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Information on upcoming or currently active missions not mentioned below would be welcome. Sources: NASA fact sheets, Cassini Mission Design team, ISAS/NASDA launch schedules, press kits.

ASUKA (ASTRO-D) - ISAS (Japan) X-ray astronomy satellite, launched into Earth orbit on 2/20/93. Equipped with large-area wide-wavelength (1-20 Angstrom) X-ray telescope, X-ray CCD cameras, and imaging gas scintillation proportional counters.

CASSINI - Saturn orbiter and Titan atmosphere probe. Cassini is a joint NASA/ESA project designed to accomplish an exploration of the Saturnian system with its Cassini Saturn Orbiter and Huygens Titan Probe. Cassini is scheduled for launch aboard a Titan IV/Centaur in October of 1997.

After gravity assists of Venus, Earth and Jupiter in a VVEJGA trajectory, the spacecraft will arrive at Saturn in June of 2004. Upon arrival, the Cassini spacecraft performs several maneuvers to achieve an orbit around Saturn. Near the end of this initial orbit, the Huygens Probe separates from the Orbiter and descends through the atmosphere of Titan. The Orbiter relays the Probe data to Earth for about 3 hours while the Probe enters and traverses the cloudy atmosphere to the surface. After the completion of the Probe mission, the Orbiter continues touring the Saturnian system for three and a half years. Titan synchronous orbit trajectories will allow about 35 flybys of Titan and targeted flybys of Iapetus, Dione and Enceladus. The objectives of the mission are threefold: conduct detailed studies of Saturn's atmosphere, rings and magnetosphere; conduct close-up studies of Saturn's

satellites, and characterize Titan's atmosphere and surface.

One of the most intriguing aspects of Titan is the possibility that its surface may be covered in part with lakes of liquid hydrocarbons that result from photochemical processes in its upper atmosphere. These hydrocarbons condense to form a global smog layer and eventually rain down onto the surface. The Cassini orbiter will use onboard radar to peer through Titan's clouds and determine if there is liquid on the surface. Experiments aboard both the orbiter and the entry probe will investigate the chemical processes that produce this unique atmosphere.

The Cassini mission is named for Jean Dominique Cassini (1625-1712), the first director of the Paris Observatory, who discovered several of Saturn's satellites and the major division in its rings. The Titan atmospheric entry probe is named for the Dutch physicist Christiaan Huygens (1629-1695), who discovered Titan and first described the true nature of Saturn's rings.

#### Key Scheduled Dates for the Cassini Mission (VVEJGA Trajectory)

10/06/97 - Titan IV/Centaur Launch

04/21/98 - Venus 1 Gravity Assist

06/20/99 - Venus 2 Gravity Assist

08/16/99 - Earth Gravity Assist

12/30/00 - Jupiter Gravity Assist

06/25/04 - Saturn Arrival

01/09/05 - Titan Probe Release

01/30/05 - Titan Probe Entry

06/25/08 - End of Primary Mission

(Schedule last updated 7/22/92)

GALILEO - Jupiter orbiter and atmosphere probe, in transit. Has returned the first resolved images of an asteroid, Gaspra, while in transit to Jupiter. Efforts to unfurl the stuck High-Gain Antenna (HGA) have essentially been abandoned. JPL has developed a backup plan using data compression (JPEG-like for images, lossless compression for data from the other instruments) which should allow the mission to achieve approximately 70% of its original objectives.

#### Galileo Schedule

10/18/89 - Launch from Space Shuttle

02/09/90 - Venus Flyby

10/\*\*/90 - Venus Data Playback

12/08/90 - 1st Earth Flyby

05/01/91 - High Gain Antenna Unfurled

07/91 - 06/92 - 1st Asteroid Belt Passage

10/29/91 - Asteroid Gaspra Flyby

12/08/92 - 2nd Earth Flyby

05/93 - 11/93 - 2nd Asteroid Belt Passage

08/28/93 - Asteroid Ida Flyby

07/02/95 - Probe Separation

07/09/95 - Orbiter Deflection Maneuver

12/95 - 10/97 - Orbital Tour of Jovian Moons

12/07/95 - Jupiter/Io Encounter

07/18/96 - Ganymede

09/28/96 - Ganymede

12/12/96 - Callisto

01/23/97 - Europa

02/28/97 - Ganymede

04/22/97 - Europa

05/31/97 - Europa

10/05/97 - Jupiter Magnetotail Exploration

HITEN - Japanese (ISAS) lunar probe launched 1/24/90. Has made multiple lunar flybys. Released Hagoromo, a smaller satellite, into lunar orbit. This mission made Japan the third nation to orbit a satellite around the Moon.

MAGELLAN - Venus radar mapping mission. Has mapped almost the entire surface at high resolution. Currently (4/93) collecting a global gravity map.

MARS OBSERVER - Mars orbiter including 1.5 m/pixel resolution camera. Launched 9/25/92 on a Titan III/TOS booster. MO is currently (4/93) in transit to Mars, arriving on 8/24/93. Operations will start 11/93 for one martian year (687 days).

TOPEX/Poseidon - Joint US/French Earth observing satellite, launched 8/10/92 on an Ariane 4 booster. The primary objective of the TOPEX/POSEIDON project is to make precise and accurate global observations of the sea level for several years, substantially increasing understanding of global ocean dynamics. The satellite also will increase understanding of how heat is transported in the ocean.

ULYSSES- European Space Agency probe to study the Sun from an orbit over its poles. Launched in late 1990, it carries particles-and-fields experiments (such as magnetometer, ion and electron collectors for various energy ranges, plasma wave radio receivers, etc.) but no camera.

Since no human-built rocket is hefty enough to send Ulysses far out of

the ecliptic plane, it went to Jupiter instead, and stole energy from that planet by sliding over Jupiter's north pole in a gravity-assist maneuver in February 1992. This bent its path into a solar orbit tilted about 85 degrees to the ecliptic. It will pass over the Sun's south pole in the summer of 1993. Its aphelion is 5.2 AU, and, surprisingly, its perihelion is about 1.5 AU-- that's right, a solar-studies spacecraft that's always further from the Sun than the Earth is!

While in Jupiter's neighborhood, Ulysses studied the magnetic and radiation environment. For a short summary of these results, see *\*Science\**, V. 257, p. 1487-1489 (11 September 1992). For gory technical detail, see the many articles in the same issue.

OTHER SPACE SCIENCE MISSIONS (note: this is based on a posting by Ron Baalke in 11/89, with ISAS/NASDA information contributed by Yoshiro Yamada (yamada@yscvax.ysc.go.jp). I'm attempting to track changes based on updated shuttle manifests; corrections and updates are welcome.

#### 1993 Missions

##### o ALEXIS [spring, Pegasus]

ALEXIS (Array of Low-Energy X-ray Imaging Sensors) is to perform a wide-field sky survey in the "soft" (low-energy) X-ray spectrum. It will scan the entire sky every six months to search for variations in soft-X-ray emission from sources such as white dwarfs, cataclysmic variable stars and flare stars. It will also search nearby space for such exotic objects as isolated neutron stars and gamma-ray bursters. ALEXIS is a project of Los Alamos National Laboratory and is primarily a technology development mission that uses astrophysical sources to demonstrate the

technology. Contact project investigator Jeffrey J Bloch

(jjb@beta.lanl.gov) for more information.

- o Wind [Aug, Delta II rocket]

Satellite to measure solar wind input to magnetosphere.

- o Space Radar Lab [Sep, STS-60 SRL-01]

Gather radar images of Earth's surface.

- o Total Ozone Mapping Spectrometer [Dec, Pegasus rocket]

Study of Stratospheric ozone.

- o SFU (Space Flyer Unit) [ISAS]

Conducting space experiments and observations and this can be

recovered after it conducts the various scientific and

engineering experiments. SFU is to be launched by ISAS and

retrieved by the U.S. Space Shuttle on STS-68 in 1994.

- o Polar Auroral Plasma Physics [May, Delta II rocket]

June, measure solar wind and ions and gases surrounding the Earth.

- o IML-2 (STS) [NASDA, Jul 1994 IML-02]

International Microgravity Laboratory.

- o ADEOS [NASDA]

Advanced Earth Observing Satellite.

- o MUSES-B (Mu Space Engineering Satellite-B) [ISAS]

Conducting research on the precise mechanism of space structure

and in-space astronomical observations of electromagnetic waves.

Elucidating the crust structure and thermal construction of the moon's interior.

Proposed Missions:

- o Advanced X-ray Astronomy Facility (AXAF)

Possible launch from shuttle in 1995, AXAF is a space observatory with a high resolution telescope. It would orbit for 15 years and study the mysteries and fate of the universe.

- o Earth Observing System (EOS)

Possible launch in 1997, 1 of 6 US orbiting space platforms to provide long-term data (15 years) of Earth systems science including planetary evolution.

- o Mercury Observer

Possible 1997 launch.

- o Lunar Observer

Possible 1997 launch, would be sent into a long-term lunar orbit. The Observer, from 60 miles above the moon's poles, would survey characteristics to provide a global context for the results from the Apollo program.

- o Space Infrared Telescope Facility

Possible launch by shuttle in 1999, this is the 4th element of the Great Observatories program. A free-flying observatory with a lifetime of 5 to 10 years, it would observe new comets and other primitive bodies in the outer solar system, study cosmic birth formation of galaxies, stars and planets and distant infrared-emitting galaxies

- o Mars Rover Sample Return (MRSR)

Robotics rover would return samples of Mars' atmosphere and surface to Earth for analysis. Possible launch dates: 1996 for imaging orbiter, 2001 for rover.

## o Fire and Ice

Possible launch in 2001, will use a gravity assist flyby of Earth in 2003, and use a final gravity assist from Jupiter in 2005, where the probe will split into its Fire and Ice components: The Fire probe will journey into the Sun, taking measurements of our star's upper atmosphere until it is vaporized by the intense heat. The Ice probe will head out towards Pluto, reaching the tiny world for study by 2016.

NEXT: FAQ #12/15 - Controversial questions