From the Project Manager

We have been informed this week (February 12) that the planetary missions will not be launched in May this year, and that both Galileo and Ulysses have been directed to work toward the next Jupiter launch opportunity, which is in June 1987.

I am pleased that this direction came as quickly as it did, after the tragedy of the Challenger mission. The accident was a terrible experience for those personally involved—certainly the families and friends of the crew, but also all of the dedicated people who have worked so diligently and so hard to make the national Space Transportation System a reality. We at JPL have been deeply moved by the experience, and we share, as does the rest of the nation, in the sorrow and personal loss of those involved.

It is gratifying to see how quickly Jesse Moore’s team and the Presidential Commission have been established, and how vigorously they are working to find out what happened, why it happened, and to determine what must be done to assure that it will not happen again. We can be confident that our space program will be back on track quickly.

In December, we celebrated shipment of the Galileo orbiter and probe to the launch center in Florida. We are planning to continue with spacecraft testing and integration and to go as far as we can, including mating the spacecraft to the Centaur upper stage in Kennedy Space Center’s Vertical Processing Facility (VPF),

The Galileo spacecraft (minus the high-gain antenna) was hoisted onto a platform and then the “clamshell” shipping container was closed around it.

With its precious cargo in place on a drop-bed trailer, the convoy left JPL in the early morning hours of December 19 and arrived at Kennedy Space Center, Florida, 75-1/2 hours later, on December 22. Other spacecraft hardware and support equipment also travelled in convoys to the Cape.
and hopefully continuing with operations through the integrated wet (propellant loaded) Countdown Demonstration Test on Pad 39 with the Centaur and the shuttle orbiter Atlantis.

Current plans are to leave the spacecraft at the Cape in "active storage," that is, in a condition that will allow us to continue to test it during the next year. This will mean sending selected support equipment from Pasadena to establish a test environment at KSC similar to JPL's Spacecraft Assembly Facility (SAF) environment.

In the near term we will complete ground data system testing, as well as some mission operations system test and training activities—specifically, one launch exercise and one trajectory correction maneuver exercise. We will complete the design work for the early months of the cruise to Jupiter, continue to prepare flight team procedures, and continue contingency planning.

The mission design people will be busy defining new targeting specifications, selecting the new Jupiter arrival date, and establishing a new design for the orbital tour of Jupiter's satellites. The earliest possible Jupiter arrival date will overlap with Voyager 2's Neptune observations in late summer of 1989, so we may be forced to select an arrival date a little later than that. Much depends on the scheduling of the Deep Space Network's tracking coverage.

Of course, the opportunity to study the asteroid 29 Amphitrite was lost when the May 1986 launch was cancelled. The trajectory designers will be looking for other opportunities to study an asteroid, but it is unlikely that another asteroid as large, as accessible, and as scientifically interesting will be found in the new trajectory.

There has been a lot of speculation on what would have happened had Galileo and its Centaur upper stage been onboard the Challenger. It won't be possible to analytically assess that until the data from the accident is available. However, based on the limited data that is available, expert opinion indicates that the explosion and fire were of an intensity far below the levels that the radiotrace thermoelectric generators are designed to withstand.

The House Committee on Science and Technology, chaired by Congressman Don Fuqua (D-FL), visited JPL this week to assess the impact of the Challenger accident on planetary programs, and I am encouraged by the continuing Congressional support of the planetary programs.

NASA is moving forward with plans to modify another shuttle, most likely the Discovery, to carry the Centaur. This is essential if both Ulysses and Galileo are to be launched in 1987.

The Challenger accident was a tragedy of great human dimension, touching not only the lives of those personally involved, but the entire nation as well. It will certainly affect the space program but it will not stop it. The problem will be resolved and the program will go on. We on the Galileo team must press on with our own challenge: the successful execution of a scientifically rich and fascinating mission of discovery at Jupiter. □

— J.R. Casani

(Ed. note: Jesse Moore was the NASA Associate Administrator for Space Flight until he recently assumed the directorship of NASA's Johnson Space Center in Houston, Texas.)

Meet the Team

"For me, the most exciting aspect of my job is the actualization: turning concepts into hardware," says Frank Locatell, test and operations engineer for JPL's Mechanical and Chemical Systems Division. "And the interactions with the people rank right up there, too. This is an exciting community to work in."

Upon meeting Frank, one very soon becomes aware of the intensity and enthusiasm he brings to everything he does. Whether designing hardware or training crews on safe handling procedures for critical hardware, he is articulate and focused.

A member of JPL's System Integration Section, Frank is responsible for all support from his division to the Galileo test and operations activities. He is the cognizant engineer for the Super*Zip separation joint between the spacecraft and the Centaur upper stage, for the launch vehicle adapter structures, and for the interface with the retro-propulsion module. He is also responsible for the conceptual design of the despun section of

Frank Locatell
the spacecraft and for the configuration design of the spin bearing assembly.

A native Californian, Frank grew up in the Napa wine country and is a product of the University of California at Berkeley during the turbulent '60's. He holds a master's degree in science and engineering.

Frank and his wife Debbie (who is lead secretary in the Galileo project office) live in a craftsman home in nearby Altadena. They both meditate and practice yoga, and enjoy poking around archaeological sites in southern Mexico and Central America. Frank also hopes to teach and write.

Energetic Particle Detector

Jupiter’s magnetosphere is the region within which the planet’s magnetic field and charged particle population is confined by the flowing solar wind. Energetic particle charges are so intense in this region that careful design is required to protect the spacecraft against radiation damage, a particular concern for Galileo which must operate in this environment for its 22-month prime mission.

An immense and dynamic reservoir of energetic particles must be continually replenished to replace those particles which escape into interplanetary space. The processes responsible for this remarkable replenishment are unknown. Coupled with the study of magnetospheric dynamics, the identification of these processes represents the primary focus of Galileo’s Energetic Particles Detector (EPD). The EPD measures the composition, intensity, energy, and angular distribution of charged particles (with energies greater than approximately 20 kiloelectron volts) within the Jovian magnetosphere.

Voyager’s observations have led to the identification of three sources for Jupiter’s energetic particles: the Sun, the Jovian ionosphere, and the Jovian moons.

The Sun (solar wind and energetic particles) is the most likely candidate for the helium, carbon, nitrogen, oxygen, neon, magnesium, silicon, and iron seen in the outer magnetosphere. Closer to the planet, the high abundances of sulphur, sodium, and oxygen provide strong evidence that these particles originate from Io and its plasma torus (a region containing about equal numbers of positively and negatively charged particles). Of the molecular ions observed in Jupiter’s magnetosphere, hydrogen (H₂) may come from both the ionosphere and the moons, whereas H₃ is most likely of ionospheric origin. Jupiter’s intense proton population probably comes from both the Sun and the ionosphere.

A comparison of Voyager 1 and 2 data strongly suggests that the relative contribution of Jovian and solar sources varies considerably with time. Thus, obtaining a long history of the Jovian energetic particle population is crucial to beginning a study of the dynamics of the Jovian magnetosphere.

Q&A

Q: Since the launch scheduled for May 1986 has been cancelled, why must Galileo wait thirteen months for another launch opportunity?

A: Due to the relative motions of Earth and Jupiter, opportunities to launch directly to Jupiter exist only when Earth and Jupiter are in approximately fixed positions relative to each other. However, Earth takes one year to orbit the Sun, while Jupiter completes its orbit once every 12 years. Therefore, the Earth must complete one full orbit plus the same angular distance Jupiter has travelled (one-twelfth of its orbital path) before the planets will be properly aligned again for a direct flight from Earth to Jupiter. Galileo’s next launch opportunity will be in late June 1987.

Q: In light of the Shuttle 51-L accident, are there other options available to lift Galileo and its Centaur G' upper stage into low-Earth orbit?

A: No other system exists that is immediately available to lift Galileo and the Centaur into orbit. While future, expendable boosters (like the Titan III-D-7) are being developed, these will not be available until at least 1990. Galileo and the Centaur were specifically designed to be compatible with the Shuttle.
The EPD uses two silicon solid-state detector systems: the Low Energy Magnetic Measurement System (LEMMSS) and the Composition Measurement Subsystem (CMS). The magnetically focused LEMMS separately measures ions and electrons. The CMS uses a multiparameter detection technique to measure ions ranging from protons to iron (an energy range from 80 to 10,000 kiloelectron volts per atomic mass unit). The CMS also determines the velocity of these ions by measuring the time it takes to pass between the front and the back detectors, a distance of 7.5 centimeters (3 inches). This added capability allows a separate check on data validity, which is particularly helpful for particles at high incoming rates.

The detector assemblies use magnetic deflection, absorber materials to differentiate between incoming particle types, and varying aperture sizes to allow operation over a wide dynamic rate range. radioactive calibration sources are mounted on a vertical shield that is observed by the detectors every 140 seconds.

The primary new thrust to be gained from Galileo will be an understanding of the Jovian magnetosphere and its dynamics. Unlike Pioneer and Voyager, Galileo will be placed into orbit around Jupiter and will obtain (for the first time) continuous coverage of the Jovian magnetospheric particle and field environment. Thus, it will be possible to determine characteristic time variations of the Jovian magnetosphere.

The Galileo mission also affords a much larger coverage of the Jovian magnetosphere, including the important midnight meridian region of the Jovian magnetic tail. The extended coverage will detect how and how much of Jupiter's particle population is lost to interplanetary space.

In addition, the Galileo spacecraft will be maneuvered to perform a total of 10 flybys of Jupiter's four largest satellites, ranging in altitude from a few hundred to a few thousand kilometers. From these close flybys, scientists will determine how the satellites interact with Jupiter's magnetospheric plasma and how this affected the evolution of these bodies.

Finally, the EPD will create a three-dimensional "map" of the energetic particle distribution by rotating through 225° over seven Galileo spin periods (140 seconds). These data will yield information on particle energization and transport, the magnetic field configuration, and particle output from the satellites. Because the ranges of several instruments overlap, Galileo will provide the first continuous spectral observations of the overall Jovian charged particle distribution.

Jim Willett, the EPD science coordinator at JPL, emphasizes, "each of the fields and particles (F&P) instruments senses only a portion of the whole picture. By combining the results of all the F&P instruments we will be able to more exactly shape our model of the Jovian system." The EPD science team also includes The Johns Hopkins University, the Max-Planck-Institut für Aeronomie, the University of Alaska, the University of Kansas, and Bell Laboratories. The principal investigator for the EPD is D.J. Williams of The Johns Hopkins University.

The new dimensions of the Galileo mission may solve the many mysteries raised by the Pioneer and Voyager flyby missions. What are the intrinsic time variations of the Jovian magnetosphere? How do the charged particles escape? What physical processes maintain the intense particle populations in this vast but porous energetic particle reservoir? Are such powerful energization processes universally common? Do these processes sustain a Jovian magnetospheric wind of charged particles flowing away from the planet? Does the interaction of the Galilean satellites with the Jovian magnetosphere affect or guide their evolution? The Galileo mission gives us our best (and for the foreseeable future, the only) opportunity to answer these and other basic questions on the behavior of plasmas in the solar system.

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D.J. Williams

Work is underway for final integration and checkout at Kennedy Space Center.

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