NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 755-8370

25th Anniversary
1958-1983

P83-10102

For Release:

IMMEDIATE

Charles Redmond
Headquarters, Washington, D.C.
(Phone: 202/755-3054)

Peter Waller
Ames Research Center, Mountain View, Calif.
(Phone: 415/965-5091)

John Gustafson
Ames Research Center, Mountain View, Calif.
(Phone: 415/965-5091)

RELEASE NO: 83-91

PIONEER 10 SPACECRAFT DEPARTS SOLAR SYSTEM

The first departure of a spacecraft from the solar system will occur on Monday, June 13 at approximately 5:00 a.m. PDT.

At that time, the Pioneer 10 spacecraft will cross the orbit of Neptune and be farther from the sun than all of the known planets.

Pioneer's final step across Neptune's orbit happens at a distance of 2.81 billion miles from the sun. Neptune is currently the outermost planet. Pluto will be nearer to the sun than Neptune for the next 17 years because part of its elongated oval orbit lies inside Neptune's orbit.

It was the first spacecraft to cross the asteroid belt, fly by Jupiter, chart Jupiter's intense radiation belts, measure the mass and density of its four planet-sized moons, and find that Jupiter is a liquid planet. It now becomes the first craft to depart from the solar system.

Scientists calculate that Pioneer will travel among the stars virtually forever because the vacuum of interstellar space is so empty and, hence, non-damaging to spacecraft. Pioneer should even outlast the solar system itself when, about five billion years from now, the sun becomes a red giant and engulfs the earth.

June 7, 1983

-more-

"It's exciting to think about the spacecraft," says Catherine McGhan, mission operations manager. "Every time a Deep Space Network receiver locks onto Pioneer, it's like an athlete setting a record."

Pioneer continues to gather and relay detailed scientific information from the previously unexplored outer reaches of the solar system. Virtually all systems are performing flawlessly after more than 11 years in space.

"Tracking Pioneer for so long lets us measure the sun's full range of phenomena, something we'll never do for similar stars even with the best telescopes," says project scientist Palmer Dyal.

Perhaps the most important finding about the outer solar system is that the sun's atmosphere, the heliosphere, does not end at the orbit of Jupiter as previously believed. Pioneer is now six times that distance and has not yet detected the boundary of the solar atmosphere or any lessening of the sun's influence. Scientist's now believe that this boundary may be twice Pioneer's present distance.

A tenth planet or, more likely, a dark star at the outer fringes of the solar system may well be located by measuring changes in Pioneer's flight path. Such an object has long been suggested by unexplained irregularities in the orbits of Uranus and Neptune.

Tracking Pioneer to its great distance also gives scientist's a unique opportunity for detecting "gravity waves," a form of radiation predicted by Einstein's Theory of Relativity.

In theory, huge events such as collisions between galaxies or two massive black holes would "rattle" the entire universe, and such waves may be detectable in the extremely long wavelengths (one to three billion miles) that Pioneer can measure.

Scientists have been expecting that as Pioneer nears the limit of the sun's influence it should detect increasing numbers of cosmic rays. But even at almost three billion miles, the magnetic field of the heliosphere still shelters the solar system from all but the fastest-moving cosmic ray particles.

Because Pioneer will last in interstellar space for billions of years, it is being used much as a castaway uses a bottle to carry a message across the seas.

Pioneer carries an easily-interpreted message in the rare event that it encounters any beings on its journey. Engraved on a gold-anodized aluminum plaque, the message features a drawing of a man and woman, a diagram of the solar system, and a map locating the solar system with reference to some galactic "lighthouses" (pulsars).

Pioneer crosses Neptune's orbit at 2,813,685,909 miles from the sun and departs at 30,558 miles per hour to travel among the stars in the sun's neighborhood of the Milky Way. It joins those stars in orbit around the center of the galaxy.

Pioneer's first encounter with a star happens 10,507 years from now when it passes Barnard's Star at a distance of 3.8 light years. Barnard's Star, a cool, small red star, changes its position in the sky faster than any other star.

The spacecraft's nearest encounter will be with a star named Ross 248, a red dwarf "flare" star. Ross 248 gives off flares similar to solar flares only much more powerful. Pioneer passes Ross 248 at 3.2 light years more than 32,000 years from now.

Also among the scores of stars Pioneer will pass in the next 800,000 years is Altair, a star hotter and bigger than the sun and nearly nine times as bright.

Pioneer's primary mission was an encounter with Jupiter in December 1973, 21 months after its launch in March 1972. Now, nearly a decade later, the craft is on an "extended" mission looking for a tenth planet and gravity waves, charting galactic cosmic rays, and making a range of findings about the heliosphere.

The heliosphere is created and maintained by the solar wind, a million-mile-an-hour flow of charged atomic particles "boiling" off the sun's surface.

Pioneer is seeking the heliopause, the boundary where the solar wind "dies" as it hits the interstellar gas. Scientists believe that at this boundary the solar wind piles up and is heated in a shock front.

The leading edge of the heliosphere is thought to be blunted and the trailing edge stretched out as the solar system moves at 66,000 mph through the interstellar gas. Because Pioneer 10 is thought to be traveling down the extended "tail" of the heliosphere, opposite the direction of the sun's motion, it may not reach the heliopause while it still has electrical power.

Project manager Richard Fimmel expects that NASA will be able to track Pioneer until the craft's radioisotopic generators give out around 1994. The craft would then be some five billion miles from the sun.

Even now, though, Pioneer's sun sensor is almost insensitive to the sun's fading image. To get information for determining Pioneer's orientation, controllers are reprogramming the imaging photopolarimeter, which returned pictures during Pioneer's passage by Jupiter. The imaging photopolarimeter, or camera, will detect star images and take over the sun sensor's duty.

"The science instruments need to know the craft's orientation," says Alan Fernquist, assistant flight director for Pioneer. Without that information they can, for example, only tell how strong the solar wind is, but not which way it blows.

Once Pioneer enters interstellar space it will last essentially forever. The most damage Pioneer suffers is due to the solar wind and micrometeoroid impacts.

The solar wind wears away a tenth of a centimeter of the moon's unprotected surface in 10 billion years. Micrometeoroid impacts would remove a full centimeter in this same time.

Pioneer will experience these slow erosive processes for less than 100 years, so their total damage will only be slight.

In interstellar space only cosmic rays disturb the craft. But they either pass completely through the craft or only temporarily disturb the electrons in the metal of the spacecraft. cosmic rays have almost no net effect on Pioneer 10.

Pioneer's departure from the solar system will be honored by ceremonies at Ames Research Center in Mountain View, Calif., at TRW in Redondo Beach, Calif., and at the Smithsonian Institution in Washington, D.C.

Pioneer is managed by NASA's Ames Research Center. Ames is the site of the Pioneer Operations Control Center which controls and communicates with the spacecraft.

TRW Space and Communications Group built both Pioneers 10 and 11.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS.)

PIONEER 10 BACKGROUND

To editors: Pioneer 10 will be beyond all the known planets on June 13, 1983 at 5 a.m., PDT, the first such flight in human history.

Pioneer has a large number of accomplishments to its credit.

Descriptions of times, distances, performance, and other circumstances of the spacecraft and its operating system also are striking, and are listed here.

Pioneer is operated and managed by NASA's Ames Research Center, Mountain View, Calif. The spacecraft was built by TRW Space and Communications Group, Redondo Beach, Calif. Tracking and data return is by NASA's Deep Space Network.

Features of Pioneer 10's Journey:

1) Pioneer will pass beyond the outermost planet at a speed of 30,558 mph. This is more than five million miles a week, more than 267 million miles a year.

2) Pioneer carries the longest-distance letter ever sent -- a plaque designed by Carl Sagan, showing a man and a woman, location of the solar system and other information. This "letter" to beings who might find the spacecraft has so far traveled 3.5 billion miles.

3) NASA hopes to track Pioneer 10 with the Deep Space Network (DSN) radio receivers for another 10 years, out beyond 5 billion miles, 2.2 billion miles beyond the spacecraft's present distance.

4) Round-trip "light time" for Pioneer's 2.8 billion mile communications is now 8 hours and 40 minutes. This means that commands sent when controllers get to work are answered by Pioneer at quitting time.

5) Pioneer sends its information with an 8-watt radio transmitter, which has a power equivalent to that of a Christmas tree light. When it is received by the 210-foot-diameter radio antennas of the DSN, the original 8-watt signal has weakened to one billion-trillionths of a watt (.000,000,000,000,000,001 watt).

6) If the signal from the spacecraft could be collected and stored with one of the DSN radio dishes for 67 million years, the total energy collected would not be enough to power an 8-watt light bulb for even one-thousandth of a second. That such a tiny signal is detectable at all is a tribute to the tremendous increases in receiver sensitivity achieved by the Deep Space Network since the spacecraft's launch in 1972.

7) Pioneer uses a 9-foot, parabolic radio dish to focus the radio signal into a narrow, degree-and-a-half-wide, conical beam. Despite such a "tight" beam, by the time the signal has covered the 2.8 billion miles to earth, it has spread over an area more than 11 million miles across.

8) Because the orbit of Pluto, normally the outermost planet, is such a stretched-out oval, Pluto will be inside Neptune's orbit for the next 17 years. It will be close to Neptune's orbit for the next 50 years. By 2050, Pluto will be far outside Neptune's orbit, as well as high above the plane of the other planets. Pluto and its newly-discovered moon Charon, take 250 years to complete a trip around the sun.

9) Pioneer's basic mission was for a 21-month trip to Jupiter. However, by now the rugged spacecraft has lasted 11 years, and may well last another 10 years.

10) Because sunlight beyond Mars is too weak to power solar cells, the spacecraft uses a radioisotope power supply, which may well run it for 21 years.

11) Currently, pioneer is exploring the outer solar atmosphere, the heliosphere.

12) It is also looking for a tenth planet or dark star, and for evidence of universe-shaking collisions, in the form of gravity waves. These would have wave-lengths of 1 to 3 billion miles.

13) At the long-lived spacecraft's current distance (2.8 billion miles), the earth would be seen as a pin point of light, never more than 2.2 degrees away from a sun still intensely bright (20 times brighter than the moon appears to earth), but no larger than a pin head.

14) Over the next 850,000 years, Pioneer's closest approach to any star system probably will be to the star, Ross 248. This will take place 32,610 years from now, with passage at 3.27 light years from the star (a big distance). Star trajectories are not well-known, and beyond 850,000 years, closer approaches may well occur. At typical star-separation distances, Pioneer might expect a relatively close approach to a star system on an average of once every million years.

15) Since launch in 1972, pioneer 10 has operated almost without flaw. By June 13, 1983, Pioneer 10 will have traveled 3.59 billion miles on its flight path, will have received more than 98,900 commands from earth, and transmitted more than 126 billion bits of scientific data.

Firsts for Pioneer 10:

1) First flight beyond Mars.

2) First trip to Jupiter.

3) First crossing of the asteroid belt and discovery that it presents little hazard to spacecraft.

4) First passage through Jupiter's tremendously powerful radiation belts (five to 10 thousand times as intense as earth's, with millions of times the energy).

4) First closeup pictures of Jupiter's Great Red Spot and belts and zones showing details of atmosphere circulation.

6) First crossings of the orbits of Uranus, Pluto, and Neptune.

Discoveries by Pioneer 10:

1) Pioneer 10 has found that the heliosphere (the sun's atmosphere) extends much farther than previously thought. Previously, the heliosphere's boundary, or "heliopause," was believed to lie just beyond Jupiter. But Pioneer 10 is six times that far out and has yet to encounter the boundary.

2) Discovery that Jupiter is a liquid planet.

3) First model of Jupiter's huge, pulsating, magnetosphere (a million times the volume of earth's).

4) First description of jupiter's magnetic field.

5) First accurate measurements of mass and densities of Jupiter's planet-sized moons, key to the planet's formation history.

6) Proof of origin of the gegenschein and zodiacal light (reflections of interplanetary dust near the sun and inner planets).

7) The heliosphere (the magnetic bubble formed by the solar wind, containing the solar system) appears to "breathe" in and out once every 11-year solar cycle.

8) The shock waves of the enormous storms on the sun seem to persist in the heliosphere for as long as a year, probably changing the heliosphere bubble's shape, as if it were a huge pulsating jelly fish.

9) The solar wind was expected to slow with distance from the sun, but this has not happened. Almost no motion energy has been lost as heat.

10) As the solar wind thins out going away from the sun, scientists expected to find many more cosmic ray particles penetrating the protective solar atmosphere. This has not happenned so far.

11) The primary source of turbulence in the outer heliosphere is storms on the sun, not solar wind collisions, as in the inner solar system.

12) Near solar maximimum, cosmic ray particles incoming from the galaxy in all velocity ranges (even near light speed) become half as numerous or are shut out completely from the heliosphere.

13) For unexplained reasons, high velocity streams of electrons from Jupiter moving through the heliosphere don't wobble as expected from the planet's axial tilt.

14) The heliosphere is bisected by a 'flapping' current sheet, aligned with the sun's equator, and believed to extend to the interstellar boundary.

15) As solar storm activity builds up, the heliosphere is believed to deform into a more oval shape lined up with the sun's equator, from its rounder shape at solar minimum. It also may expand in size.

-end-

(Index: 28. 36)