Session 9: Interplanetary Ranging and Time Transfer

John Degnan

Anja Schlicht

1. D. E. Smith, “Can Planetary SLR Measure the Expansion of the Solar System?

   Best estimates to date of the change in GM of the Sun is $-1\text{x}10^{-12}$per year. A loss of this magnitude could result in a change of 15 cm/year in the orbit of a satellite about the planet, and the distance between Earth and its closest neighbors, Mars and Venus, would change by tens of centimeters over a period of one year and should be easily observable by laser transponders in orbit about the three planets. A three year observation period was recommended. Dave is hoping that a collaboration between the major international space agencies can supply the three spacecraft and laser transponders needed to perform the mission.

2. U. Schreiber, “Testing Fundamental Physics with Clocks in Space: The ACES Mission”

   The launch of the ACES Mission (Atomic Clock Ensemble in Space”) is currently scheduled for launch in early 2018. Mission goals include measurements of the gravitational red shift, temporal drifts in fundamental relativistic “constants”, violations of Special Relativity, and measurements of the gravitational potential (relativistic geodesy”).

3. A. Schlicht, “Status of the ELT Data Center”

   Calculations are performed in UTC. The analysis steps and the structure of the data center were described.

4. **Wendong Meng, “The project and plan of ground-satellite laser time transfer in China”**

The Beidou time transfer experiments were carried out during the period 2007 to 2012. In 2022, the LTT system will be installed on China’s Space Station in a 400 km orbit. LTT will include a single photon sensitive detector with a timing resolution less than 30 psec and an onboard timer with better than 10 psec resolution. Laser Time Transfer goals are 60 psec timing stability and 1 psec per day stability.

S. Dell’Agnello, “The Moon and Mar as Laser-Ranged Test Bodies for General Relativity”

The “Moonlight” laser retroreflector was described (“INRII on the Moon”). A small, lightweight (25g) reflector was described that includes 8 half-inch retros. They were developed for use on surface vehicles on planned lunar and Mars missions. Goals are to provide experimental support to the study orf relativistic phenomena such as PPN, Weak Energy Principal (PEP), Strong Energy Principal (SEP), G-dot, as well as the Inverse Square Law and provide geodetic precision on extraterrestrial bodies.

6. Hirotomo Noda, “”Laser link experiment between Hayabasu2 laser altimeter and SLR Stations”

Results of a laser link experiment between a laser altimeter aboard the Japanese Hayabusa2 asteroid explorer and ground SLR stations were described. The experiment was carried out for 16 days from October to December 2015 when the spacecraft was close to the Earth. Laser shots from the Mt. Stromlo station in Australia were detected successfully by Hayabusa2 LIDAR at 6.6 million km distance, meaning that one-way laser link was established. By scanning the spacecraft attitude, a trial to find out the field of view direction of the receiving telescope of LIDAR in the spacecraft frame was also successful. Finally, Hayabusa2 became the third spacecraft which established a laser link farther than the lunar distance, following NASA’s MESSENGER and Mars Global Surveyor experiments.