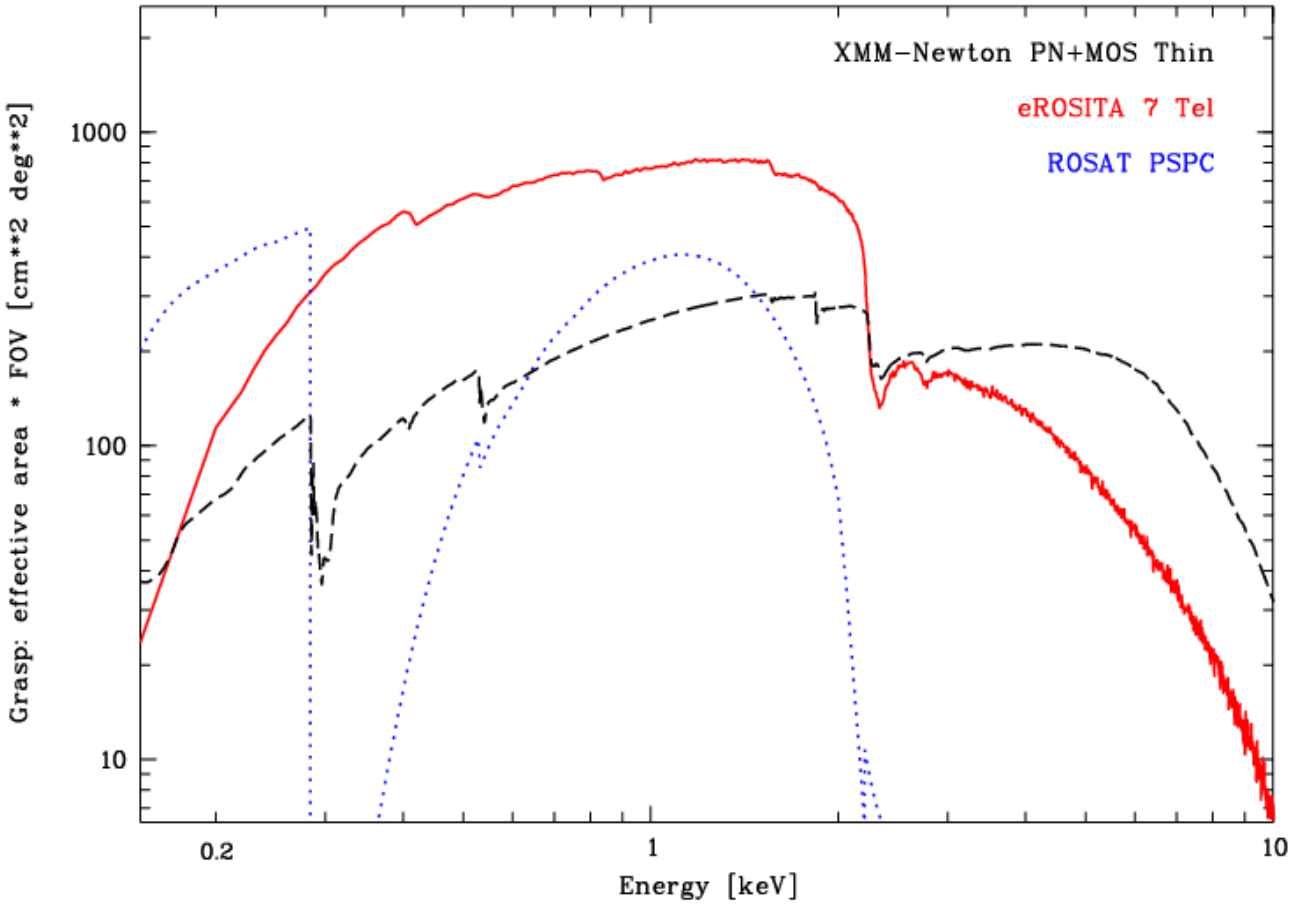
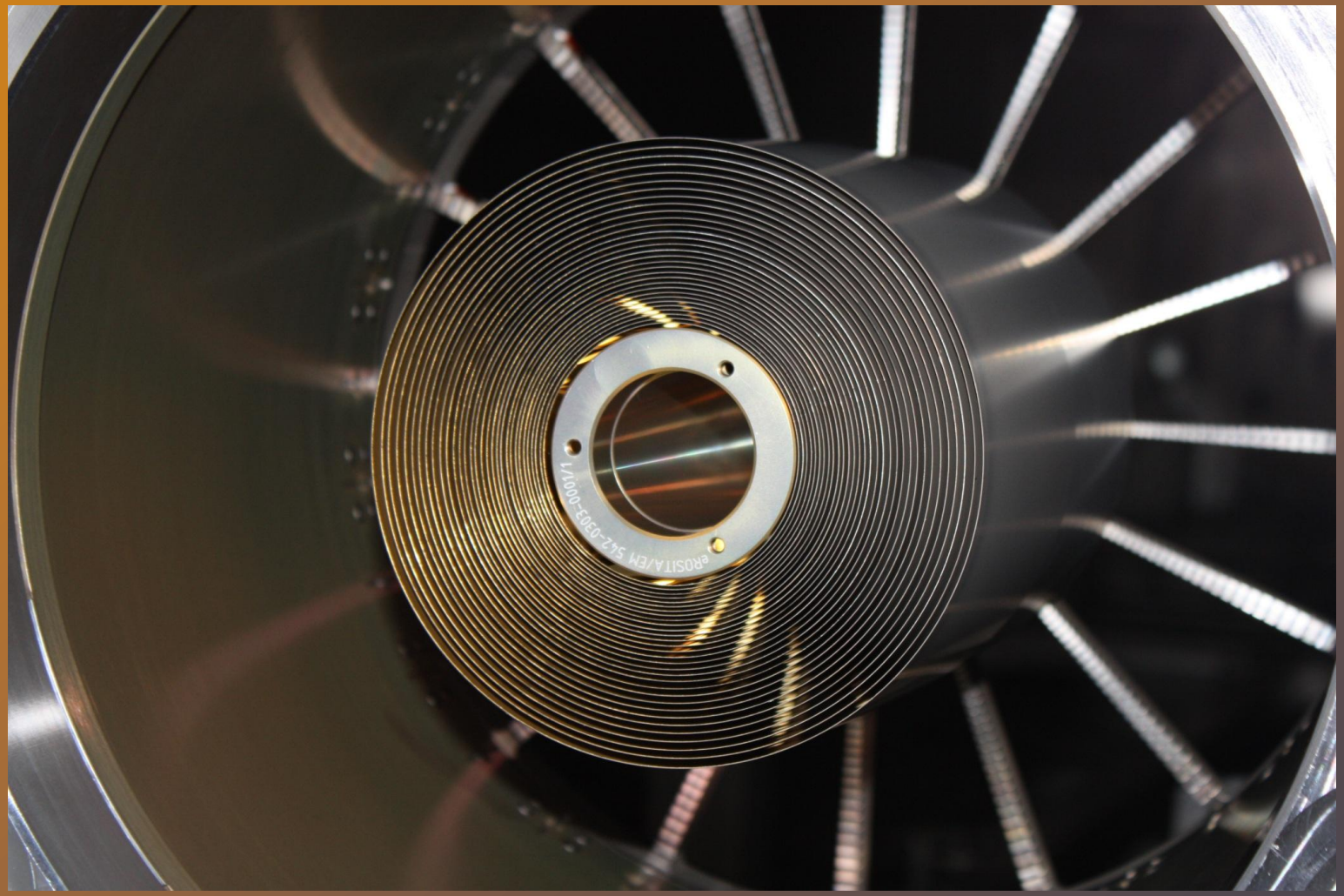
e-Rosita: Grasp

Grasp [cm^2 deg^2]



Grasp of 7 e-ROSITA telescopes is 3-4 x higher than 3 XMM-Newton telescopes in the energy range 0.3-2 keV!

FM1 with 31 shells in X-Ray Test (realized in Italy by Media Lario!)



PSF of FM1 with 31 shells

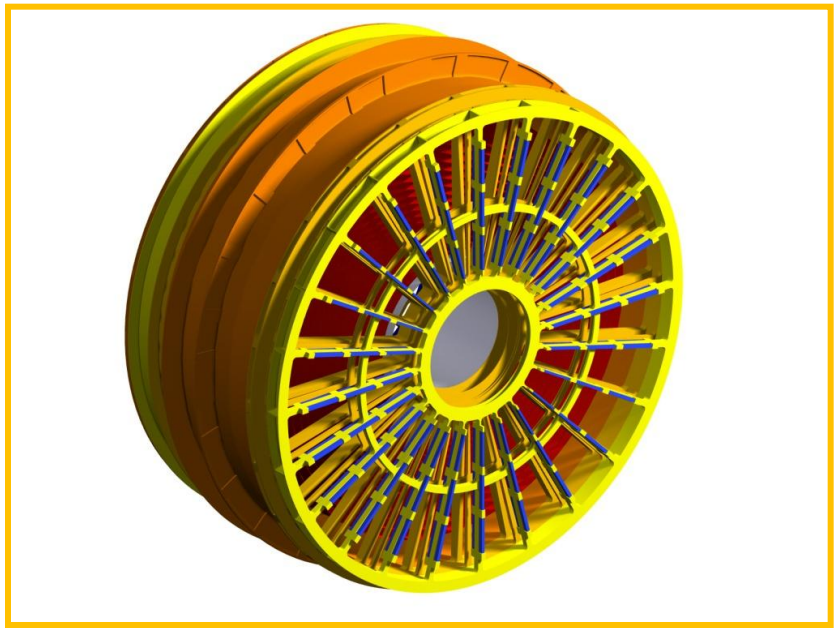
MM and Mirror Groups

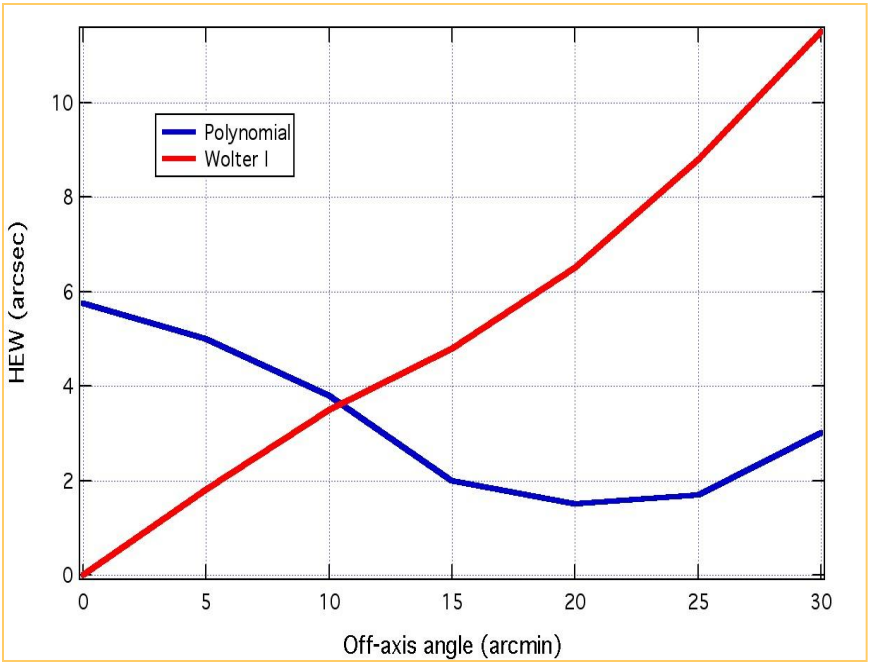
Target	Energy	PSF			Date
		HEW*	W90	scattering	
C-K	0.28 keV	16.2 arcsec			8th June 2011
Al-K	1.49 keV	16.0 arcsec	74.3 arcsec	5.1%	6th June 2011
Ag-L	2.98 keV	16.3 arcsec	92.8 arcsec	6.9%	8th June 2011
Cr-K	5.41 keV	17.0 arcsec	130.3 arcsec	9.5%	10th June 2011
Cu-K	8.04 keV	15.6 arcsec	140.9 arcsec	11.8%	8th June 2011

Group	Energy	PSF			Date
		HEW*	W90	scattering	
Shells 40-54	1.49 keV	13.8 arcsec	43.5 arcsec	2.5%	7th June 2011
Shells 24-39	1.49 keV	17.8 arcsec	94.6 arcsec	5.2%	7th June 2011
Shells 34-39	1.49 keV	19.5 arcsec	101.6 arcsec	9.0%	9th June 2011
Shells 28-33	1.49 keV	17.3 arcsec	100.6 arcsec	8.4%	10th June 2011
Shells 24-27	1.49 keV	16.5 arcsec	84.5 arcsec	3.2%	7th June 2011
Shells 24-27	5.41 keV	20.9 arcsec	186.7 arcsec	14.3%	10th June 2011

*HEW determined by using the sub-pixel resolution which is based on the detailed analysis of split events; the effective resolution from this method is approximately 5 arcsec.

Thin glass shell oriented to Wide Field X-Ray Telescope

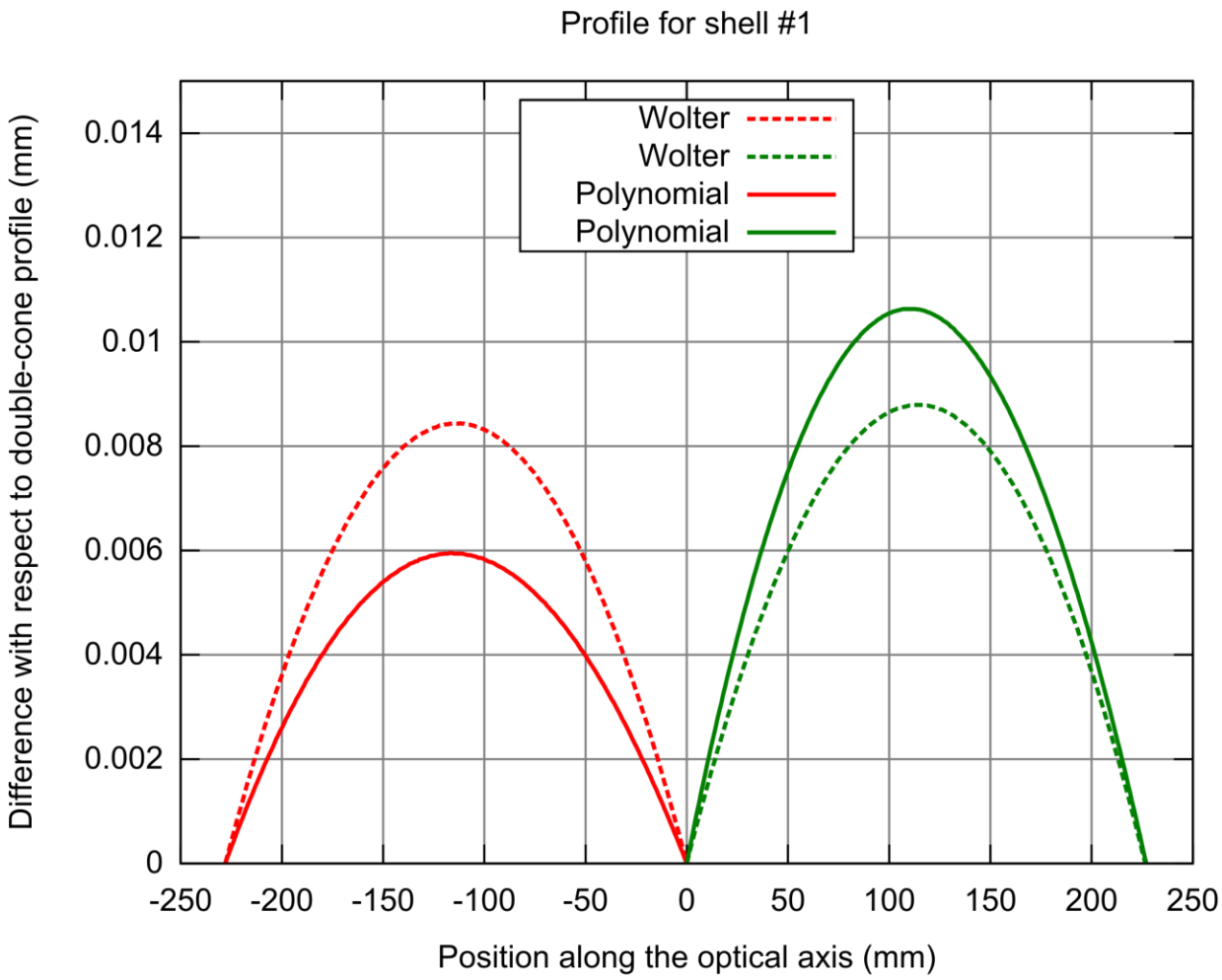




N.B.: same mirror height/FL aspect ratio =0.07

WFXT being proposed to NASA in the context of the RFI call (Sept 2011)- P.I. S. Murray

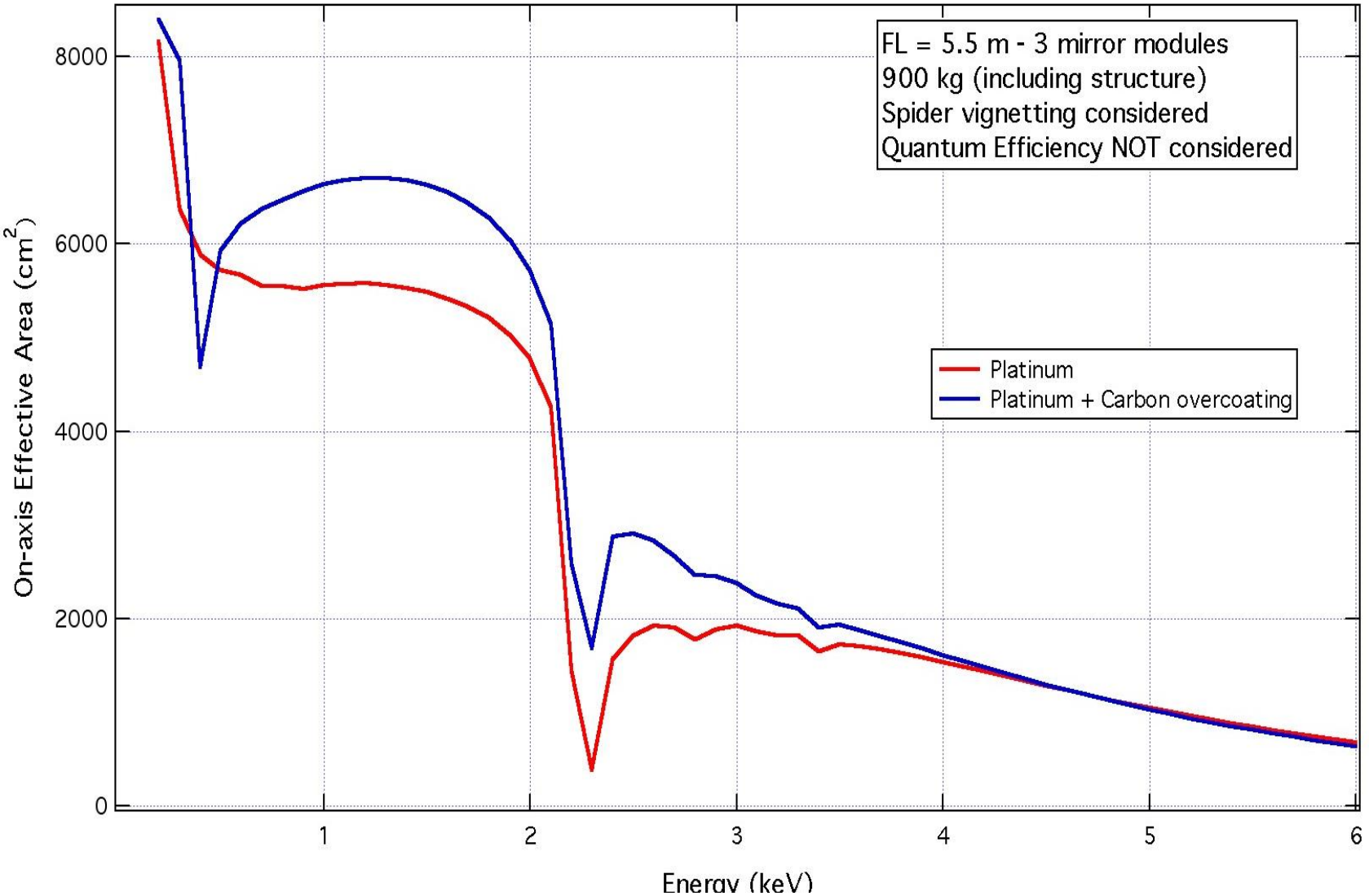
Sag of the first polynomial mirror wrt a Wolter I



WFXT Telescope Configuration

Parameter	Design
Number of Modules	3
Material	Fused Silica
Configuration	Polynomial Profile
Focal Length	5.5 m
MAX & min top diameters	0.36 & 1.1 m
MAX and min mirror Length (2 reflections)	408 & 220 mm
Coating	Pt + C overcoating
Wall Thickness	3 – 1.7 mm
Number of mirror shells /module	55
Total Weight	900 kg (3 modules including structure)

WFXT On-axis effective area



Survey capabilities comparison

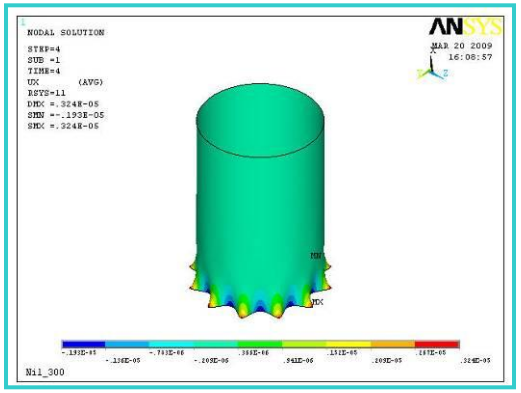
GRASP = on-axis A_{eff} x 0.75 * FOV

MERIT FACTOR FOR SURVEY= GRASP / HEW^2

	ROSAT	CHANDRA	XMM	eROSITA	ATHENA	WFXT*
GRASP @1 keV (cm^2 deg^2)	300	50	240	750	2300 (just imager)	4400
HEW @2/3 FOV (arcsec)	30	3	20	30	10	5
MERIT FACTOR (cm^2 deg^2 / $arcsec^2$)	0.3	5.5	0.6	0.83	23	176

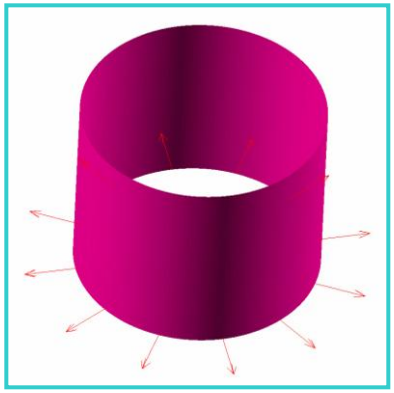
Challenge of thin shells with small aspect ratio

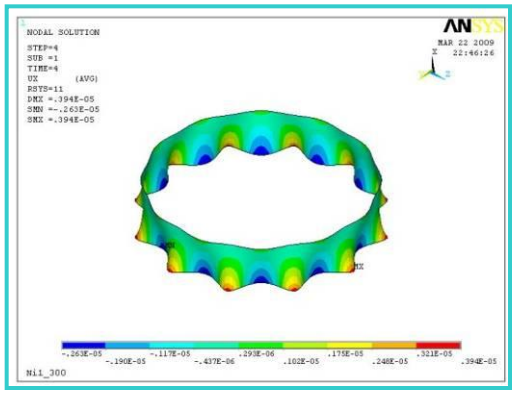
Small aspect ratio ➔ difficulty in reaching good angular resolution because they are **more sensitive to perturbing effects related to edges loads**:



- mechanical behavior closer to a “belt-like” configuration rather than a “tube-like”
- border effect errors with a much higher weight in determining the PSF
- angular resolution more strongly affected by the slope errors caused by out-of-phase azimuthal errors

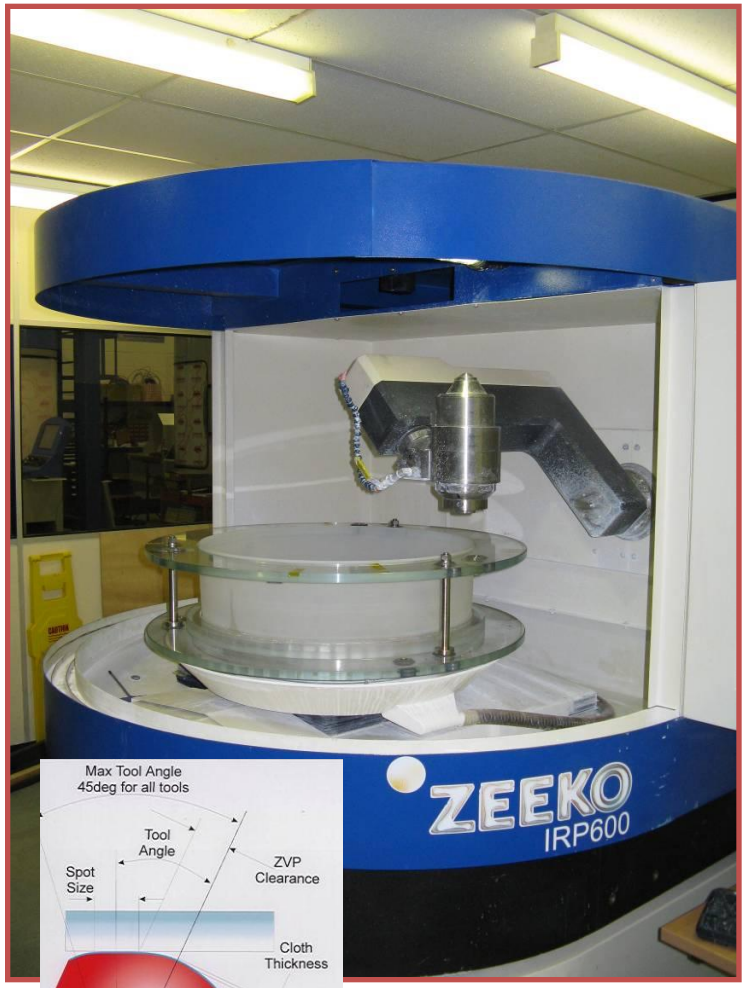
12 r F 0.1N in 12 front section points 30°



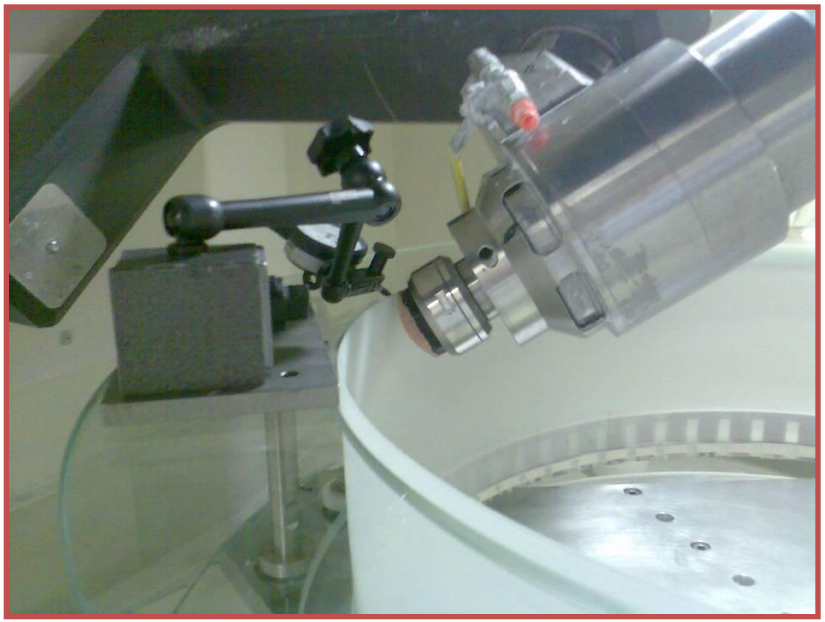


very short MSs show degradation 6-16 times larger with respect to long MS

Polishing Step

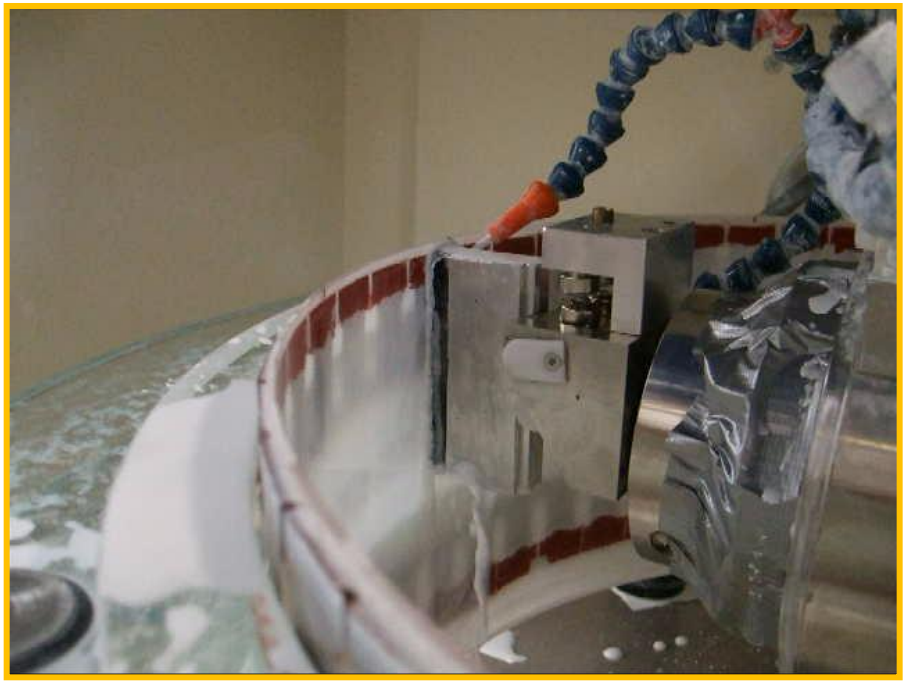


- IRP 600 Machine developed by ZEEKO (UK)
- 7 axis CNC machine tool controller
- Bonnet tool can be used for:
  - Grolishing (grinding/polishing) coarser-higher removal rate
  - Polishing

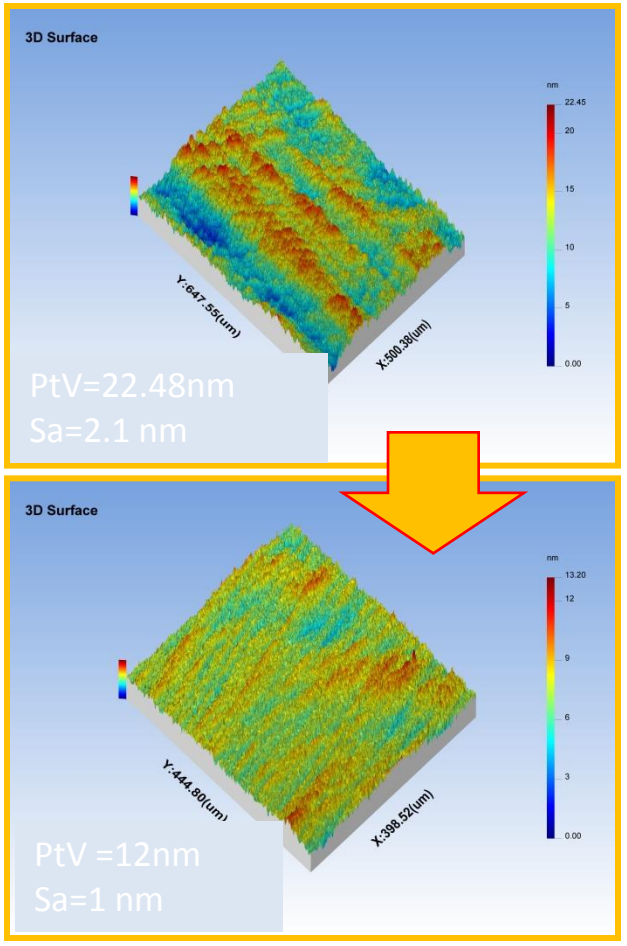


Shell on IRP 600 machine during a grolishing phase

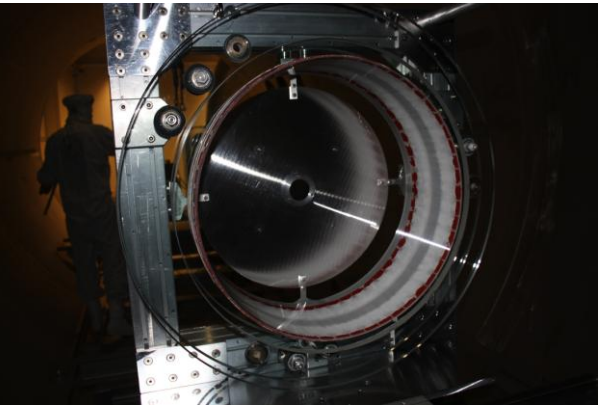
Super-polishing with pitch tool

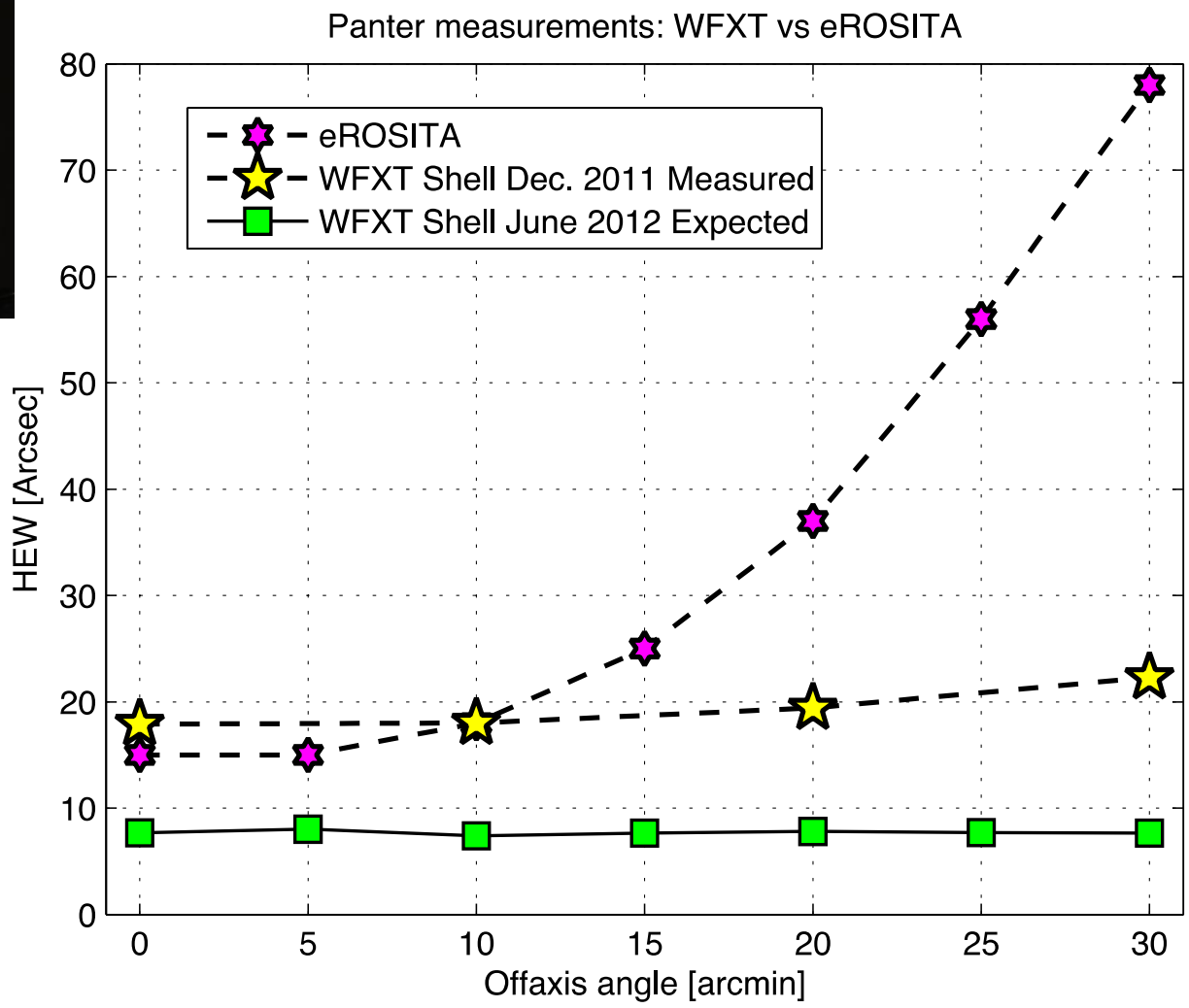


Dedicated to:
- Micro-roughness requirement achievement (0.5nm)
- Mid frequencies removing

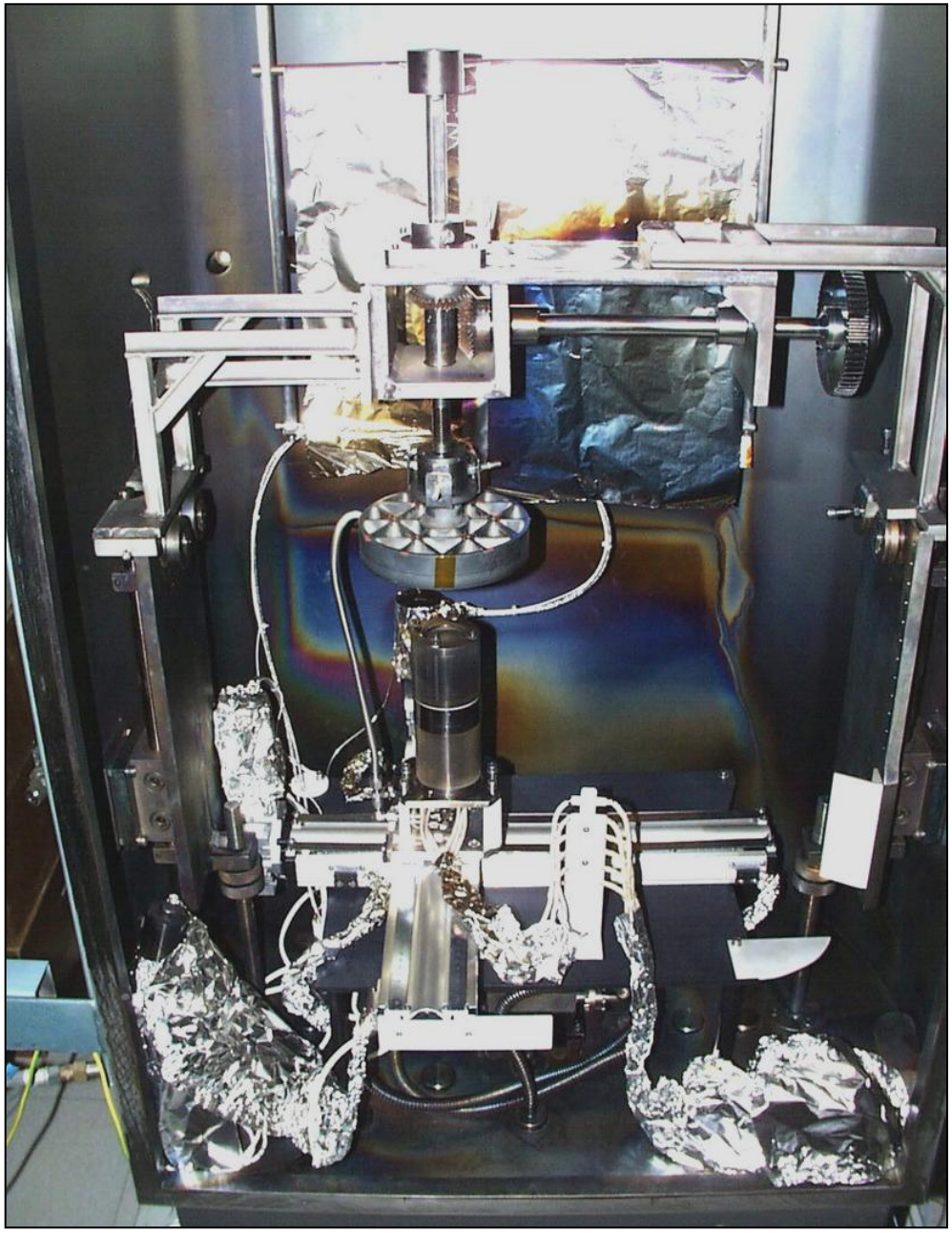


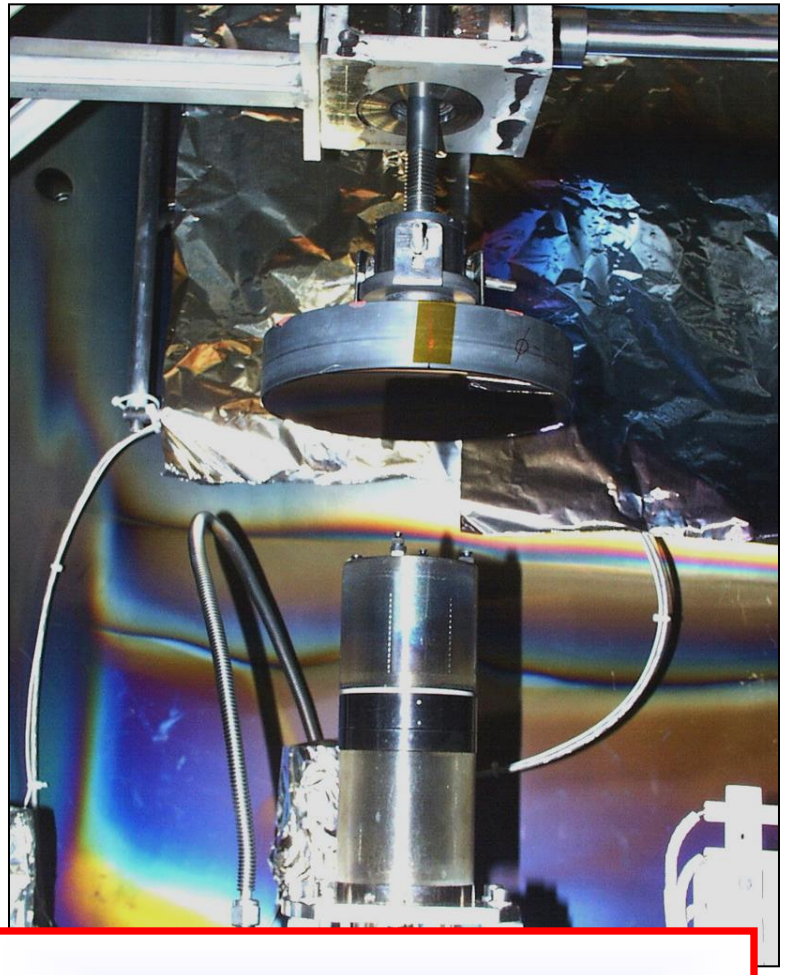
Result after calibration @ PANTER





Use of Ion-Figuring for <<5 arcsec HEW?

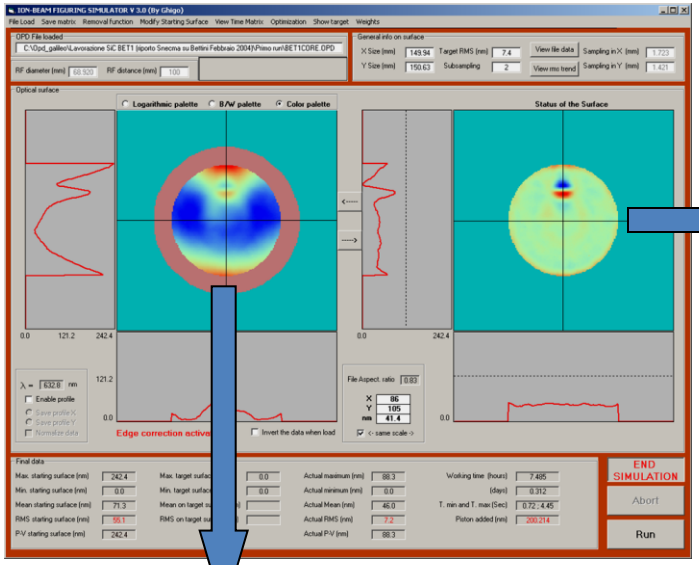


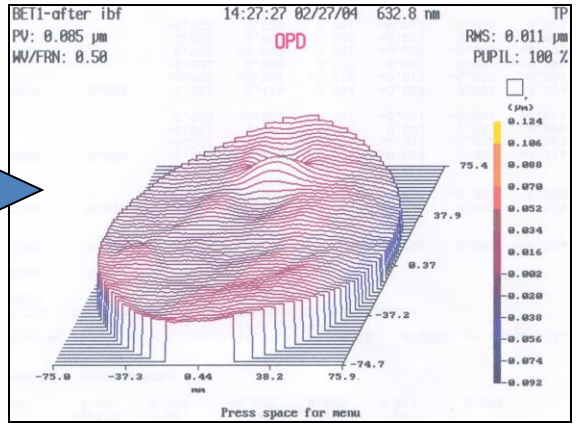


Max working diameter :
54 cm in polar config.
30 cm in cartesian config.

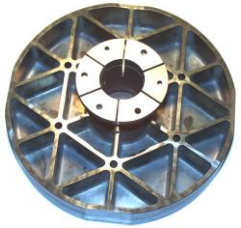
Example of IBF correction of a mirror

Theoretical computation

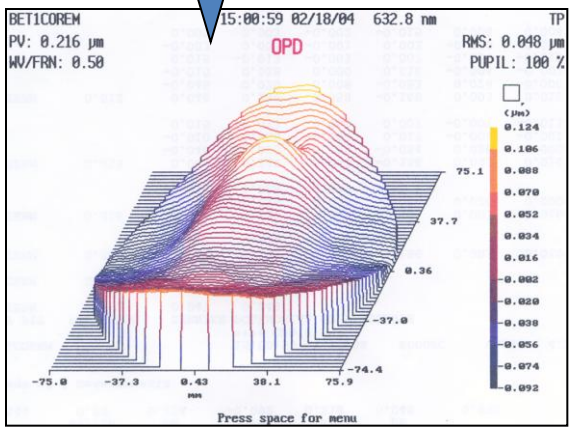




Final surface obtained



Galileo Avionica

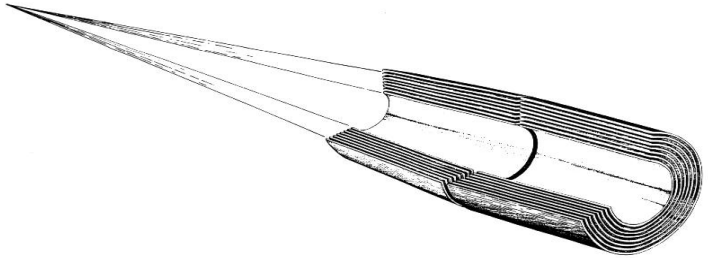


Starting surface

Shape correction of a 150 mm SiC mirror with a local deformation. (λ=632.8 nm)

- Initial surf: 48 nm rms (λ/13), 216 nm p-v
- Final surf: 11 nm rms (λ/57), 85 nm p-v
- Working time: 2.5 hours

Focusing in the hard X-ray region (> 10 keV)



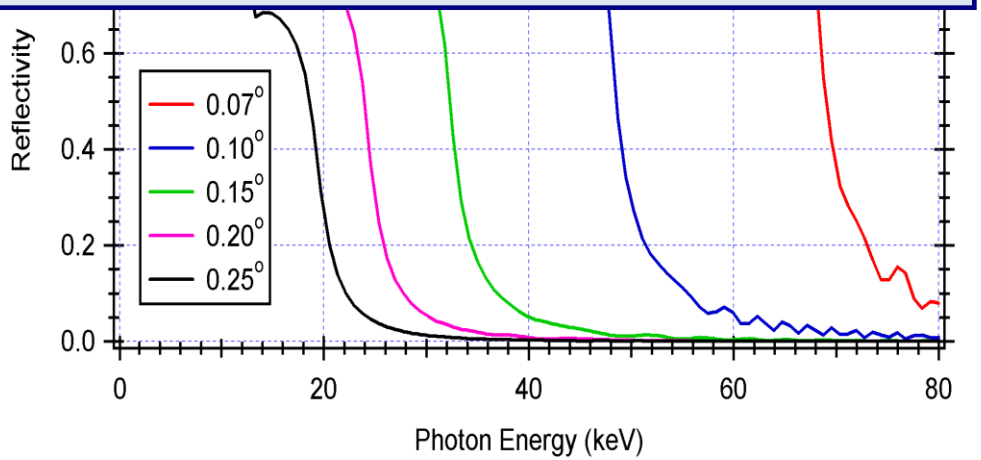
$$A_{eff} \approx F^2 \times \theta_c^2 \times R^2$$

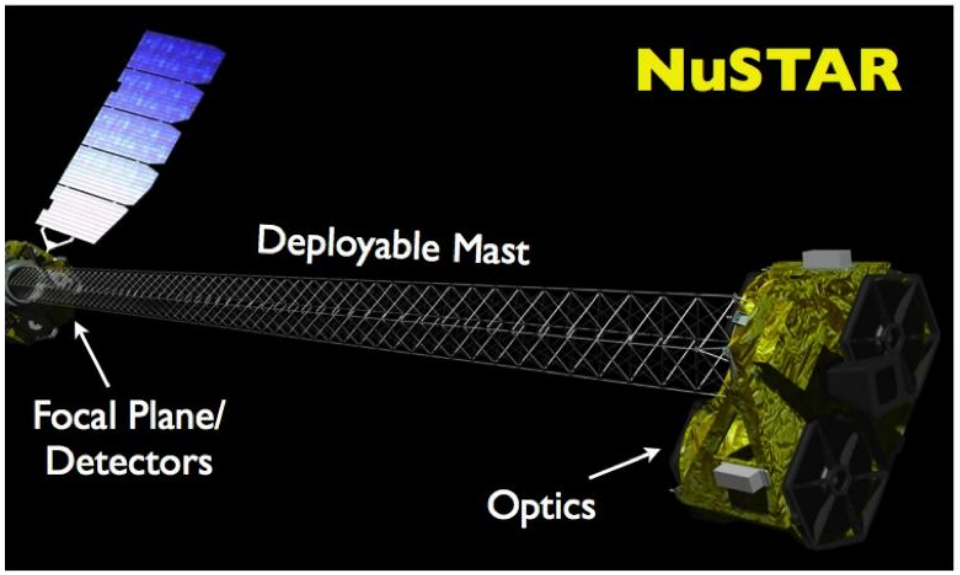
At photon energies > 10 keV the cut-off angles for total reflection are very small also for heavy metals

➔ **the geometrical areas with usual focal lengths (> 10 m) are in general negligible**

but

$$\vartheta_{crit} \propto \frac{\sqrt{\rho}}{E}$$

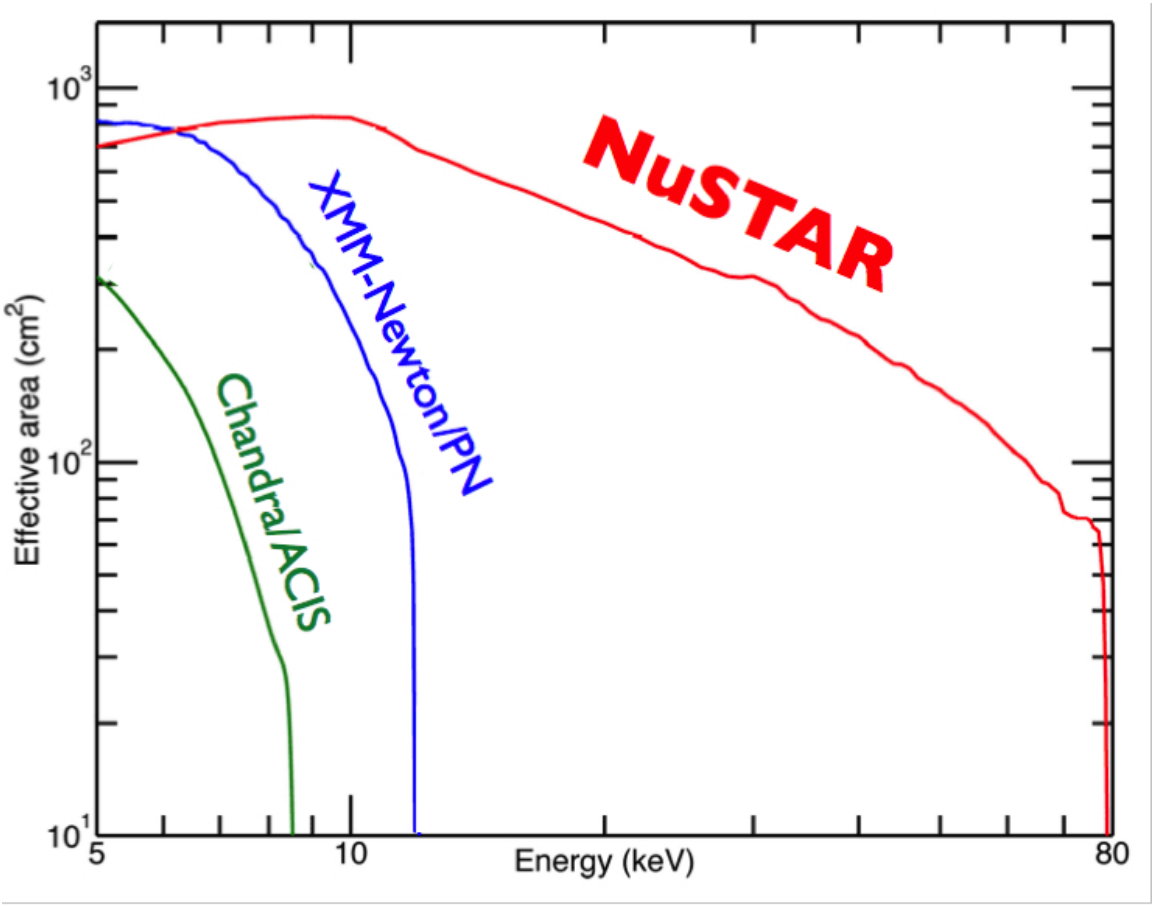




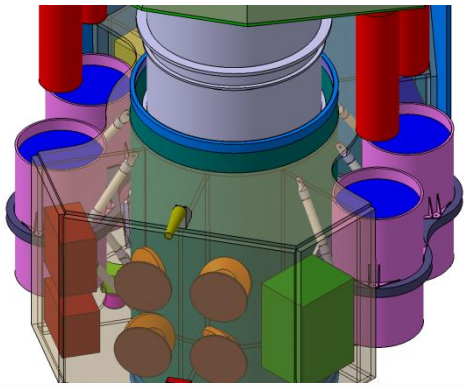
NUSTAR

- **Energy Band:** 5 - 80 keV
- **Angular Resolution:** ~50" (HPD), ~10" (FWHM)
- **Field of View:** 13' x 13'
- **Energy Resolution:** 0.5 keV at 6 keV, 1.0 keV at 60 keV (FWHM)
- **Maximum Flux Measurement Rate:** 10,000 cts/s
- **ToO response:** < 48 hours
- **Launch date:** February 2012
- **Orbit:** 550 km x 600 km, 6 degree inclination

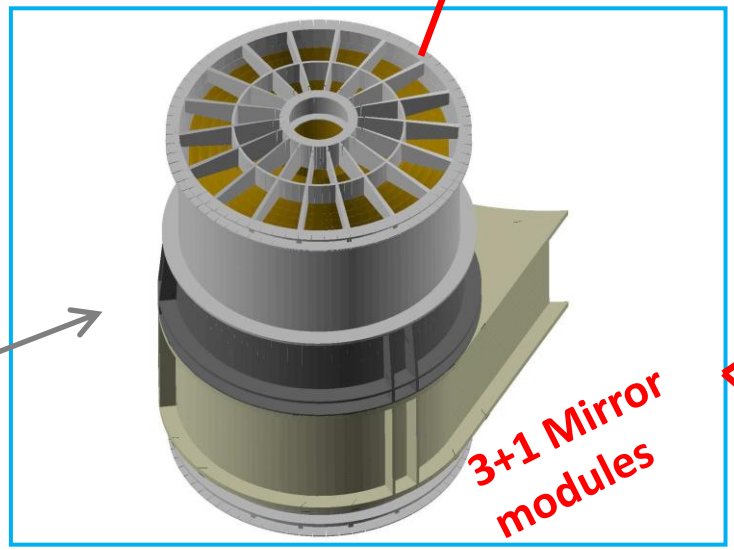
Nustar effective Area



The NHXM mission



70 shells with a diameter from 150 to 394 mm



3 X-ray telescopes

1 X-ray polarimeter