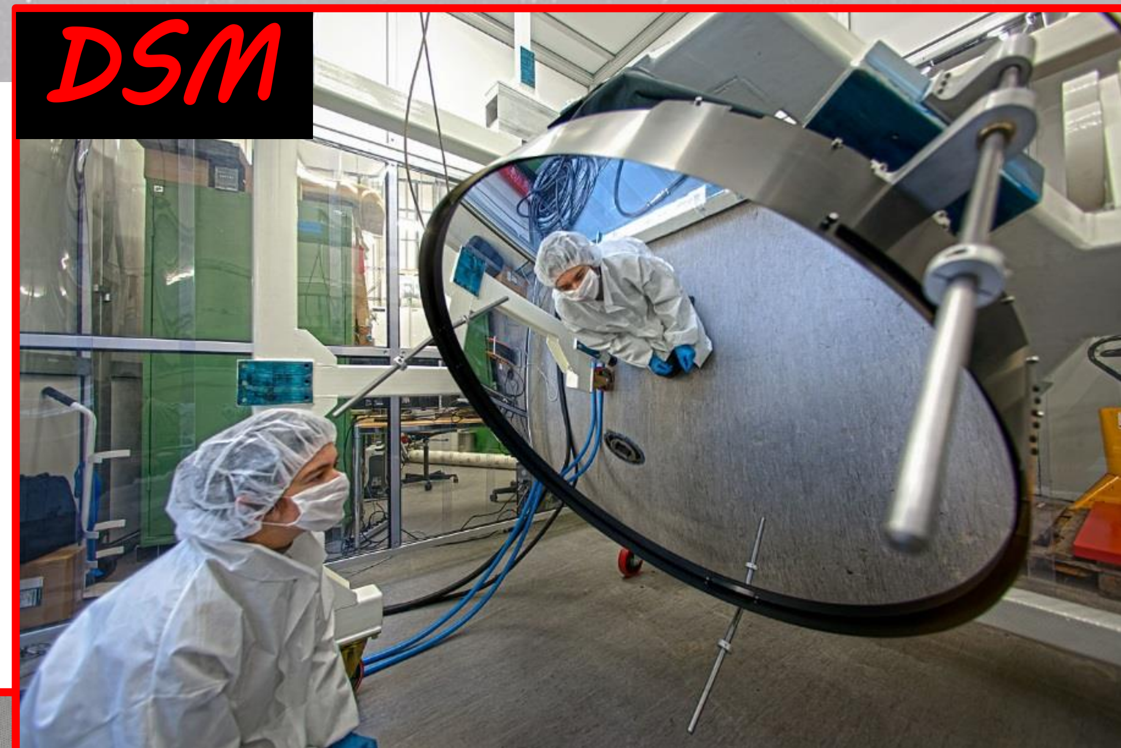
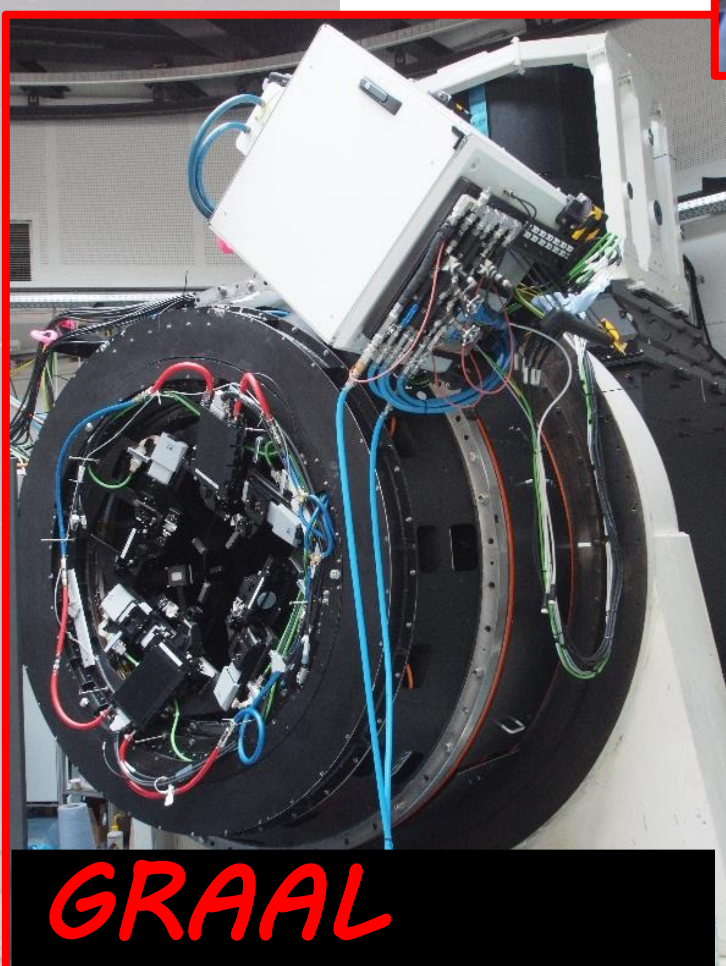
AOF: first on-sky performance of the GALACSI GLAO mode

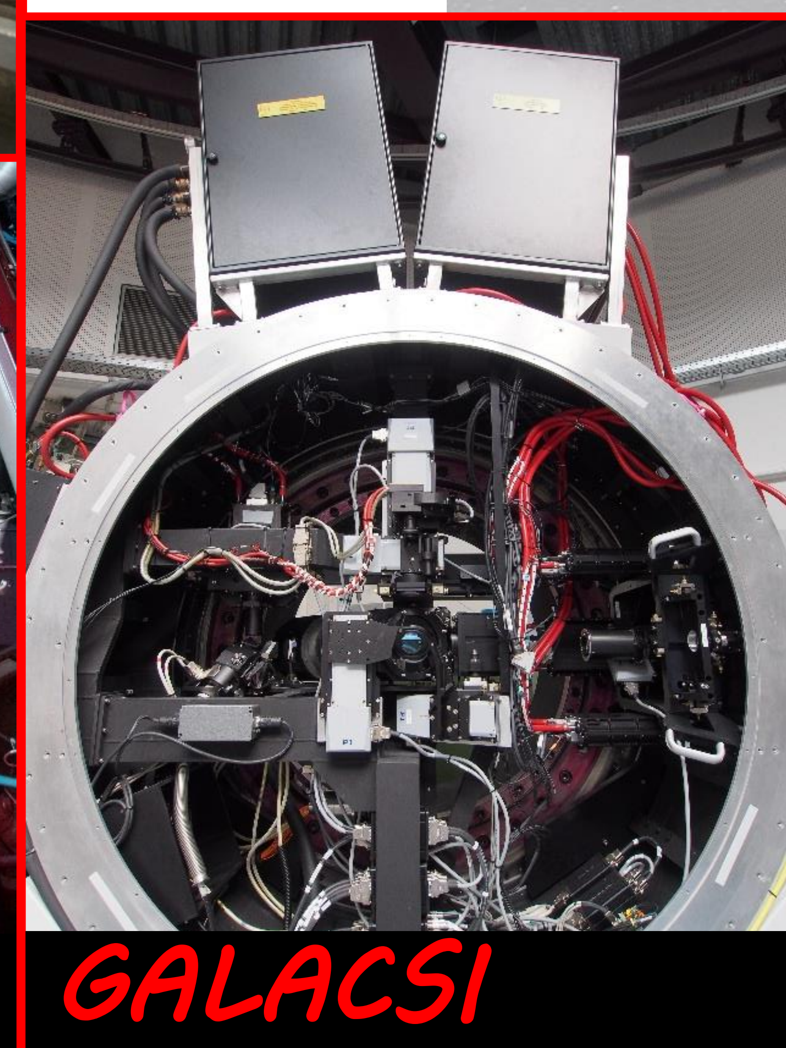
or how to close 10 loops in less than ~~5~~ 2 minutes

Johann Kolb, on behalf of the AOF team

The Adaptive Optics Facility







AOF timeline

2005-2013: Concept, design, manufacturing, assembly

2014: System tests of GRAAL in the lab

2015: System tests of GALACSI in the lab
Installation of GRAAL at the VLT UT4
Installation of 1 LGS
Combined test of GRAAL + 1 LGS

2016: Installation and test of the 4LGSF
Installation of the DSM
UT4 telescope re-commissioning with the DSM

see D. Bonaccini Thursday 10:20

Poster P2006 Tuesday by P. Hibon

2017: 01-02: Installation of GALACSI at the VLT UT4
02: Validation of the DSM performance using the GRAAL on-axis NGS mode
03-09: Commissioning of the GALACSI GLAO, including MUSE in Wide-Field Mode
10-12: Comm. of the GR ... UK-I

Poster P1040 today by P. La Penna

see J. Paufique Tuesday 16:50

This talk

March: Alignment verification on-sky

April & May: GALACSI Commissioning

June, July & September: MUSE re-commissioning with GALACSI

2018: 01-05: Commissioning of ... MUSE in Narrow-Field Mode

GALACSI

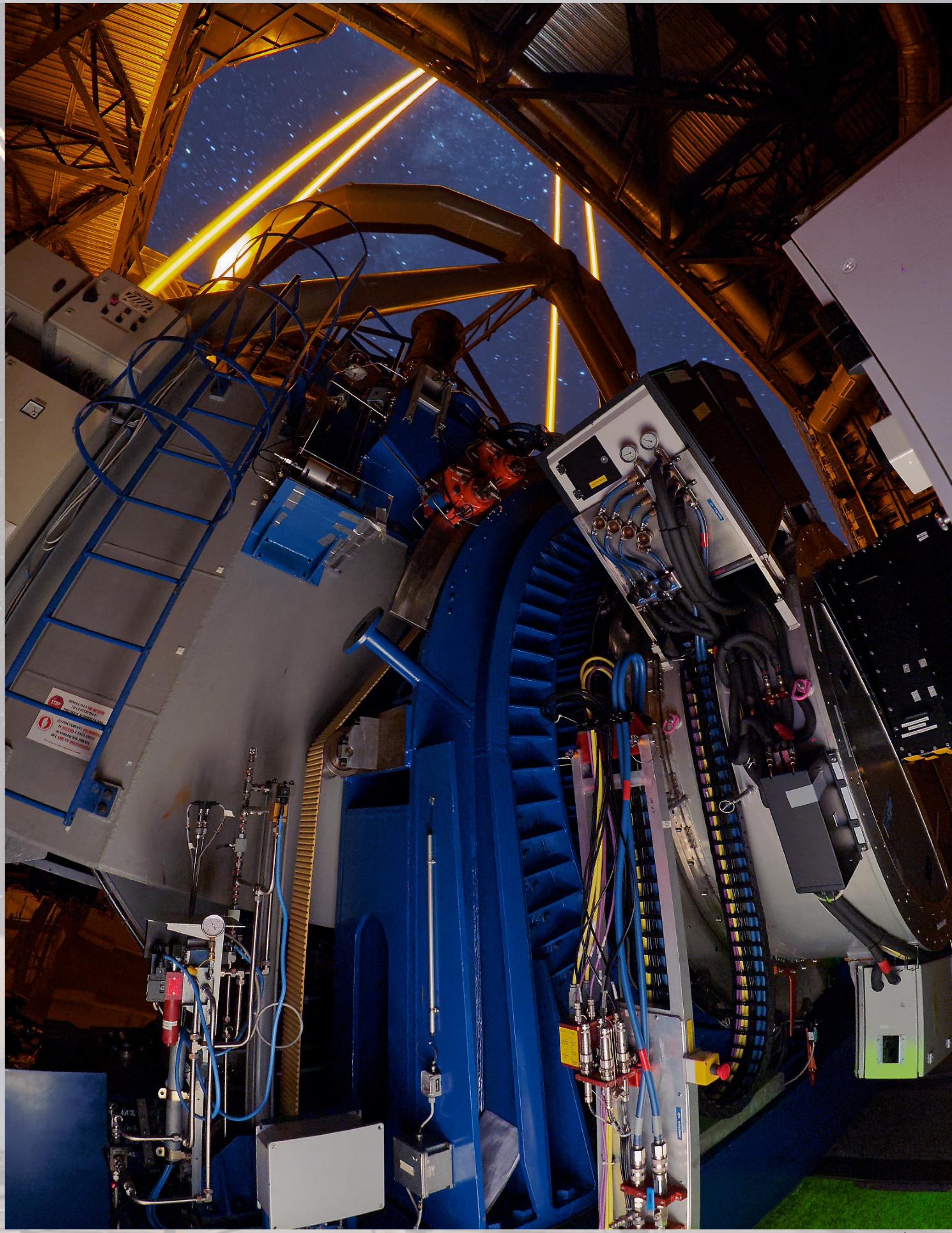
GLAO to feed the MUSE Wide-Field Mode:

- seeing enhancer in 1x1 arcmin^2 FoV @ 750 nm
- 4 LGSs located ≈ 1 arcmin from the optical axis
- No optics inserted in the MUSE scientific FoV

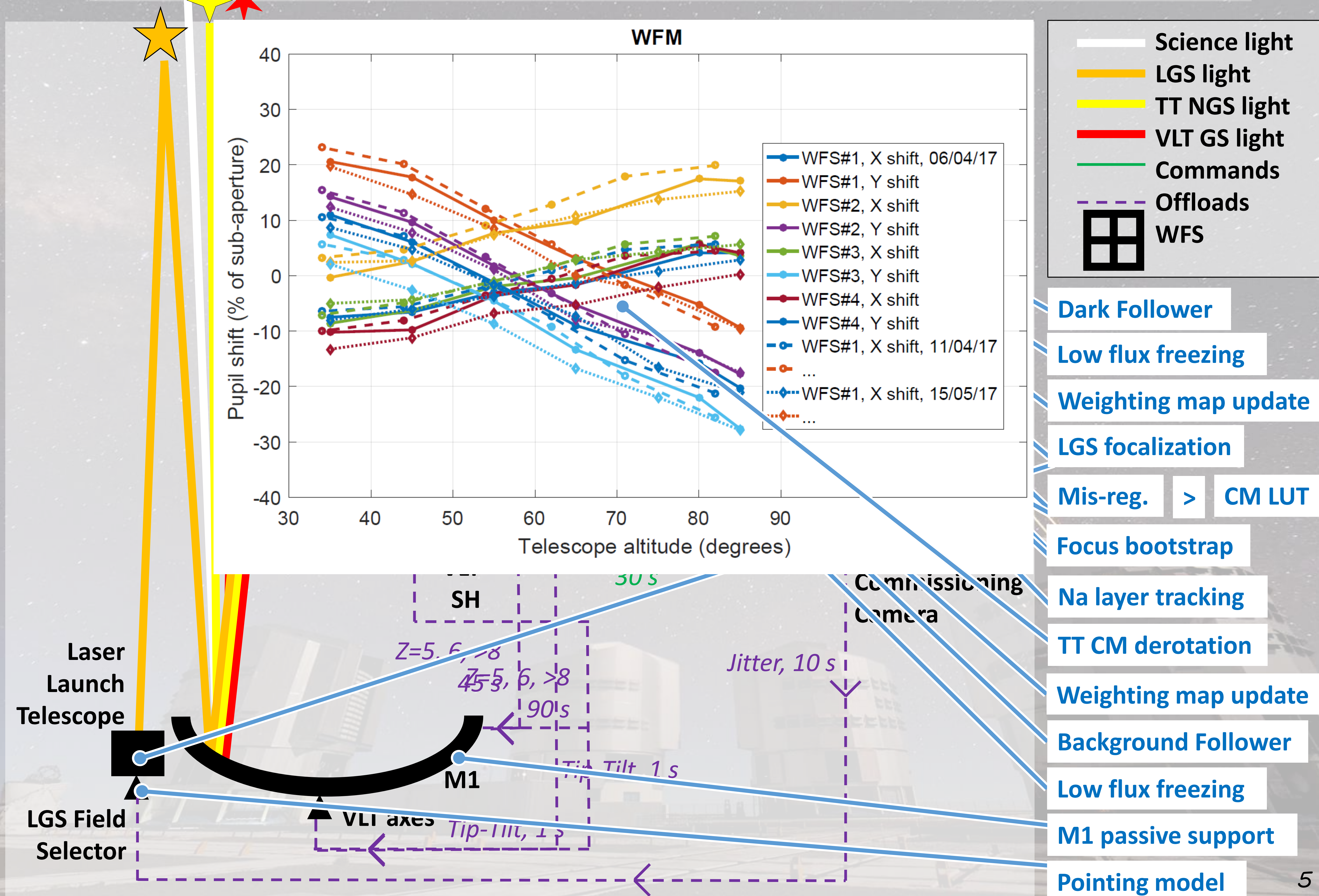
Four 40x40 Shack-Hartmann 1 kHz LGS WFS + 1 Tip-Tilt 200 Hz NGS sensor (50-110”), all using <1e RON CCD220 from e2v

4LGSF return flux often 3-4 times the initial spec

Uses the 1156 actuators of the DSM (600 modes). Actuator low death rate (<1 per year) which anyway don’t affect performance



AOF control - GALACSI



GALACSI Acquisition sequence

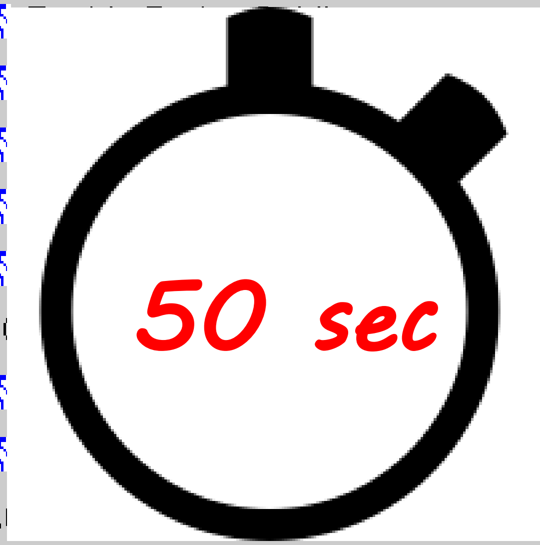
Preset of telescope, 4LGSF, motors, RTC, MUSE

Wait for 1 Act. Opt. correction

NGS acquisition

- MUSE AOF Acquisition
  - MUSE AOF acquisition
    - Preset Phase
      - 4LGSF FS Preset
      - Telescope Preset
      - Set DSM in TF mode
      - Deploy GALACSI mode
      - Disable DSM simulation on RTC
      - 4LGSF LPC Preset (set asterism)
      - AOF Preset
      - LGS WFS initial setup
    - Tip/Tilt Sensor Bootstrap
      - Tip/Tilt Sensor Camera Bootstrap
      - Sky map measurement
      - NGS Detection and Centering

- LGS Acquisition
  - LGS WFS Camera Bootstrap
  - Set AODRIVEN
  - LGS Set Search Mode
  - LGS JM Search
  - LGS Apply Corrections
  - LGS Unset Search Mode
  - LGS Check Flux
  - LGS Focus bootstrap
  - LGS Skymap Measurements
- High Order Loop Closure
  - Close jitter loop
  - Close focus offload loop
  - Bootstrap High Order Control Matrix
  - SL1: DSM Modes Offload
  - SL2: CM update
  - SL3: TT Derotation Loop



LGS acquisition

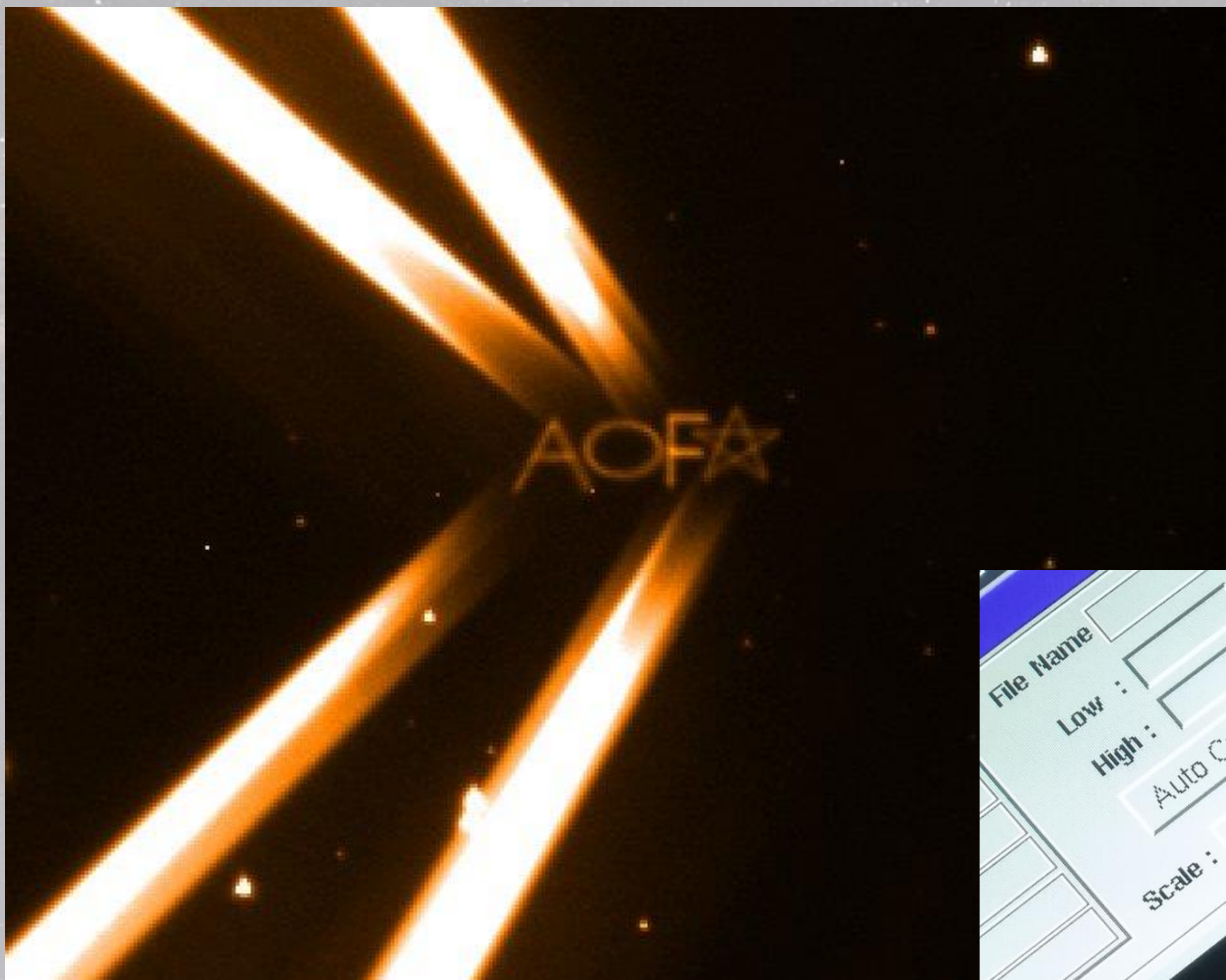
2 Act. Opt. correction

Close LGS WFS loops. Take control of telescope

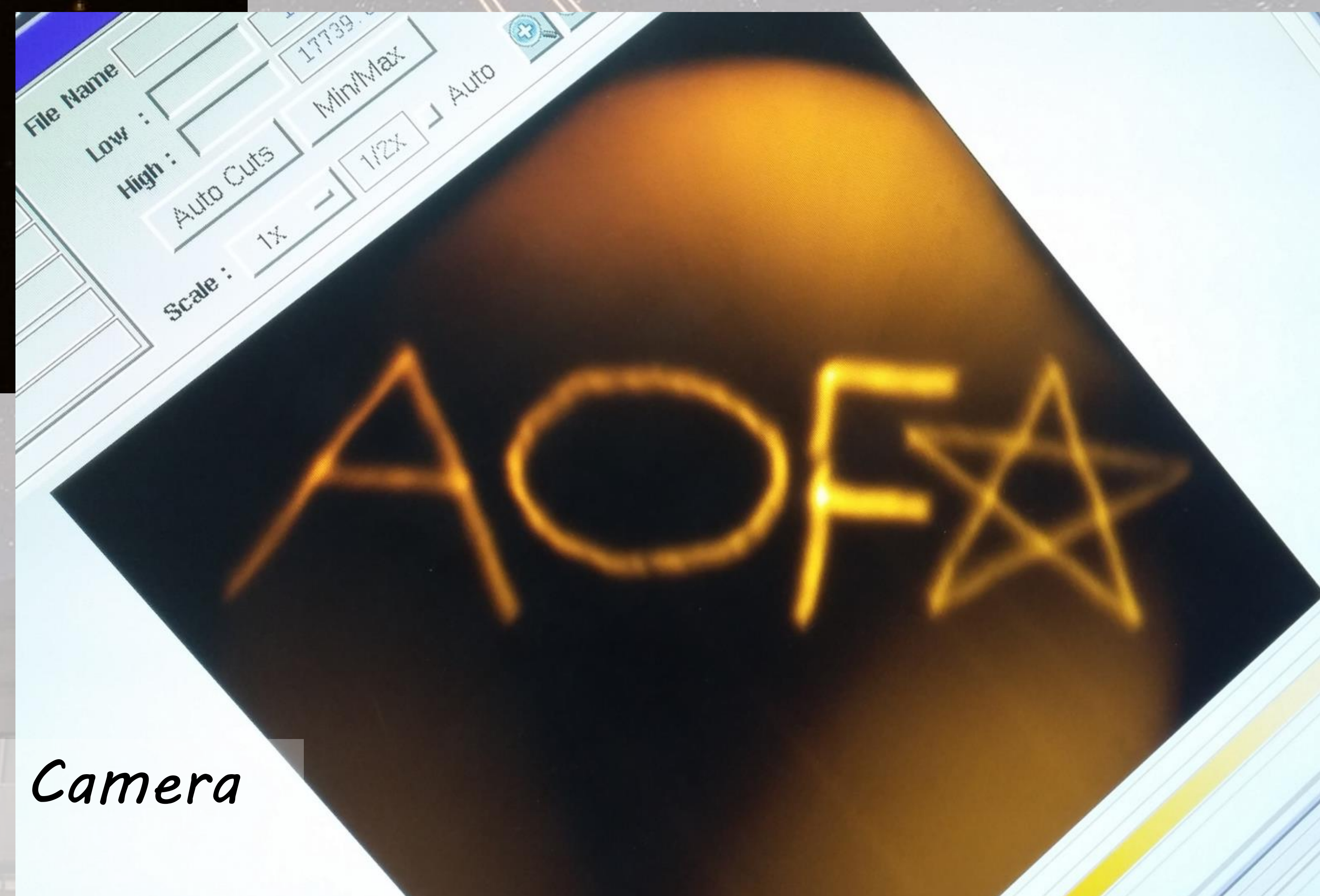
Close NGS TT loop

Close auxiliary loops

Control of the 4LGSF



4LGSF Laser Pointing Camera
4 sec exposure



GALACSI Commissioning Camera
1 sec exposure

The AOF: an Adaptive Telescope

Acquisition of the Lasers

- Pointing model
- Instrumental offsets
- Laser Pointing Camera in parallel to NGS Acquisition
- Spiral search

Focus Loop

- In non-Adaptive Mode, the telescope Active Optics set the position of the Scientific focus
- Focus Compensator tracks Sodium Layer
- Focus bootstrap minimizes Focus on LGS WFS
- When in Adaptive Mode, the Active Optics WFS used as Truth Sensor sends focus offsets to the Focus Compensator
- This Focus is immediately corrected by the High-Order loop and the DSM, and seen corrected by the Science instrument
- It is then slowly offloaded to the DSM Hexapod

Adaptive Telescope Loop

- Average DSM commands
- Measure Truth Sensor Focus

→

- Focus offload
- Offset Focus Compensator
- M1 support

→

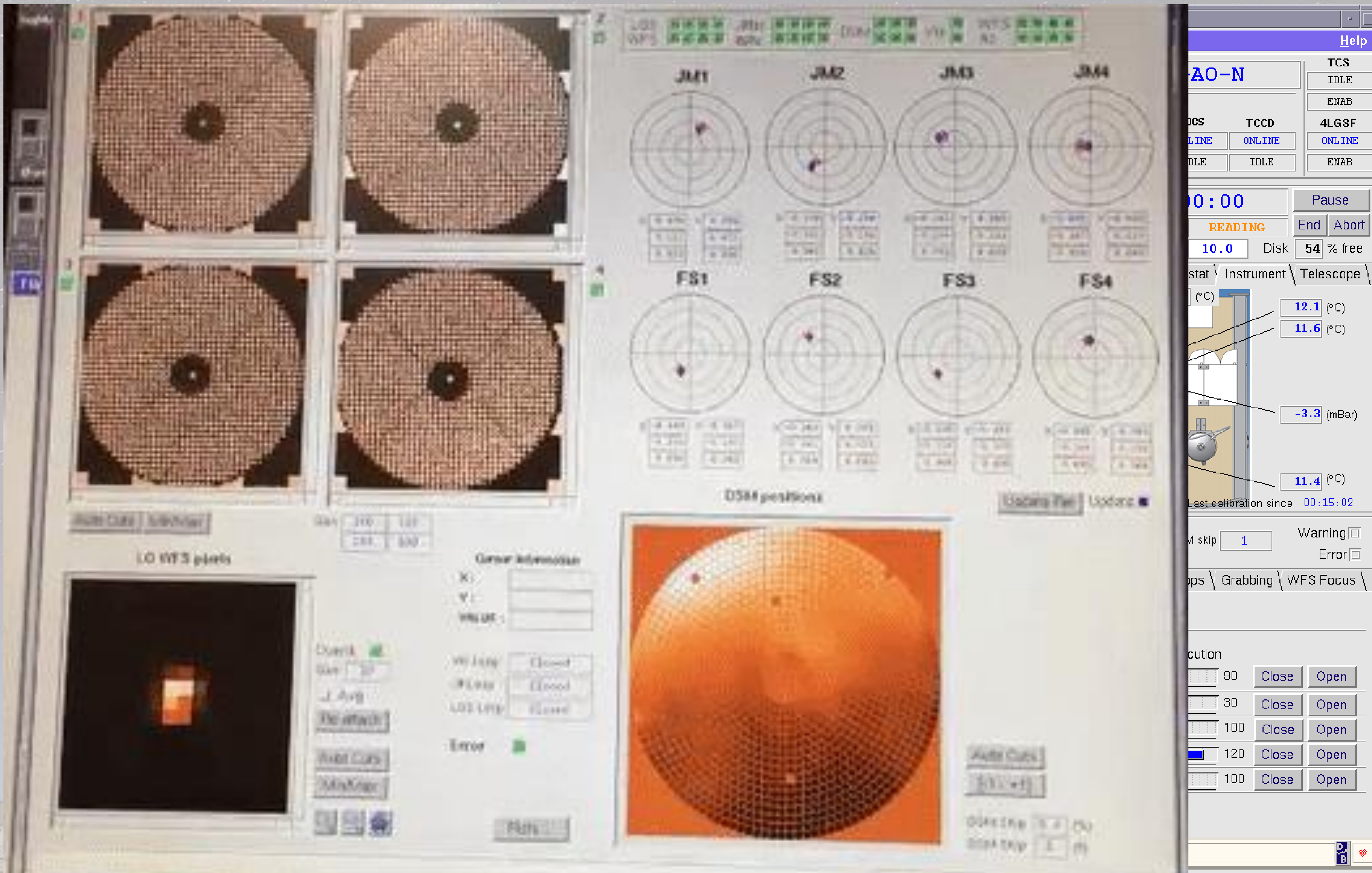
- Coma offload

→

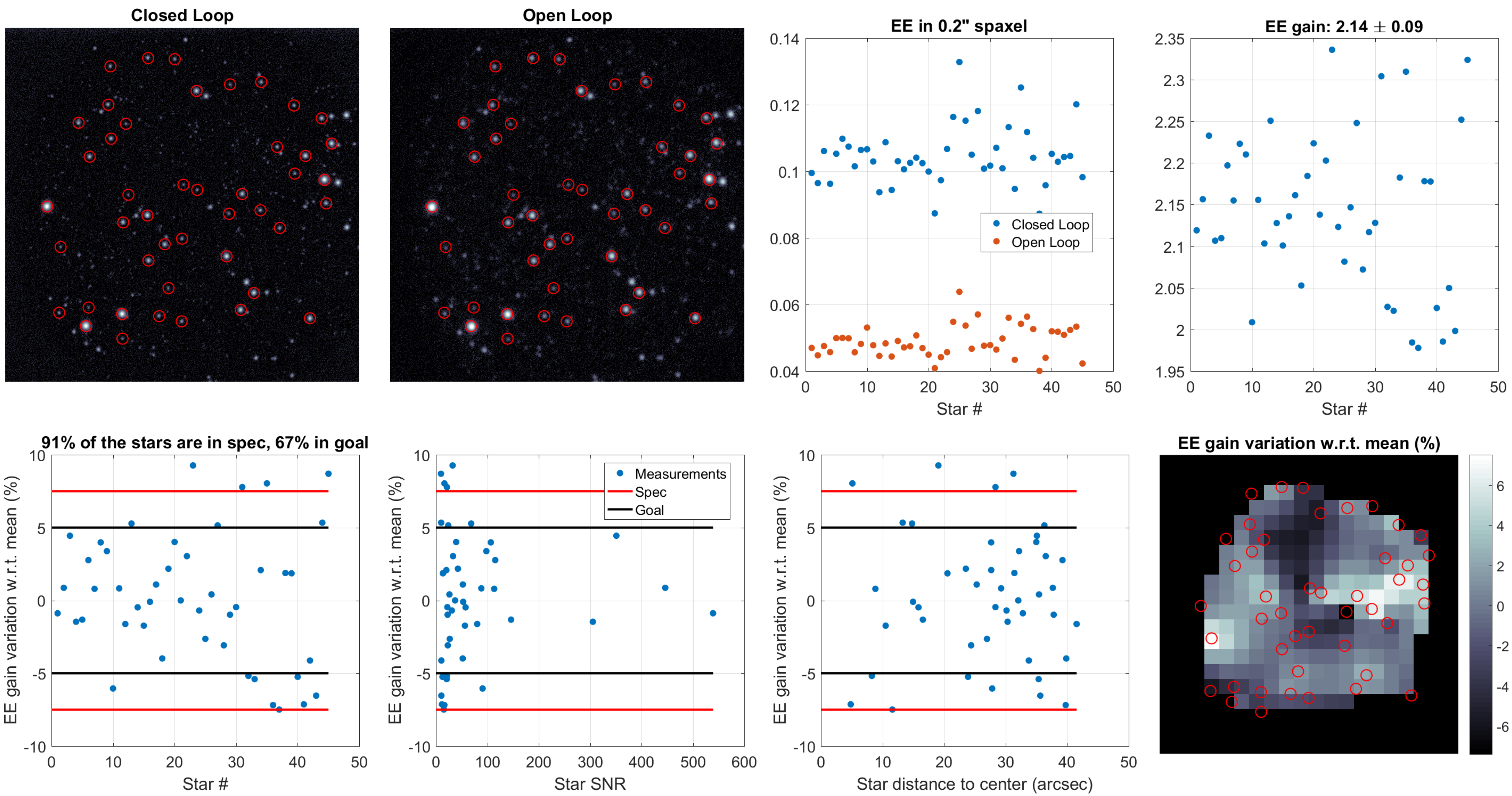
- High-order offload

↔ 90 sec

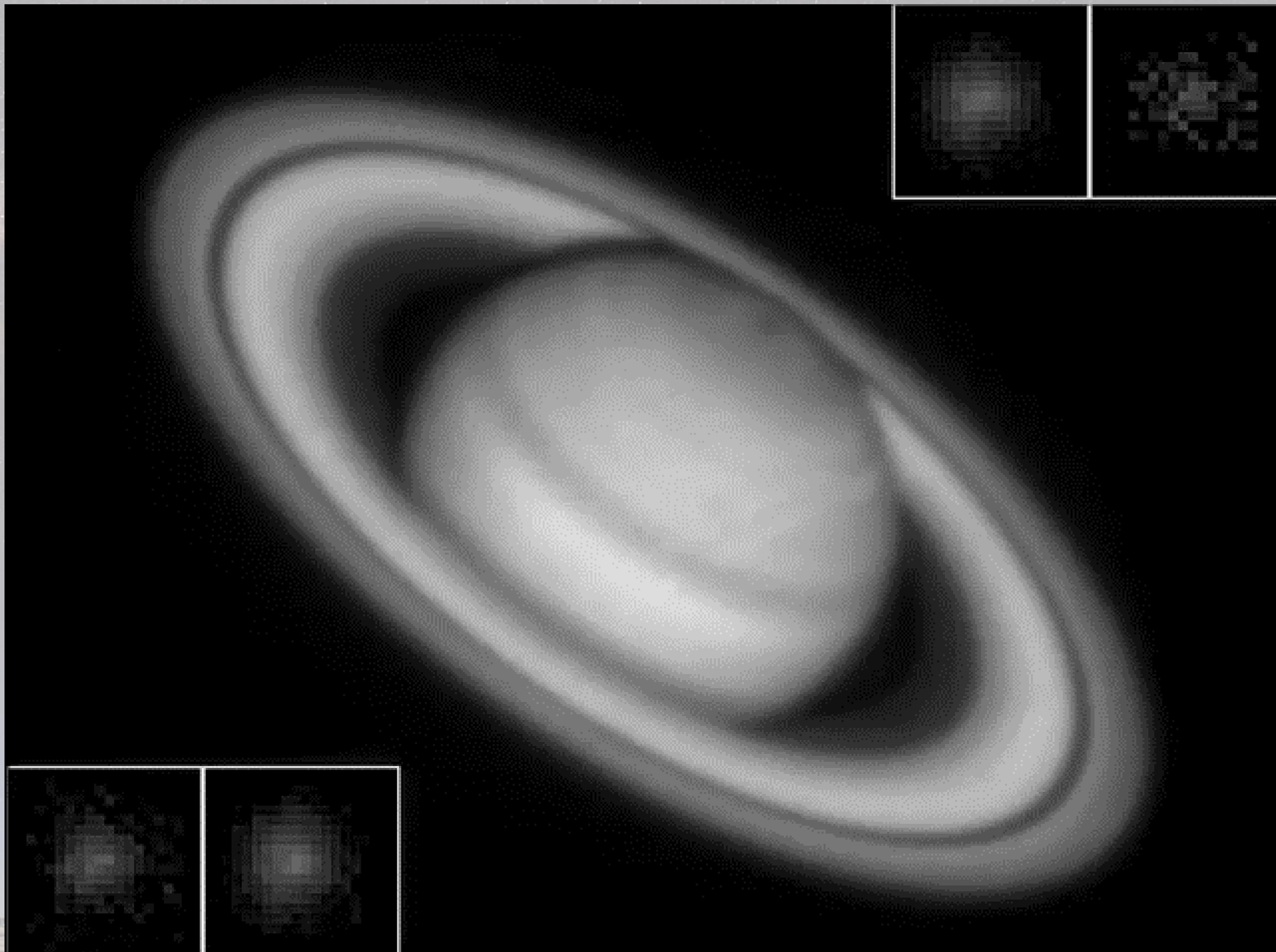
Displays


JM1
JM2
JM3
JM4
FS1
FS2
FS3
FS4
Help
AO-N
TCS
IDLE
ENAB
TCCD
ONLINE
IDLE
4LGSF
ONLINE
ENAB
Pause
End
Abort
READING
10.0
Disk
54
% free
Instrument
Telescope
12.1
11.6
-3.3
(mBar)
11.4
Last calibration since
00:15:02
Warning
Error
Grabbing
WFS Focus
Close
Open

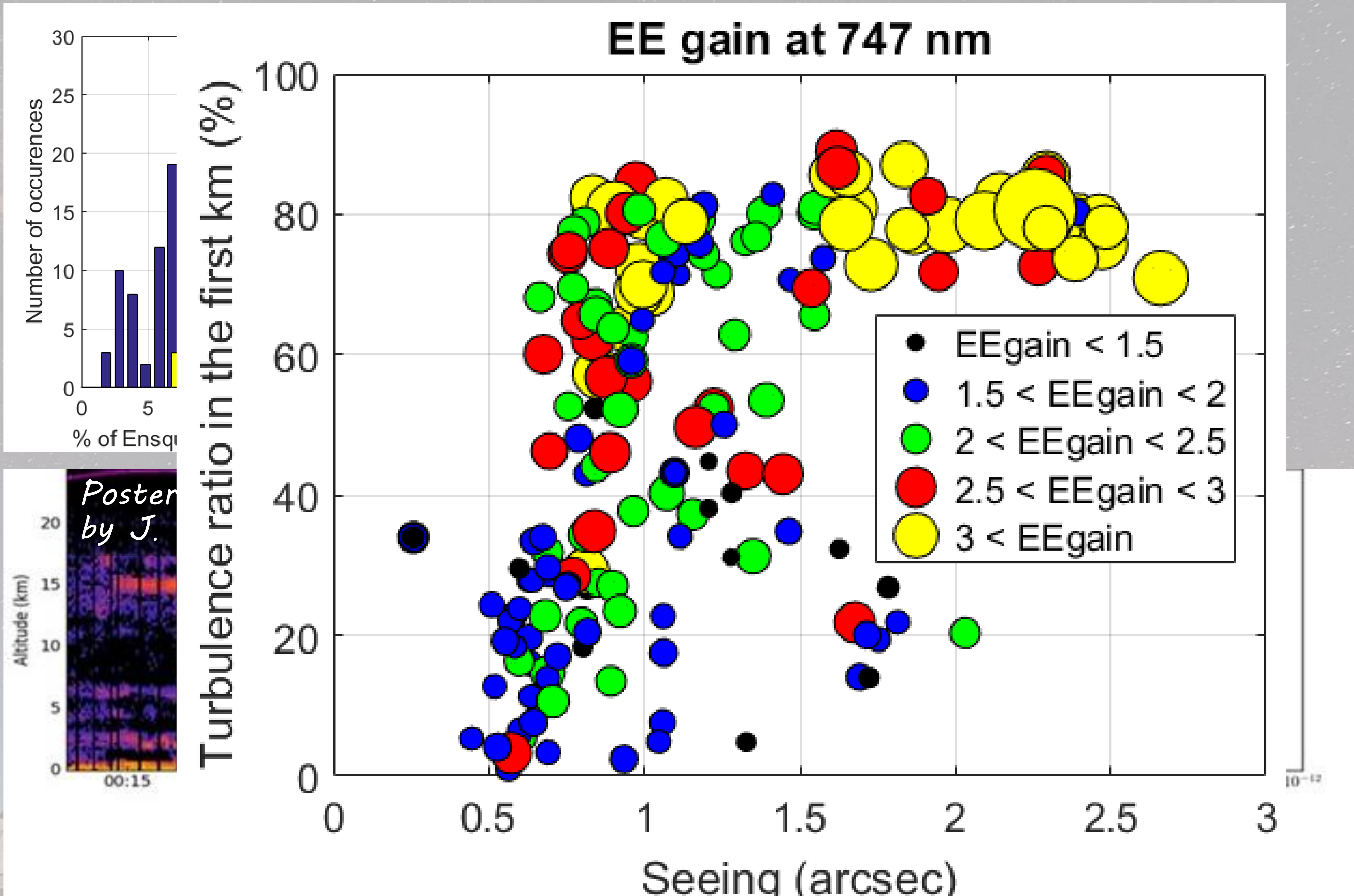
GLAO performance on sky #1



GLAO performance on sky #2



GLAO performance on sky #3



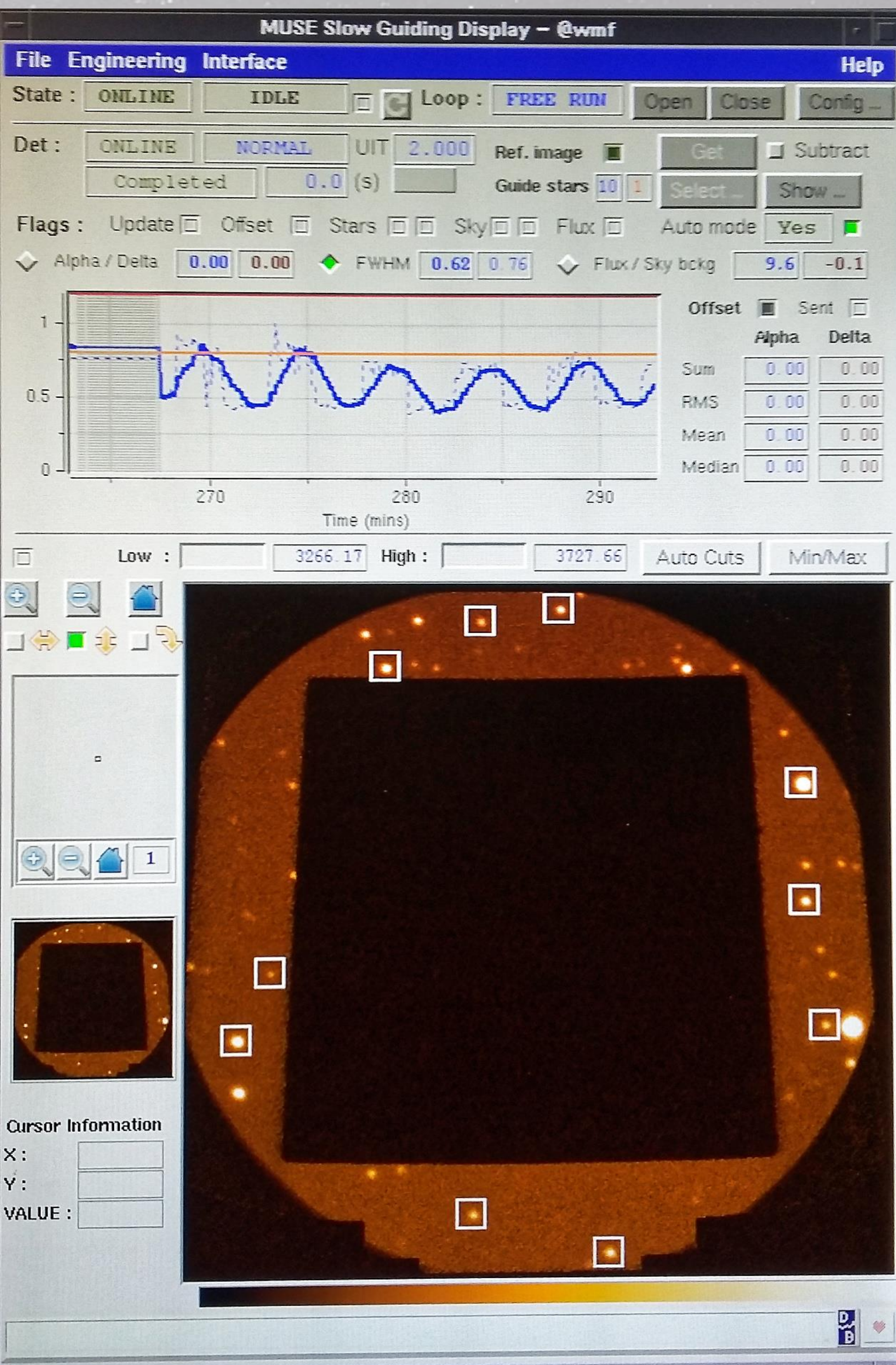
GLAO performance on sky #4

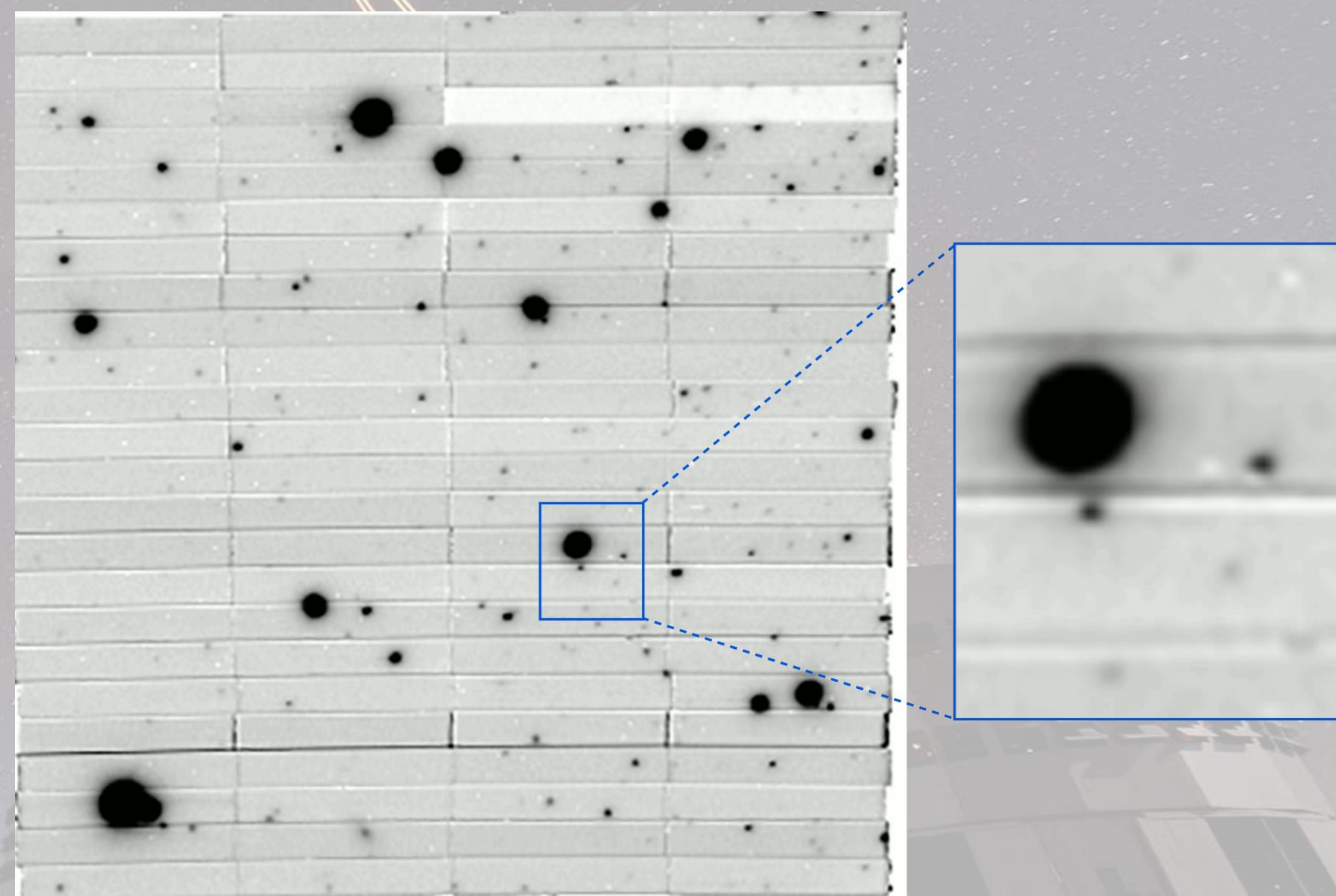
Various results:

- NGS faint-end results confirm the ones obtained in Garching: V magnitude 18.5 can be offered comfortably
- Beyond that GALACSI can still be used in "TT-free" mode (TT from Field Stabilization at 65 Hz far away in the FoV)
- Bright LGSs → no WFSing optimization required
- Jitter Loop keeps the LGS spots close to the WFS center
- Insignificant Non Common Path Aberrations
- Low sensitivity to loop gain and number of controlled modes
- Aircraft detection (< twice a night) freezes the LGS and Jitter loops for ~10 seconds
- When conditions are favorable (strong Ground layer), excellent performance improvement down to 500 nm
- Atmospheric and Performance parameters estimation from RTC data available every minute

MUSE results

http://muse-vlt.eu/blog/





To be Continued...