

Mission Design and Development of the REDSoX Polarimeter

Sarah Heine

XRSIG Splinter Group, HEAD Meeting

April 9, 2024

REDSOX Team

MIT Team



H Marshall-PI



S Heine-Deputy PI



A Garner-PM

Optics Fabrication:
Marshall Space Flight
Center-Steve Bongiorno



A Metivier-ME



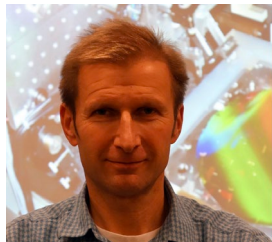
J Juneau-EE



B LeMarr-Detector Scientist

Major Vendors

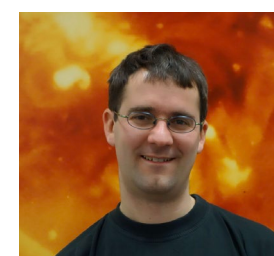
Multilayer Mirrors:
Lawrence Berkeley
National Lab-Eric Gullikson



R Heilmann-Gratings



S McNeil-SE



M Guenther-Ray Tracing

Grating Fabrication:
Izentis LLC-
Alex Bruccoleri/MIT Space
Nanotechnology Lab



S Ravi-Graduate Student

Undergraduate
Students:
Nithya Kothnur
Candace Ramirez

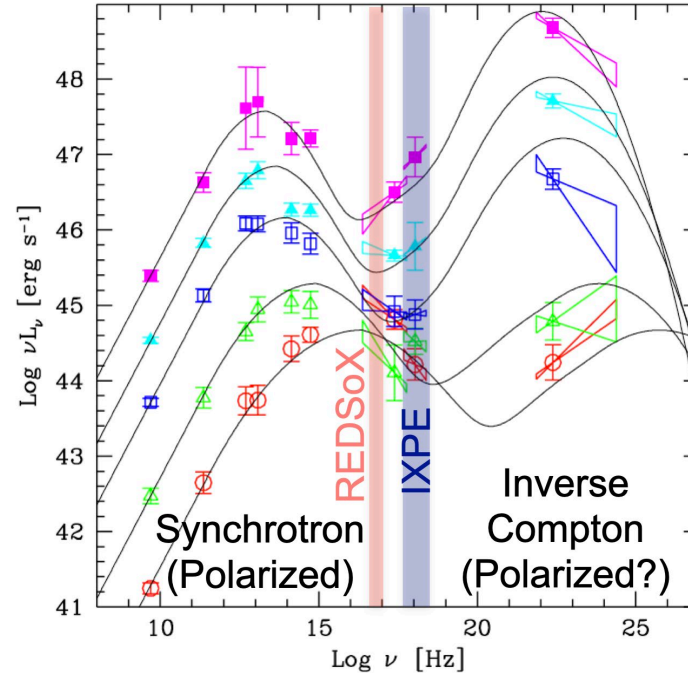


N Shultz-Optics Integration

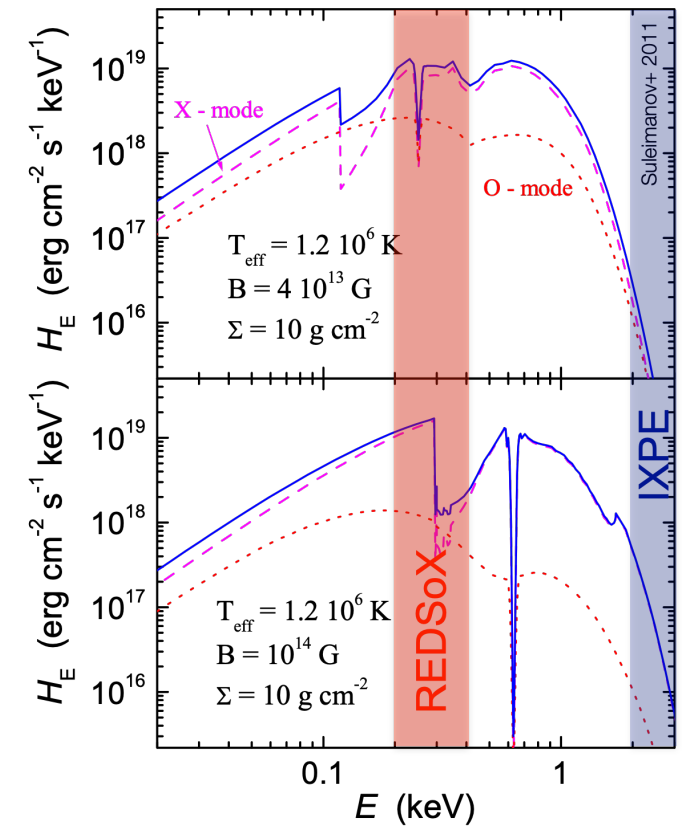
CCD Detectors: XCAM
Ltd. Utilizing Teledyne-
e2V CCD chips

Science

- REDSoX will observe one blazar
- AGN with relativistic jets (blazars): B-field uniformity, switchover to iC emission
- AGN soft excesses: disk or jet?
- Tidal disruption events with jets

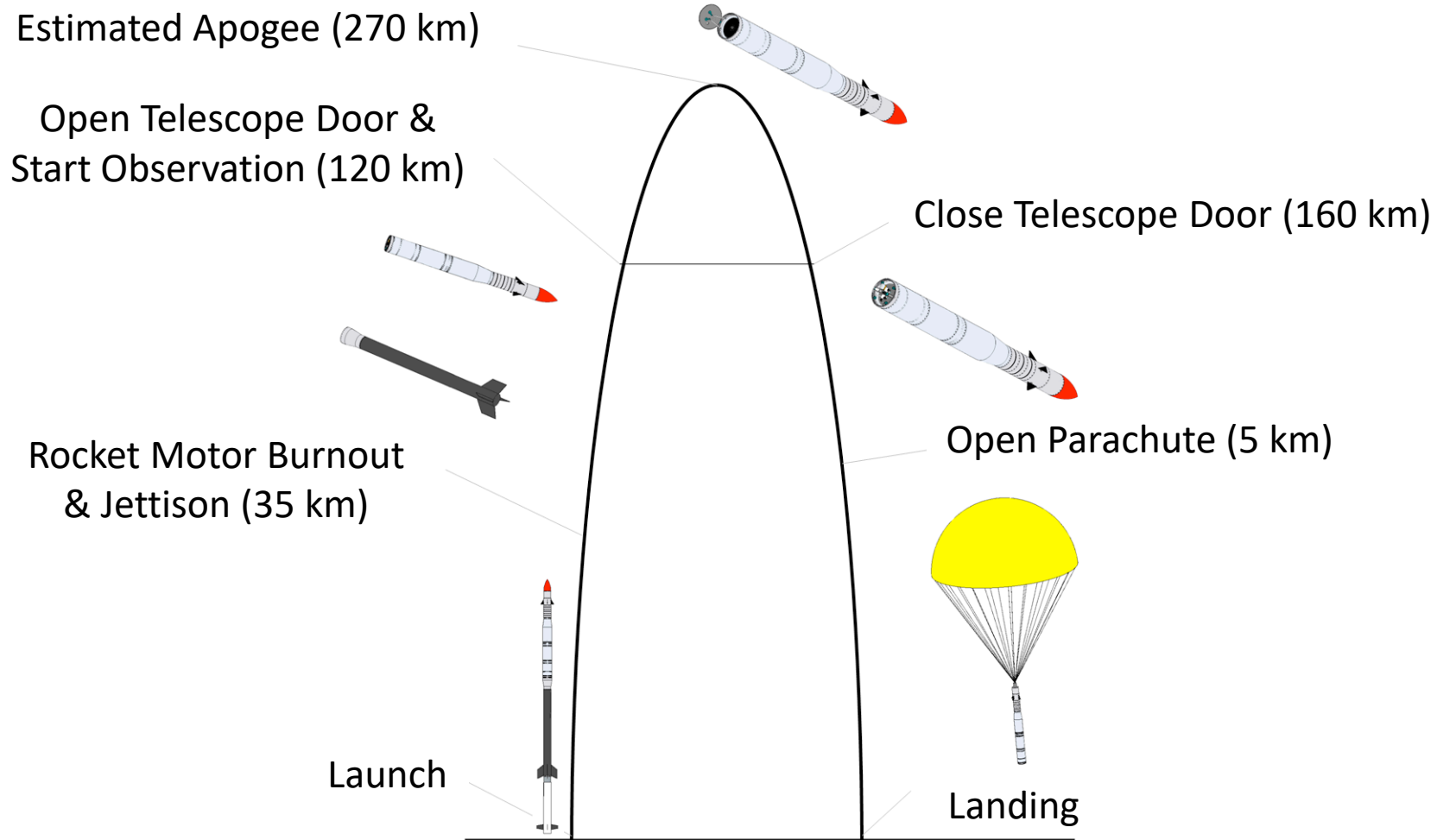


- Isolated neutron stars with magnetized atmospheres
- Atmosphere is polarized if gaseous, unpolarized if condensed
 - Explore range of surface melting points, nature of absorbed lines
 - Complementary to IXPE (2-8 keV)
- **Spectropolarimetry** of absorption features

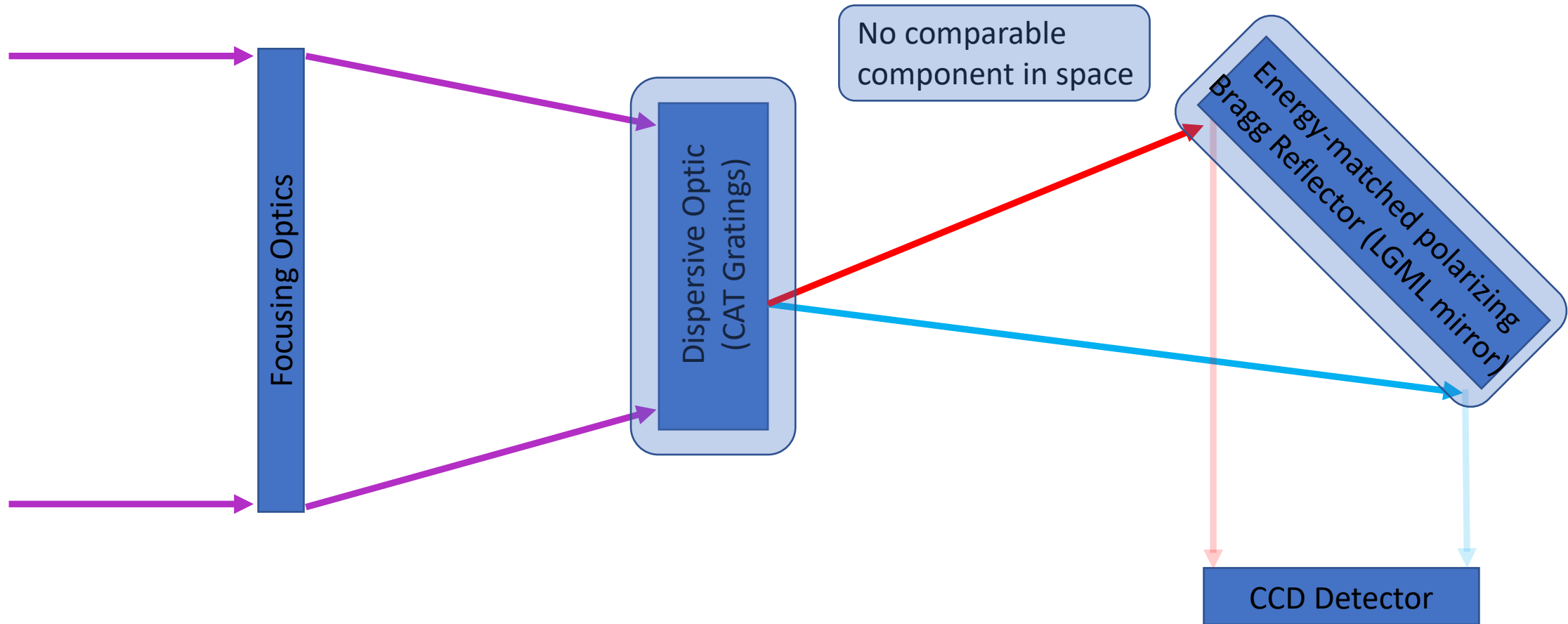


Sounding Rocket Platform

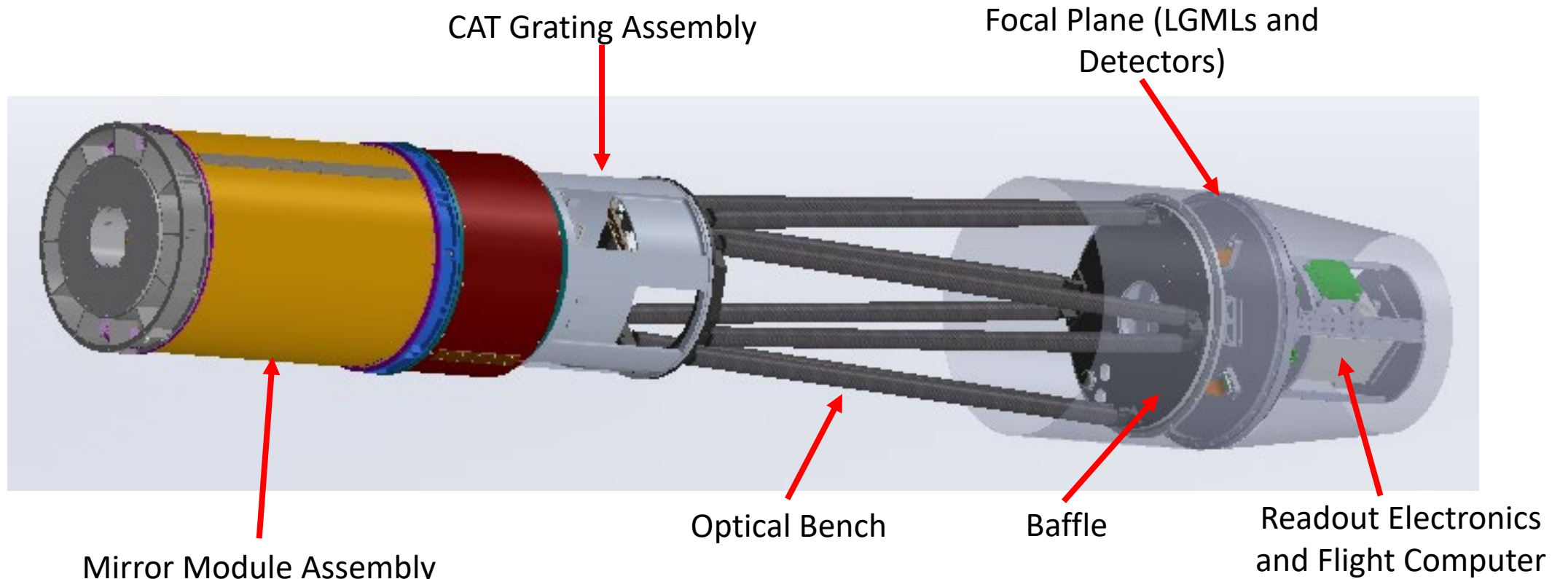
Rocket Experiment Demonstration of a Soft X-ray Polarimeter



Polarimeter Concept



Payload Overview



Mirror Module Assembly
(MMA)
5 shells, electroformed Ni
Wolter-I, 2.5 m focal length

CAT Grating Assembly

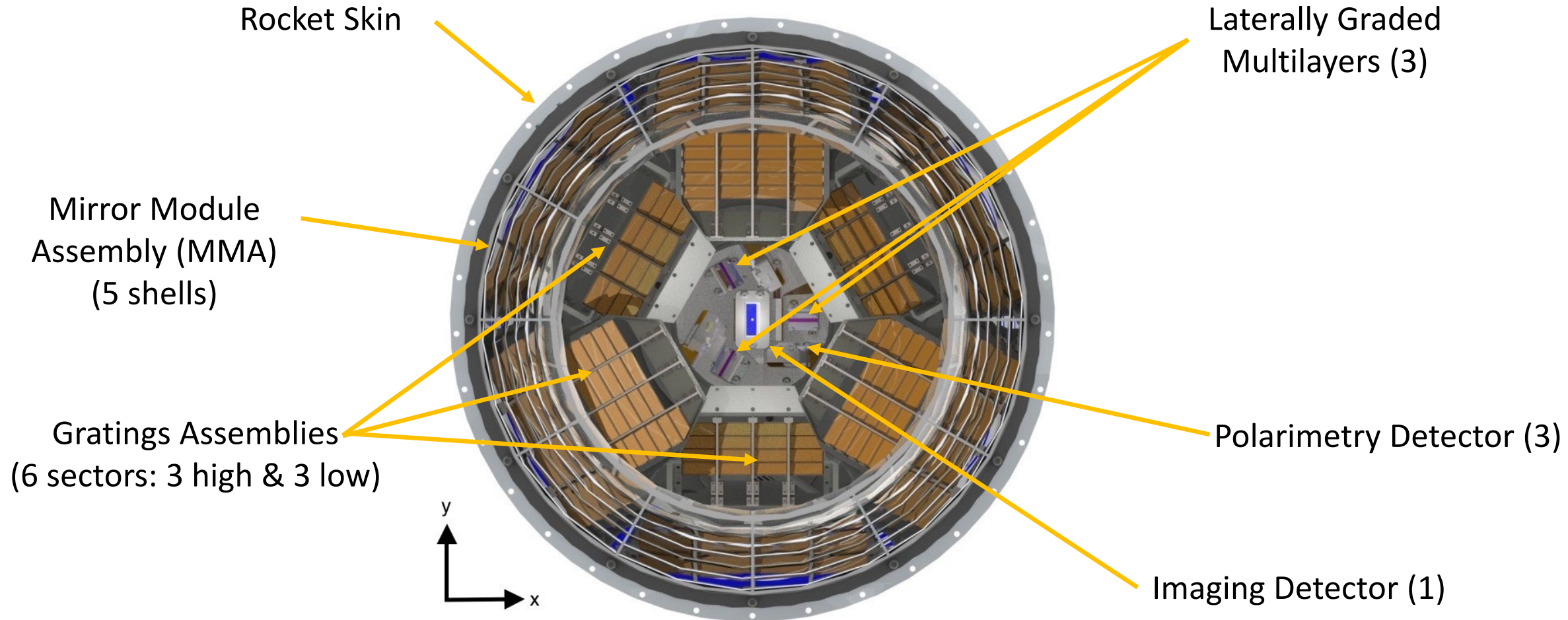
Optical Bench

Focal Plane (LGMLs and
Detectors)

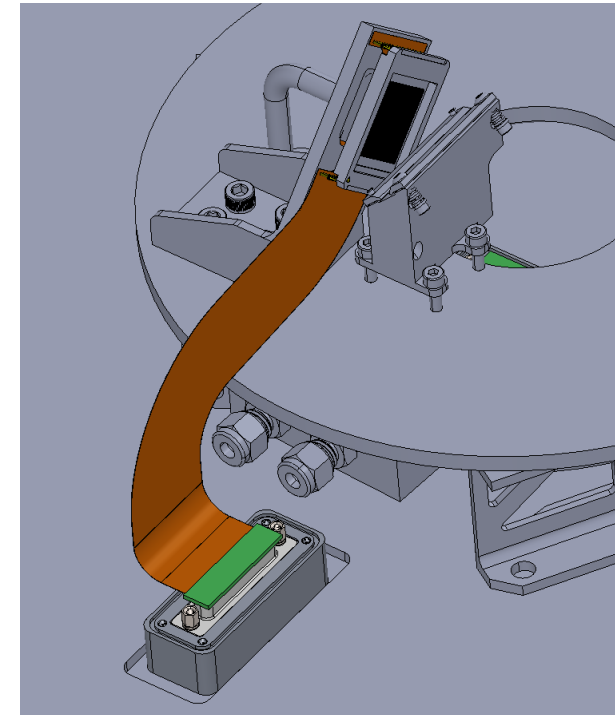
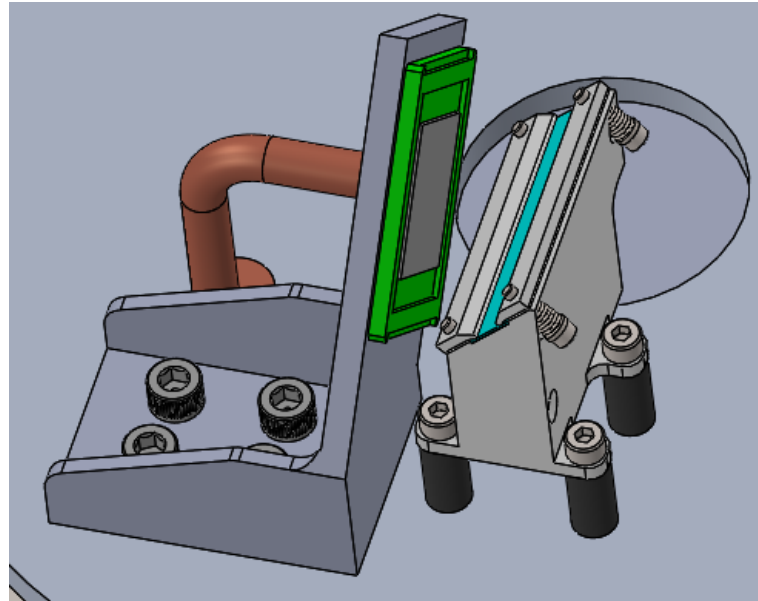
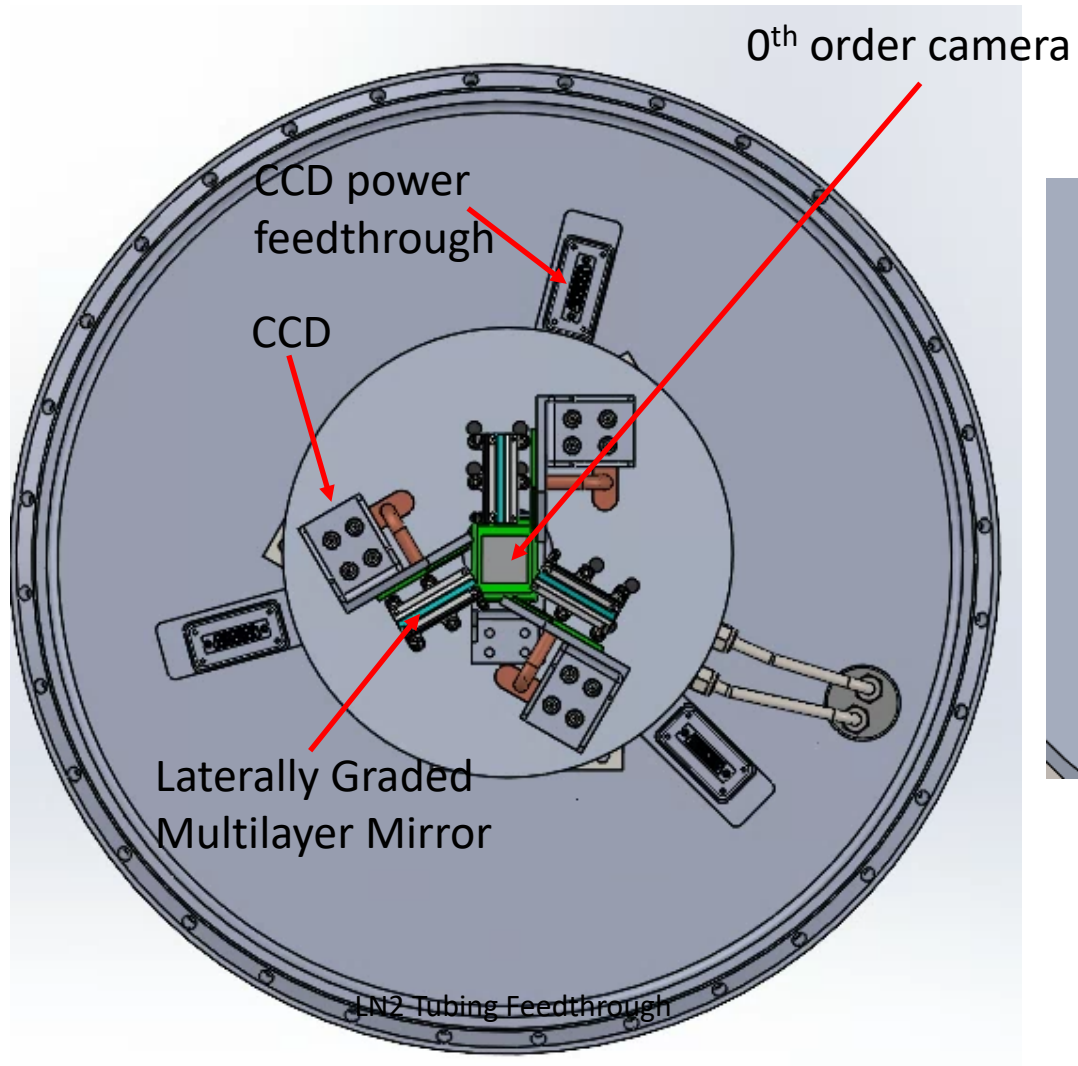
Baffle

Readout Electronics
and Flight Computer

Payload Overview

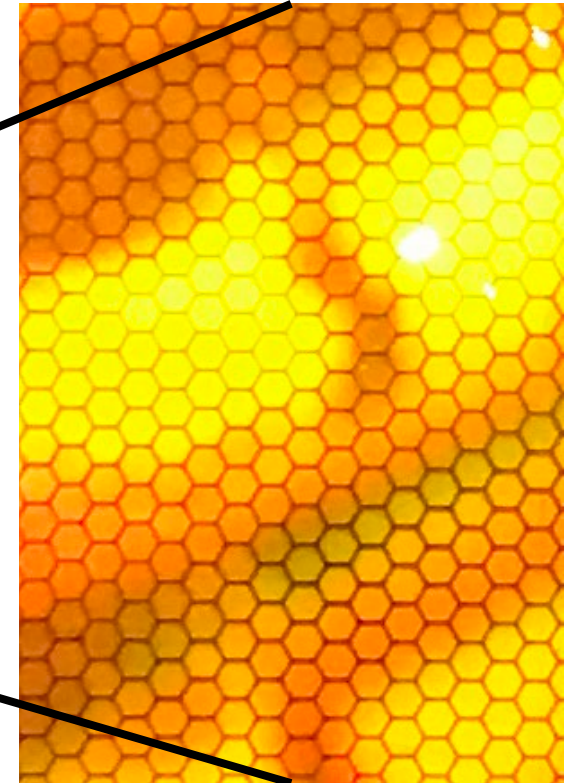
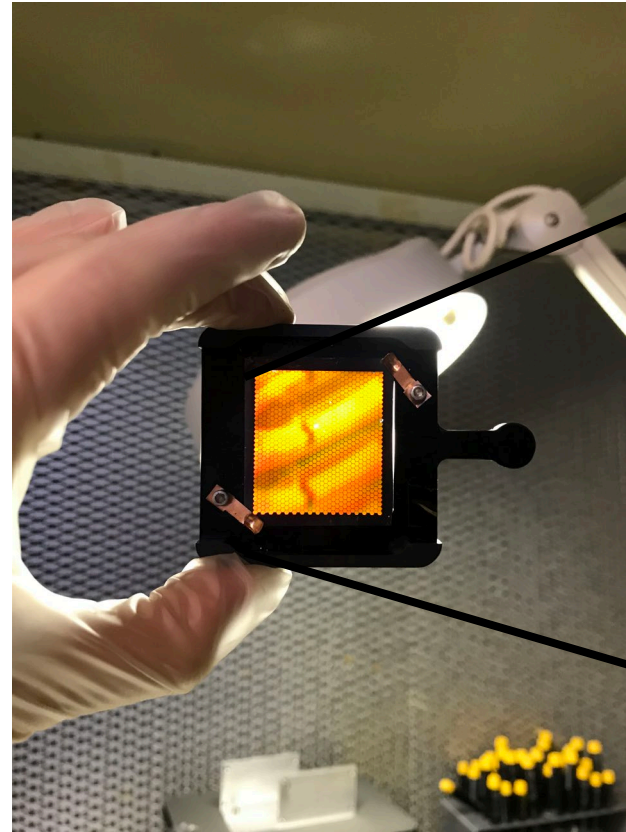
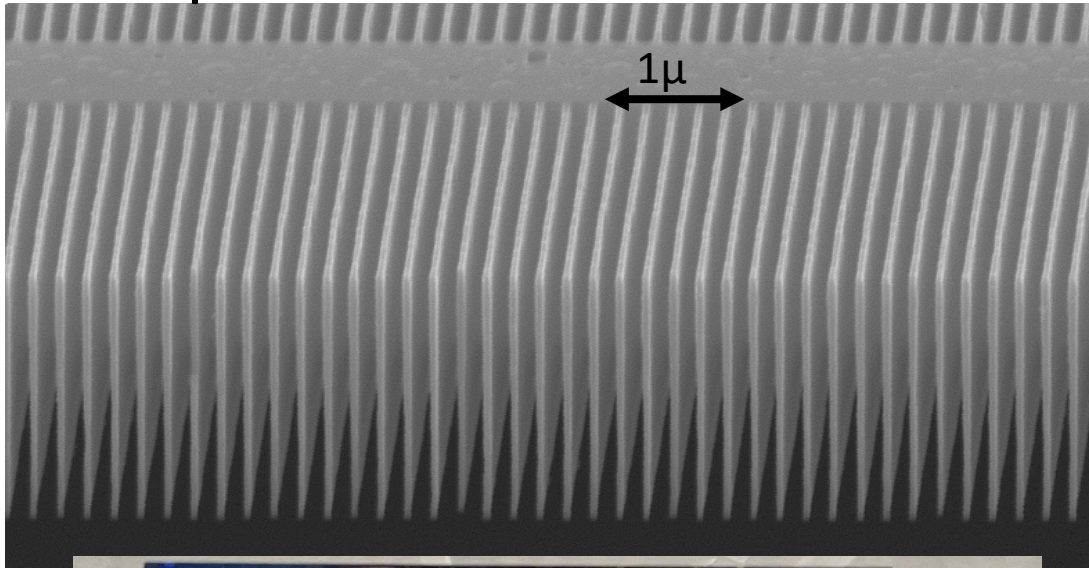


Focal Plane

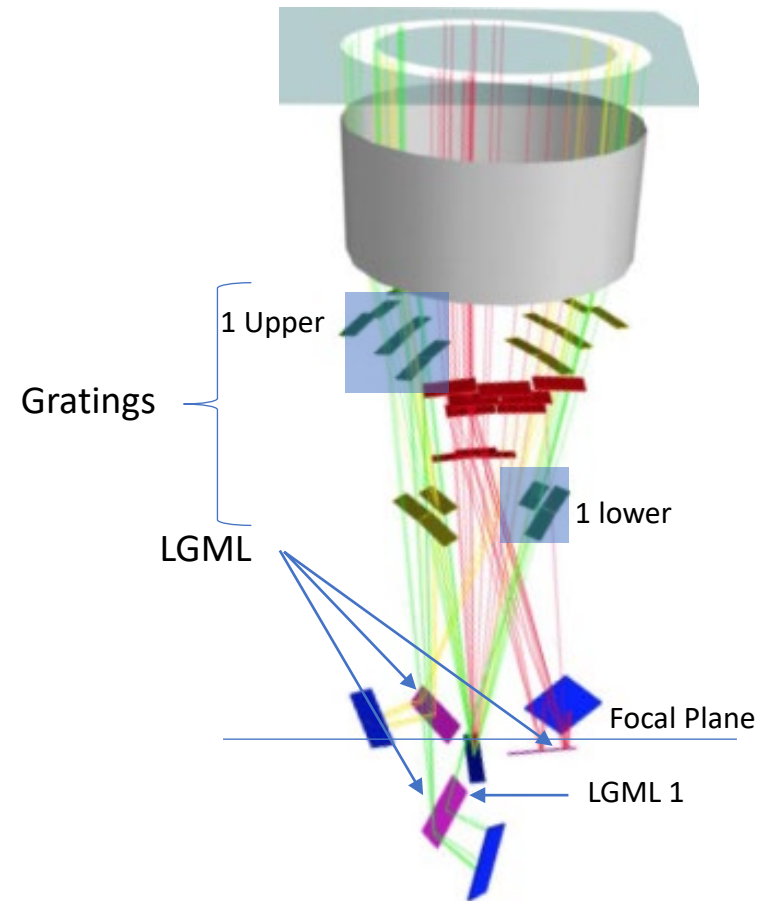
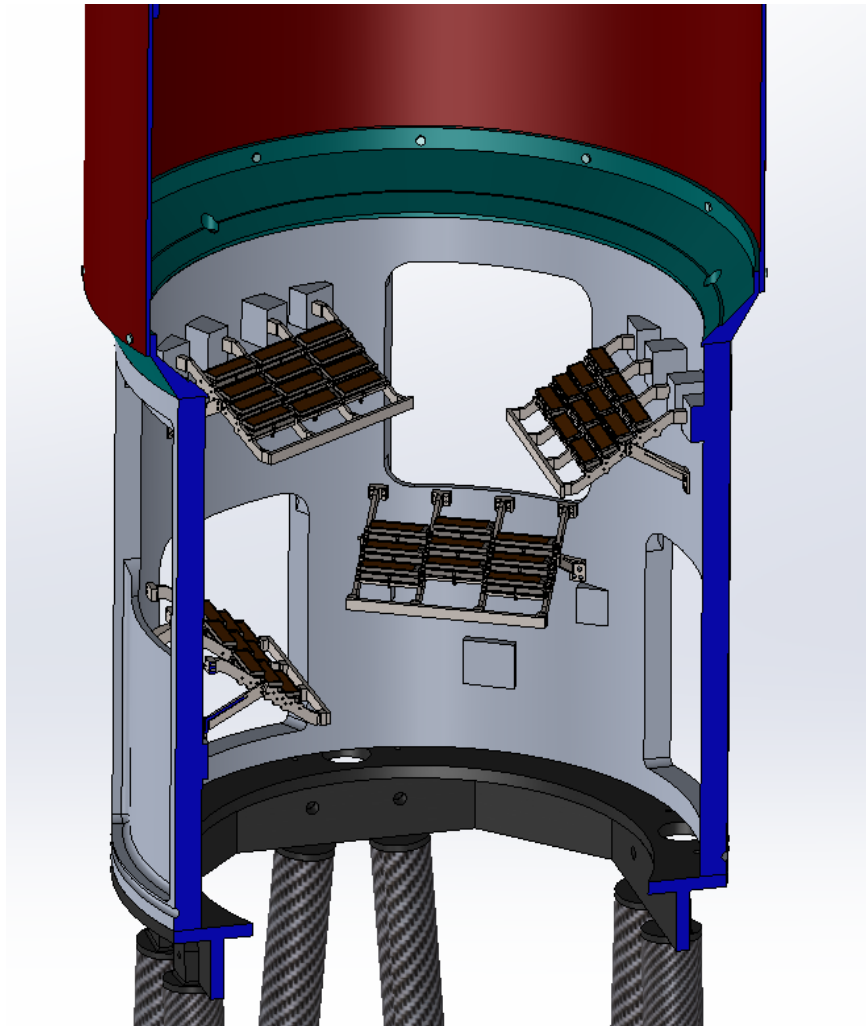


Critical Angle Transmission Gratings

- 200 nm period gratings 4 μm deep, etched from Si wafers, up to 25% measured efficiency
- 1 μm bars @ 5 μm spacing perpendicular to gratings on hexagons 0.5mm deep 1mm wide



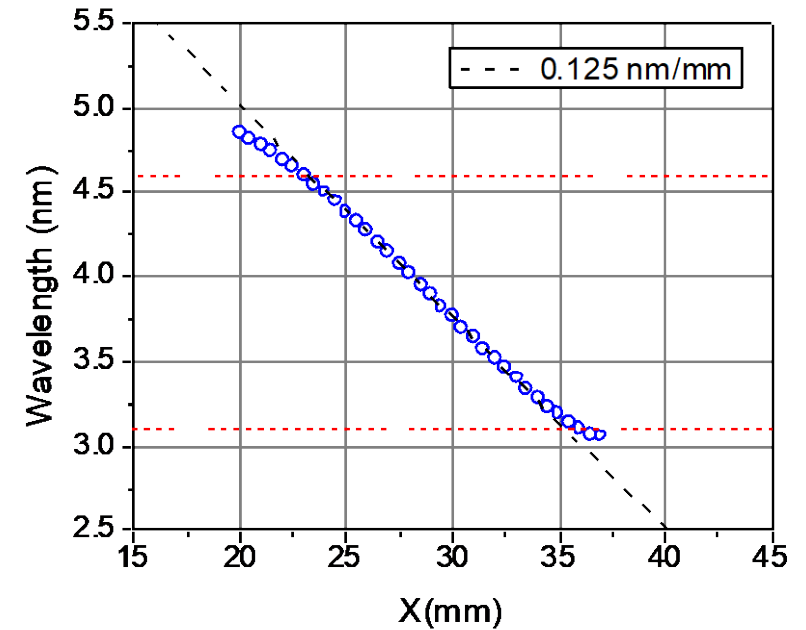
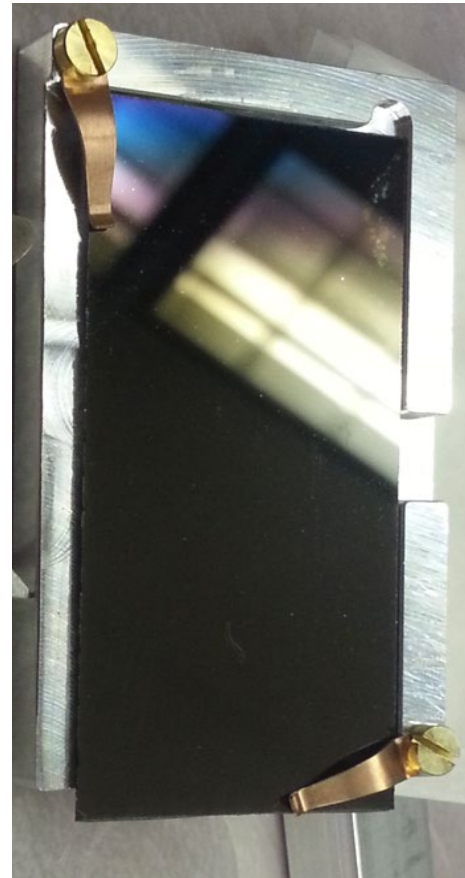
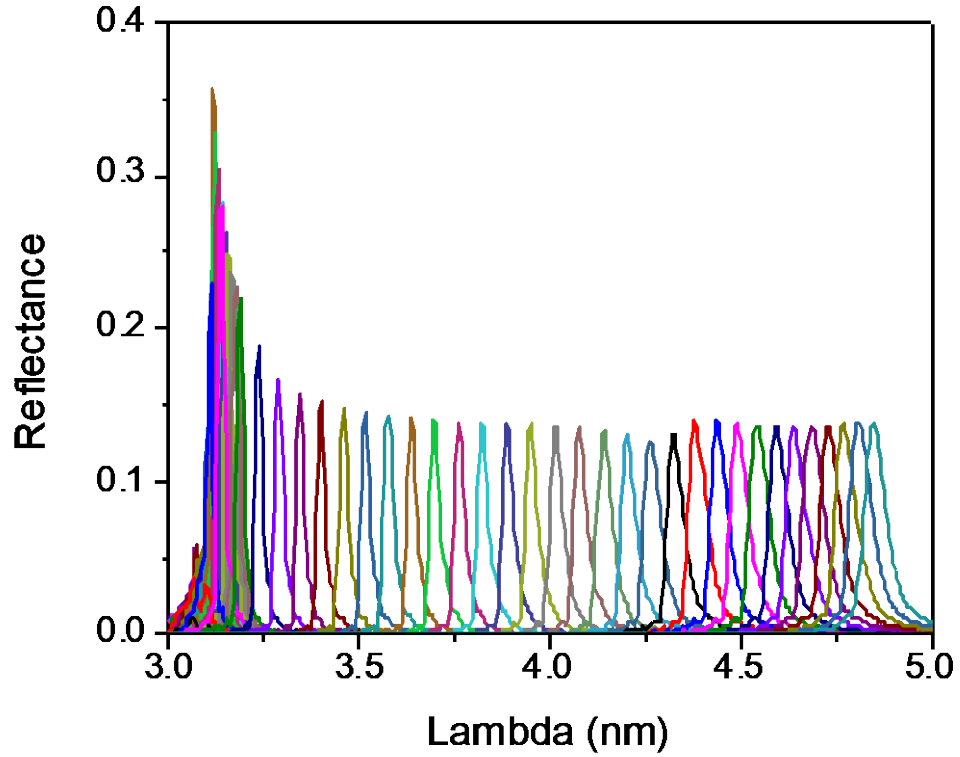
CAT Gratings



Laterally Graded Multilayer Mirrors (LGMs)

- REDSoX will use a Chromium Scandium multilayer

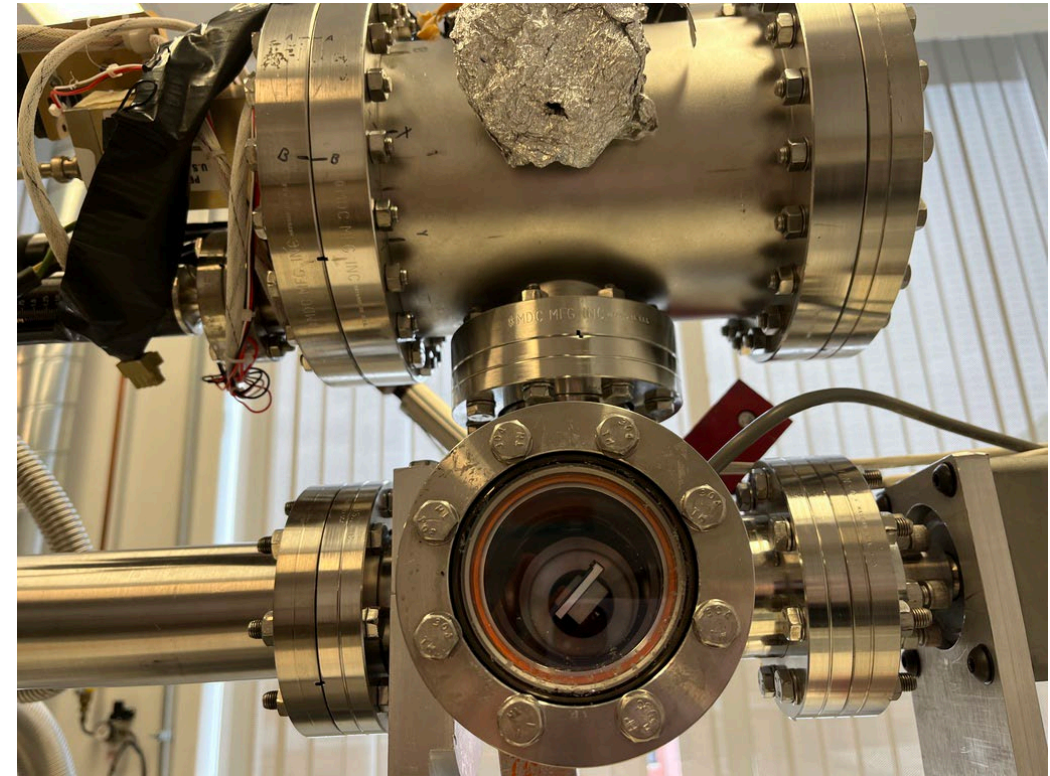
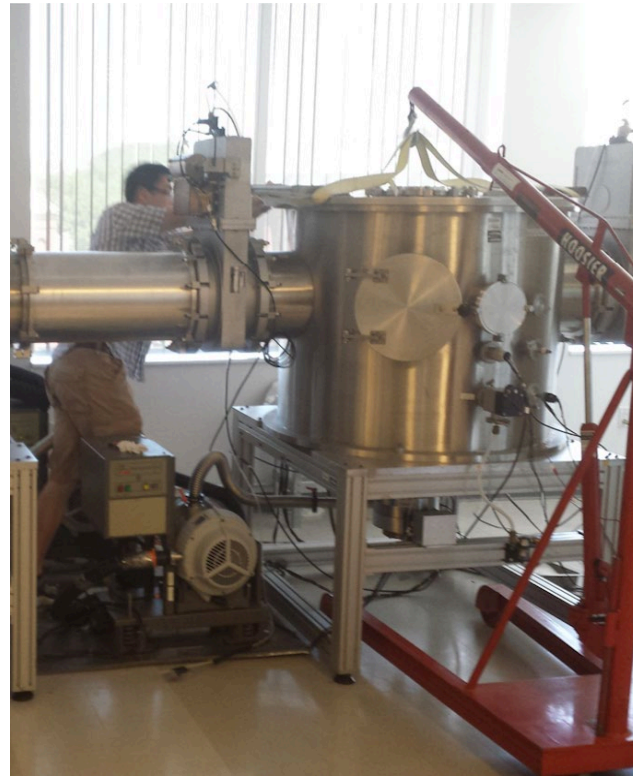
CX170419A2 (45 deg)



Component Testing and Development



Component Testing and Development



Progress and Schedule

- Completed PDR (March 27-28)
- Mirror mandrel polishing in progress-expect mirror completion February 2026
- Have one flight-like grating in house-will order full flight set upon completion of vibration checks in late April 2024
- Laterally Graded Multilayers ordered-expected delivery June 2024
- Detectors ordered-expect EM unit in August 2024, FMs 9-12 months later
- Flight computer chosen-ready to order pending decisions on details
- Mechanical and Electrical designs in progress
- Interfacing with Wallops/NSROC to specify power, telemetry, uplink, etc.
- Expect CDR in Q1 of 2025
- Flight planned for summer 2027