An artist's conception of the SELENE spacecraft

Image: The SELENE Project Team

SELENE: Moon Science With A Soft Landing

By Susumu Sasaki

[Editor's Note: Japan has a traditional fascination with and affection for the Moon, which figures prominently in Japanese art and literature. The Japanese scientific community is currently broadening this interest, with two major lunar missions in the works. The Lunar-A mission, scheduled for launch in early 1999, will image the lunar surface, monitor moonquakes, measure near-surface thermal properties and heat flux, and study the lunar core and interior structure. Lunar-A will carry a mapping camera and three surface penetrators, the latter equipped with seismometers and devices to measure heat flow. The penetrators will be individually released, and burrow one to three meters below the surface. The second planned Japanese lunar mission is the somewhat more ambitious SELENE mission. ISAS scientist Susumu Sasaki provides the following overview.]

Selene was the Greek goddess of the Moon. The SELENE (SELenological and Engineering Explorer) project is an upcoming Japanese mission to the Moon, scheduled to launch in 2003. The mission's overall objective is twofold: to gather basic scientific information on the origin and evolution of the Moon, and to develop the technology for soft-landing on the lunar surface.

SELENE is a joint project involving both of Japan's space agencies: the National Space Development Agency of Japan (NASDA) and The Institute of Space and Astronautical Science (ISAS). As originally conceived, the project was to have included a 2-ton orbiting satellite and a 400-kilogram detachable lander. Due to budget cuts suffered by NASDA in 1997, it was decided to terminate the lander portion of the project, and instead land the main spacecraft after a year of gathering science data. The upshot is that two spacecraft have been turned into one, and the twofold mission objectives can still be achieved, albeit on a revised schedule.

Mission Profile

Five days after launch by an H-IIA rocket, the SELENE spacecraft will enter an elliptical lunar orbit. Its altitude will gradually decrease to a final polar circular orbit of 100 kilometers. During this orbit transition, a 39-kilogram spin-stabilized relay satellite will be released, to an elliptical orbit of 100 kilometers by 2400 kilometers. The relay satellite will relay signals from the orbiter to the Earth station, measuring the gravitational field of the Moon's far side. The orbiter will operate for one year, using an array of instruments to map the entire lunar surface. After the year of mapping, the propulsion module component of the orbiter will separate and land on a pre-selected spot on the lunar surface.

Science Objectives

Although the Moon has been as extensively observed and explored as any solar system body other than Earth, its origin and evolution still present many questions. SELENE aims to study the Moon's chemical constituents, interior structure, magma ocean, magnetic field, tectonics, and differences between near and far sides. Data on elemental and mineralogical composition will be provided by x-ray and gamma-ray spectrometers, a multi-band imager, and a spectral profiler. For data on surface and subsurface structure, SELENE will use a terrain camera, laser altimeter, and lunar radar sounder. A lunar magnetometer will collect remnant magnetic field data, and a plasma analyzer and charged particle spectrometer will measure charged and high energy particles in the lunar environment.

Technology Objectives

After a year of science investigation, the propulsion module component of the orbiter will separate from the mission module component, which carries the science instrumentation. The 360-kilogram (without fuel) propulsion module will descend for a soft landing at a preselected sight in a near-side mare region. The soft landing aims to demonstrate the technology required for transporting a payload from lunar orbit to the surface. The propulsion module will also demonstrate thermal control and energy storage technologies required for day and nighttime survival in the harsh lunar environment. The mission will continue for two months following the landing, during which period radio sources in a thermally insulated compartment will carry out VLBI (Very Long Baseline Interferometer) experiments. ✯

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PLANET-B: Investigating The Upper Atmosphere Of Mars

By Dr. Hajime Hayakawa

In July 1998, Japan's Planet-B mission will launch from Kagoshima Space Center on an M-V-3 launch vehicle. The mission, which is sponsored by the Institute of Space and Astronautical Science (ISAS), is called "Planet-B" because it is the second mission in a series which began with the Planet-A (or "Suisei") mission to the comet Halley. After a couple of lunar swingbys, Planet-B is expected to approach Mars in October of 1999. For one Martian year (about two Earth years), the spacecraft will remain in Martian orbit, studying the upper atmosphere with an array of more than a dozen instruments, including spectrum analyzers, spectrometers, imagers, plasma analyzers, and experiments to detect Martian dust and measure the Martian magnetic field. All of these instruments, including several provided internationally, pack into a 36-kilogram instrument payload.

Primary Mission Objective

The primary objective of the Planet-B mission is Martian aeronomy—the study of chemical and physical phenomena in the upper atmosphere of the planet. The Martian upper atmosphere has never been systematically explored by an instrument-equipped spacecraft. The scarcity of in situ measurements has made it difficult to compare the structure and physical processes of the upper Martian atmosphere with that of Earth and Venus.

Planet-B will focus in particular on the interaction of the Martian upper atmosphere with the solar wind (the stream of ionized particles emanating from the Sun). It is believed that Mars has no intrinsic magnetic field strong enough to prevent the solar wind from impinging directly against the upper atmosphere. If so, the Martian upper