

Advanced Lunar Laser Ranging for High-Precision Science Investigations

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Recognizing the value of lunar laser ranging (LLR) for investigations of the deep lunar interior, recently JPL completed an upgrade at a 1-m telescope at the Table Mountain Observatory (TMO), turning it into a unique LLR facility. The new ranging station uses a high-power CW laser (~1.1 kW) bringing about major advances in the precision of LLR measurements. Equipped with a high-power laser at operating 1064 nm, TMO receives many more return photons thus entering in a new photon-rich regime when differential LLR is feasible. In such a regime, (nearly-)simultaneous ranging to two or more CCR arrays is possible. This can be done by switching between two (or several) CCR arrays on the Moon. Differencing these ranges largely eliminates atmospheric perturbations that currently limit range accuracy. The resulting differential LLR architecture would have a significantly reduced atmospheric contribution and site-related errors improving the sensitivity needed to study lunar interior, beyond the contributions from the GRAIL mission and current LLR. The new LLR station will enable major progress in lunar science and will focus on the study of the lunar core aiming at determination of its size, shape, rotation, and turbulence, as well as interior rigidity and possible regions of partial melting. We will discuss other relevant topics including development of new CCRs and interplanetary laser ranging transceivers for high-precision science investigations.

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