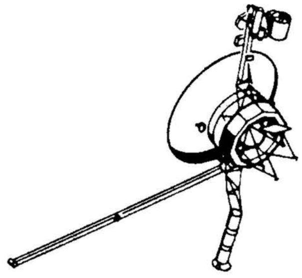
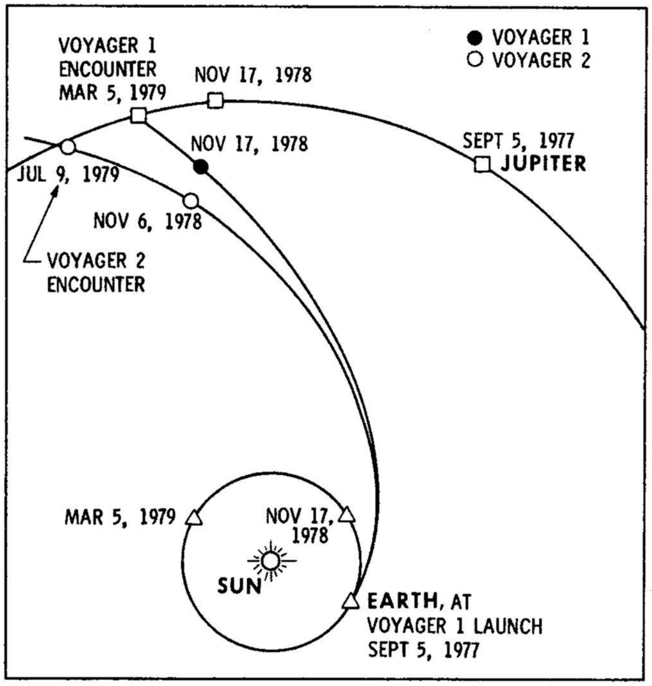


MISSION STATUS BULLETIN
VOYAGER

November 17, 1978 **No. 26**



CLOSING IN. Voyager 1 has traced an arc of about 840 million kilometers (520 million miles) in its chase of the giant planet. Earth has completed 1-1/4 orbits of the Sun in that time, while Jupiter has traveled about 1/10 of its own orbit. One-way light time to Voyager 1 is 35 minutes 46 seconds. Voyager 2's arc distance is about 850 million kilometers (530 million miles), and one-way light time is 33 minutes 40 seconds. Soon, Voyager's Jupiter pictures will surpass the quality of Earth-based observations.

The Voyager Spacecraft

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

Part 8 — Plasma Wave Investigation

As the twin Voyagers hurtled out of the earth's atmosphere, they soon entered a new environment where they are surrounded by a low-density, ionized gas called a "plasma." This plasma, composed entirely of atoms that are broken apart into electrons and charged positive ions, is a good electrical conductor with properties that are strongly affected by magnetic fields.

Plasma sources include the Sun, as well as the planets themselves and perhaps some of the satellites. Low density plasmas are unusual in other ways: ordinary collisions

(contd)

Update

Voyager 1 — IRIS Performance Improves

The infrared interferometer spectrometer (IRIS) performance has improved considerably as the result of a 54-hour warm-up initiated on October 24. The data indicates that proper operation has been restored in the Michelson motor which is used by both the reference and infrared interferometers. Symptoms of increased resistance to movement in the linear-travel motor had been present since July 1978. It was theorized that hardening of the motor dampers could be responsible for the problem.

Using the flash-off heater, the instrument optics module temperature was raised from 200° Kelvin (the normal operating point) to 275° Kelvin in an effort to reverse any crystallization and associated hardening of the motor dampers. The flash-off heater was installed to evaporate condensation accumulated in the launch phase. Future warm-ups of the Voyager 1 IRIS may be performed to maintain the improved performance.

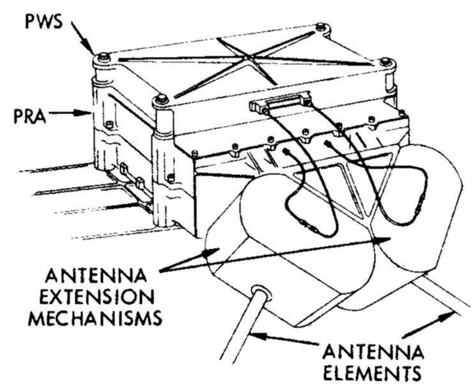
Voyager 2 — Multiple Data Rate Tests

The last of three in-flight capability demonstration tests, the multiple data rate test, was run on November 14. During the 12-hour test, a 2-hour sequence exercising various data modes and rates was repeated six times. The data rates ranged from 7200 bits (of computer data) per second (bps) to 115,200 bps, while the modes ranged from general science to tape recorder playback and imaging.

During the encounter period, the spacecraft will be changing rates and modes frequently to gather as much information as possible. The purpose of the test was to familiarize ground personnel with the nature of the changing spacecraft signal data rates during the encounter sequence, to verify the capability of the ground data system to "lock" onto the signal and process it within the specified time, and to validate the mission planning allowance for data losses due to data rate changes.

PRA Communications Test

Another test of the communications link between Voyager 2's planetary radio astronomy (PRA) experiment's radio receiver and the radio telescope at Stanford University will be conducted on November 18. The six-hour test will further explore the adequacy of the signal strength against background interference. A possibility of communicating with Voyager through the PRA receiver, should the remaining radio receiver fail, exists, but would require new ground facilities and extensive re-programming of existing spacecraft software.



between ions are unimportant, and individual ions and electrons interact with the rest of the plasma by means of emission and absorption of waves. These localized interactions between waves and particles strongly control the dynamics of the entire plasma medium, and the Voyager plasma wave investigation (PWS) will provide the first measurements of these phenomena at the outer planets.

What are Plasma Waves?

The plasma waves are low-frequency oscillations that have their origins in instabilities within the plasma, and they are of two types, either electrostatic oscillations (similar to sound waves) or electromagnetic waves of very low frequency. The PWS measures the electric field component over the range of frequencies between 10 and 56,000 Hertz (Hz). In comparison, Vogager's magnetometer measures the magnetic vectors of electromagnetic plasma waves below 10 Hz, while the planetary radio astronomy instrument measures waves with frequencies over 56 kHz.

The plasma ions and electrons both emit and absorb plasma waves. While the resulting particle-wave interactions are known to affect the magnetospheric dynamics of the outer planets and the properties of the distant interplanetary medium, they have never been directly observed in these regions, since plasma waves cannot generally be observed far from the source and since there have been no previous wave investigations at the outer planets.

Voyager will return the first direct observations of wave-particle interactions at this distance from the Sun. Some of the effects to be studied include the heating of solar wind particles at the outer planet bow shocks (the line of interaction between the solar wind and the planetary magnetospheres), the acceleration of solar wind particles that produce high-energy trapped radiation, and the maintenance of boundaries between the rotating inner magnetospheres and the solar wind streaming around the planets.

Another objective is to study the influence of wave-particle effects on the interactions between the inner satellites of the major planets and the planets' rapidly rotating magnetospheres. Control of Jupiter's decametric (10 kilometer) radio bursts through the coupling of the satellite Io's ionosphere with the planet's magnetic field is an example, and special intensive plasma wave measurements will be made as Voyager 1 passes through the Io "flux tube", where strong current systems are driven by Io's motion through the Jovian magnetosphere. An analogy is the current produced by a conductor moving through a magnetic field. Io is thought to have salt deposits on its surface which are weakly conducting. As Io moves through Jupiter's magnetic field, it produces current flow along the magnetic field lines connecting Io to Jupiter (the 'flux tube').

Detection of lightning discharges in the atmospheres of Jupiter and Saturn would also be very significant. The plasma wave investigations will search for the audible "whistler" signals that escape into the magnetosphere from such discharges. The characteristic descending whistle that is detected from lightning is due to the scattering of similar velocities when the direction of travel is along magnetic lines of force: the higher frequencies of a broadband pulse arrive at the receiver in advance of lower frequencies. Using high-rate telemetry usually used by the imaging subsystem, the PWS will be able to send back the entire audio signal in the range 50 Hertz (Hz) to about 14.4 kHz.

The instrument will actually return "sounds" of low-frequency waves in the plasma surrounding the spacecraft. Some of these waves may be caused by the spacecraft's power system, the firing thrusters, or other instruments aboard the craft.

Instrumentation and Investigators

A late addition to the Voyager complement of fields and particles experiments, the PWS joined the mission in mid-1974 after the spacecraft design and mission plan were well along. The PWS shares the planetary radio astronomy experiment's two 10-meter (33-foot) antennas, but uses them entirely differently, as a balanced electric dipole rather than as a pair of orthogonal monopoles, as shown in the figure.

The beryllium-copper antennas, about one-half inch in diameter, were rolled flat onto a spool, and then extended by command after launch. Astro Research Corporation, Santa Barbara, California, designed and fabricated the antennas.

Plasma wave signals are processed with a 16-channel spectrum analyzer, which provides a frequency sampling from 10 Hz to 56 kiloHertz (kHz) every four seconds during planetary encounters. In addition, the broadband audio amplifier, in combination with the Voyager video telemetry link, gives electric field waveforms over the frequency range 50 Hz to 14.4 kHz at selected times during the encounter periods. The electronics, which ride piggyback atop the PRA electronics box, were designed and built by the physics department of the University of Iowa.

Principal investigator for the PWS is F. L. Scarf, TRW Defense and Space Systems Group, Redondo Beach, California. Co-investigator is D. A. Gurnett of the University of Iowa, while W. Kurth of the University of Iowa is in charge of data processing.