

Adaptive Optics Facility

*When cutting-edge technology
meets operational robustness
and performance*



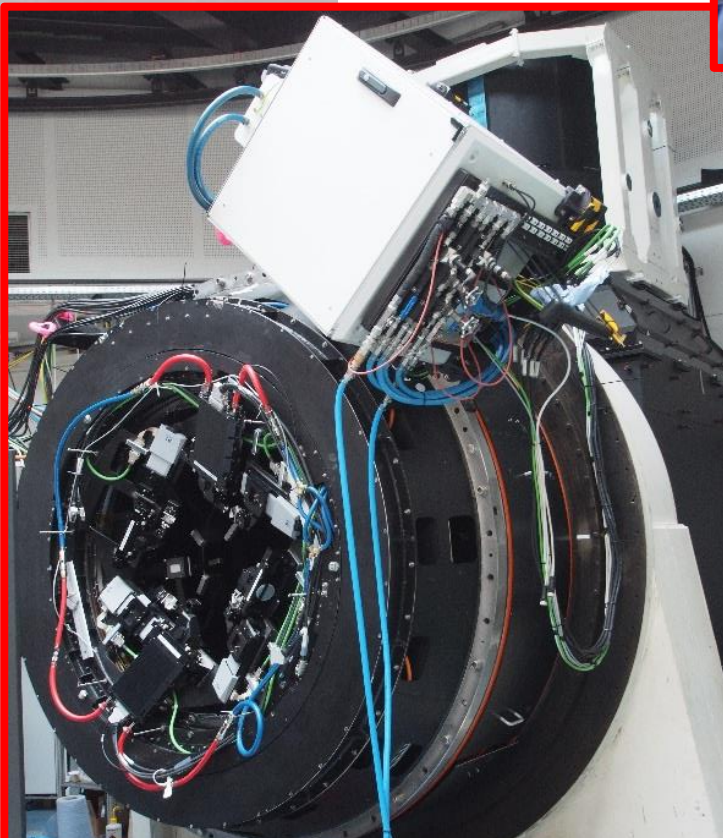
Pierre-Yves MADEC, on behalf of the AOF team



The Adaptive Optics Facility

DSM

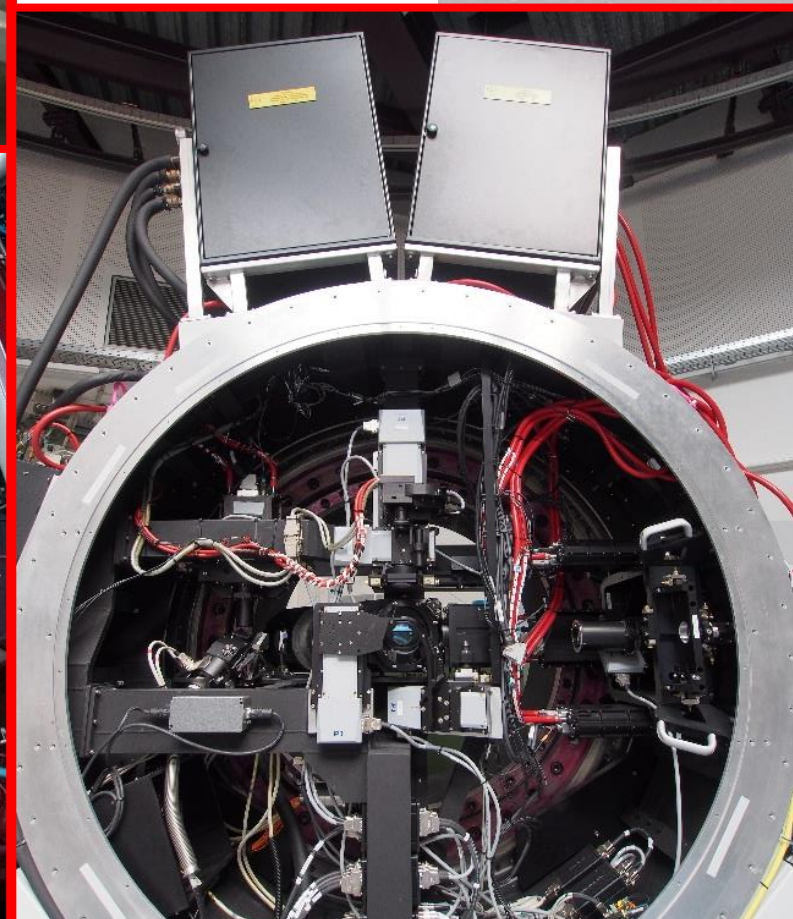
Four Shack-Hartmann LGS WFS 40x40 subap. 1 kHz
1 Tip-Tilt NGS sensor 200 Hz (visible or IR)
All visible sensors using $<1e$ RON CCD220 from e2v



GRAAL



4LGSF

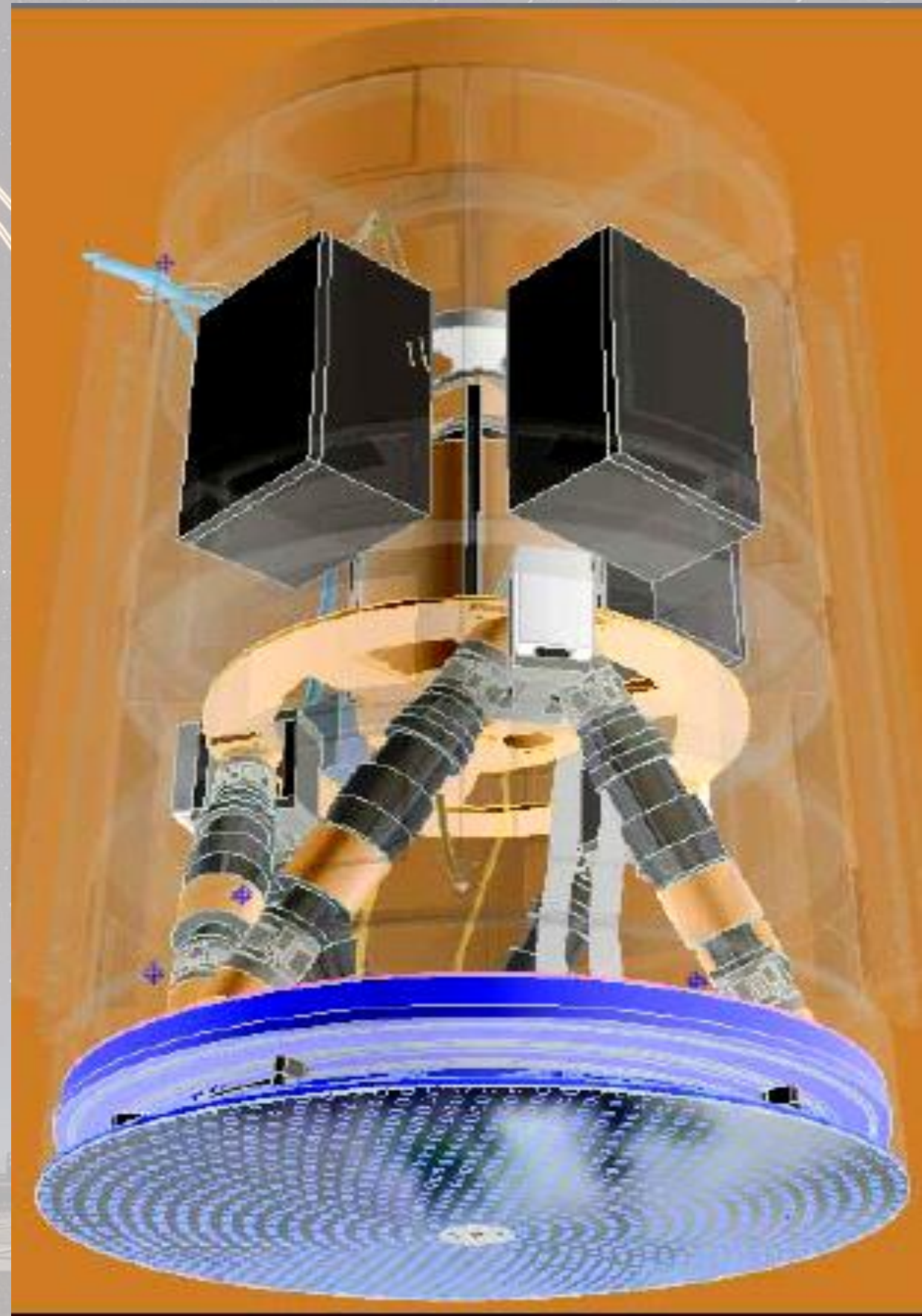


GALACSI



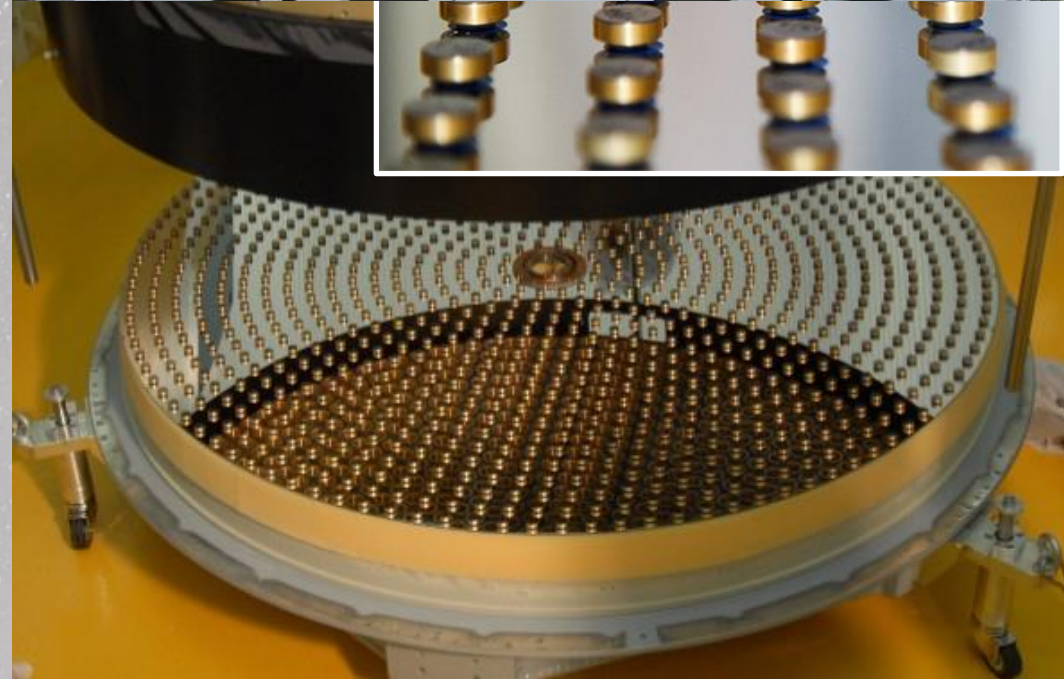
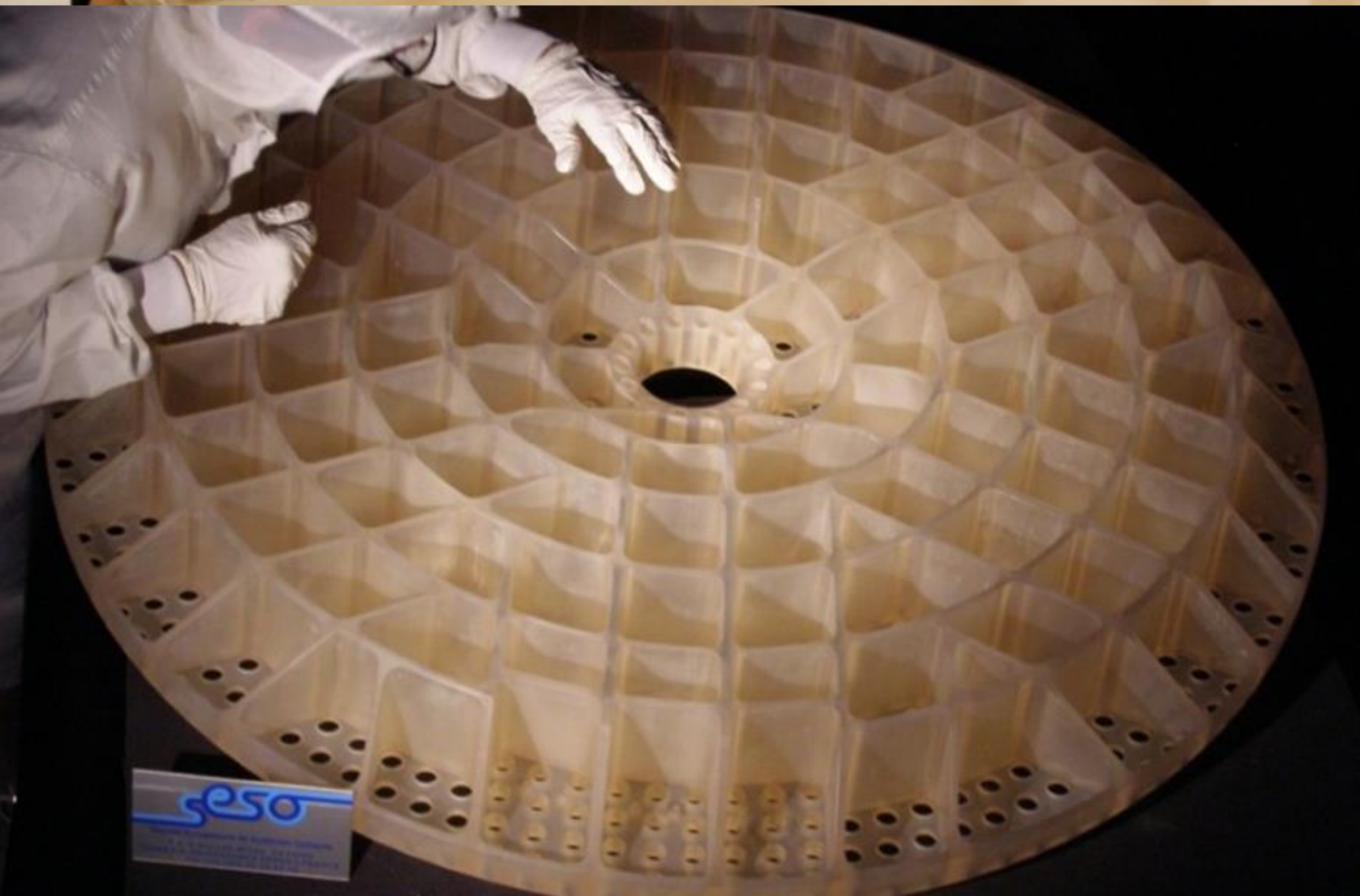
DSM/M2 Unit (Adoptica)

- Same functions and interfaces as the actual M2 Dornier
 - Optical diameter 1120 mm
 - Focus, centering, tilt/chop
 - Hub interfaces
- 2 mm Zerodur thin shell, with magnets glued on
- 1170 voice coil actuators
- Zerodur Reference Body
- DSM response time < 1 ms
- Liquid cooled (1.5 kW)





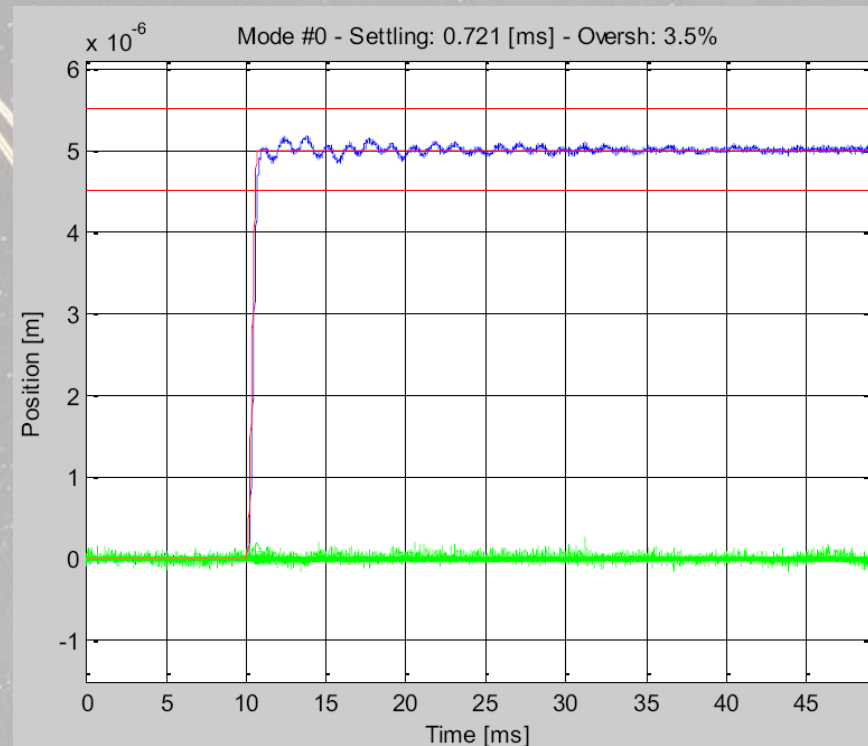
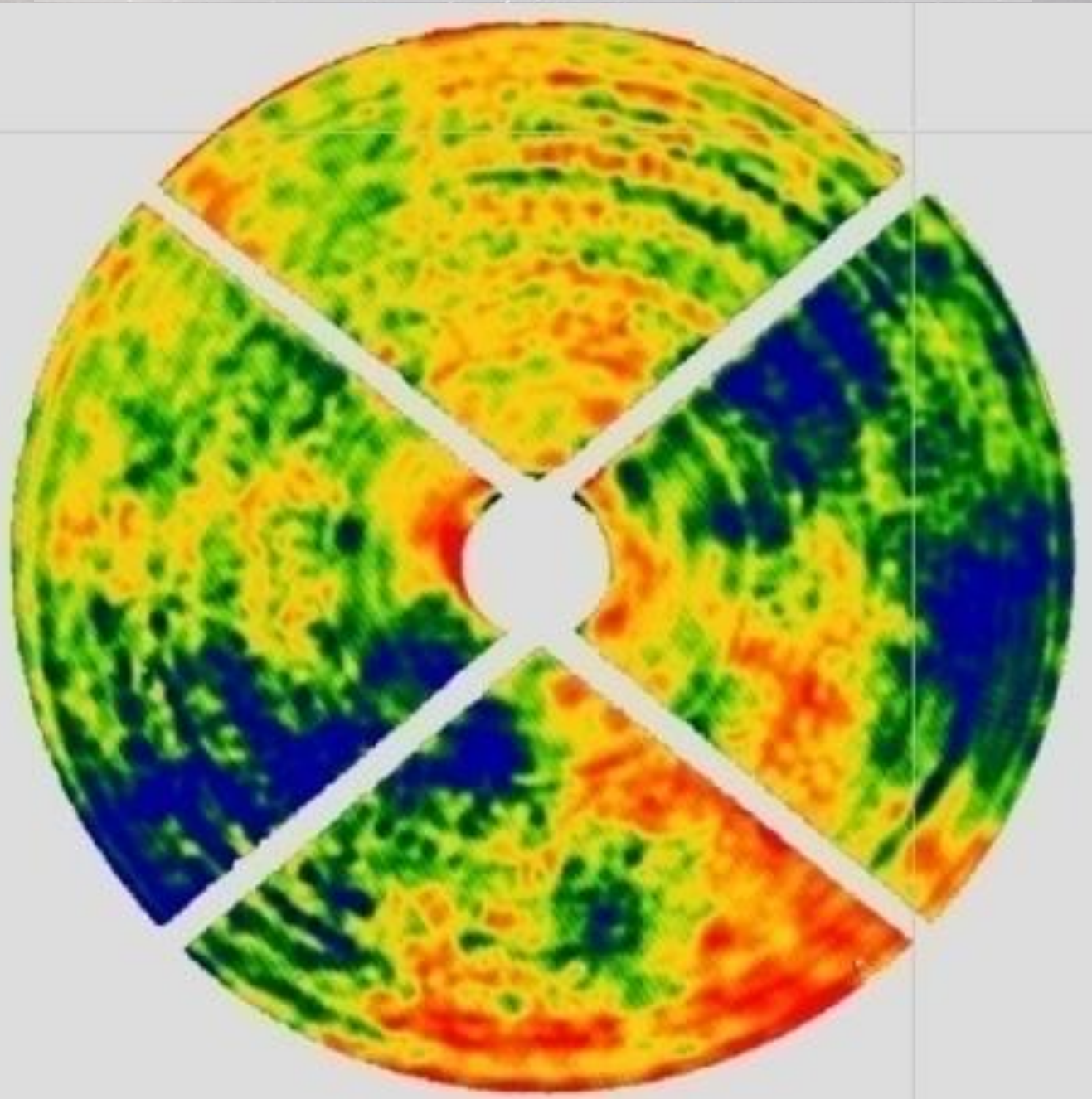
DSM Hardware (Adoptica / REOSC / SESO)



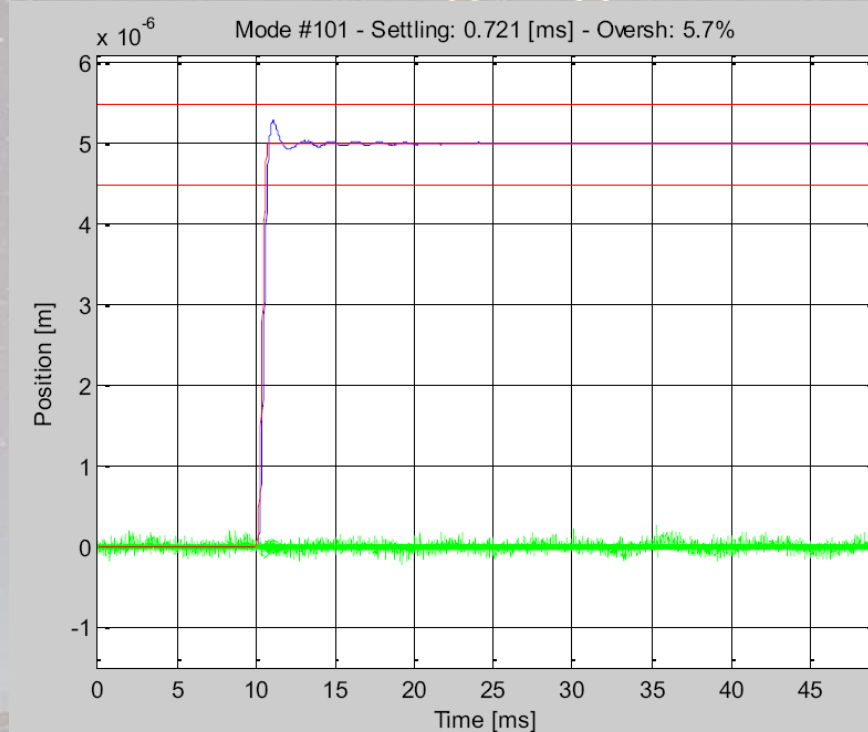
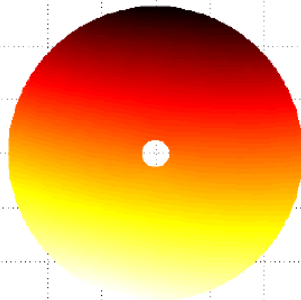


DSM performance

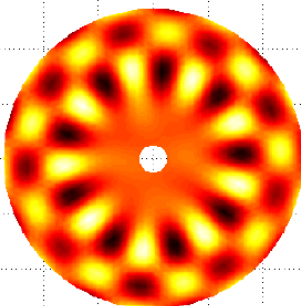
Best surface figure of the DSM
< 10 nm RMS



Mode# 1 (tip)



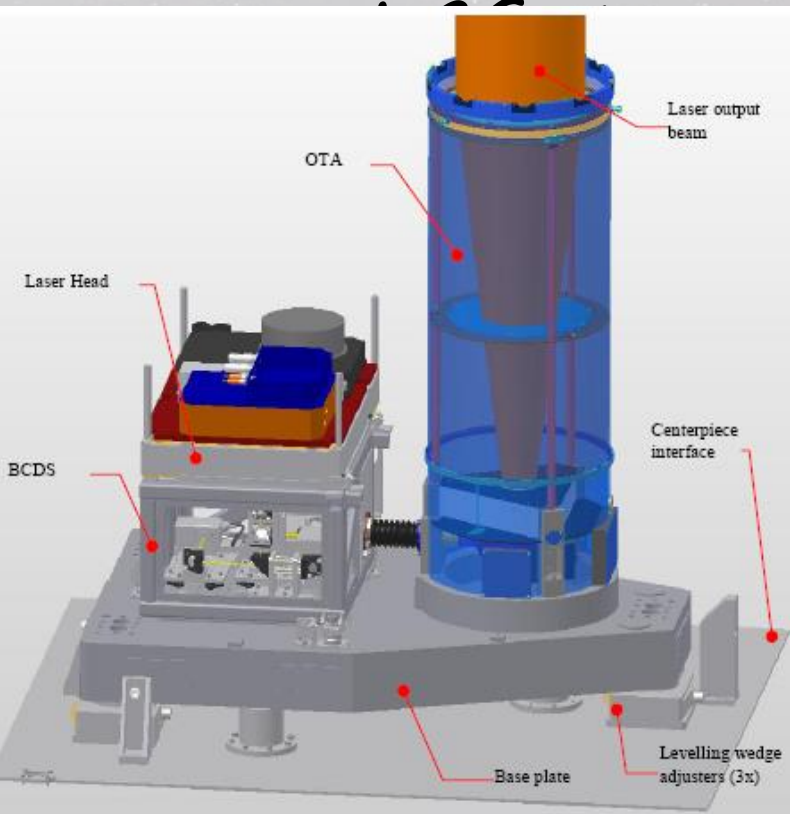
Mode# 100





4 Laser Guide Star Facility

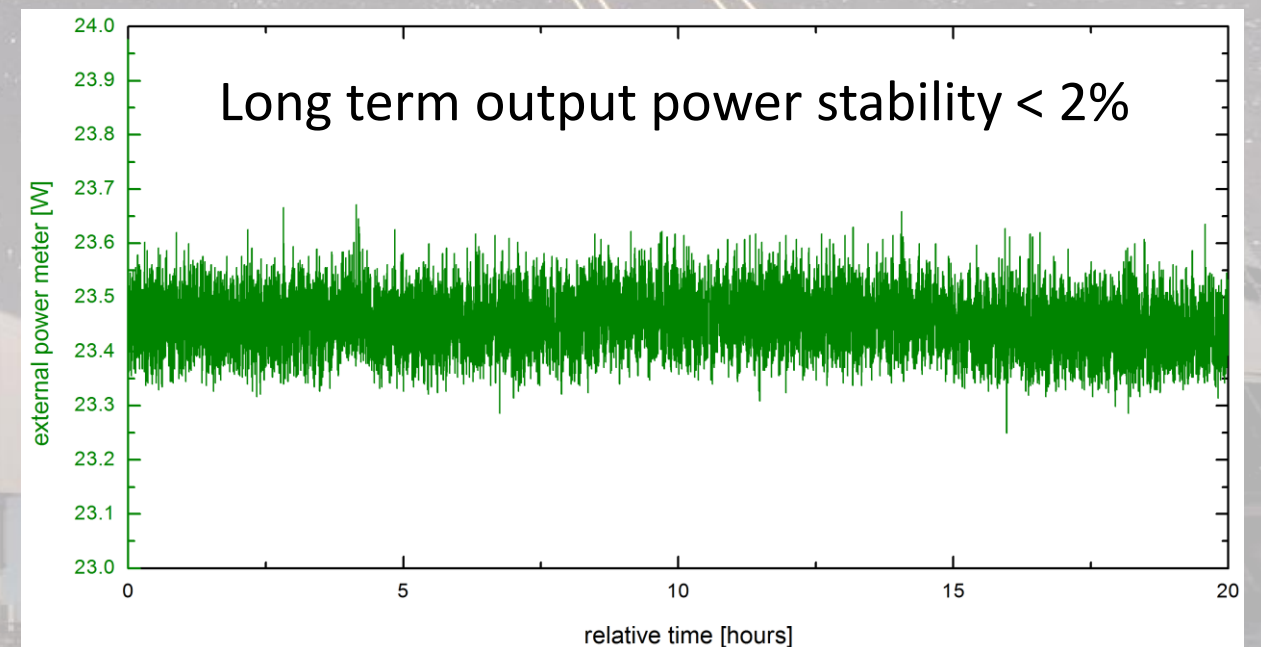
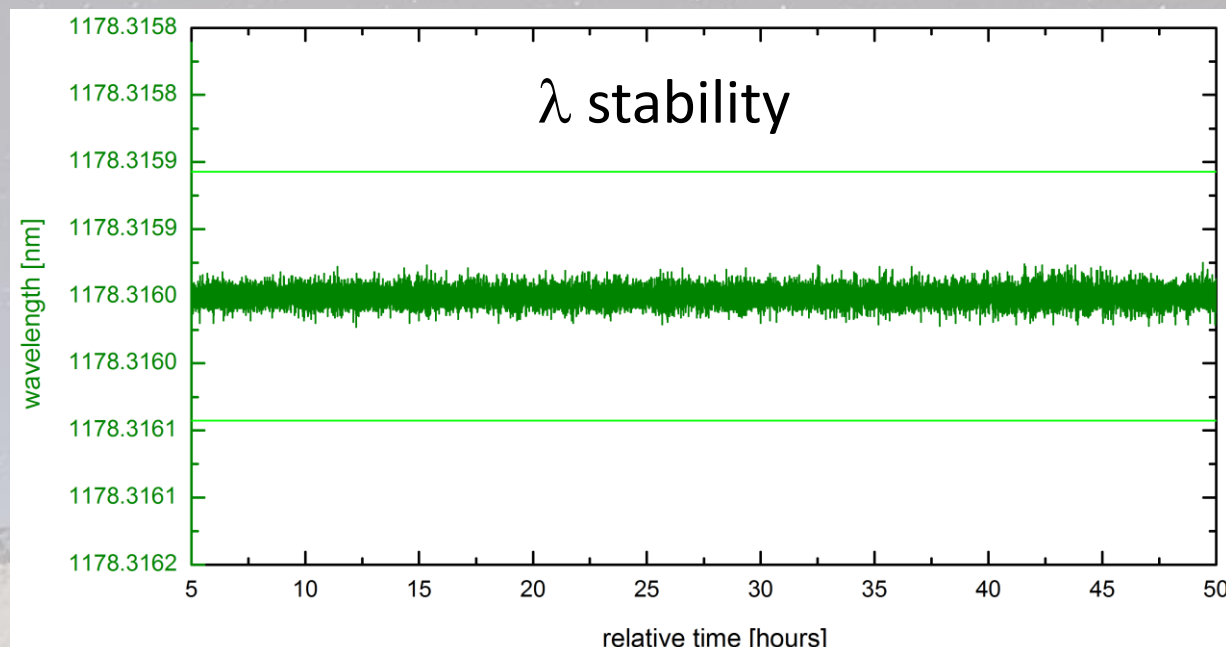
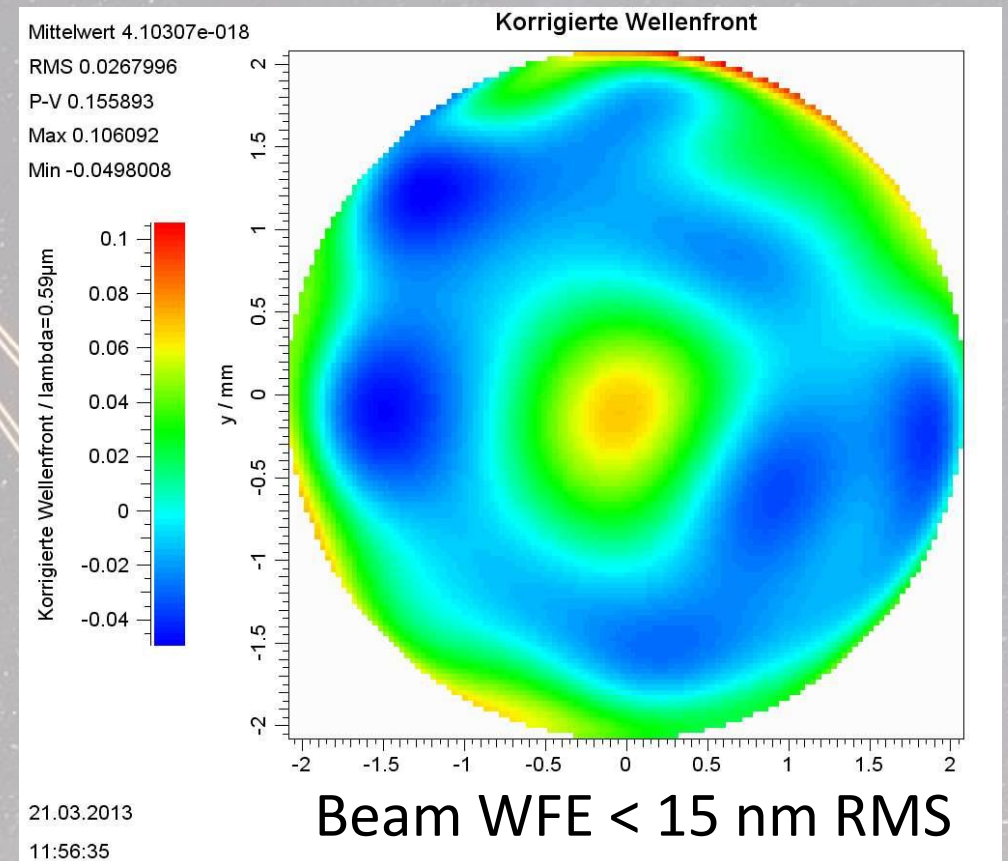
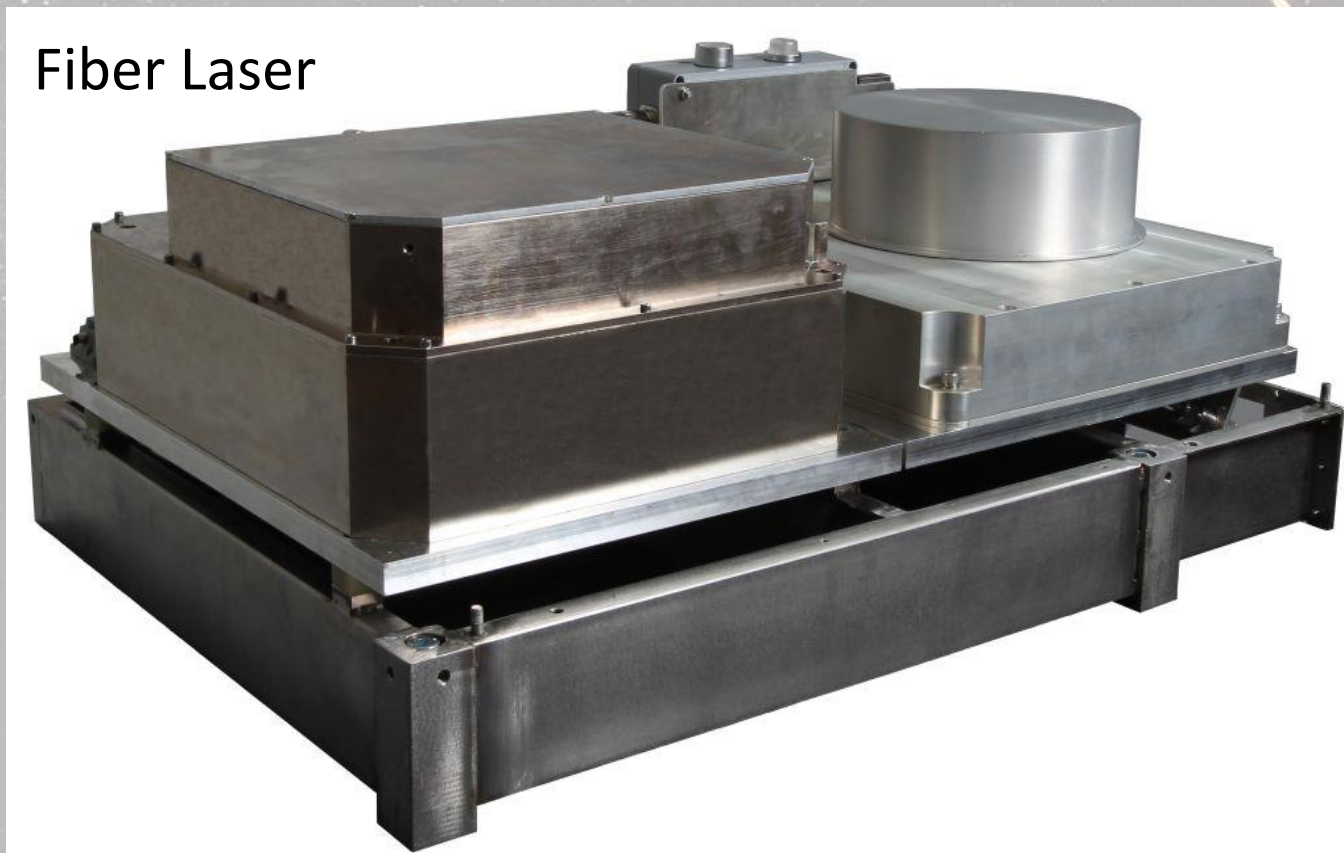
- 4 identical LGS Units, assembled on UT4 Center Piece
 - One 40 cm diameter Launch Telescope (TNO)
 - Control of LGS position (0-6 arcmin from optical axis)
 - One Beam Control and Diagnostic System (ESO)
 - Control of focusing altitude (70 to 200 km)





Toptica laser performance (courtesy Toptica)

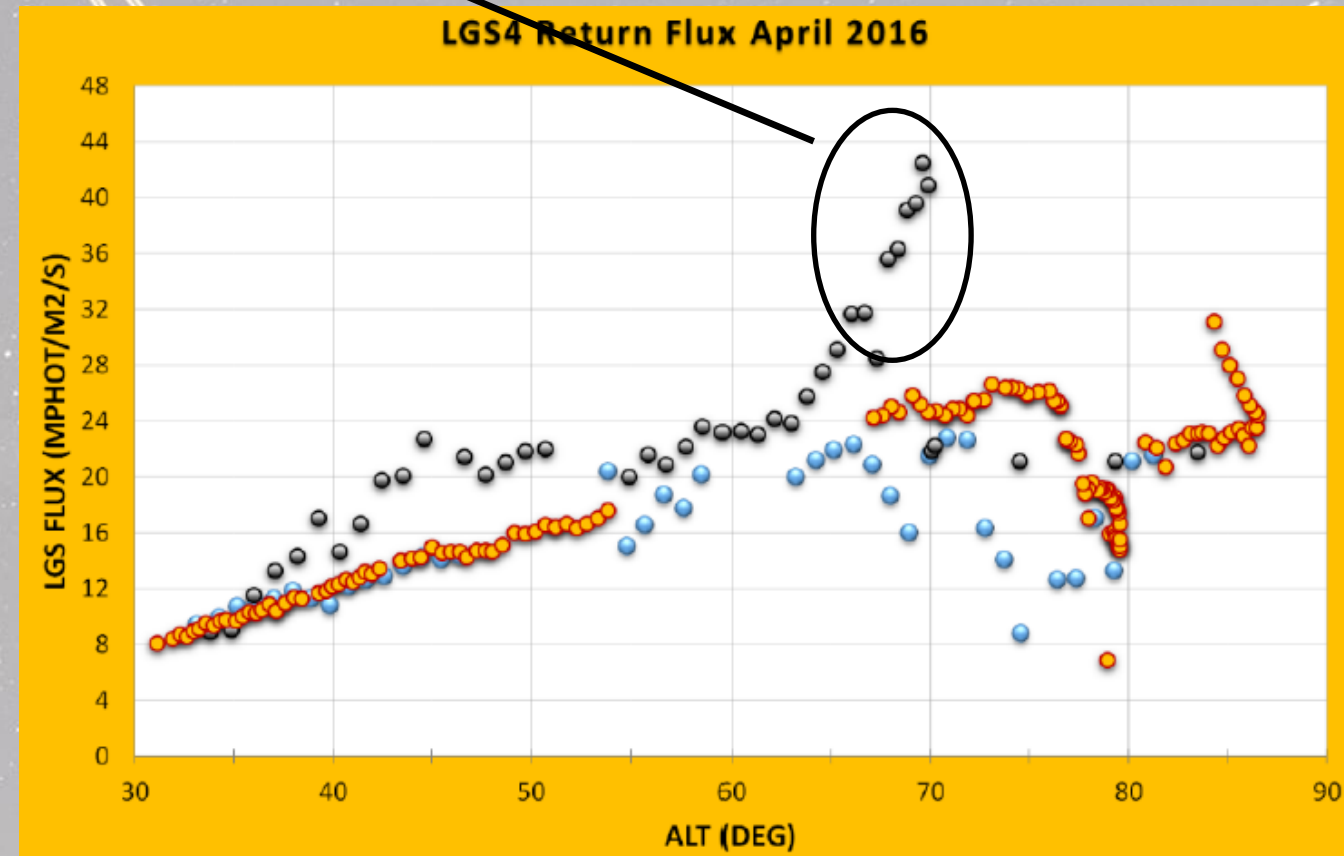
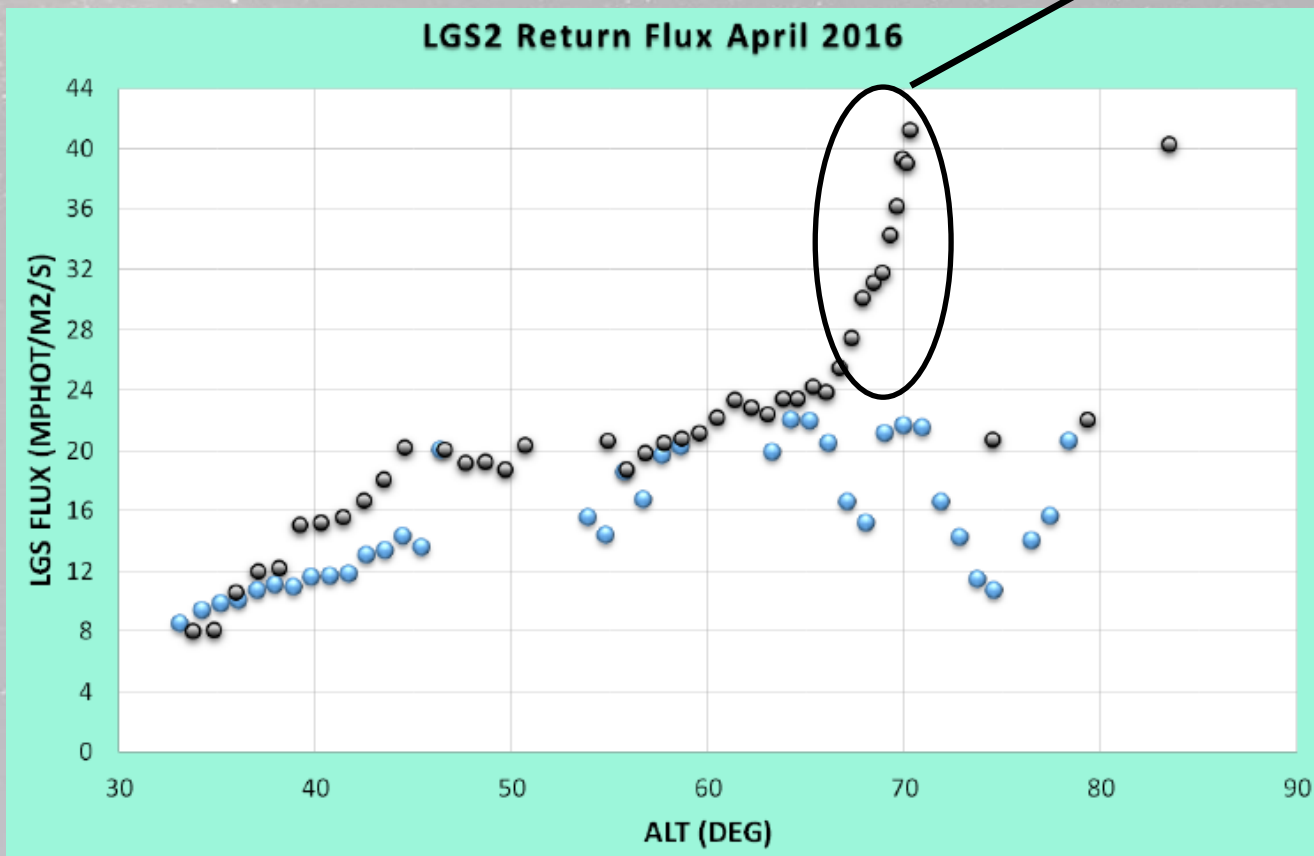
Fiber Laser





Return flux - on-sky data

Na sporadic



Return flux > 8 Mphotons/m²/s in UT4 entrance pupil
(data recorded in May 2016)

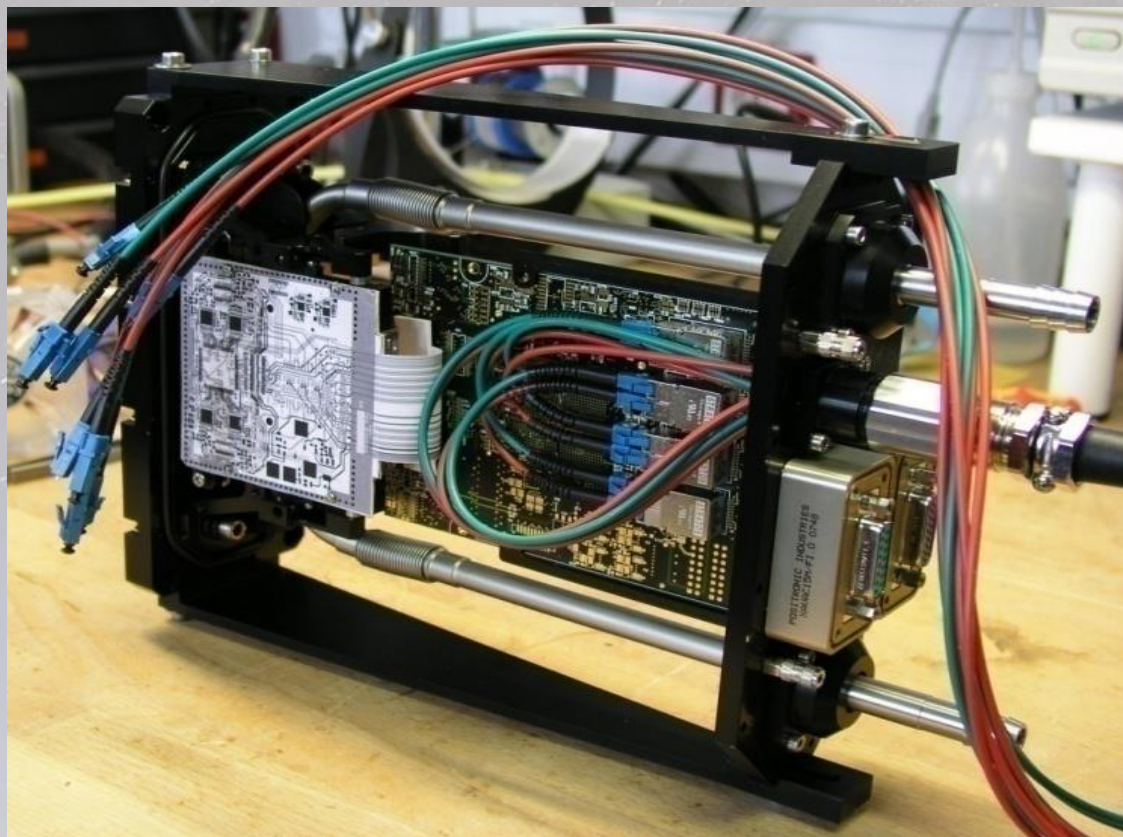


0 Read-out Noise WFS cameras



E2V CCD 220

- EM CCD detector
- 240x240 pixels
- 24 μm pixel scale
- > 80% QE @ 589 nm
- 0.1 e⁻ RoN @ gain 1000
- Up to 1200 fps



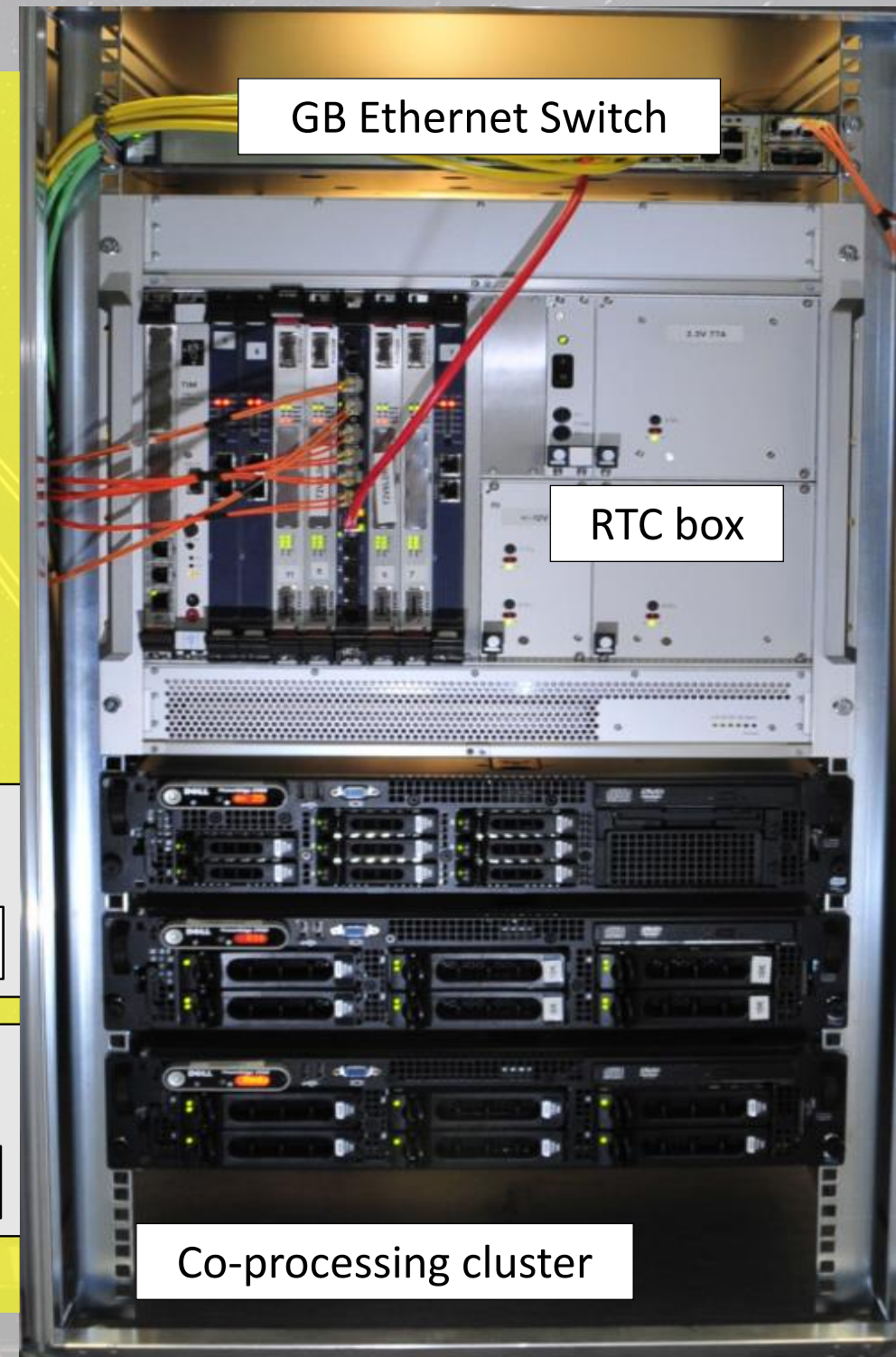
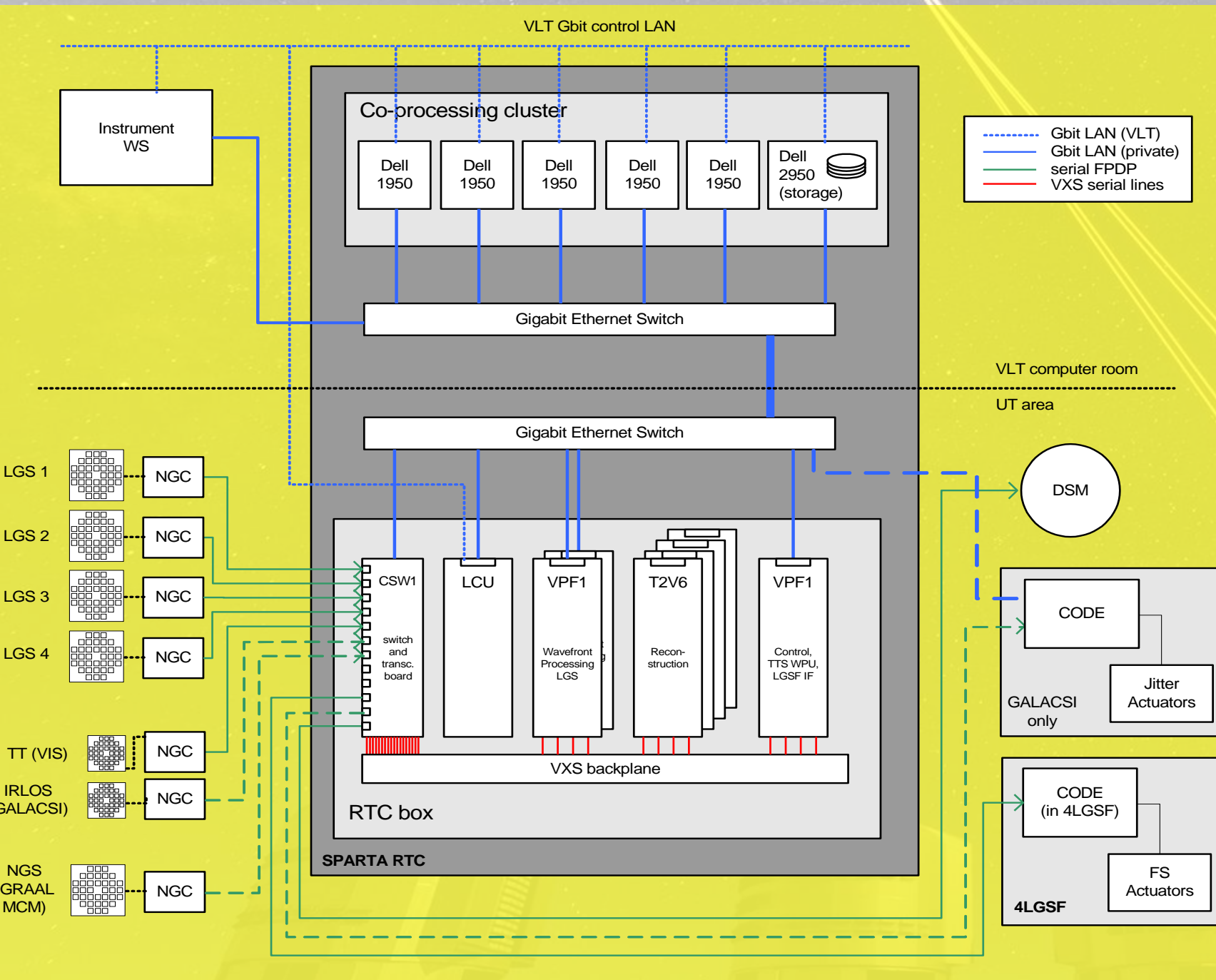
WFS camera head



The 16 AOF WFS cameras

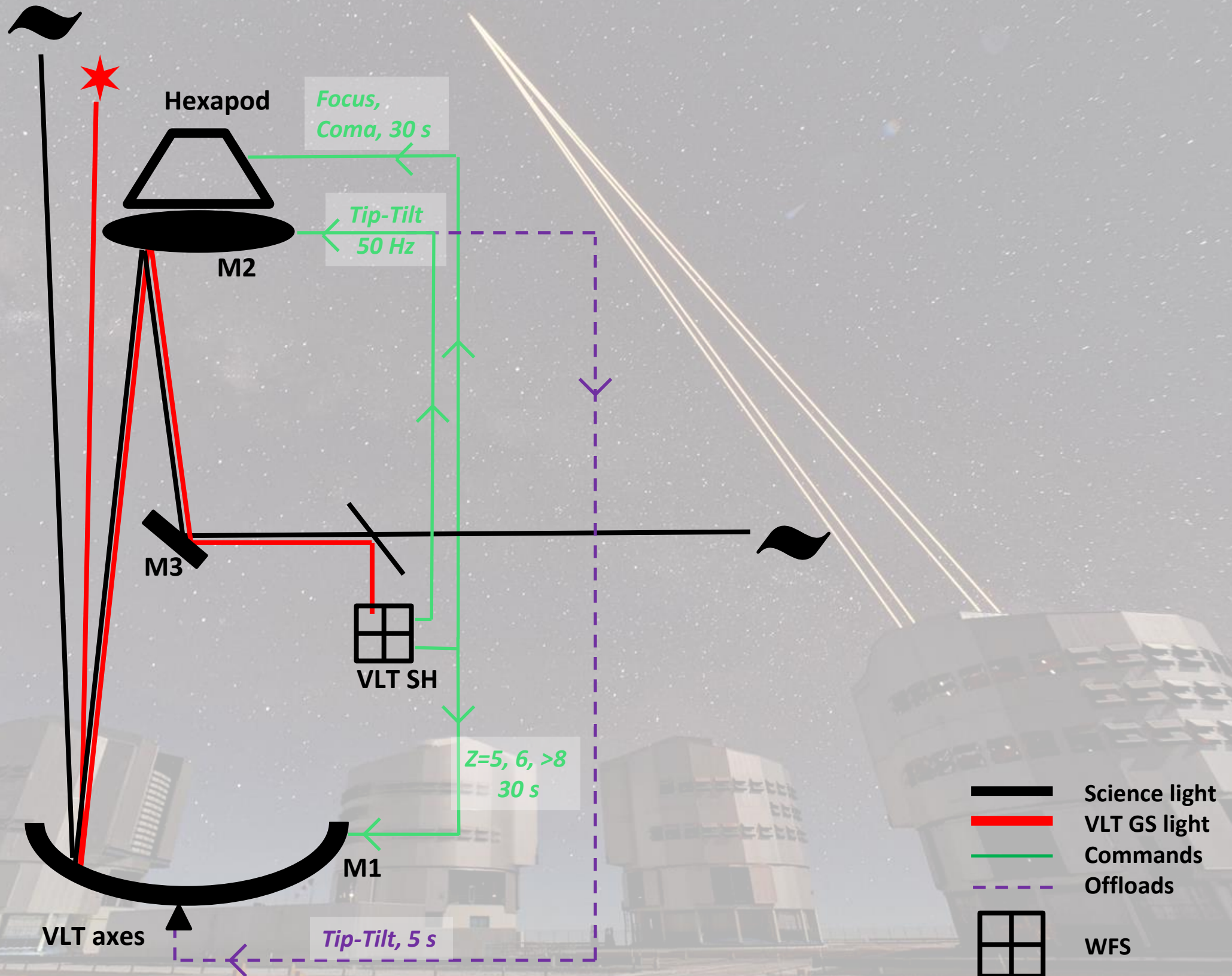


SPARTA: the ESO RTC platform for VLT



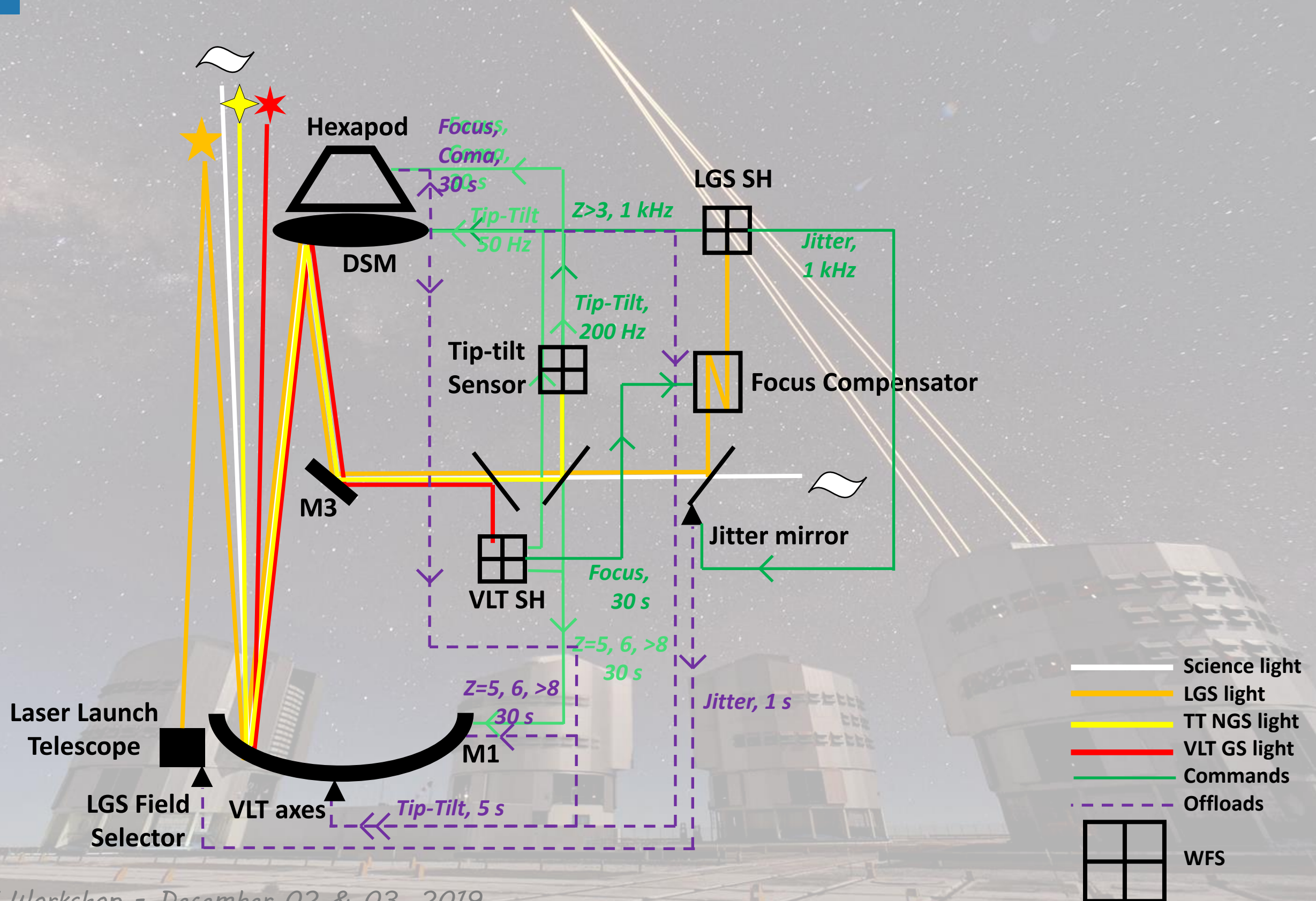


Telescope control in non-AO mode





Telescope control in AOF mode



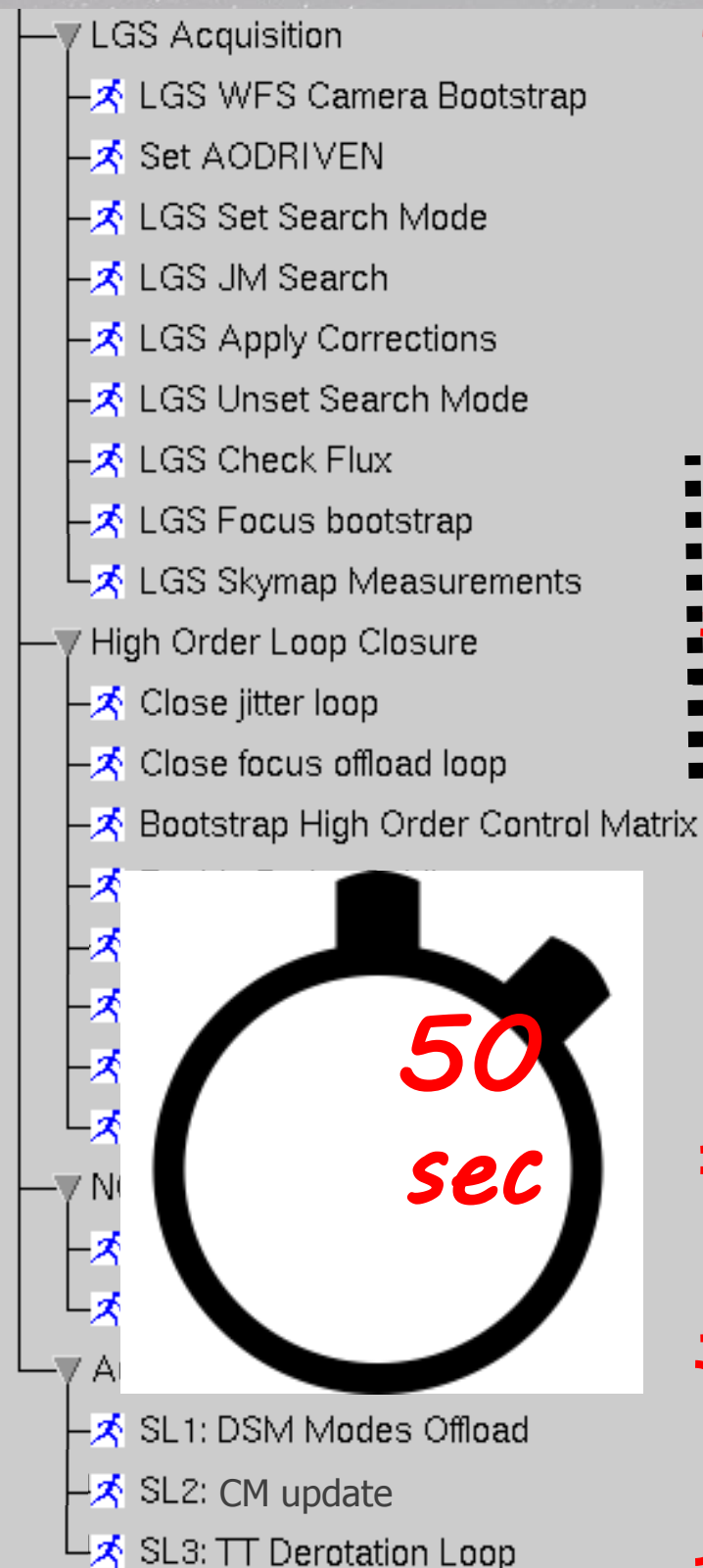
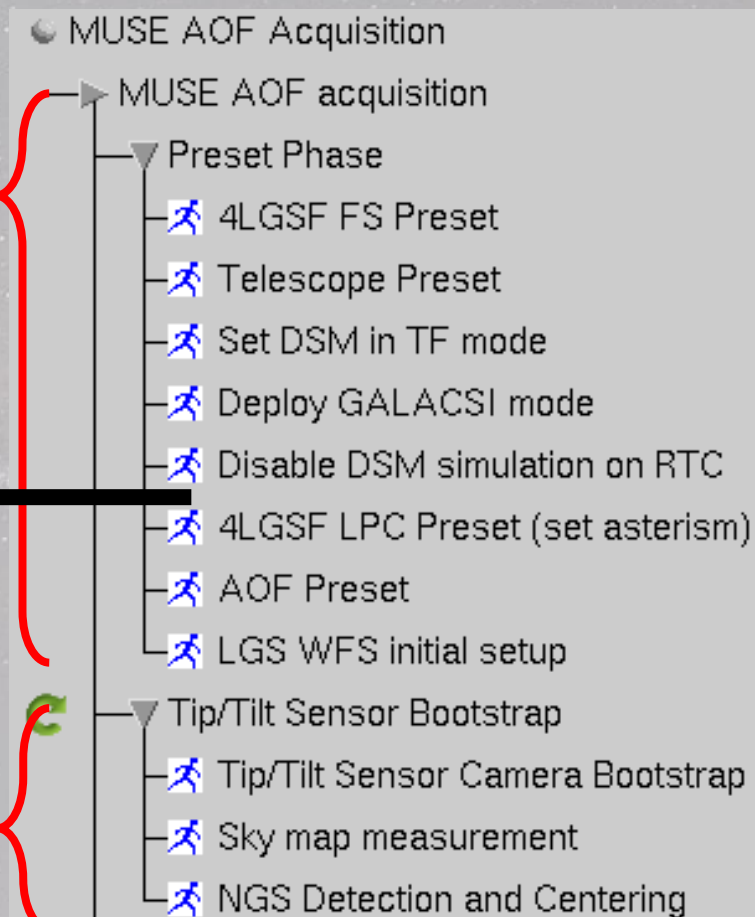


AOF acquisition sequence

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

*Wait for 1
Act. Opt.
correction*

*NGS
acquisition*



*LGS
acquisition*

*2 Act. Opt.
correction*

*Close LGS
WFS loops.
Take control
of telescope*

*Close NGS
TT loop*

*Close
auxiliary
loops*

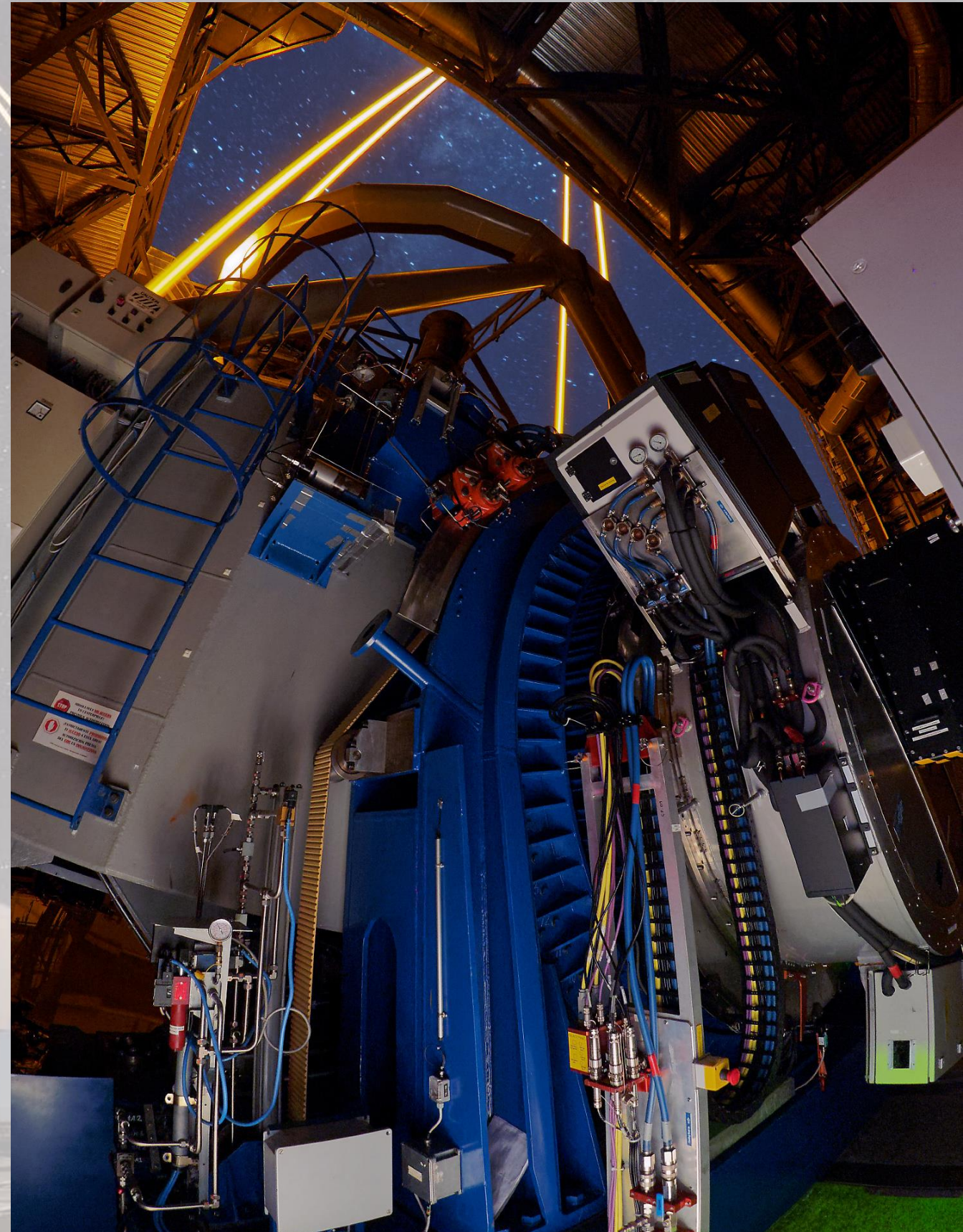
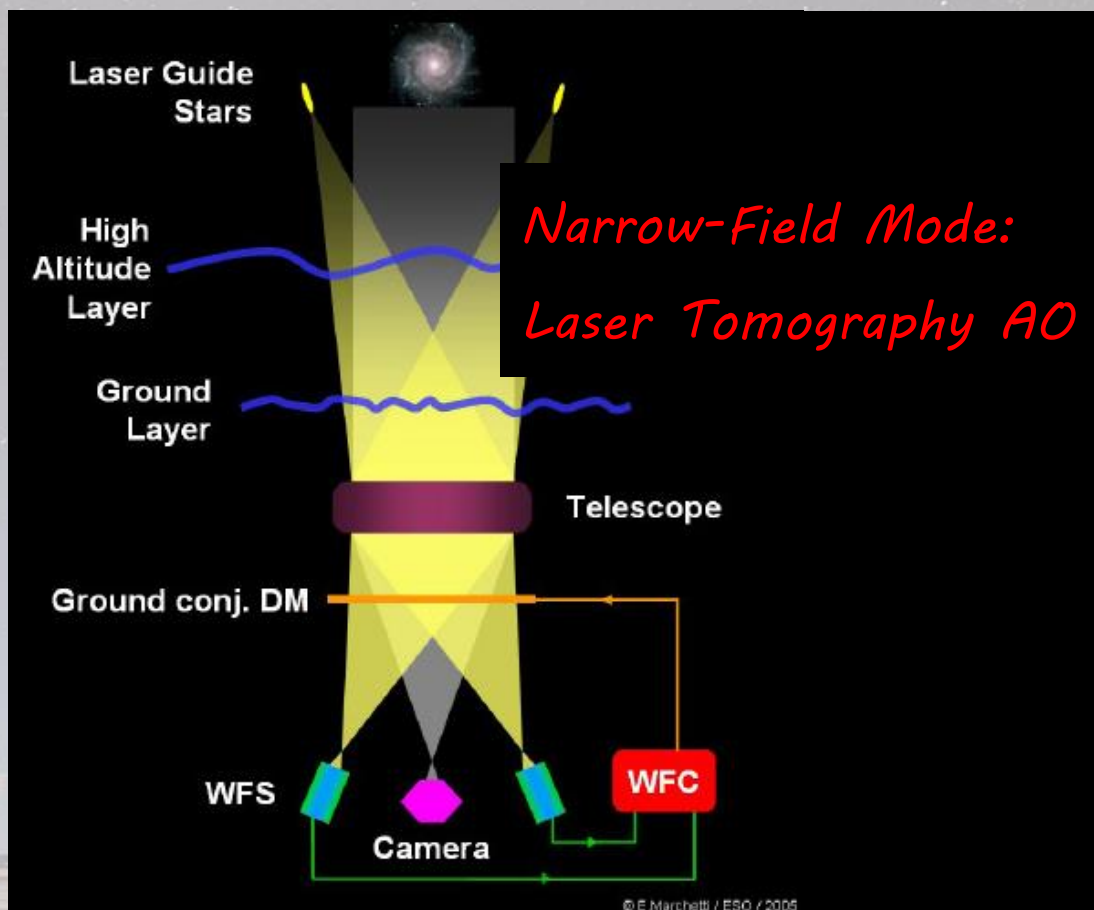




Laser Tomography mode of AOF

LTAO to feed the MUSE
Narrow-Field Mode:

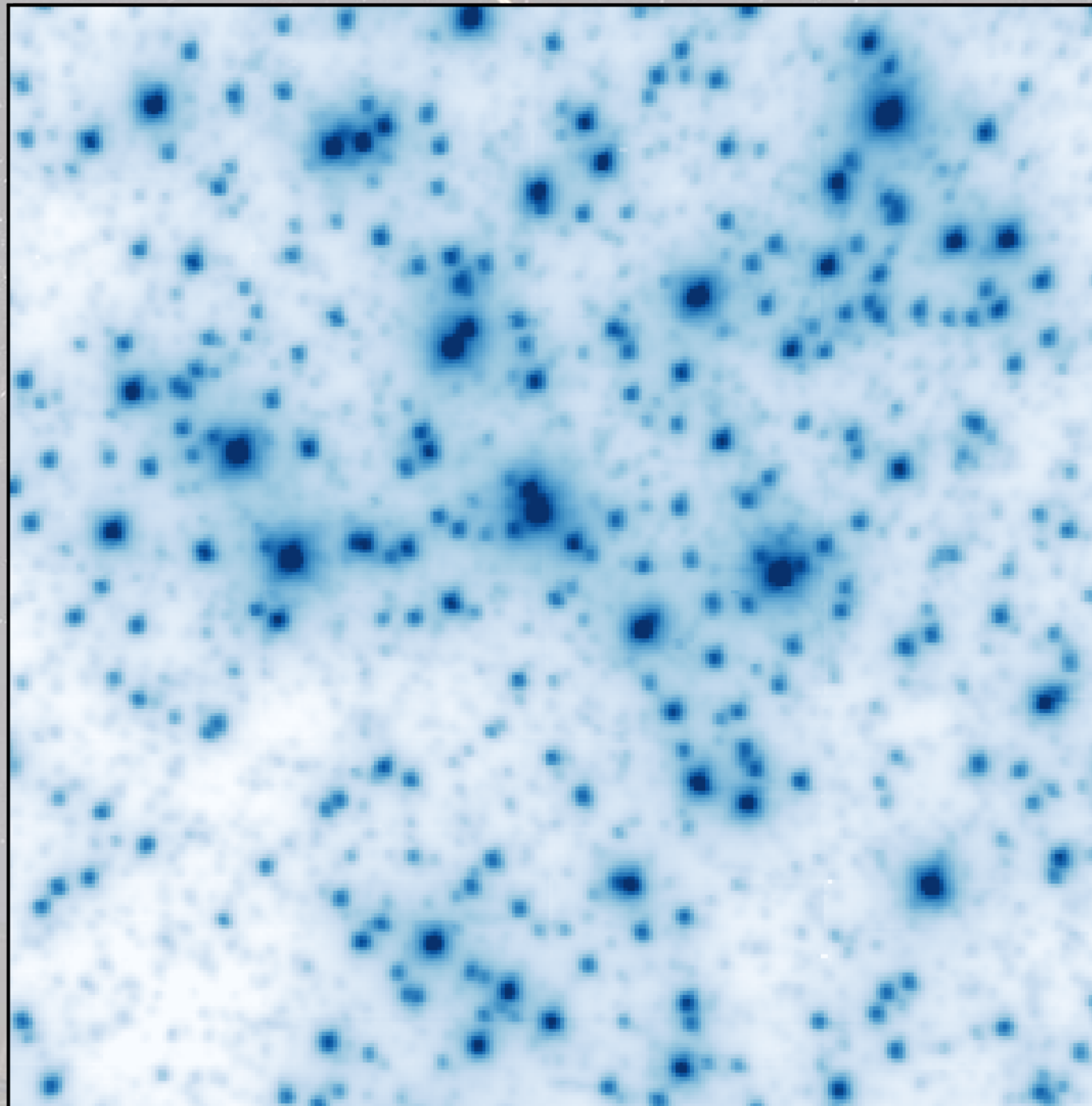
- Goal: 10% Strehl Ratio in the visible
- 4 LGSs located ≈ 10 arcsec from the optical axis
- Only 1 dichroic inserted in the MUSE scientific FoV





LTAO - AOF on-sky results

NGC 6388
MUSE MFM image
7x7 arcsec²
Seeing limited
0.05 arcsec fwhm





What could also have been of interest for you...

LTAO reconstructor: how to go from 4 LGS WFS to one DM control, going through a tomographic reconstruction process

Synthetic Interaction Matrix: numerical model of the DM influence functions, numerical model of the WFS, mis-registration parameters

On-line measurement of the DM/WFS mis-registration: from closed loop telemetry data, without any additional perturbation signal

On-line characterization of r_0 , L_0 , C_n^2 profile, return laser flux, laser spot size...

Vibration control

...



AOF Family

- **Sub-Systems Responsible**

J. Paufigue, P. La Penna, E. Vernet, J.-F. Pirard, W. Hackenberg

- **Science**

H. Kuntschner, J. Vernet, R. Siebenmorgen

F. Selman, P. Hibon, B. Yang, G. Hau, F. Vogt, C. Opitom

- **AO Experts**

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- **Laser Experts**

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- **Mechanics**

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- **Control & RTC**

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- **Electronics**

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- **Detectors**

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- **Software**

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- **Integration**

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- **Operation**

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C. Reyes, I. Blanchard, D. Parraguez, I. Aranda

- **Oversight**

N. Hubin, L. Pasquini, B. Leibundgut

Major Contractors

MicroGate (DSM): R. Biasi, M. Andreghettoni, G. Angerer, D. Pescoller, C. Mair, F. Picin

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OAA: A. Riccardi, R. Bruglia, M. Xompero

REOSC (Shell): F. Poutriquet, A. Rinchet, E. Ruch

TOPTICA (Laser): W. Kaenders, B. Erntsberger, A. Friedenauer

SESO (Ref.Body): J.-F. Carre, D. Fappani