June 25, 2020

ILRS QCB Meeting
June 25, 2020
Virtual Meeting

Participants

Erricos Pavlis, Matt Wilkinson, Peter Dunn, David Sarrocco, Stefan Riepl, Toshi Otsubo, Van Husson, Jose Rodriguez, Tom Varghese, Graham Appleby, Jason Laing, Carey Noll, Mike Pearlman, and Tom Oldham.

Chart Posting

The charts from the meeting are available at
https://ilrs.gsfc.nasa.gov/docs/2020/ILRSQCB_slides_20200625.pdf

We had some difficulty with reception from Peter and Stefan; Peter gave an abbreviated introduction based on some charts from Van and Tom, and then we focused on more extensive material presented by Van Husson.

Brief from Peter

Analysis of full rate data from single photon systems show differences between LAGEOS 1 and LAGEOS 2. Observations of different satellite transfer functions can help clarify the apparent 2 mm smaller size of LAGEOS2, which is currently observed at most stations. ETM data from some NASA systems also indicate in the CRD record a different system transfer function from the originally implemented HP5370s. The latest Rodriguez CoM model, based on Hx detection, projects these differences between both the satellites and the systems at Yarragadee:

- HP 5370: L1-L2 = 0.7mm
- ETM: L1-L2 = 0.5
- L1: EMT-HP5370 = 0.7
- L2: EMT-HP5370 = 0.9

Pulse width and pulse shape differences are also expected as a result of PMT voltage changes at MCP stations. A more detailed analysis of information collected, but left behind by the normal point procedure, can probably help improve the accuracy of all systems tracking all satellites.

A very nice talk was given by Dr. David Lucchesi from the Institute for Space Astrophysics and Planetology (IAPS/INAF), Rome, Italy, on "Thermal thrust accelerations on LAGEOS and LAGEOS II" July 7, 2020.

Van's Summary

- Starting in April 2011, NASA SLR stations implemented some new tracking procedures in order to maximize data yield on the geodetic satellites with relatively weak satellite link budgets (i.e. LAGEOS, LARES and Etalon). Higher PMT voltages were used to track these satellites while calibration data were taken at lower voltages. Recent PMT ground tests

from a few of the NASA SLR stations reveals the potential of a few to several mm of range bias may be introduced under these conditions. More work is needed to better characterize this systematic effect. Peraton will take an action to develop some new PMT system characterization tests;

- There was some discussion about potential discrepancies of 15 to 25 mm in Etalon range biases between the different analysis centers; this may just be a manifestation using different models and requires a further look;
- If the LAGEOS range bias changes abruptly by 3 to 5 mm at a station and if it persists for at least a few weeks, the ITRF2020 process should be able to see it. However, it would be advantageous to have a process that reveals mm level changes this during normal operations.

Discussion

It will be some time (several to many years) before the NASA SLR systems are replaced by the SGSLRs. As such, we should at least identify low cost operational things that could improve the performance/accuracy of the NASA SLR systems. Note that the implementation of the ETMs has already provided a very noticeable improvement.

Van's work has been focused on tracking down suspicious features in the data residuals from the SLR stations (not just the NASA stations), and working with the stations to try to figure out the source. Sometimes it was an event that was reported in the Station History, but often it was not. Sometimes, these features are abrupt changes, other times they might be gradual changes.

Historically some stations had increased PMT voltage on higher satellites to increase PMT gain. Typical settings might be 2800 v for LEO, 3000 v for LAGEOS, and 3200 v for GNSS. The downside is that the noise also increases with voltage. The PMT voltage is recorded on a pass by pass basis on the raw full rate data, but only a standard value was recorded on the CRD files (full rate and normal points).

Recognize that the 5370's are disappearing; maybe some correction at the few mm level could be made to historical data, if considered useful.

In the meantime, Periton is pushing the stations to use a standard PMT voltage for calibration and satellites at each station and to record the PMT voltage value on the CRD file (note: This requires a Peraton software change unless the same voltage is used for every satellite).

An alternative approach would be to calibrate each station at a standard PMT voltage (where the response is flattest), use a few standard PMT voltages (e.g. 2800, 3000, 3200, and 3400 volts) to accommodate the return signal levels from the different categories of satellites, and add a correction offset to the ranges to account for the different PMT voltage used (this would be based in the PMT voltage calibrations done at each station.

Next QCB meeting on July 16, at 9 am EDT (13:00 UT)

Mike