Co-location on the Ground and in the Space

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First International Workshop on VLBI Observations of Near-field Targets

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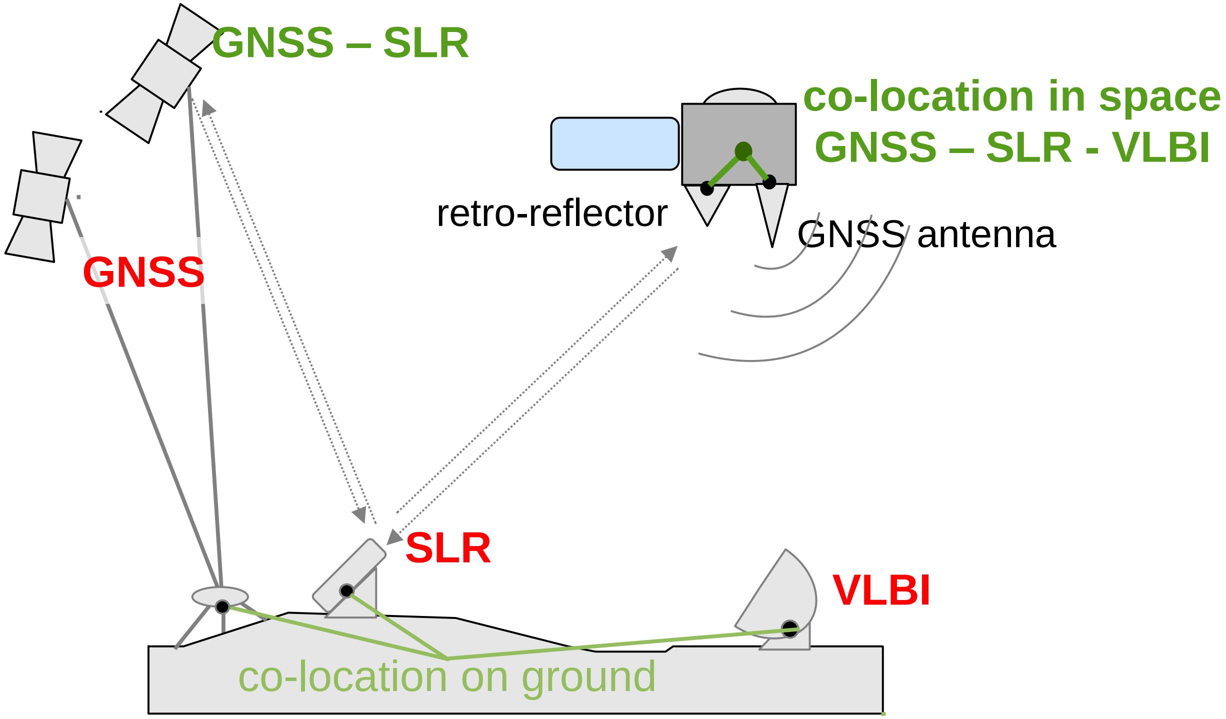
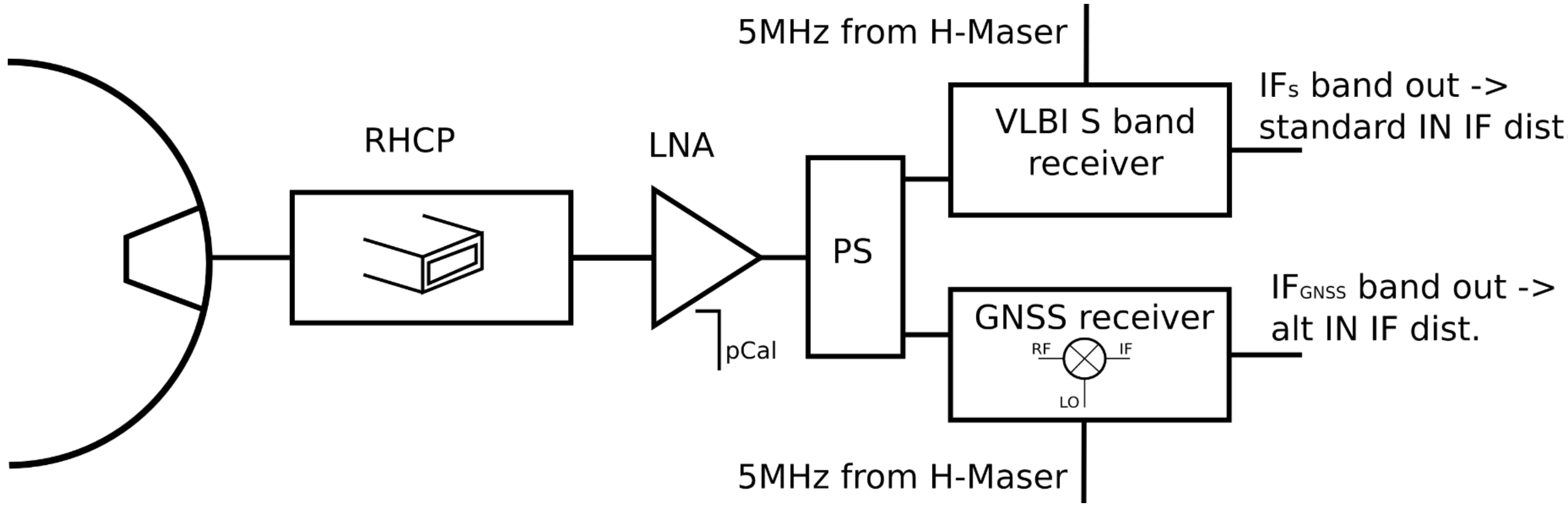
GNSS Satellites Observations Using VLBI

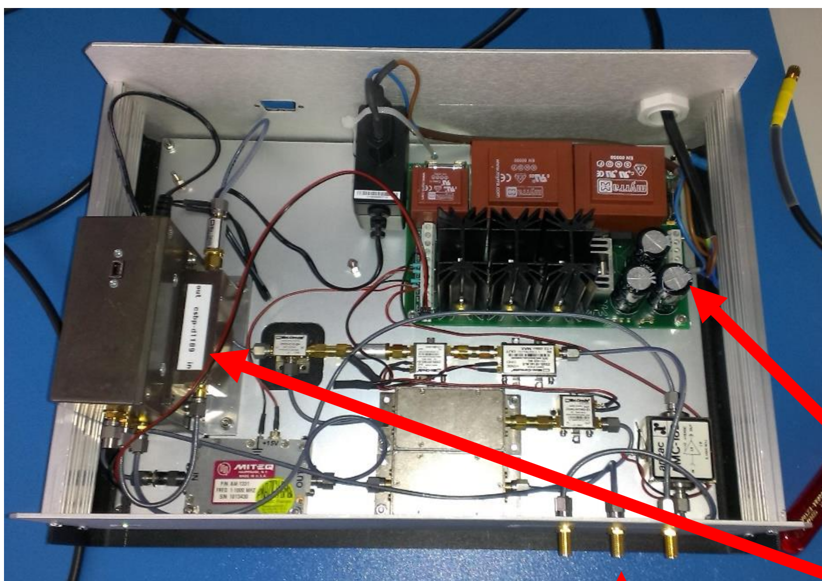


- Co-location in space
- Improvements of local ties and technique-specific effects (e.g. calibration of antennas)
- Combining kinematic and dynamical reference frames
- Get GNSS orbital parameters in the International Celestial Reference Frame

GNSS Satellites Observations Using VLBI

RT Wettzell S-Band Receiver Upgrade





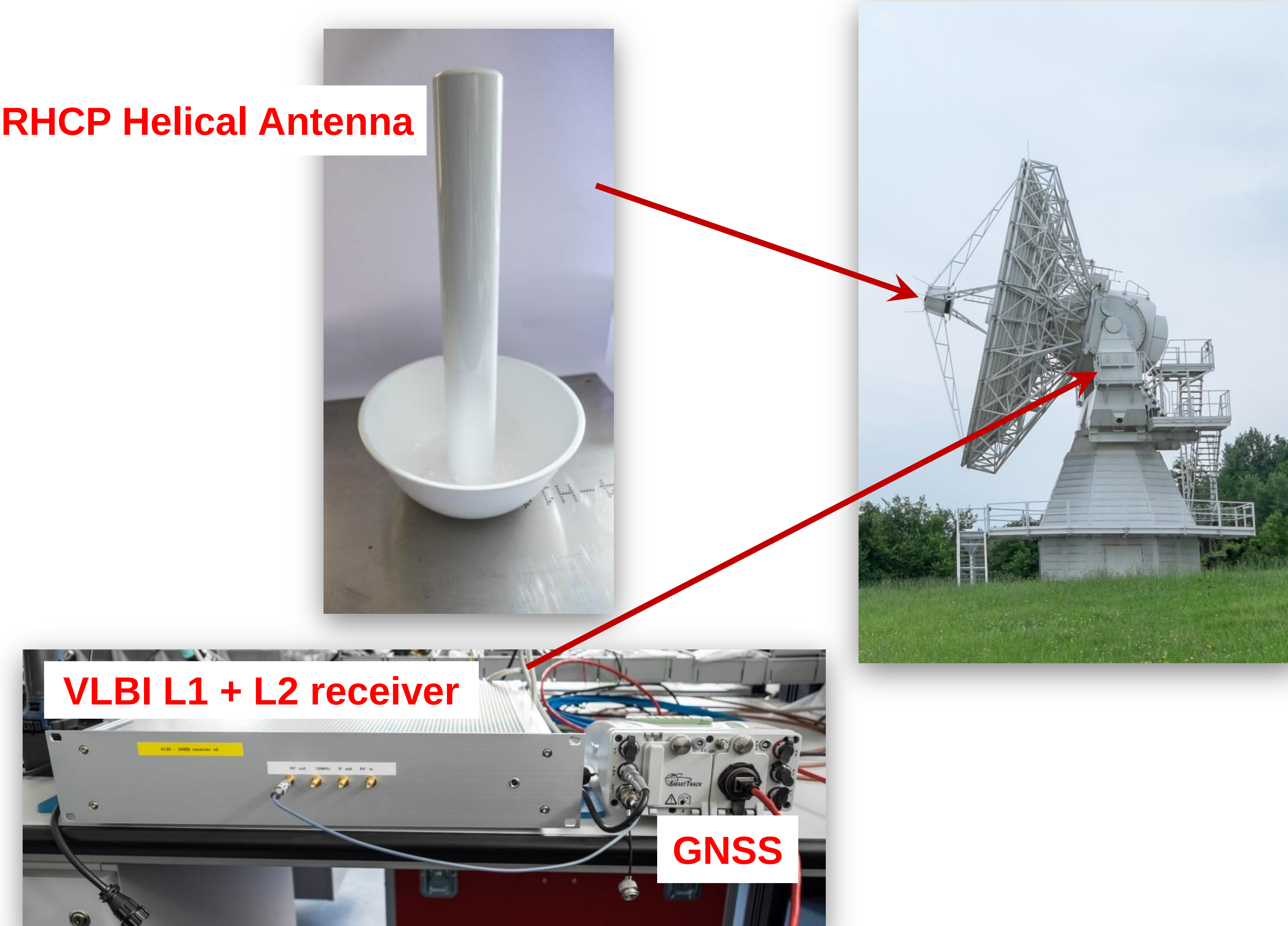
Power supply

LO 1200MHz

5MHz IN; S-LNA IN; IF band OUT

- S band feed disables to observe L band quasars
- pCal can be used to estimate group delay difference (S – L band)

Observation of GNSS using TWIN1



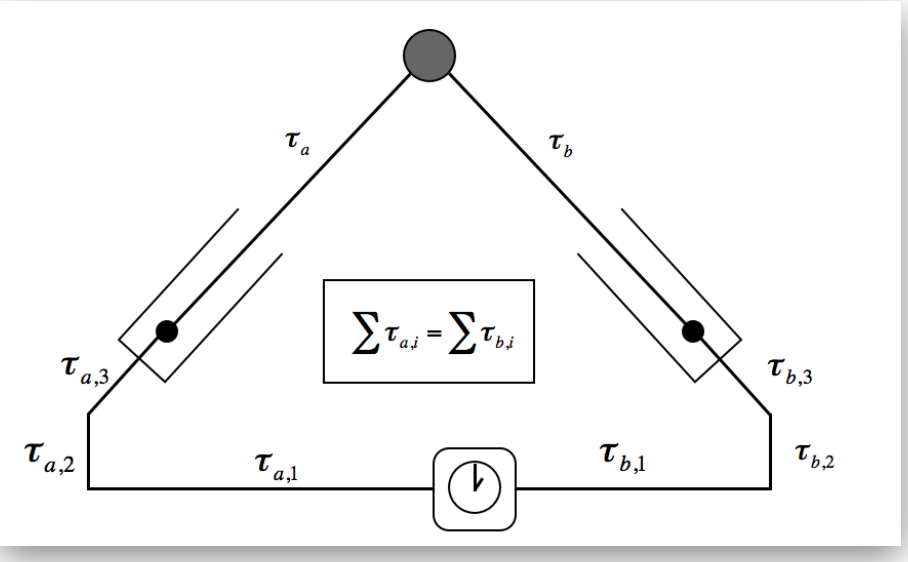
Observation of GNSS using RTW and TWIN

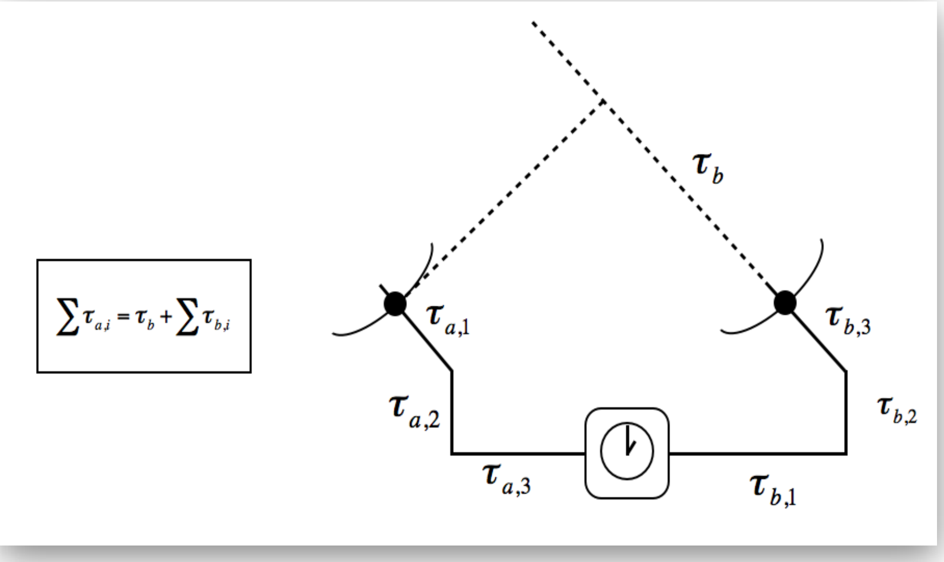
- Scheduling was implemented to VieVS and first experiment proofed tracking possibility by RTW and TWIN1 + GNSS antenna
- Campaign of 3 small experiments focused on Glonass during April 2016
- Data are waiting for correlation

Conclusions VLBI GNSS observations

- RTW is capable to track L1 GNSS signal
  - Proved in several experiments (JIVE, Wettzell – Onsala baseline, R. Haas)
  - Hardware limitations caused by large attenuation of L band in S band feed
- TWIN 1 is capable to track L1 and L2 GNSS signals using GNSS antenna installed on the roof of TWIN control room
- TWIN 2 has broad band feed working from ~1 GHz, tracking was not tested
- Scheduling was implemented to VieVS

Common Clock for Space Geodetic Techniques





Using two or more measurement systems of the same technique with a common clock provides equal delays in the time regime if all systematic biases are correctly established. The illustration shows the case for SLR on the left and VLBI on the right side.

Multi-Technique Ground Target Construction

GNSS Antenna

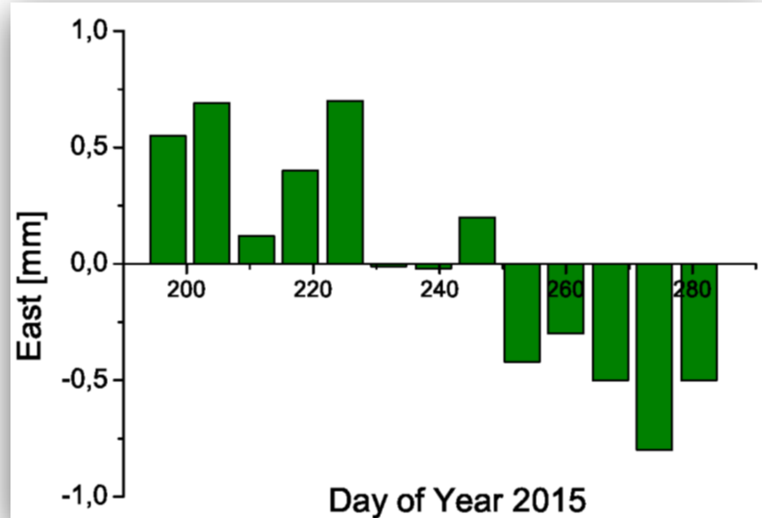
SLR Reflector mounted on rotating table

VLBI Radio-source

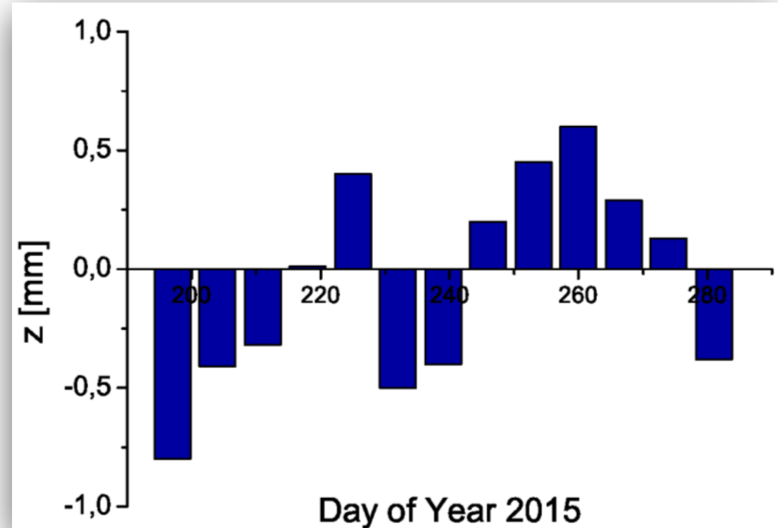
Multi-Technique Ground Target

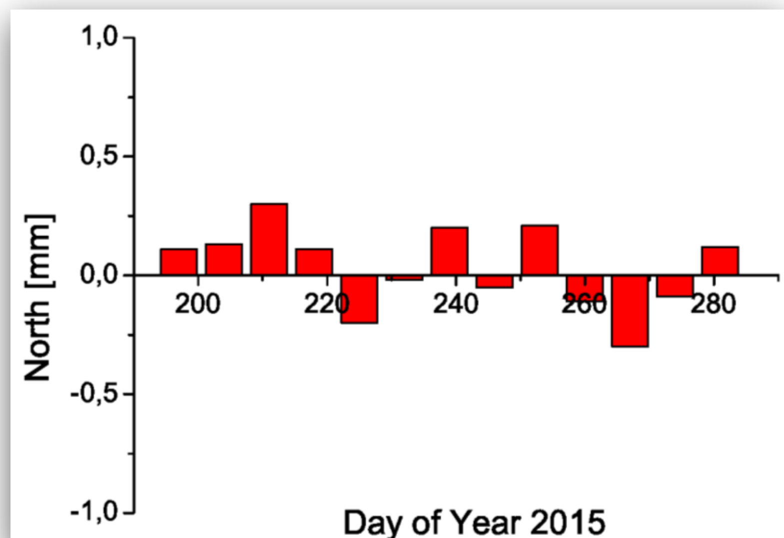
Multi-Technique Ground Target

Multi-Technique Ground Target GPS Solution

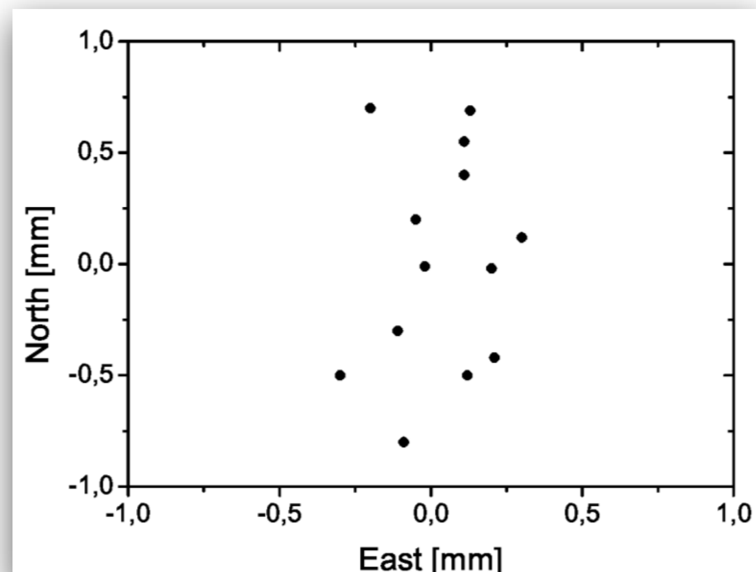


±1mm

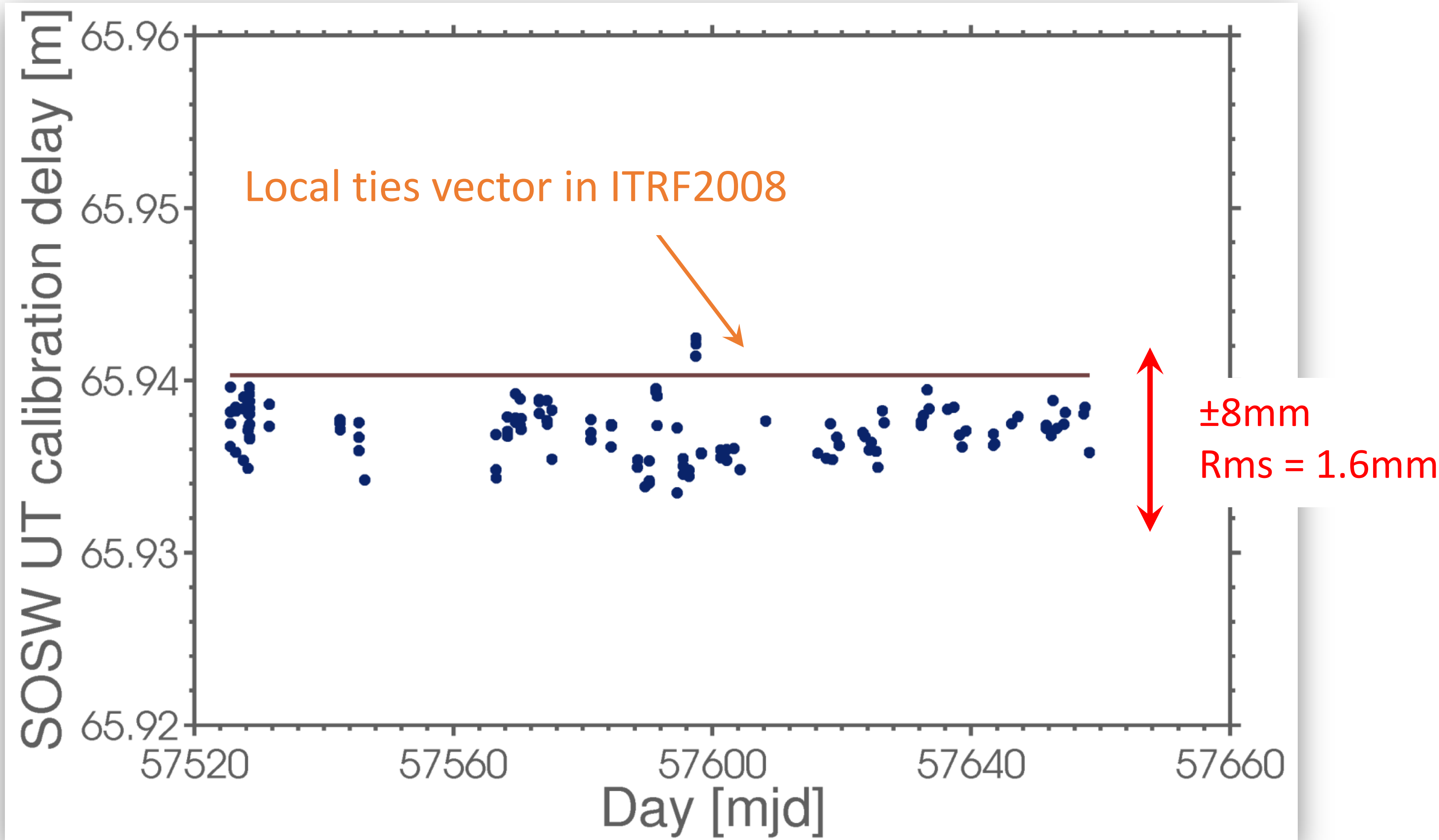




±0.5mm



Multi-Technique Ground Target
Calibration with SLR (SOSW)



Multi-Technique Ground Target VLBI Concept

$\Delta\varphi = \varphi_1 - \varphi_2 = const.$

When τ_{cUC} = const. $\Rightarrow$

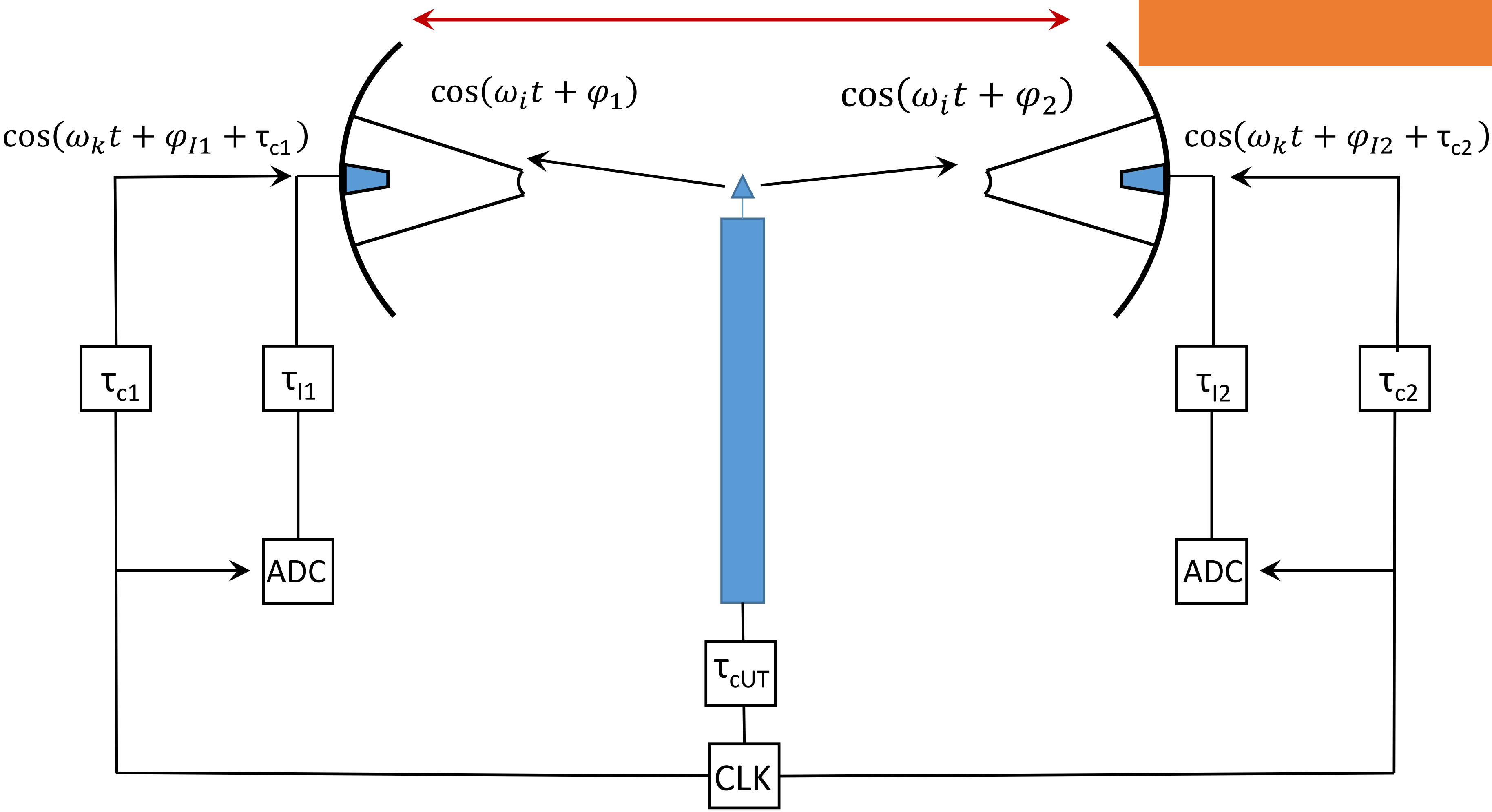
$\varphi_1 \, and \, \varphi_2 = const.$

$\Delta\tau_g = \tau_{g1} - \tau_{g2} = const.$

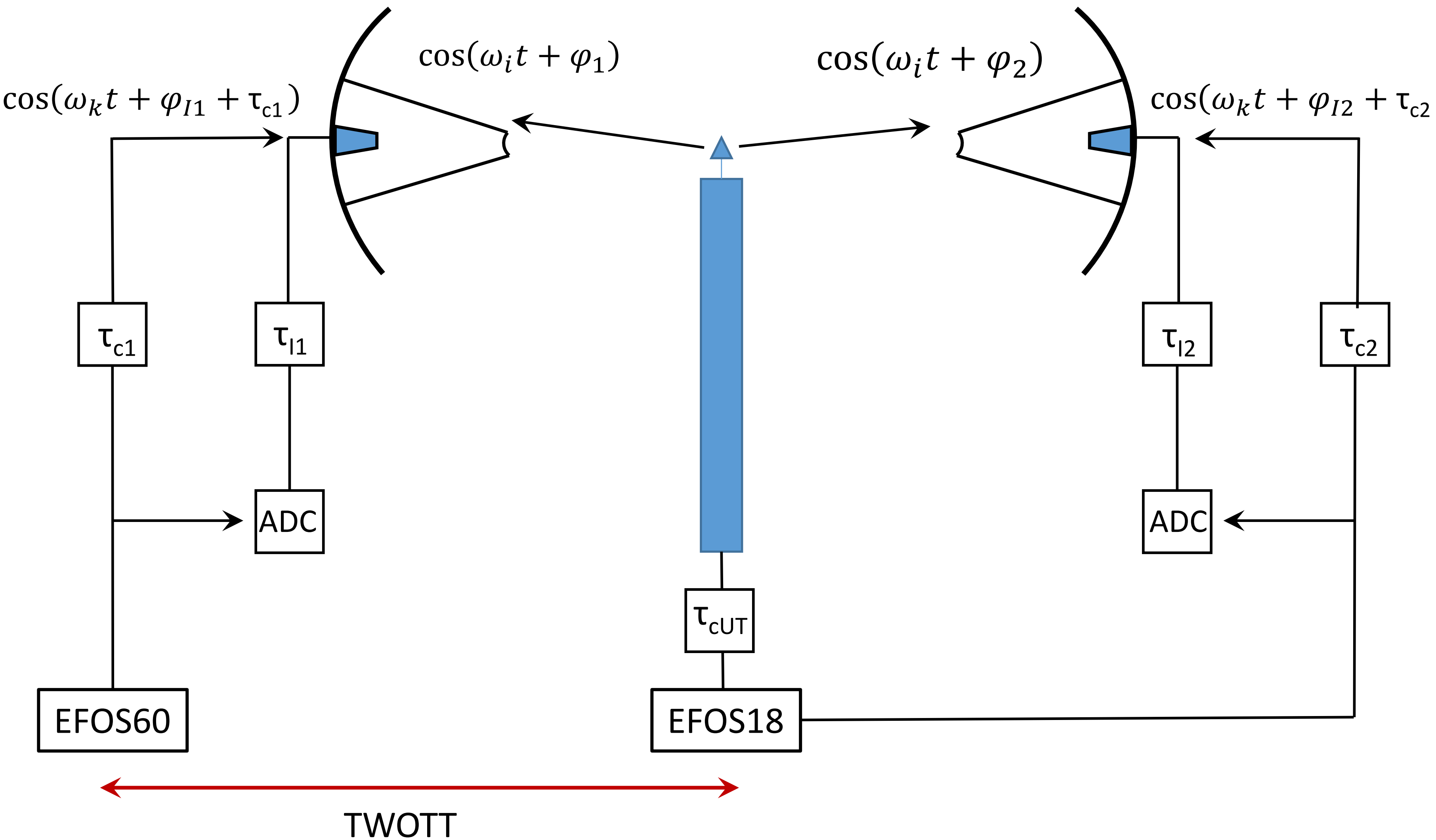
$\Delta\tau_g = \frac{d\varphi_1}{d\omega} - \frac{d\varphi_1}{d\omega} = const.$

When τ_{cUC} = const. $\Rightarrow$

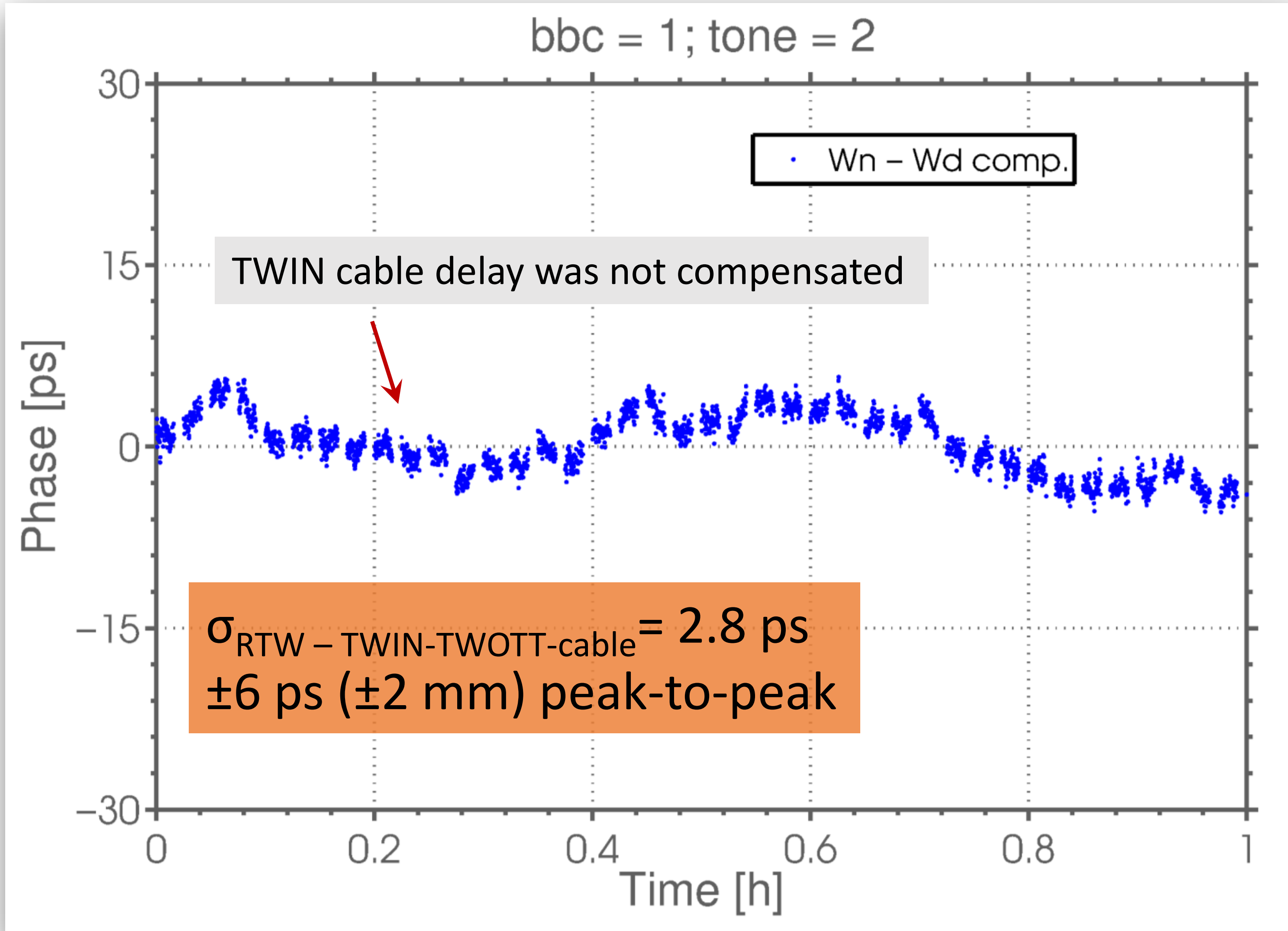
$\tau_{g1} \, and \, \tau_{g2} = const.$



Multi-Technique Ground Target VLBI Experiments

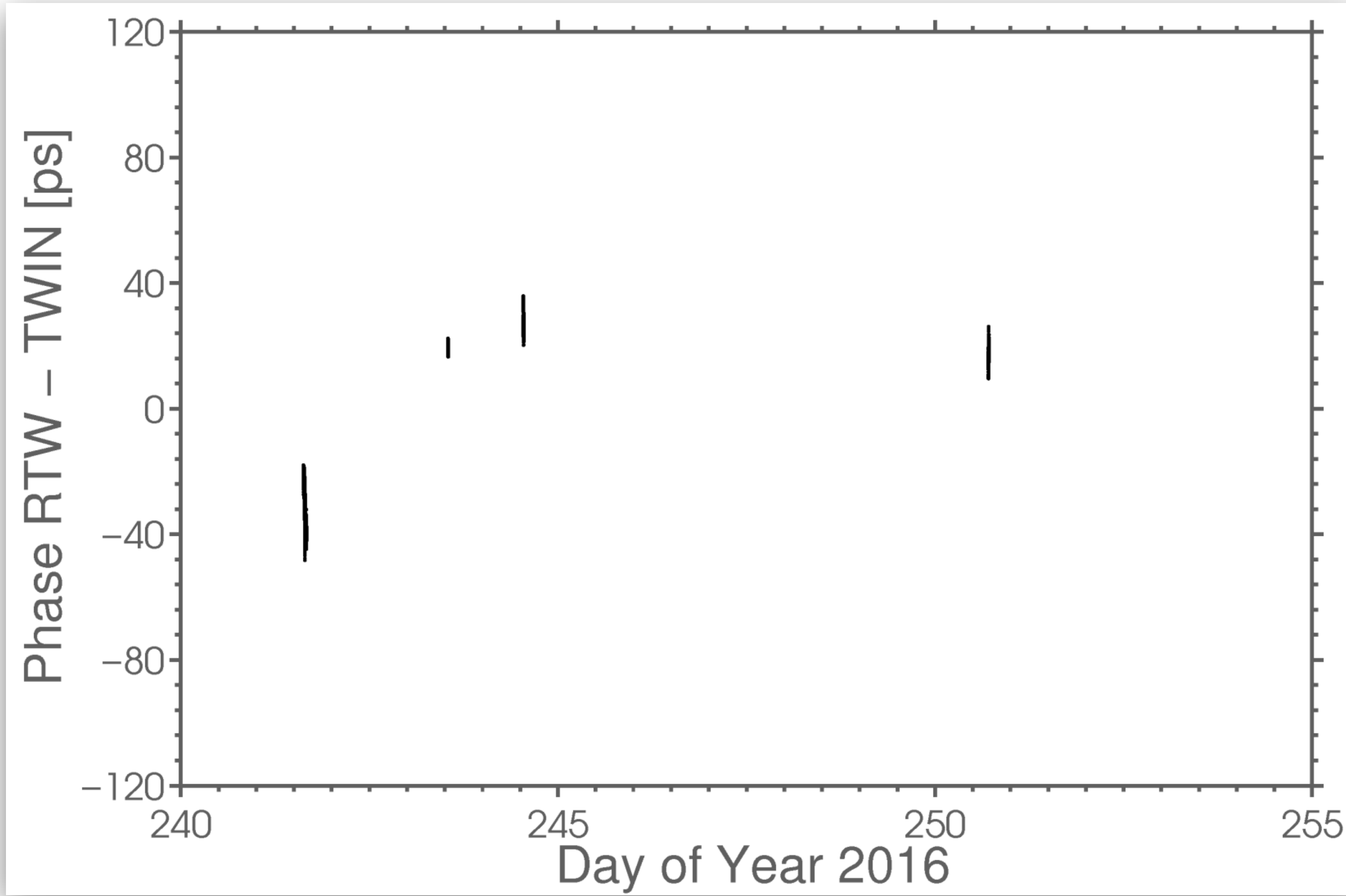


Multi-Technique Ground Target
RTW - TWIN 1 all known delays distracted



Multi-Technique Ground Target

RTW - TWIN 1 all known delays distracted



Conclusion

- The experiment proved that these technique can work and is repeatable
- For geodetic application several changes must be considered