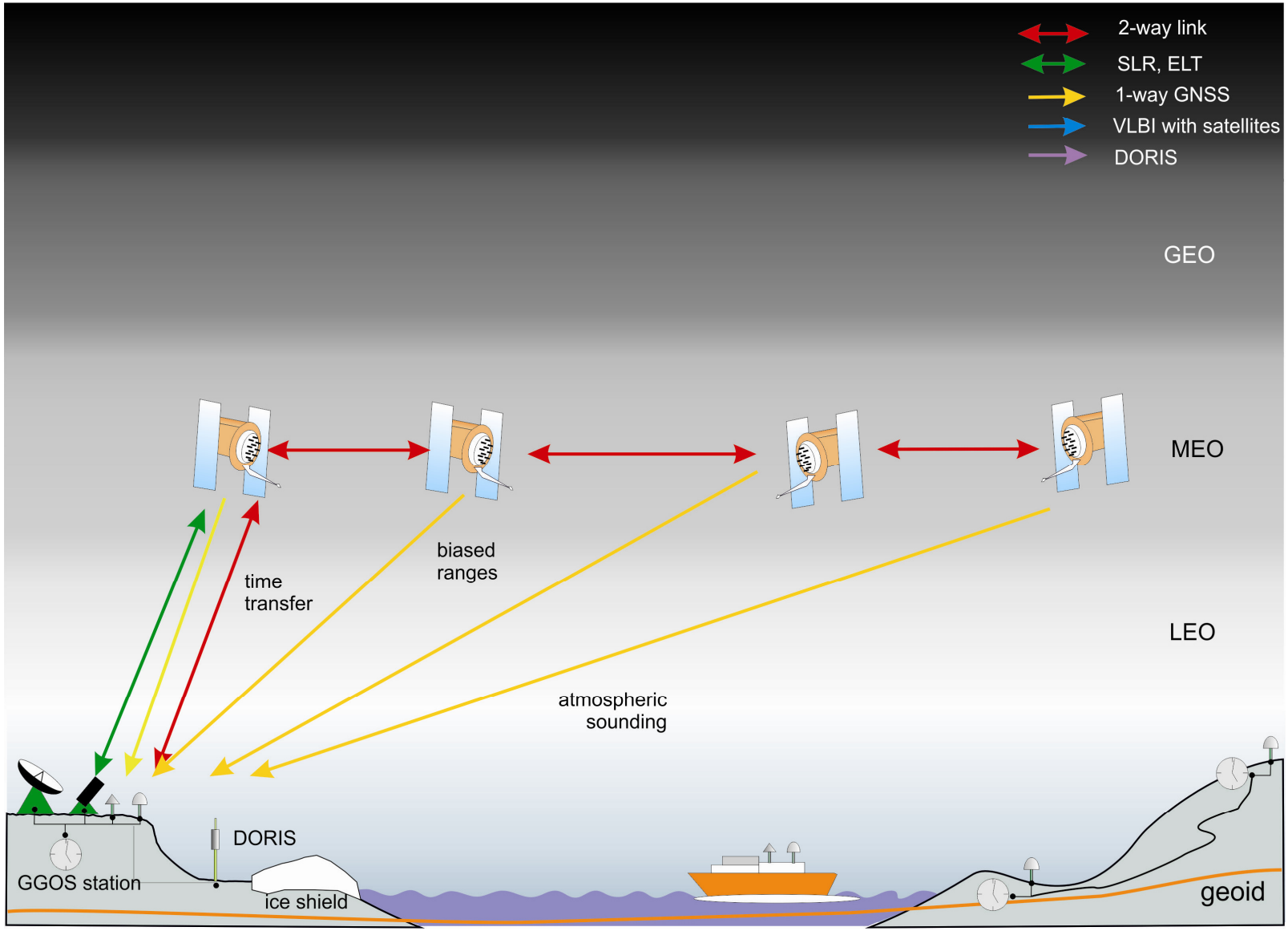
Why Geodesy needs Time!

Anja Schlicht

How to get along with the troposphere?



A new and old ranging technique

Now working in the Ku-Band

MWL and ELT

MWL

- All weather
- High availability
- High precision
- Easy to operate

ELT/SLR

- Low dispersion
- Single shot
- Accurate time tagging
- Used to calibrate MWL

Frequency stability for interplanetary ranging

$$\langle \Delta R^2 \rangle \approx R^2 \left[\frac{\langle \Delta f_{\mathrm{A}}^2 \rangle}{f_c^2} + \frac{\langle \Delta f_{\mathrm{B}}^2 \rangle}{f_c^2} \right]$$

Asynchronous transponders

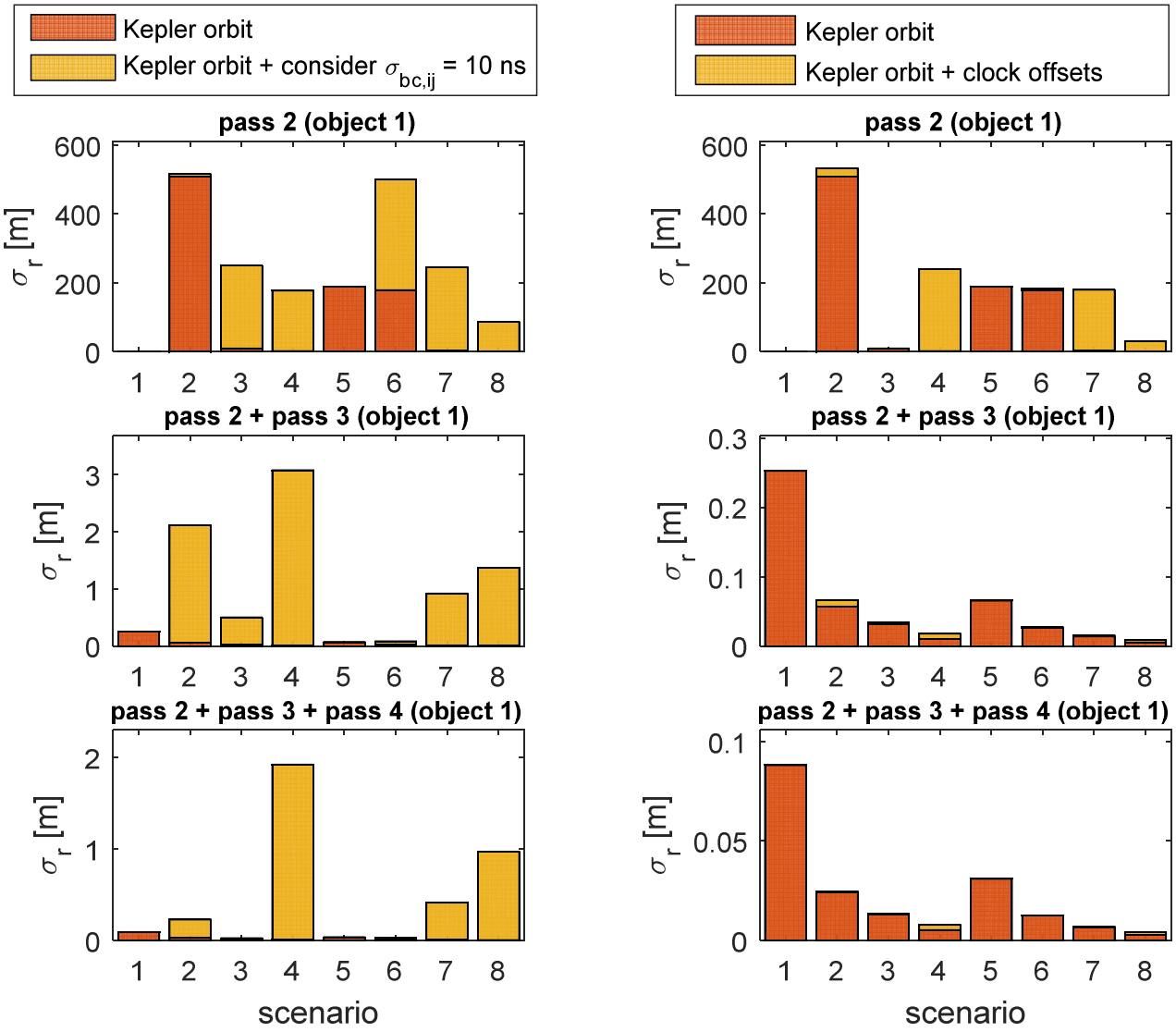
Degnan 2002

and

$$\langle \Delta \tau^2 \rangle = \left[\frac{R}{2c\left(1 + \frac{\dot{R}}{c}\right)} \right]^2 \left[\frac{\langle \Delta f_{\mathrm{A}}^2 \rangle}{f_c^2} + \frac{\langle \Delta f_{\mathrm{B}}^2 \rangle}{f_c^2} \right]$$

transfer, the latter clock would introduce a timing jitter on the order of 250 ps (<4 cm). However, if both clocks were of maser quality ($\sim 1 \times 10^{-15}$ over time intervals of several minutes), clock errors would introduce submillimeter errors over distances on the order of 1 AU and range accuracy would then be limited, as in conventional SLR to artifical satellites, at the sub-cm level by uncertainties in the atmospheric propagation paths.

Use of timing predictability for multi-static space debris

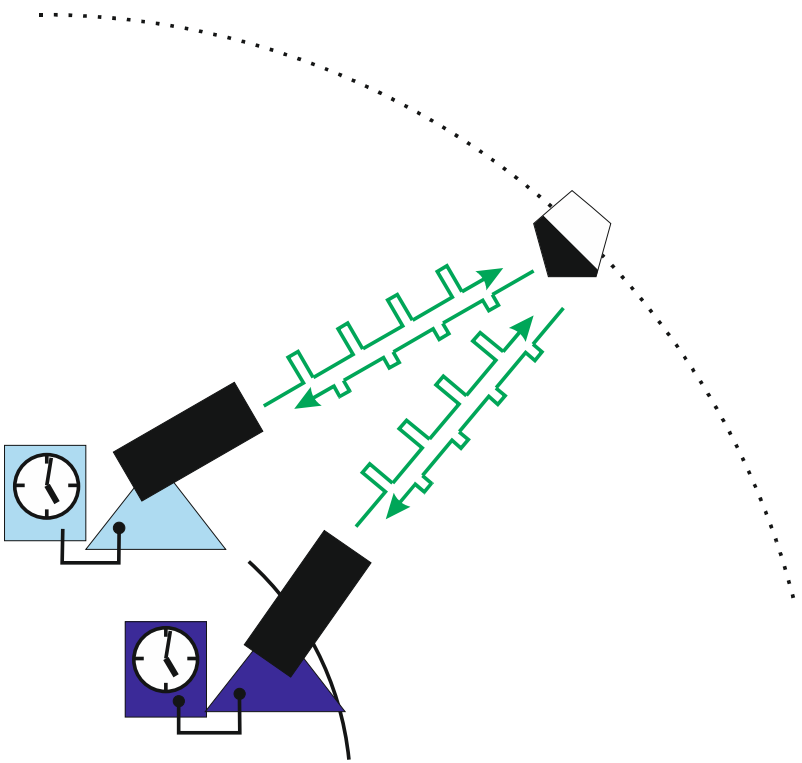


See poster

Christoph Bamann

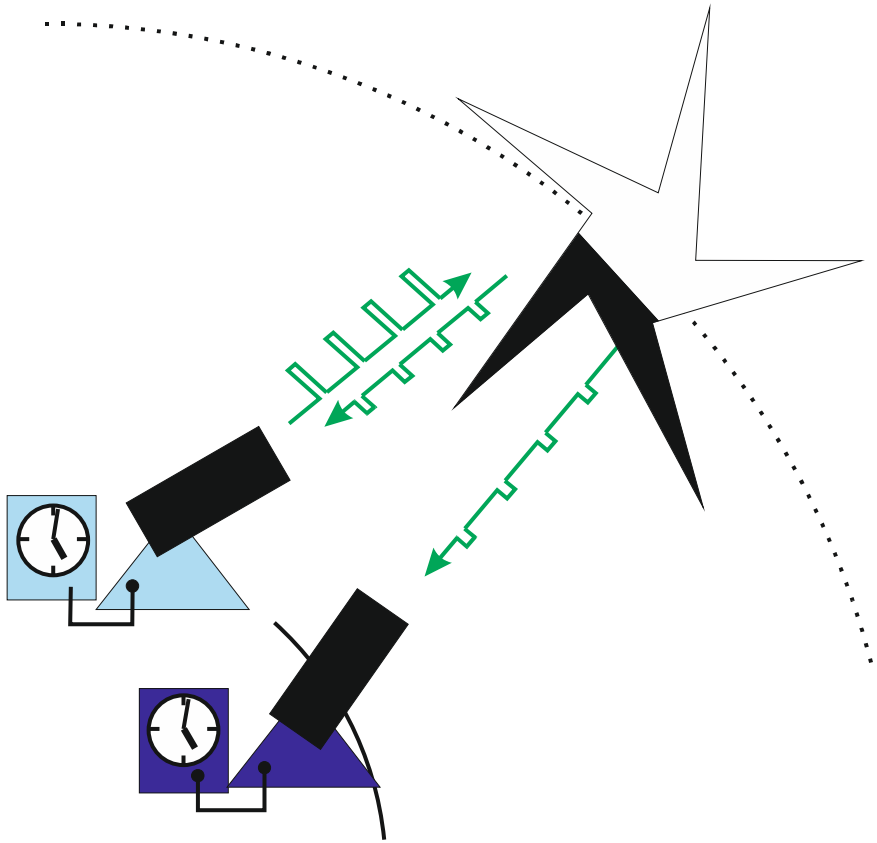
Transporting time information

Combined two-way, multistatic



-> time offset and drift of maser

multi-static



-> implement time information

Consider to buy a maser now and be part of ELT!

Thank you very much!