



CHALMERS

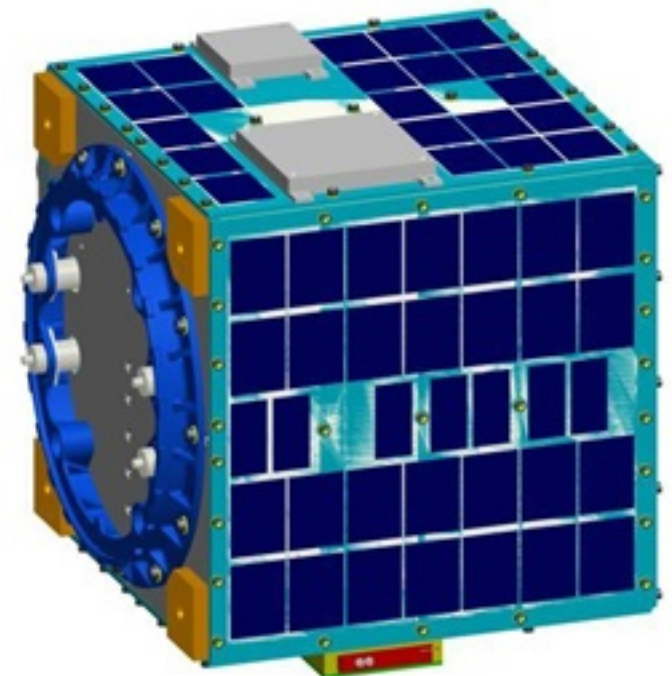


First VLBI observations of the APOD satellite on the Onsala–Wettzell baseline

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The APOD satellite

- Prototype of a geodetic co-location satellite
- SLR reflectors, GNSS receivers, S/X VLBI sender
- circular high-inclination orbit (97 deg)
- Low earth orbit (450 km)
- Launched in 2015
- Frequencies:
 - 5 DOR tones in X-band
 - 5 DOR tones in S-band



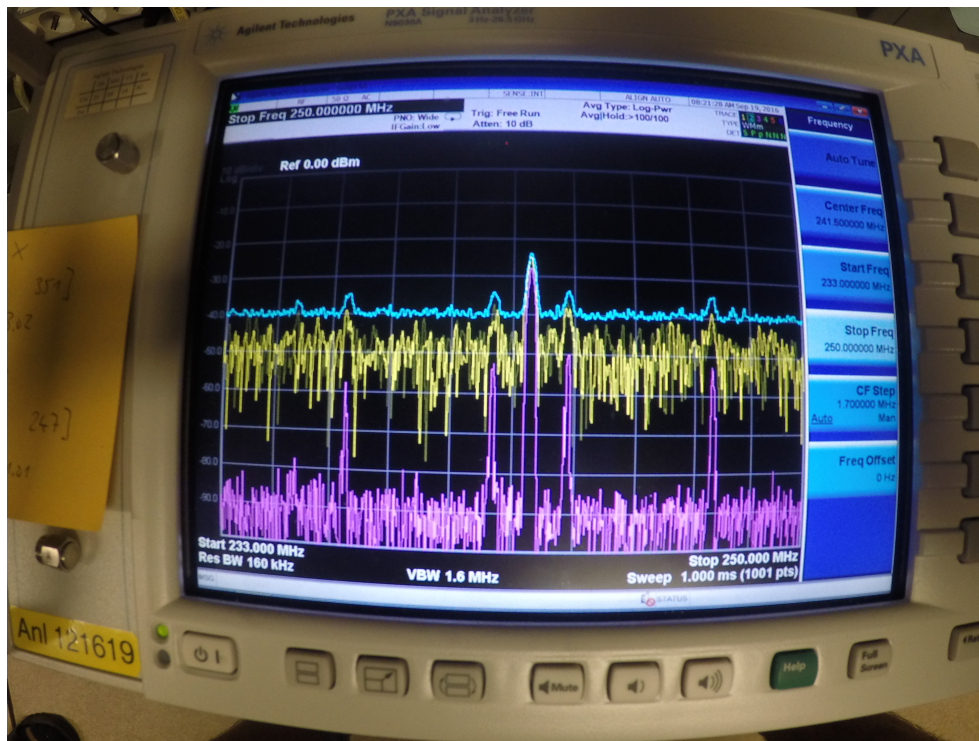
The APOD S/X sender

- S-Band:
 - 2256.87 MHz
 - 2260.98 MHz
 - 2262.01 MHz
 - 2263.04 MHz
 - 2267.15 MHz
- X-Band:
 - 8404.87 MHz
 - 8420.19 MHz
 - 8424.02 MHz
 - 8427.85 MHz
 - 8431.66 MHz

Signal transmission needs to be "ordered", i.e. arranged at least one day ahead of time

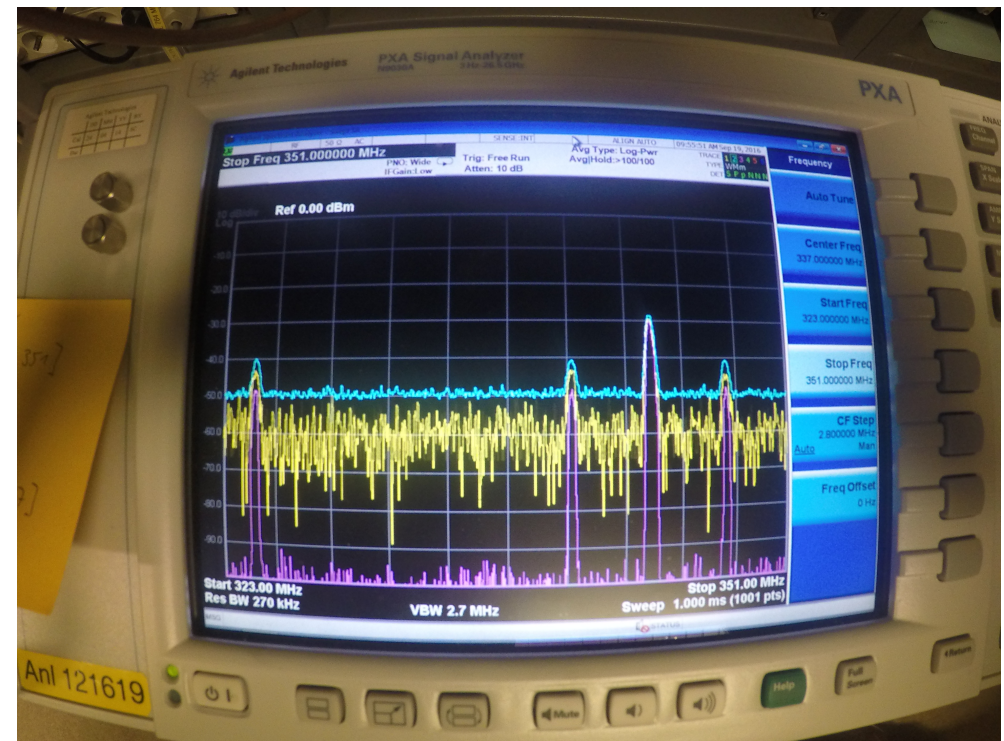
The APOD S/X signals

- S-Band:



- Onsala: downconverted with 2020 MHz

- X-Band:



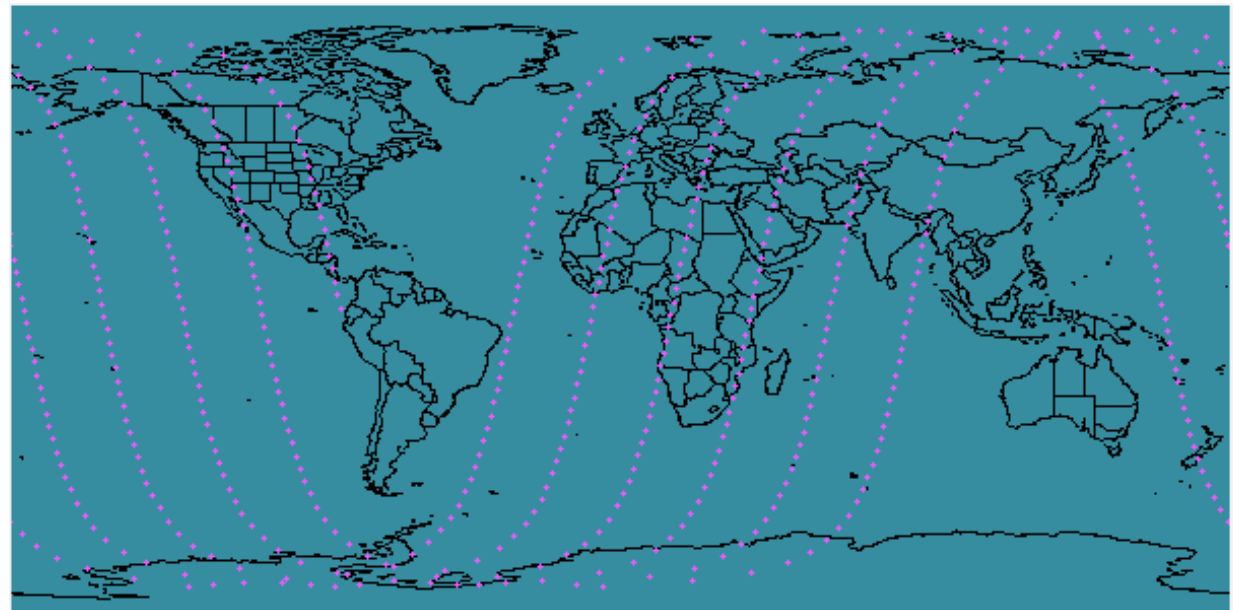
- Onsala: downconverted with 8080 MHz

The APOD signals



The APOD ground track

- Ground track causes visibility constraints:
 - Short visibility times (5 – 10 min)
 - Few stations can see the satellite simultaneously
 - Predominately North-South track

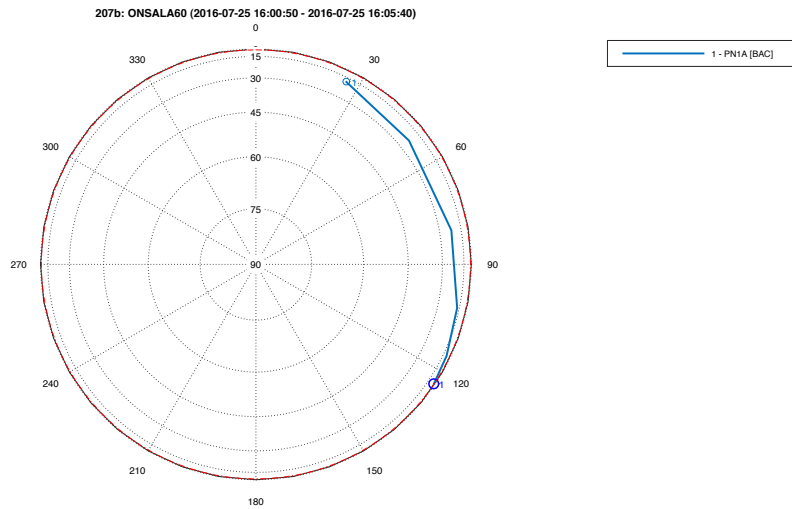


Observations

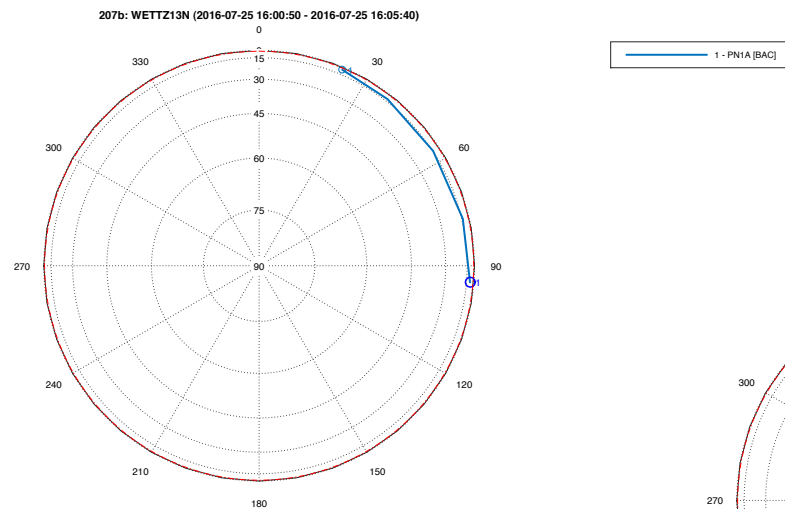
- Telescopes need to be rather fast-slewing
 - About 2–3 deg/s in az/el required
 - TLE-tracking from the ACU preferred (works with WETTZELL 20 m and WETTZ13N)
- Problem at Onsala 20 m: no TLE tracking possible, instead kinematic 1 s updates to follow satellite track
- Test observations with On – Wz – Wn
 - DOY207, 25 July 2016
 - DOY263, 19 September 2016

Observations AP207b

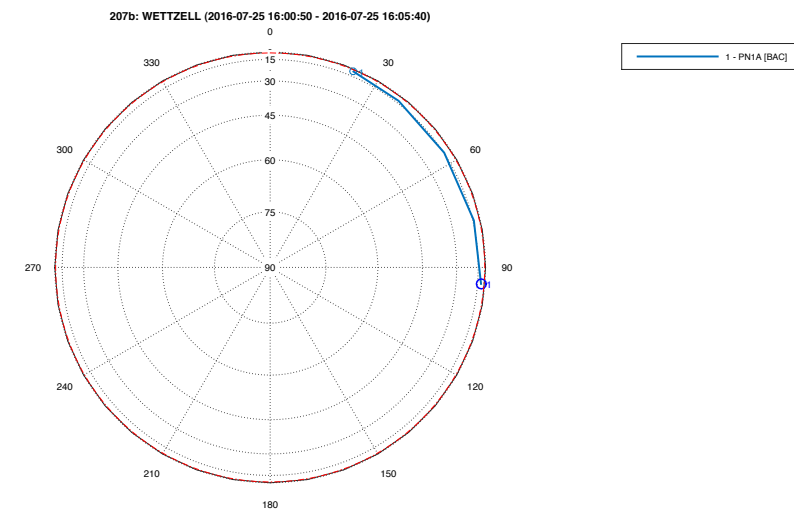
On



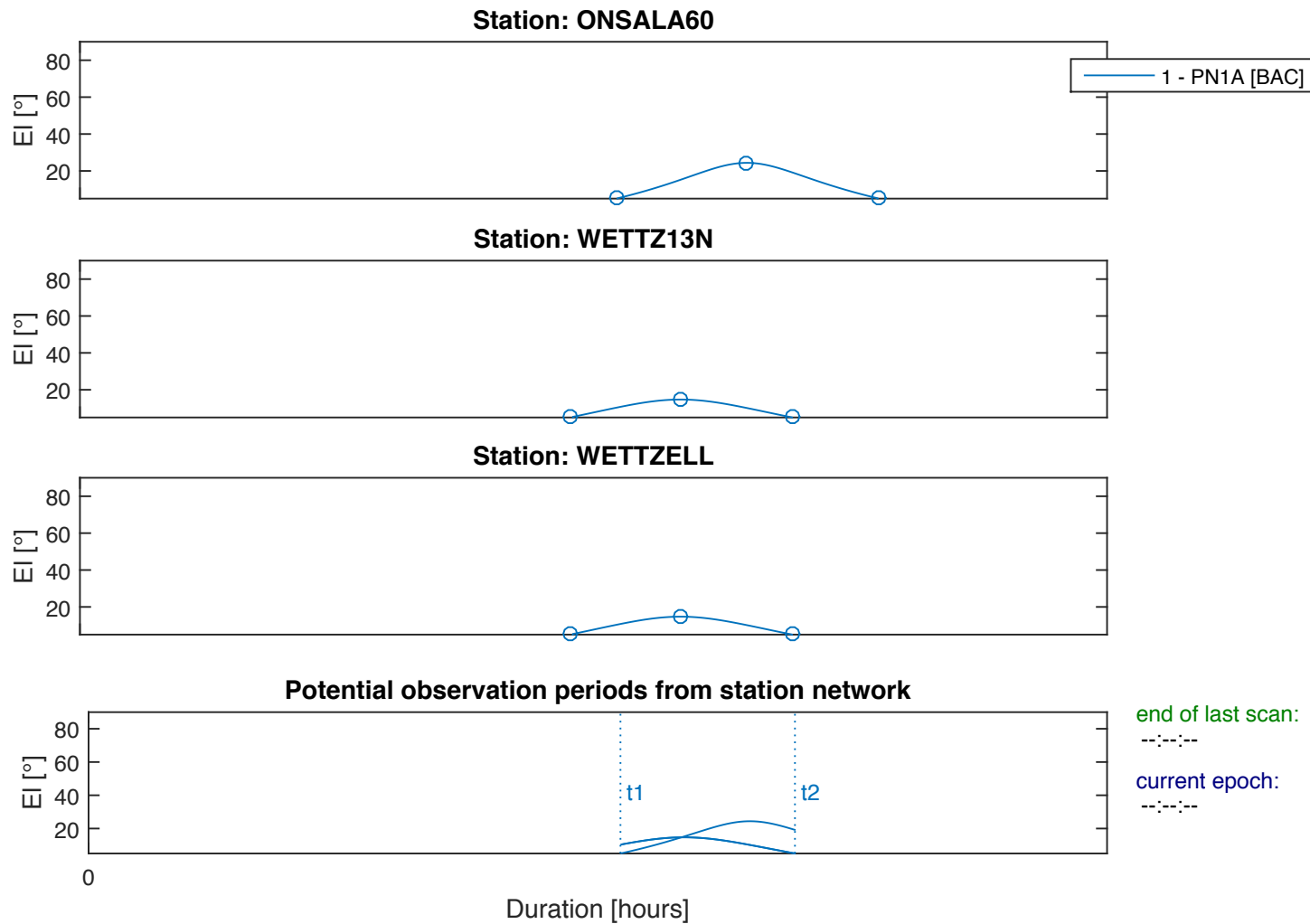
Wn



Wz



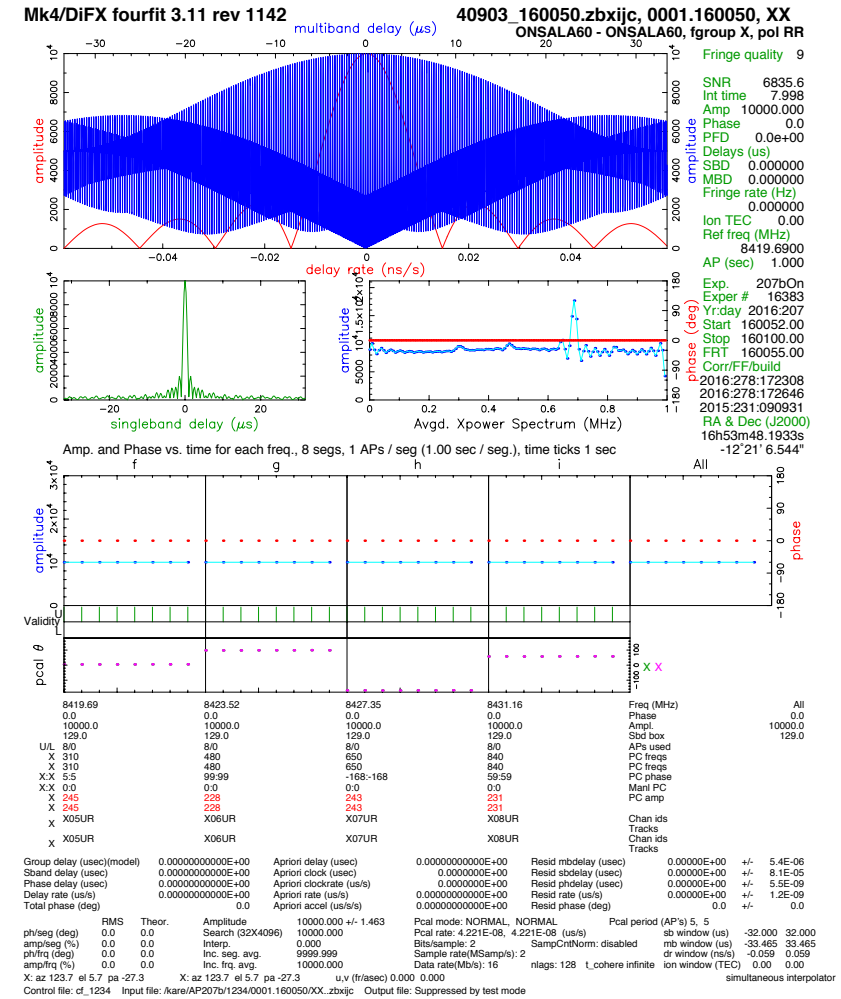
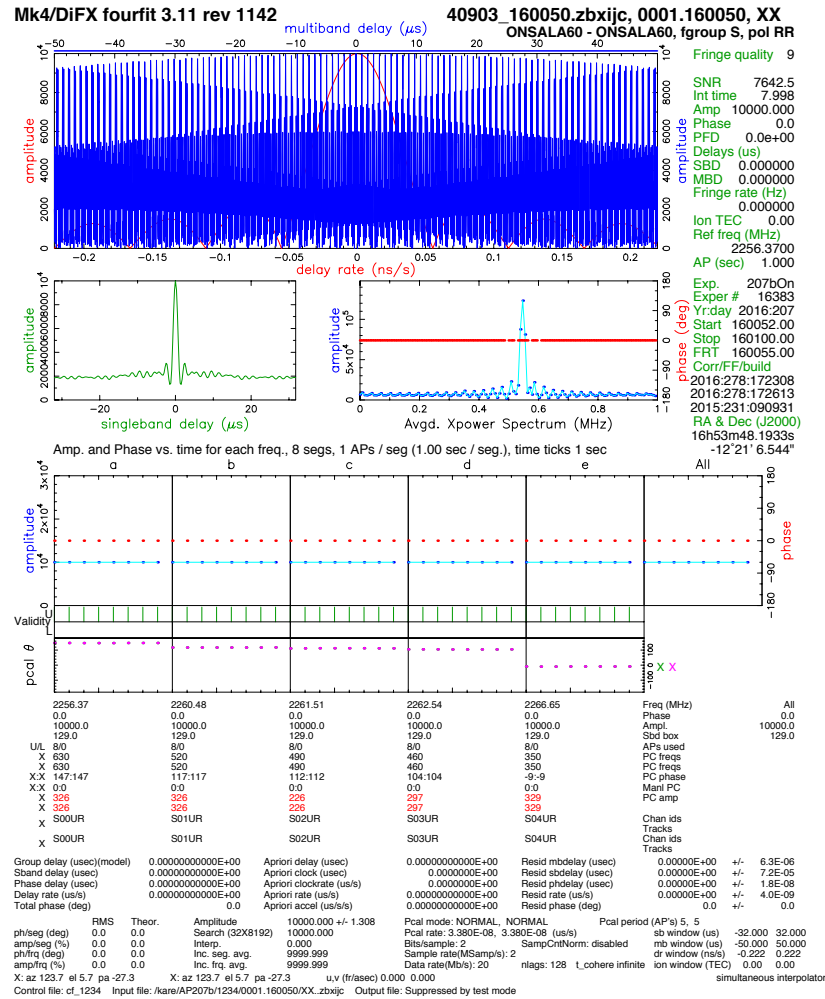
Observations AP207b



AP207b

- WETTZELL: problem with tracks allocation
- WETTZ13N: recording problems, not all data recorded
- ONSALA60: potential problem due to kinematic step-wise tracking
- So far only auto-correlation

Auto-Correlation AP207b On



[illegible]

AP263b and AP263c

- WETTZELL: potential problem with track allocation in VEX-file again
- ONSALA60: “shooting ahead” tracking this time
- Data not correlated yet

Conclusions

- Several attempts to perform S/X observation of the APOD satellite on the baseline Onsala–Wettzell
- Difficulties due to high satellite speed:
 - Short visibility and thus observation times
 - Kinematic tracking at Onsala where TLE-tracking is not implemented yet
- Signals were detected at all participating stations
- Some problems in vex files, e.g. track allocation

Outlook

- Observations:
 - Further test experiments planned with Onsala and Wettzell, maybe include further stations along North-South direction (Ny-Ålesund, Medicina?)
- Correlation:
 - DiFX using a priori delays from the near-field model APP in c5++
- Analysis:
 - Aim: Preparing VGOSDB and geodetic VLBI data analysis software c5++