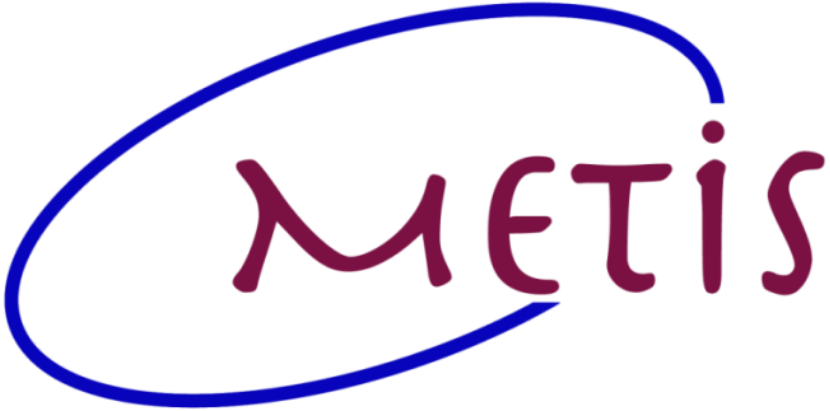


The RTC for METIS SCAO

4th RTC4A0 workshop, Paris, 19.-21.12.2016

Thomas Bertram (MPIA)

Science & Technology Facilities Council
UK Astronomy Technology Centre

- METIS in a nutshell
- SCAO for METIS
- RTC considerations

METIS

- Mid-infrared E-ELT Imager and Spectograph
- Consortium:
  NOVA (NL), MPIA (D), CEA-Saclay (F), UK-ATC (GB), KU Leuven (B), ETH Zürich (CH), A* (A)
- PDR in Spring 2018

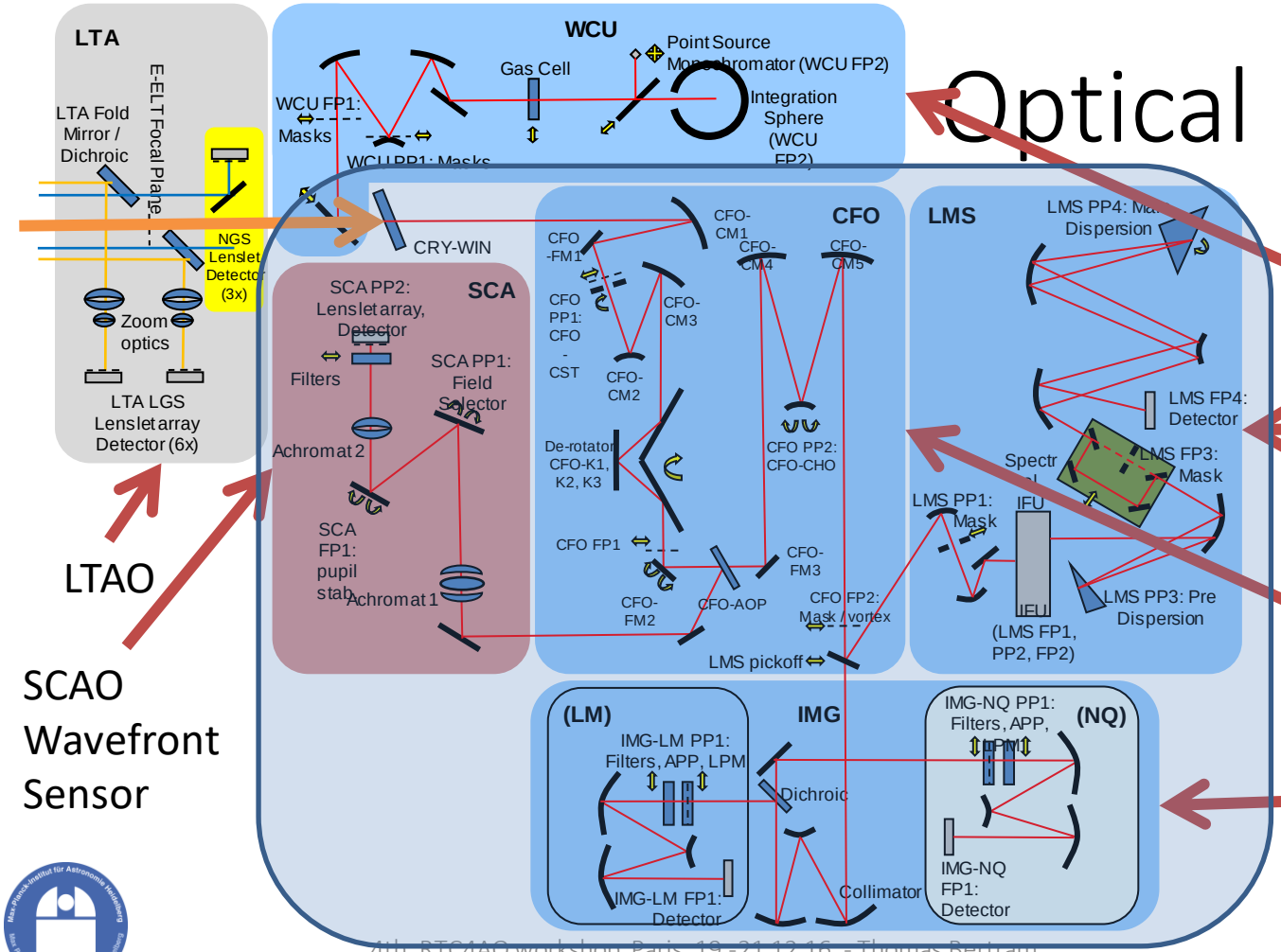
METIS Observing Modes

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

METIS Adaptive Optics

- Single Conjugate Adaptive Optics (SCAO)
- Laser Tomography Adaptive Optics (LTAO)

Optical Overview



LTAO

SCAO Wavefront Sensor

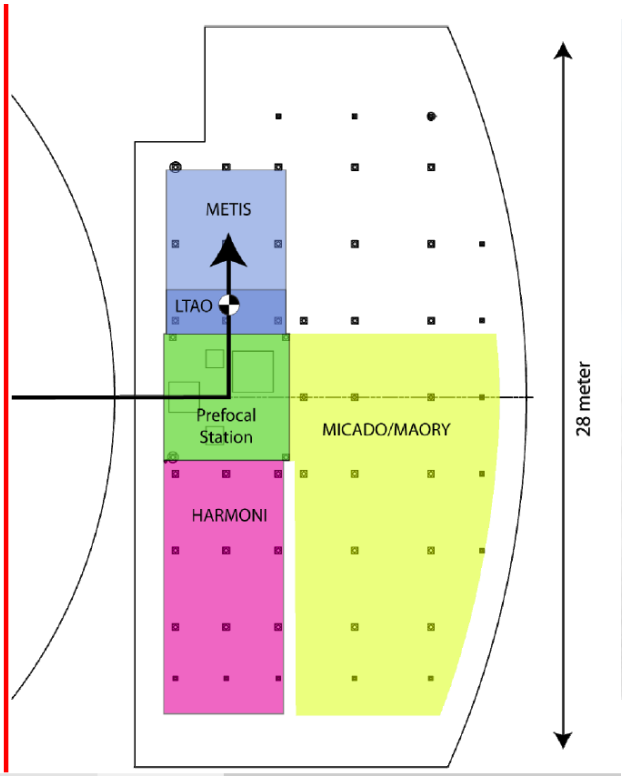
Warm Calibration Unit

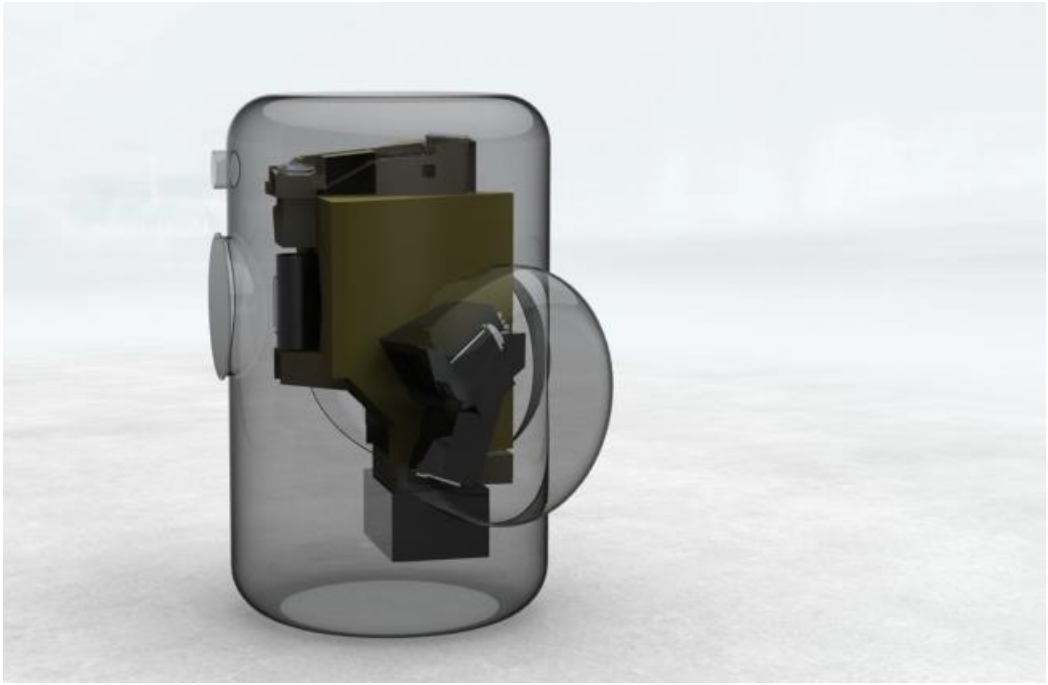
L/M IF Spectrograph

Central Fore Optics

Imagers

Mid Infrared E-ELT Imager and Spectrograph





Mid Infrared E-ELT Imager and Spectrograph

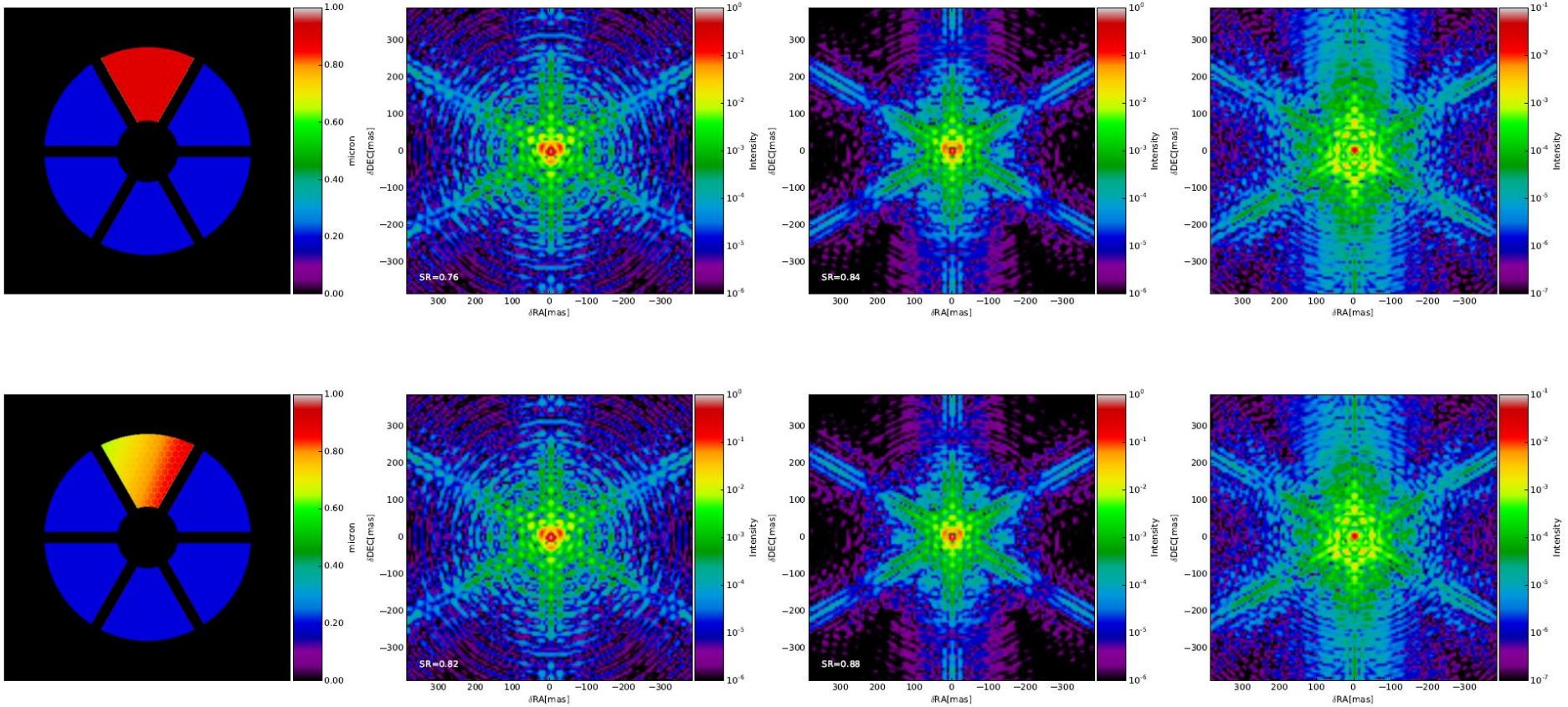
SCAO for METIS

- Strehl: ≥ 93% @ 10µm, ≥ 60% @ 3.7µm
  (m_K = 10mag, median seeing, 30deg Zenith distance)
- < 2 mas tip-tilt jitter for HCI

SCAO for METIS

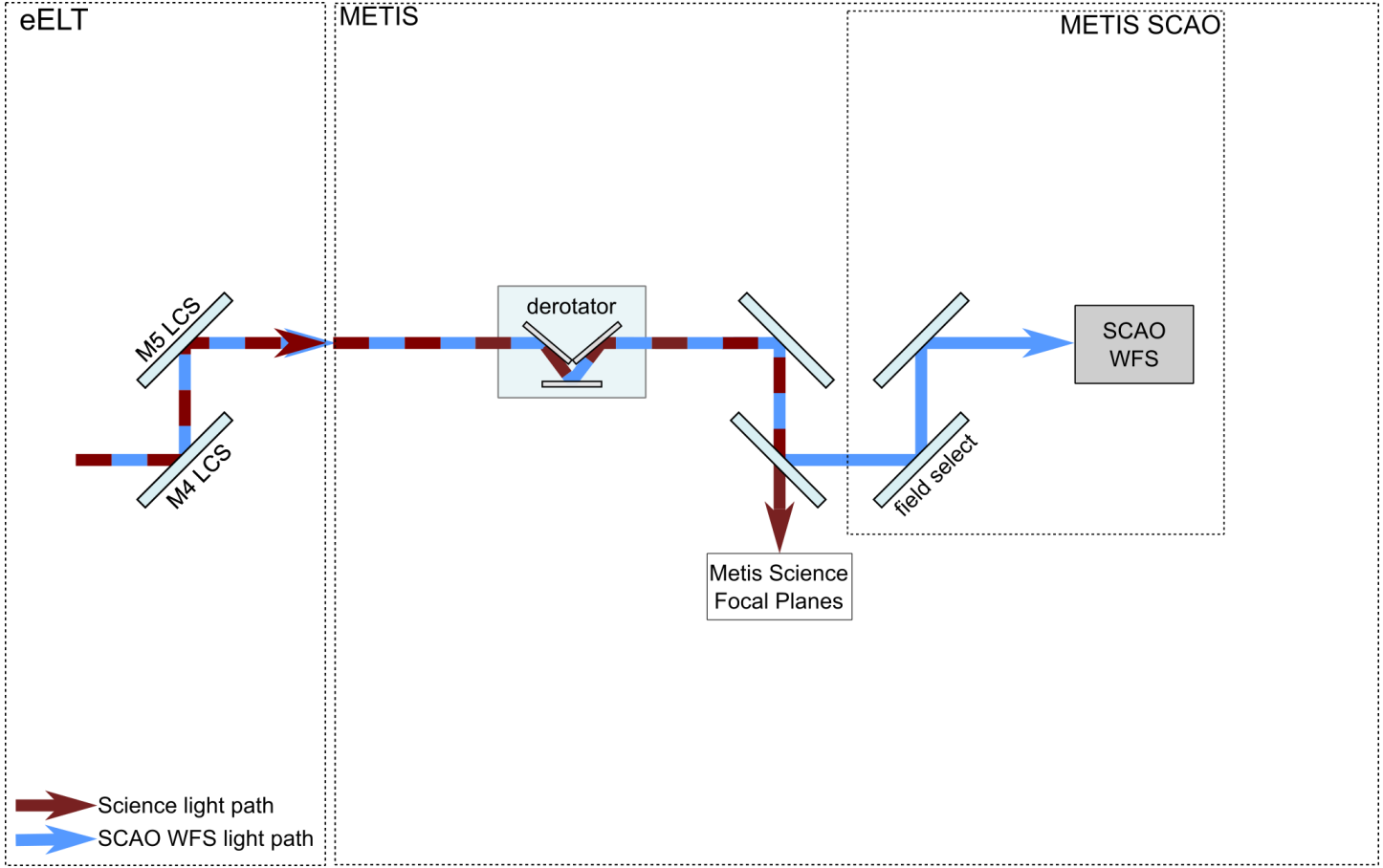
- NIR Wavefront Sensor
- 74x74 Subapertures
- Shack-Hartmann type WFS
- SAPHIRA eAPD
- MVM wavefront reconstruction (CuReD optional)

Phasing of Segmented Pupil

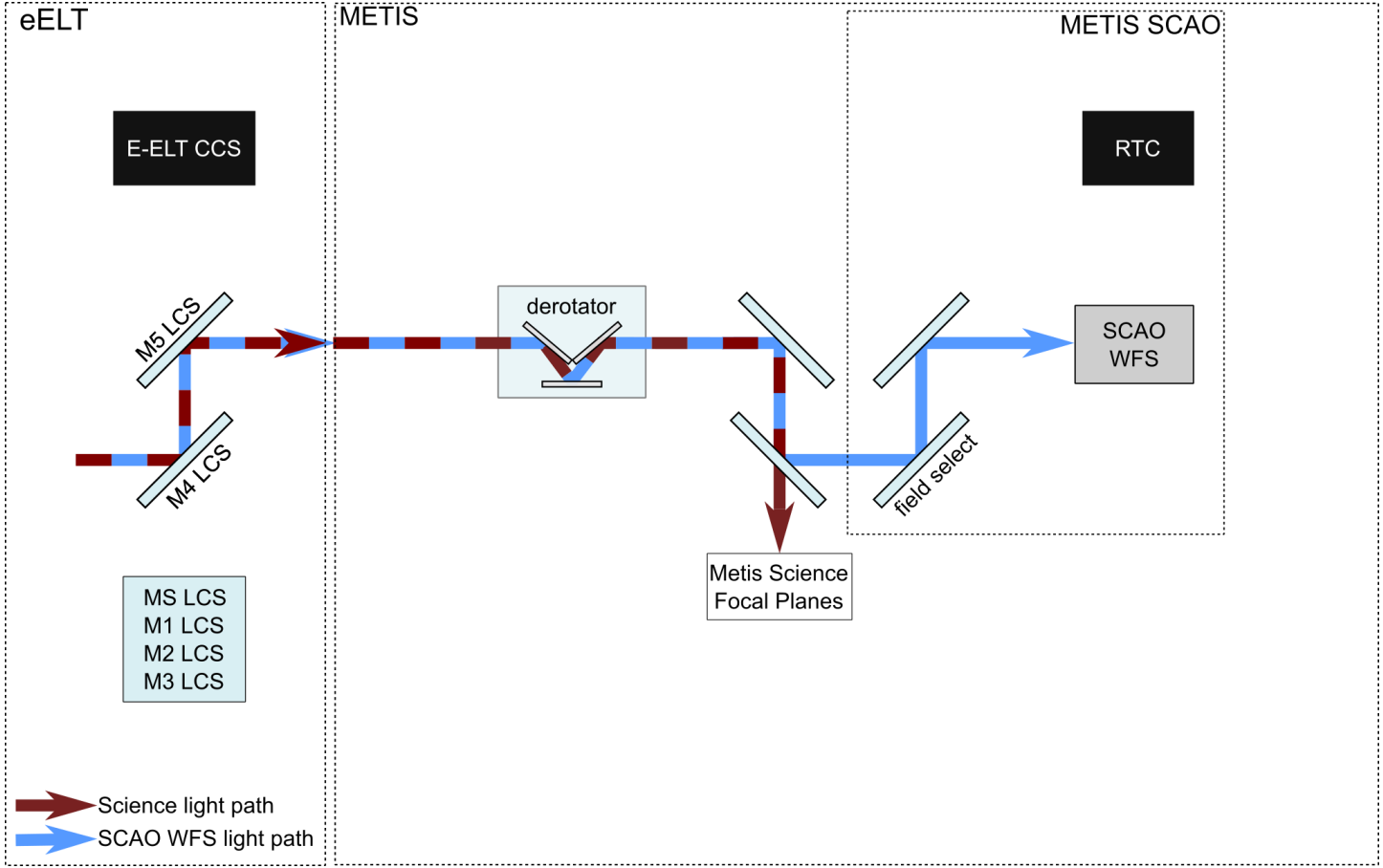


RTC

SCAO Wavefront Control Loop



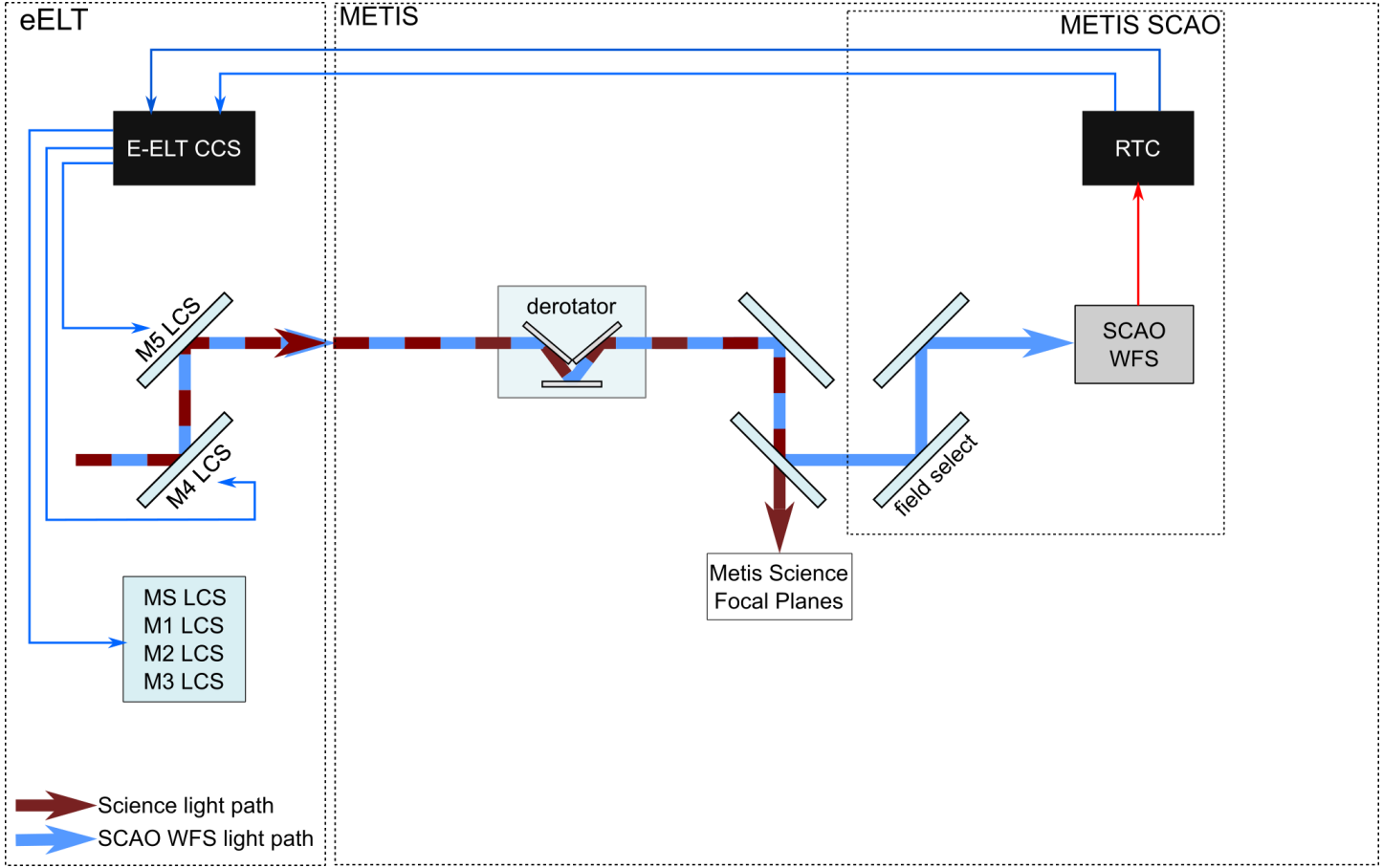
SCAO Wavefront Control Loop



- CCS = E-ELT Central Control System
- RTC = METIS Real Time Computer

Mid Infrared E-ELT Imager and Spectrograph

SCAO Wavefront Control Loop



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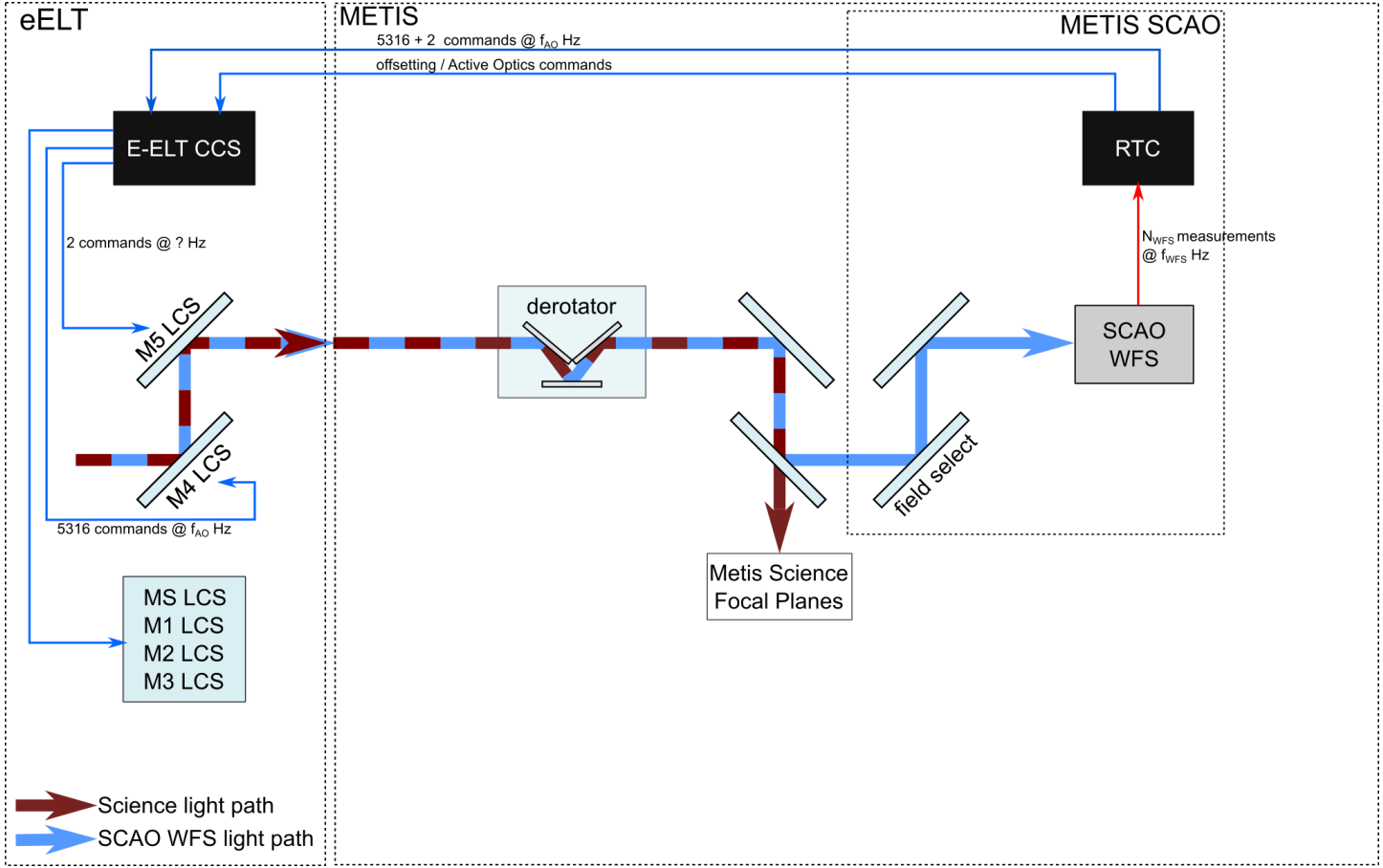
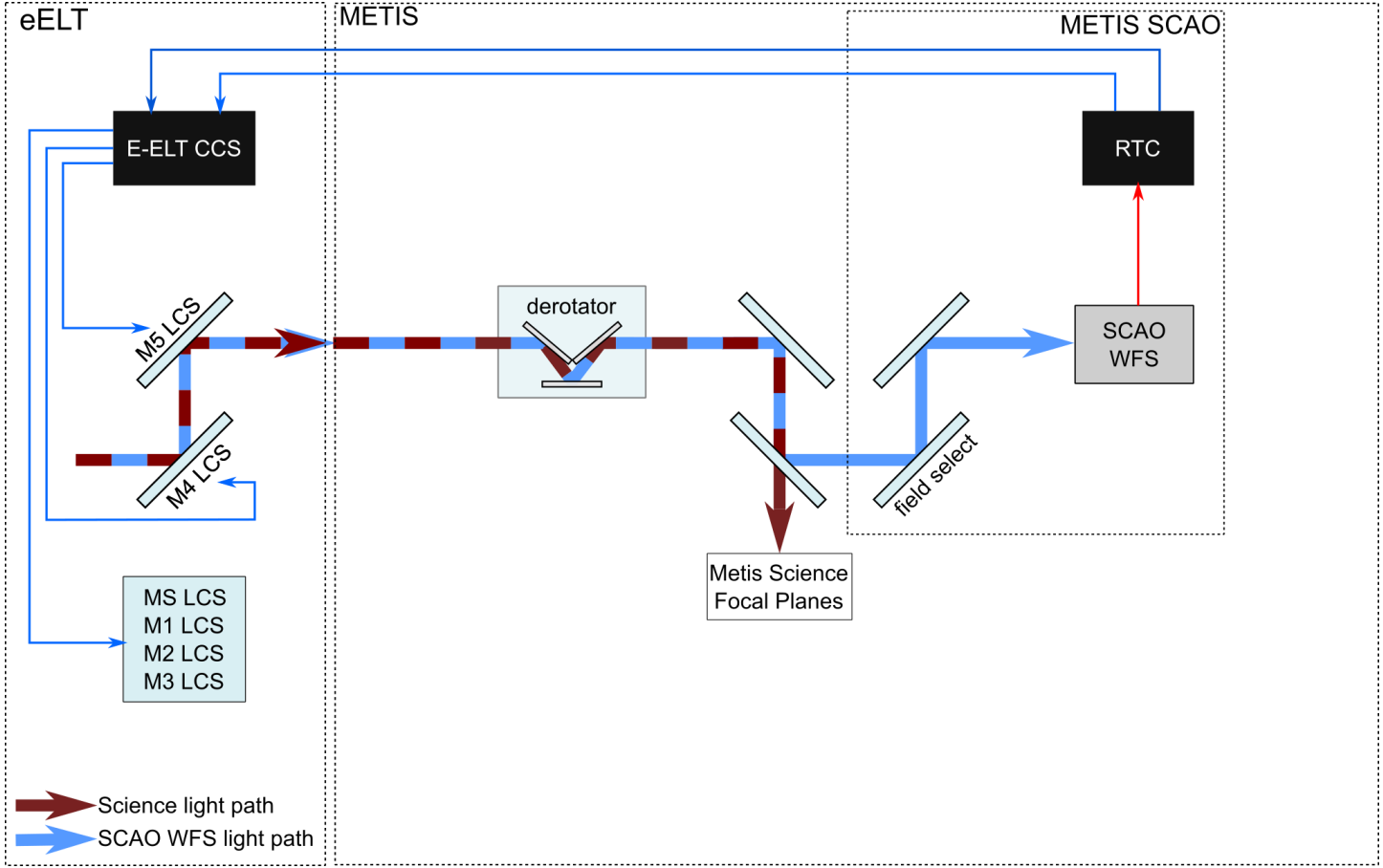
Mid Infrared E-ELT Imager and Spectrograph

SCAO Wavefront Control Loop

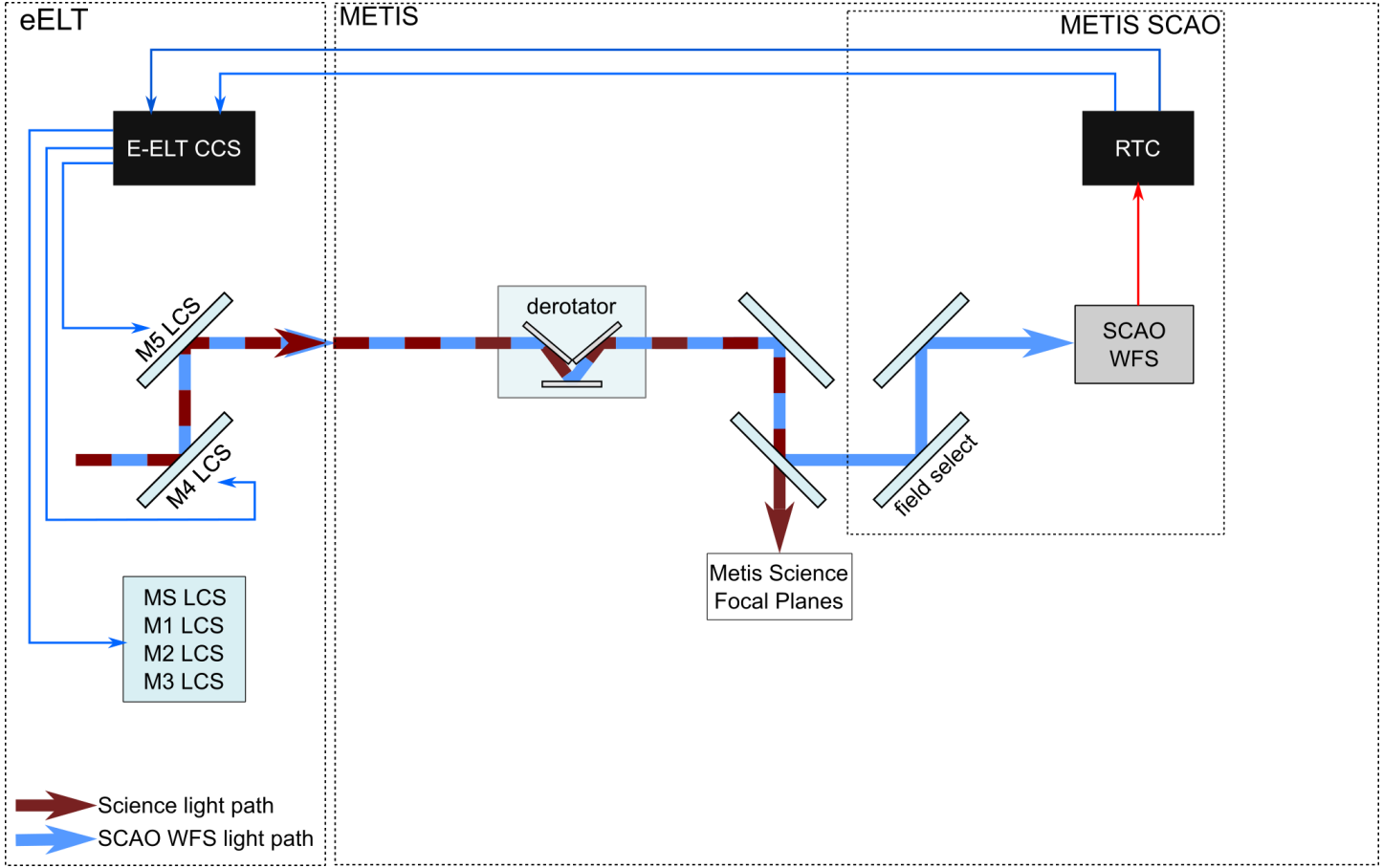


- CCS = E-ELT Central Control System
- RTC = METIS Real Time Computer
- Field stabilization with M5
- 2 methods for RTC-CCS handover: sequential and cascaded

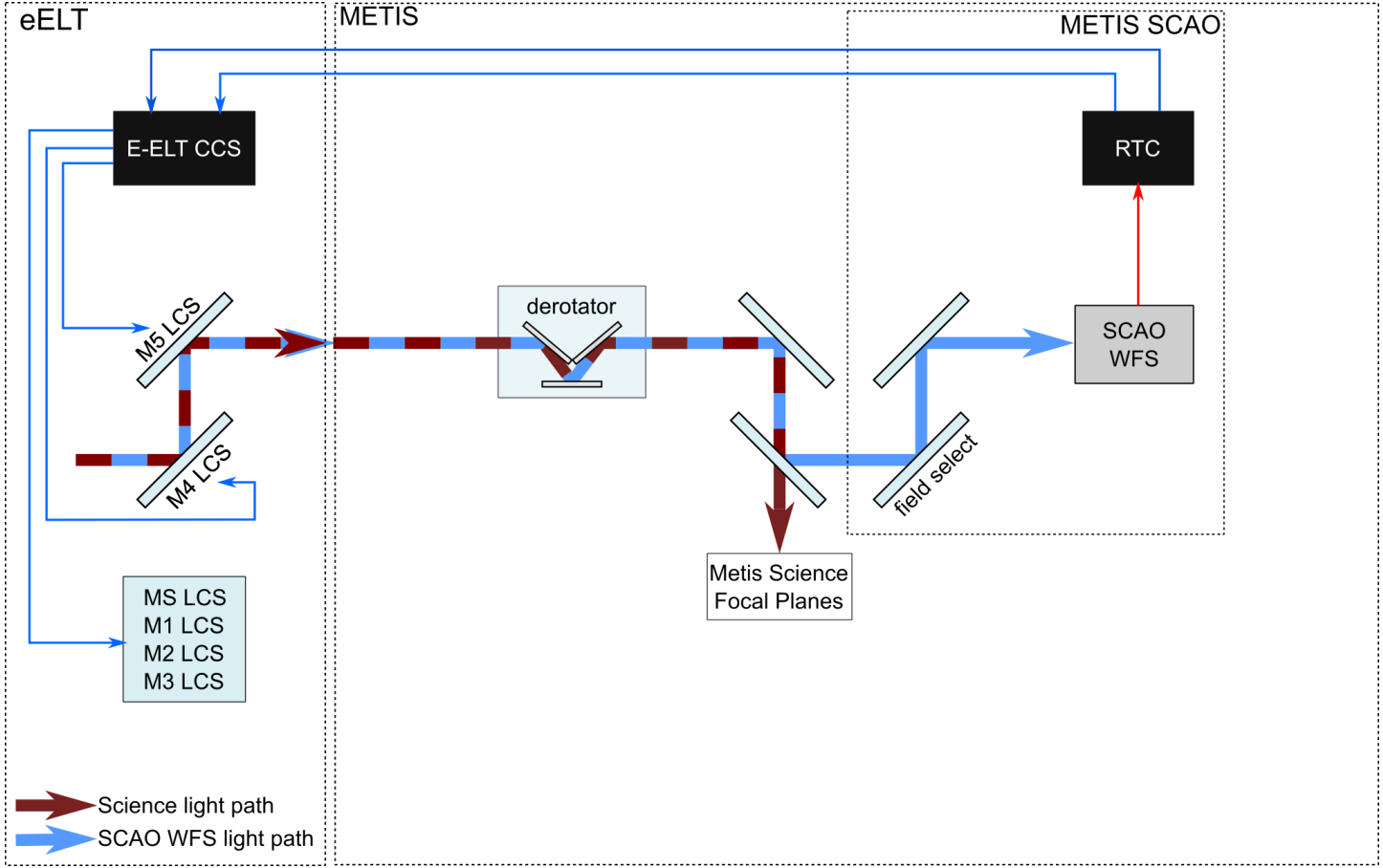
Mid Infrared E-ELT Imager and Spectrograph


eELT
METIS
METIS SCAO
E-ELT CCS
RTC
M5 LCS
derotator
SCAO
WFS
M4 LCS
field select
Metis Science
Focal Planes
MS LCS
M1 LCS
M2 LCS
M3 LCS
Science light path
SCAO WFS light path

SCAO Registration Control Loop

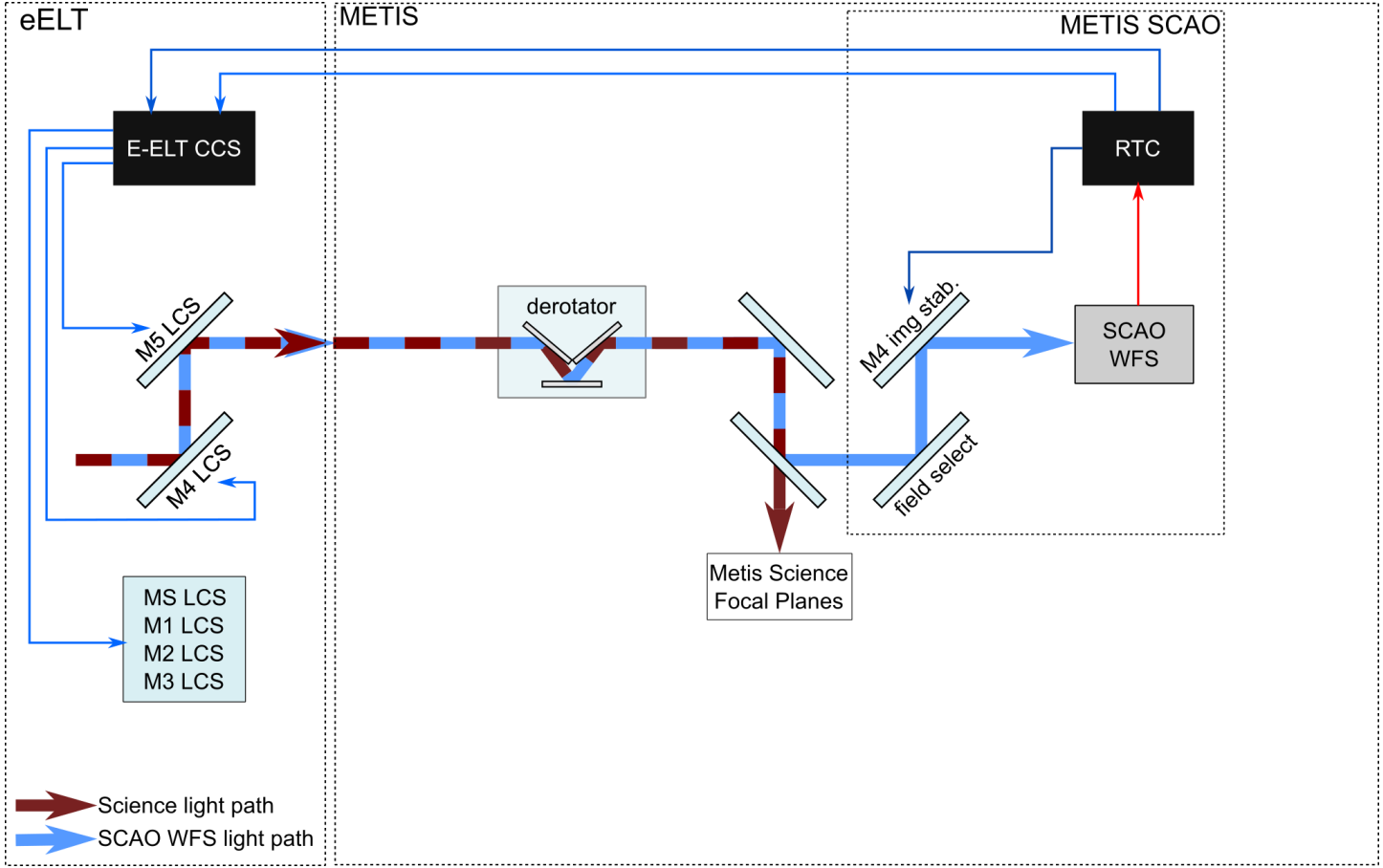


SCAO Registration Control Loop



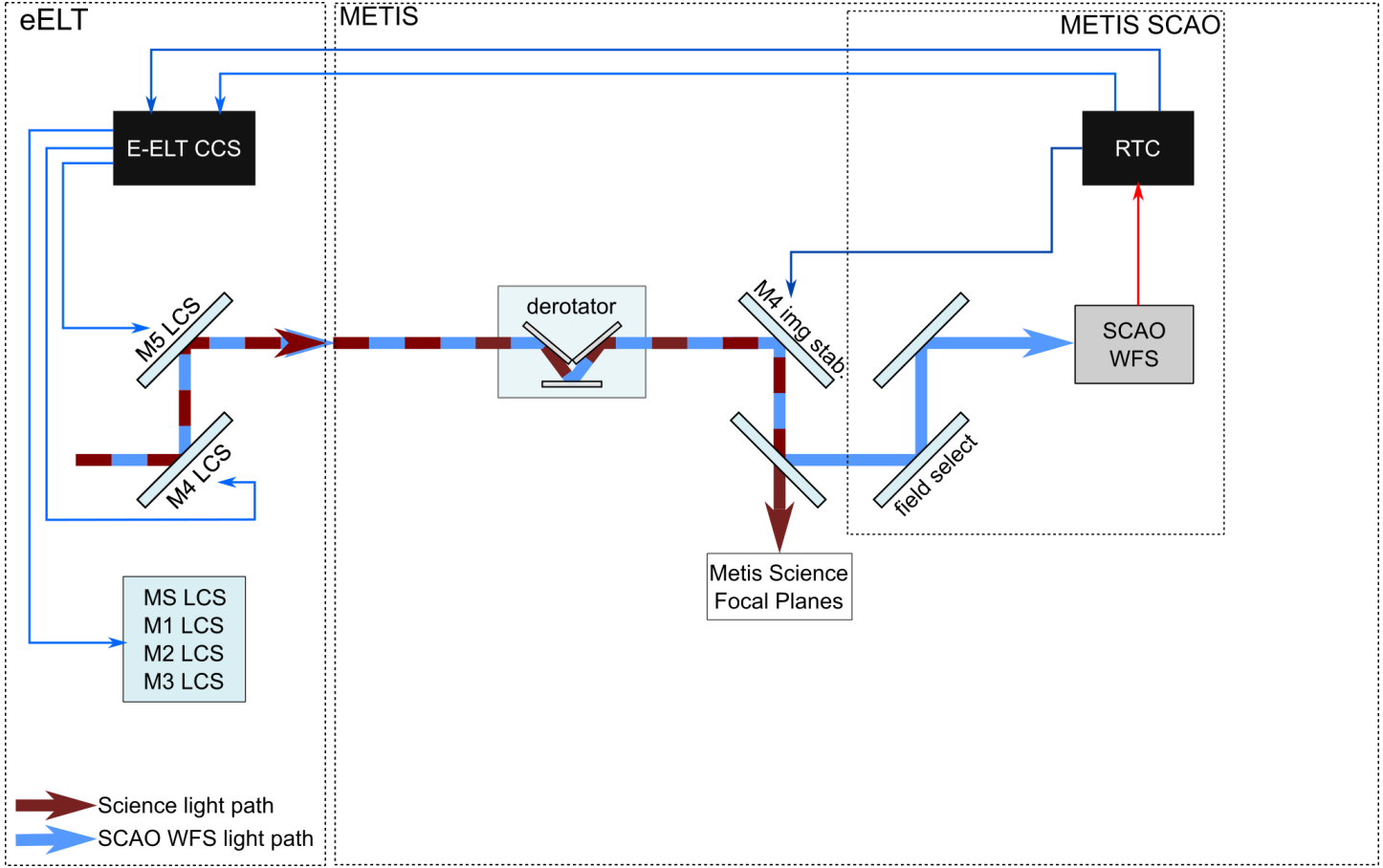
- Control of registration between M4 and WFS (lateral and rotational)
- Stability: 0.1 Subapertures
- Derived from WFS data: RTC task

SCAO Registration Control Loop



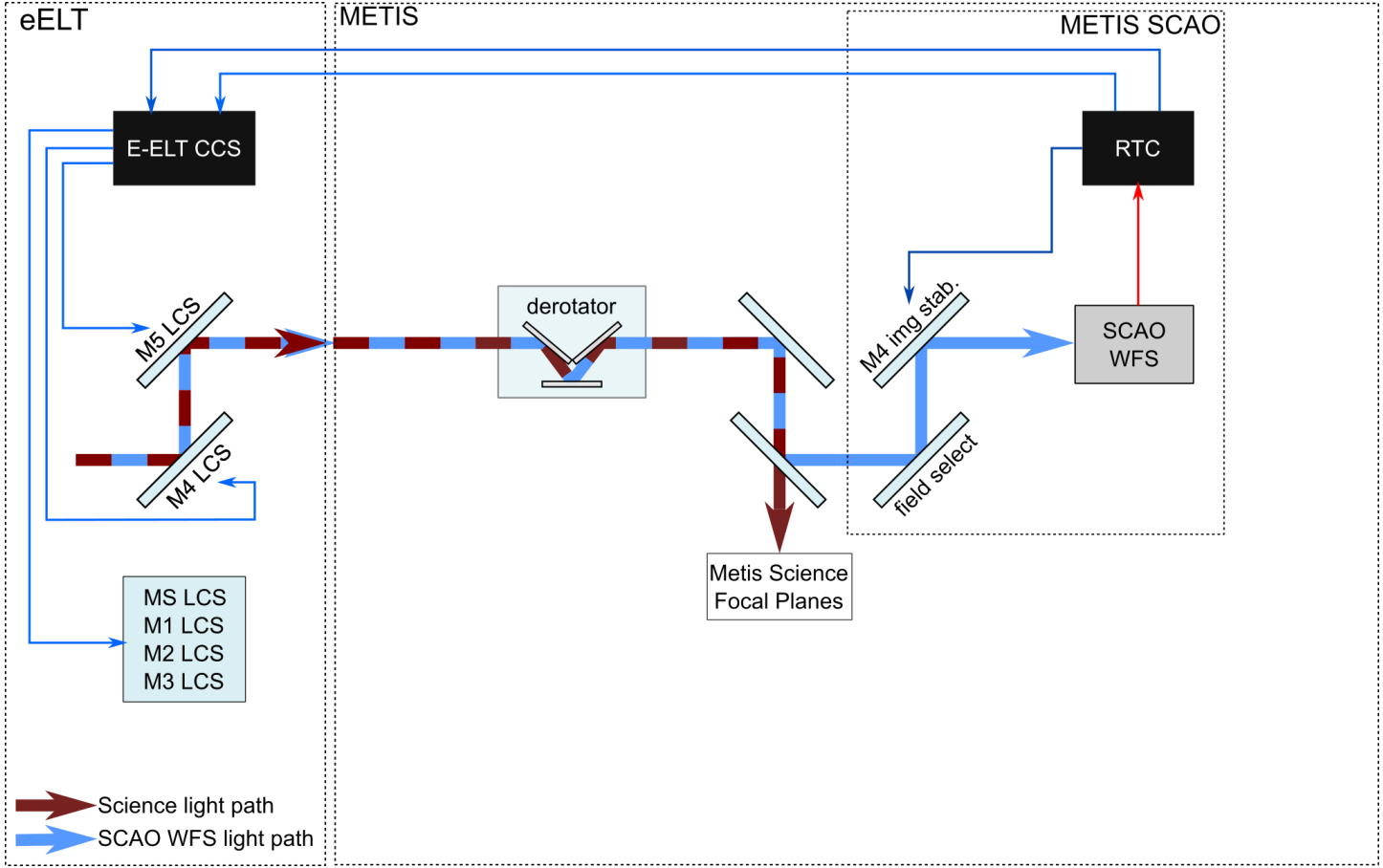
- Lateral correction with M4 image stabilization actuator

SCAO Registration Control Loop



- Lateral correction with M4 image stabilization actuator.
- Actuator could be also in the common path.

SCAO Registration Control Loop



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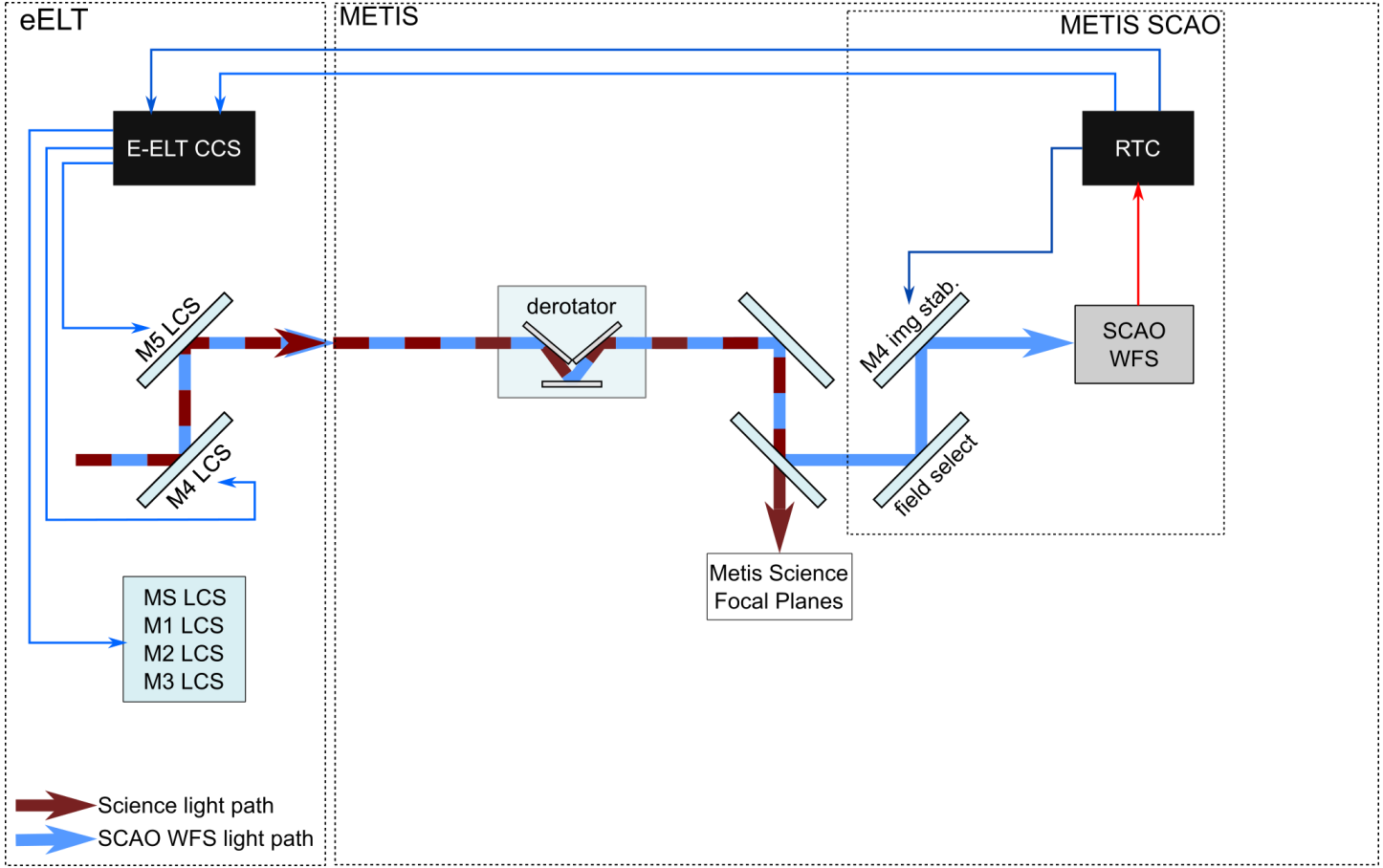
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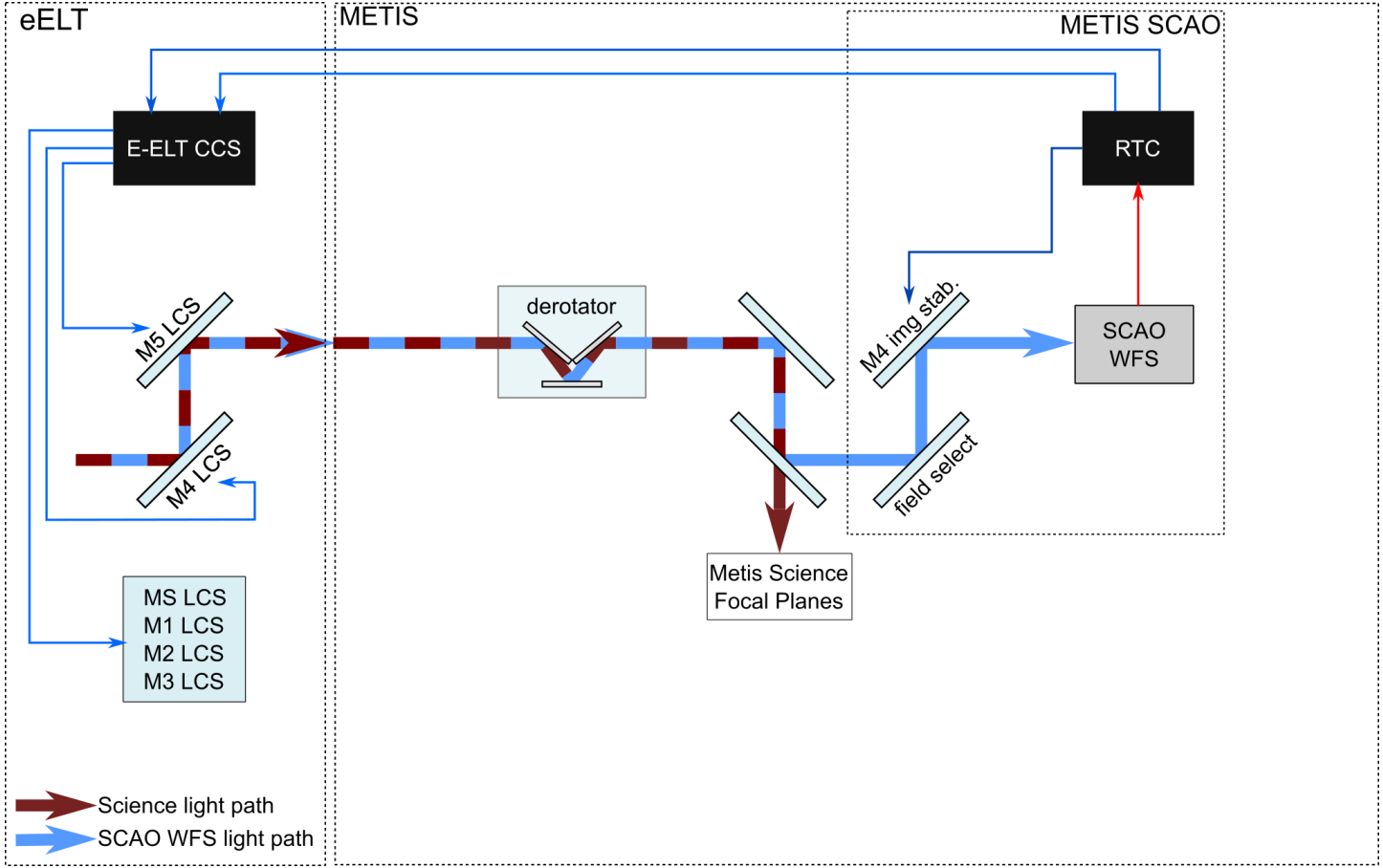
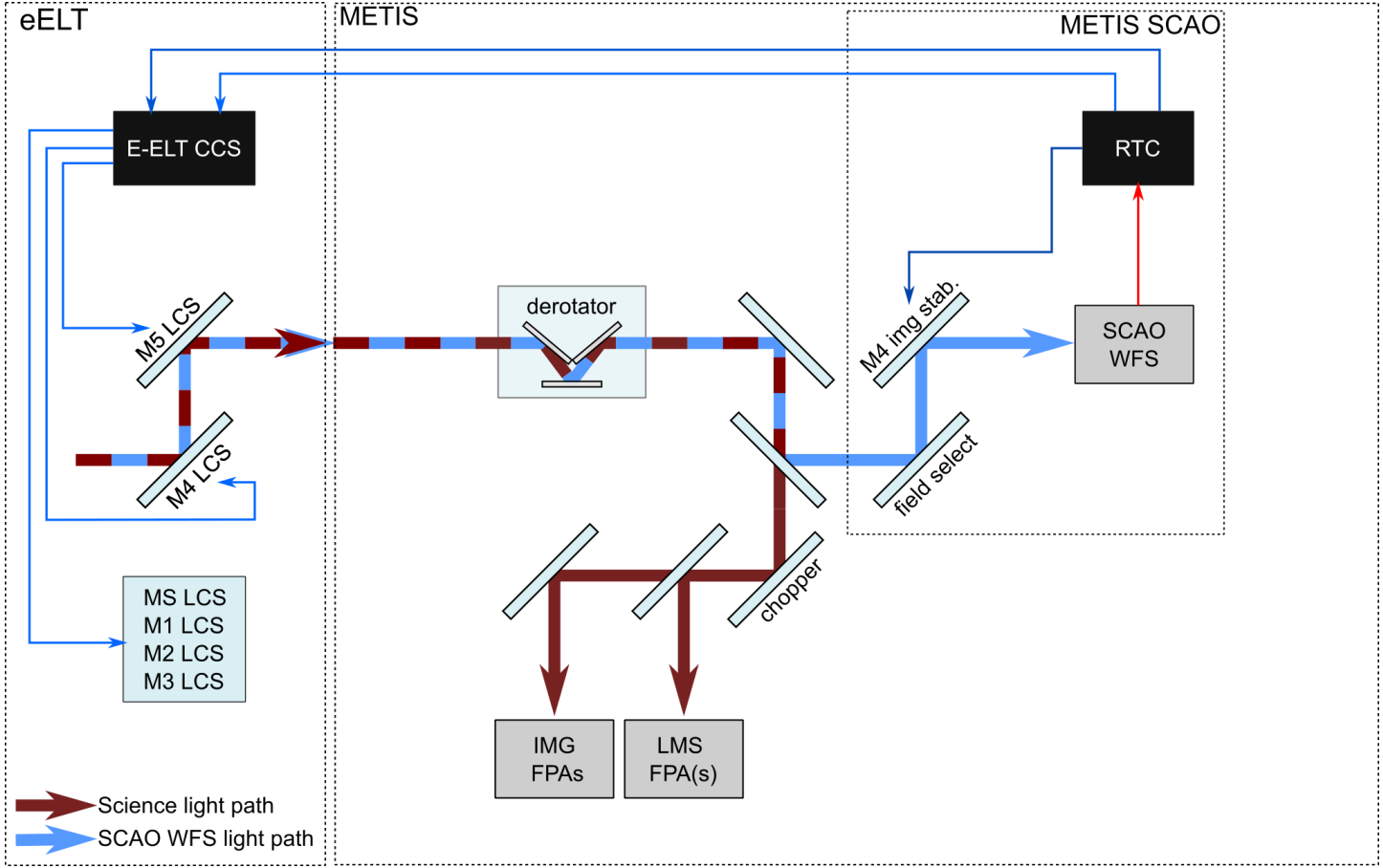
M3 LCS
Science light path
SCAO WFS light path

Non-Common-Path Aberration Control (HCI)

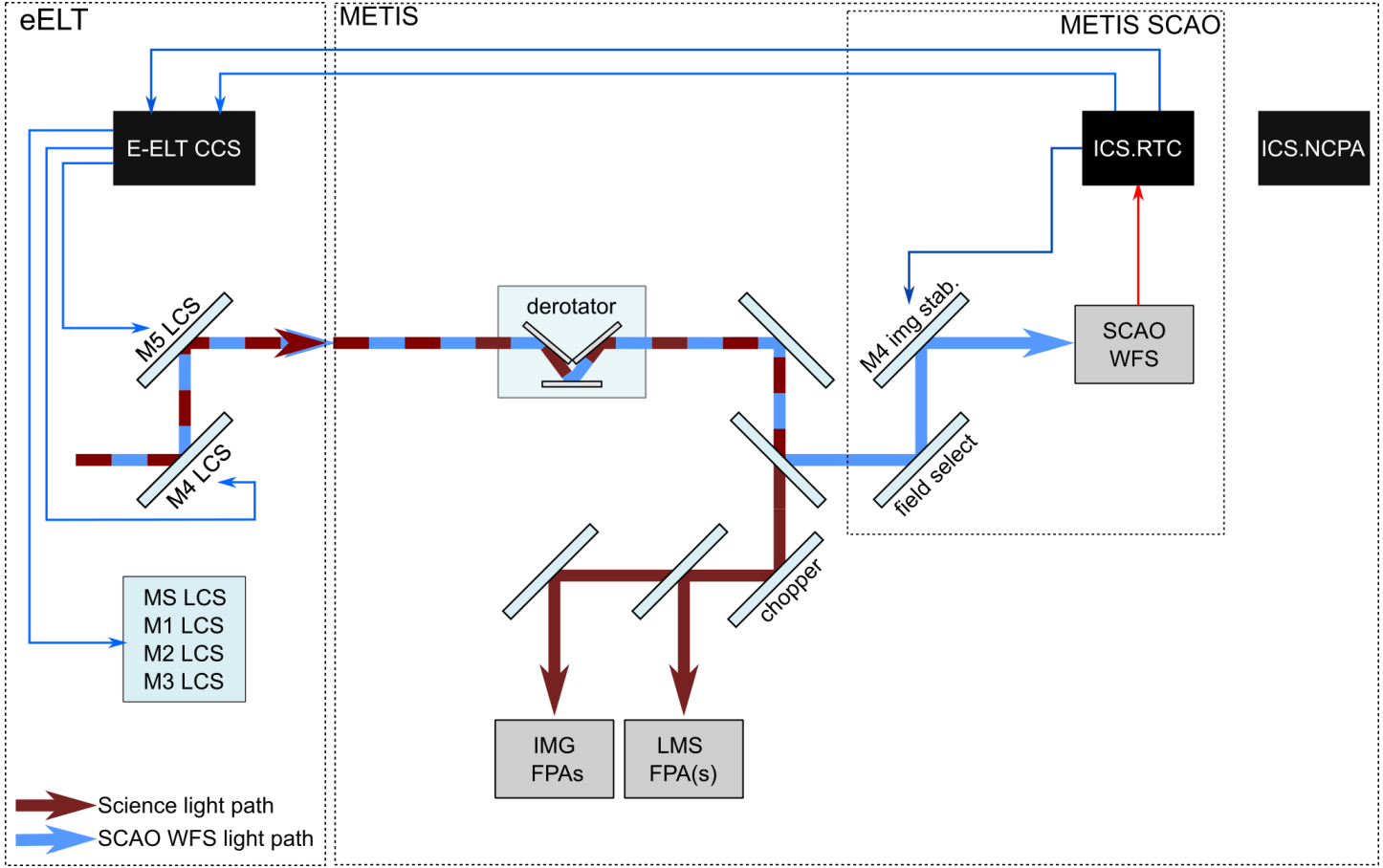


Mid Infrared E-ELT Imager and Spectrograph

Non-Common-Path Aberration Control (HCI)

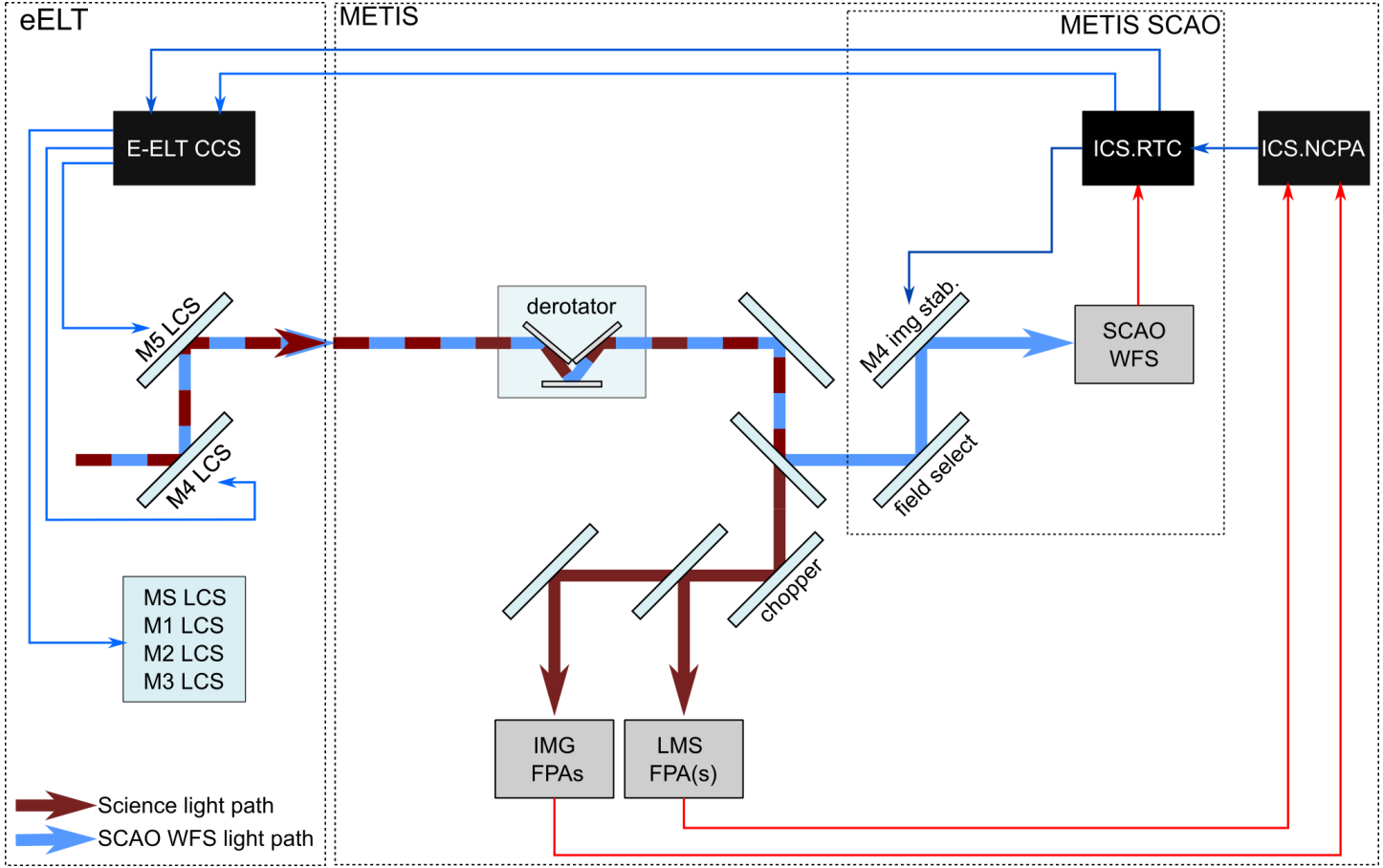


Non-Common-Path Aberration Control (HCI)

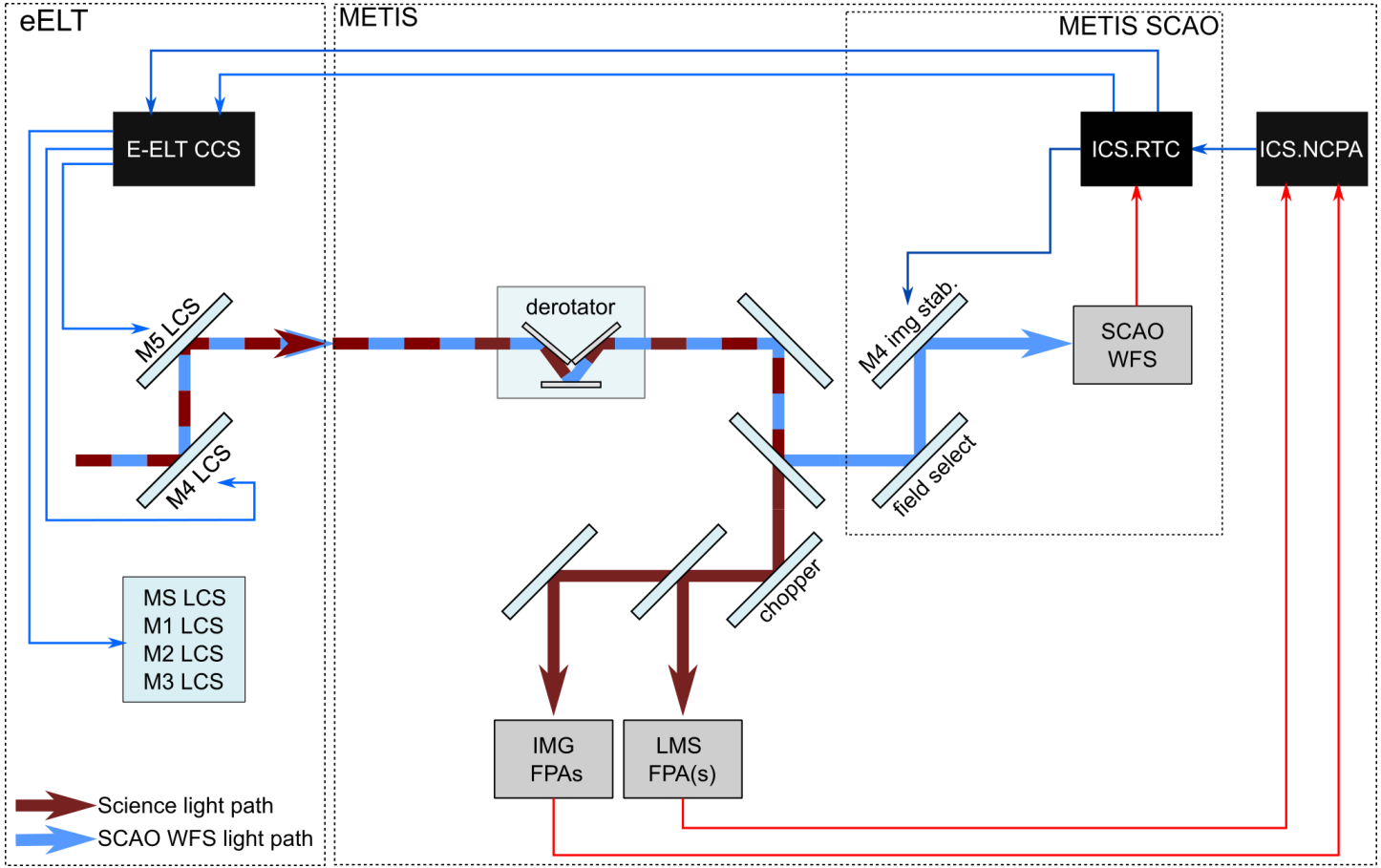


- Separate NCPA control entity outside RTC.

Non-Common-Path Aberration Control (HCI)



- Separate NCPA control entity outside RTC.
- RTC provides interface for actuator command offsets
- (Not shown): RTC provides slopes for NCPA computation.
- Updates @ 0.01Hz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M4 LCS
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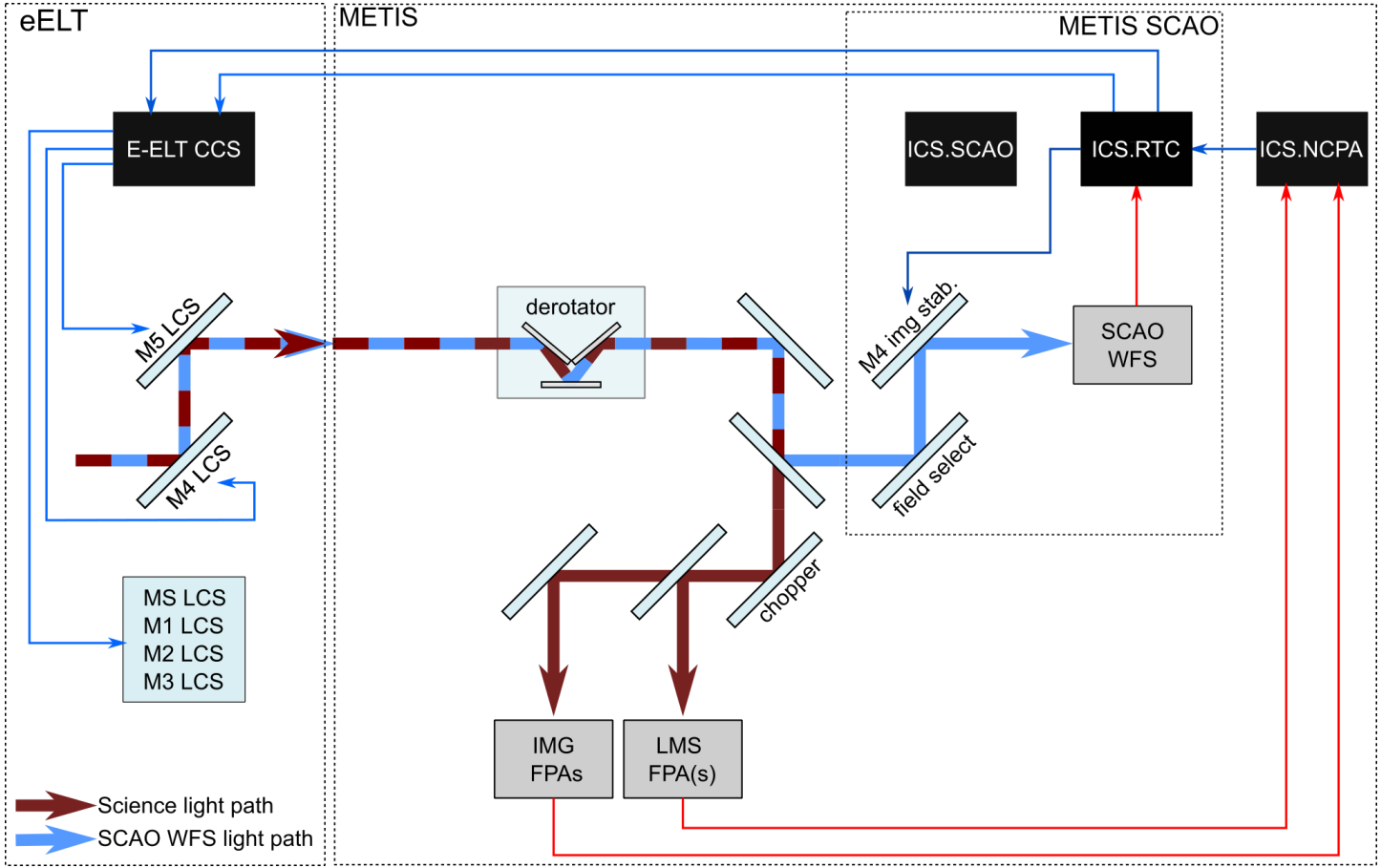
MS LCS
M1 LCS
M2 LCS
M3 LCS
chopper
IMG FPAs
LMS FPA(s)
Science light path
SCAO WFS light path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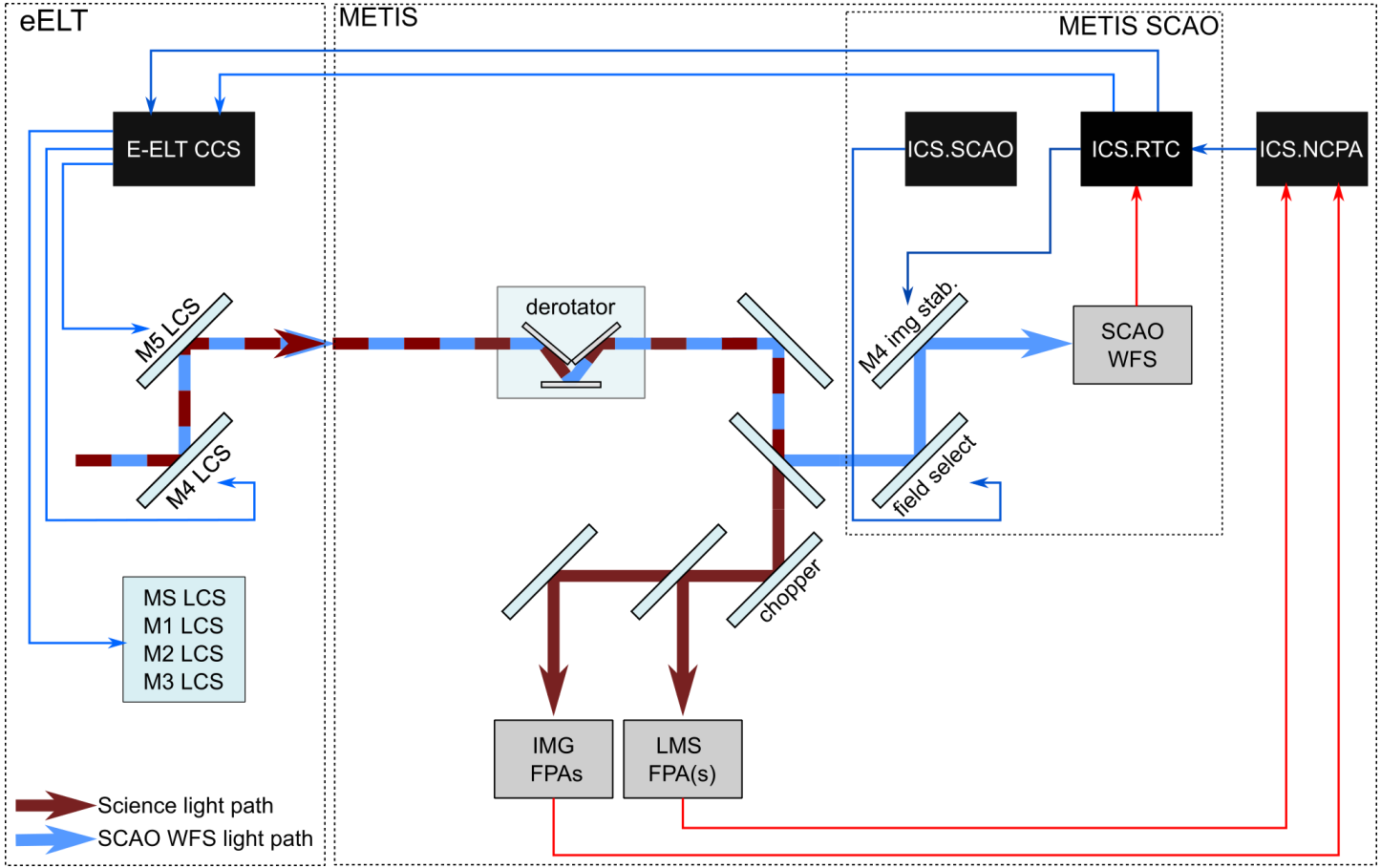
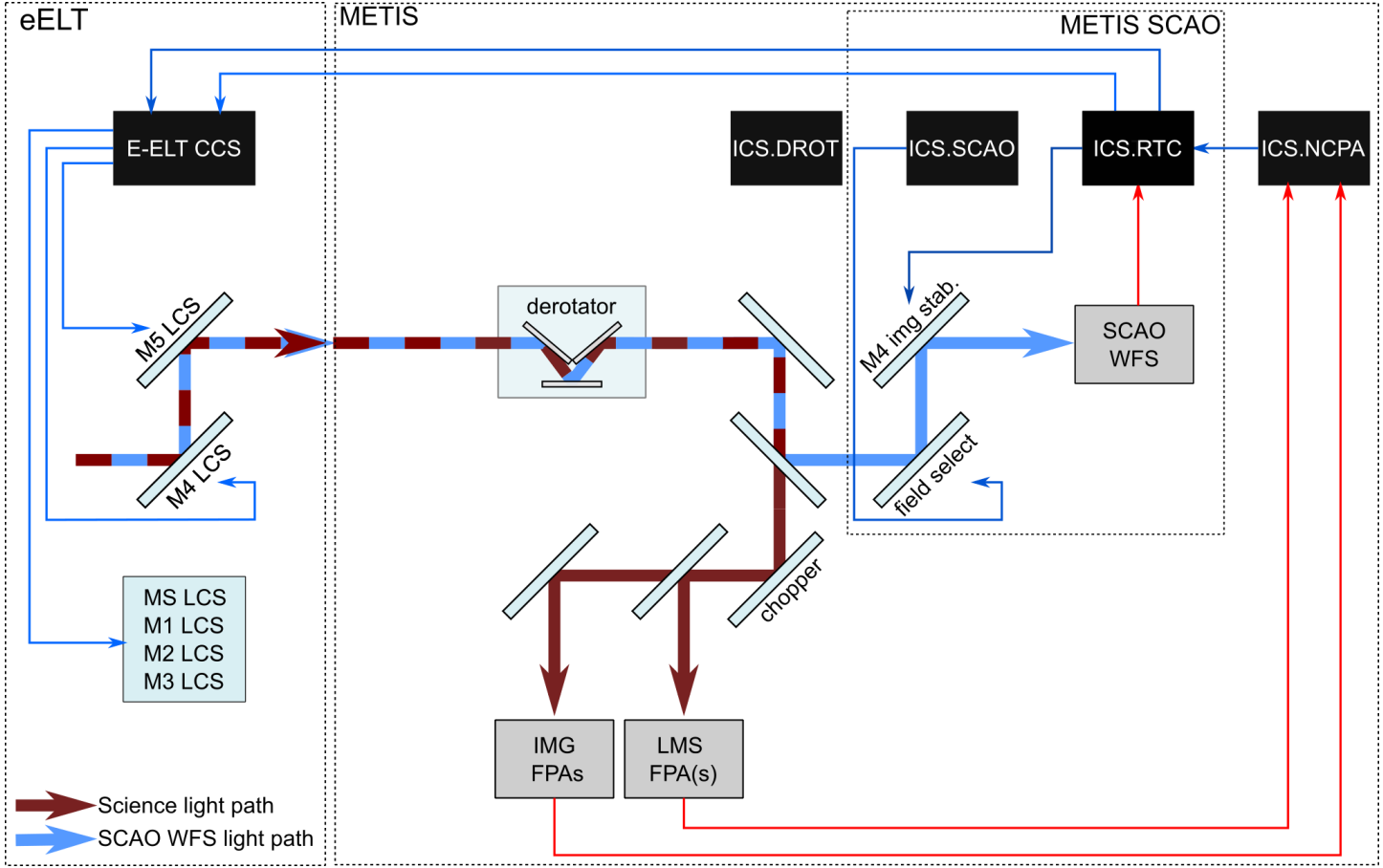
Field Selector Trajectory Control

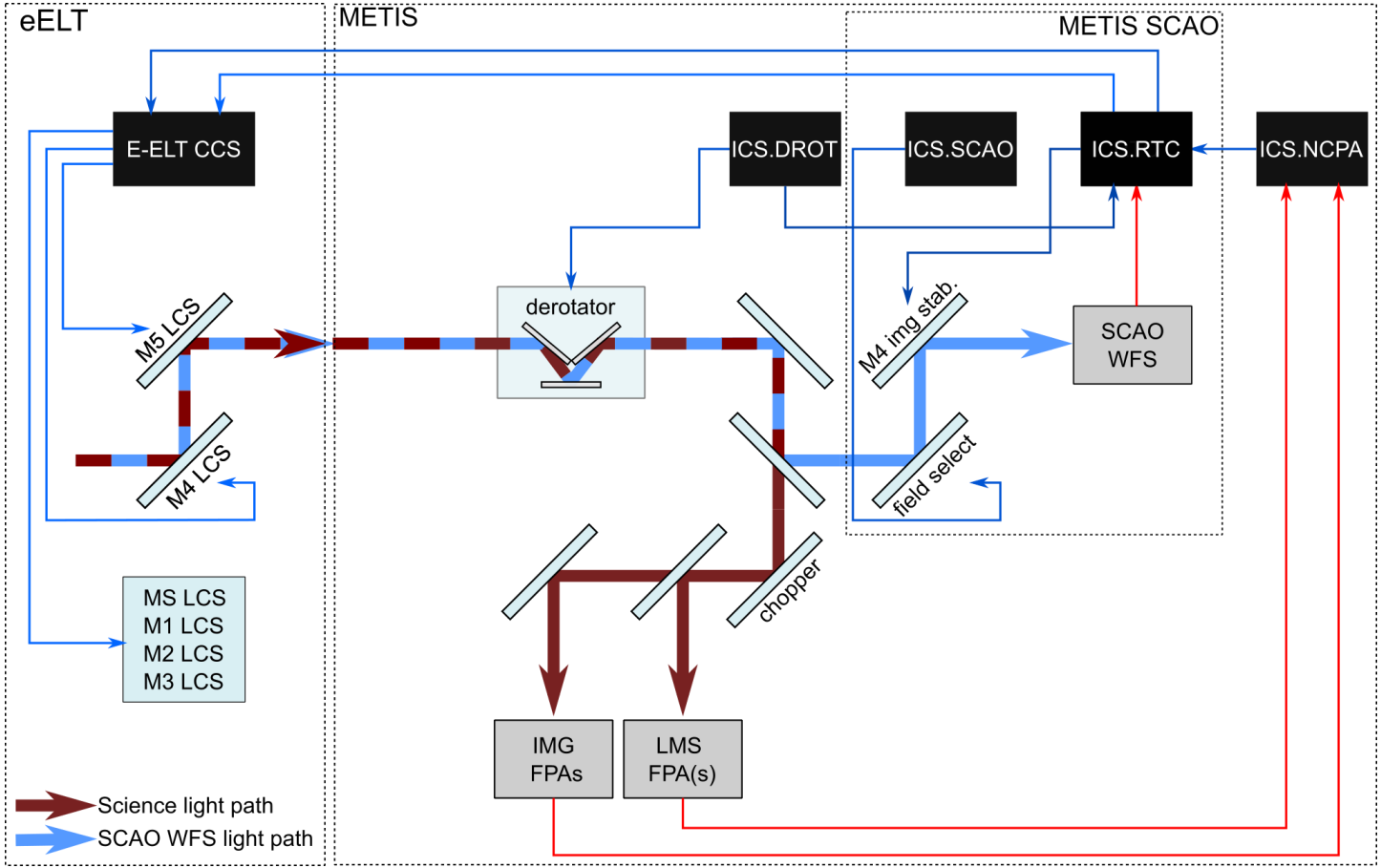


- Atmospheric differential refraction
- Non-siderial tracking

Derotation Control



Derotation Control



- Pupil rotation angle required for RTC
- Depends on mode (field or pupil tracking)
- Pupil rotation considered in reconstructor
- Closed-loop control for K-Mirror rotation required?

THANK YOU!

METIS