Voyager Bulletin

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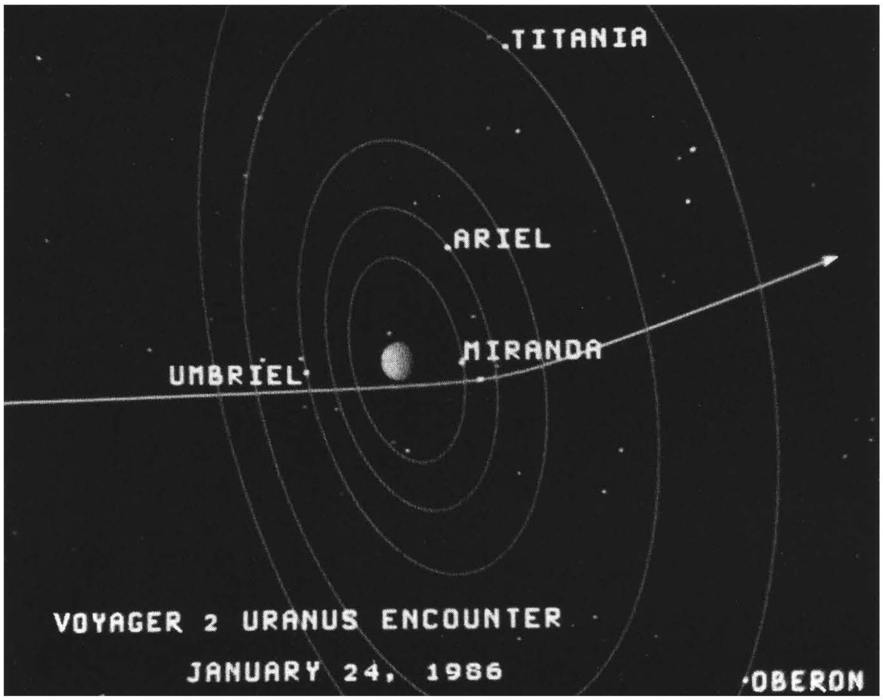


Voyager 2's path through the Uranian system is shown in this computer-generated view.

Uranus Science Objectives

Voyager 2 is truly a pathfinder at Uranus because so little is known about the seventh planet. In February 1984, Voyager scientists held a workshop to establish a scientific framework within which to plan the Voyager encounters with Uranus and Neptune. As a result of this workshop, a list of the 30 highest priority science objectives was compiled for Uranus, and Voyager 2 is now being programmed to perform experiments designed to meet these goals. Twenty-seven of these experiments occur in the 96-hour "near-encounter" period, most of them within 6 hours of Voyager's closest approach to Uranus.

Voyager will use its 10 scientific instruments and its radio to study the Uranian system. Four of these instruments are optical, and ride on the steerable scan platform. These include the wide and narrow angle cameras, the ultraviolet spectrometer, the infrared interferometer, and the photopolarimeter. Six other instruments measure energetic particles, radio emissions, and magnetic fields in space and near planets. These include magnetometers as well as instruments to measure plasma, plasma waves, planetary radio emissions, low-energy charged particles, and cosmic rays. Finally, the spacecraft's radio is used for very important scientific measurements as well as for communication with Earth.

The scientific observations can be categorized into several groups: planetary (atmospheric), satellites, rings, magnetospheres, and deep space. The observations are designed so that complementary data from several instruments contribute to knowledge in each of these groups.

So far, no structure has been seen in Voyager images of the Uranian atmosphere — no brightly colored bands or large storms as were obvious at Jupiter and Saturn. Scientists hope to observe and characterize the global circulation and meteorology of the upper, visible clouds, as well as the horizontal and vertical structure of these clouds and the nature of any colored material. Voyager will measure the hydrogen and helium abundances, in comparison to primitive solar abundances, and will also study the composition of the high atmosphere — be it hydrogen, methane, or acetylene.

The spin rates and shapes of the satellites will be studied, as well as the physical composition of these surfaces. The mass of Miranda will be determined by the amount of gravitational pull this small satellite exerts on the spacecraft during its very close (within 29,000 kilometers) pass. And, as was the case at both Jupiter and Saturn, additional, small satellites may be discovered.

In Voyager images to date, four of the five known satellites have been seen. Only Miranda has not been seen, probably because it is small, dark, and near the planet. The rings are so dark that many of our most important observations will be after closest approach, as the spacecraft swings behind the planet and observes the rings backlit by the Sun and also measures starlight passing through the rings. This will help determine the structure and density of the rings, possibly expose new rings, and detect diffuse material between the rings. As the spacecraft crosses the ring plane, it will search for tiny satellites embedded within the rings, and small satellites that "shepherd" ring material between them in a gravitational game of tag. Voyager will determine the size of the particles in the Uranian rings. At Saturn, Voyager determined that the size of the ring particles ranges from boulders to dust particles.

At this point, it is not known whether Uranus has a magnetosphere. Observations by the International Ultraviolet Explorer (IUE) spacecraft have detected what appear to be polar auroras on the planet, which implies that Uranus has a magnetic field. However, as late as July, Voyager's Planetary Radio Astronomy Experiment had detected no radio emissions from Uranus, perhaps weakening the case for the existence of a Uranian magnetic field. If Uranus does have a magnetic field, the fields and particles instruments will explore its structure and charged particle composition; locate the bow shock, magnetopause, trapped radiation, and magnetotail; determine the relationships between the magnetic field and the solar energetic particles; investigate the interaction of the planet or satellites with the plasma environment; study isotopes from hydrogen through sulfur; and measure the spectra and elemental composition of all cosmic ray nuclei from hydrogen through iron. Even if Uranus proves not to possess a magnetic field, these studies will provide important data on Uranus' interactions with the solar wind.

Two important scientific questions about Uranus are: what is its rotation rate? and does it have an internal heat source? Current direct measurements place the length of a Uranian day between 12 and 24 hours, but measurement of radio emissions from the planet will give the most precise figure. Measurements of wind speeds in the planet's atmosphere will give a less precise answer if there are no radio emissions to measure. Jupiter and Saturn both radiate about twice as much heat as they receive from the Sun, indicating that they have internal heat generators. By measuring the amount of sunlight absorbed by the planet as opposed to the amount of heat it radiates, Voyager will be able to determine if Uranus also has a hot interior. Observations on both the approach (sunlit hemisphere) and departure (shadowed hemisphere) from the planet are crucial to this measurement.

The Uranus encounter period has been divided into four phases: observatory, far encounter, near encounter, and post encounter. The divisions are based in part on the size of the images in the field of view of the narrow angle camera. The periods are:

Observatory: November 4, 1985 to January 10, 1986

Far Encounter: January 10–22, 1986

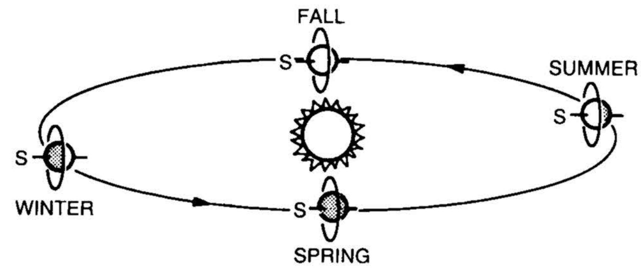
Near Encounter: January 22–26, 1986

(Closest approach to Uranus is January 24, 10 a.m. PST)

Post Encounter: January 26 - February 25, 1986

August 20, 1985 is the eighth anniversary of the launch of Voyager 2. On August 24, Voyager 2 will be four years from its 1989 encounter with Neptune.

Southern Summer



Seasons on Uranus last approximately 21 years, as different hemispheres face the Sun.

Uranus orbits the Sun once every 84 years, making for very long seasons on the planet. Spring, summer, autumn and winter — each lasts about 21 years at any particular spot on the planet.

To complicate matters even more, Uranus is tilted on its rotational axis so that its poles lie nearly in the plane of the ecliptic (the plane in which most of the planets and their satellites orbit around the Sun). In other words, Uranus lies on its side. So how does one establish a point of reference for north and south? The governing body for astronomical nomenclature, the International Astronomical Union (IAU), has established a convention that uses Earth as the reference: all poles above the ecliptic are north poles, all poles below the ecliptic are south poles. Since the Uranian pole currently illuminated by the Sun is tilted slightly (about 8°) below the plane of the ecliptic, it is designated the south pole by the IAU. It is this hemisphere that Voyager 2 is approaching.

A second nomenclature used with regard to poles involves the so-called "rotational pole". If one could imagine grasping the spin axis of a planet with the right hand in such a way that the fingers curled in the direction of the planet's rotation about its axis, then the rotational pole would, by definition, be the one in the direction of the thumb. For Earth and all of the planets except Uranus (whose rotation axis is tilted about 98° with respect to the north pole of the ecliptic) and Venus (which rotates clockwise rather than counterclockwise), the rotational pole corresponds to the north pole. No end of confusion and inconsistency has been generated by the lack of agreement in the cases of Uranus and Venus.

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