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European Laser Timing for ACES status 2023-2024

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Laser time transfer ground to space is an attractive and promising measuring technique. Photon counting approach provides top precision and accuracy. The space missions operational up to now demonstrated its capabilities.

The European Laser Timing (ELT) detector package was completed and delivered by our laboratory in 2016. All device parameters are within specification including big margin. The ELT timing in space will be provided by the MWL timing unit built by TimeTech company. Unfortunately since 2017 the parameters of this timing unit are significantly worse than specifications. The tests and solutions are completed in Airbus laboratories. The data processing is done by Technical University in Munich. We have developed and demonstrated a new testing scheme to determine the timing performance of the complete setup of ELT detector and MWL timing system. This test may be done also on finally assembled device. Just common clock frequency of 10 MHz is needed. The capabilities of this test were verified in laboratory experiments at our University laboratory February 2024. The necessary hardware was provided to Airbus for tests completed in April 2024.

Permanent effort is focused on improvement of critical components of ELT ground segment - Satellite Laser Ranging (SLR) system. The goal is to improve its timing stability. In the last years the new version of single photon detection device optimized for SLR and laser time transfer was developed. Its single shot timing jitter is better than 18 ps rms, its detection delay temperature drift is within ± 300 fs/K. The second key device is the optical trigger device - Start detector. Its single shot timing jitter is well below 1 ps rms and its detection delay temperature drift is within ± 300 fs/K. The key element of measurement chain is the epoch timing device. We do continue to tune the capabilities and parameters of the New Pico Event Timer (NPET). Its timing jitter is < 1 ps of a single measurement, its stability may be characterized by $TDEV < 10$ fs @ hours of operation. These devices have been installed on several SLR sites worldwide within the last years (Germany, S. Korea, USA, Spain, China).

The ELT Calibration device is available and ready. In total five European SLR site were calibrated in the last years: Graz, Austria, Wettzell, Germany, Herstmonceux, UK, Potsdam, Germany and Zimmerwald, Switzerland.