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Next Generation of Lunar Laser Ranging Instruments STEPHEN MERKOWITZ, NASA Goddard Space Flight Center, DAVID ARNOLD, PHILIP DABNEY, JEFFREY LIVAS, JAN MCGARRY, GREGORY NEUMANN, THOMAS ZAGWODZKI — Laser ranging over the past 40 years to retroreflector arrays placed on the lunar surface by the Apollo astronauts and the Soviet Luna missions have dramatically increased our understanding of gravitational physics along with Earth and Moon geophysics, geodesy, and dynamics. The precision of the range measurements has historically been limited by the ground station capabilities. With the APOLLO instrument at the Apache Point facility in New Mexico now routinely achieving sub-centimeter level precision, future measurements are likely to be limited by errors associated with the Apollo retroreflectors. In addition, the clustering of the lunar arrays and similar latitudes of the available lunar ranging stations weakens our ability to precisely measure the lunar librations. Advanced retroreflectors placed at locations far from the Apollo sites would enable the study of additional effects, particularly those that rely on the measurement of the lunar librations. Active laser transponders are also under development that can provide a strong enough signal to enable the use of most of the more than 40 existing satellite laser ranging stations to make frequent range measurements, even during the daytime. We report here on a recent study of possible next generation lunar laser ranging instruments that will be ready for NASA's return to the Moon.

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