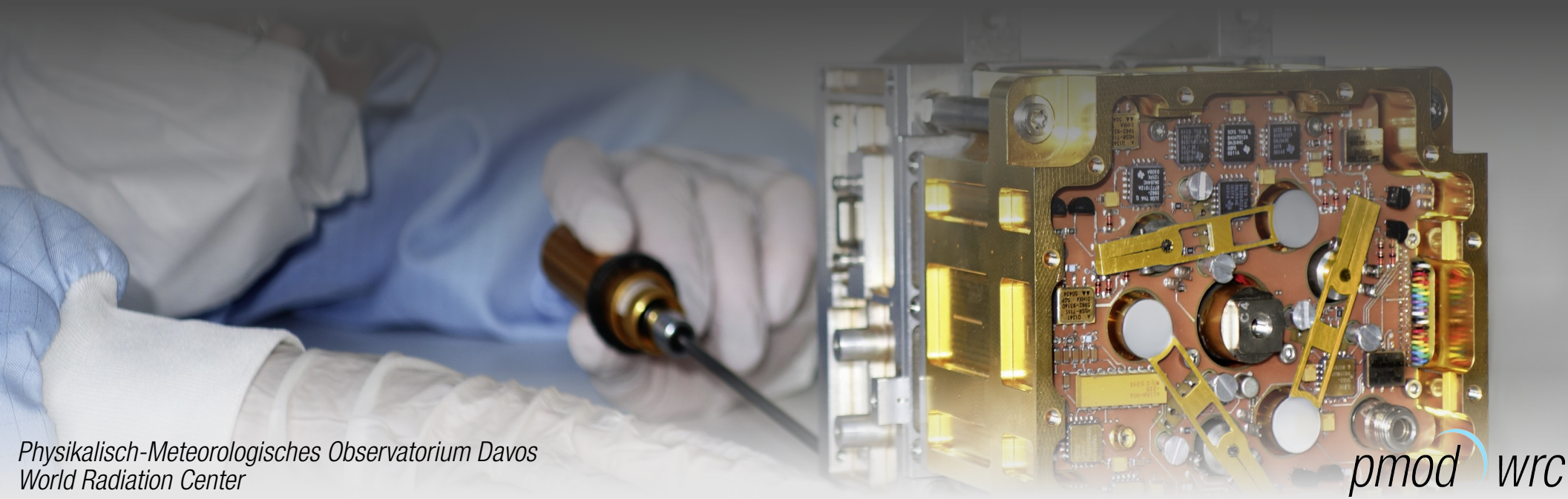


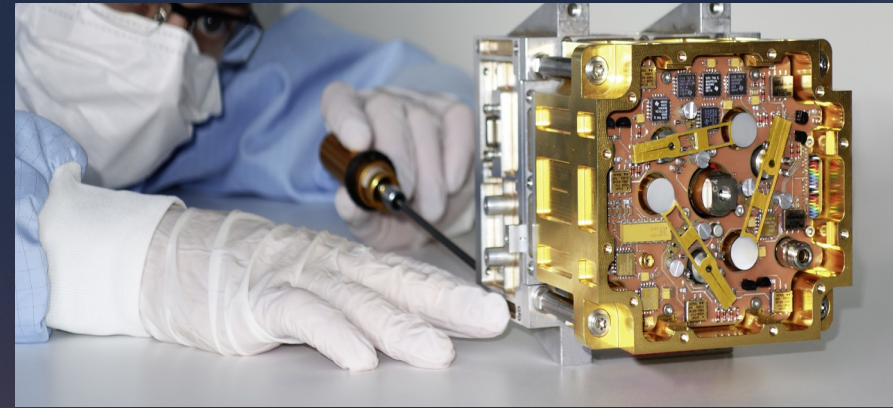
Absolute Radiometers on upcoming TSI and future EO Missions

21. March 2018, Sun-Climate Symposium, Lake Arrowhead
Wolfgang Finsterle, Margit Haberleiter, Benjamin Walter, Alberto Remesal Oliva and Silvio Koller

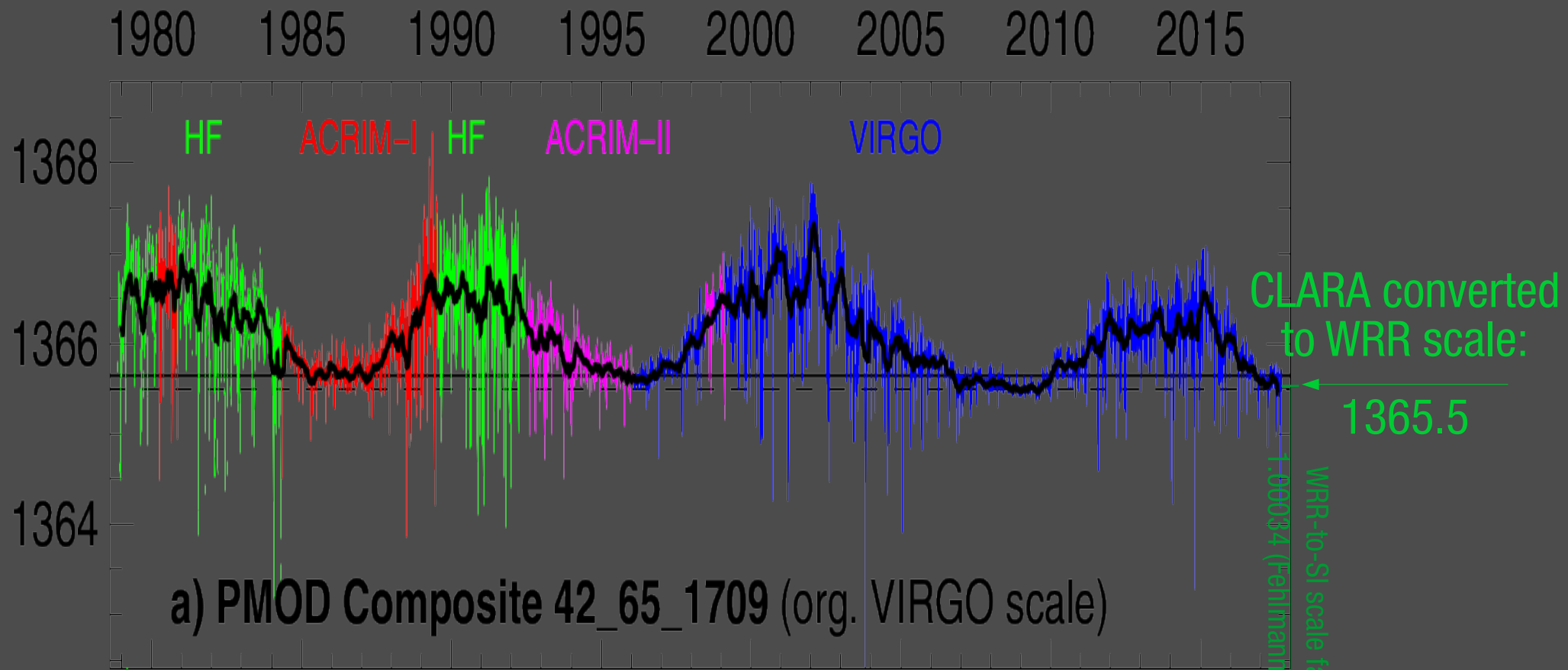


A new generation of TSI radiometers

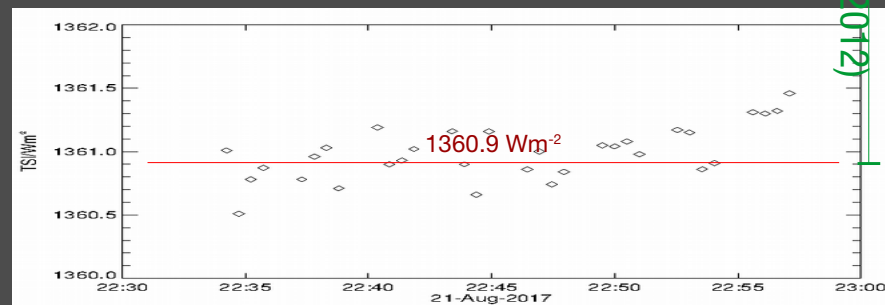
- The Compact and Lightweight Absolute Radiometer (CLARA)
 - Calibrated against TRF
 - Launched on 14 July 2017 on NORSAT-1
- First light on 21 August
 - 1360.9 Wm^{-2} , i.e. $\sim 0.3\%$ lower than the **WRR**-traceable VIRGO on SOHO



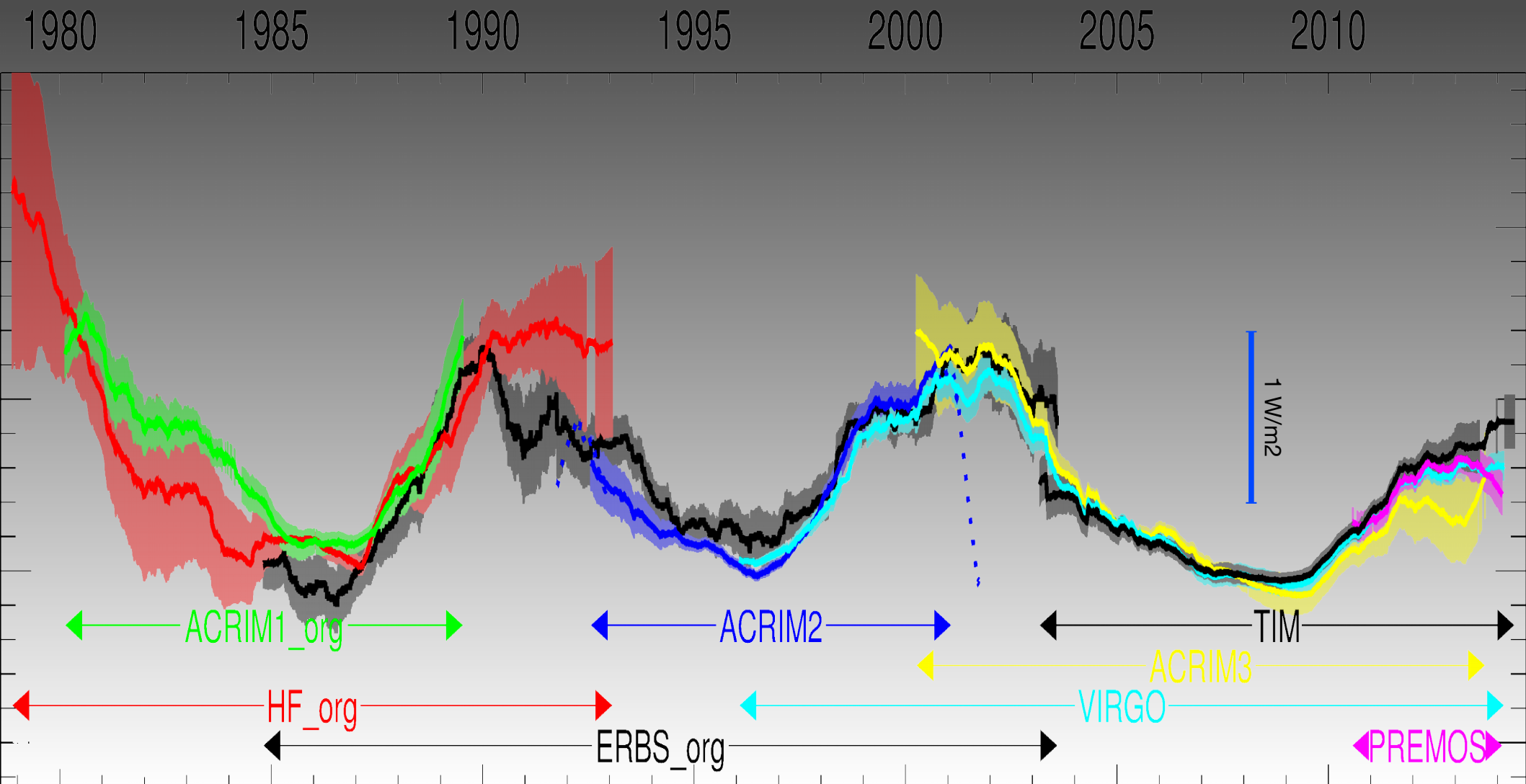
The PMOD Composite



a) PMOD Composite 42_65_1709 (org. VIRGO scale)



The TSI CDR

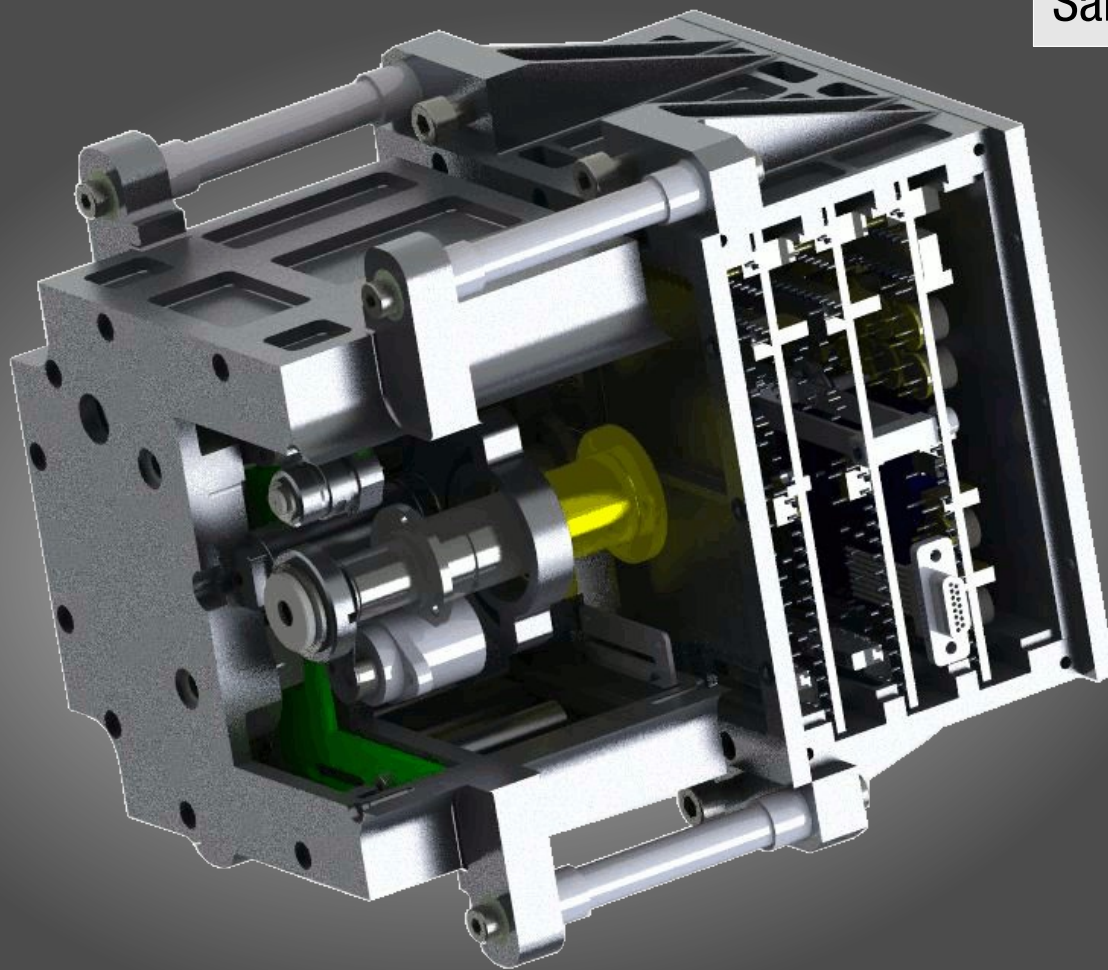


courtesy C. Fröhlich and ISSI-TSI Team

TSI radiometry on μ -satellites

- A great opportunity to ensure the continuation of the TSI CDR
- Challenges and strategies
 - Temperature variations \rightarrow add thermal mass (bad!) or improve thermal symmetry (CLARA!)
 - Pointing accuracy \rightarrow requires larger FOV and homogeneous sensors (absorptance, non-equivalence)
 - Electronic noise, interference \rightarrow better shielding, grounding, ...

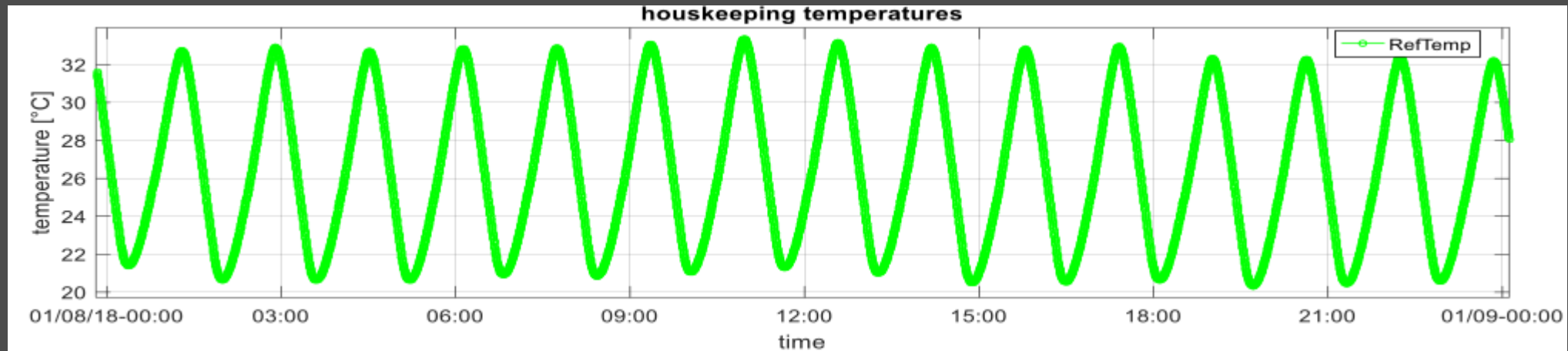
CLARA



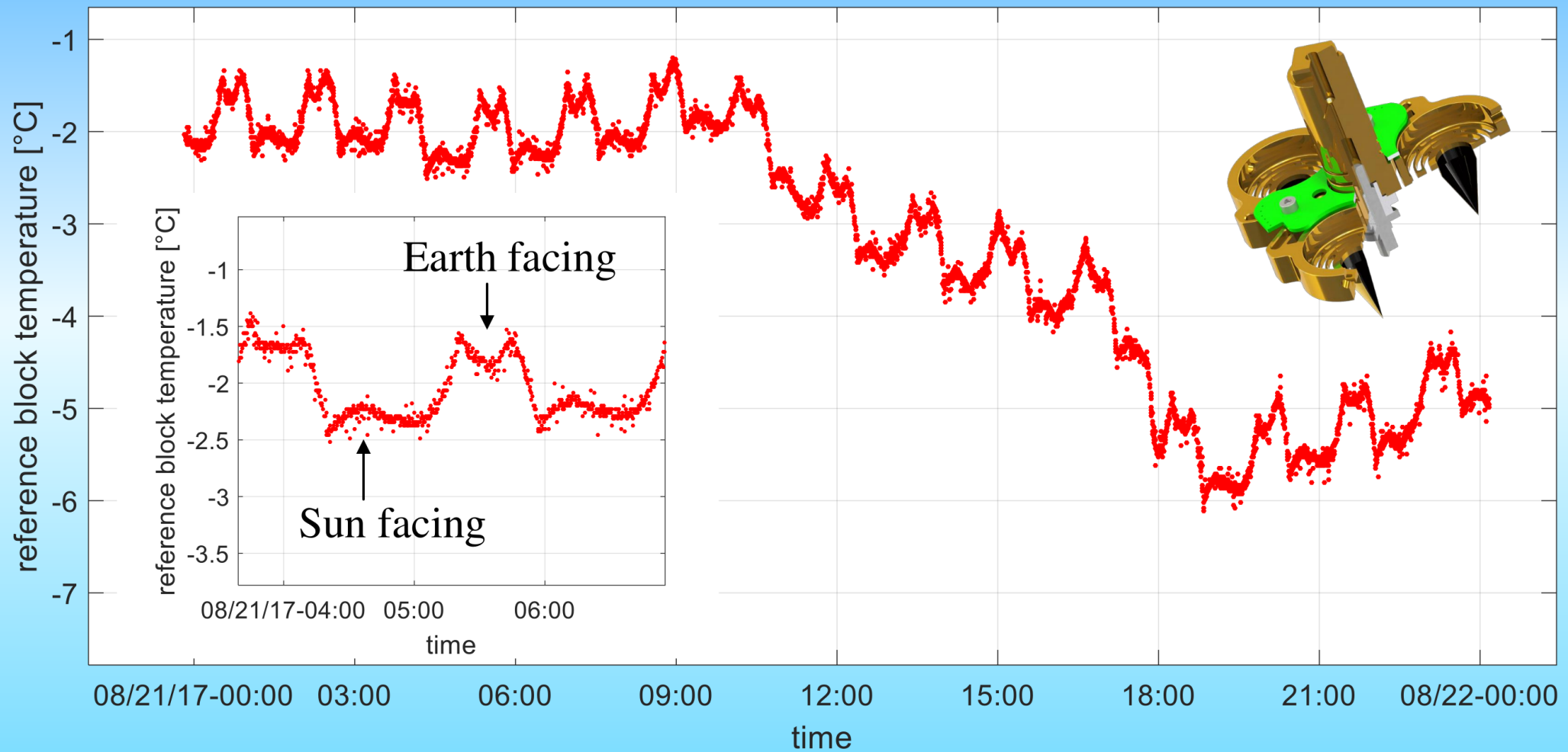
Dimensions	120 x 140 x 150 mm ³
Mass	2.21 kg
Power consumption	5.6 W
Measuring cadence	30 s
Sampling rate	20 Hz

- Passive temperature control via front shield
- Highly symmetrical thermal properties of the three channels
- Can tolerate temperature drifts of up to 10 K/h

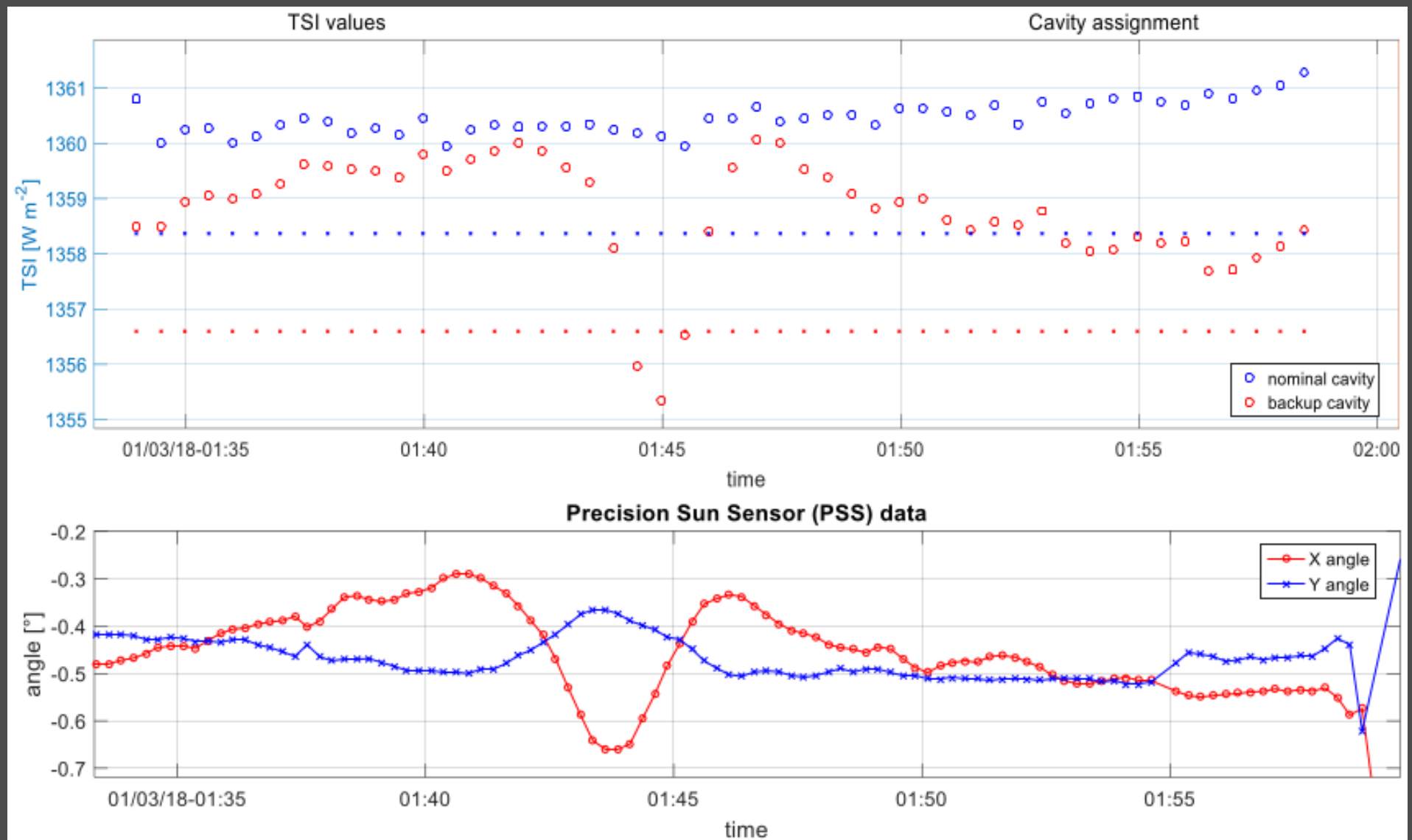
Temperature compensation



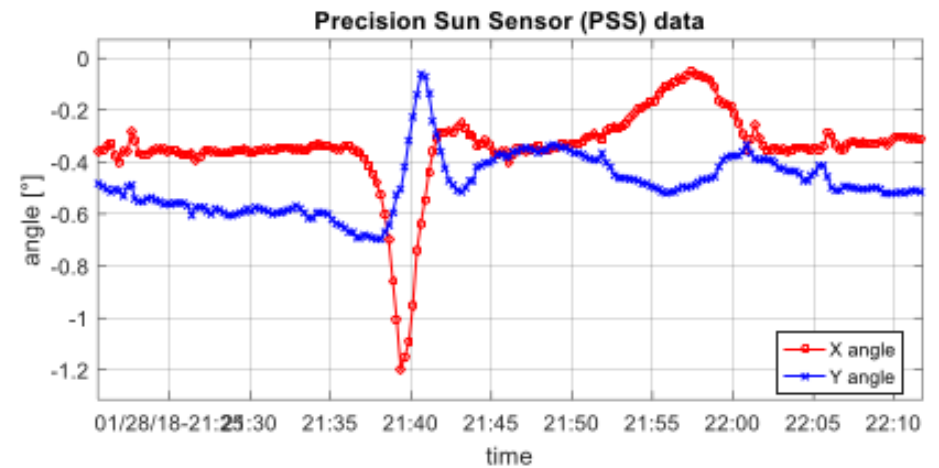
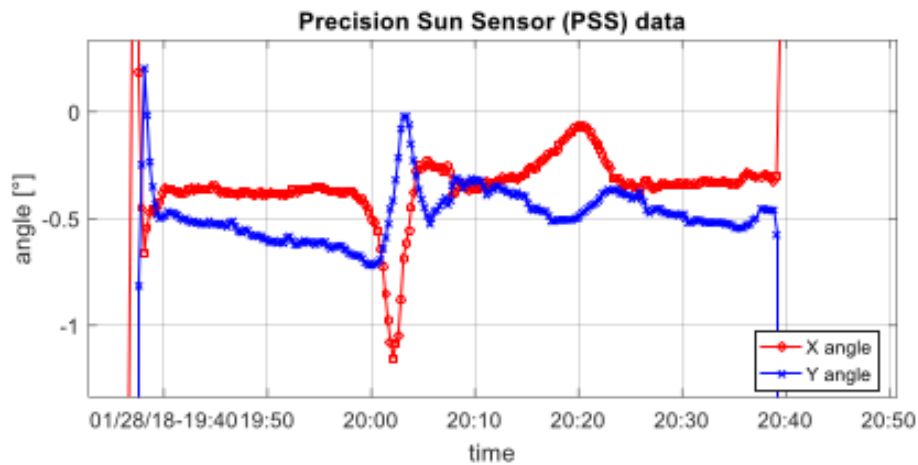
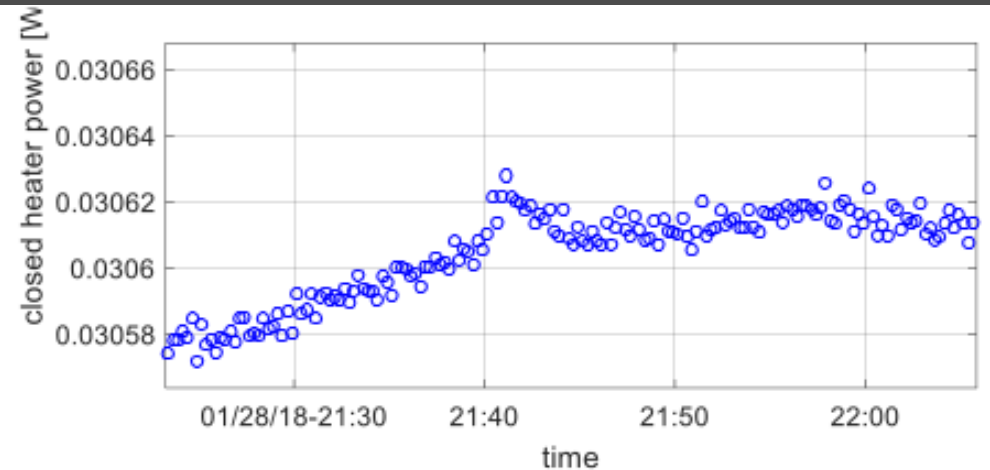
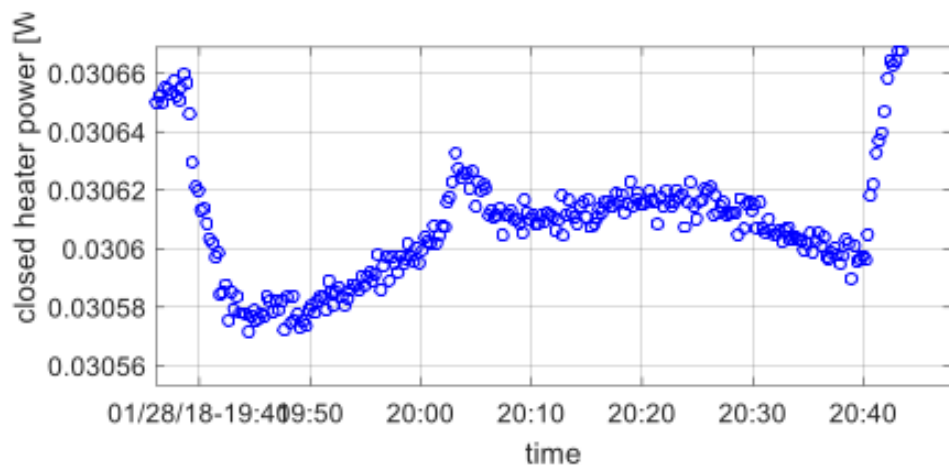
Passive temperature control

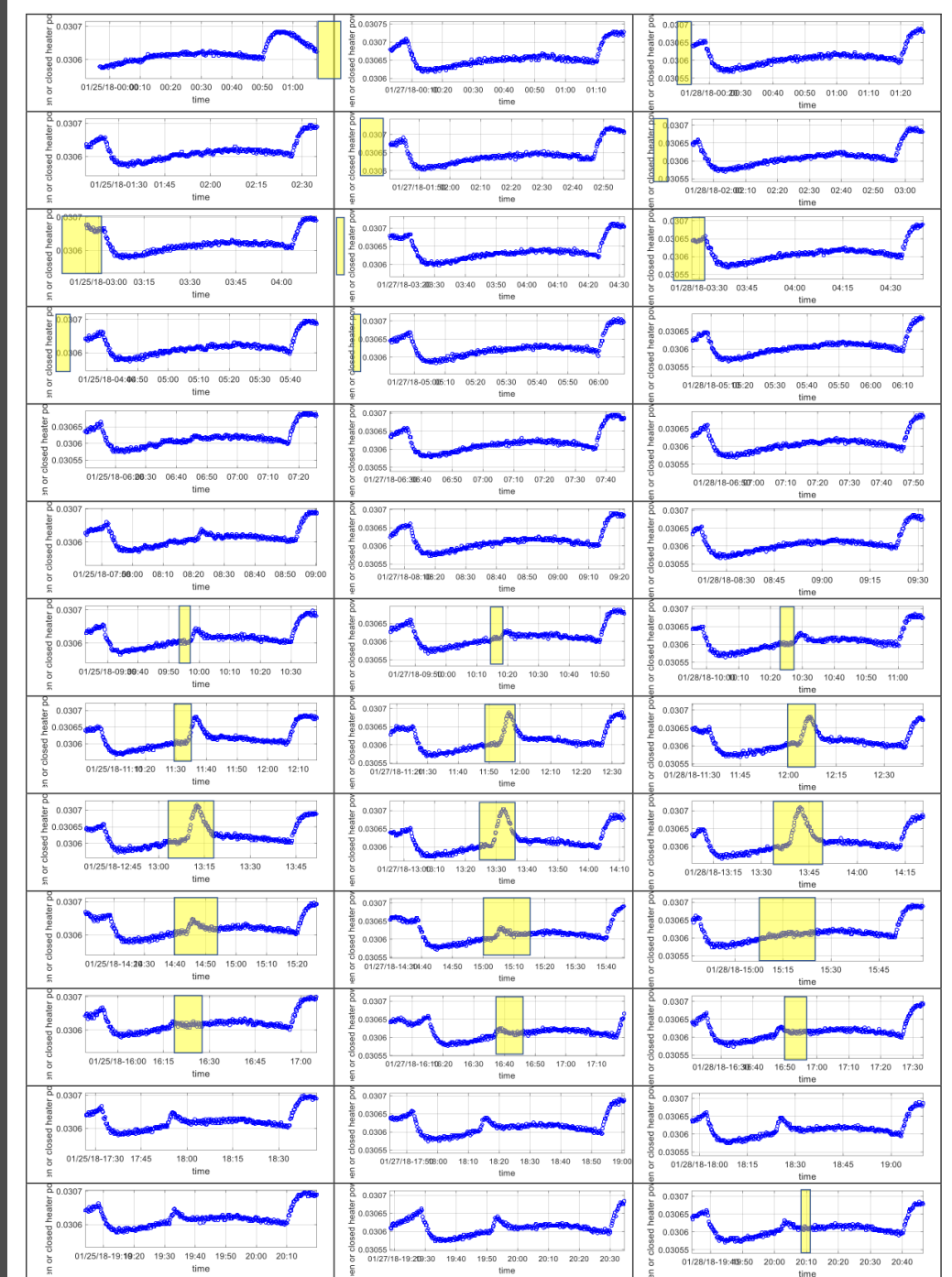
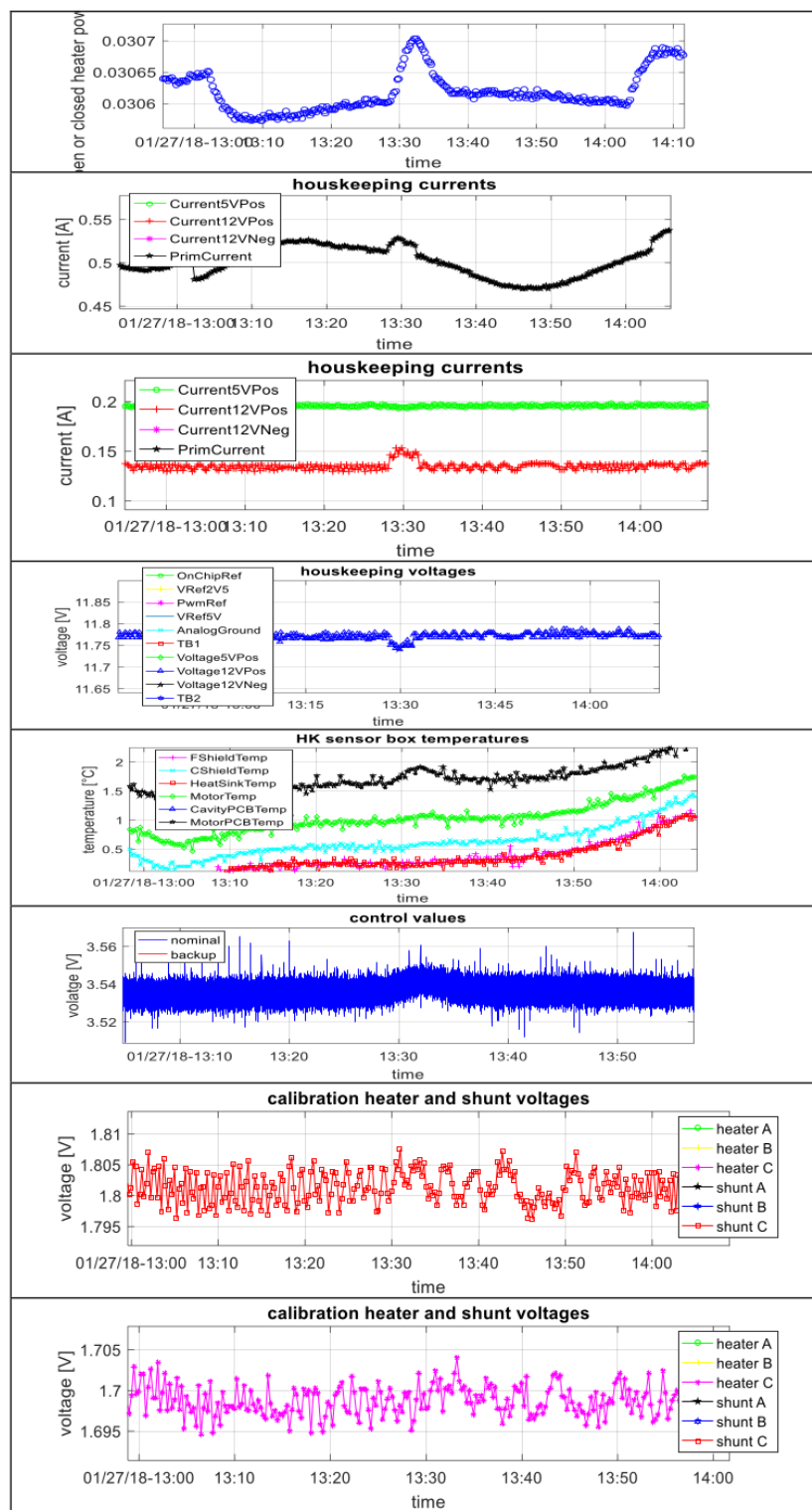


Pointing sensitivity



Pointing sensitivity?





South Atlantic Anomaly?

TSI radiometry on μ -satellites

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- Challenges and strategies
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Conclusions

- CLARA/NORSAT-1 is the first flight of a new and versatile type of TSI radiometer
- Upcoming and proposed missions
 - JTSIM/FY-3E (“standard group in space”)
 - DARA/PROBA3
 - EAGER (Earth Energy Imbalance)
- Attempts to improve long-term stability
 - Understand/reduce optical efficiency losses
 - Establish/improve on-orbit traceability

DARA on JTSIM/FY-3E

- FY-3E Chinese EO (meteo) mission with solar tracking platform
- JTSIM Standard Group in space concept with
 - Chinese SIAR TSI radiometer
 - DARA TSI radiometer
- Launch 2019

DARA on PROBA3

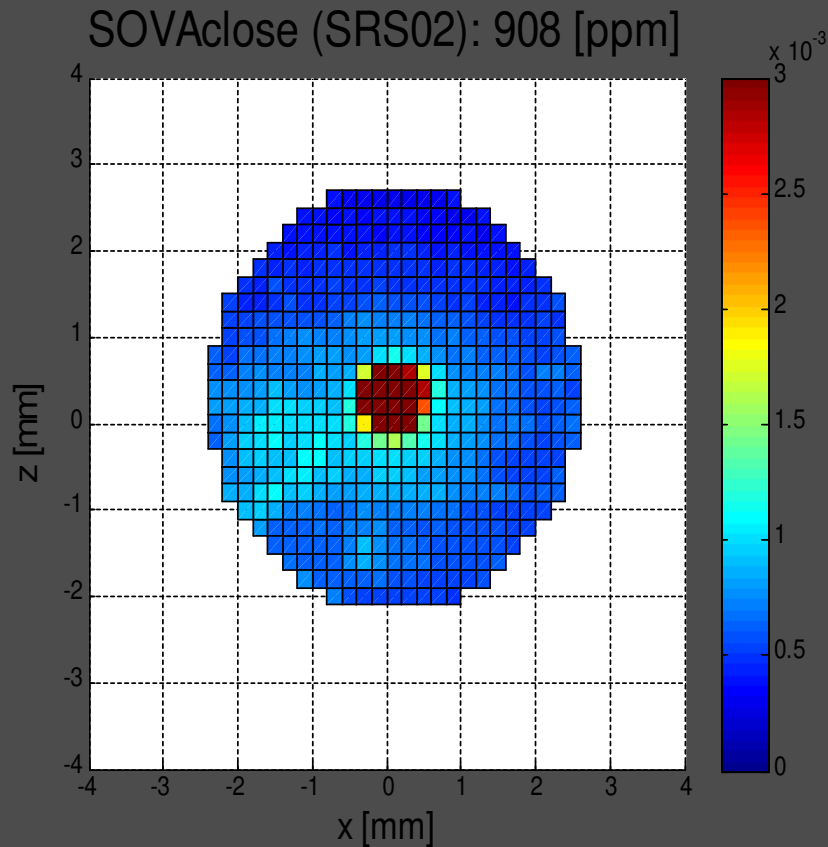
- PROBA3 is an ESA technology demonstrator for formation flying
- Main payload is the ASPIICS coronagraph with a telescope on the main spacecraft and an external occulter spacecraft separated by ~150 m.
- A DARA TSI radiometer will be on the occulter spacecraft
- High eccentricity orbit (600x60'000 km)
- Launch > 2020



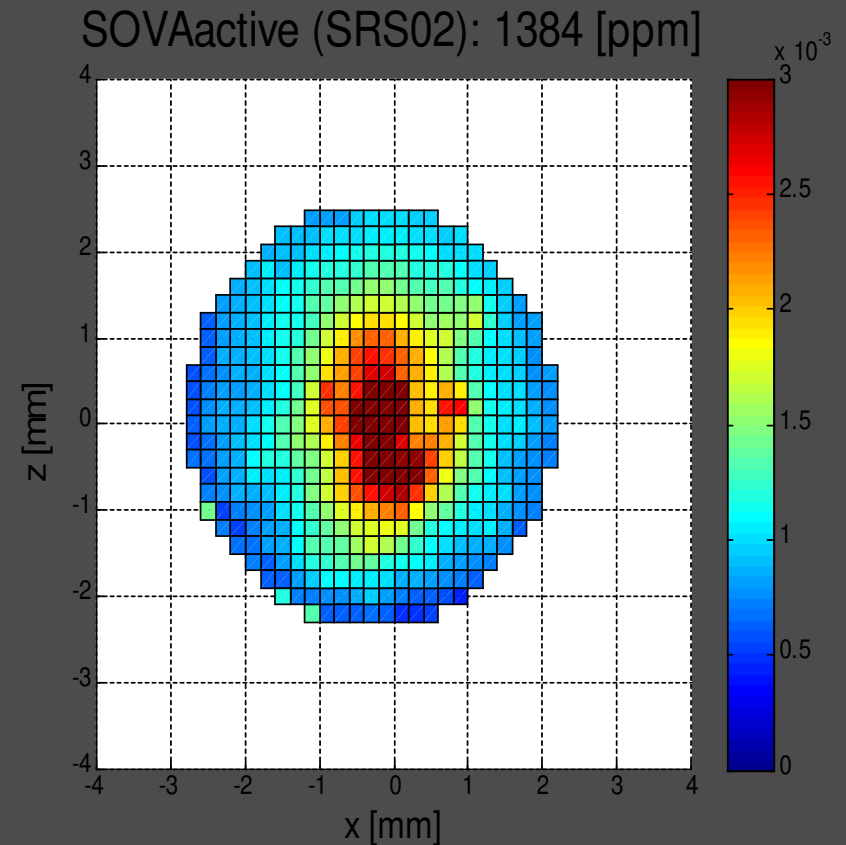
DARA on EAGER (proposed)

- EAGER is a proposed mission to measure the Earth Energy Imbalance
- DARA will serve as on-board calibration reference for (TSI), SSI, TOR, OLR, OSR instruments
- See poster session!

Cavity aging in orbit



Not exposed to sun

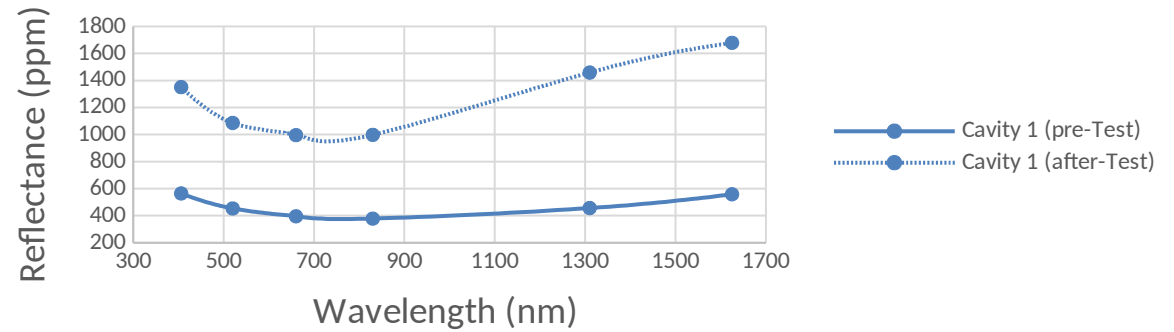


Exposed to sun for ~3 months

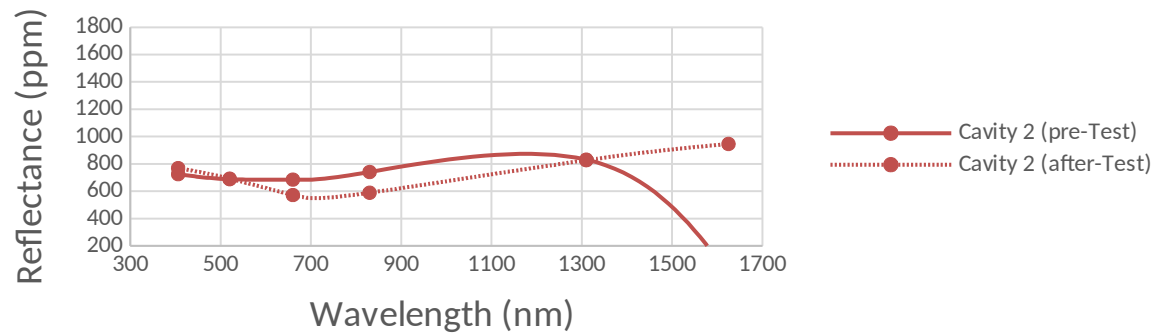
Cavity aging tests

UV exposure (248 nm)

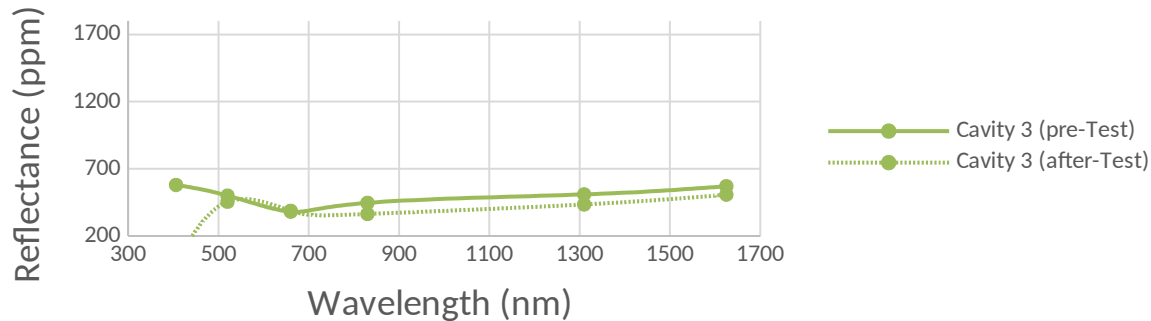
Comparison Cavity 1 - UV treatment



Comparison Cavity 2 - no treatment



Comparison Cavity 3 - thermal cycle treatment



thermal cycling

Degradation mechanisms

- Sensitivity loss
 - Change in reflectance characteristics (BRDF)?
 - Enhanced reflectivity?
- Early increase (in PMO6)
 - BRDF?
 - Stray-light characteristics?
 - CLARA shows no early increase

Thank you for you
attention!

