

The logo for METIS, featuring the word "METIS" in a stylized, dark red font. A blue, hand-drawn oval shape encircles the letters, with the top and bottom loops extending beyond the text.

Wavefront Sensing for METIS

Workshop: WFSensing in the VLT/ELT era II

Padova, 02. - 04. October 2017

Thomas Bertram (MPIA)



Science & Technology Facilities Council

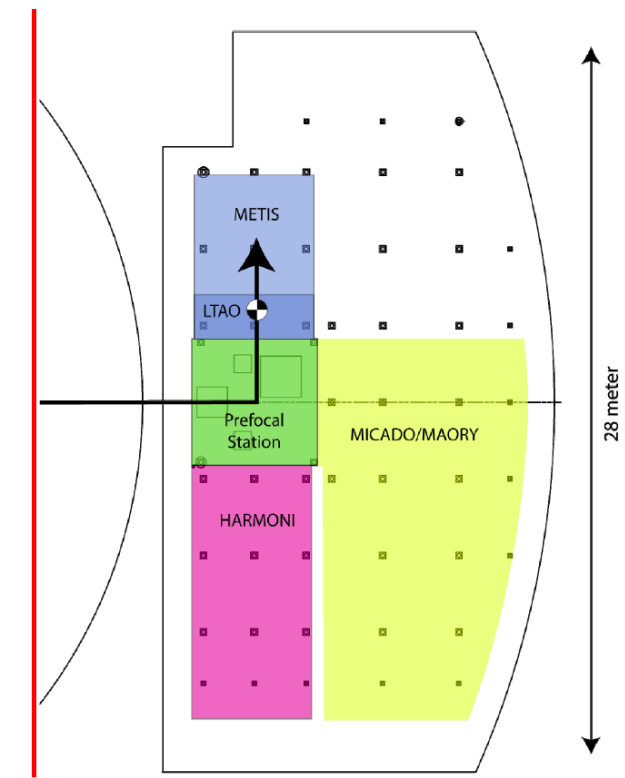
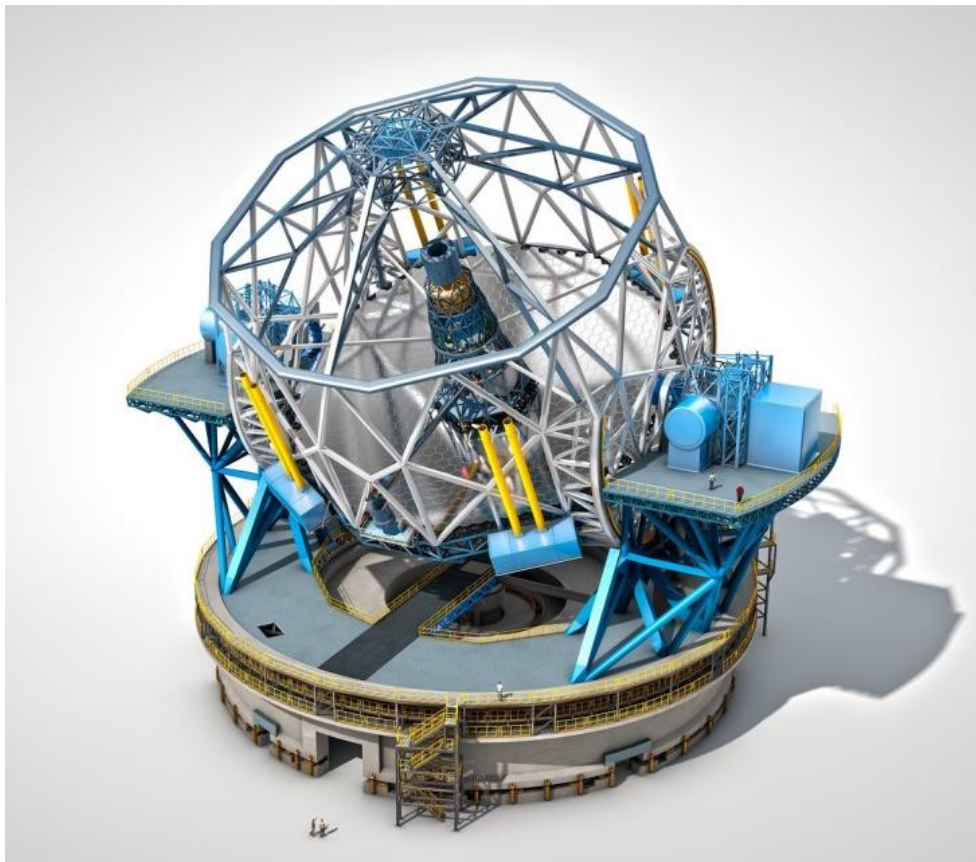
UK Astronomy Technology Centre



ETH zürich

METIS: Mid-infrared E-ELT Imager and Spectrograph

- Imaging + low / med. resolution Spectroscopy
@ L/M band (2.9 - 5.3 μm)
@ N/Q band (7.0 – 19.0 μm)
- High resolution IFU @ L/M band
- Coronagraphy for High Contrast Imaging (HCI)



Mid Infrared E-ELT Imager and Spectrograph



Observing in the Thermal Infrared



Science

- Exoplanets (direct imaging, chemistry)
- Protoplanetary disks, formation of planets
- Supermassive black holes
- Solar System



Adaptive Optics for METIS

- Single Conjugate Adaptive Optics
- Near Infrared
- 74 x 74 Subapertures
- Strehl: $\geq 93\%$ @ $10\mu\text{m}$, $\geq 60\%$ @ $3.7\mu\text{m}$
($m_K = 10\text{mag}$, median seeing, 30deg Zenith distance)
- < 2 mas tip-tilt jitter for HCI
- NCPA



Wavefront Sensor Trade-off

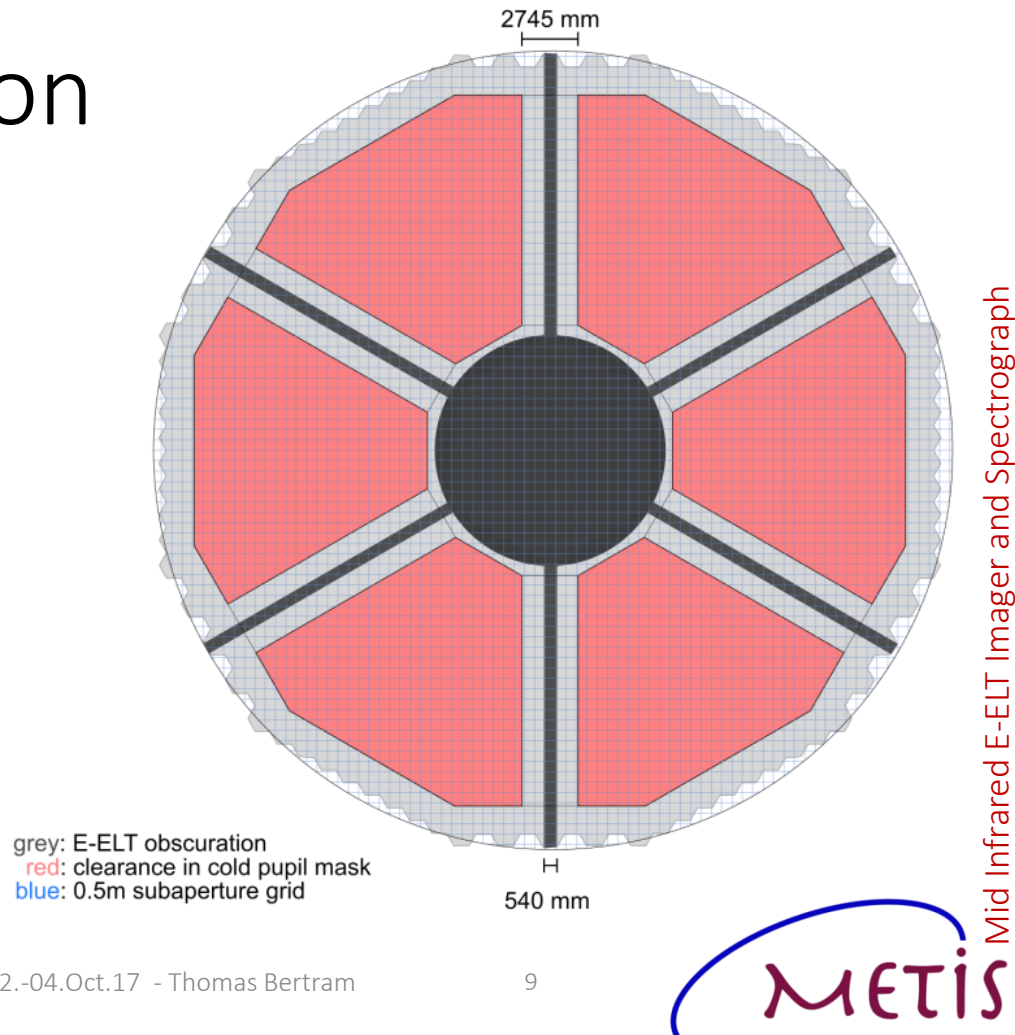
Shack-Hartmann WFS vs. Pyramid WFS

- Fragmentation of the E-ELT Pupil
- WFS Performance
- Technical and Programmatic Considerations



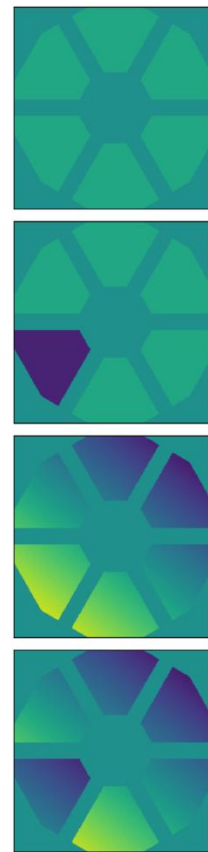
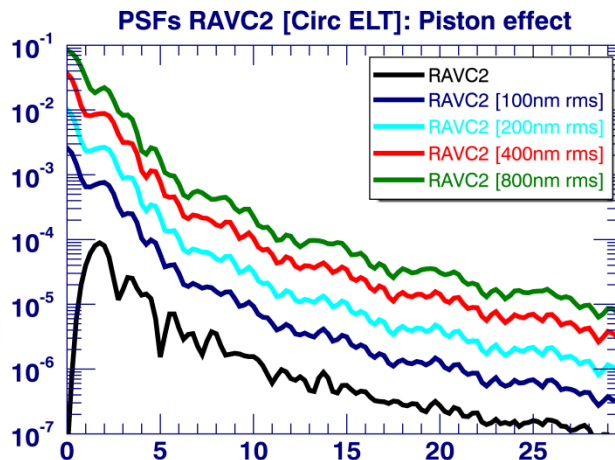
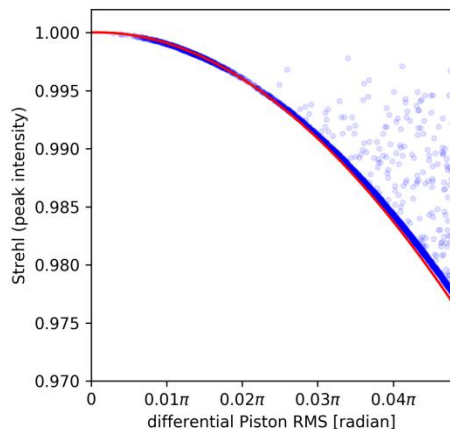
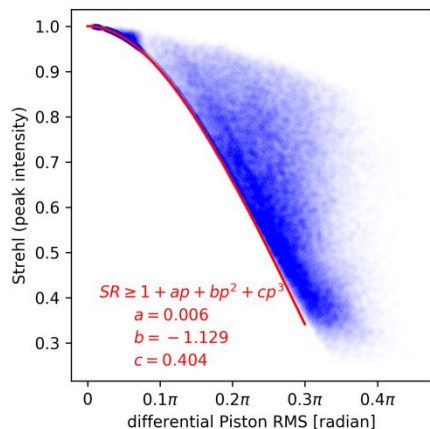
Pupil Fragmentation

- Spider dissects pupil in 6 fragments. No overlapping subapertures.
- Introduces unknowns for wavefront reconstruction.

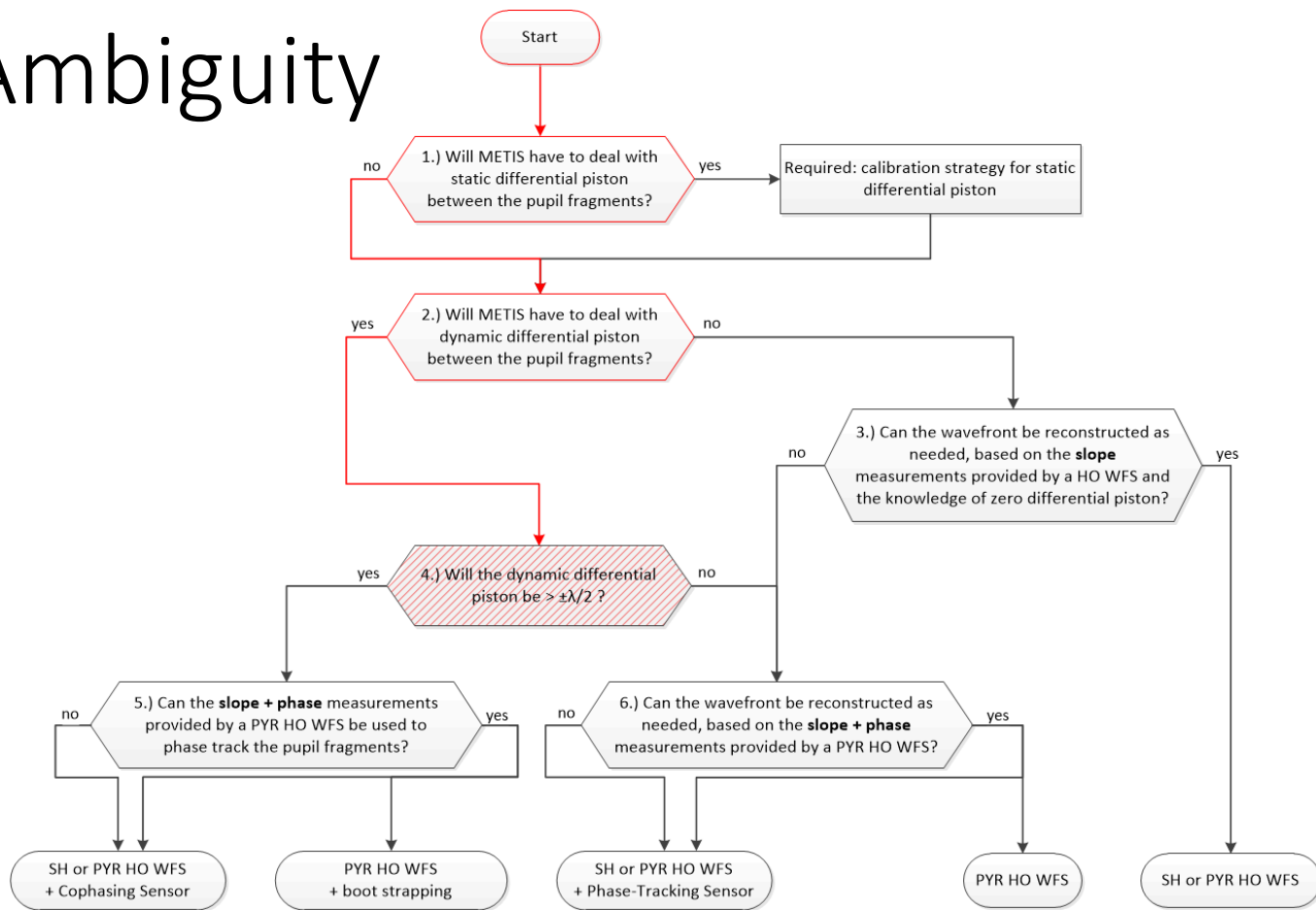


Differential Piston

- Fragment sticks out wrt. actual wavefront in pupil
- Detrimental for Contrast, Strehl ...

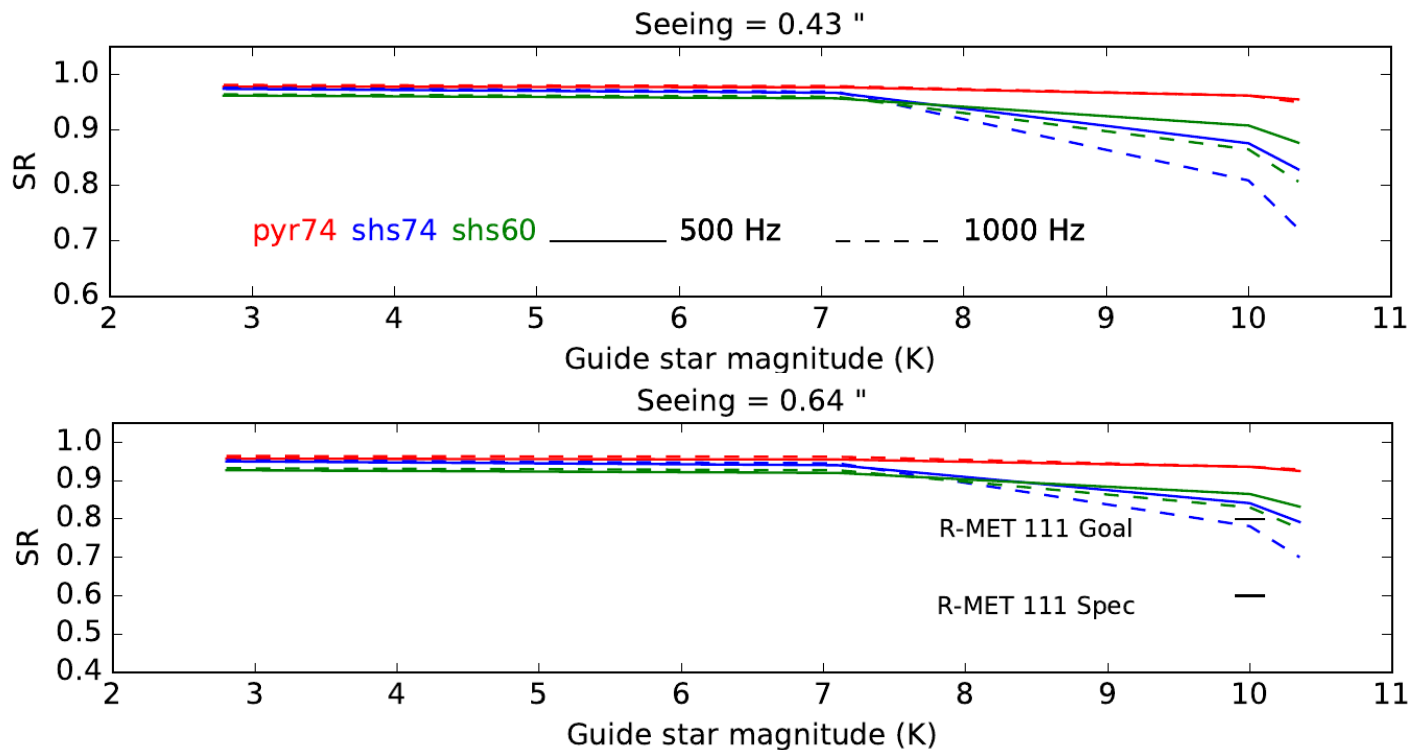


Phase Ambiguity



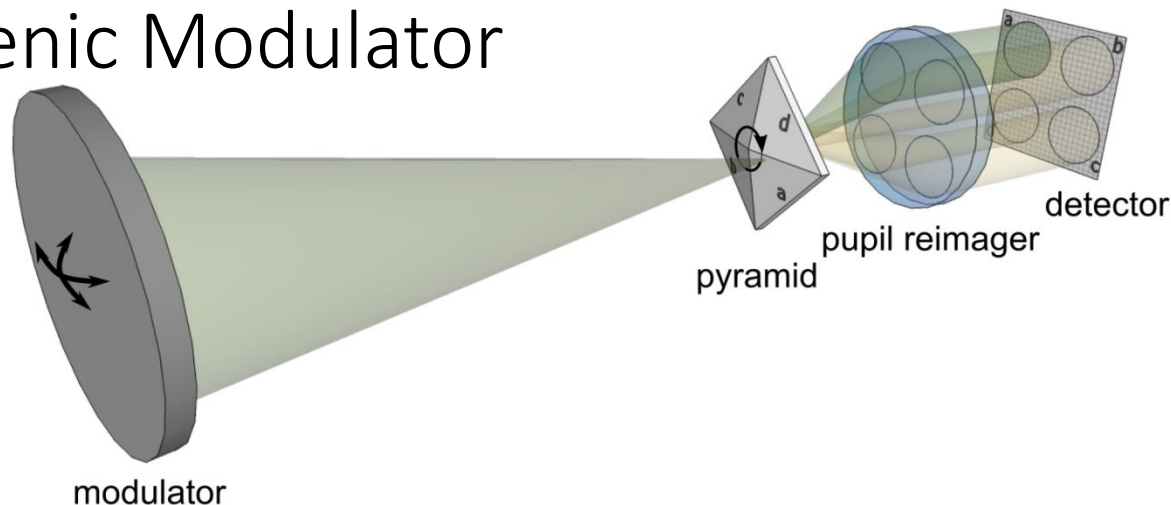
WFS Performance

METIS WFS study, $\lambda=3.70\mu\text{m}$, $z=30.0^\circ$



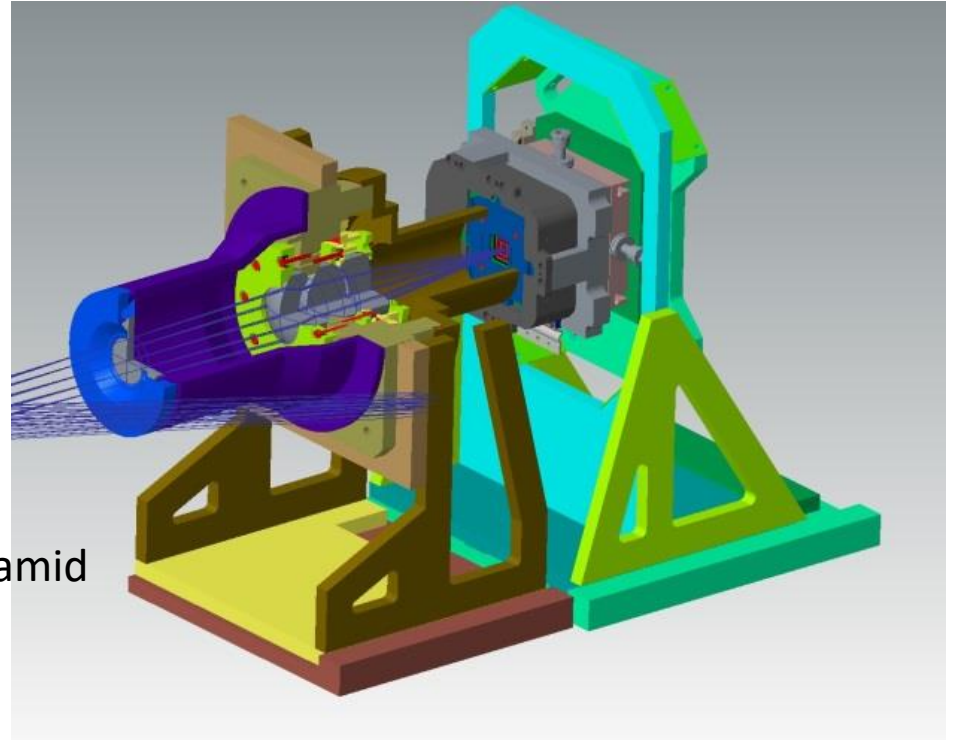
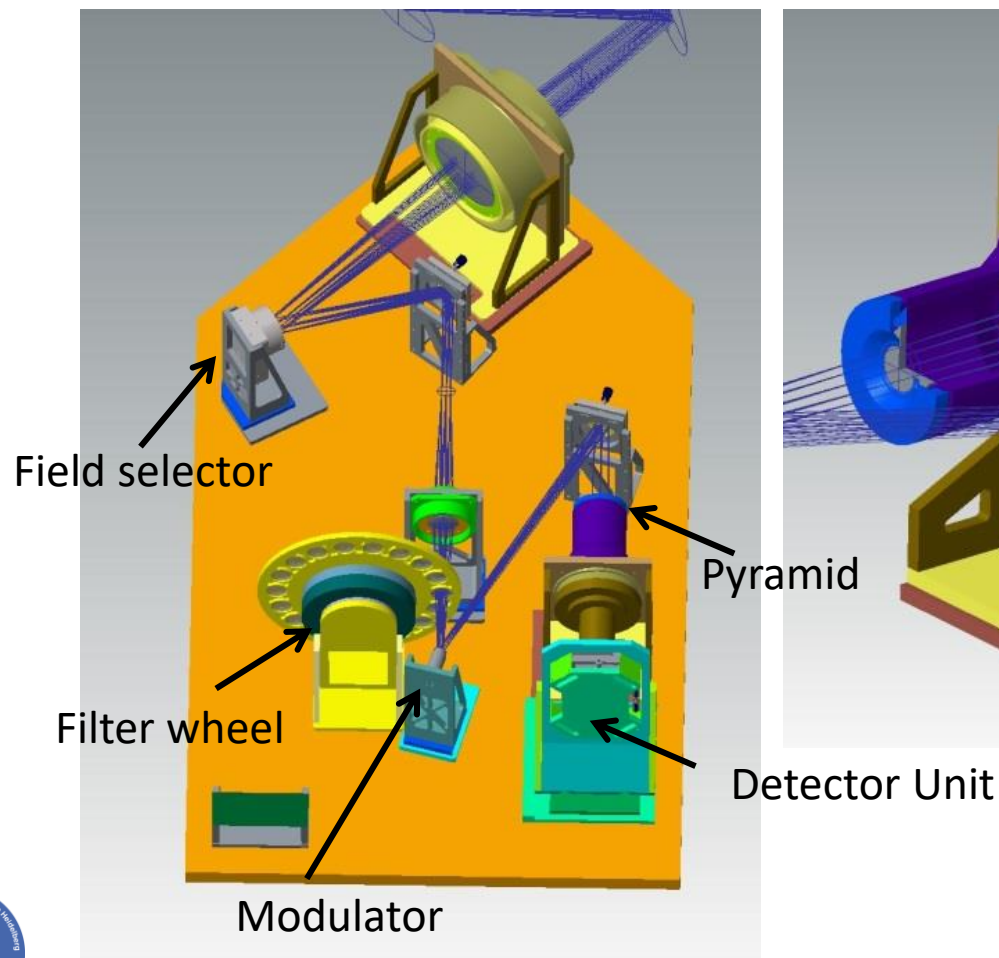
Technical Considerations

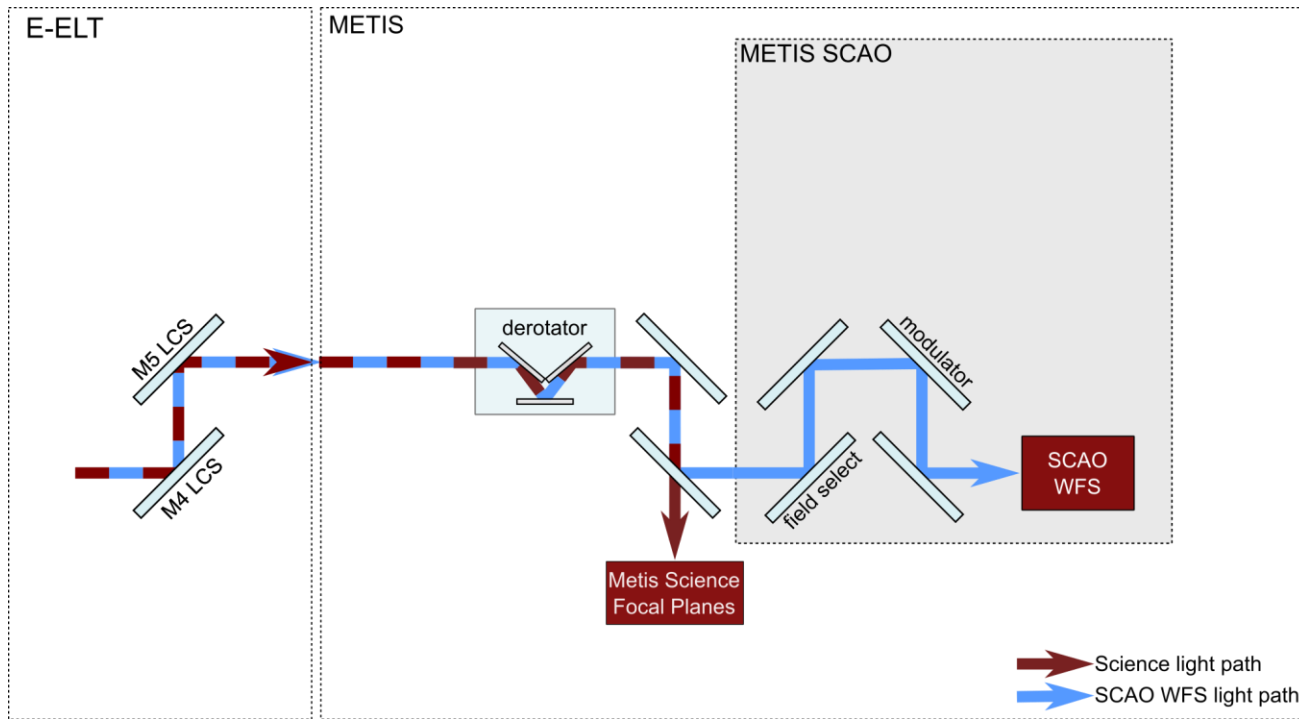
- NIR Detector
 - Pyramid WFS with existing Leonardo SAPHIRA eAPD device
- Cryogenic Modulator

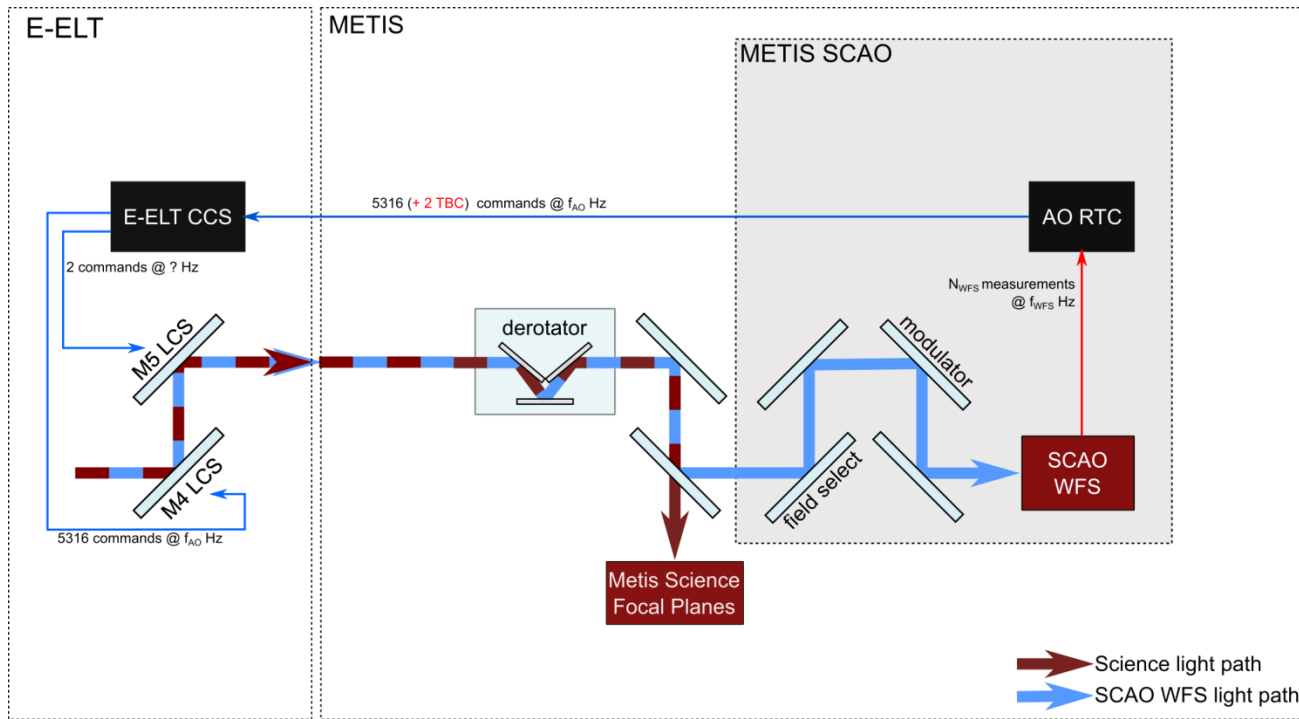


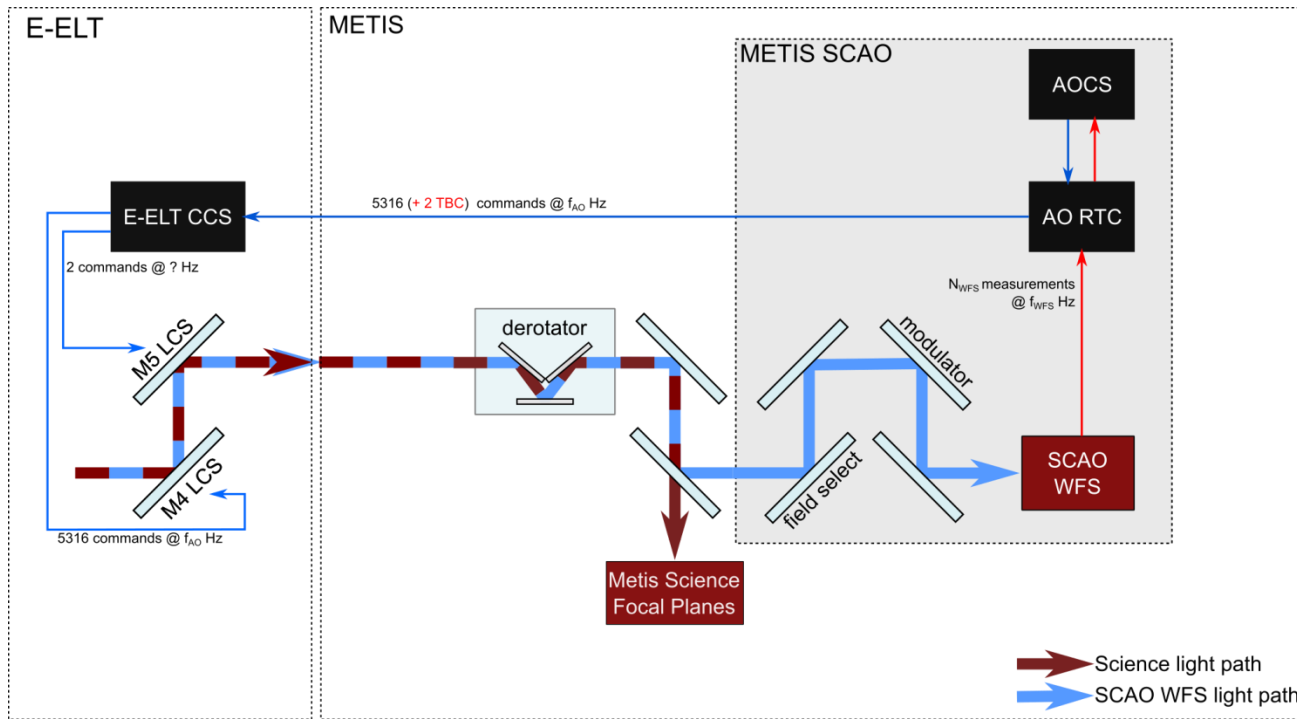
It's a ... Pyramid!

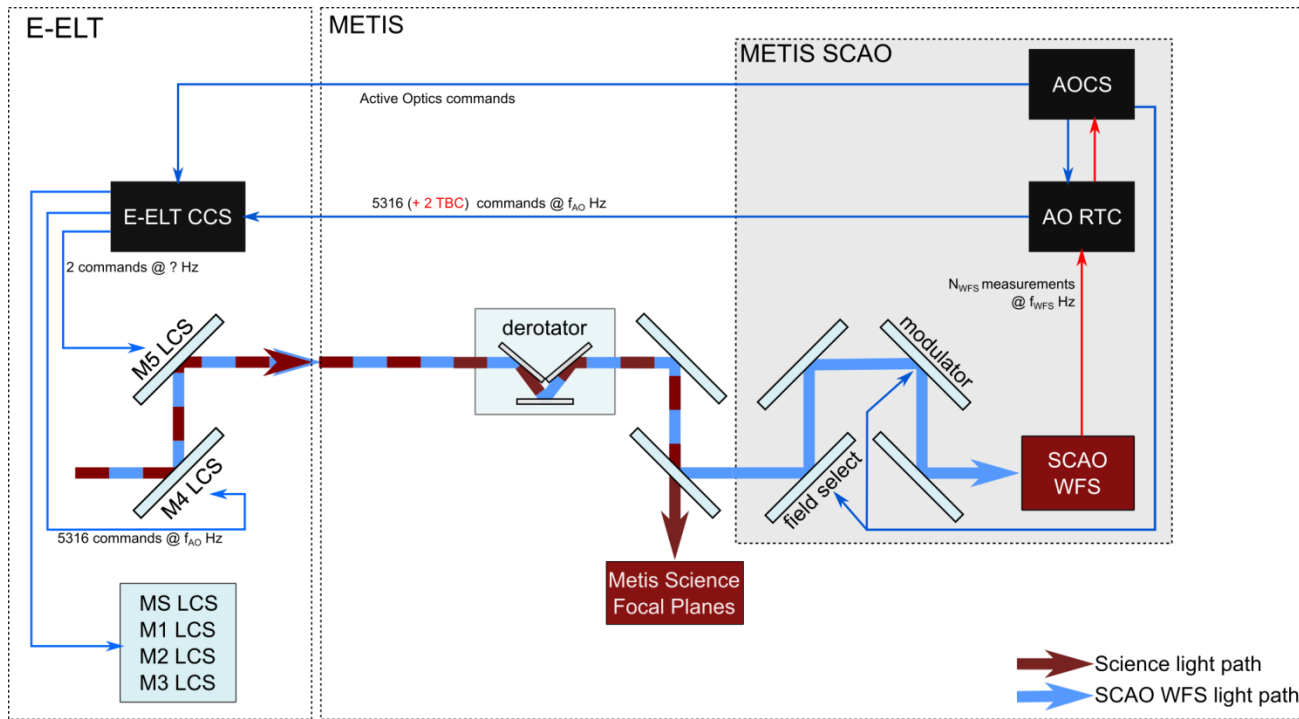


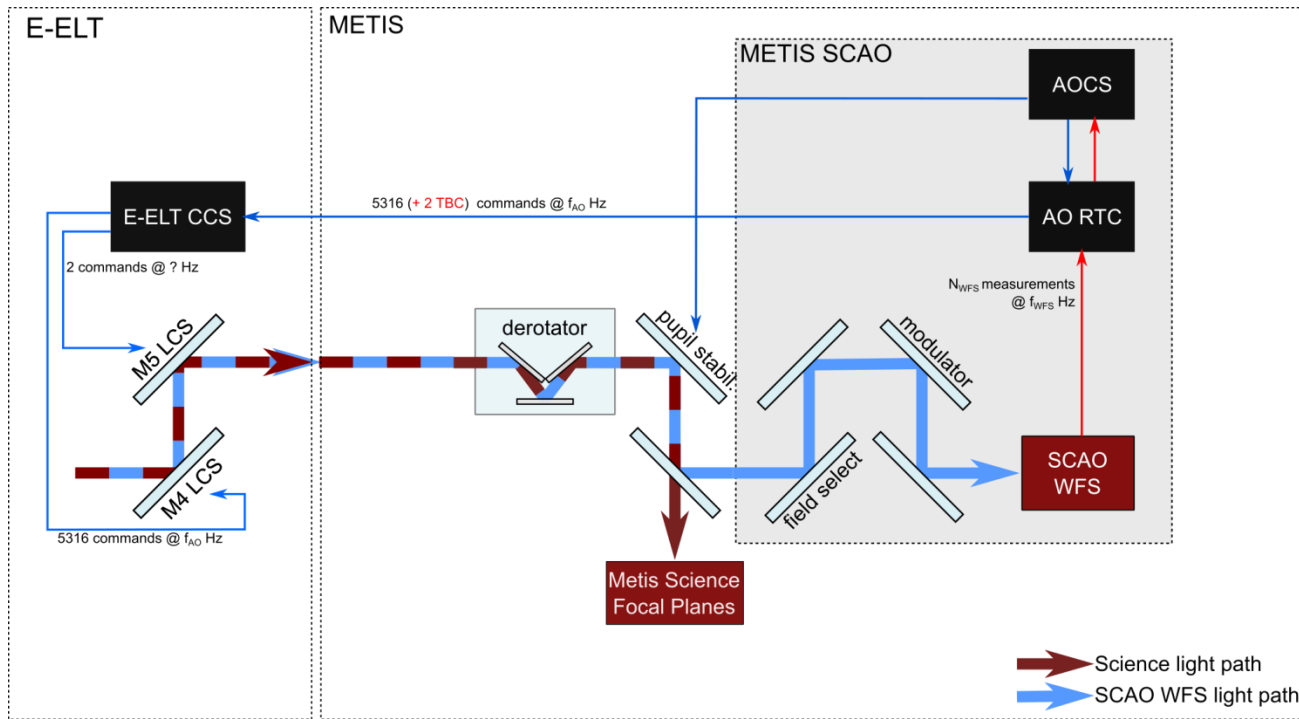


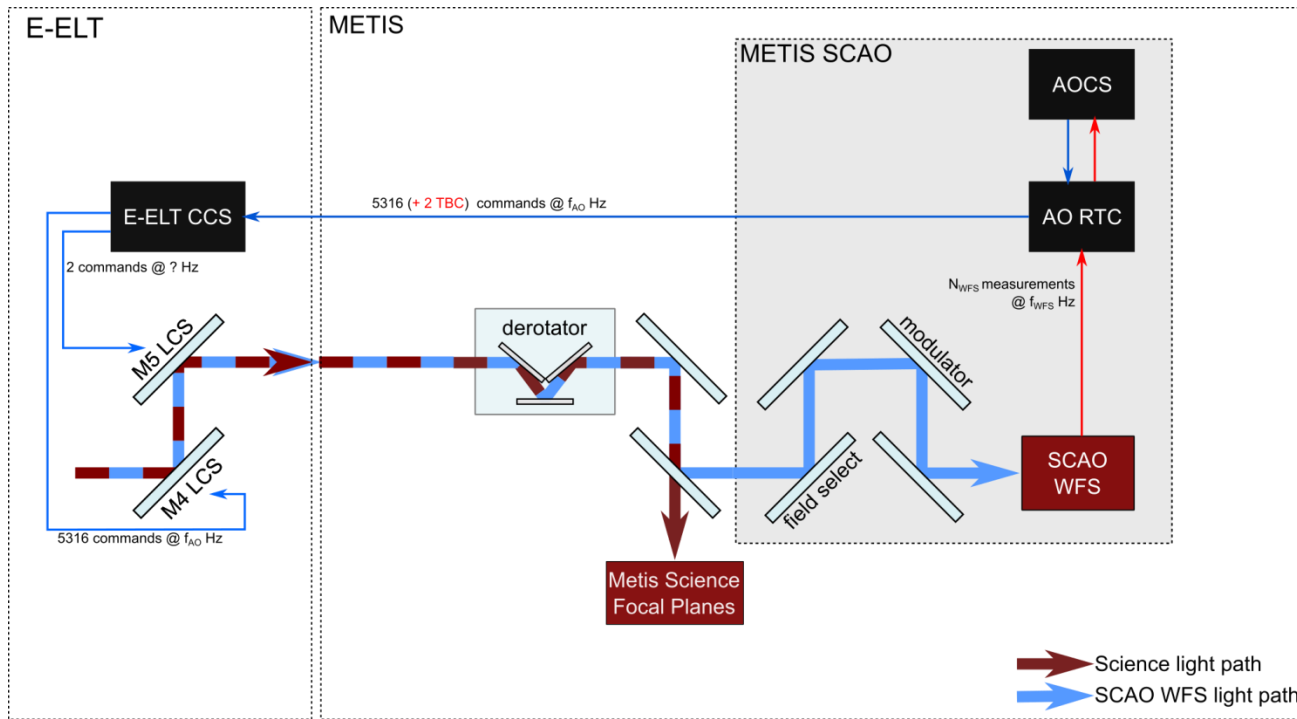


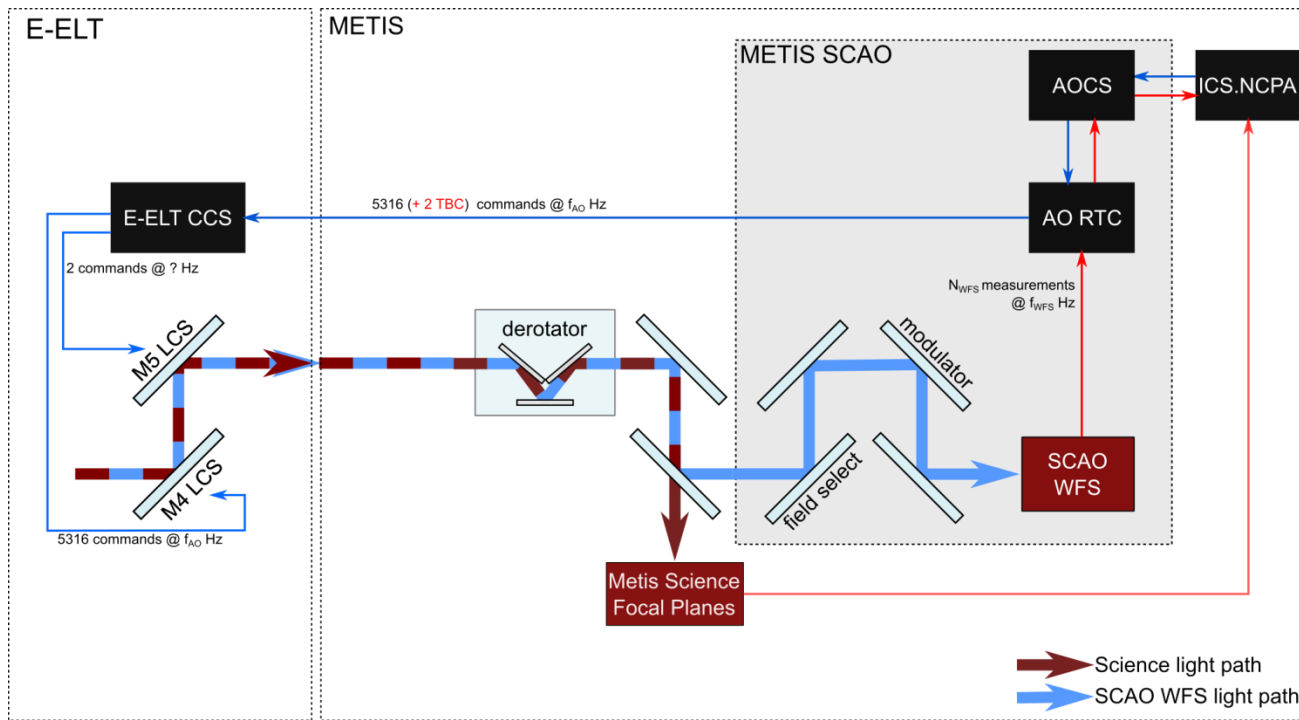












THANK YOU!