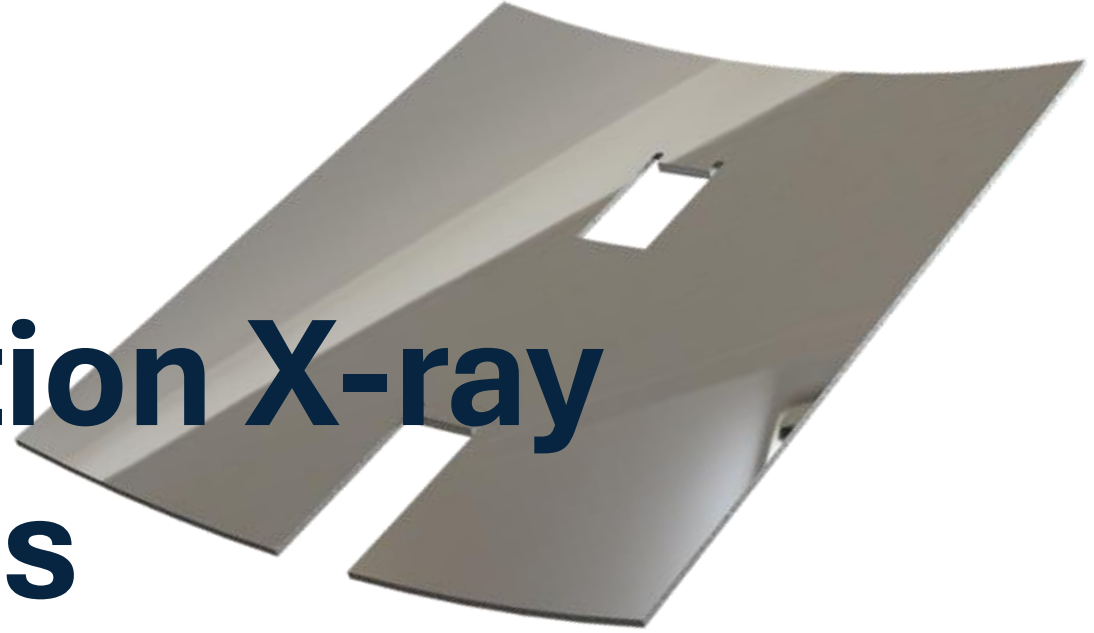


Next Generation X-ray Optics

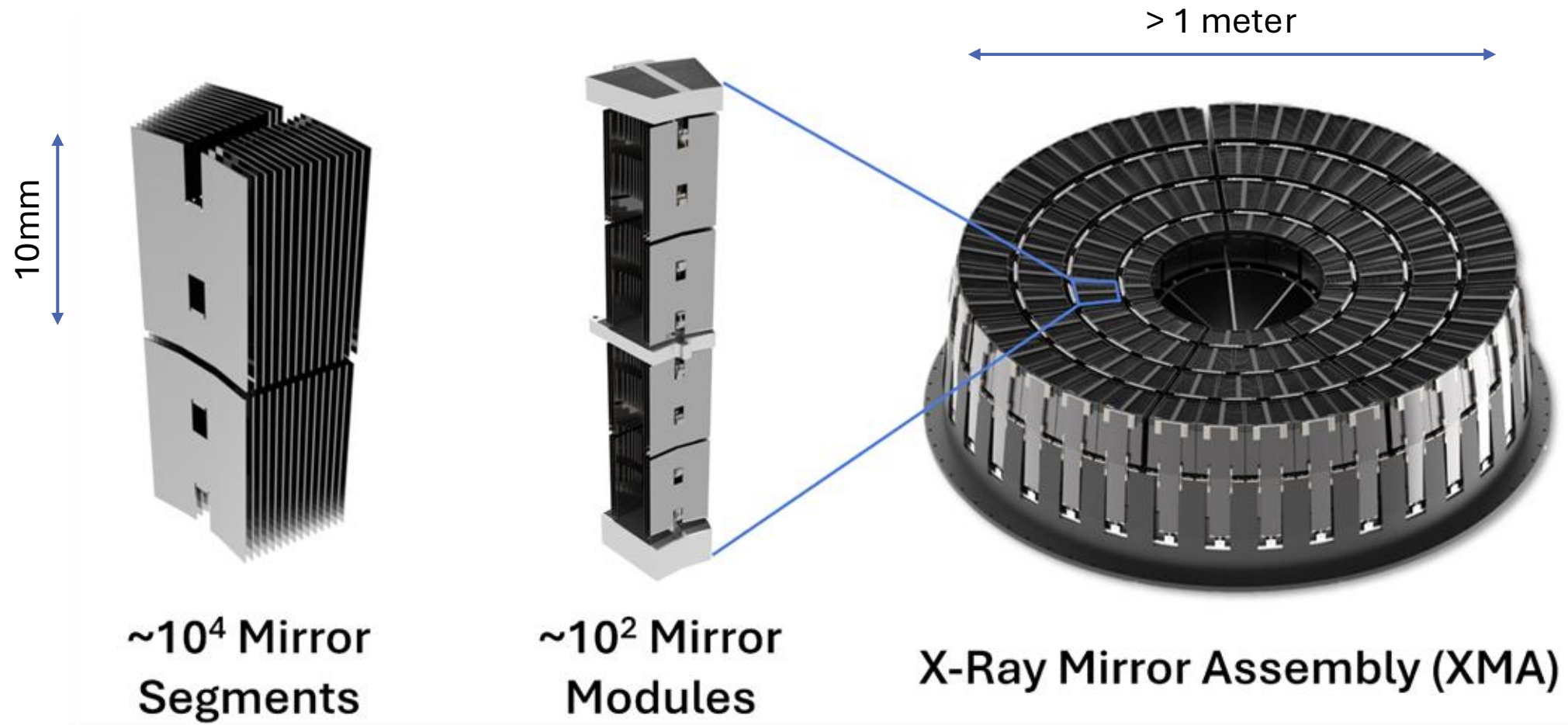


Kristin K. Madsen¹, Joseph Colosimo¹, Kai-wing Chan^{1,2}, Raul Riveros^{1,2},
Youwei Yao^{1,2} and et al
and the NGXO team

¹NASA Goddard Space Flight Center

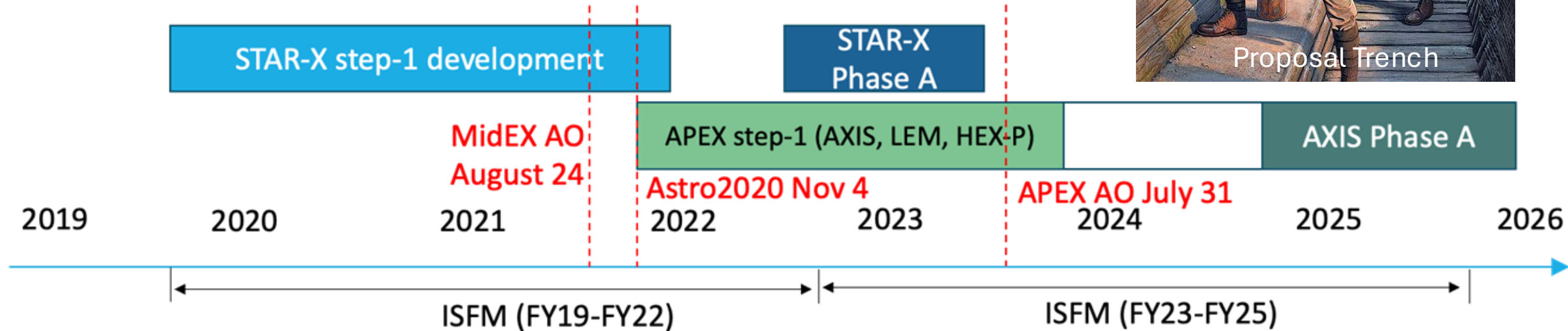
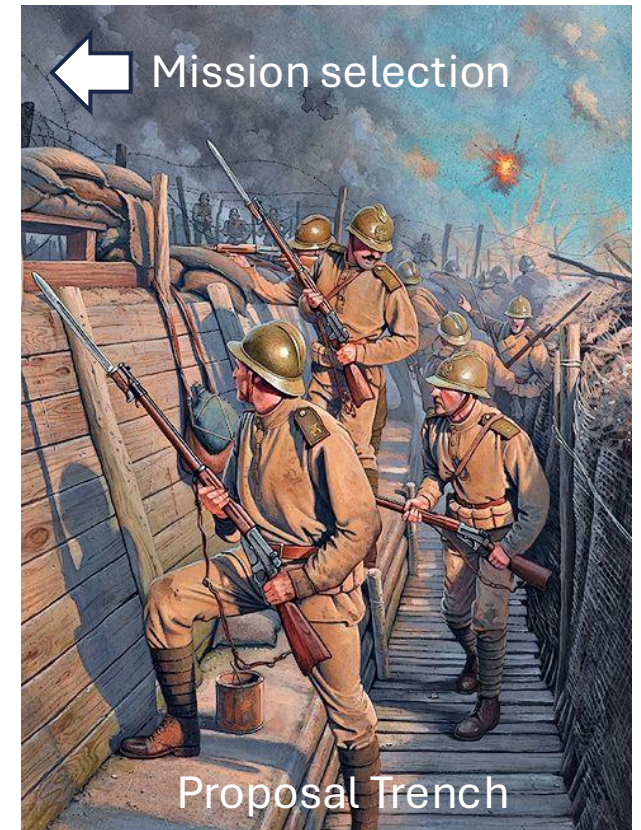
²University of Maryland Baltimore County

Next Generation X-ray Optics (NGXO)

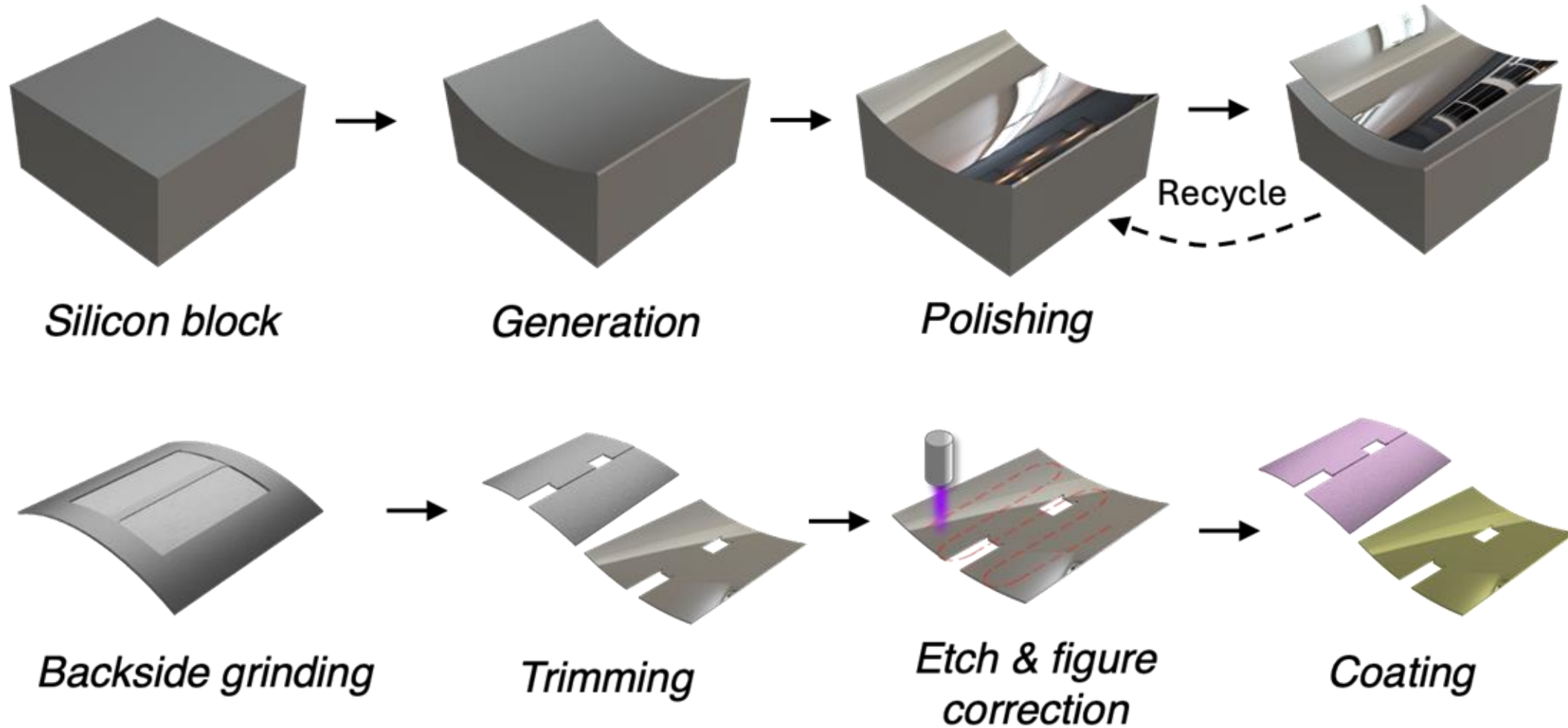


History

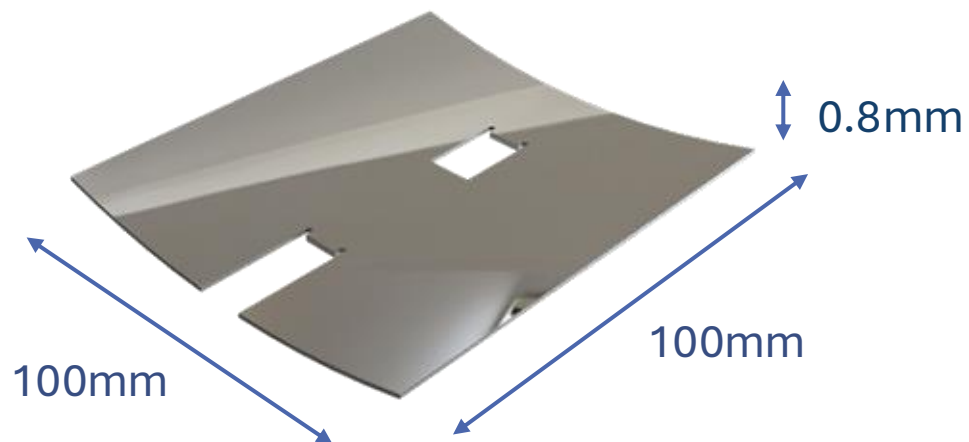
- **Astro2020 Decadal Survey:** November 4, 2021
- **MidEX STAR-X [2.5"] submission:** December 2021
- **STAR-X Phase A concept study:** August 2022 – May 2023
- **APEX submissions (AXIS [1.5"], HEX-P [5"], and LEM[10"]):** November 16, 2023
- **AXIS APEX Phase A:** November 14, 2024 – January 2026
- **AXIS APEX down-select:** February 2026, Out of competition
- **NASA ASTRA initiative:** October 2026, Technology Maturation Program



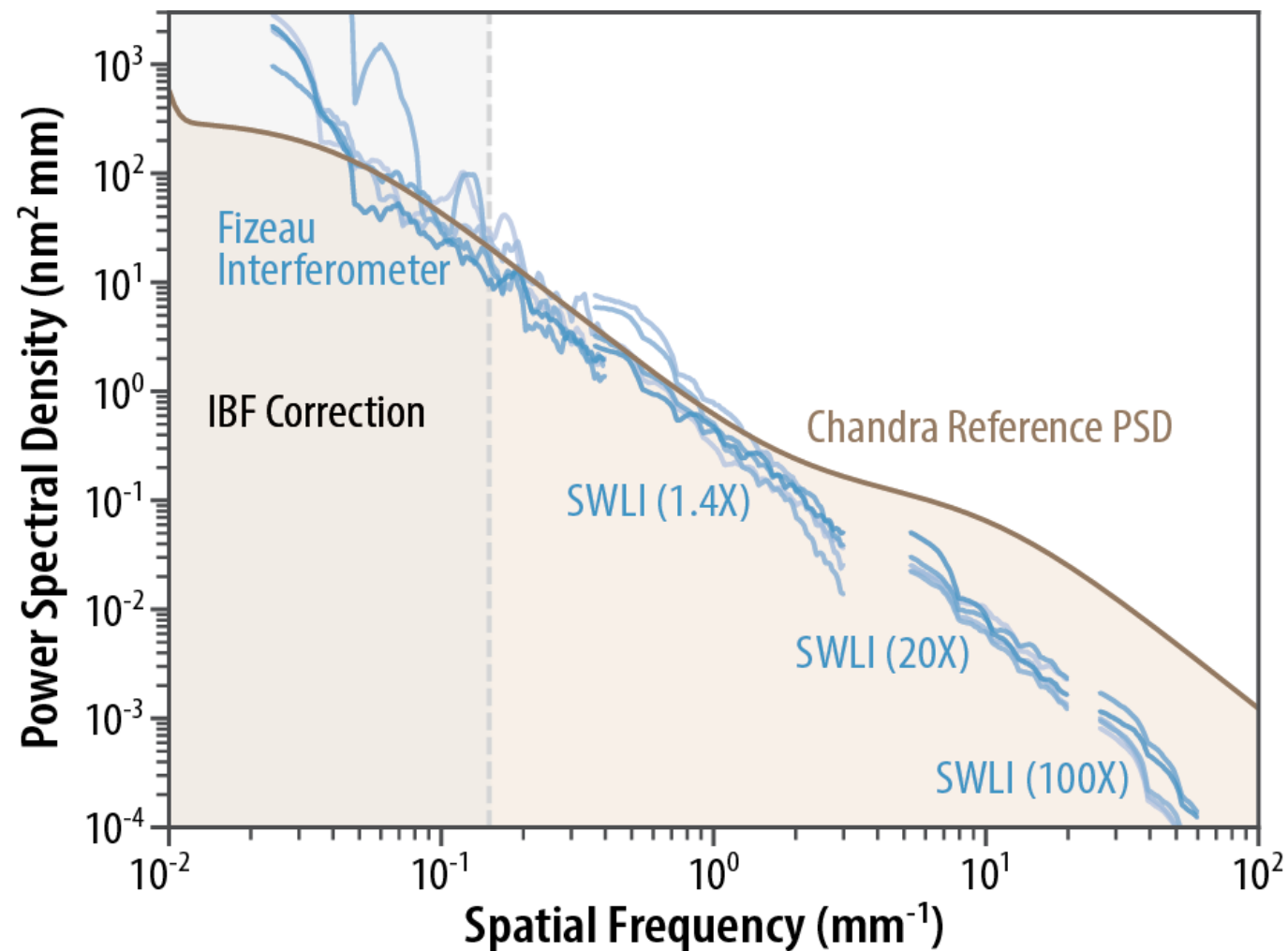
Segment Production



NGXO Silicon X-ray Mirror segment



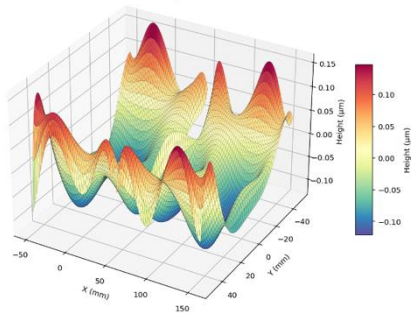
Data type	Range physical	Frequency domain
Zygo SWLI data	1e-3 mm -> 1mm	1000 - 1
Fizcam data	1 mm -> 100 mm	1 - 0.01
IBF	10 mm <	0.1 <



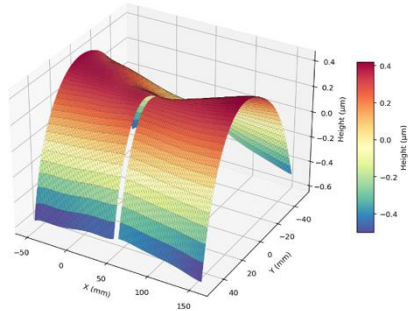
AXIS (Phase A) Accomplishments

- EDU1 & EDU2
- Coating stress-compensation
- Segment rates and performance

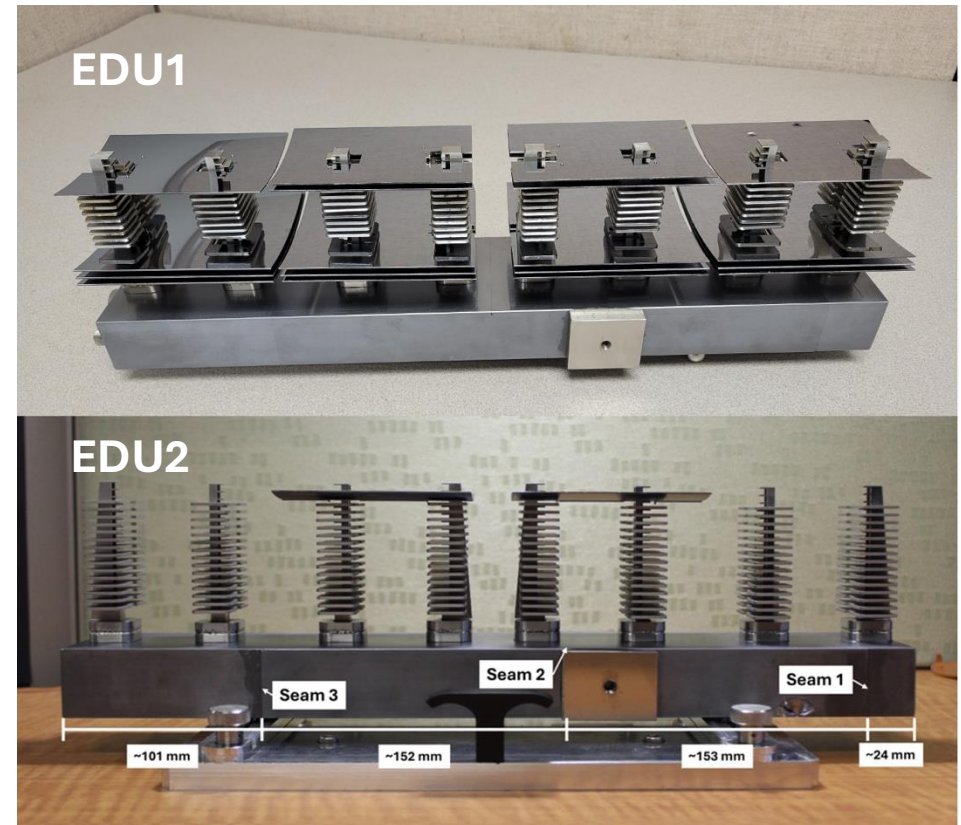
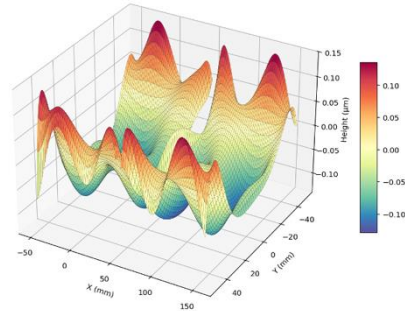
Initial
RMS Y-Slope: 1.26"



Coating Distortion
RMS Y-Slope: 4.69"

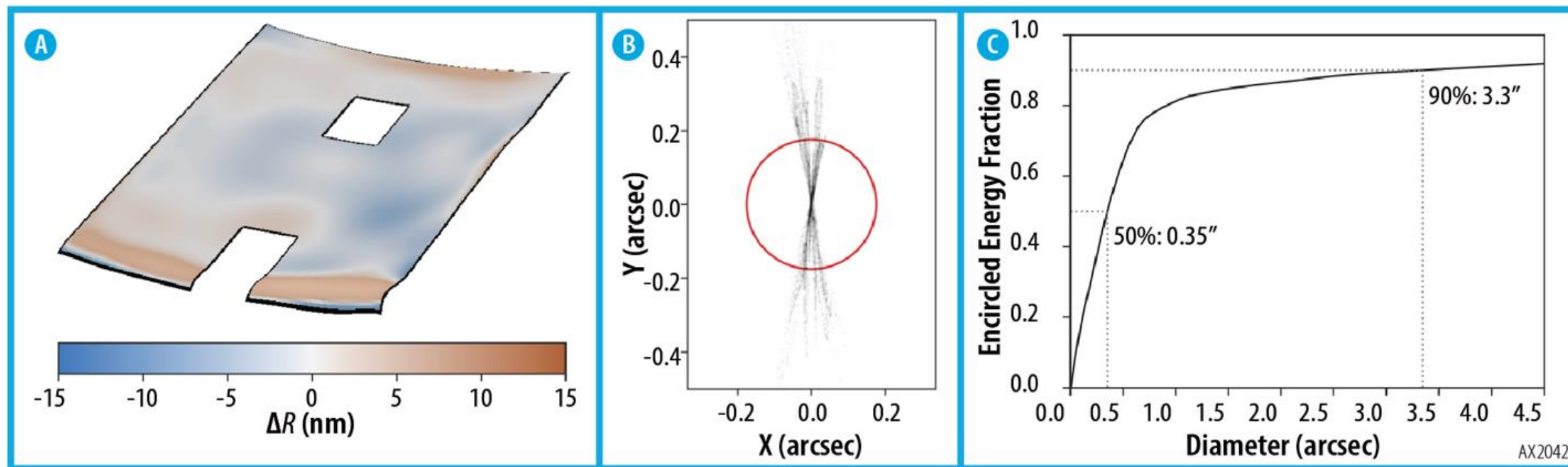
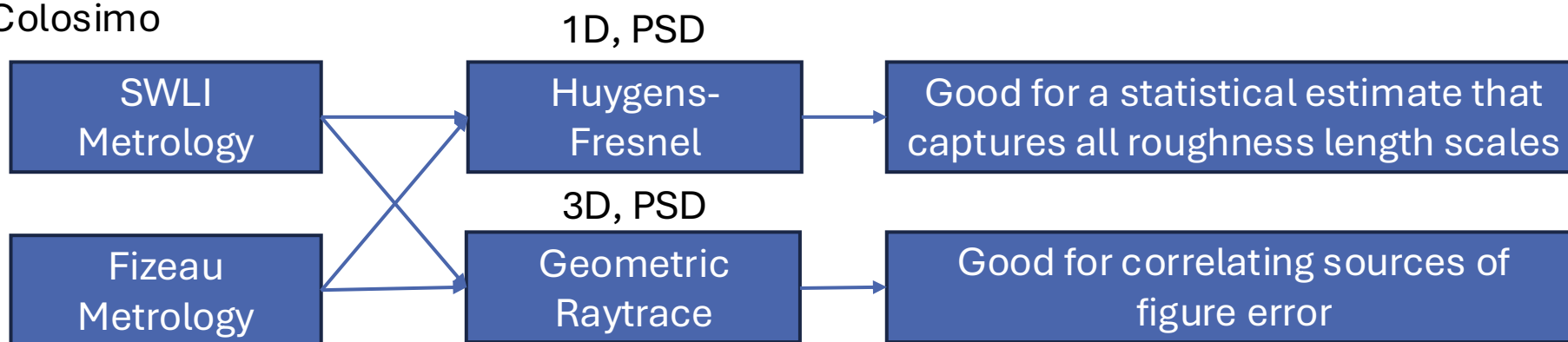


After Correction
RMS Y-Slope: 1.17"



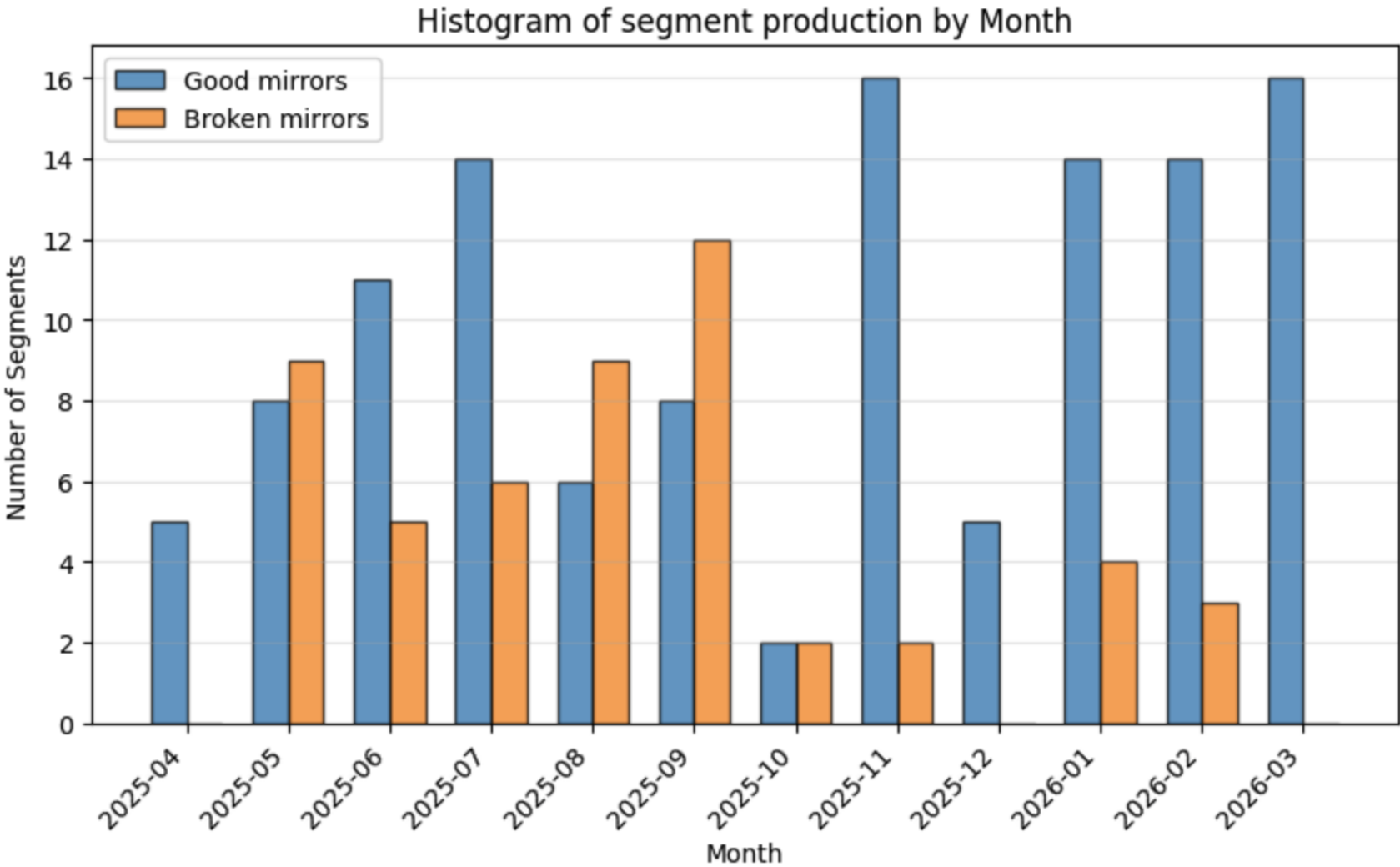
PSF estimation

Work of Joseph Colosimo

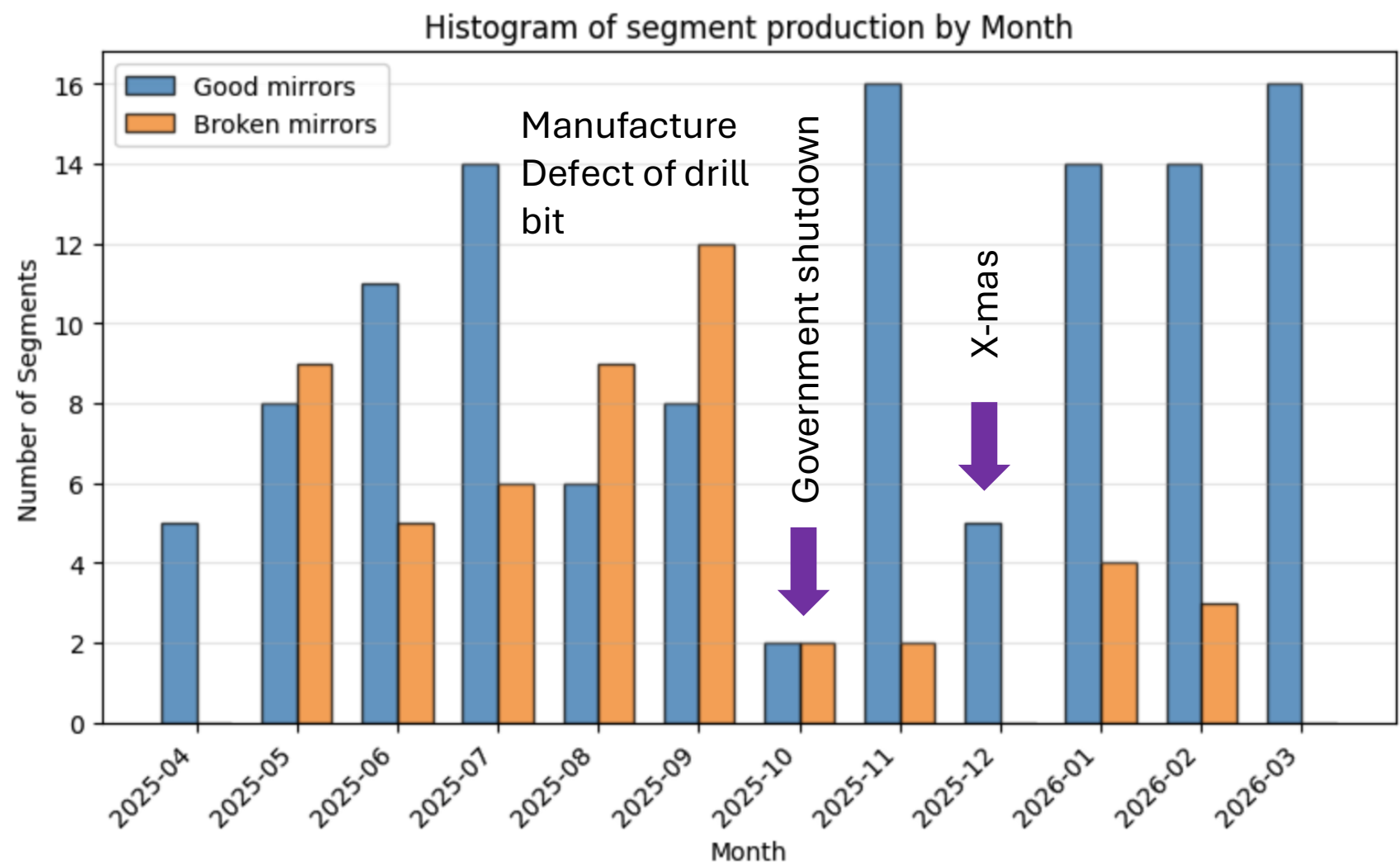


AX2042

Production rates Phase A



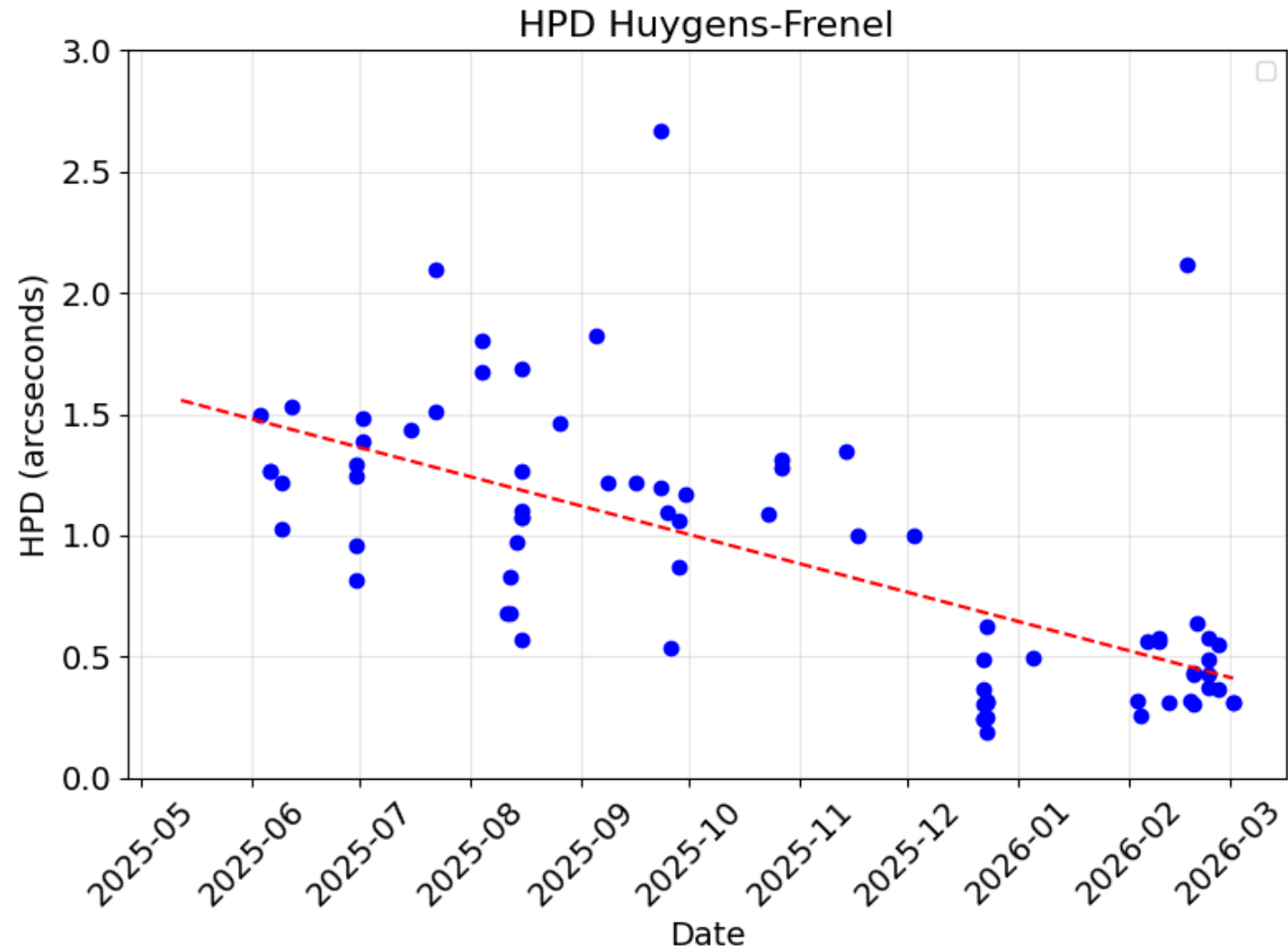
Production rates Phase A



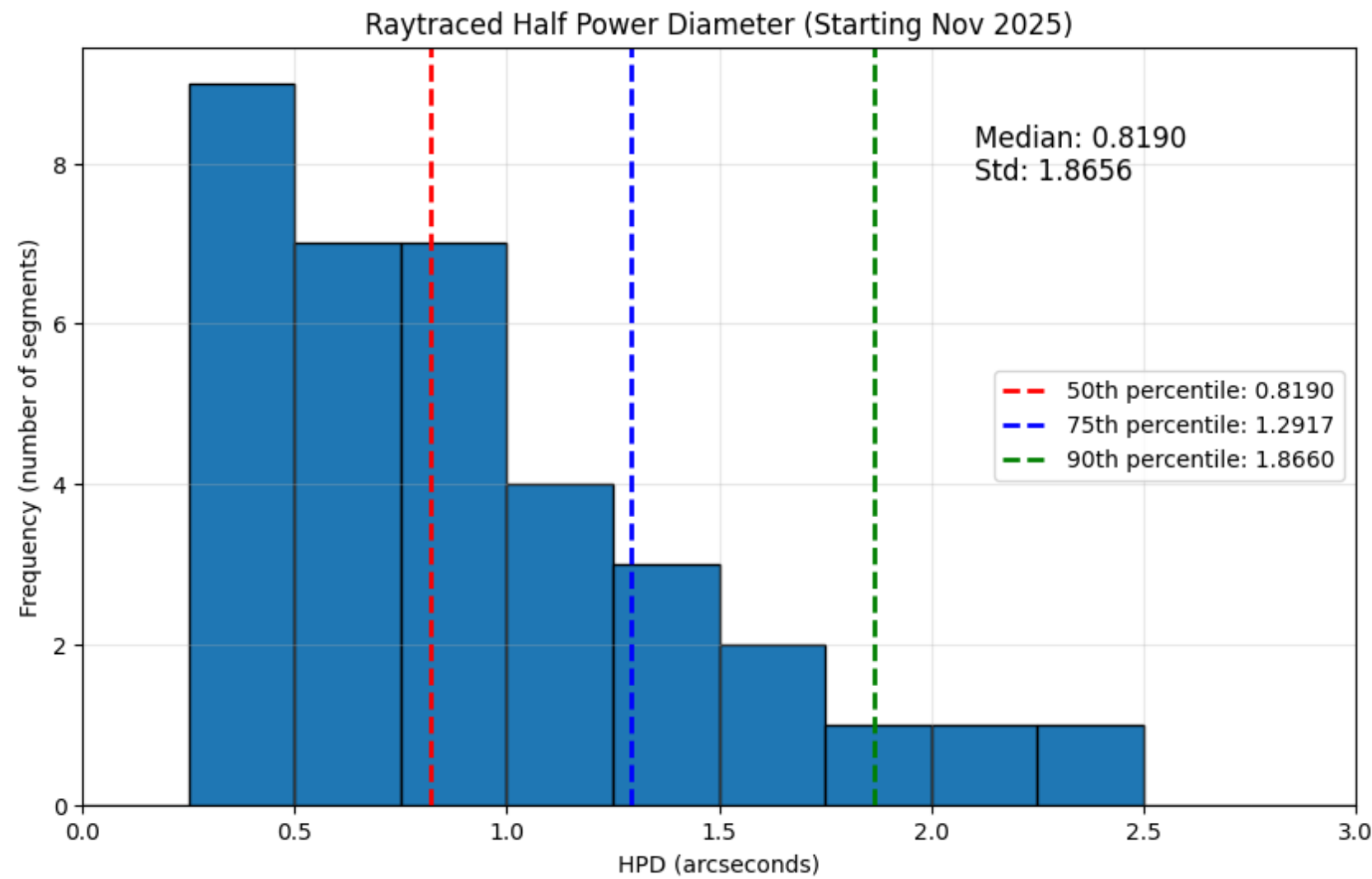
Huygens-Fresnel

Individual
segment
performance

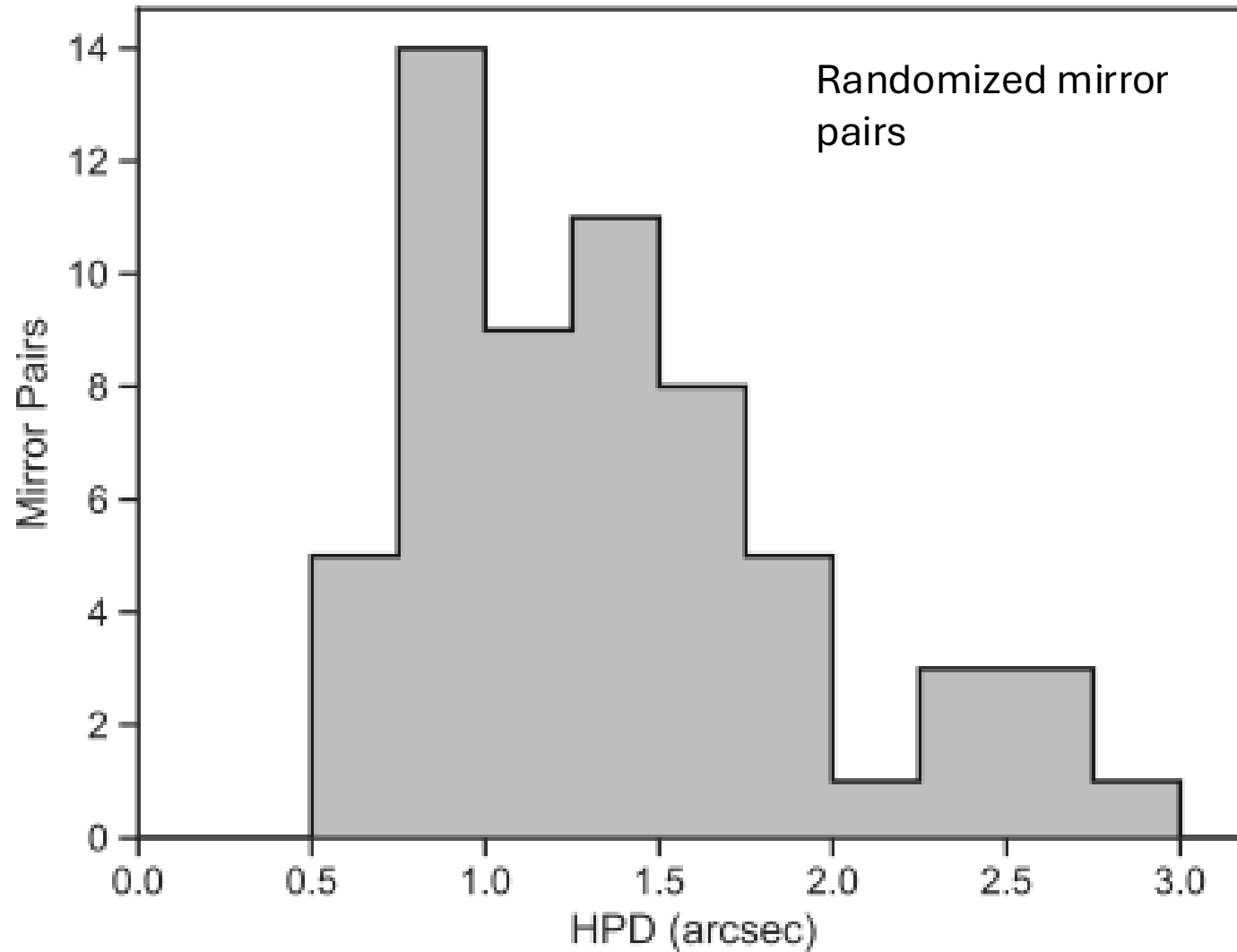
Assumes
conjugate
reflection
perfect



Segment production quality



Projected mirror module quality



Future developments

- Segment production and quality well under control
- Alignment ($<1''$) is challenged by metrology – requires upgrades
- Better understanding on the effects of bonding stress on mirror deformations
- Module design development
 - Depends on the mission under study
- Mass production
 - Partnerships with industry