GALILEO SPACECRAFT ENCOUNTERS WITH THE EARTH/MOON SYSTEM

by

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The Galileo spacecraft, scheduled to be launched October 12, 1989 on a Venus-Earth-Earth-gravity-assist (VEEGA) trajectory to Jupiter, includes two encounters with the planet Earth and the Earth-Moon system, the first in December 1990 and the second in December 1992. Besides being an excellent training ground for the scheduled December 1995 Jupiter encounter, the Earth and Moon encounters by Galileo provide unique Earth and Moon scientific observing opportunities in their own right. Observing plans for the Galileo Earth/Moon encounters are being developed [1, 2].

The Galileo Orbiter science instrument payload, optimized to study the Jovian system, and which will be fully operational during the Earth/Moon encounters, includes a suite of five remote sensing instruments, six fields and particles instruments for in situ measurements, and the spacecraft radio system for radio science measurements. The remote sensing instruments, including a solid state imaging camera, a near infrared mapping spectrometer, a photopolarimeter, and an ultraviolet spectrometer and extreme ultraviolet spectrometer, cover the spectral range from 0.04 to 42 microns. The Galileo Probe science instrument payload is not available for observations at the Earth/Moon encounters.

The Galileo Project Science Group held an Earth-Moon Science Workshop, chaired by Fraser Fanale, in May 1988 at NASA's Ames Research Center in Moffett Field, California. The purpose of the workshop was to study the Earth-Moon science opportunity provided by the Galileo VEEGA trajectory to Jupiter, and develop a baseline list of Earth and Moon science objectives. Given the Galileo Orbiter science payload, and the conditions and constraints of the encounter (observing geometry, lighting, temperature, telemetry, safety), the workshop developed a candidate set of science objectives. This paper reviews the conditions and constraints of the Earth and Moon encounters which define the observing opportunity and bound the science objectives, reviews the Earth and Moon science observation objectives developed for and during the Workshop, and reviews a preliminary sequence of events developed for the first Earth encounter.

High priority lunar science observation objectives during the first Earth encounter, or first Earth gavity assist (EGA1), include (1) remote sensing coverage of Mare Orientale, as well as the entire lunar farside, for unique composition and multispectral characterization, (2) remote sensing coverage of unmapped regions of the lunar south polar region, (3) search for hydrated material on the Moon, (4) nearside - farside asymmetries in the lunar maria and highlands, (5) radiometric brightness vs. wavelength and position on the lunar disc for topographic characterization and calibration against similar observations on the Jovian satellites.

Earth science observation objectives during EGA1 and EGA2 include (1) global mapping of mesospheric water and mesospheric carbon dioxide, (2) global mapping of methane and other "greenhouse" gases, (3) groundtruth spatial and spectral resolution measurements for comparison with observations of the Jovian satellites, (4) magnetotail and hydrogen geotail and geocorona observations, (5) airglow studies, (6) measurements of the mass of the Earth,

(7) movies of the crescent Moon orbiting past the crescent Earth and rotation movies of the crescent Earth, on the inbound trajectory leg, and a 5 day rotation movie of the fully lit Earth on the departure leg of the trajectory.

During the second Earth gravity assist the spacecraft trajectory passes directly over the north pole of the Moon providing a unique opportunity to map and characterize this lunar polar region, and to search for the possible existence of water in shaded craters in the polar region.

Additional observations planned during the Earth/Moon system encounters include a search for evidence of postulated cometesimals raining down on the Earth [3,4] by detecting the presence of molecular hydrogen and water near the Moon, OH radicals near the orbit of the Moon, and increased Lyman alpha in a shell about one AU from the sun; and a search for evidence of an Earth shepherded dust ring near the Earth [5].

REFERENCES

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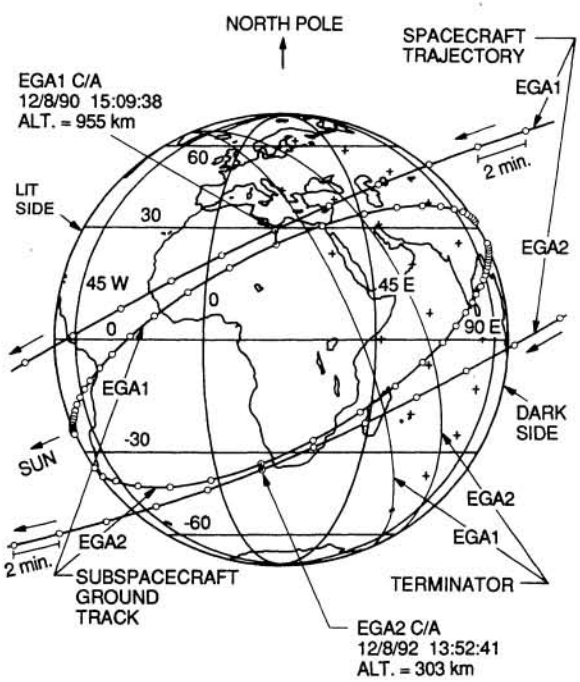
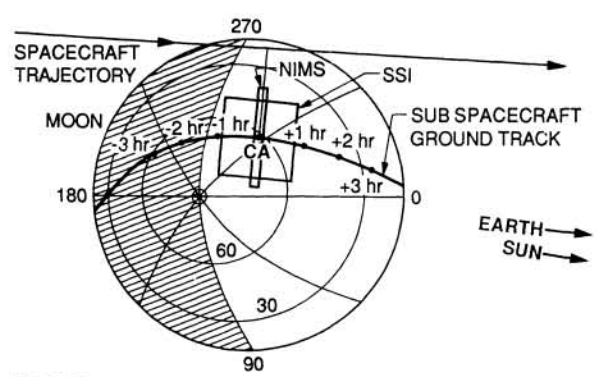


Earth Encounters at EGA1 and EGA2



CLOSEST APPROACH ALTITUDE:	108,000 km
PHASE ANGLE AT CLOSEST APPROACH:	67 deg
CONE ANGLE SUB SPACECRAFT AT CLOSEST APPROACH:	113 deg
SUB SPACECRAFT LATITUDE AT CLOSEST APPROACH:	63 deg
HIGHEST SUB SPACECRAFT LAT:	71 deg
SUB SPACECRAFT LONGITUDE AT CLOSEST APPROACH:	314 deg

Lunar Encounter at EGA2