Requirements on SLR System for Participation in ELT and Future Laser Time Transfer Experiments

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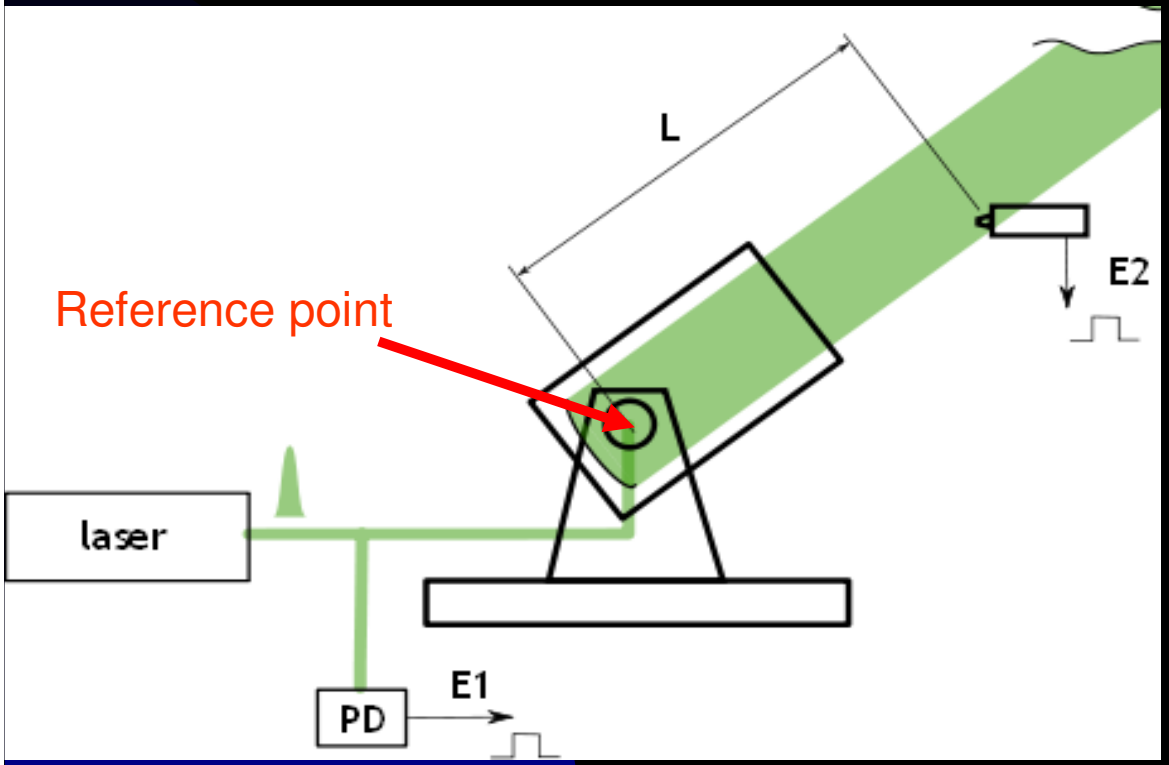
ELT delays on SLR site
Ground – Ground referencing



Every participating ground station will be characterised by a single delay calibration value **C**

C is a difference between emitting epoch reading **E1** and a time of crossing of the optical pulse the reference point

Calibration value computed from
- epoch dif. **(E2-E1)**
- geometry distance **L**
- delays of Cal. Device (DT_5, DT_6)

Both systems use common time & frequency

For G-G time transfer the Calibration Tool delay stability is the only critical parameter

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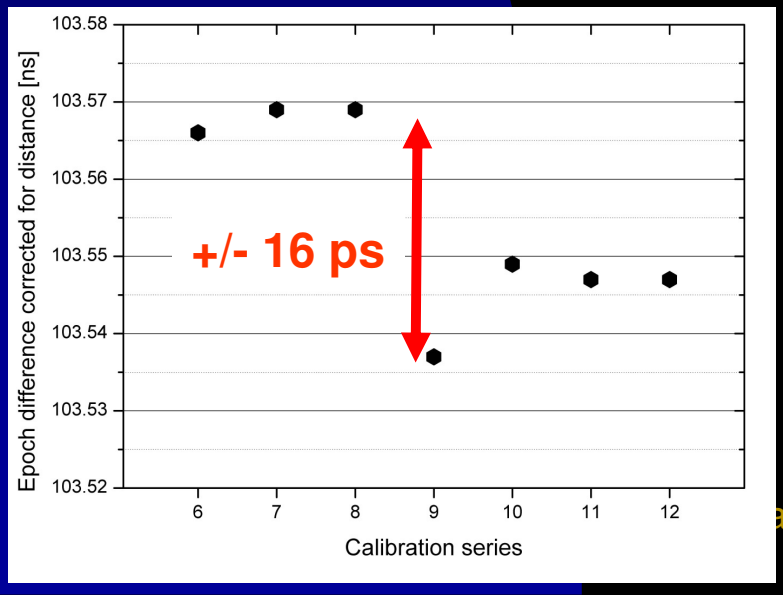
ELT Calibration Device

- **<u>ESA support appreciated</u>**
- The ELT Calibration Device has been completed
- ELT Detector Package FM twin
- NPET Epoch Timing unit
- calibrated signal cables
- calibrated signal connectors, converters etc..
- process control and data processing SW
- Manufactured and tested
- Signal propagation delays measured +/-2 ps accuracy
- Tested in Wettzell and Graz
- Ready for use

ELT Calibration Mission at SLR Graz
August 2015



- ELT Test Calibration Campaign
  Graz SLR August 19-21, 2015
- Single ~ 20 ps rms, TDEV < 2 ps @ 20s
- ELT Calibration constant

C = 94.329 +/- 0.018 ns

- ELT Calib.Device performance verified
- SLR Graz to implement for ELT mission:
- laser trigger phase programming
- time reference (GNSS rec.) “1pps”
- Hydrogen maser integration

SLR station requirements

prerequisites for ELT participation

SLR tracking capability	ISS orbit
local time base ties to UTC	GNSS, (or better)
frequency reference	H_2 maser (or better)
laser fire epoch precision	20 ps (or better)
laser wavelength	532+/- 2 nm
laser nominal rep.rate	10 Hz min., >= 100 Hz opt.
laser fire epoch	**prgm =< 100 ns steps**
laser power density adjustable	beam divergence control in a real time

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Conclusion

- European Laser Timing should provide laser time transfer ground-ground and ground to space with accuracy ~ < 20 ps
- The critical system delays of the participating SLR stations should be mapped down to ~10 ps level using a Calibration Device (2016 – 2017)
- The Calibration Device is simulating ELT operation - the calibration campaign will serve as an “exercise” before the real mission operation
- ACES – ELT launch is scheduled for February 2017
- Looking forward broad SLR community participation