R&D @LPNHE on HK time synchronization

« Internal » synchronization : atomic clock

« External » synchronization : GNSS

Data acquisition (all PMTs front-ends)

Local time reference point

Universal (reference) time e.g.: UTC

SNEWS

J-PARC

Need for time precision and synchronization :

- **Cherenkov ring reconstruction by PMTs signal coincidence**
- **Trigger from J-PARC for beam neutrinos**
- **Timing of astrophysical neutrinos (supernova) for triangulation with other experiments**

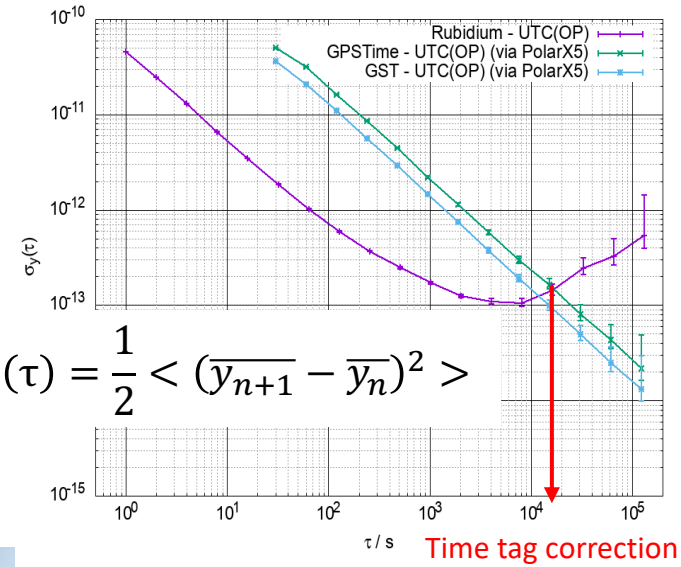
Caracterization at Syrte :

- Rubidium FS725
- Antenna + PolarX5 receiver

→ Against UTP OP reference clock

- Data : Δt *between pps of DUS and reference clock*

→ Allan standard deviation to quantify time stability at various time scales

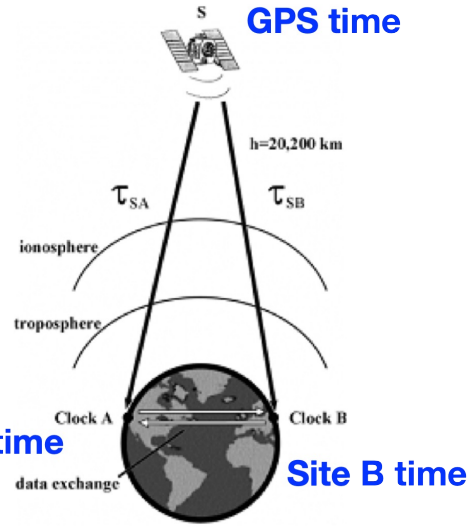


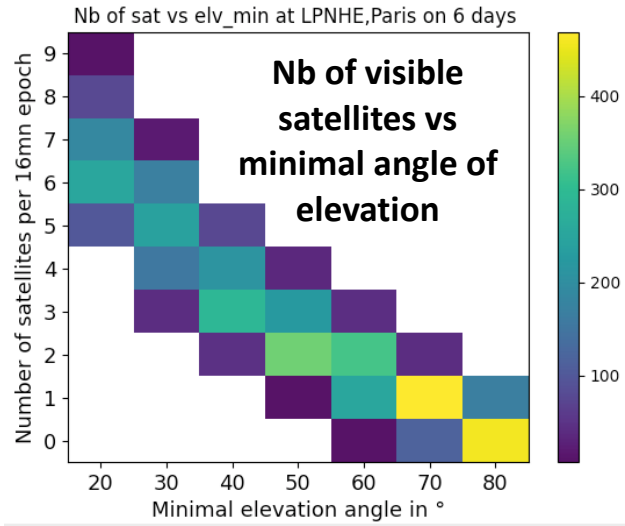
$$\sigma_y^2(\tau) = \frac{1}{2} < (\overline{y_{n+1}} - \overline{y_n})^2 >$$

Time tag correction

Measurement at LPNHE

- **1pps + 10MHz from Syrte reference clock (UTC OP) through White Rabbit (WR) link**
- **Time interval counter → Δt *clock -WR***
- **Receiver → CGGTTS files → Δt with GPS time and/or common view**





Time transfer common view technique

Site A CGGTTS data : GPS Time – SiteA Time = $\Delta t_{GPS-A} = \tau_{SA}$
Site B CGGTTS data : GPS Time – SiteB Time = $\Delta t_{GPS-B} = \tau_{SB}$
Time transfer software computes $\tau_{SA} - \tau_{SB}$
If site B is the reference time keeper : → $\tau_{SA} - \tau_{SB} = \Delta t_{site\ A}$