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ORIGINAL ARTICLE

Corner-cube retro-reflector instrument for advanced lunar laser ranging

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Abstract Lunar laser ranging (LLR) has made major contributions to our understanding of the Moon's internal structure and the dynamics of the Earth–Moon system. Because of the recent improvements of the ground-based laser ranging facilities, the present LLR measurement accuracy is limited by the retro-reflectors currently on the lunar surface, which are arrays of small corner-cubes. Because of lunar librations, the surfaces of these arrays do not, in general, point directly at the Earth. This effect results in a spread of arrival times, because each cube that comprises the retroreflector is at a slightly different distance from the Earth, leading to the reduced ranging accuracy. Thus, a single, wide aperture corner-cube could have a clear advantage. In addition, after nearly four decades of successful operations the retro-reflectors arrays currently on the Moon started to show performance degradation; as a result, they yield still useful, but much weaker return signals. Thus, fresh and bright instruments on the lunar surface are needed to continue precision LLR measurements. We have developed a new retro-reflector design to enable advanced LLR operations. It is based on a single, hollow corner cube with a large aperture for which preliminary thermal, mechanical, and optical design and analysis have been performed. The new instrument will be able to reach an Earth–Moon range precision of 1-mm in a single pulse while being subjected to significant thermal variations

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