157)

Pioneer Venus 1

Nation: U.S. (60)
Objective(s): Venus orbit
Spacecraft: Pioneer Venus Orbiter
Spacecraft Mass: 582 kg
Mission Design and Management: NASA ARC
Launch Vehicle: Atlas-Centaur (AC-50 / Atlas no. 5030D)
Launch Date and Time: May 20 1978 / 13:13:00 UT
Launch Site: ETR / launch complex 36A
Scientific Instruments:

1) charged-particle retarding potential analyzer
2) charged-particle mass spectrometer
3) thermal electron temperature Langmuir probe
4) neutral-particle mass spectrometer
5) cloud photopolarimeter/imaging system
6) temperature sounding infrared radiometer
7) magnetic field fluxgate magnetometer
8) solar wind plasma analyzer
9) surface radar mapper
10) electric field experiment
11) transient gamma-ray burst experiment
12) gas and plasma environment experiment
13) radio occultation experiment
14) atmospheric and solar corona turbulence experiment
15) drag measurements experiment
16) internal density distribution experiment
17) celestial mechanics experiment

Results: The Pioneer Venus project comprised two spacecraft to explore the atmosphere and surface of Venus. Both spacecraft used a basic cylindrical bus. Pioneer Venus 1, the orbiter, was designed to spend an extended period in orbit around Venus mapping the surface using a radar package. The orbiter entered an elliptical orbit around Venus on 4 December 1978 after a 6.5-month journey. The initial orbital period was 23.4 hours, which was altered within two orbits to the desired 24 hours—a maneuver that would allow the orbit's high and low points (about 150 kilometers) to occur at the same time each Earth day. Data from the radar mapper allowed scientists to produce a topographical map of most of the Venusian surface between 73° north and 63° south latitude at a resolution of 75 kilometers. The data indicated that Venus was much smoother and more spherical than Earth. The orbiter identified the highest point on Venus as Maxwell Montes, which rises 10.8 kilometers above the mean surface. Infrared observations revealed a clearing in the planet's atmosphere over the

north pole. In addition, ultraviolet light photos showed dark markings that covered the clouds in the visible hemisphere. Cameras also detected almost continuous lightning activity in the atmosphere. The spacecraft confirmed that Venus has little, if any, magnetic field. Although the mapping radar was switched off on 19 March 1981, it was reactivated again in 1991, thirteen years after launch, to explore the previously inaccessible southern portions of the planet. In May 1992, Pioneer Venus 1 began the final phase of its mission, maintaining its periapsis between 150 and 250 kilometers until propellant depletion. The last transmission was received at 19:22 UT on 8 October 1992, as its decaying orbit no longer permitted communications. The spacecraft burned in the atmosphere soon after, ending a successful fourteen-year mission that was planned to last only eight months.

158)

Pioneer Venus 2

Nation: U.S. (61)
Objective(s): Venus impact
Spacecraft: Pioneer Venus Multiprobe
Spacecraft Mass: 904 kg
Mission Design and Management: NASA ARC
Launch Vehicle: Atlas-Centaur (AC-51 / Atlas no. 5031D)
Launch Date and Time: 8 August 1978 / 07:33 UT
Launch Site: ETR / launch complex 36A
Scientific Instruments:

Bus:
1) neutral mass spectrometer
2) ion mass spectrometer
3) differential long baseline interferometry experiment
4) atmospheric propagation experiment
5) atmospheric turbulence experiment

Large probe:
1) neutral mass spectrometer
2) solar flux radiometer
3) gas chromatograph
4) infrared radiometer
5) cloud particle size spectrometer
6) atmospheric structure experiment

Small probes (each):
1) atmospheric structure experiment
2) cloud particles experiment
3) net flux radiometer

Results: Pioneer Venus 2, the twin to Pioneer Venus 1, comprised a main bus, a large probe (316.5 kilograms), and three identical small probes, all of which were designed to collect data during independent atmospheric entry into Venus. Each probe was shaped like a cone and not designed to survive past surface impact. After a course correction on 16 August 1978, Pioneer Venus 2 released the 1.5-meter-diameter large probe on 16 November 1978, at about 11.1 million kilometers from the planet. Four days later, the bus released the three small probes while 9.3 million kilometers from Venus. All five components reached the Venusian atmosphere on 9 December 1978, with the large probe entering first. Using a combination of air drag and a parachute, the large probe descended through the atmosphere until it impacted on the Venusian surface at 4.4° north latitude and 304.0° longitude at a speed of 32 kilometers per hour. Transmissions ceased at impact as expected. The three 76-centimeter-diameter small probes arrived in the atmosphere within minutes of the bigger one and descended rapidly through the atmosphere without the benefit of parachutes. Amazingly, two of three probes survived the hard impact. The so-called Day Probe transmitted data from the surface for 67.5 minutes before succumbing to the high temperatures and power depletion. All three small probes suffered instrument failures, but none significant enough to jeopardize their main missions. Their landing coordinates were 59.3° north latitude and 4.8° longitude (North Probe); 31.3° south latitude and 317.0° longitude (Day Probe); and 28.7° south latitude and 56.7° longitude (Night Probe). The main bus, meanwhile, burned up in the atmosphere at an altitude of 120 kilometers—about 1.5 hours after the other probes—and provided key data on higher regions. Data from the probes indicated that between 10 and 50 kilometers, there is almost no convection in the atmosphere. Below a haze layer at 30 kilometers, the atmosphere appears to be relatively clear.

159)

ISEE-3

Nation: U.S. (62)
Objective(s): Earth-Sun L1 Libration Point, Comet Giacobini-Zinner flyby, lunar flybys

Spacecraft: ISEE-C
Spacecraft Mass: 479 kg
Mission Design and Management: NASA GSFC
Launch Vehicle: Delta 2914 (no. 144 / Thor no. 633)
Launch Date and Time: 12 August 1978 / 15:12 UT
Launch Site: ETR / launch complex 17B
Scientific Instruments:

1) solar wind plasma experiment
2) magnetometer
3) low-energy cosmic-ray experiment
4) medium-energy cosmic-ray experiment
5) high-energy cosmic-ray experiment
6) plasma waves experiment
7) protons experiment
8) cosmic-ray electrons experiment
9) x-rays and electrons experiment
10) radio mapping experiment
11) plasma composition experiment
12) high-energy cosmic-rays experiment
13) ground-based solar studies experiment

Results: ISEE-3 was the third of three International Sun-Earth Explorers (ISEE) designed and operated by NASA in cooperation with the European Space Agency. NASA built the first and third spacecraft, while ESA built the second. The three spacecraft were to simultaneously investigate a wide range of phenomena in interplanetary space. After launch, on 20 November 1978, ISEE-3 was successfully placed at Libration Point 1 (L1) on the Sunward side of Earth, a point 1.5 million kilometers from Earth, where the gravitational forces of Earth and the Sun are exactly counterbalanced. ISEE 3 became not only the first spacecraft to be put into orbit around a Libration Point, but also the first spacecraft to monitor the solar wind approaching Earth. ISEE-3 completed its primary mission in 1981, but Goddard Space Flight Center scientists proposed sending the spacecraft first through Earth's magnetic tail and second into position to intercept a comet. By 10 June 1982, the spacecraft began to use its thrusters to move into the geotail. ISEE-3 completed the first deep survey of Earth's tail and detected a huge plasmoid of electrified gas that was ejected from Earth's magnetosphere. Subsequently, after a series of five complex flybys of the Moon (the last on 22 December 1983 at a range of only 120 kilometers), ISEE-3 was sent on a trajectory to encounter the Comet Giacobini-Zinner. At this point, the spacecraft was renamed the International Cometary Explorer (ICE). On 11 September 1985 at 11:02 UT, ICE passed within 7,862 kilometers of the comet's core, becoming the first spacecraft to fly past a comet. The spacecraft returned excellent data on the comet's tail, confirming theories that comets are essentially "dirty snowballs" of ice, with surface material sleeting off during motion. ICE also flew to 40.2 million kilometers of the sunward side of Comet Halley on 28 March 1986 and provided upstream solar wind data. ICE remains in heliocentric orbit at about 1 AU; it continued to return information until NASA authorized termination of operations on 5 May 1997. On 10 August 2014, ICE will return to the vicinity of Earth, where it could possibly be captured for analysis of its exterior for dust impacts. If it is recovered, NASA will donate the spacecraft to the Smithsonian Institution for display.

160)

Venera 11
Nation: USSR (96)
Objective(s): Venus flyby and landing
Spacecraft: 4V-1 (no. 360)
Spacecraft Mass: 4,450 kg
Mission Design and Management: NPO Lavochkin
Launch Vehicle: 8K82K + Blok DM (Proton-K no. 296-01 / Blok DM no. 3L)
Launch Date and Time: 9 September 1978 / 03:25:39 UT
Launch Site: NIIP-5 / launch site 81L
Scientific Instruments:

Flyby bus:

1) plasma spectrometer
2) Konus gamma-ray detector
3) Sneg-2MZ gamma- and x-ray burst detector
4) ultraviolet spectrometer
5) magnetometer
6) solar wind detectors
7) cosmic-ray detectors

Lander:

1) imaging system
2) Sigma gas chromatograph
3) mass spectrometer
4) gamma-ray spectrometer

5) Groza lightning detector
6) temperature and pressure sensors
7) nephelometer
8) anemometer
9) optical spectrophotometer
10) remote soil collector
11) x-ray fluorescence cloud aerosol analyzer
12) Arakhis x-ray fluorescence spectrometer and drill

Results: Venera 11 was one of two identical probes (the other being Venera 12) that followed up on the highly successful Soviet missions to Venus in 1975. Veneras 11 and 12 differed from their predecessors principally in the fact each carried a flyby bus/lander combination instead of the previous orbiter/lander combination. Engineers reverted to the flyby combination partly because of the weight limitations of the 1978 launch window, but also because flyby probes afforded better transmission time for landers. Several of the scientific instruments were also modified and new ones added. Venera 11 arrived at Venus after two course corrections on 16 September and 17 December 1978. On 23 December 1978, the lander separated from the flyby probe and entered the Venusian atmosphere two days later. The lander probe safely landed on Venus at 03:24 UT on 15 December 1978 and then relayed 95 minutes of data from the surface. Landing coordinates were 14° south latitude and 299° longitude. The point of cutoff was determined by the range of visibility of the flyby probe. A soil-drilling instrument collected soil for chemical and physical analysis, but soil analysis was unsuccessful because the soil was not properly deposited to an examination container for analysis (probably due to leaking air that disturbed the soil). The lander also failed to take color panoramas of the Venusian surface due to a failure of the lens covers of the camera system to open. While extensive atmospheric data was later released, the Soviets have published relatively little data from surface measurements. The flyby probe entered heliocentric orbit after flying past the planet at a range of 35,000 kilometers.

161)
Venera 12

Nation: USSR (97)
Objective(s): Venus flyby and landing
Spacecraft: 4V-1 (no. 361)
Spacecraft Mass: 4,461 kg
Mission Design and Management: NPO Lavochkin
Launch Vehicle: 8K82K + Blok DM (Proton-K no. 296-02 / Blok DM no. 4L)
Launch Date and Time: 14 September 1978 / 02:25:13 UT
Launch Site: NIIP-5 / launch site 81P
Scientific Instruments:

Flyby bus:
1) plasma spectrometer
2) Konus gamma-ray detector
3) Sneg-2MZ gamma- and x-ray burst detector
4) ultraviolet spectrometer
5) magnetometer
6) solar wind detectors
7) cosmic-ray detectors

Lander:
1) imaging system
2) Sigma gas chromatograph
3) mass spectrometer
4) gamma-ray spectrometer
5) Groza lightning detector
6) temperature and pressure sensors
7) nephelometer
8) anemometer
9) optical spectrophotometer
10) remote soil collector
11) x-ray fluorescence cloud aerosol analyzer
12) Arakhis x-ray fluorescence spectrometer and drill

Results: Venera 12 was the identical sister craft to Venera 11. Launched successfully towards Venus, the spacecraft performed two midcourse corrections on 21 September and 14 December 1978. As with its twin, two days prior to the planetary encounter, the flyby probe released its lander. On 21 December, the lander entered the Venusian atmosphere at a velocity of 11.2 kilometers per second and performed a descent profile almost identical to that of the earlier Veneras 9 and 10 in 1975. The lander safely touched down at 03:30 UT on 21 December 1978 after a descent lasting about an hour. Landing coordinates were 7° south latitude and 294° longitude, about 800 kilometers from its twin. From the ground, the probe relayed data for a record 110 minutes,

although like Venera 11, the spacecraft suffered two major failures: its soil sample delivery instrument failed to deposit the soil appropriately for scientific analysis; and lens covers on the imaging system failed to release, effectively rendering the color imaging system useless. The flyby probe passed by the planet at a range of 35,000 kilometers after performing its data transmission mission and then entered heliocentric orbit.