LOFAR2.0 Commissioning

Michiel Brentjens
Emma van der Wateren
Manu Orru'

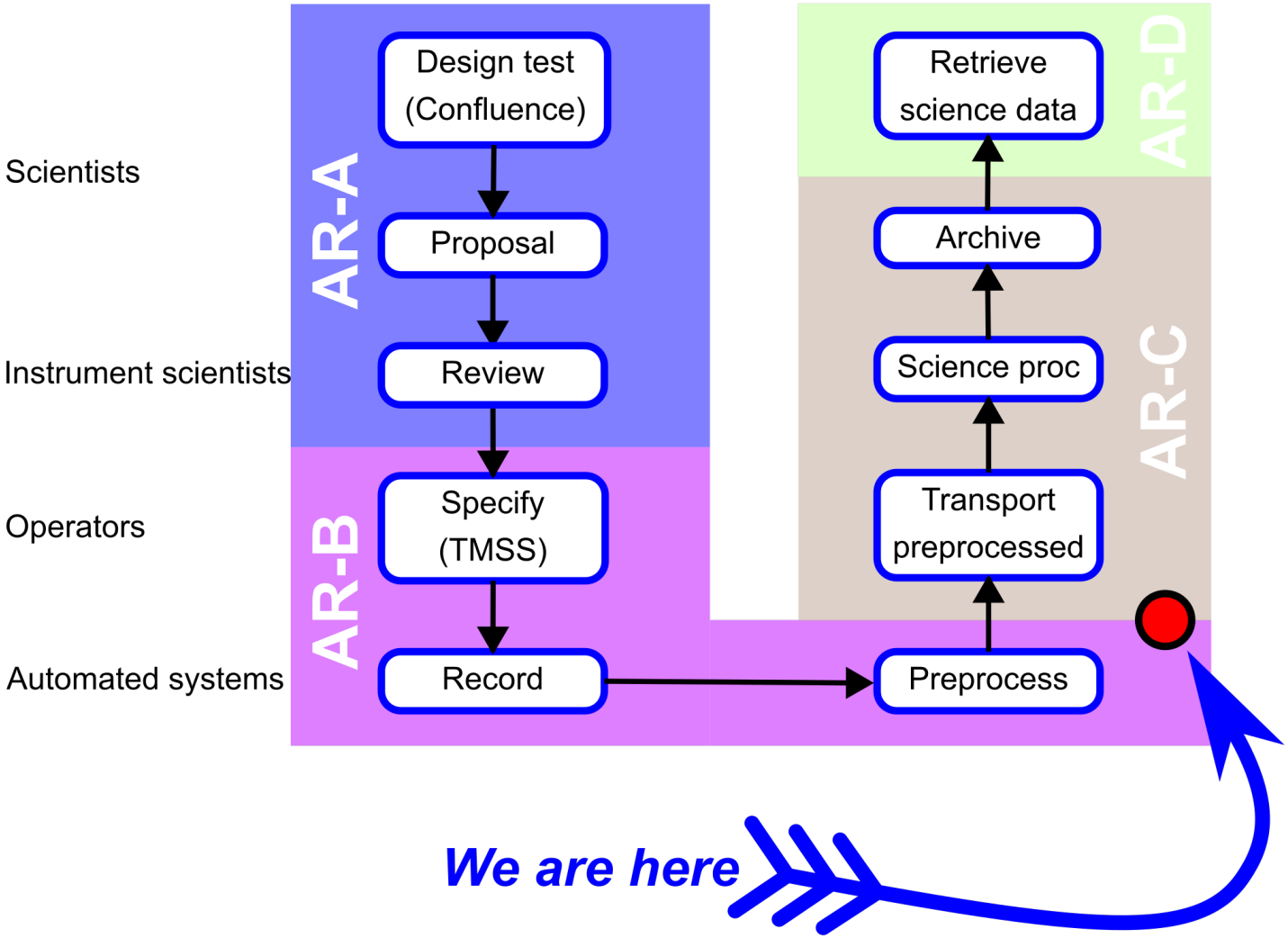
What *is* commissioning anyway?

ASTRON

- **Bridges AIV** and initial **operations** / Science verification
- **Prove** 57 LOFAR2.0 **science requirements** (level 0)
  - ~1500 Levels 1 (system), 2 (sub-system),…5 demonstrated at varying levels of rigour during engineering, (pre-) production, and AIV
- Prove in ***Operational* context**

Observing workflow

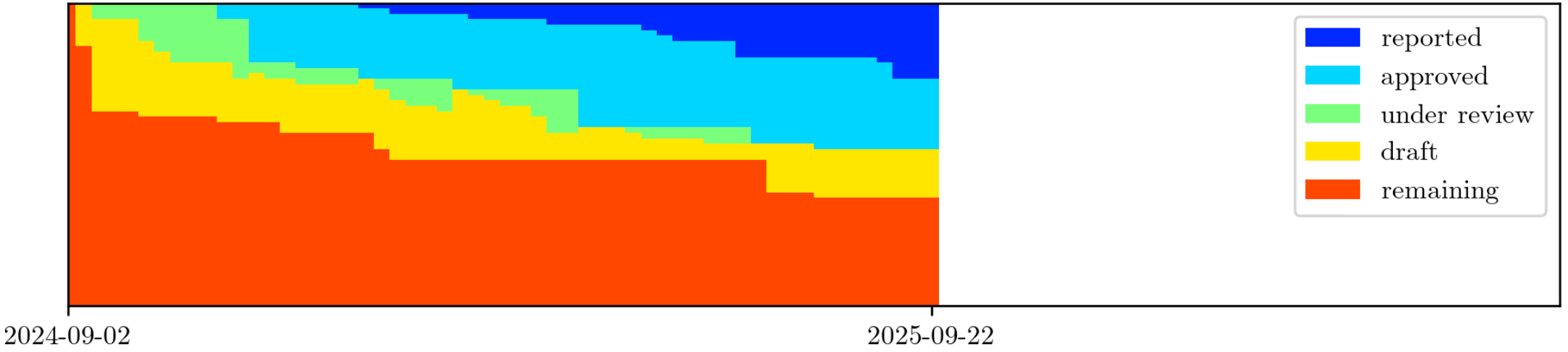
ASTRON



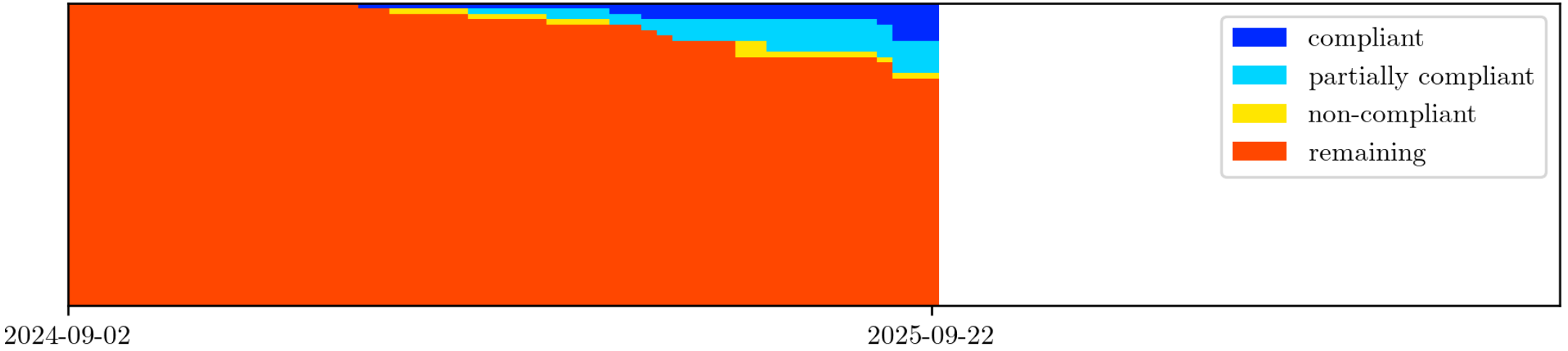
Current status

ASTRON

LOFAR-2.0 commissioning progress 2025-09-22

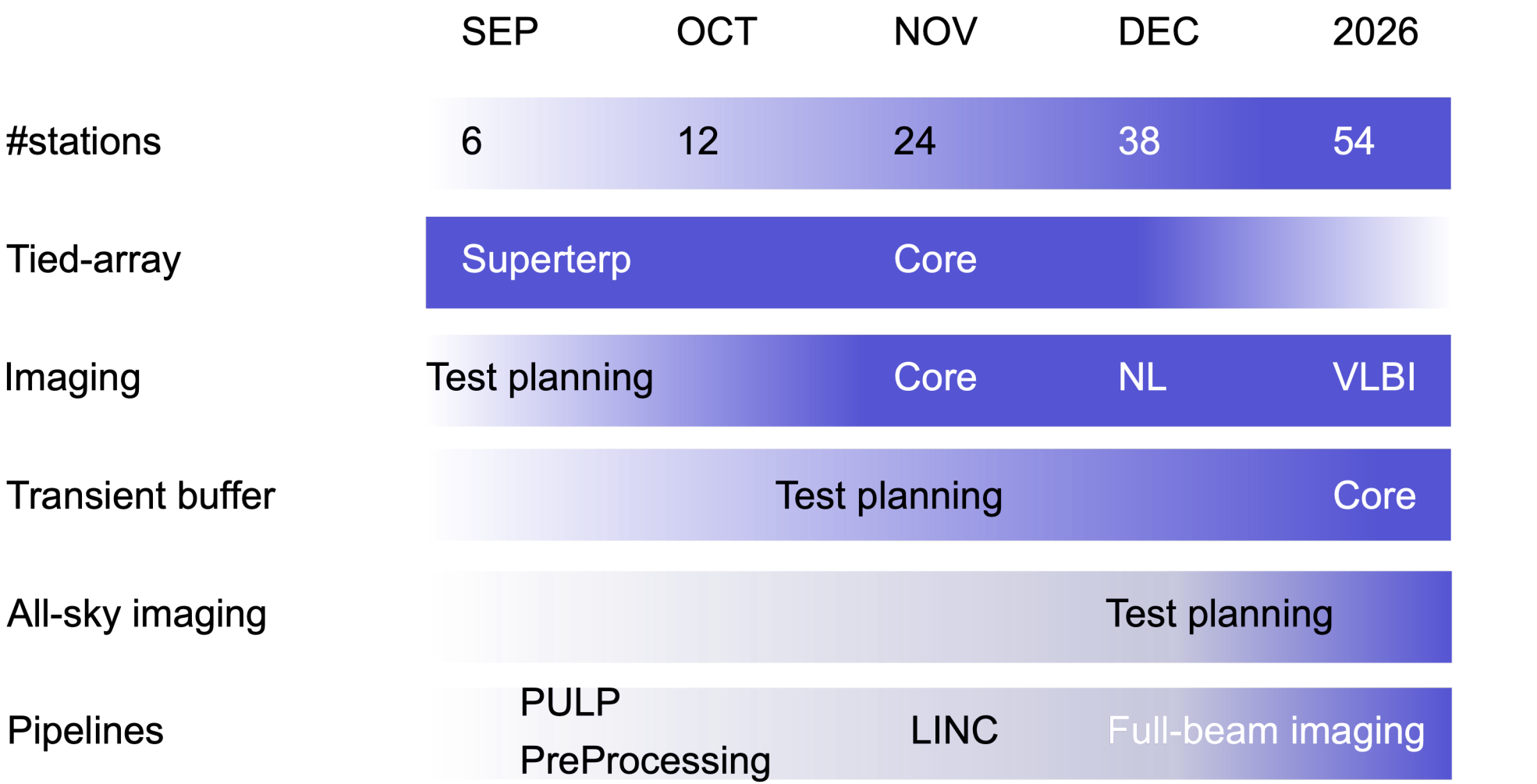


LOFAR-2.0 L0 compliance 2025-09-22



Next months of *COMMISSIONING*

ASTRON



Three teams (themes?)

ASTRON

Telescope *Bassa, Kondratiev*

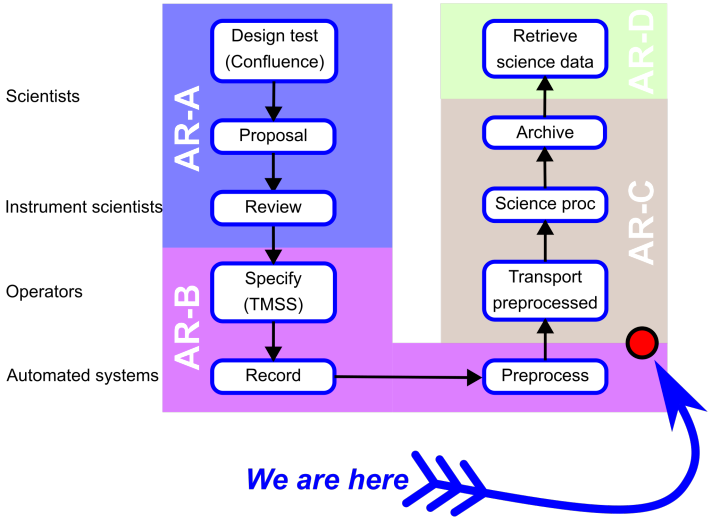
- Antennas
- Stations
- Timing
- Real-time processing

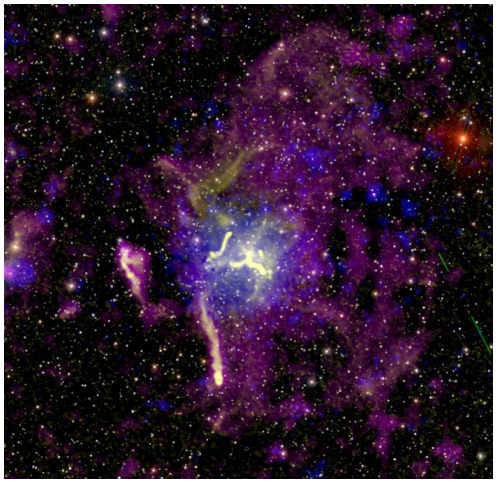
Operations *Orru', Asabere*

- Proposal management
- Specification
- Observing workflow
- Archiving

Pipelines *Shimwell, Iacobelli*

- Commissioning *with* pipelines
- Resource measurement
- Operations manuals





Station commissioning

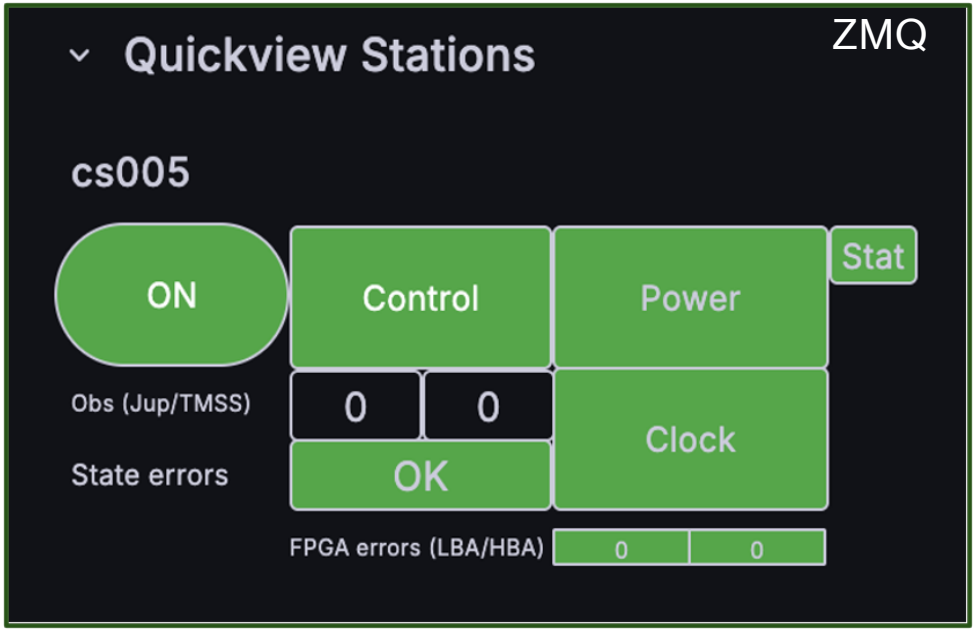
Emma van der Wateren

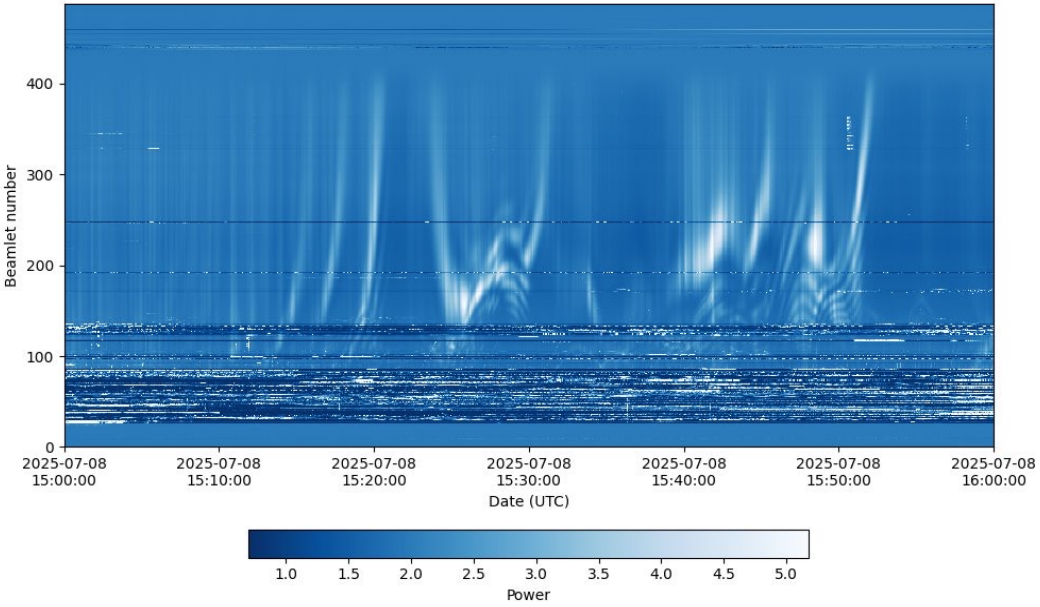
TEAM: **Cees Bassa, Vlad Kondratiev**, Boudewijn Hut, Aleksandar Shulevski, Harish Vedantham, Cristina Cordun, Tammo Jan Dijkema, Emma van der Wateren, Jason Hessels, Michiel Brentjens, Pragya Chawla, Xiaoxi Song, Paulus Kruger, Sander ter Veen, Betsey Adams, Joe Callingham, Aditya Parthasarathy Madapusi, Bernard Asabere, David McKenna, Gemma Janssen, Menno Norden, Ilse van Bemmel, Maaijke Mevius, Caterina Tiburzi, Richard Fallows, Vergil Yotov, Jean-Mathias Griessmeier, Eleni Vardoulaki, Jun Wang, Ben Stappers, Kamen Kozarev, Hariharan Krishnan

ASTRON
Netherlands Institute for Radio Astronomy

Station commissioning

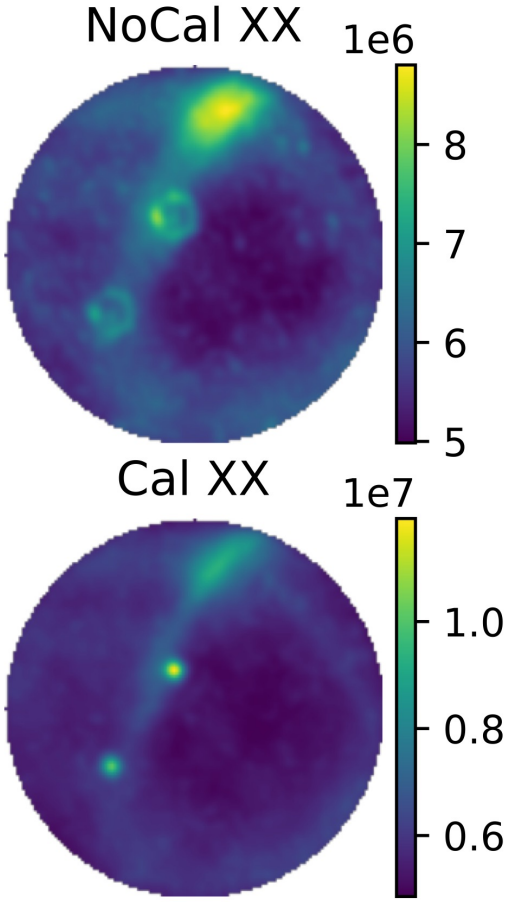
Station health and station statistics





Station calibration

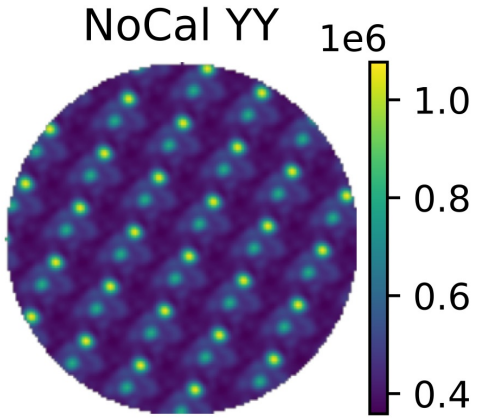
- All dipoles within a station MUST add coherently
- Well-defined station beam, required for accurate imaging
- Without it, array calibration fails → loss of sensitivity, artifacts, and unusable images



Example of before and after for CS004 at 53 MHz

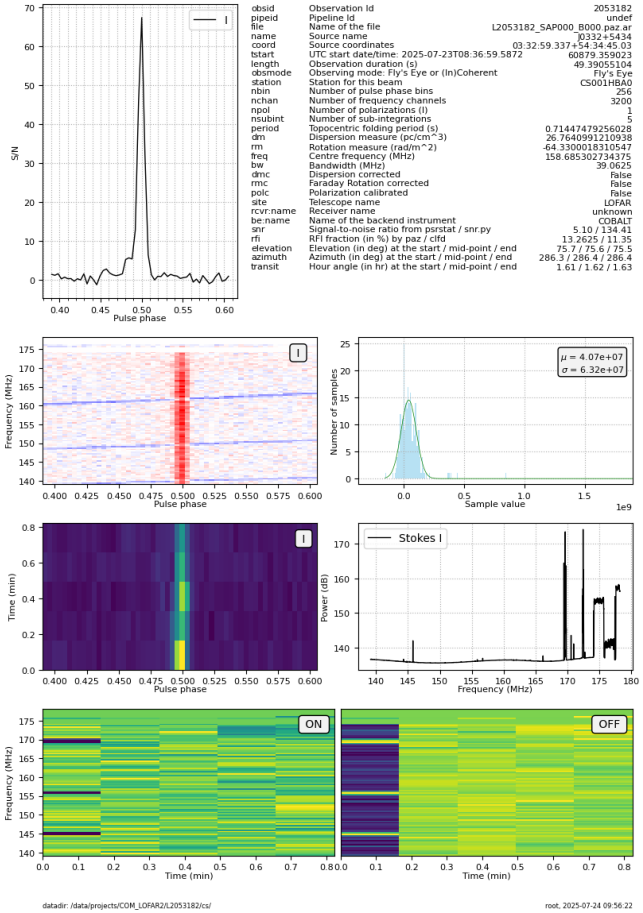
Calibration improvements from LOFAR1

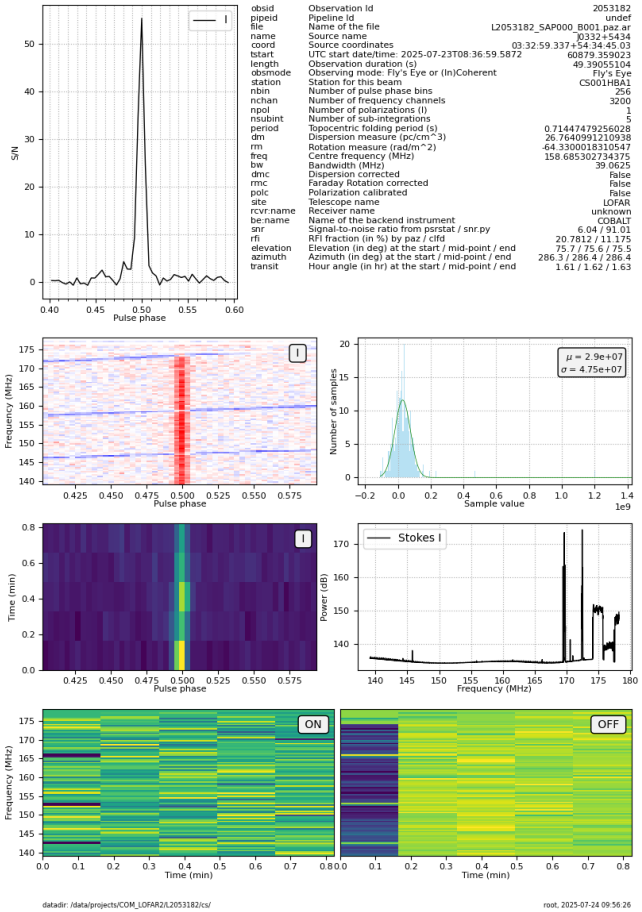
BEFORE	AFTER	Which band?
24h-observation to average the beam	Few seconds-observation - dipole beams simulated in full station configuration	LBA
Simple point source model	Point sources and diffuse emission from the Milky Way	LBA
Independent solver for XX and YY	Full Jones solver	LBA, HBA
Bright sources in grating lobes → failed calibration	Grating-lobe sources included in model → stable calibration	HBA

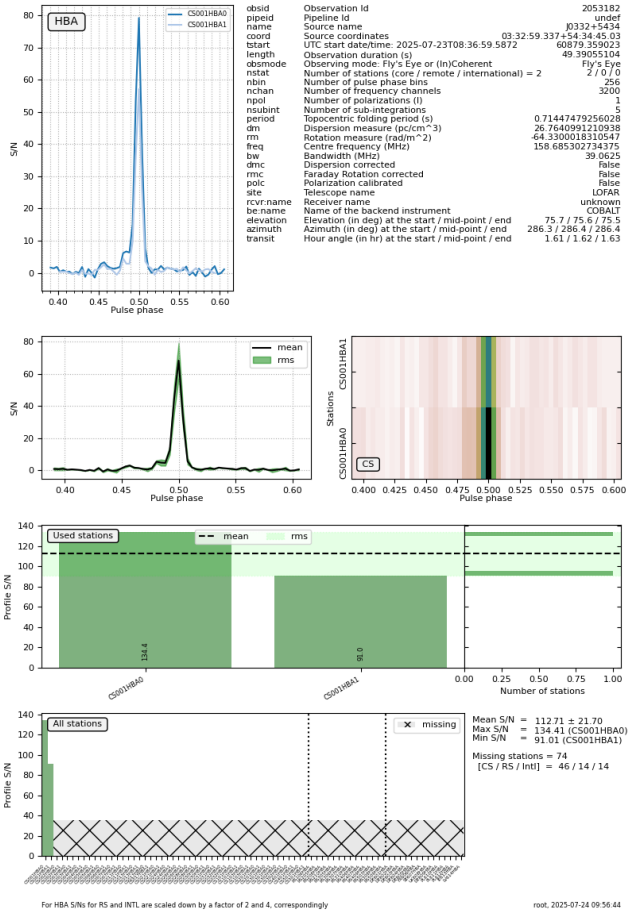


Example of HBA image with the Sun in the grating lobe

Single station

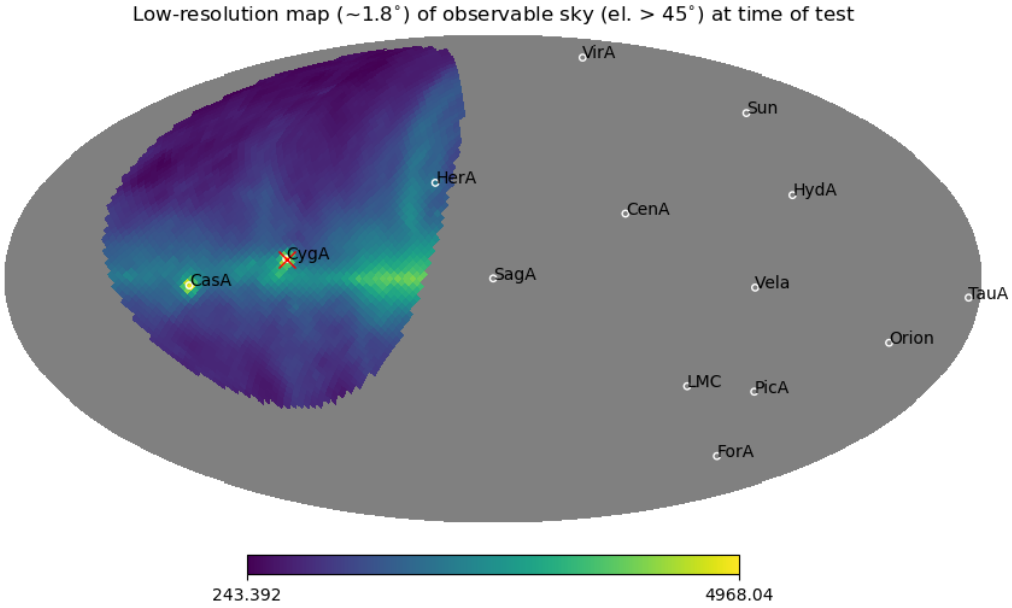


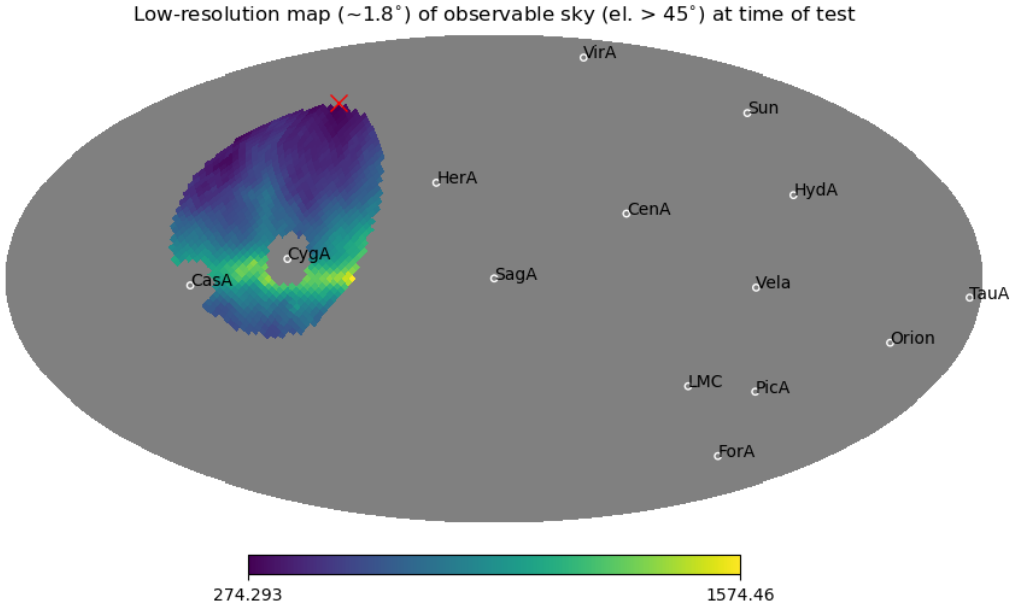


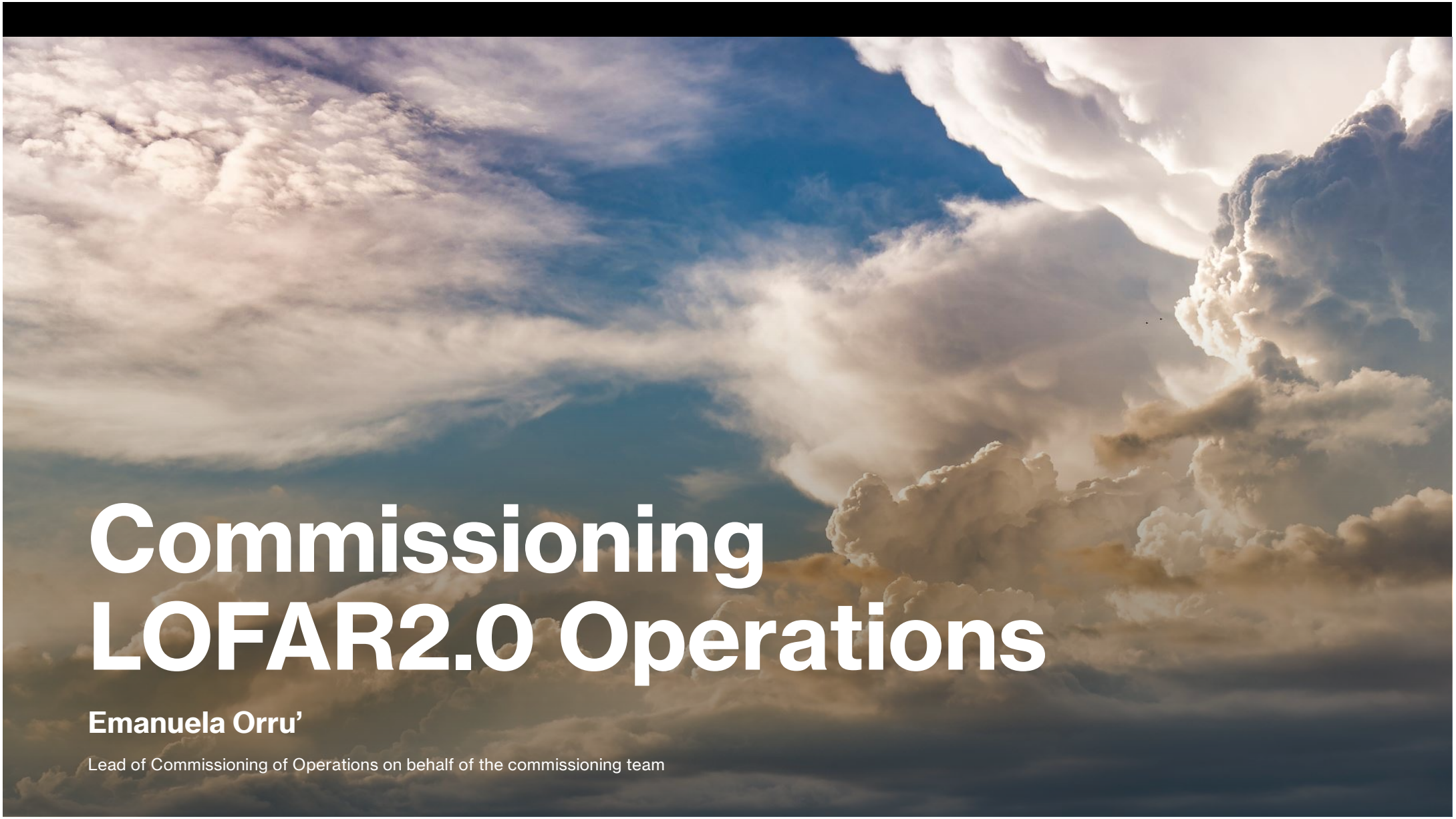


SEFDs (more later!)

- ON/OFF scan
- S/N comparison, convolving station beam response with sky models
- Tsource/Tsys





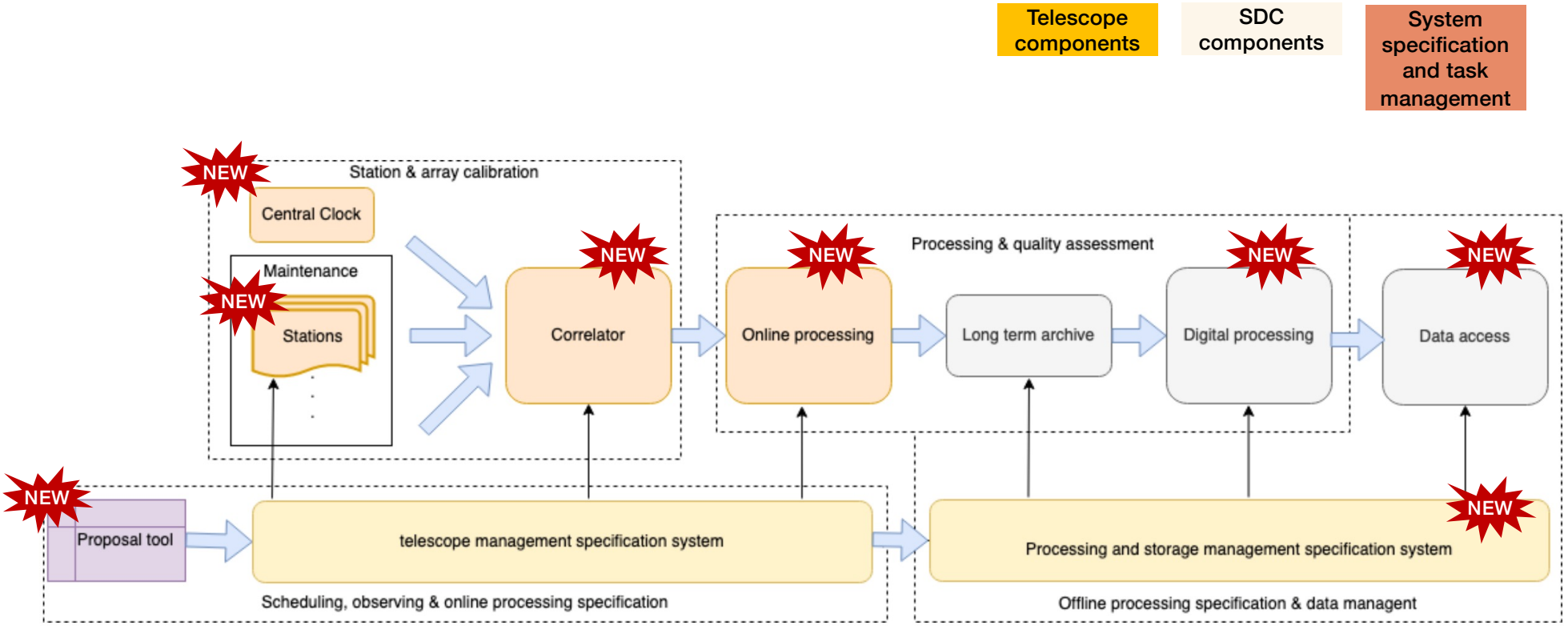


Commissioning LOFAR2.0 Operations

Emanuela Orru'

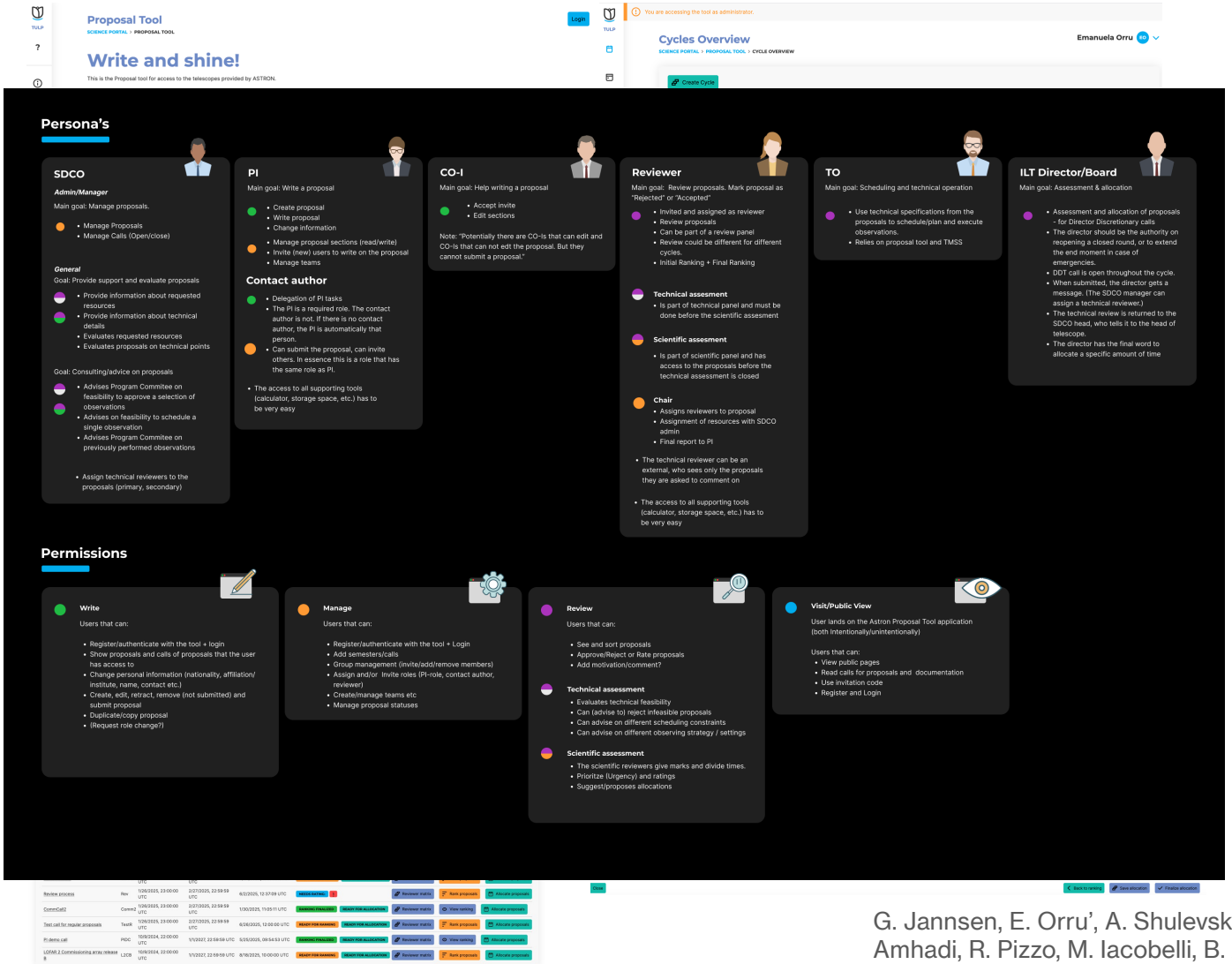
Lead of Commissioning of Operations on behalf of the commissioning team

LOFAR2.0: Data flow



TULP

MVP is ready needs to be tested.

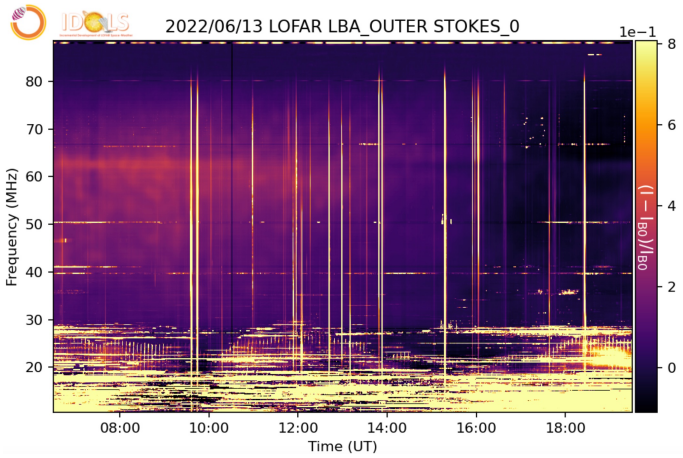


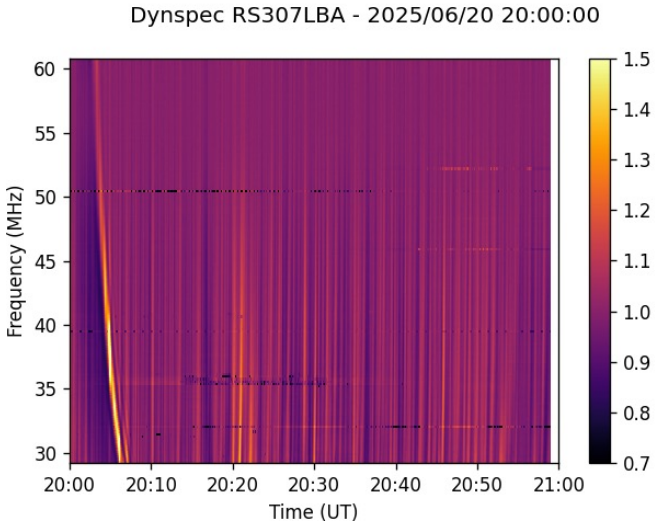
Proposing

Reviewing

G. Jannsen, E. Orru', A. Shulevski, V. Kondratiev, N. Peters, E. van der Wateren, A. Amhadi, R. Pizzo, M. Iacobelli, B. Asebere, M. Brentijens& more

Scheduling





DINOS see A. Wood's talk given by **G. Dorian**

Scheduling. See **A. Shulevski's** poster

Solar monitoring. See **P. Zucca's** talk

Multi disciplinary approach

700 LBA observations

Solar activity scores

Ionospheric analysis based on solutions

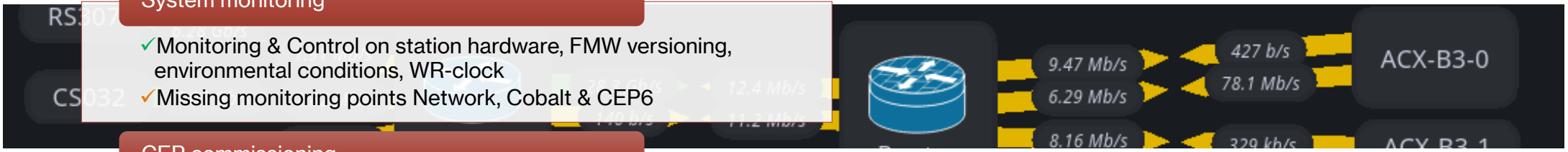
Implementing this in operations and testing it on real observation is our next goal.

A. Shulevski, M. Mevius, P. Zucca, A. Wood, H. Edler, G. Dorian, E. Orru' & more

Observing

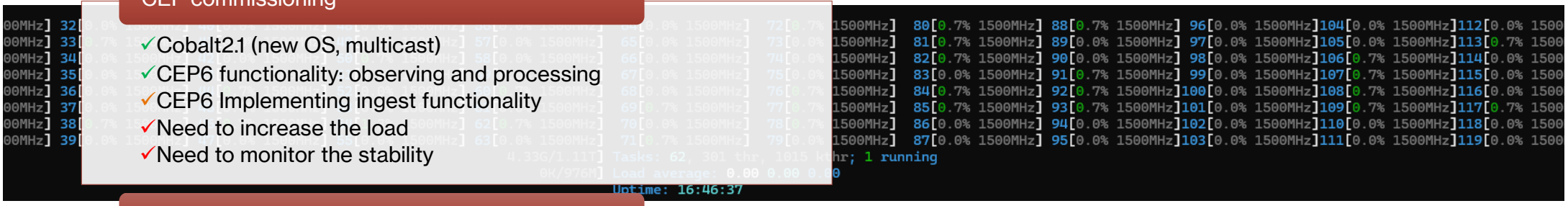
System monitoring

- ✓Monitoring & Control on station hardware, FMW versioning, environmental conditions, WR-clock
- ✓Missing monitoring points Network, Cobalt & CEP6



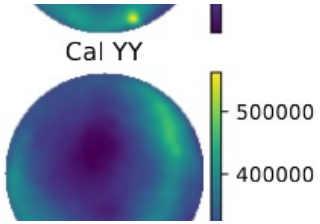
CEP commissioning

- ✓Cobalt2.1 (new OS, multicast)
- ✓CEP6 functionality: observing and processing
- ✓CEP6 Implementing ingest functionality
- ✓Need to increase the load
- ✓Need to monitor the stability



Operational automated procedures

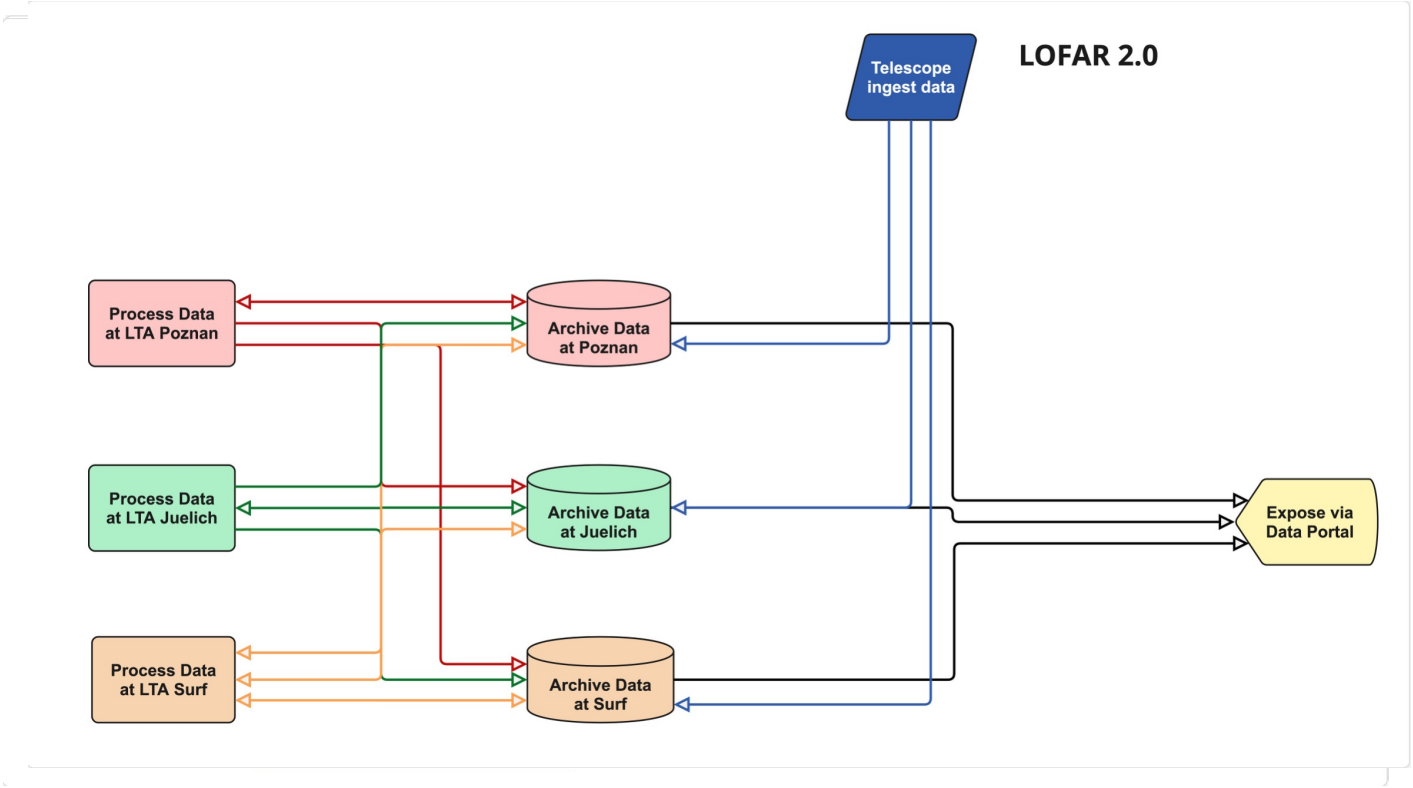
- Station calibration
- Polarization calibration of a station
- Array calibration
- SEFD measure



see talks given by
C. M Cordun

LOFAR data processing system

- Processing system from LOFAR1 towards LOFAR2.0.
- Complexity increases needs scalability to be sustainable
- Growth of the breadth of data products types hosted in the LTA



LOFAR data processing system