



Leibniz-Institut für  
Astrophysik Potsdam

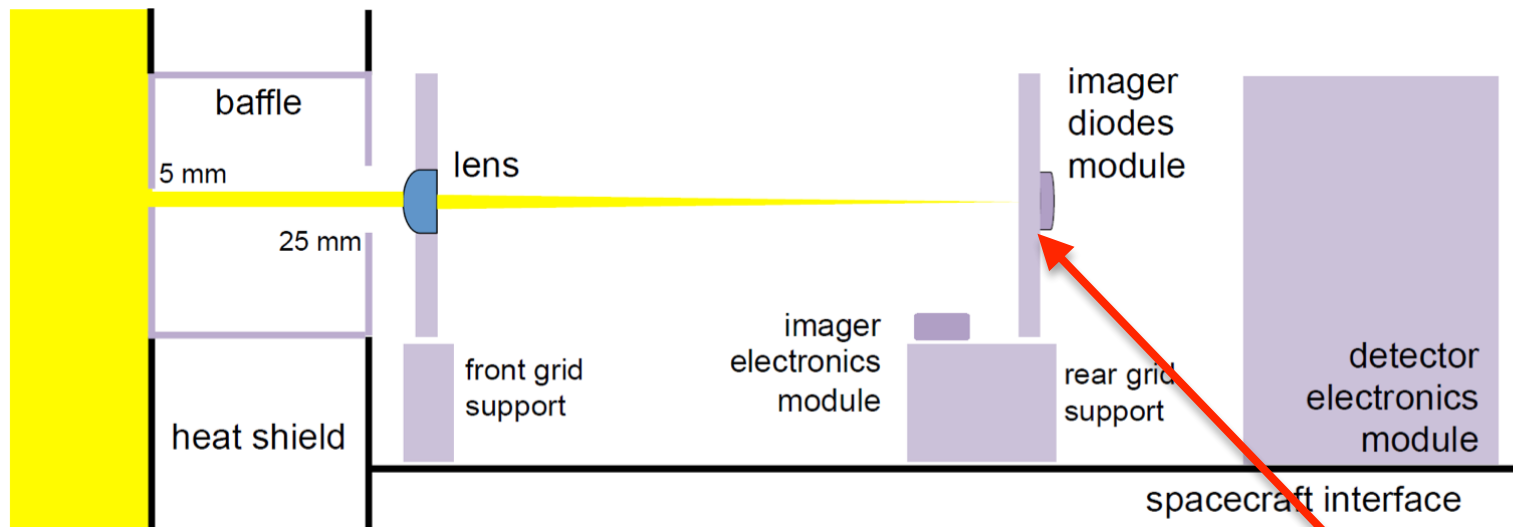


# The STIX Aspect System

## Instrument design, operations, and first results

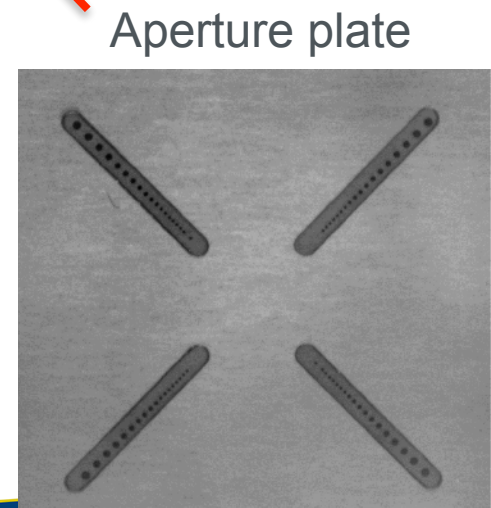
Frédéric Schuller, A. Warmuth, G. Mann, V. S. Pavai,  
E. Dickson, G. Hurford, S. Krucker

# The STIX Aspect System (SAS)

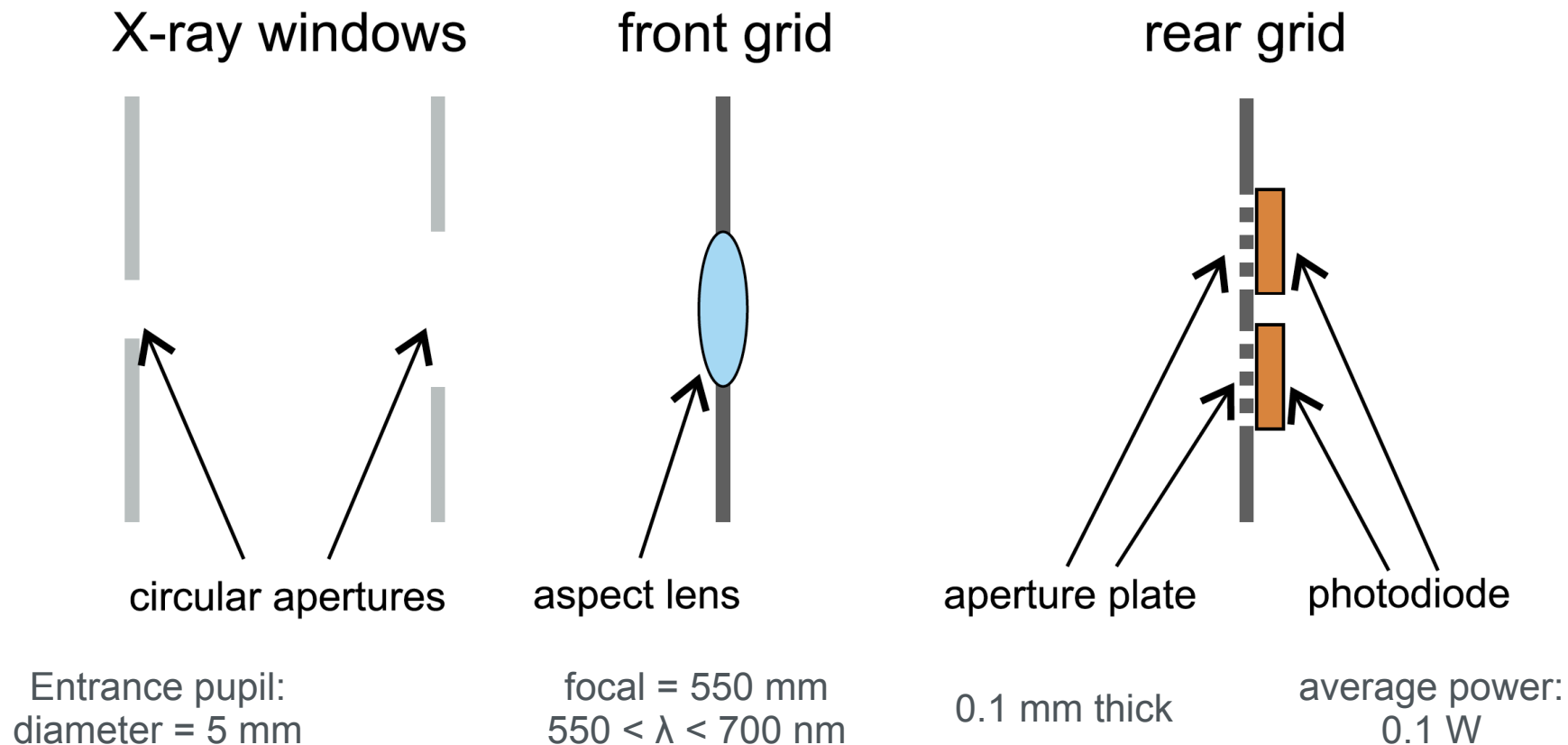


- Goal: provide pointing information on 4" level
- 4 photodiodes → 4 signals
- changing solar diameter and off-pointing modify output → aspect solution

(Warmuth et al. 2020, Sol. Phys. 295, 90)



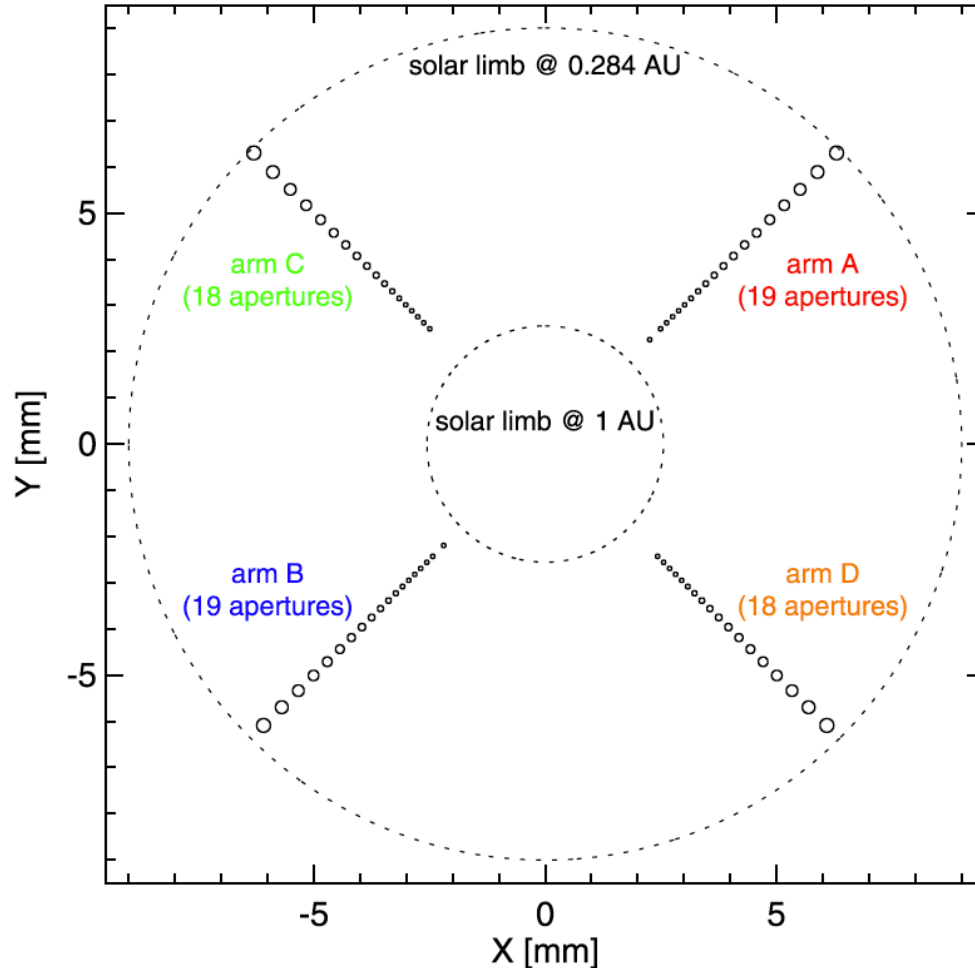
# SAS: Main elements



(Warmuth et al. 2020, Sol. Phys. 295, 90)

# SAS: aperture plate

aperture geometry (as seen from detector)



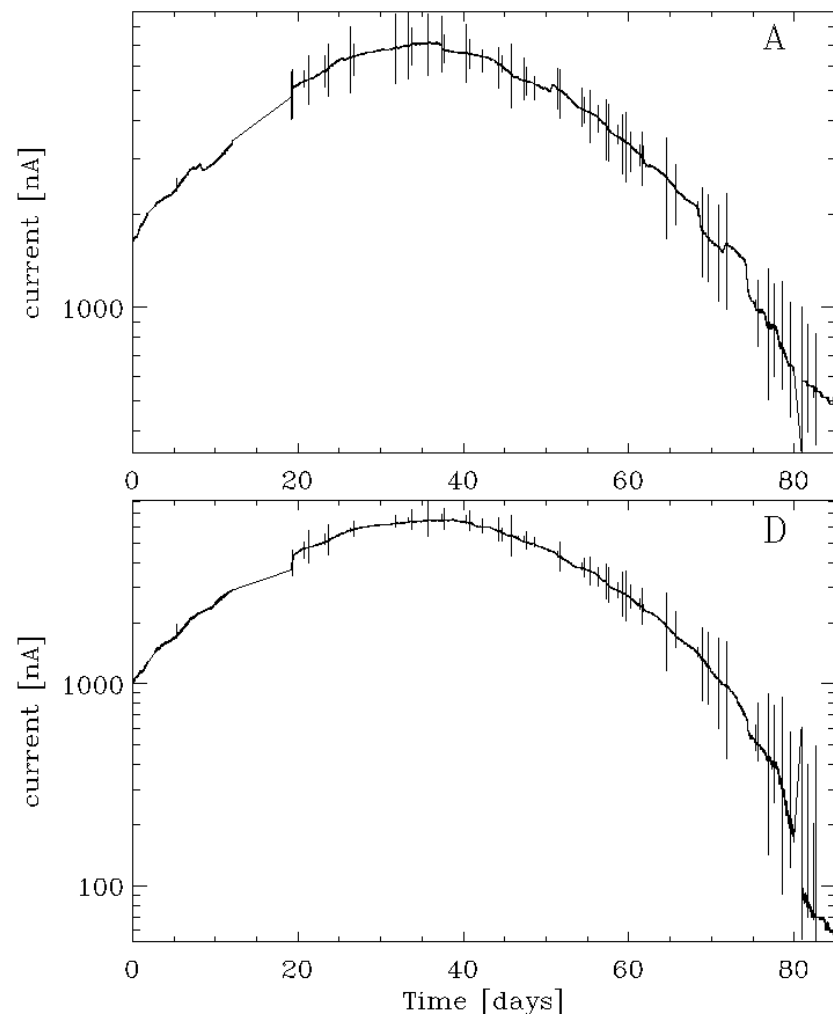
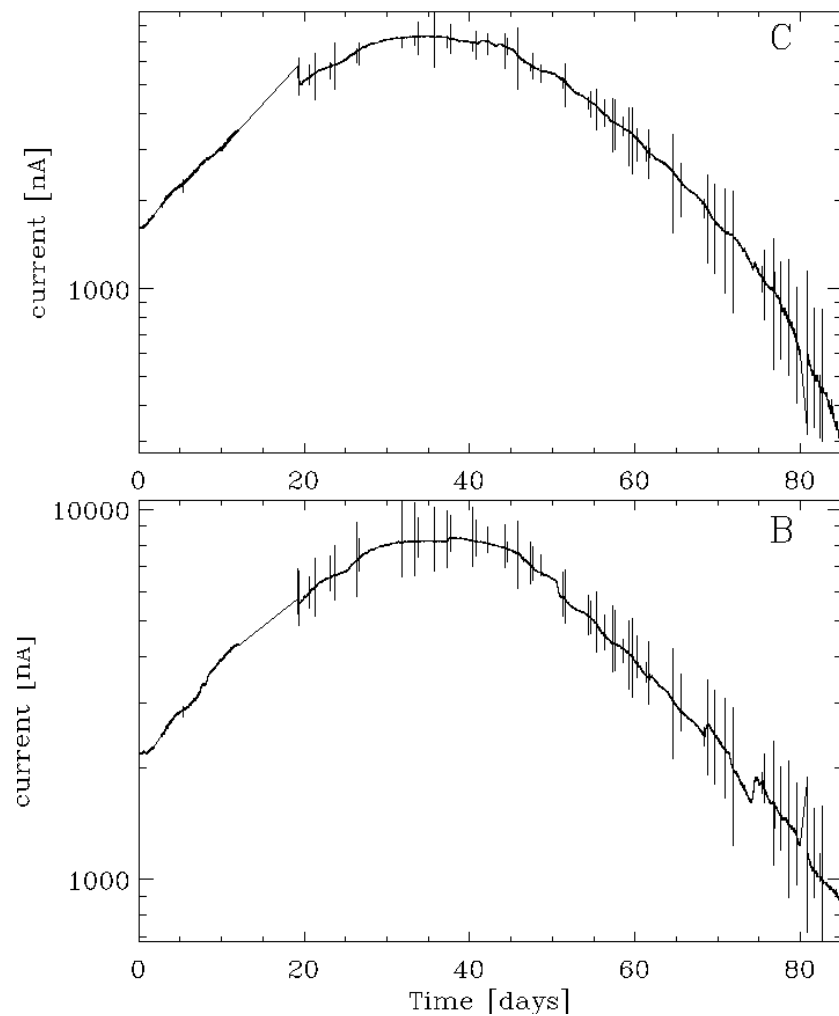
- Apertures: 90 to 300  $\mu\text{m}$
- Plate scale:  $0.375''/\mu\text{m}$   
 $4'' \Leftrightarrow 10.7 \mu\text{m}$
- Innermost apertures:  
 3.1 to 3.5 mm  
 $\Rightarrow \text{max } d_{\text{hel}} \sim 0.8 \text{ AU}$

(Warmuth et al. 2020, Sol. Phys. 295, 90)

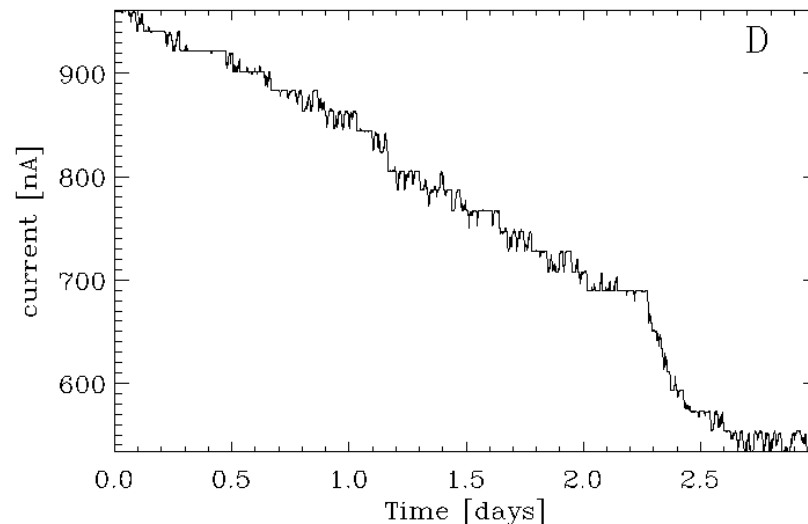
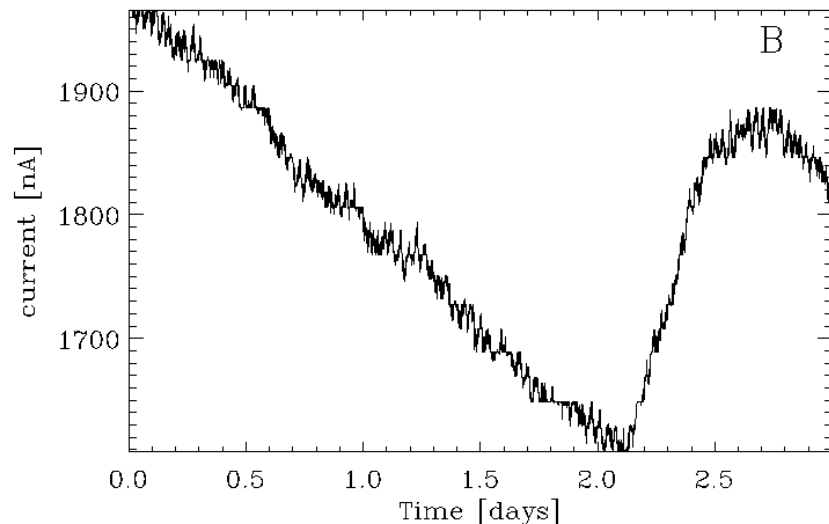
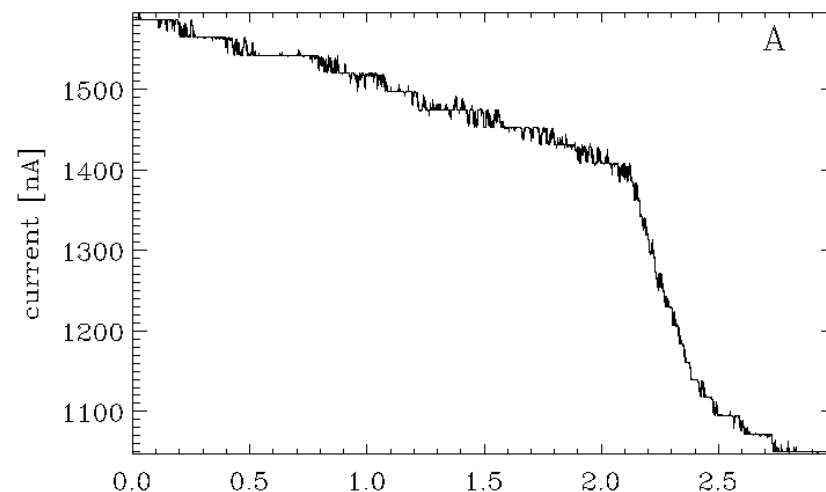
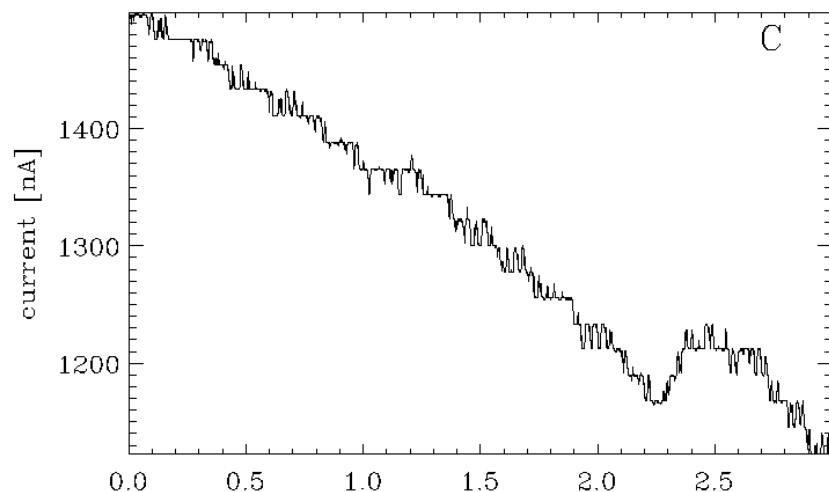
# Data acquisition

- Signals (= voltages) from the 4 arms recorded at 1 kHz
- 16 (by default) values accumulated every 16 ms
- Two modes of operation:
  - ▶ **Regular:**
    - one set of measurements transferred to house-keeping (HK) data stream every 64 s
    - telemetry rate: 1 bit/s
    - HK data transferred to Earth ~every day
  - ▶ **Burst mode:**
    - retrieve data at full resolution (16 ms), or average to lower rate (up to 1.024 s) for some time range
      - 10 min. at full resolution (16 ms)  $\Rightarrow$  300 kB
      - 3.5 hr at 1s resolution  $\Rightarrow$  100 kB

# SAS signals: 2021 January to March

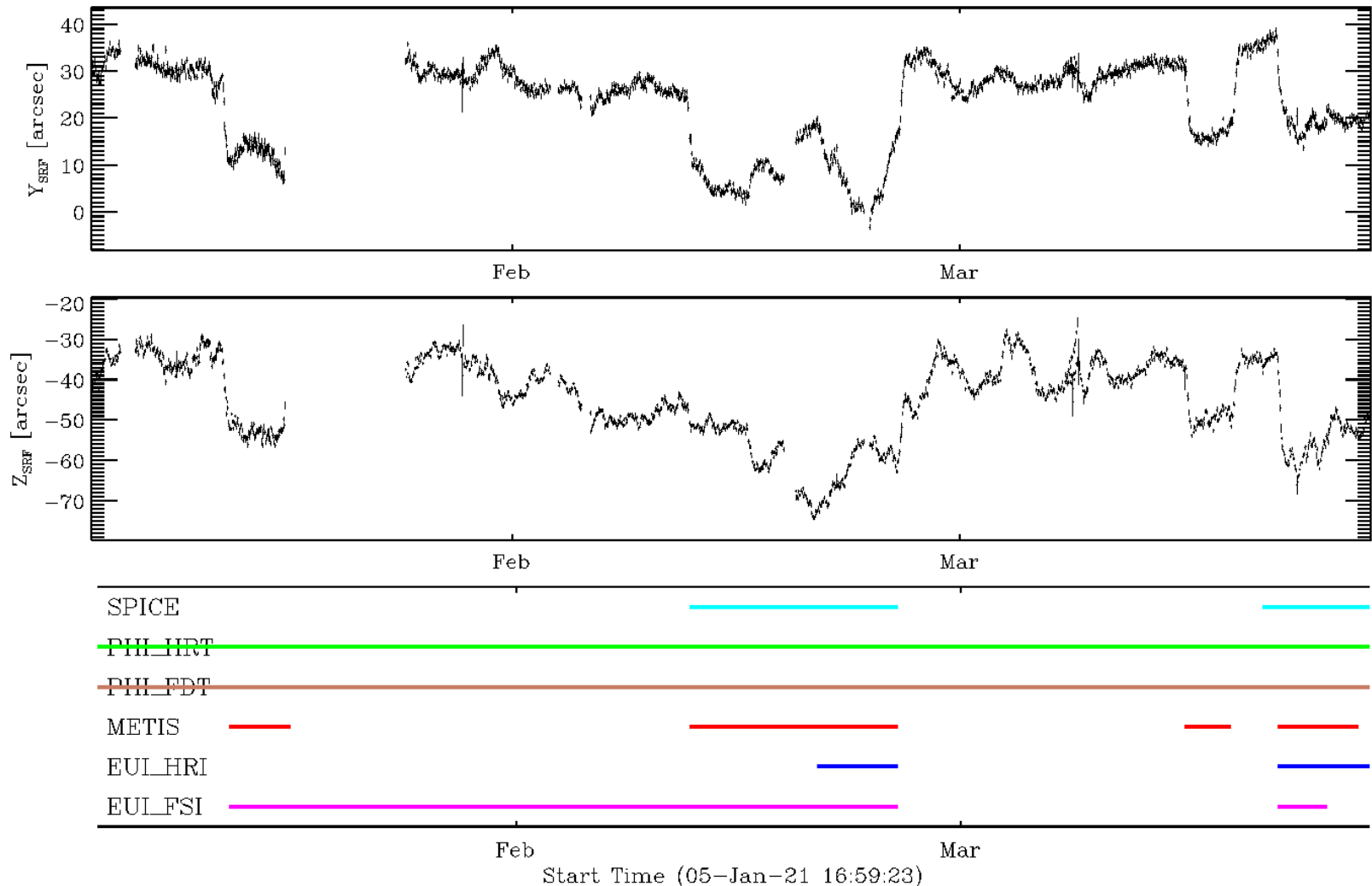


# SAS signals: 2021-03-18 to 03-21



# Pointing variations: Jan-Mar 2021

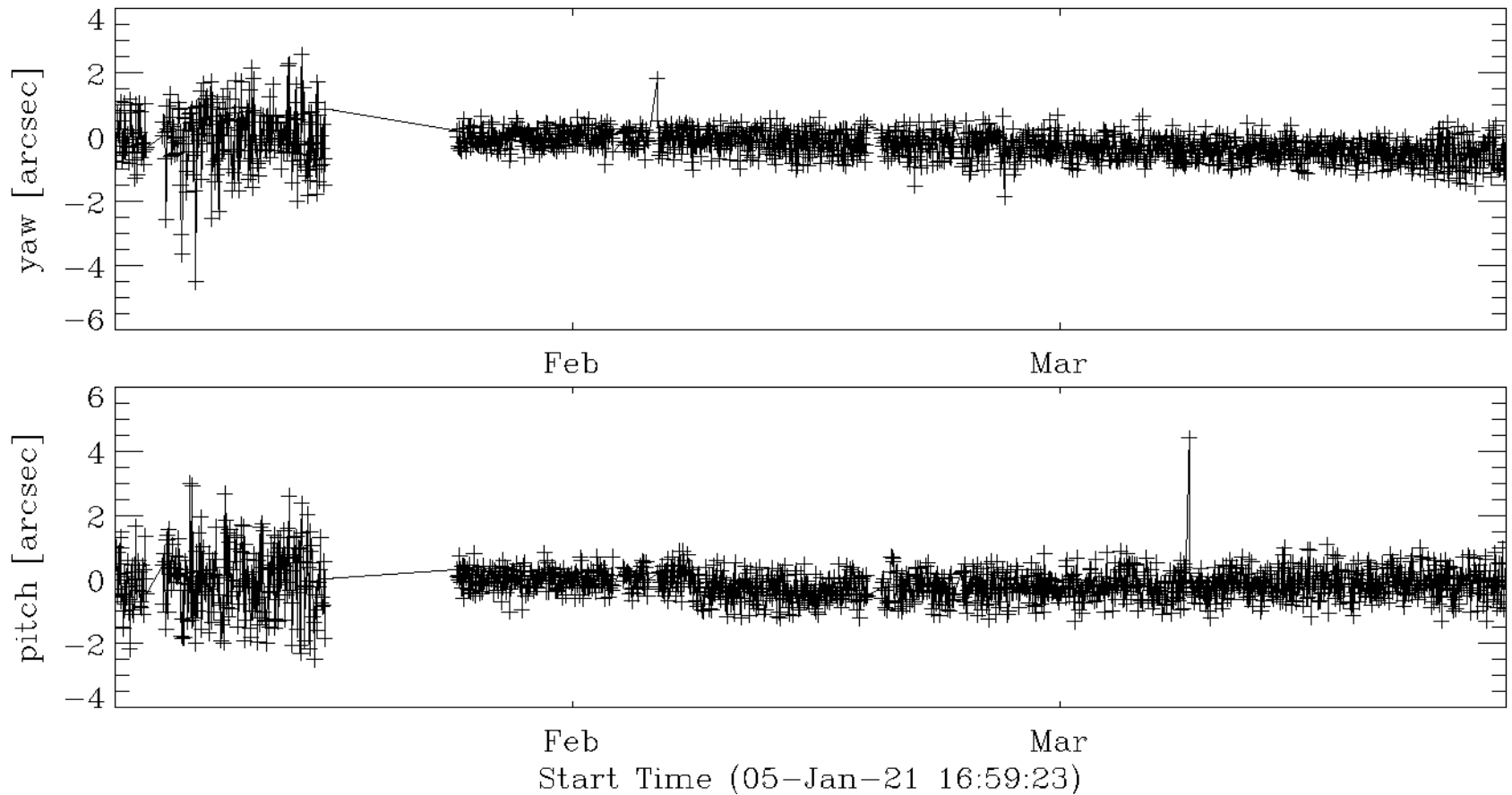
Aspect solution computed from regular HK data (64s) in 1hr bins





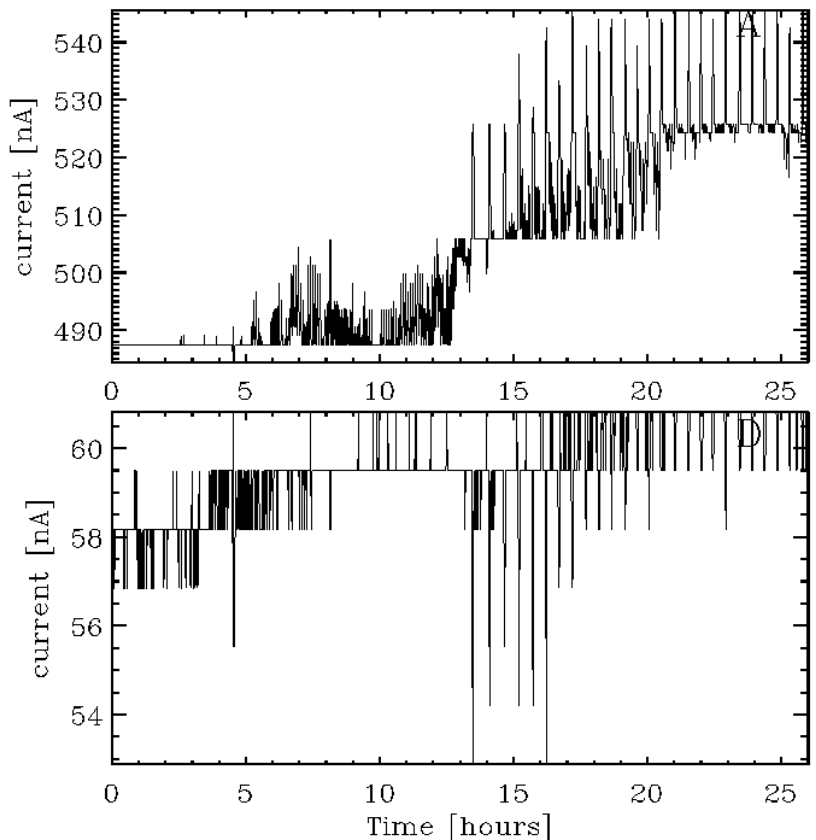
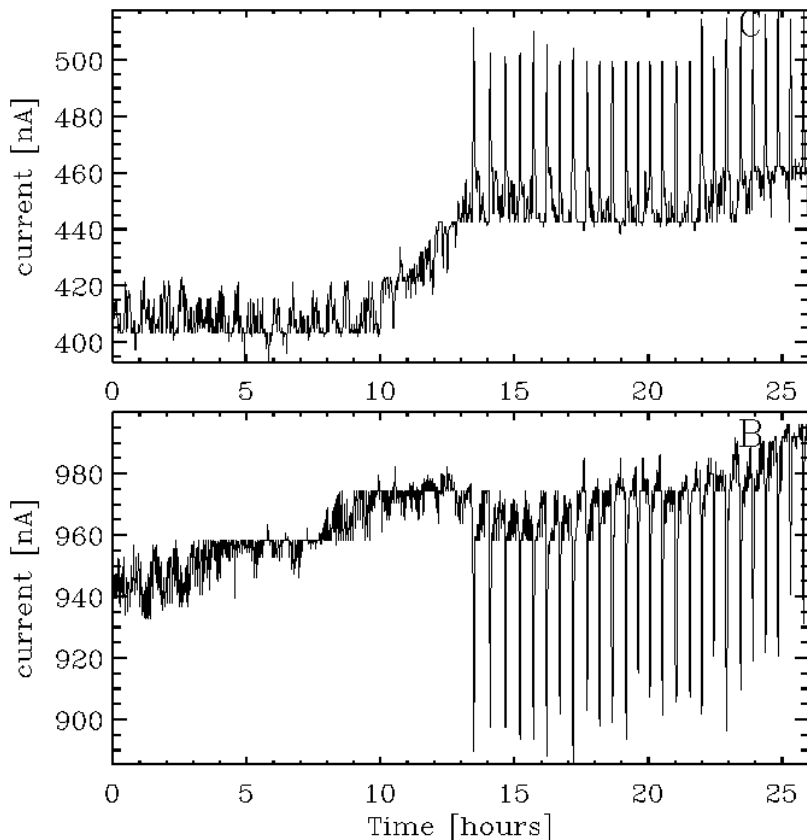
# Spacecraft attitude Jan-Mar 2021

(every 1hr, special manoeuvres filtered out)



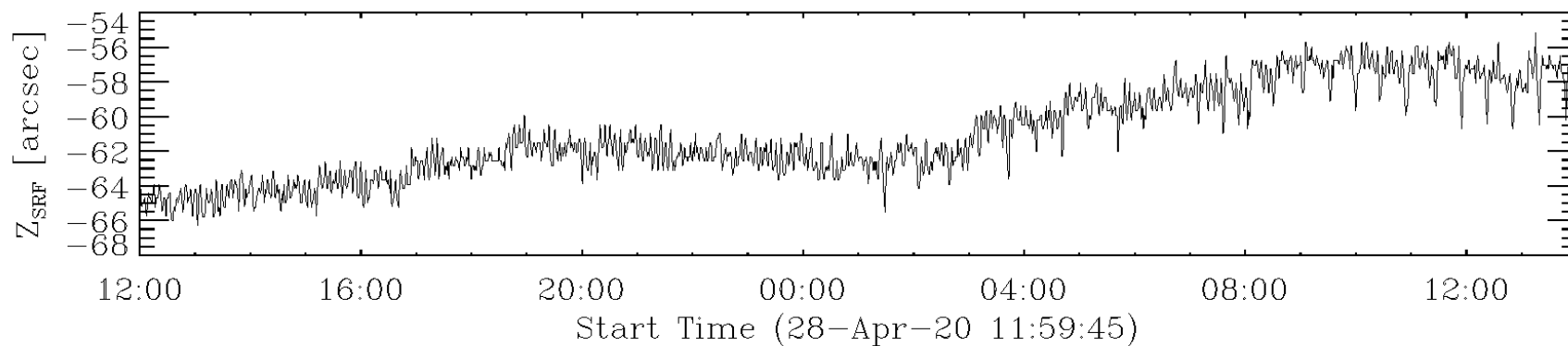
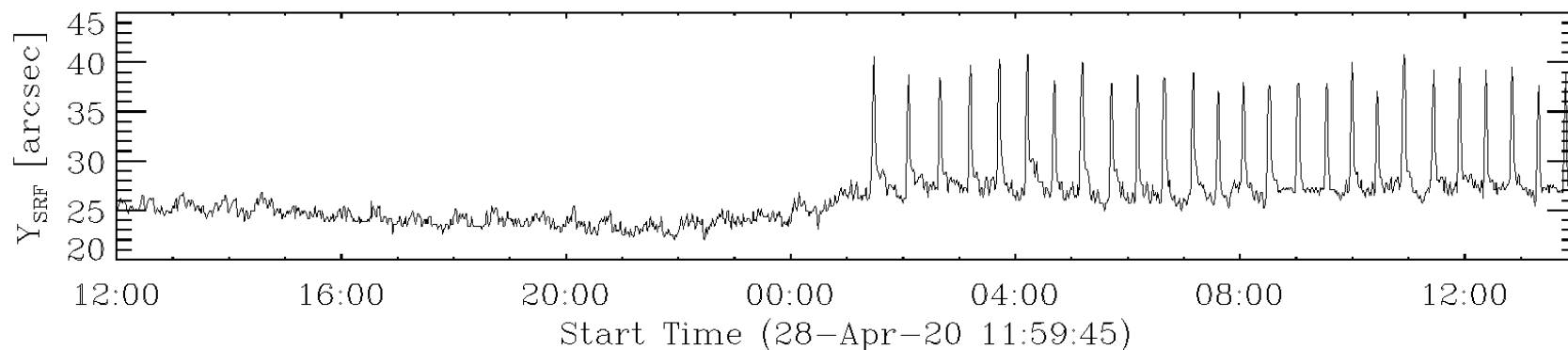
# Discovery of periodic deviations

- 2020-04-29: apparition of “spikes” with  $\sim 30$ -min. period in SAS signals



# Discovery of periodic deviations

- Interpretation: periodic deviations in pointing (mostly along Y)

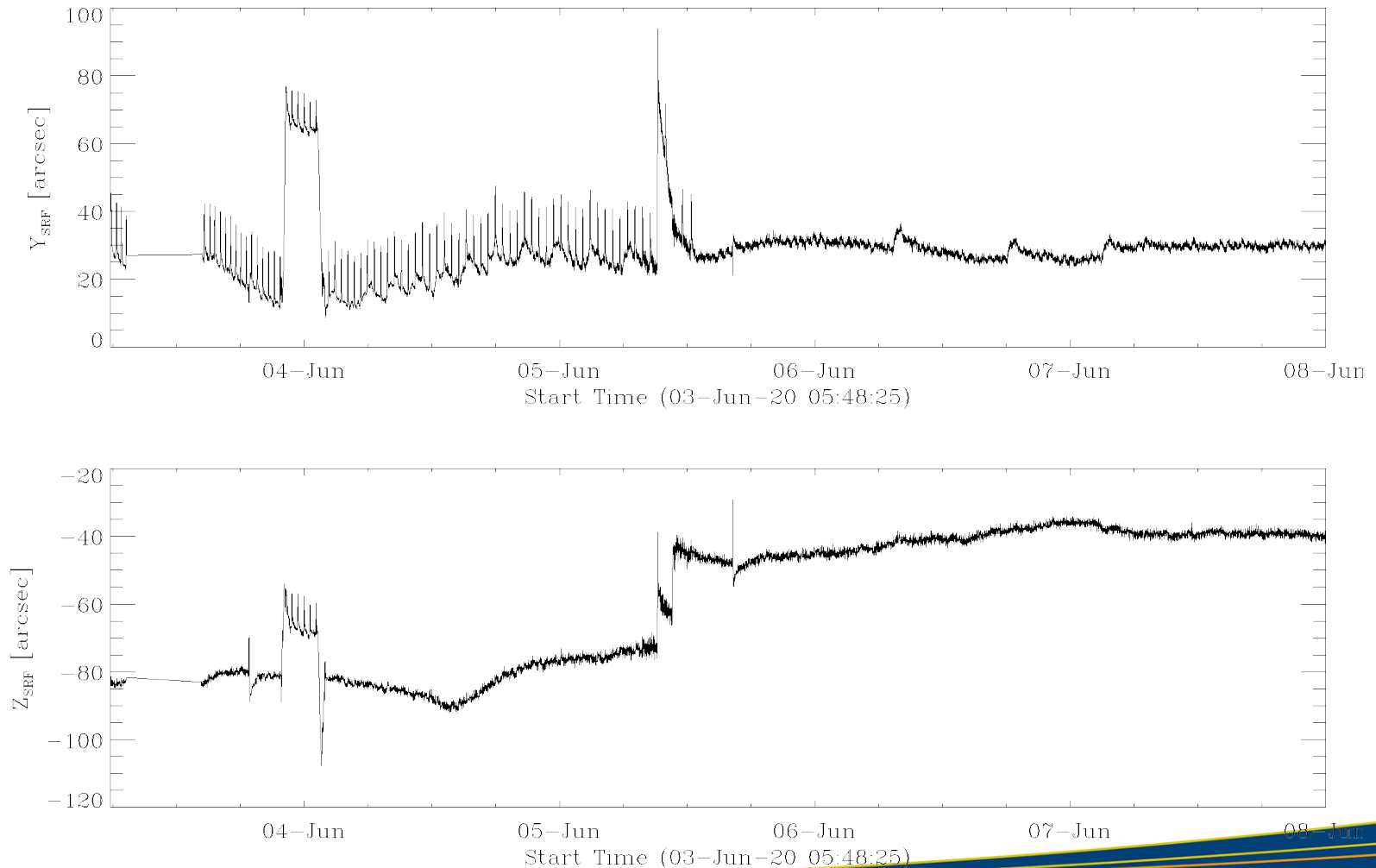


# Discovery of periodic deviations

- Periodic deviations ( $\sim 15''$ ) in pointing (mostly in Y)
- Also seen (but only once) with EUI
- Continuous measurements with SAS  $\Rightarrow$  periodicity
- After communication with ESA and Airbus, the root cause could be identified (heater cycling in IMU)
- Issue was fixed on 2020-06-05 (changed setting of heaters' set-points)
  - $\Rightarrow$  clear improvement in pointing stability !

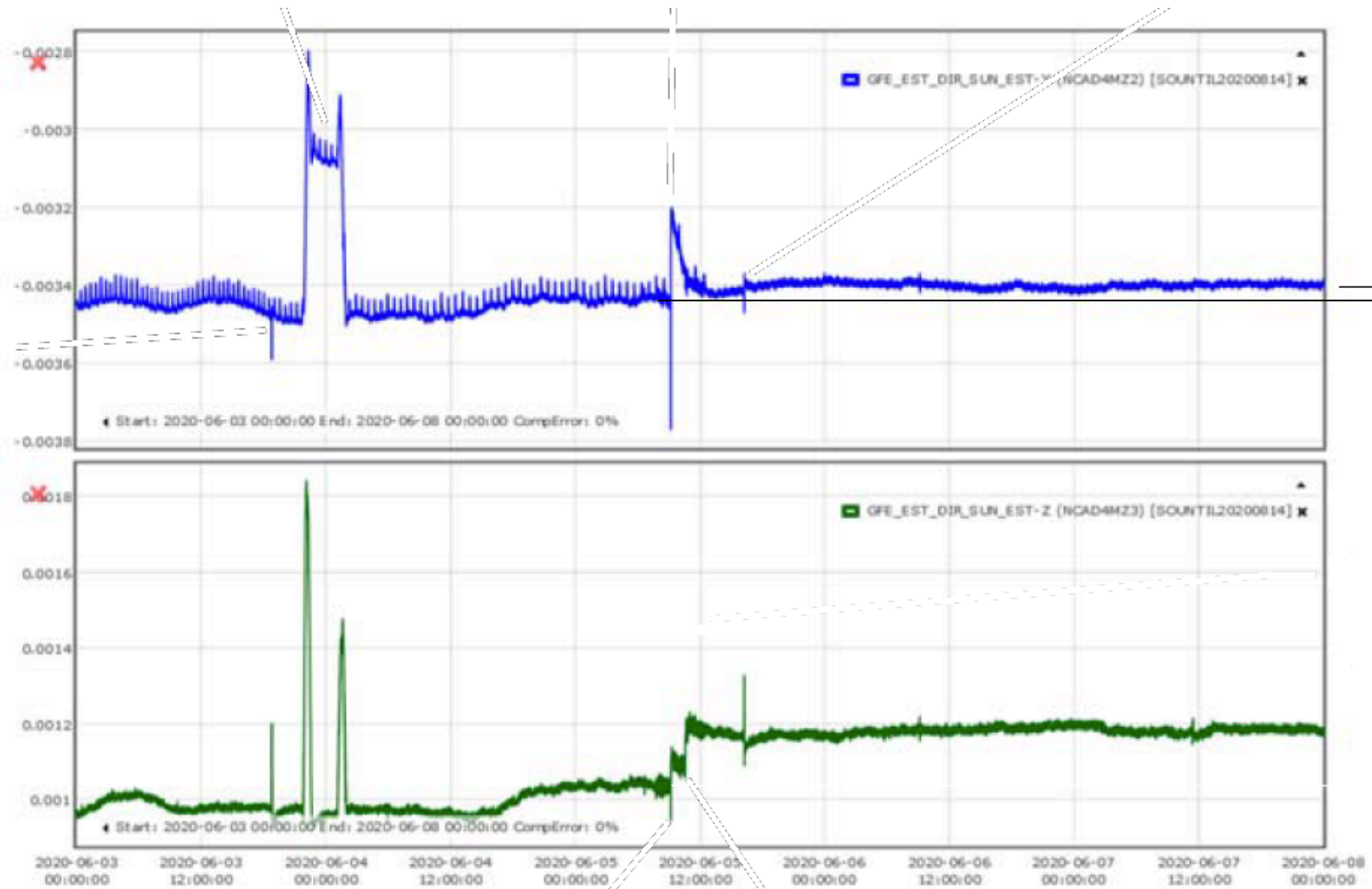
# Pointing drifts confirmed with other instruments

2020-06-03 to 06-08: pointing derived from our SAS



# Pointing drifts confirmed with other instruments

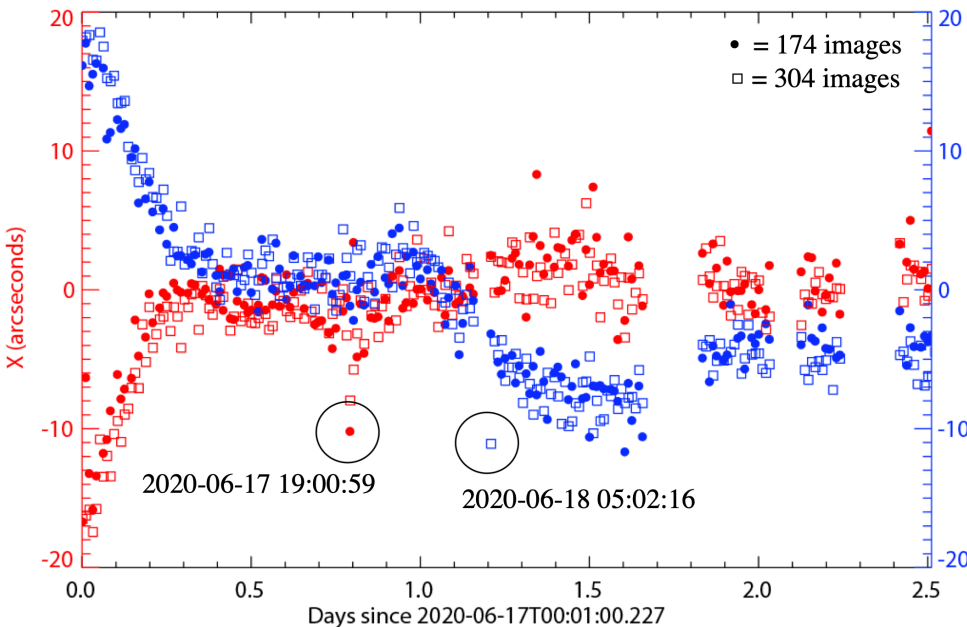
2020-06-03 to 06-08: pointing derived from Fine Sun Sensor



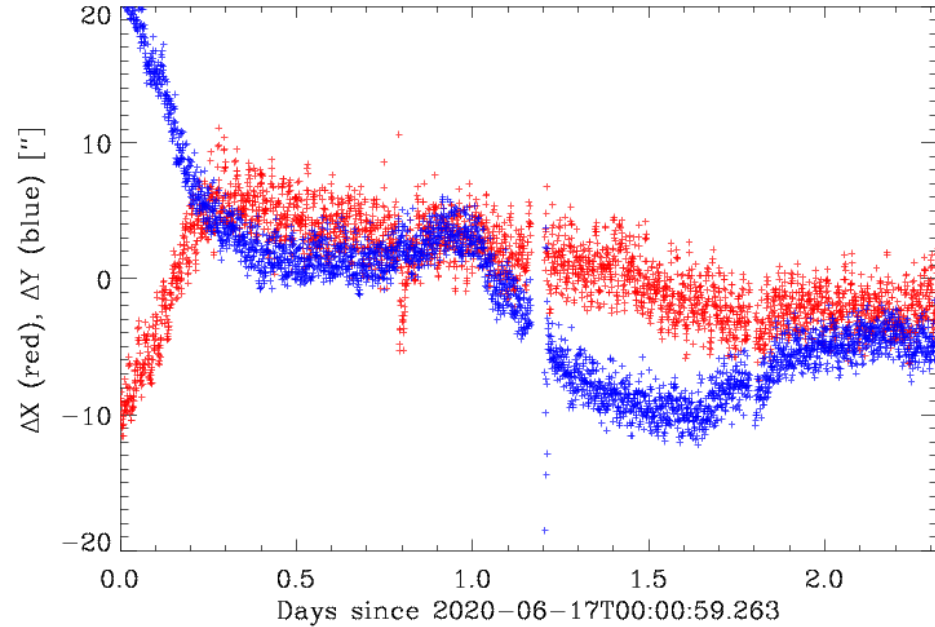
# Pointing drifts confirmed with other instruments

During RSCW 1: comparison with EUI

**EUI**

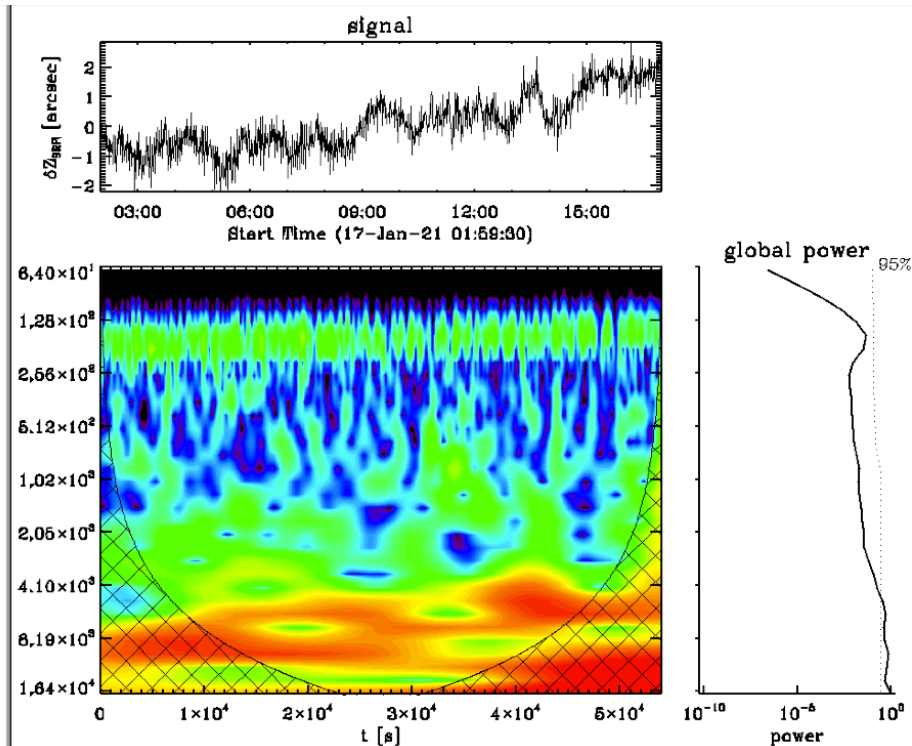
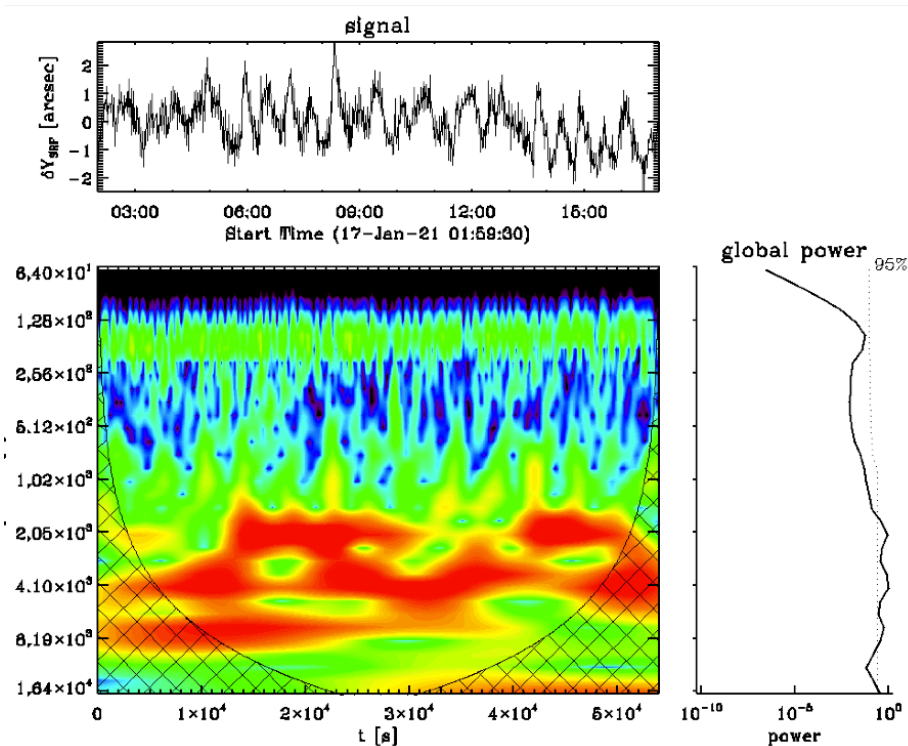


**STIX**



# Pointing stability: periodic features

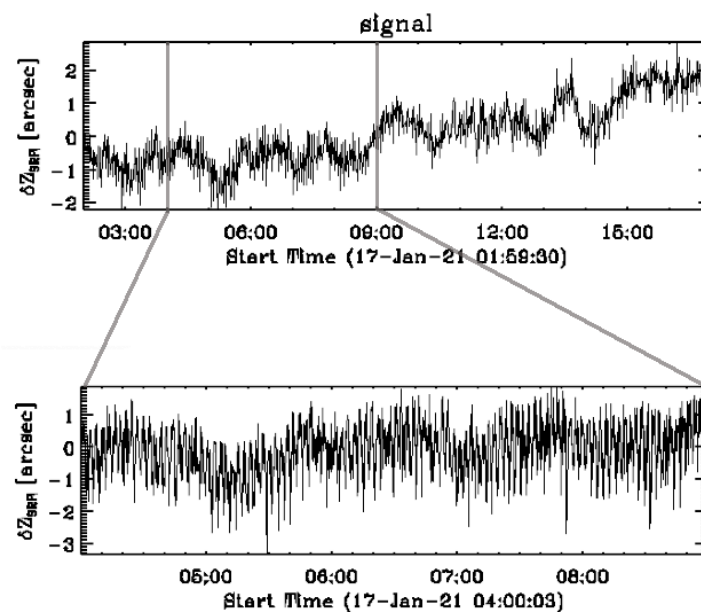
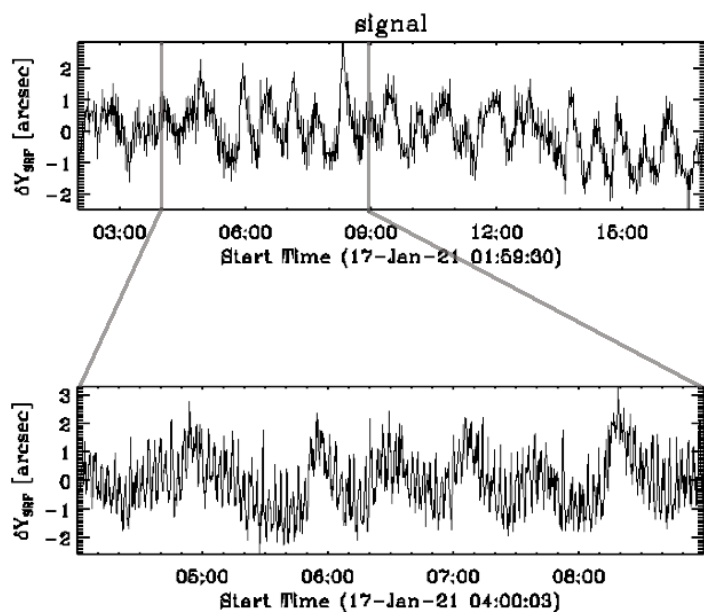
**2021-01-17** : Offsets derived from HK (64s) data





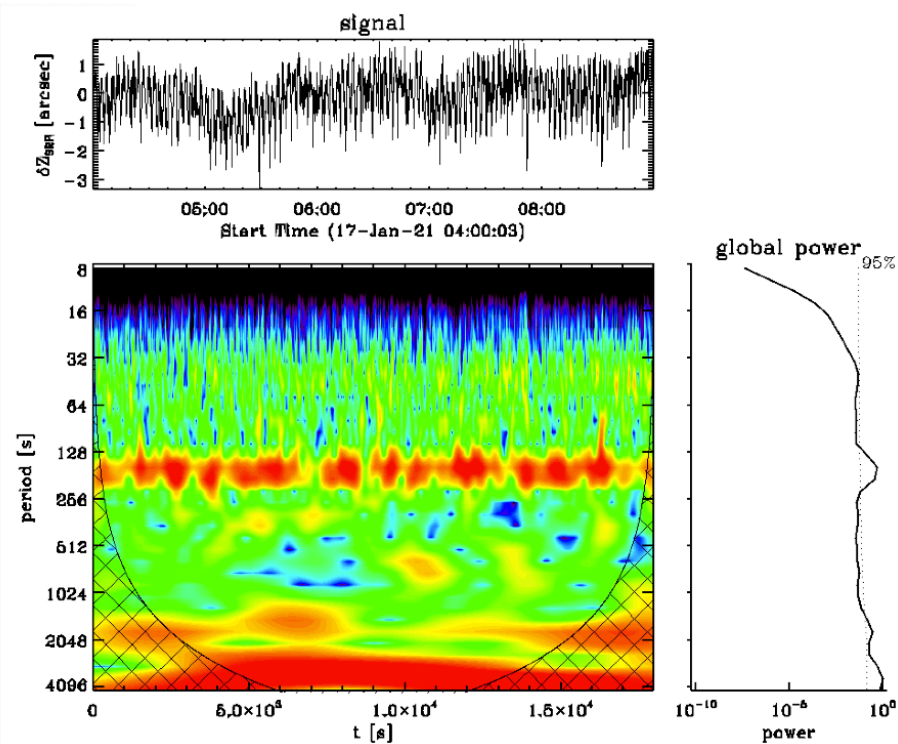
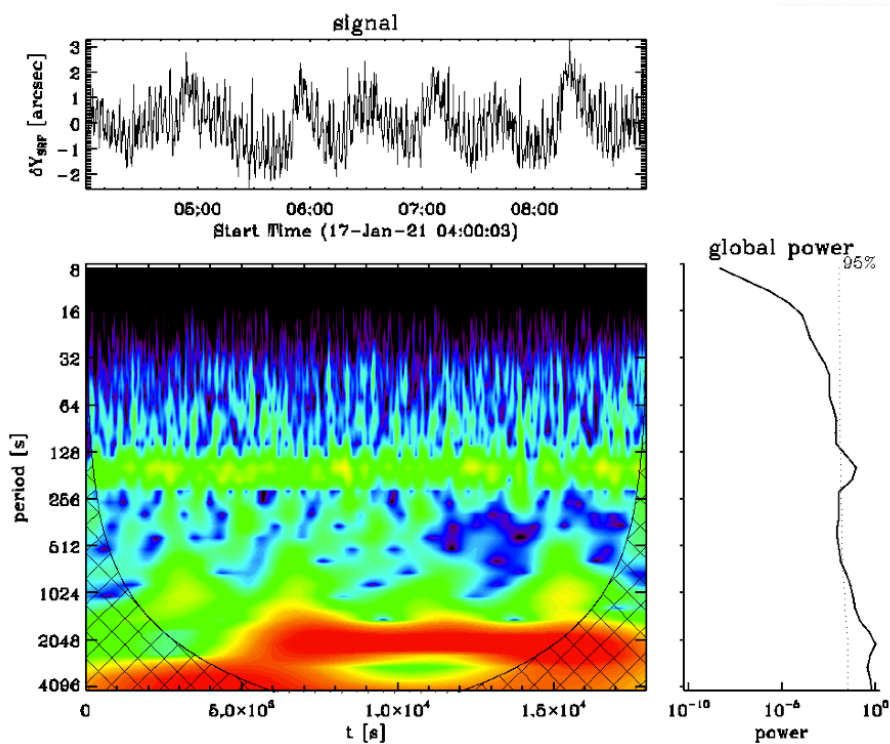
# Pointing stability: periodic features

2021-01-17 : 64s resolution  $\rightarrow$  1s resolution



# Pointing stability: periodic features

2021-01-17 : oscillations with  $\sim 3$  min. Period



r.m.s. (10 min.) =  $0.74 \pm 0.16''$

r.m.s. (10 min.) =  $0.74 \pm 0.18''$

# Summary

- System is working well:
  - Characterise short-term and long-term stability
  - Consistent with effects seen by other instruments, but data collection (almost) uninterrupted
  - Provides *relative* pointing accuracy better than 1''
- Limitations:
  - No meaningful result when  $d_{\text{hel}} > 0.75 \text{ AU}$
  - Absolute pointing of STIX still needs to be calibrated

# Summary



- Access to the data:
  - Processing of SAS signals to derive aspect solution done by STIX team
    - generate “level 2” data: STIX pointing with respect to Sun center every 64s  
(can be made available through SOAR)
  - This needs to be taken into account to correctly position STIX images on the solar disk
    - To be included in coordinates in image products