Challenges facing satellite laser ranging systems

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Outline
Challenges facing satellite laser ranging systems

- Satellite Laser Ranging
- Precision, accuracy, stability
- Productivity
- Lunar laser ranging
- Laser time transfer
- Space debris laser ranging and optical tracking
- New wavelengths
- Conclusion

Satellite Laser Ranging
Challenges facing satellite laser ranging systems

- SLR Precision
  Single shot precision - is reaching few mm to units of cm,
  NPT precision – sub-mm values are obtained

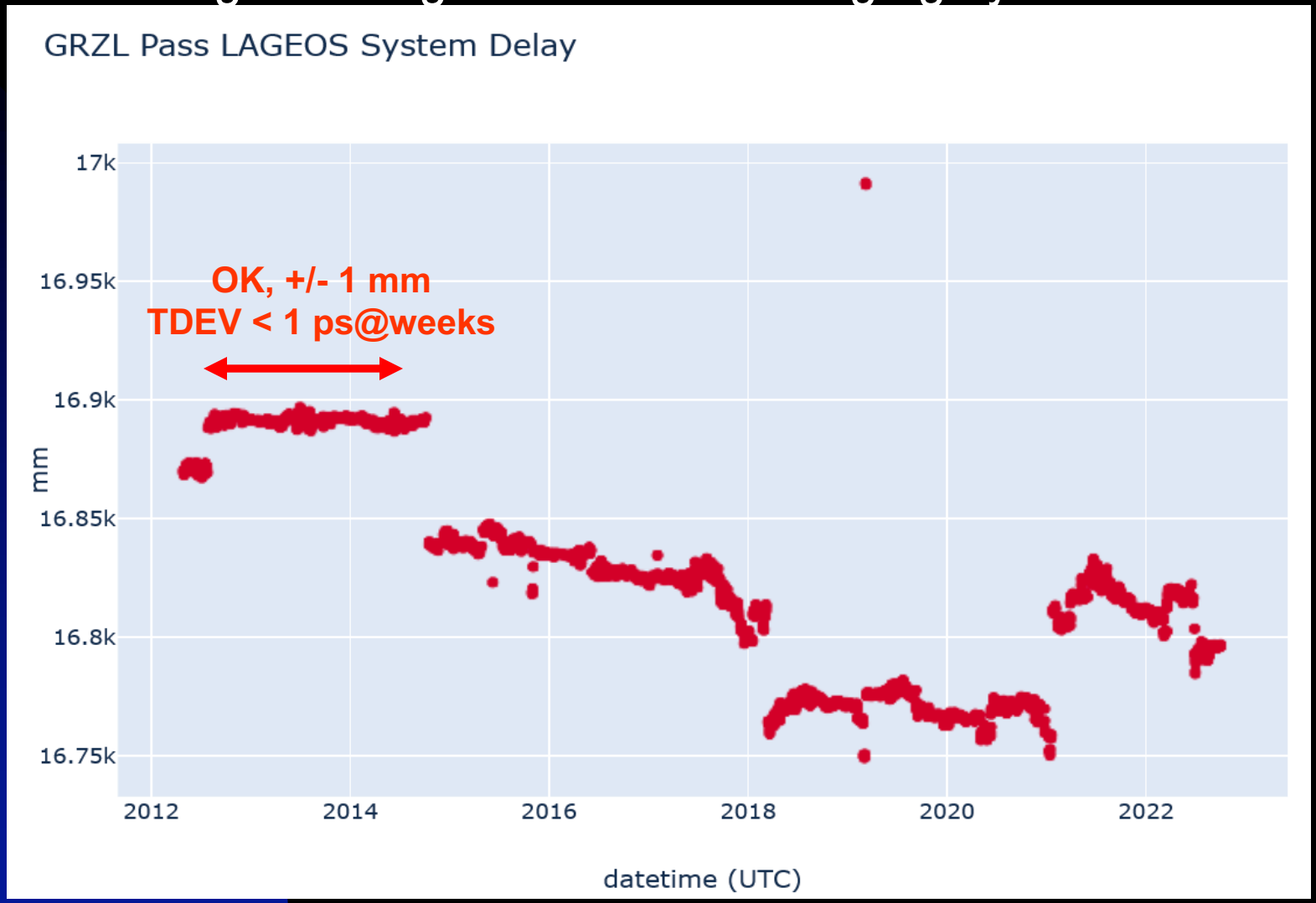
- System delay stability is a permanent issue for most sites,
  mm system stability is a goal GGOS.
  It is a crucial parameter also for laser time transfer.

- Station productivity is becoming more and more important,
  the number of SLR targets is permanently increasing.
  The SLR tracking scheduling, planning etc.

- Lunar laser ranging
  No. of targets will increase in a near future:
  surface, orbiter

System delay stability

Challenges facing satellite laser ranging systems



Most of other SLR sites stability is significantly lower

I.Prochazka, ILRS Workshop, Yebes Obsy, November 10, 2022

Laser time transfer
Challenges facing satellite laser ranging systems

- Key requirement - system stability
- Laser fire epoch control shot by shot < 100ns
- Local connection to high quality clock(s)
- More details in dedicated presentation
  J. Kodet, this session

Space debris laser ranging and optical tracking
Challenges facing satellite laser ranging systems

- ENERGY BUDGET
- High energy/pulse laser (ns)
- Maximum photon detection efficiency detector
- New wavelenght (1064 nm, ?)
  attractive also for LLR
- Optional capability of CW signals monitoring
  and images recording
- More details in dedicated presentation, this session

New wavelength laser ranging
Challenges facing satellite laser ranging systems

- New wavelength 1064 nm, (1540 nm,.. ?)

- Energy budget advantages 1064 nm versus 532 nm

no SHG generation	> 2 x
photon energy	2 x
atmospheric attenuation	1.2… 1.5 x
Lunar dust attenuation	> 1 x

- In LLR pioneered by C. Courde, 2016 and J. Eckl, 2017

- Compact InGaAs/InP SPAD detector package for satellite and space debris laser ranging (IP 2022)

- More details in presentation I. Prochazka, Thursday

Conclusion

Challenges facing satellite laser ranging systems

- Although SLR became a routine procedure within the last decades, we are facing new and new challenges ☺

- Thank you for your attention

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