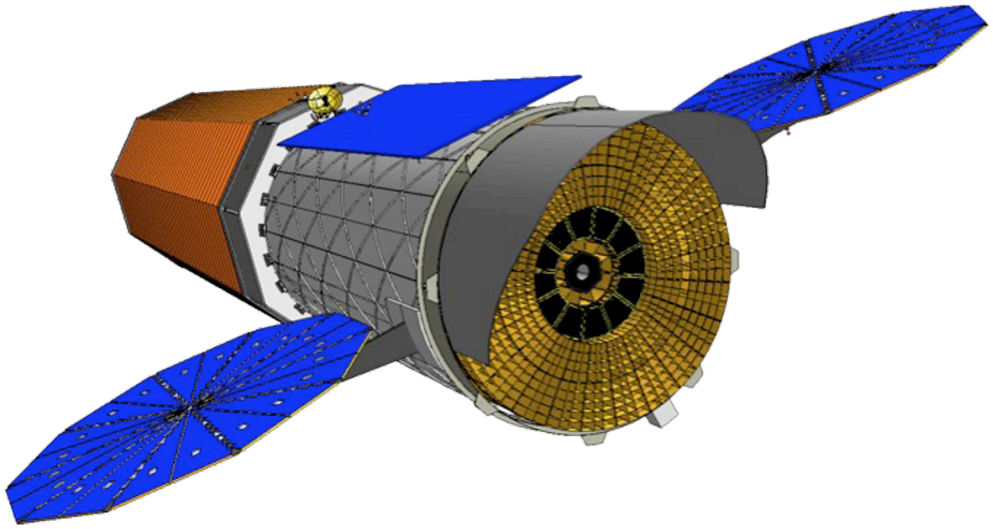


The International X-ray Observatory

Paul Plucinsky on behalf of Randall Smith

on behalf of the ESA-JAXA-NASA IXO team

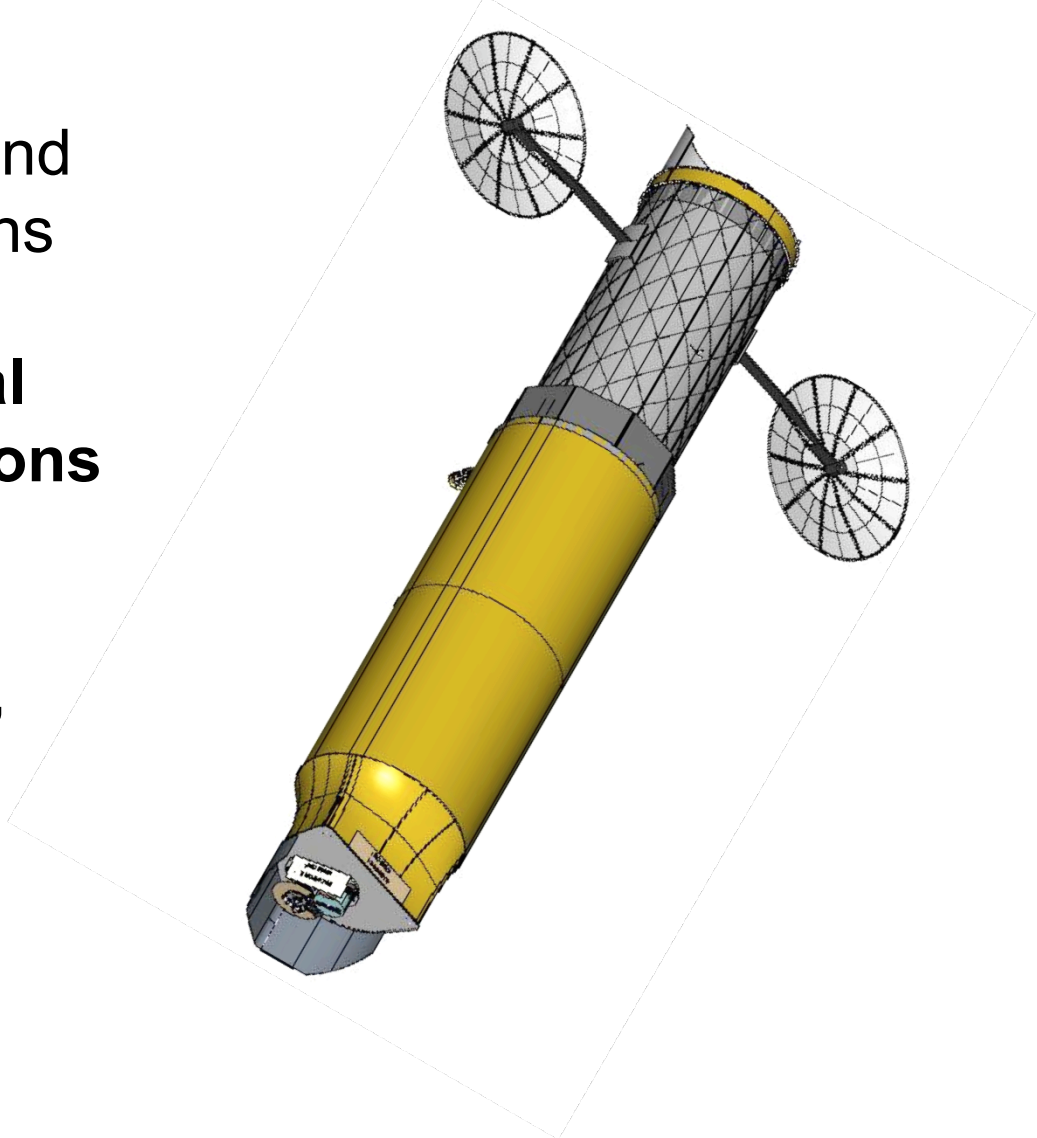
Basic Facts about IXO

- Merger of ESA/JAXA XEUS and NASA's Constellation-X missions

- Part of US Astro2010 **Decadal Review** and ESA **Cosmic Visions**

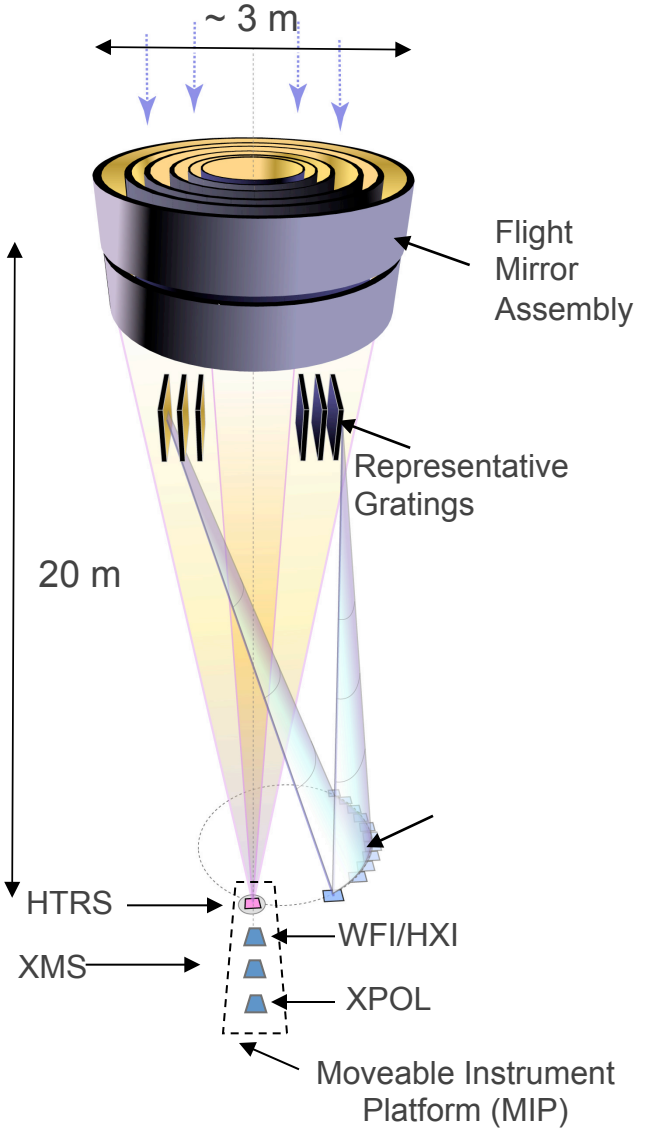
- Guest Observatory, with time allocation done as with Hubble, Chandra, Spitzer

- Launch planned 2020

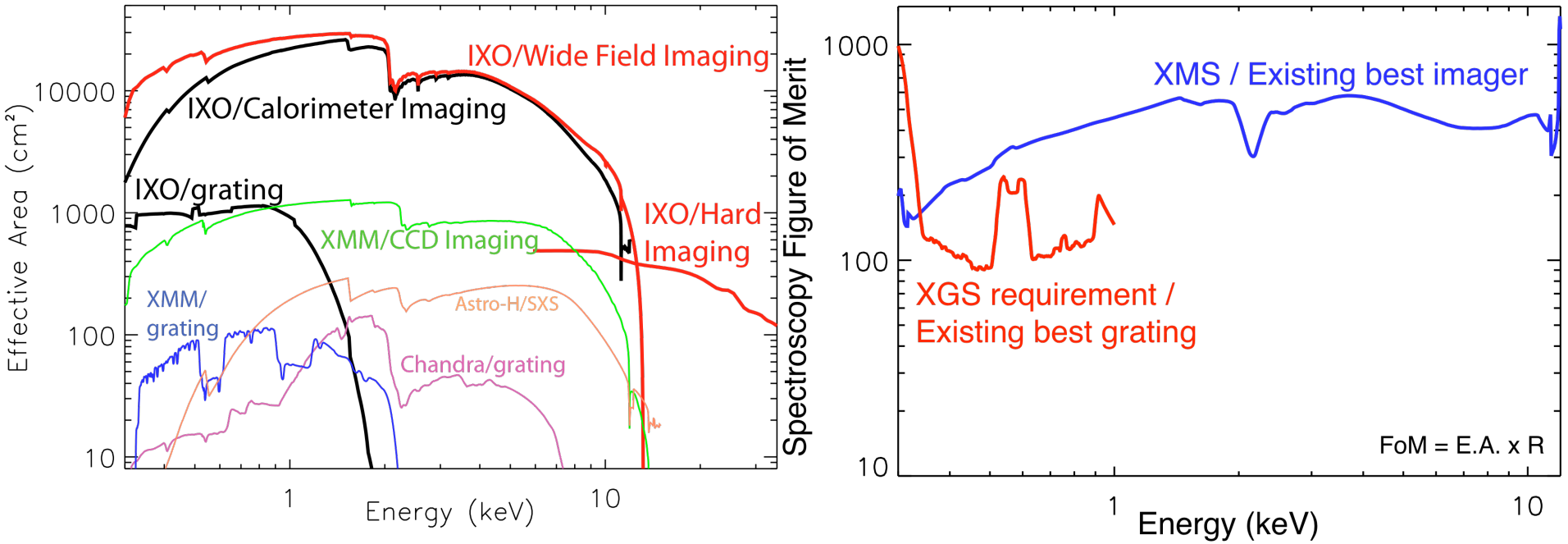


Basic Facts About IXO

- Flight Mirror Assembly (FMA)
  - Highly nested grazing incidence optics
  - 5'' PSF (HEW)
- Instruments
  - X-ray Micro-calorimeter Spectrometer (XMS)
  - X-ray Grating Spectrometer (XGS)
  - Wide Field Imager (WFI) and Hard X-ray Imager (HXI)
  - X-ray Polarimeter (X-POL)
  - High Time Resolution Spectrometer (HTRS)
- XMS, WFI/HXI, XPOL and HTRS observe one at a time
  - XGS always operational



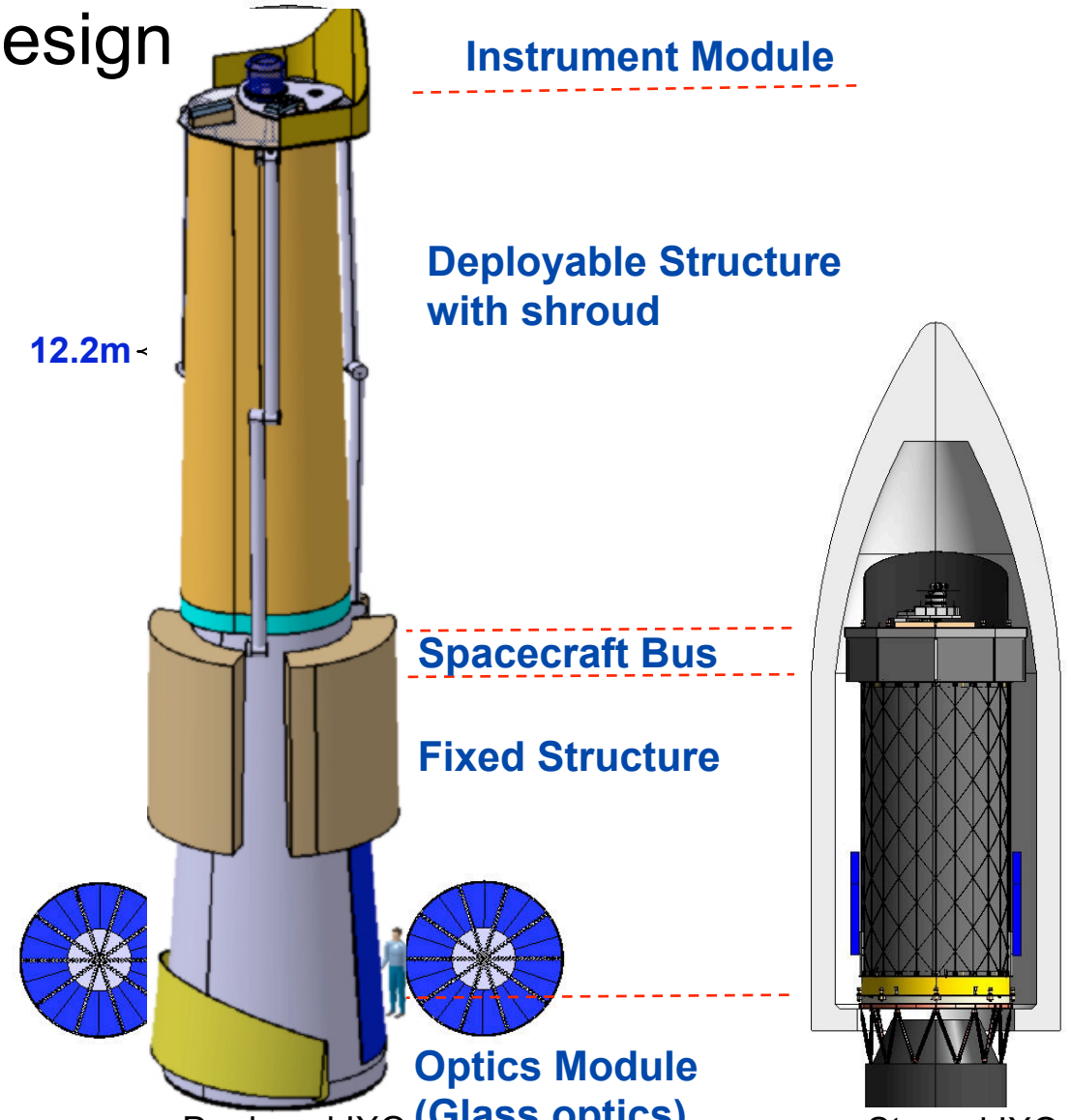
Basic Facts about IXO



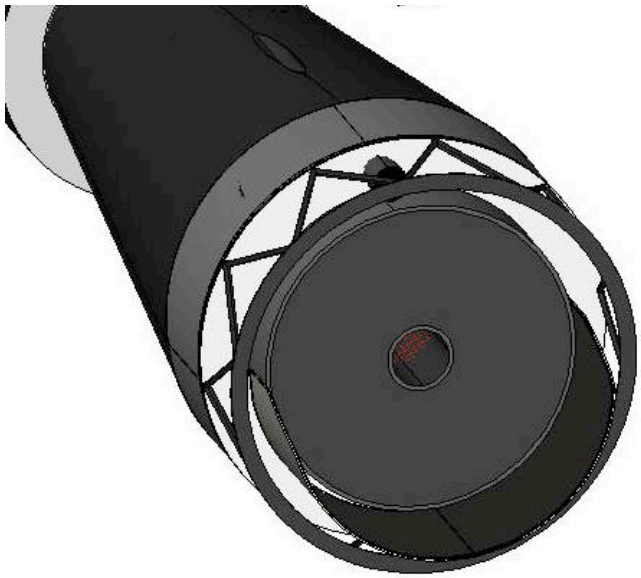
Effective area a factor of >10x of current missions
Spectroscopy capabilities >100x of current missions

NASA/ESA Mission Design

- The observatory is deployed to achieve 20 m focal length
- Observatory Mass ~6100 kg (including 30% contingency)
- Launch on an Atlas V 551 or Ariane V
- Direct launch into an 800,000 km semi-major axis L2 orbit
- 5 year required lifetime, with expendables for 10 year goal

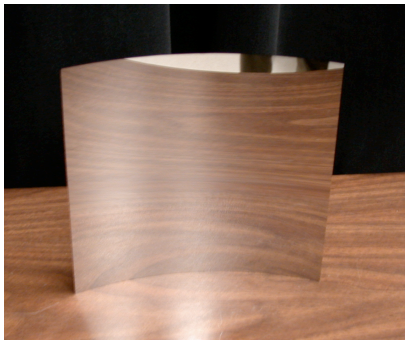


X-ray Mirror Baseline

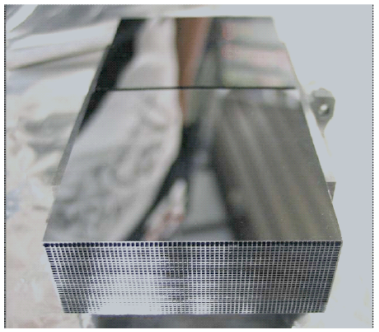


- Key requirements:
  - Effective areas:
  - ~3 m^2 @ 1 keV
  - ~1 m^2 @ 6 keV
  - Angular Resolution <= 5 arc sec
- Single segmented optic with design optimized to minimize mass and maximize the collecting area ~3.2m diameter
- Two parallel technology approaches being pursued
  - Silicon micro-pore optics – ESA
  - Slumped glass – NASA

Glass

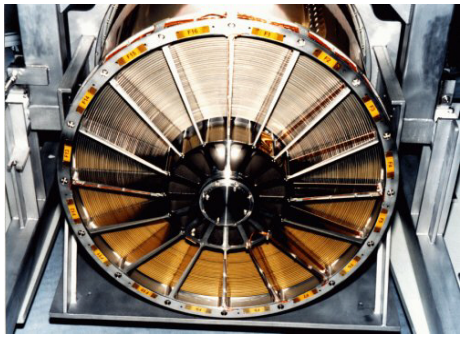


Silicon

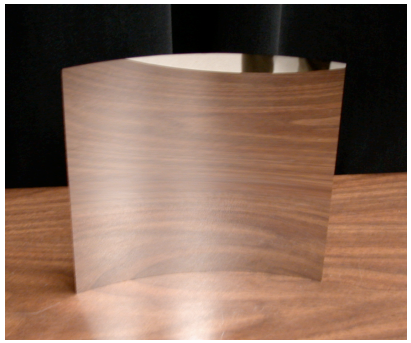


Optics Technologies: Resolution and Mass

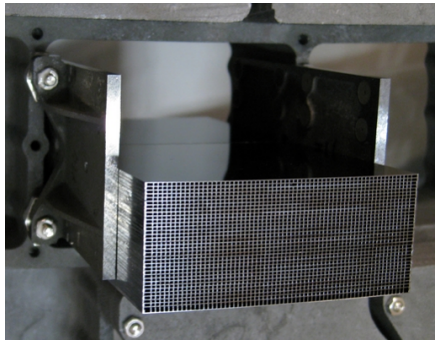
CHANDRA
<0.5" (HEW)
18500 kg/m²
A_{eff} @ 1 keV



XMM-NEWTON
14" (HEW)
2300 kg/m²
A_{eff} @ 1 keV



Slumped Glass
5" (HEW)
~270 kg/m²
A_{eff} @ 1 keV

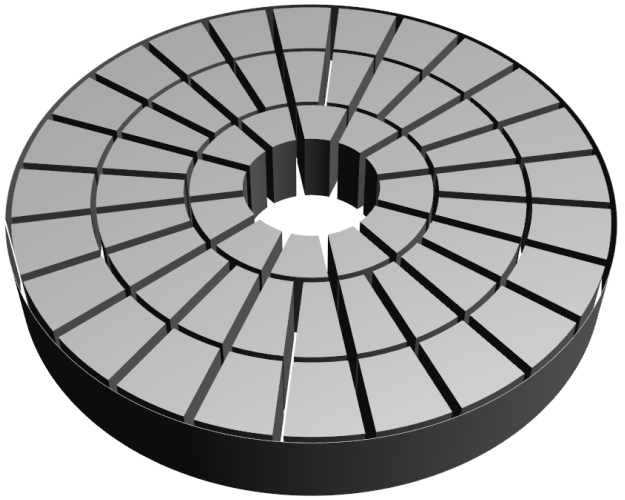


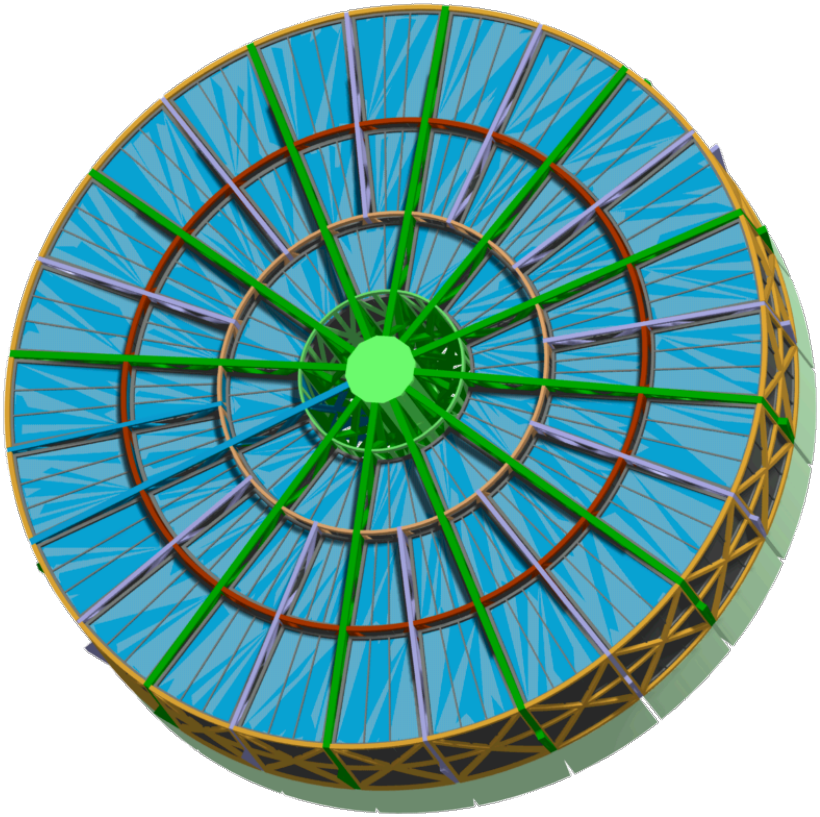
Si-HPO
5" (HEW)
~200 kg/m²
A_{eff} @ 1 keV

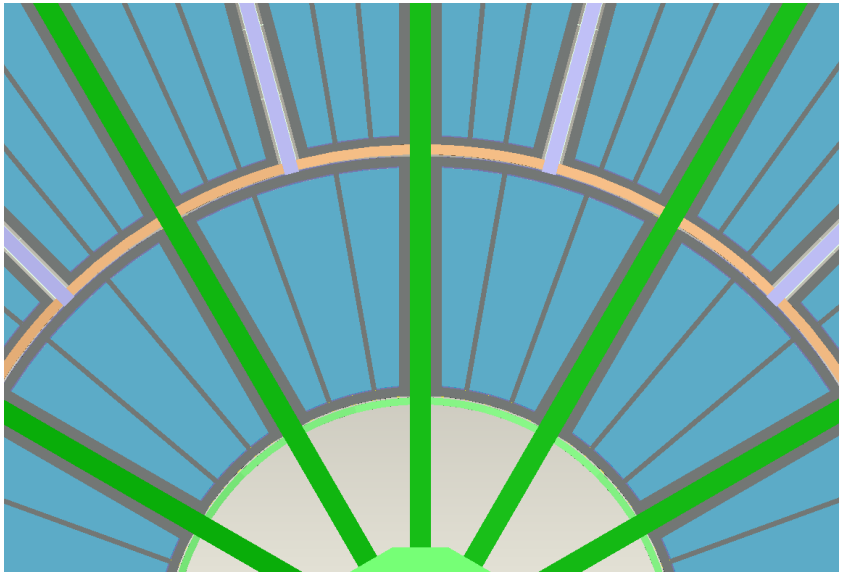
IXO Options

FMA Module Layout

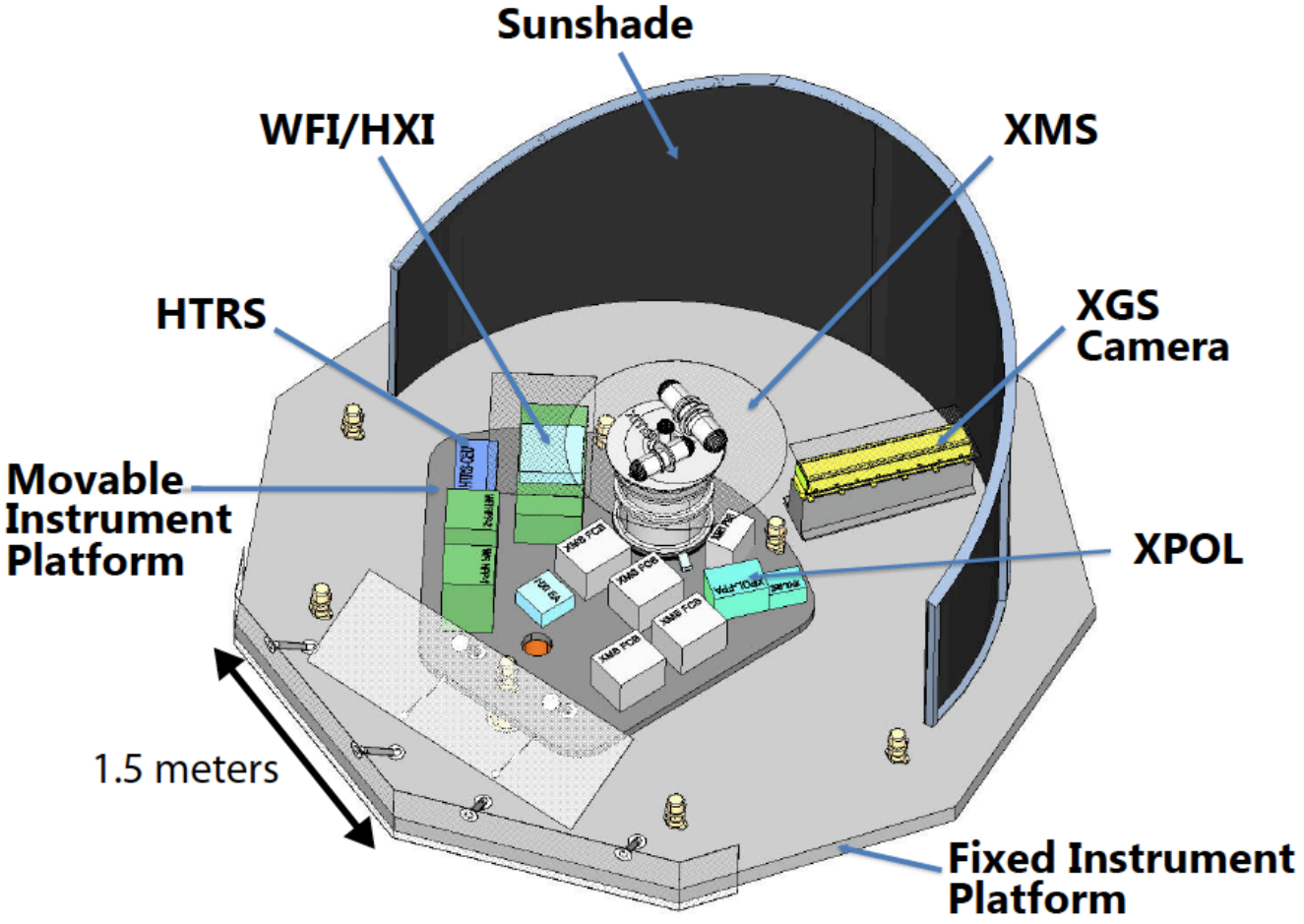
- Module size constrained by glass size (<35 cm)
- 5022 segments in 24 outer modules
  4248 segments in 24 middle modules
  2538 segments in 12 inner modules







Focal Plane Layout (Aft View)

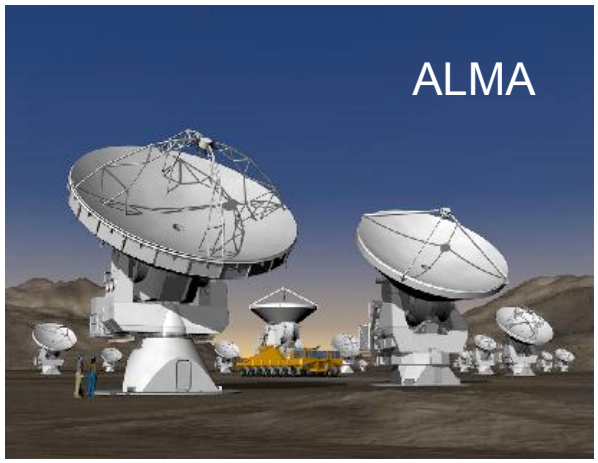


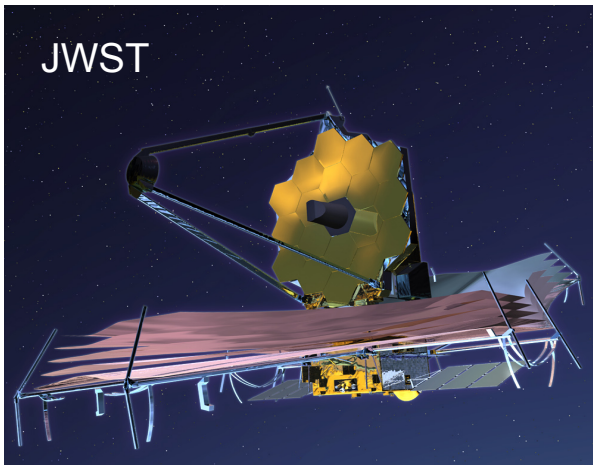
IXO Calibration Challenges

- Flight Mirror Assembly (FMA)
  - Ground calibration of modules must be time-efficient, calibration time cannot simply scale with collecting area
  - Which facility could accommodate the integrated FMA ?
- Instruments
  - XMS, gain stability & background from ASTRO-H, but a much larger number of pixels and different orbit for IXO
  - XGS, highest resolution X-ray spectrometer ever flown, pushes the limits of our knowledge of atomic physics and astrophysics
  - WFI, uniformity across the FOV
  - HXI, build on *Suzaku* and ASTRO-H experience, but will the technology be significantly different such that previous experience is less applicable
  - X-POL, how does one calibrate a polarimeter on-orbit ?
  - HTRS, build on RXTE experience
- Programmatics
  - As we discussed at the Iceland IACHEC, ground & flight calibration must be a priority of the agencies ESA/JAXA/NASA

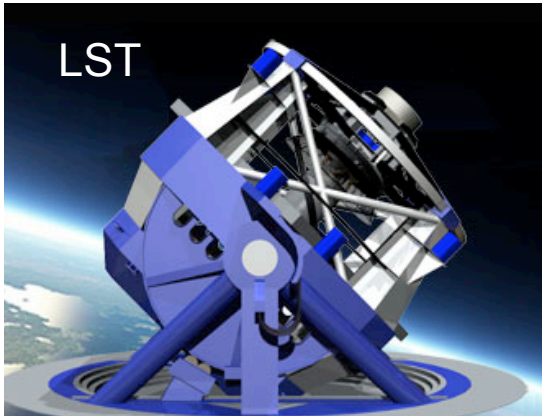
IXO: A Future Great Observatory

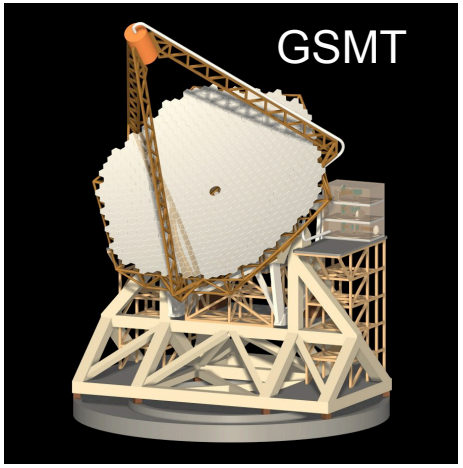
Sub-mm



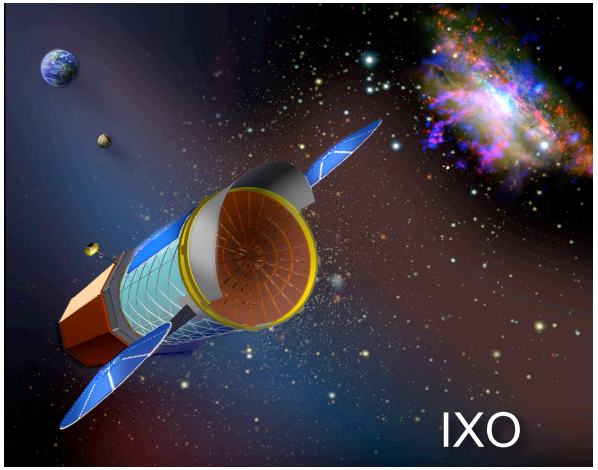


IR





Optical



X-ray

The two order of magnitude increase in capability of IXO is well matched to that of other large facilities planned for the 2010-2020 decade

Key Performance Requirements

Table 1-1. Essential IXO Performance Parameters

Parameter	Value			Science Driver	Inst.
Mirror Effective Area	3 m^2 @ 1.25 keV 0.65 m^2 @ 6 keV 150 cm^2 @ 30 keV			Black Hole Evolution Strong Gravity Strong Gravity	
Spectral Resolution (FWHM), FOV, bandpass	ΔE = 2.5 eV ΔE = 10 eV ΔE = 150 eV E/ΔE = 3000	2 arcmin 5 arcmin 18 arcmin point src	0.3– 7 keV 0.3–10 keV 0.1–15 keV 0.3– 1 keV	Galaxy Cluster Evolution Cosmic Feedback Black Hole Evolution Cosmic Web	XMS XMS WFI/HXI XGS
Angular Resolution	5 arcsec HPD 5 arcsec HPD 30 arcsec HPD		0.3– 7 keV 0.1– 7 keV 7–40 keV	Cosmic Feedback Black Hole Evolution Strong Gravity	XMS WFI/HXI WFI/HXI
Count Rate	10^6 cps with <10% deadtime			Neutron Star Eq. of State	HTRS
Polarimetry	1% MDP, 100 ksec,5 × 10^{-12} cgs (2-6 keV)			Strong Gravity	XPOL