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CURRENT STATUS AND EXPECTED PERFORMANCE OF THE LUNAR LASER RANGING RETROREFLECTOR ARRAY FOR THE 21ST CENTURY

Abstract

Introduction: The unique science results that have been obtained by Lunar Laser Ranging Pro-gram (LLRP) using the Apollo retroreflectors and the science we expect to obtain with the Lunar Laser Ranging Retroreflector Array for the 21st Century (LLRRA-21) will be discussed. This includes the discovery of the liquid core of the moon and an evaluation of its size, shape and other properties among other properties of the lunar interior.

Current Challenge: While the Apollo retroreflector arrays are still in operation and continue to produce new state-of-the-art science results, the lunar librations limit the range accuracy that may be obtained for each single photo-electron (SPE) return to 20 mm. Due to tilting of the Apollo arrays the return laser pulse is spread, reducing the accuracy of the SPE measurement.

Next Generation Lunar Retroreflector: The University of Maryland, which was the PI for the Apollo arrays, is developing a next generation lunar retroreflector (e.g., the Lunar Laser Ranging Retroreflector for the 21st Century or LLRRA-21) [2]. This holds promise for significant improvements in the understanding of the deep interior of the moon, that is, the liquid and solid core, the core mantel boundary and the inner mantle.

Deployment Issues: The magnitude of these improvements will depend critically on the method of robotic deployment. The roles of the three candidate methods of deployment will be discussed, particularly as they can be supported by the Google Lunar X Prize flights of the next few years.

Thermal Behavior Return Signal Level: The thermal behavior of the LLRRA-21 is critical to the ability for multiple ground stations to effectively conduct a ranging program over a full lunation cycle. The simulations and results required to obtain this performance will be described, with an illustration of the expected performance. Lifetime Issues: The lifetime issues, in the lunar dust environment, for the Apollo arrays and the designs of the LLRRA-21 to ameliorate these effects will be discussed.

Thermal Vacuum Testing: The package has been tested in the SCF, a unique facility developed at the INFN-LNF expressly for the evaluation of retroreflectors [4] for optical and thermal sensing of the performance under solar simulation.

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