



Ground Station Requirements for the ELT experiment

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When it comes to precise orbit determination in geodesy, Satellite Laser Ranging is the state of the art technology. Therefore, the geometrical reference point of the ground stations is well defined in space. Upgrading these systems with highly accurate clocks in combination with a good definition and stability of the local reference points in time would enable this technique for highly accurate and precise optical time transfer between space and ground. As a consequence the stations will become reference points in time as well. This poster outlines the requirements for ground stations, which consider participating in the European Laser Timing (ELT) experiment and the performance that can be expected. The implementation examples and measurements were performed at the Wettzell Laser Ranging System (WLRs).

ELT experiment

ELT is part of the Atomic Clock Ensemble in Space (ACES) experiment. ACES consists of a highly precise cesium fountain clock and a hydrogen maser installed in a microgravity environment, daher: in space on the International Space Station (ISS). The earliest mission start is scheduled at 10/2018.

While frequency-transfer to ACES is done with mobile microwave terminals, a time-transfer via Einstein-Synchronisation shall be performed in the optical regime using the onboard ELT detection and timing unit and ground stations with two-way ranging capability to the ISS. Thus SLR-stations provide a good environment for the experiment.

Nevertheless, time-transfer is not a common business of SLR-stations. Several additional requirements are necessary. These can be separated into three main items:

Laser Safety Requirements

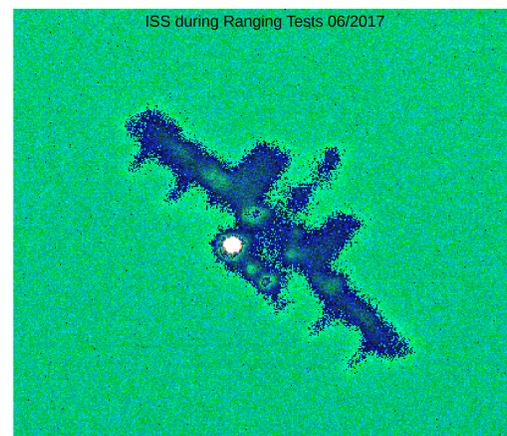
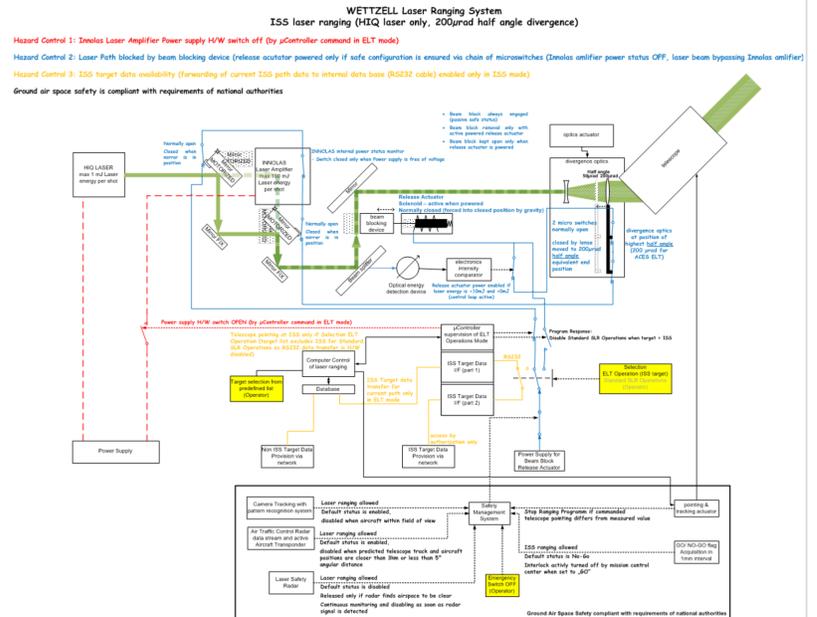
- Max. single pulse energy ~0.1mJ (ISS manned object)
- Additional beam blocking equipment needed (Fig. 1)
- ELT GO/NOGO-handling (predictions must be loaded on GO only and not be stored)

Technical Requirements

- Fast slewing telescope (ISS orbital height)
- Controllable laser fire epoch to better than 1 μs (ELT-detector gated synchronous to onboard PPS @ 100 Hz rep.-rate)
- Spurious reflections filtering necessary (see Ranging Tests)

Performance Requirements

- Few ps Epoch Stability (Event-Timer set time)
- Few ps Delay Stability (electrical & geometrical delay Start-detector to Invariant Point)
- Both calibrated in calibration campaign (Prochazka)



ISS Ranging Tests

Performed in 06/2017 to test prediction and ranging data handling and discover spurious reflections

