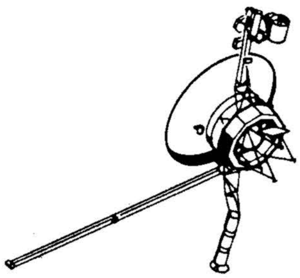

MISSION STATUS BULLETIN

VOYAGER

October 2, 1978 **No. 24**

Mission Highlights

Voyager 1 Clears Asteroid Belt; Voyager 2 Close Behind

Voyager 1 successfully cleared the area of the asteroid belt on September 8, 1978, and Voyager 2 will complete its passage on October 21.

The asteroid belt is a band of rocks and dust 360 million kilometers (223 million miles) wide between the orbits of Mars and Jupiter; its inner edge begins about 105 million kilometers (65 million miles) from Earth's orbit.

Both spacecraft entered the asteroid belt on December 10, 1977, Voyager 1 trailing a few hours behind Voyager 2. Voyager 1, launched after Voyager 2, has been flying a faster trajectory, and has been steadily pulling ahead of its companion since overtaking it last December 15.

Mark III Command System Implemented

On September 15, operations switched over to the Mark III ground data system (GDS), with elements in both the Deep Space Network (DSN) and JPL's Mission Control and Computing Center (MCCC). It includes a new command system using minicomputers rather than the IBM 360/75 computer. The 360/75 computers are still used for data records. In addition to providing the new store and forward command system, the Mark III GDS includes new data switching, and ground data error correction capability. New operations control and ground data system monitoring capabilities are provided to simplify operations.

Update

Voyager 1

Capability Demonstration Tests

Also included in Voyager 1's busy month was the first of three important capability demonstration tests, designed to test spacecraft and ground system alike under encounter conditions. All went smoothly, with only minor software problems.

The first test, conducted on September 26 and 27, consisted of three parts. Part 1 required execution of the entire near encounter sequence from Jupiter minus 24 hours to Jupiter minus 14 hours 50 minutes. The ten-hour test began at 4 a.m. PDT when the spacecraft was in view of Deep Space Station 14 (64-meter antenna) at Goldstone, California.

Part 2 of the test excercised several imaging modes planned for contingency or backup during bad weather at a station. The imaging subsystem was off during this part of the test as the flight data subsystem computer tested the data rates, acquiring at least 30 minutes of data in each mode. During the test, station handover from Goldstone to Canberra was accomplished as Earth's rotation moved Goldstone out of view of the spacecraft.

Part 3 tested the capability of the Deep Space Network and MCCC to respond to multiple data rate changes with minimal data loss during such transitions. Four mode changes in 28 minutes were made. More multiple data rate tests are planned before encounter.

Cruise Science Maneuver

On September 15, Voyager 1 successfully executed a 20-hour Cruise Science Maneuver. This maneuver involves ten 360 degree yaw turns and twenty-four full roll turns, allowing routine calibration of several instruments by looking at the entire sky. The first cruise maneuver in February stopped short of completion.

Voyager 2

Stanford Communicates with PRA

On September 13, tests were conducted to examine the possibility of communicating with Voyager 2 through its planetary radio astronomy instrument as a backup to the remaining command receiver. In a five-hour test, the radio telescope at Stanford University, Palo Alto, California, transmitted in 6-minute cycles at a frequency of 46.72 MegaHertz and with a power of 300 kw. The tests showed that the PRA receiver can operate at that frequency, although the signal is weak, and that the background noise of the spacecraft is low enough that it does not cause undue interference. Further study is required, since this method of spacecraft communication would be at a much lower data rate, and require extensive spacecraft re-programming, as well as a new ground transmitting facility.

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Infrared Interferometer Spectrometer (IRIS) Warmed Up

Commands sent September 28 turned the IRIS flash-off heater on for 20 hours, temporarily raising the spectrometer temperature to 267° Kelvin. It is hoped this will interrupt or reverse any crystallization (freezing) of the motor damper and beamsplitter bonding material that may be responsible for the slow IRIS degradation observed since launch. Spectrometer temperatures have now cooled to the normal 200° K operating point and subsequent tests will determine if the short warm-up was beneficial.

After these results are analyzed, a long warm-up may be initiated. Its purpose would be to counteract stresses in the IRIS which could also have contributed to its decreased sensitivity by affecting interferometer alignment.

This is the first time the heater has been energized in space. Ordinarily, it would be used if necessary to boil off condensates accumulated in the launch phase.

Summary

Voyager 1 is about 704 million kilometers (437 million miles) from Earth, travelling at 15 kilometers per second (34,465 miles per hour) relative to the Sun. One-way light time is about 39 minutes.

Travelling at 14 kilometers per second (31,675 miles per hour), Voyager 2 is about 667 million kilometers (415 million miles) from Earth. One-way light time is about 37 minutes.

The Voyager Spacecraft

(This is the sixth in a planned series of brief explanatory notes on the spacecraft and its subsystems.)

Part 6 — Planetary Radio Astronomy

One goal of the planetary radio astronomy (PRA) experiment is to prove or disprove the existence of lightning (a catalyst for the formation of life) on the planets with atmospheres. Together with the plasma wave experiment and possibly several of the optical experiments, the PRA may be able to demonstrate the existence of lightning on Jupiter and the Saturnian satellite Titan, if indeed it does exist.

The current hypothesis is that sparks of lightning in an atmosphere of hydrogen, methane, ammonia, and water vapor (all of which appear to be present on Jupiter and Titan, as well as clouds and convection) could set off a reaction to form the complex organic molecules generally thought of as the building blocks for living systems.

Measurement Range

The PRA will measure kilometric, hectometric, and decametric planetary radio emissions in the low frequency range from 1.2 kiloHertz (kHz) to 40.5 MegaHertz (MHz). (AM radio broadcast frequencies on Earth are between 550 kHz and 1600 kHz.) Emissions ranging from wavelengths of less than 1 centimeter to thousands of meters can result from wave-particle-plasma interactions in the magnetospheres and ionospheres of the planets.

Io May Not Influence Hectometric Bursts

Io, long known to play an integral part in the pattern of Jupiter's decametric radio emissions, appears not to have anything at all to do with Jupiter's hectometric emissions, at least in the low frequency ranges. Preliminary results from study of the first six months of data show no correlation between the bursts and Io in the low frequencies. A detailed report is in preparation.

The polarization characteristics of Jupiter's radio emissions have also been defined: In the high frequencies, there is consistent right-hand circular polarization, while in the low frequencies, there is consistent left-hand circular polarization. This was an unexpected result. (To understand right- and left-hand polarization, think of a right- or left-hand screw thread or a propeller's helical motion through water.)

Terrestrial Kilometric Emissions

In the ten days following launch, the PRA had the opportunity to observe Earth's kilometric radiation while the spacecraft was transmitting at a high data rate. For the first time, Earth's polarization in the frequency range from 100 to 300 kHz was measured. This information is valuable for comparison with Jupiter data, as Jupiter's hectometric and kilometric emissions may resemble terrestrial kilometric radiation.

In addition, radio data from Jupiter, as from Earth, quite probably relate to particle precipitation, and to magnetic field strength and orientation in the polar ionosphere. This data should give some characteristics of Jupiter auroras.

Other Science Objectives

The polarization of planetary radio emissions can be used to detect the presence of planetary magnetic fields, even at great distances from a planet. PRA measurements can enable determination of planetary magnetic field strengths, to within an order of magnitude. In addition, plasma parameters near the planets such as electron density can be measured.

Several hundred solar flare events have been recorded by the PRA since launch in 1977, and the PRA will continue to observe solar flare activity which may be invisible on Earth.

The PRA experiment uses two 10-meter (about 33-feet) long whip monopole antennas, positioned 90 degrees apart and extending from the spacecraft bus near the joint of the radioisotope thermoelectric generator (RTG) boom. The PRA receiver provides coverage in two frequency bands — one from 1.2 kHz to 1,345 kHz, and the other from 1,228.8 kHz to 40.5 MHz.

To reduce interference from the spacecraft power supply, the receiver's local oscillator is phase-locked to the spacecraft clock to allow observations between successive harmonics of the spacecraft power subsystem.

Science Team

The PRA principal investigator is J. W. Warwick, University of Colorado, Boulder. Other team members are J. K. Alexander (Goddard Space Flight Center, Greenbelt, Maryland); André Boischot, C. C. Harvey, and Y. LeBlanc (*Observatoire de Paris*, France); W. E. Brown, Jr., S. Gulkis, and R. Phillips (Jet Propulsion Laboratory); T. D. Carr (University of Florida); F. T. Haddock (University of Michigan); J. B. Pearce, R. G. Peltzer, and A. C. Riddle (University of Colorado); and D. H. Staelin (Massachusetts Institute of Technology).