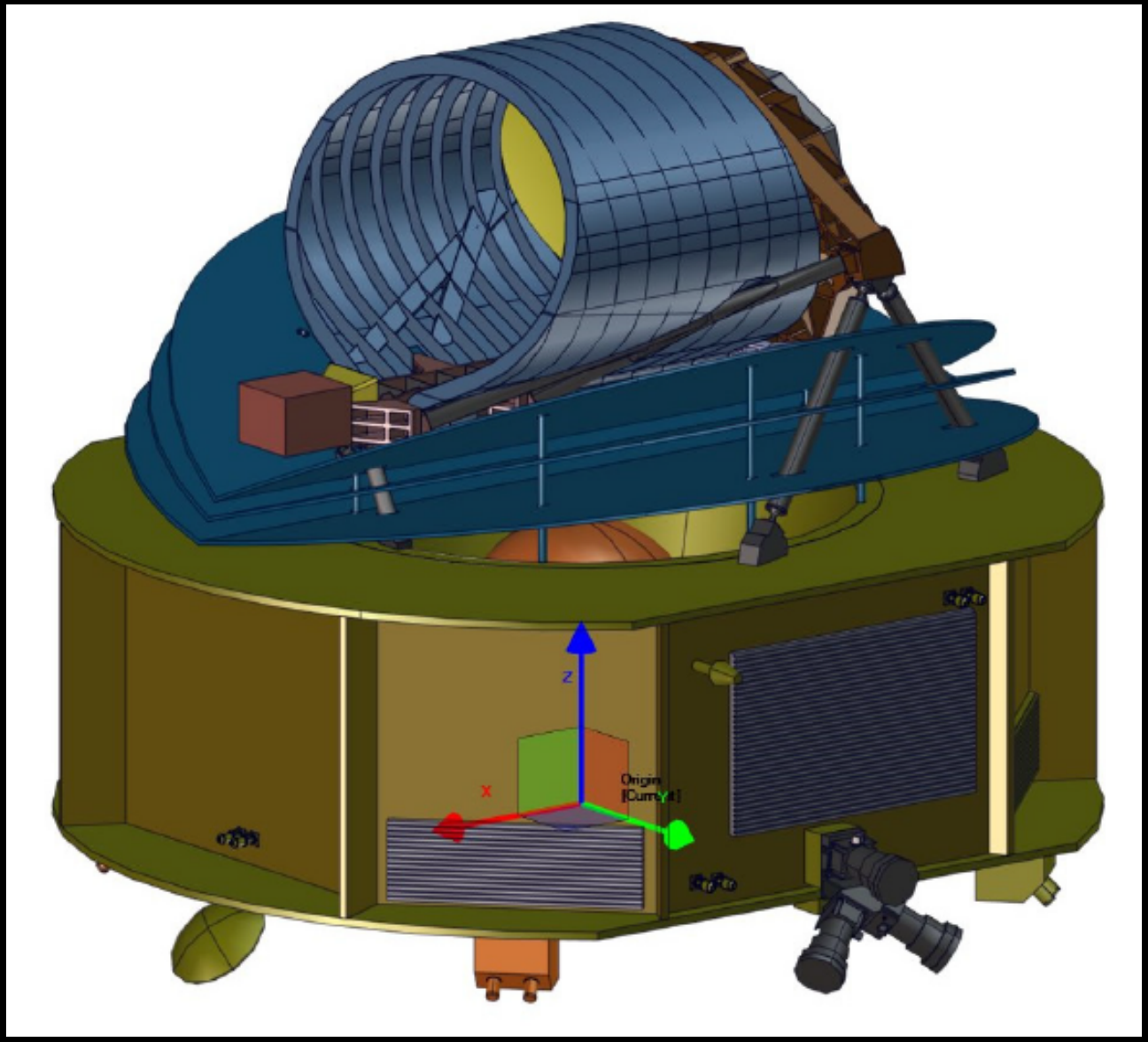
The ARIEL payload

Emanuele Pace

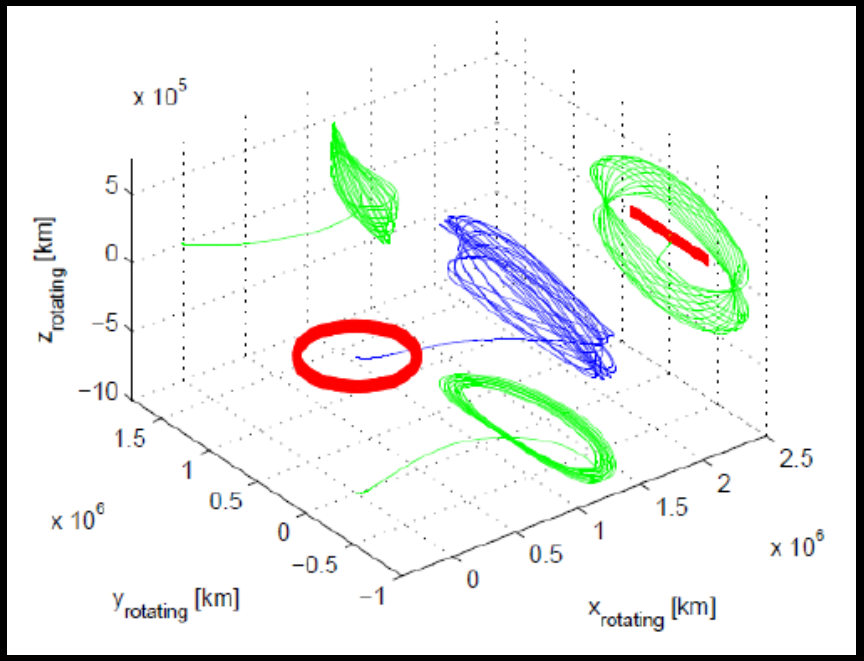
INAF, Università di Firenze

On the behalf of the ARIEL collaboration

ARIEL



Mission analysis



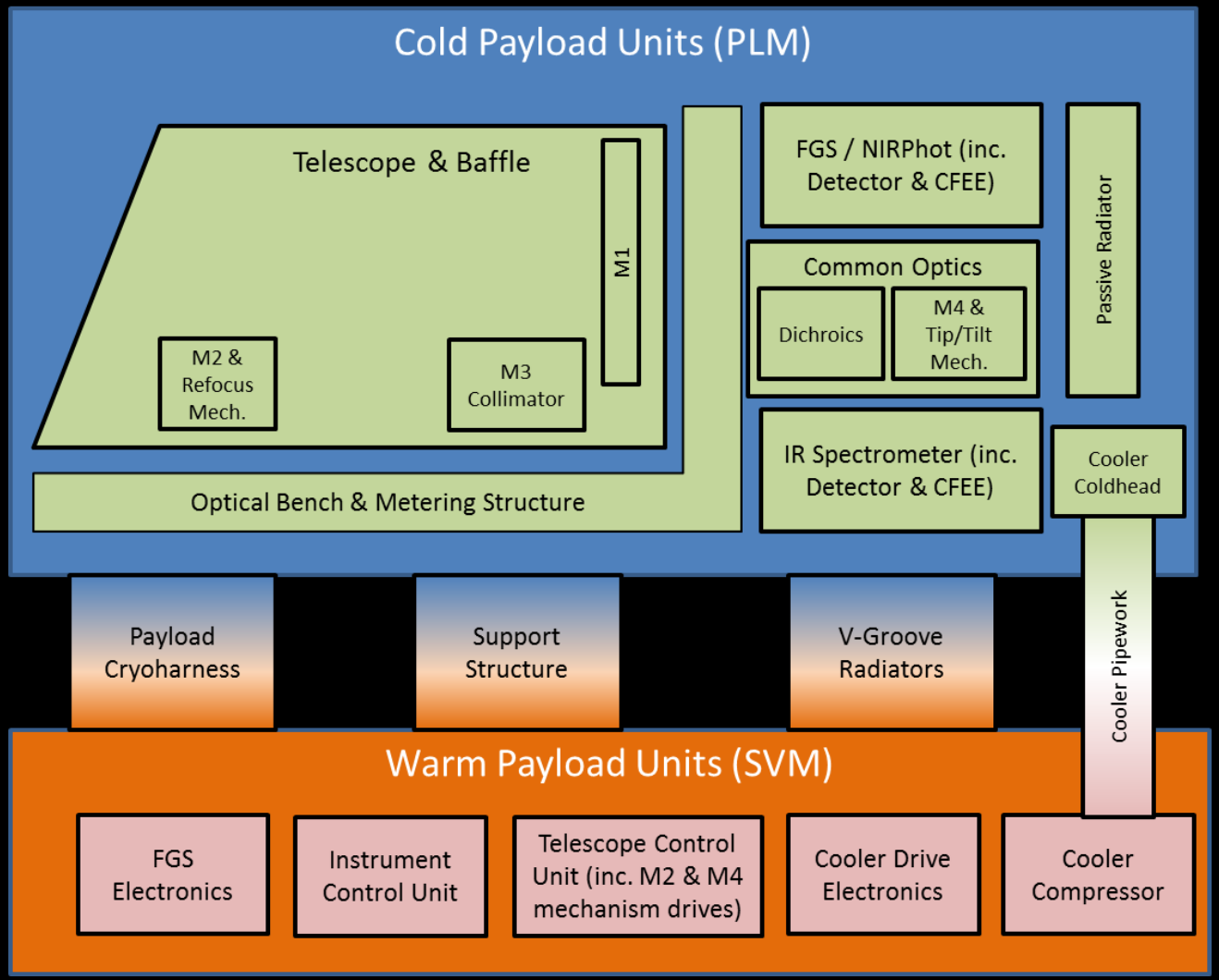
Mission sized for 3.5 years dedicated to the nominal science operations phase, with additional 2 years goal extension

- orbit around Sun-Earth L2
  - ✓ very stable thermal environment
  - ✓ very large instantaneous field of regard
  - ✓ simple design of the comm's and power subsystems
  - ✓ benign radiation environment
- observation efficiency ≥ 85%
- Solar Aspect Angle range to $\pm 5^{\circ}$ around the S/C X-axis and to $\pm 25^{\circ}$ around the Y-axis

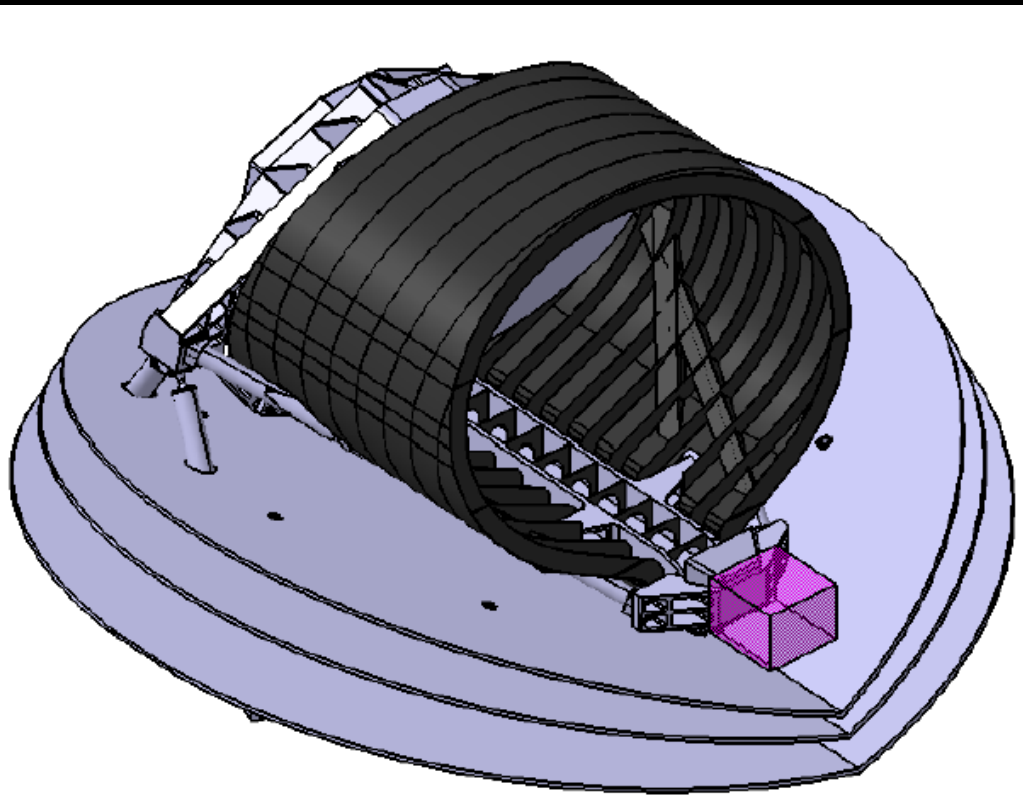
ARIEL Payload

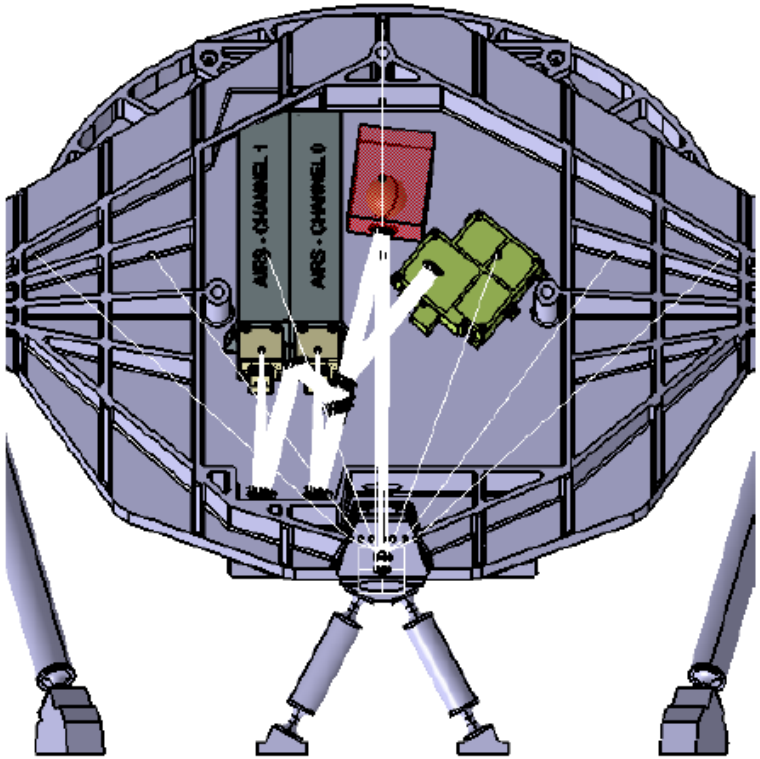
- Off-axis Cassegrain telescope, 1.1m x 0.7m elliptical M1; diffraction limited at 3 μm. Mirrors, optical bench and telescope all manufactured from Aluminium alloy for isothermal design with minimal thermo-elastic deformation and Silver coated to improve efficiency in the VIS-NIR.
- The ARIEL InfraRed Spectrometer (AIRS) provides low/medium resolution (R = 30 – 200) spectroscopy between 1.95 and 7.8 μm.
- FGS module includes 3 photometric channels (two used for guiding as well as science) between 0.5 and 1.2 μm and low resolution NIR spectrometer from 1.2 – 1.95 μm.
- Thermal: Warm SVM, cryogenic PLM cooled passively to ~55K with the thermal shield assembly. Active cooler (Neon JT) included to ensure AIRS detector operating temperature of ≤42K

Architecture

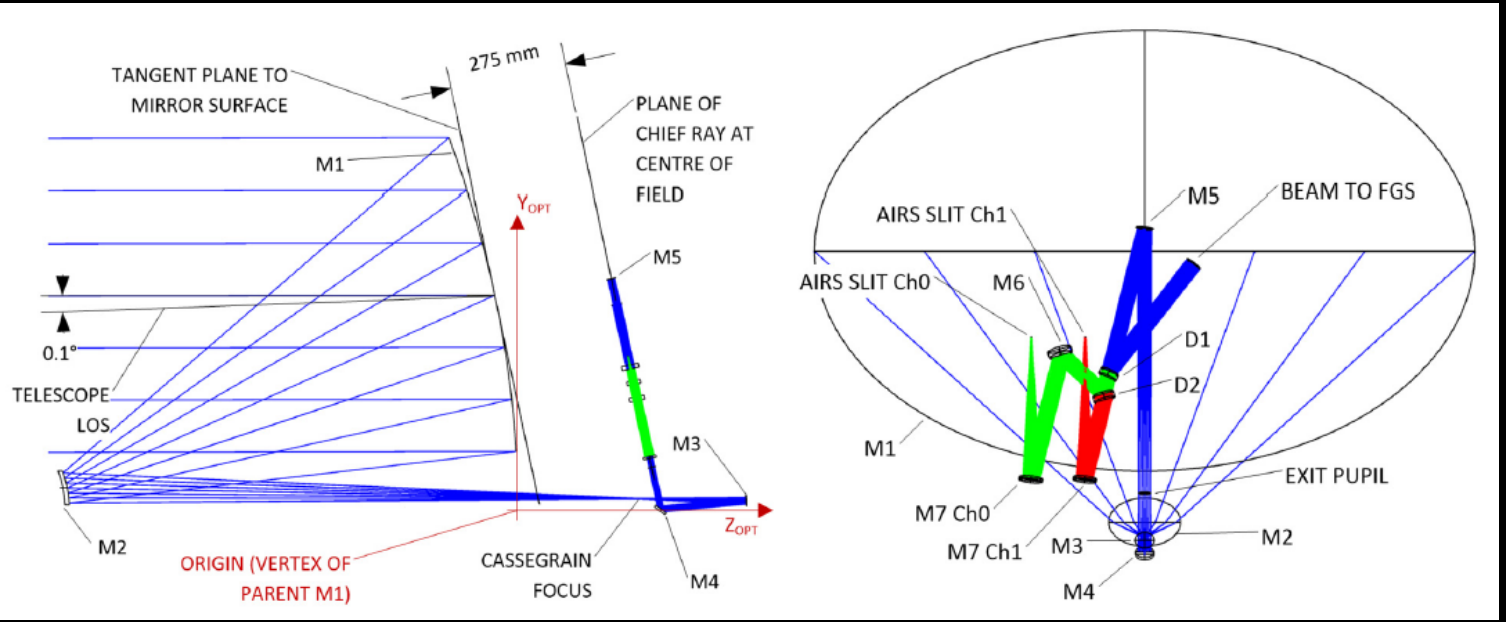


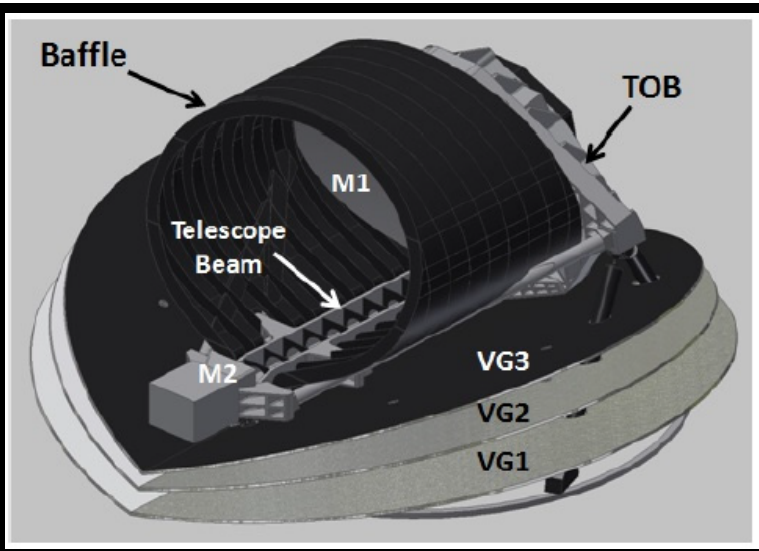
Mechanical design

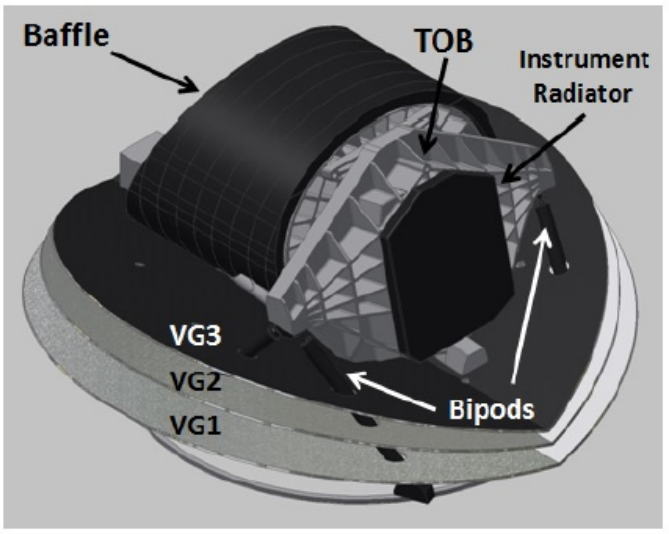




Telescope characteristics





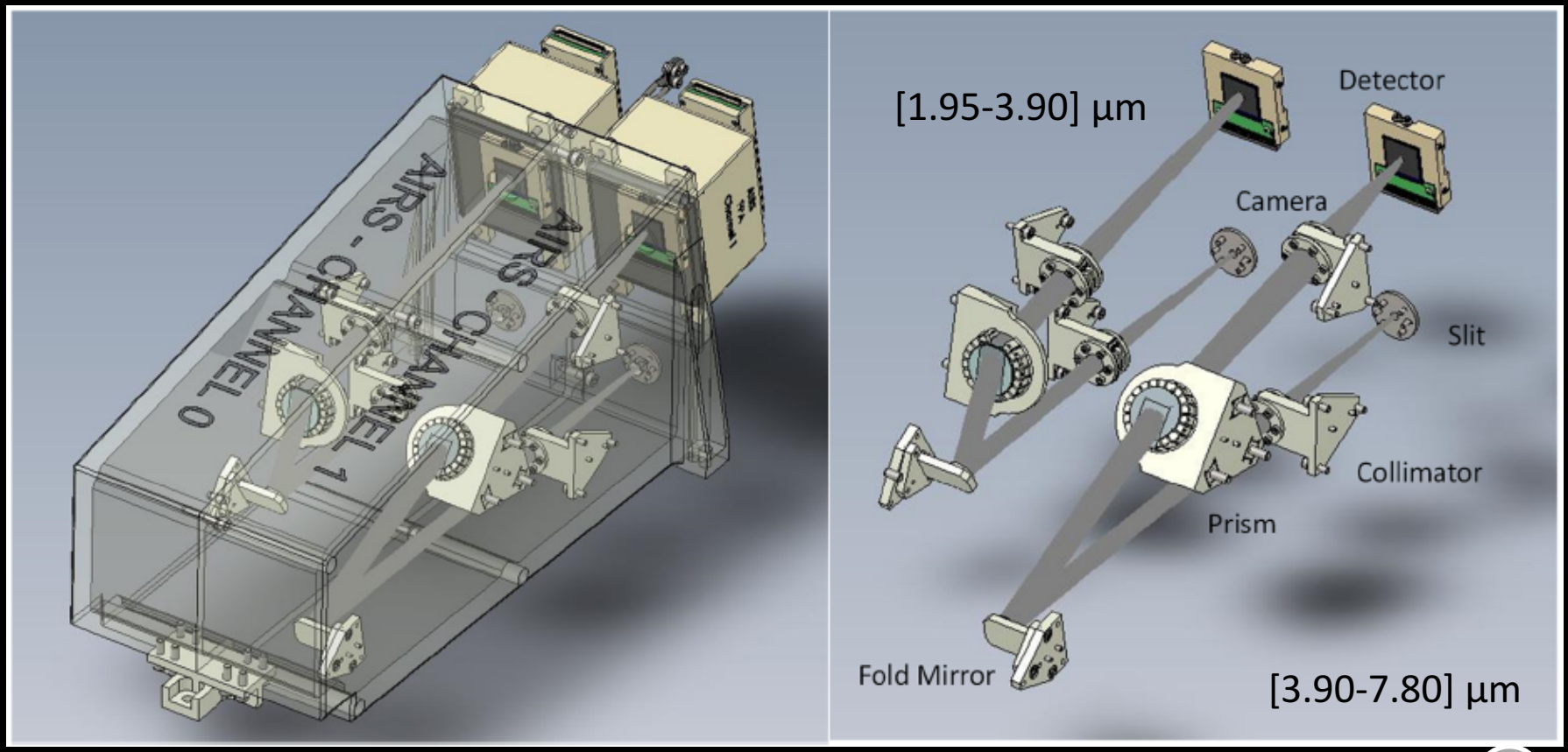


Telescope parameters

Parameter	Value
Size	1110 x 730 mm^2
Collecting area	> 0.6 m^2
FoV	30" with diffraction limited performance 41" with optical quality TBD allowing FGS centroiding 50" unvignetted
M1 WFE	Diffraction limited ≤ 3 μm (~220 nm wv RMS)
M1 Roughness	< 100 nm
Focal ratio (@ AIRS entrance slit)	f/12 (pupil major axis) f/18 (pupil minor axis)

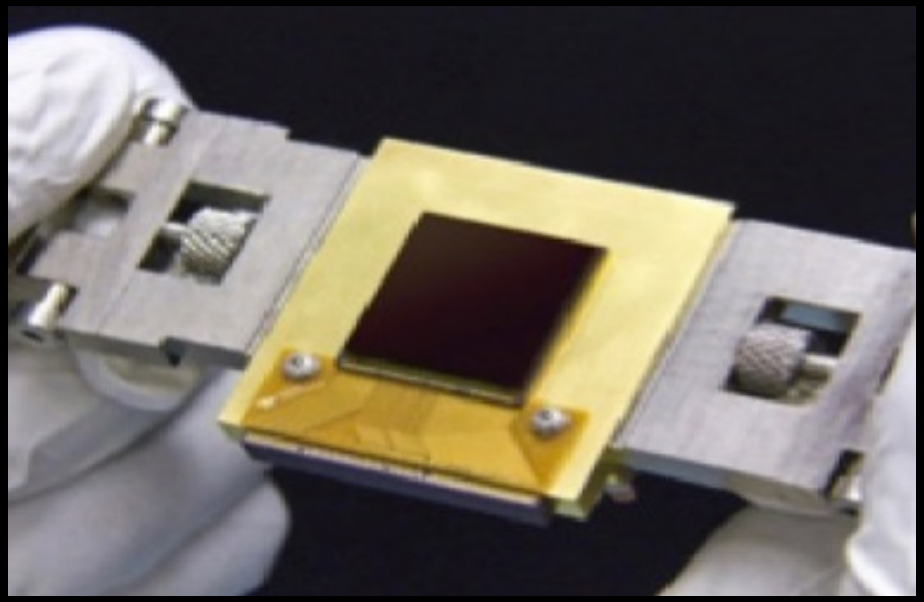
Spectrometer AIRS

2-channel prism spectrometers

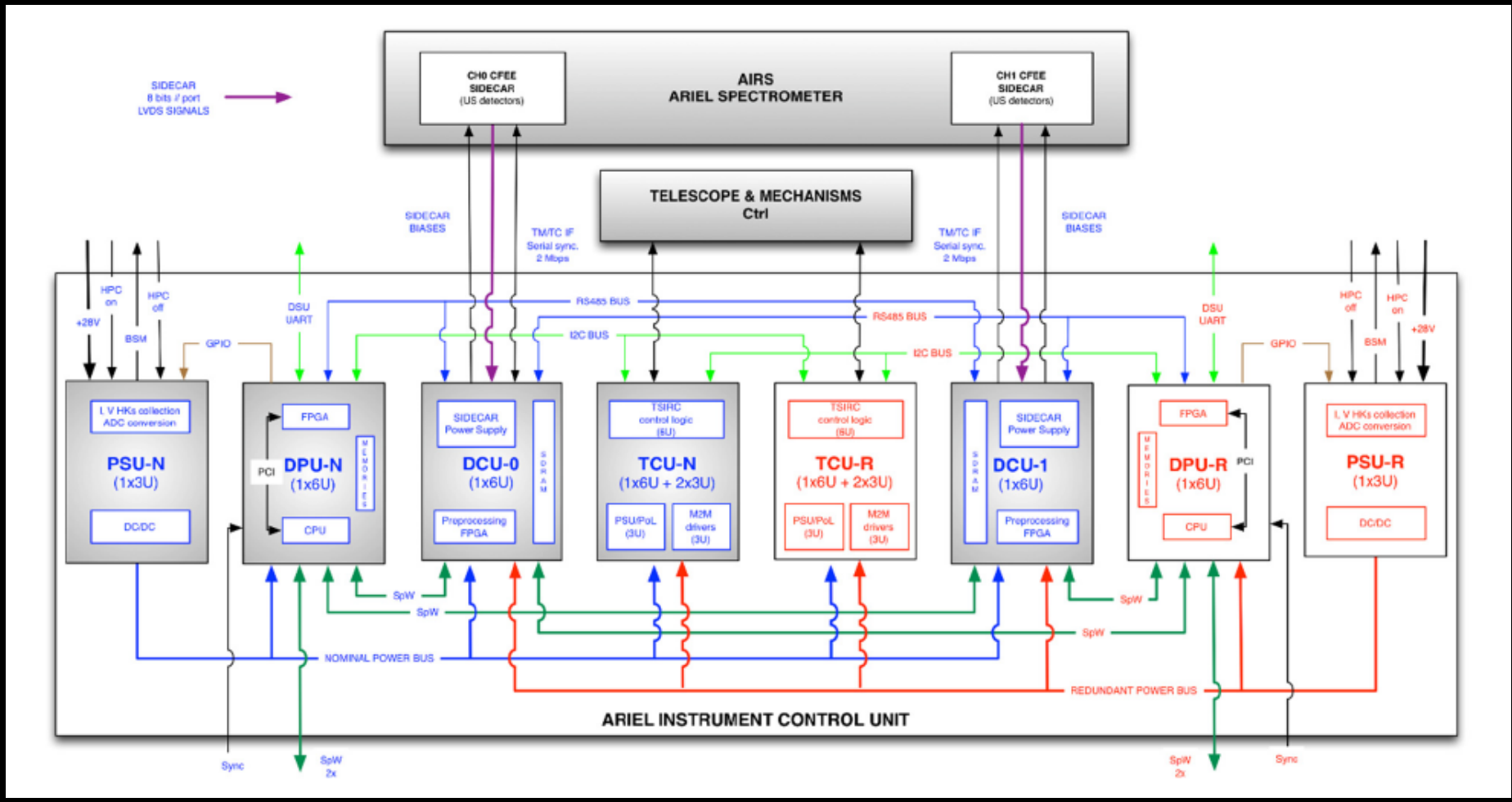


Spectrometer Detector

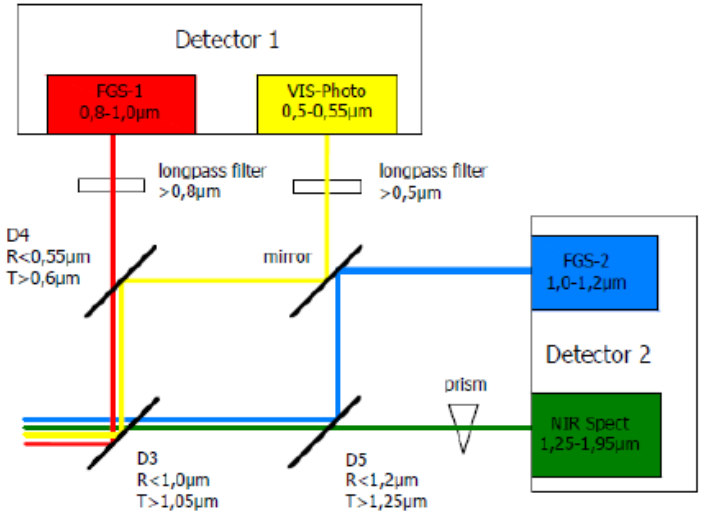
- Baseline NEOCam Teledyne MCT detector
- Work is continuing within consortium both on developing concepts to allow detectors to run warmer

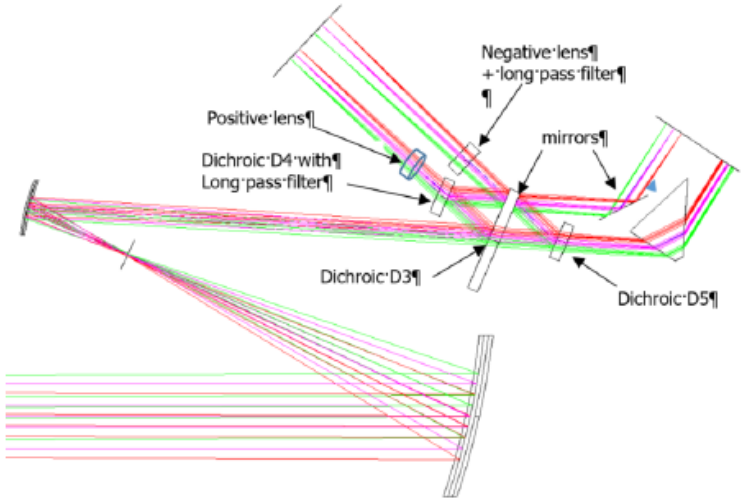


Instrument Control Unit

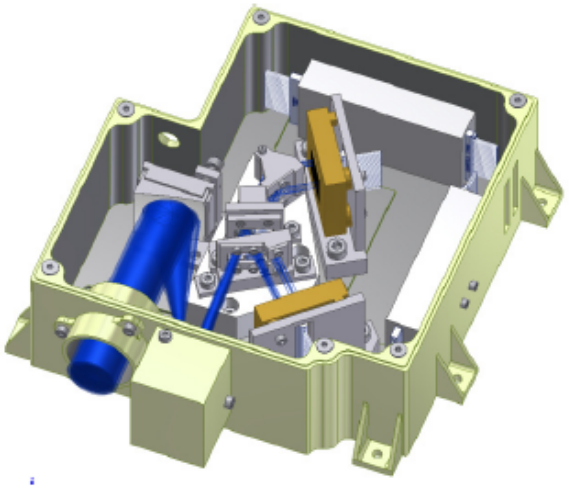


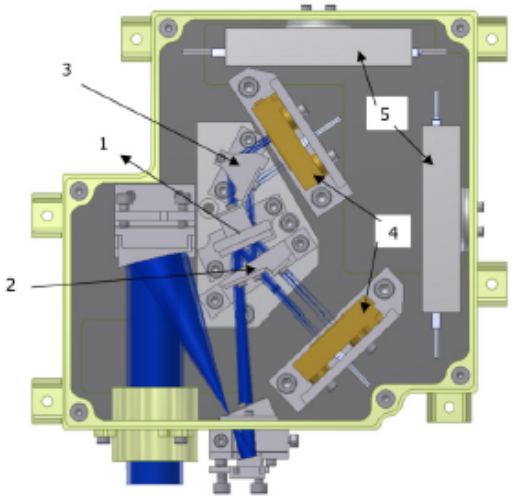
Fine Guidance System / NIRPhot



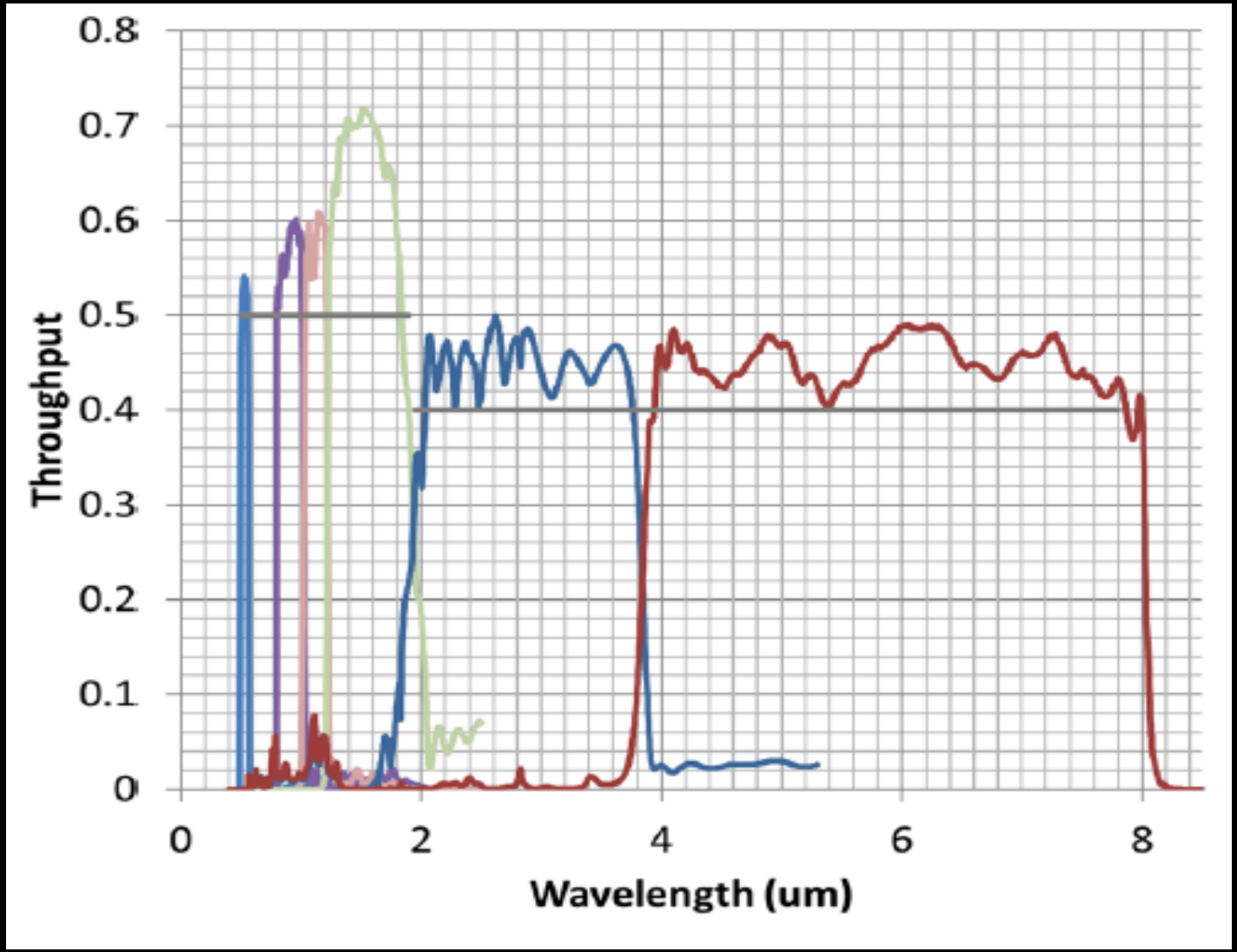


centroiding performance: 10 milli-arcsec at 10 Hz





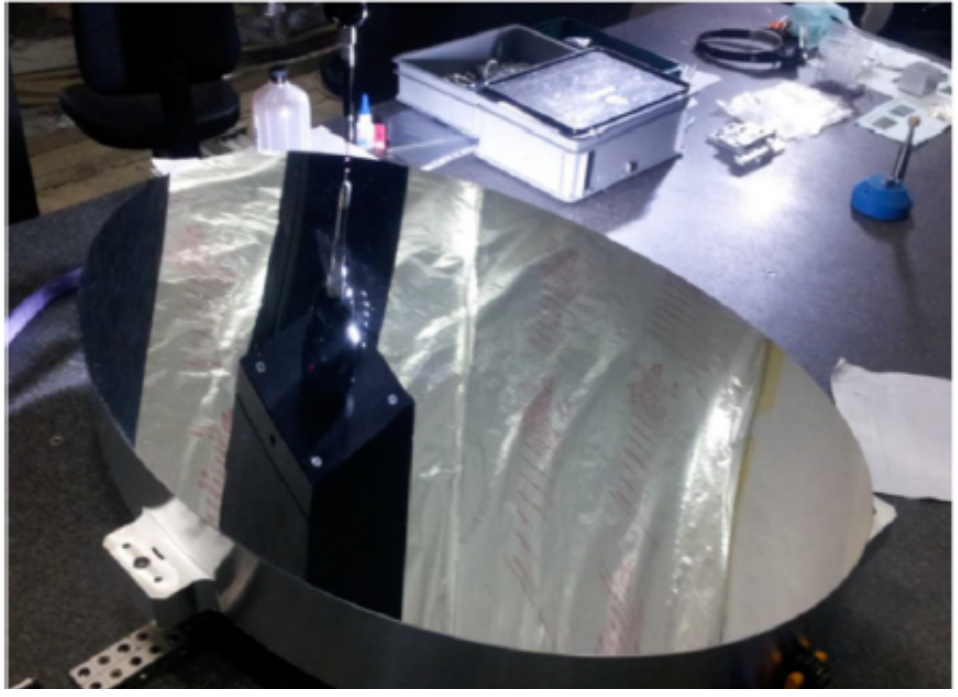
Throughput

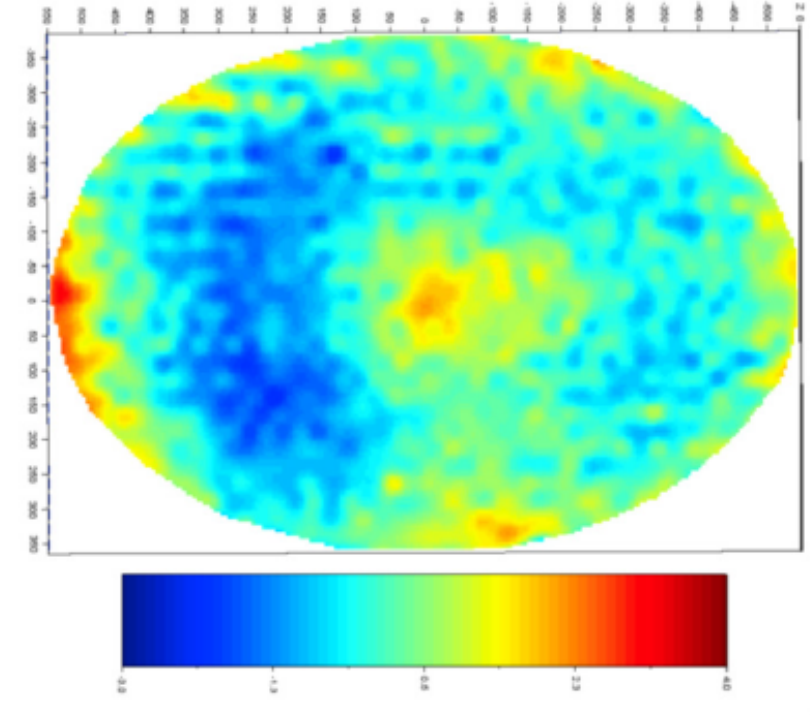


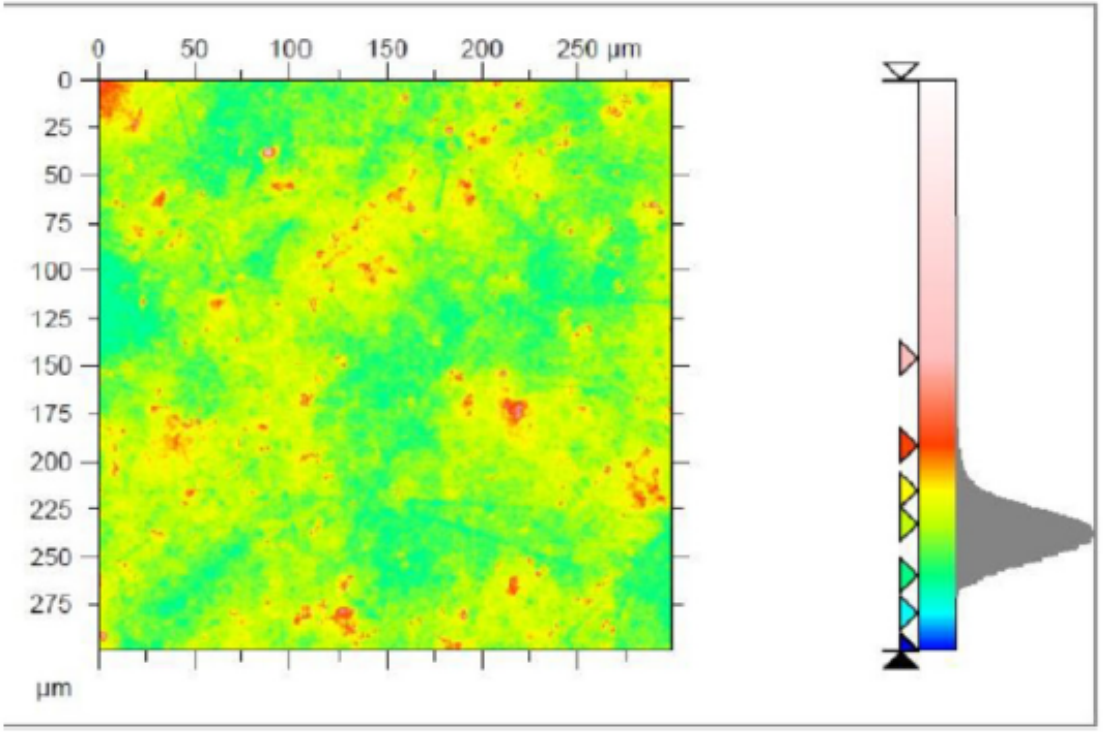
Pathfinder Telescope Mirror

In order to assess the manufacturability of M1, a Pathfinder Telescope Mirror (PTM) has been produced with the following objective:

- manufacture a representative mirror with the same size and shape of the nominal design, with relaxed req's on shape accuracy and roughness and mild light-weighting;
- verify the structural performance of the mirror, in terms of figure error, under gravity;
- Identify a support strategy of the mirror during metrology and testing that minimizes the effect of gravity.






0
50
100
150
200
250 µm
0
25
50
75
100
125
150
175
200
225
250
275
µm

Overall M4 Timeline

Timeline targeted for M4 mission	
Phase 0 (ESA internal CDF)	June to September 2015
Phase 0 completed	End September 2015
ITT for Phase A industrial studies	October 2015
Phase A kick-off	March 2016
Mission Selection Review completed (ARIEL, THOR, XIPE)	April 2017
Selection of M4 mission (SPC)	March 2018
Phase B1 kick-off of the selected M4 mission	March 2018
Phase B1 completed	March 2020
Mission Adoption Review	Q2 2020
Adoption of the M4 mission (SPC)	November 2020
Phase B2/C/D kick-off	TBD
Launch	2028