

19th SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Hitchhiking to the Moon (8)

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GRAVITY RECOVERY AND INTERIOR LABORATORY (GRAIL) MISSION: FACILITATING
FUTURE EXPLORATION OF THE MOON**Abstract**

The Gravity Recovery and Interior Laboratory (GRAIL) mission, a component of NASA's Discovery Program, launched successfully from Cape Canaveral Air Force Station on September 10, 2011. The dual spacecraft traversed independent, low-energy trajectories to the Moon via the EL-1 Lagrange point and inserted into elliptical, 11.5-hour polar orbits around the Moon on December 31, 2011, and January 1, 2012. The spacecraft executed successfully a series of maneuvers to circularize their polar orbits to 55-km mean altitude. The spacecraft fly in precise formation, between 60 and 225 km apart, and collect high-precision range-rate measurements between them using a Lunar Gravity Ranging System (LGRS) payload that operates at Ka-band. Analysis of the spacecraft-to-spacecraft range-rate data provides a direct measure of the lunar gravity field. GRAIL's primary science objectives are: (1) to determine the structure of the lunar interior from crust to core, and (2) to further the understanding of the thermal evolution of the Moon. GRAIL also has one secondary science objective: to extend knowledge gained from the Moon to other terrestrial planets. The mission's primary mapping phase initiated on March 6, 2012 and the spacecraft are returning high-quality observations that will be used to construct a gravity field of the Moon of unprecedented resolution accuracy. GRAIL observations will yield a spherical harmonic representation of the Moon's gravitational field to at least degree and order 180, corresponding to a spatial block size of 30 km. The accuracy will be improved by two to three orders of magnitude over existing knowledge. Information from GRAIL will facilitate future lunar exploration by revealing subsurface targets of scientific interest, and by facilitating precise positioning and navigation for future robotic and human missions.