The LRO Mini RF Technology Demonstration

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The Miniature Radio Frequency (Mini-RF) system is manifested on the Lunar Reconnaissance Orbiter (LRO) as a technology demonstration and an extended-mission science instrument. Mini-RF represents a significant step forward in spaceborne RF technology and architecture. It combines synthetic-aperture radar (SAR) at two wavelengths (S and X band) and two resolutions (150 m and 30 m) with interferometric and communications functionality in one lightweight (14kg) package. Previous radar observations (Earth-based, and one bistatic data set from Clementine) of the permanently shadowed regions of the lunar poles seem to indicate areas of high circular-polarization ratio (CPR) consistent with volume scattering from volatile deposits (e.g. water ice) buried at shallow (0.1-1 m) depth, but only at unfavorable viewing geometries, and with inconclusive results. The LRO Mini-RF employs new wide-band hybrid-polarization architecture to measure the Stokes parameters of the reflected signal. These data will help to differentiate “true” volumetric ice reflections from ”false” returns due to angular surface regolith. Additional lunar science investigations (e.g. pyroclastic deposit characterization) will also be attempted during the LRO extended mission. LRO’s lunar operations will be contemporaneous with those of India’s Chandrayaan-1, which carries the Forerunner Mini-SAR (S-band wavelength and 150-m resolution), and bistatic radar (S-Band) measurements may be possible. On-orbit calibration procedures for LRO Mini-RF have been validated using Chandrayaan-1 and ground-based facilities (Arecibo and Green Bank Radio Observatories).