder and some science instruments and by causing transient bus reset indications. Software patches and modified operating strategies were implemented to work around most of the radiation effects. A summary of spacecraft performance in the harsh jovian environment and the final subsystem and instrument status is provided.