Scientific Achievements, Applications, and Future Requirements Session Summary

Chairs: Zuheir Altamimi, Richard Gross**,** Steve Klosko, and Aleksander Brzezinski

The 16th International Workshop on Laser Ranging brought together an exceptional group of researchers who provided reports on the spectrum of science investigations being supported by Satellite and Lunar Laser Ranging (SLR and LLR) and Laser Altimetry. The 3 Sessions comprising this portion of the meeting, containing over 20 oral presentations and 3 posters, covered a wide range of activities. These sessions where structured as follows:

- Session 1 focused on the reference frame, positioning SLR stations with high precision within this frame, and time variations in the gravity field, which both perturb the SLR satellite orbits and cause changes of the location of the geocenter with respect to the polyhedron realized by the geographic distribution of the SLR stations. The legacy of SLR over the 1970s and 1980s where it alone provided precise Earth orientation information and through the 1990s for monitoring changes in the longest wavelengths of the gravity field were described. Also presented were results showing SLR's contribution to the International Terrestrial Reference Frame (ITRF) both in terms of providing scale and in monitoring geocenter motion. New missions, like GRACE, which now provide far more detailed information on mass flux within the Earth's system were also discussed with regard to improving SLR orbit accuracies.

- Session 2 focused on orbit determination capabilities, analyses, and new applications for SLR including support for upcoming Lunar Reconnaissance Orbiter (LRO) mission. This session also discussed various highly interesting investigations made possible through the availability of detailed topographic mapping capabilities delivered by laser altimeters and the Lunar Laser Ranging acquired on the moon. SLR remains one of the surest ways to provide precision orbits in its own right, and for independent orbit verification for solutions produced by GPS and DORIS. A laser transponder being deployed on LRO, will provide significantly improved orbits for this lunar orbiter enhancing mission science objectives. The second half of this session focused on the outstanding results for both Earth and Planetary applications, made possible with laser altimetry. Excellent papers were presented on ICESat, the MOLA system flown on Mars Global Surveyor (MGS), and a survey of applications including NEAR, MESSENGER, and LRO.

- Session 3 highlighted SLR and LLR contributions to planetary and lunar geophysics, fundamental physics (e.g. the Lens Thirring effect, the geophysical properties of the moon deduced from LLR) and the upcoming LARES experiment. SLR and LLR, given the long time history and stability of these systems, have made significant contributions to the study of fundamental physics in the field of General Relativity.

The science presentations at this workshop both individually and in total, were some of the most comprehensive ever presented within the ILRS Workshop framework. These papers clearly demonstrated the continuing role that SLR, LLR, and laser altimetry has in furthering our understanding of the dynamics ongoing in the Earth and its terrestrial-like planetary companions.