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A 660 D&O Gravitational Field of the Moon from the GRAIL Primary Mission

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The Gravity Recovery and Interior Laboratory (GRAIL) mission has completed its primary three-month tour that resulted in a gravitational field of 660 degree-and-order or equivalent surface resolution of 8 km. The primary measurement for the gravity field is the inter-spacecraft K-Band Range Rate (KBRR) measurement derived from dual spacecraft one-way range. Direct Doppler tracking at X-band from the Deep Space Network for Ebb and Flow supplemented The KBRR. Advanced system calibrations and measurement timing have resulted in unprecedented data quality of better than 0.1 microns/sec. The gravity field solution shows an error spectrum with several orders of magnitude improvement for all wavelengths when compared to previous missions. Nearly uniform correlations with topography exist through higher harmonic degrees and are a good measure of field integrity. The results of the mission satisfy the scientific objectives of determining the structure of the lunar interior from crust to core and advancing the understanding of the thermal evolution of the Moon. They also directly address the mission's investigations that include mapping the structure of the crust and lithosphere, understanding the Moon's asymmetric thermal evolution, determining the subsurface structure of impact basins and the origin of mascons, ascertaining the temporal evolution of the crustal brecciation and magmatism, constrain deep interior structure from tides, and place limits on the size of a possible solid inner core.