Progress on a High Radiance Water Window Source for Imaging

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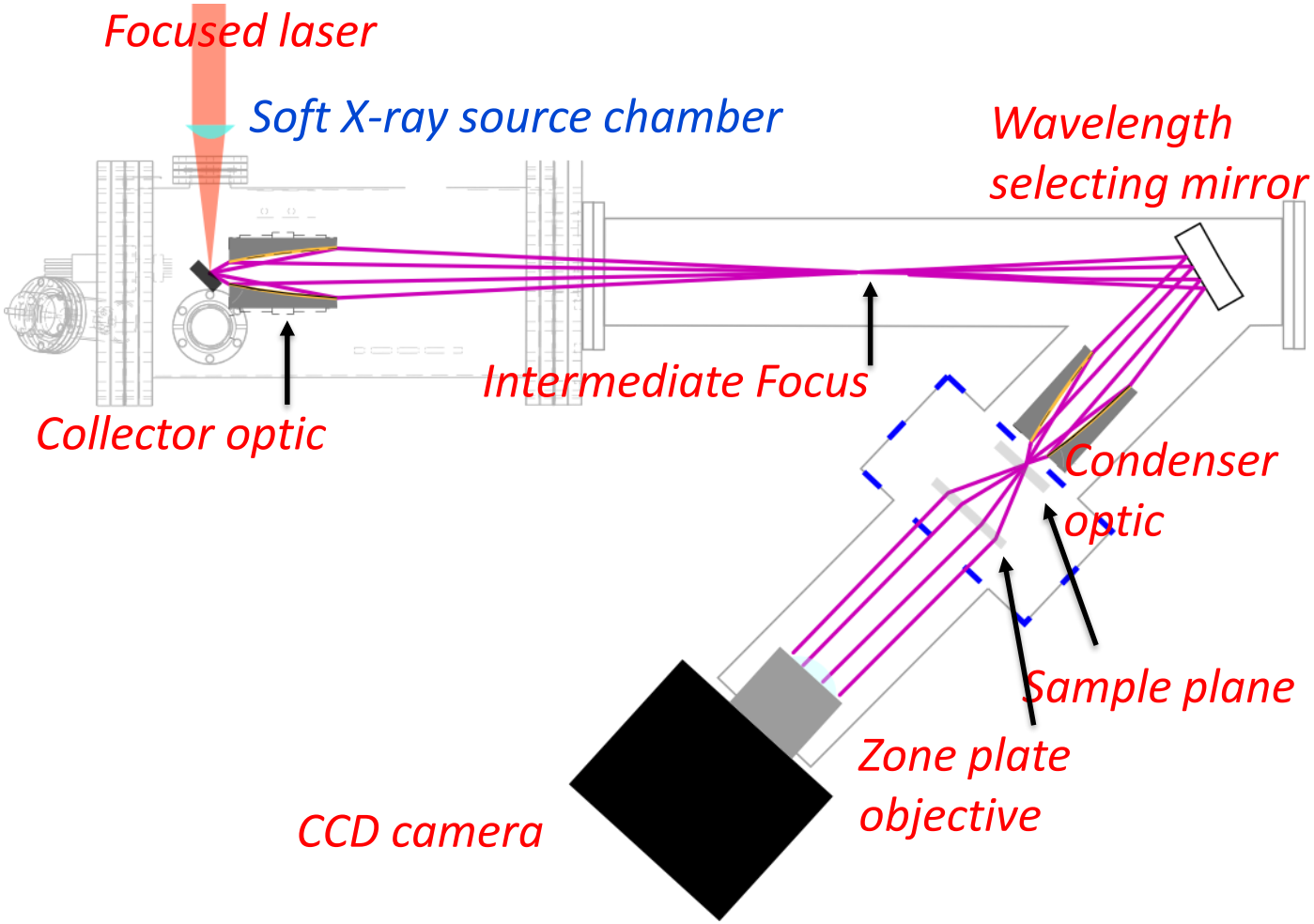
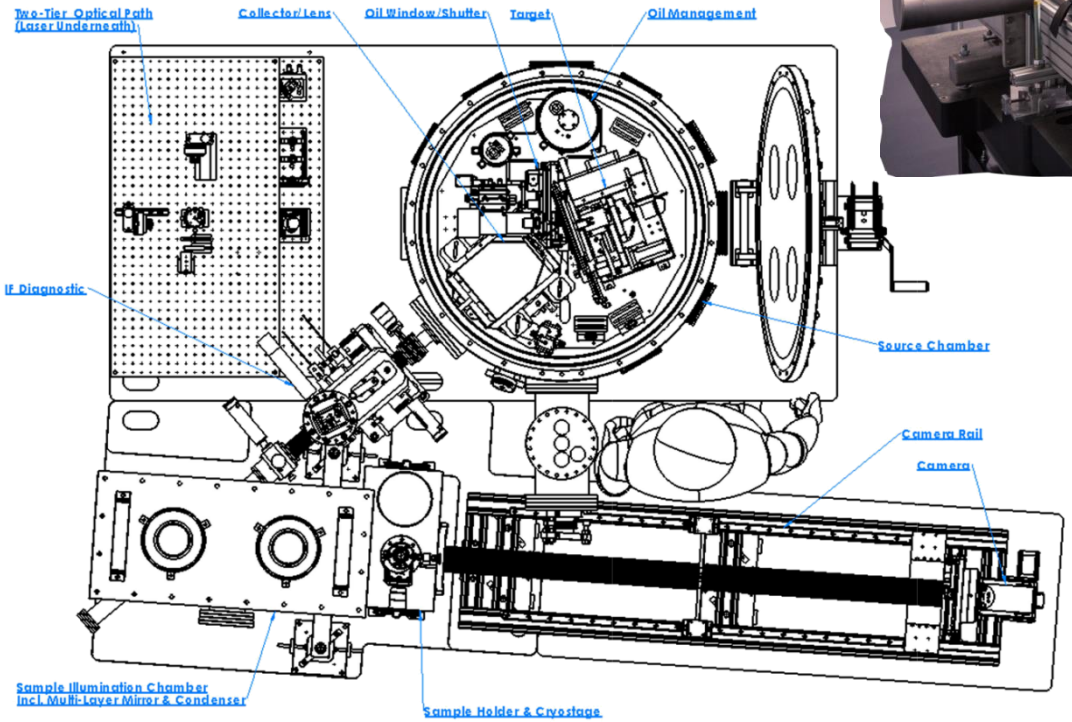
Microscope Layout



SiriusXT microscope schematic.

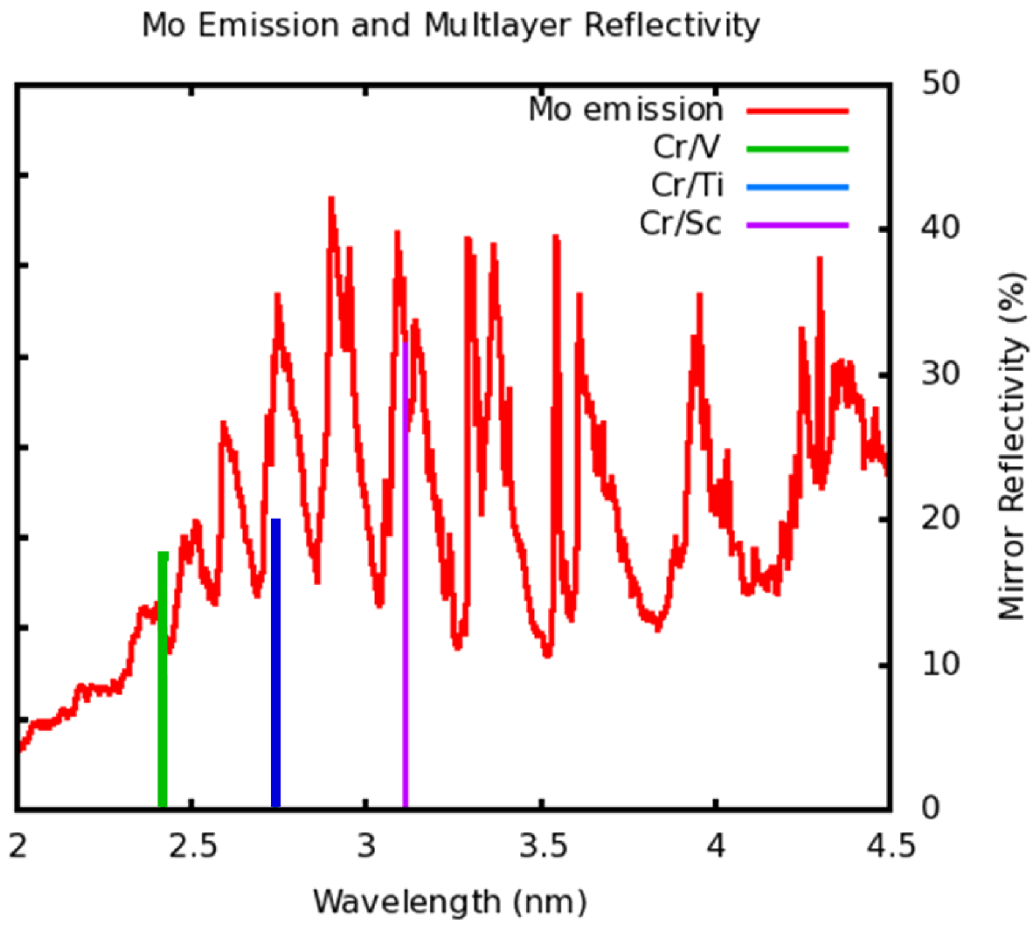
Cryo Soft X-ray Microscope



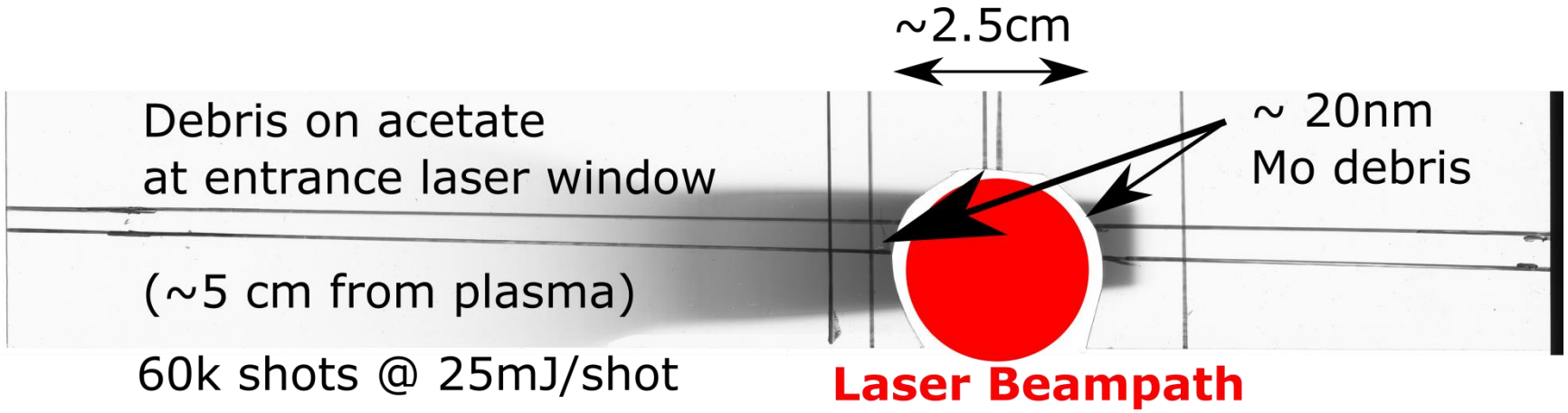
Driving Laser

Edgewave IS
Pulse Energy 25 mJ
Pulse Length ~ 6ns
Rep Rate up to 5kHz
M2 < 2

Choice of Laser Target

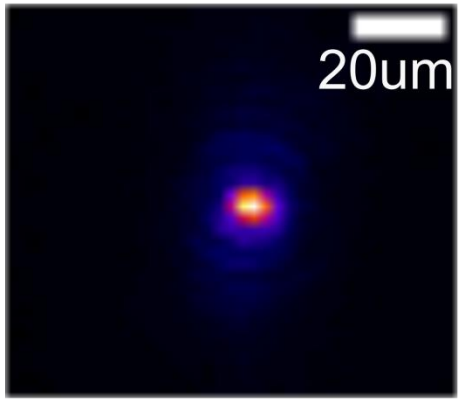


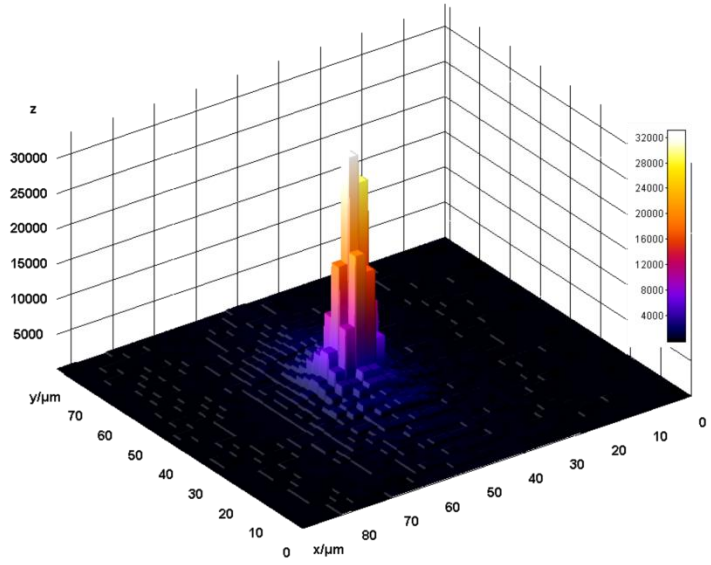
Wet Laser Optics



~20 nm of debris per minute at window at 1kHz laser rep rate

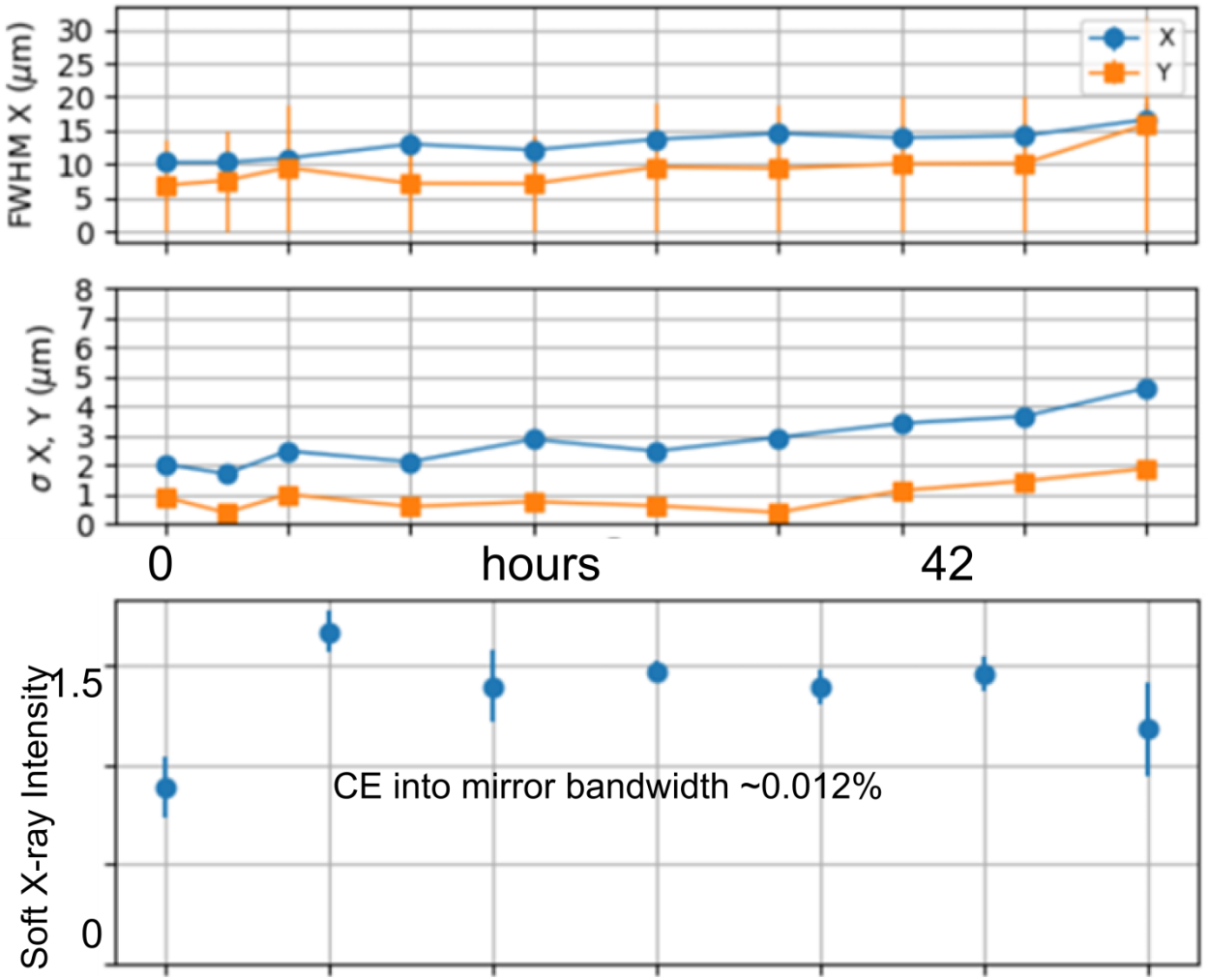
Laser Focus Through Liquid Window



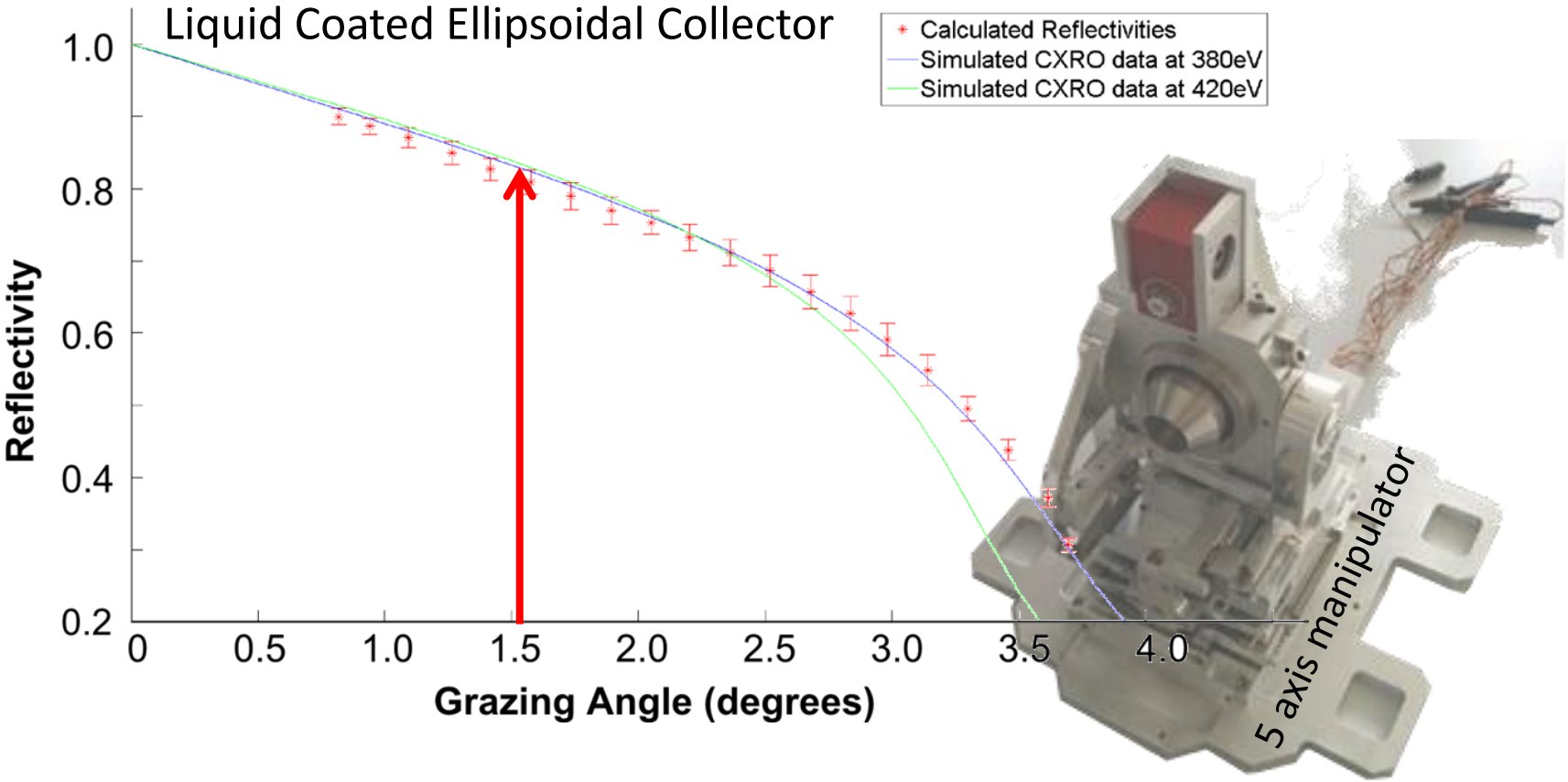


Laser Illumination NA ~ 0.25
1/e2 diameter ~ 10µm x 13µm

Output testing

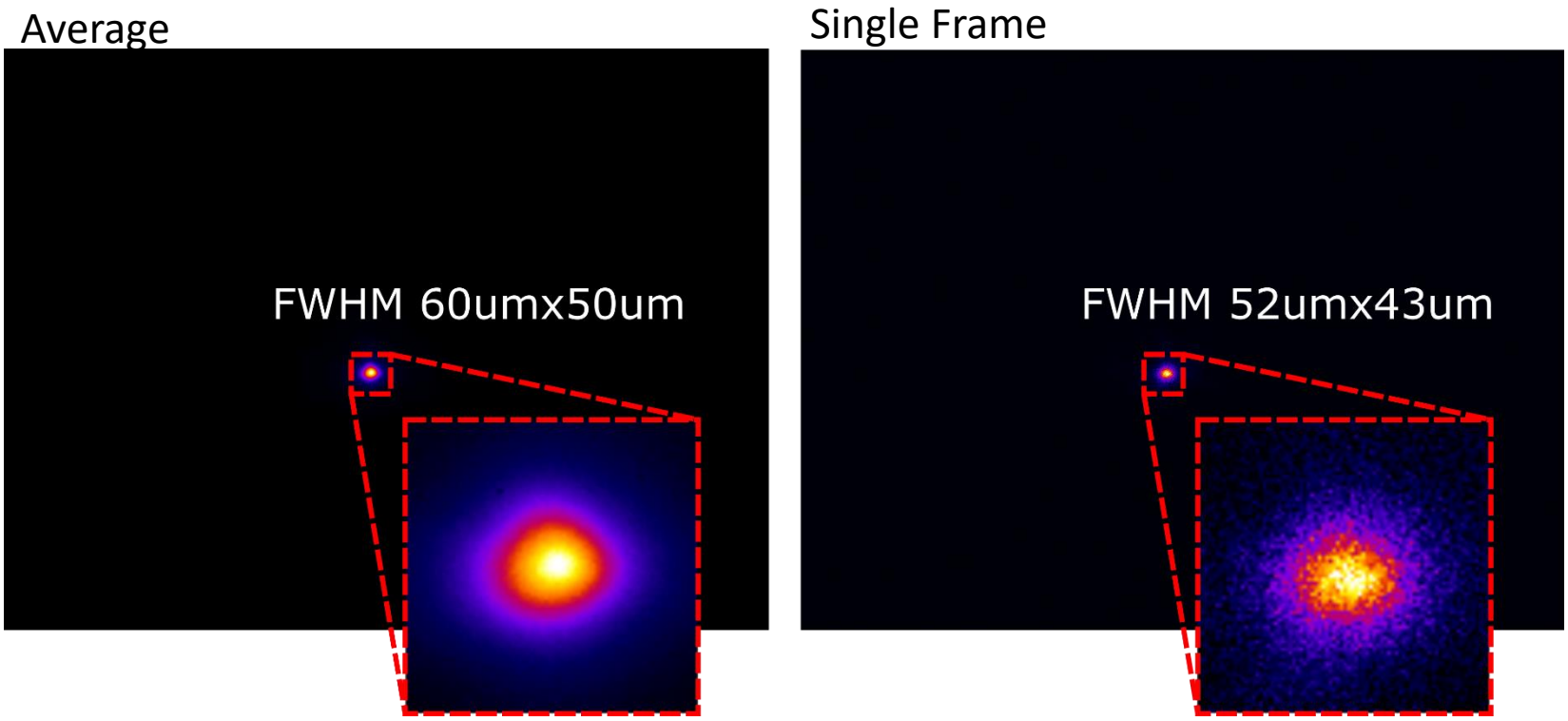


Soft Wet X-rays



Focal Length = 1 m; Collection Fraction ~0.04%)

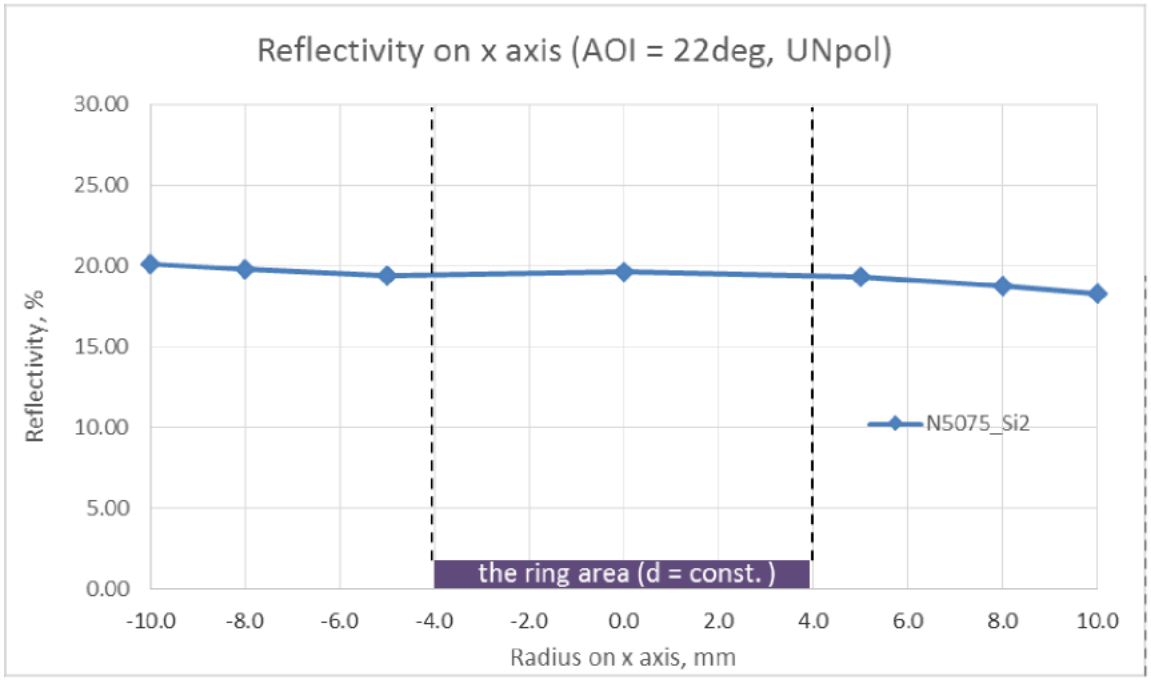
Intermediate Focal Plane

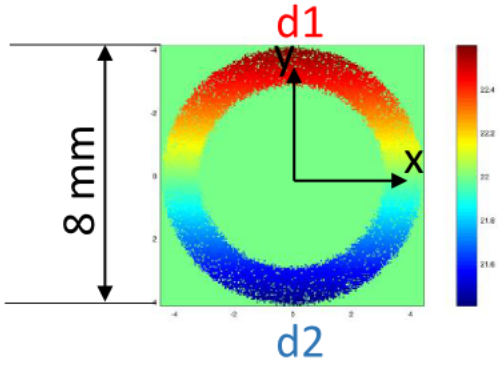


~15% of photons in 36µm x 36µm area useful for imaging

Wavelength Selecting Mirror

PTB results on mirrors (UNpol. reflectivity x axis):





Reflectivity

20% at 2.73 nm

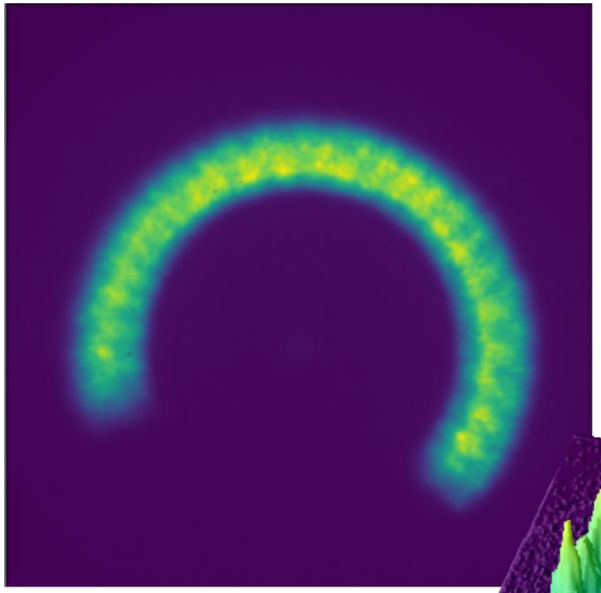
17% at 2.42 nm

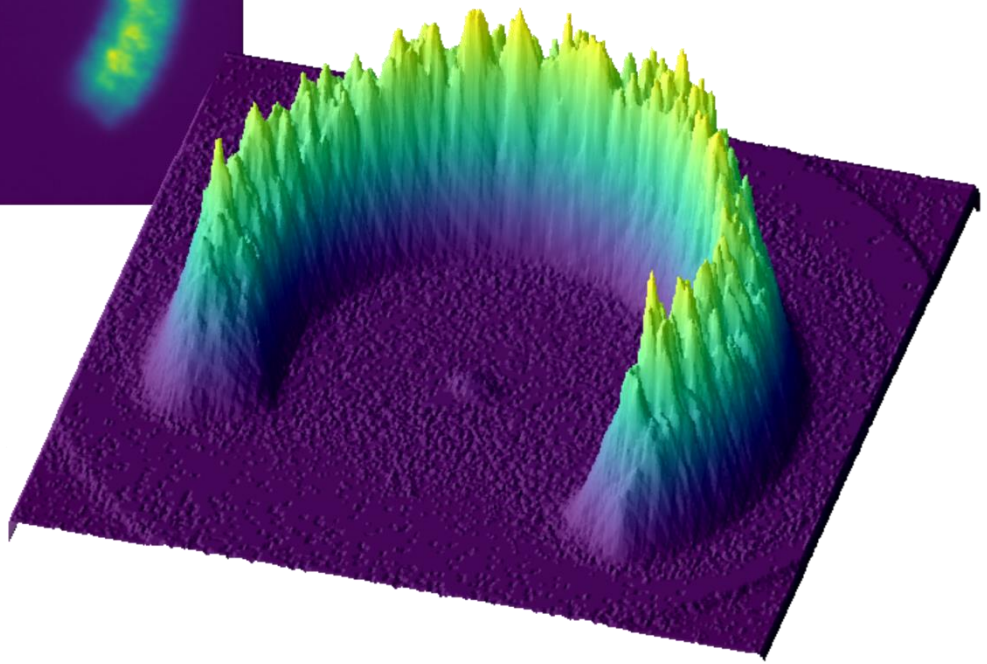
Peak reflectivity within -5 mm < r < 5 mm:

Substrate N5075_Si2: R_{unpol} = (19.48 ± 0.17)%

optiX fab.

Post Multilayer Annular

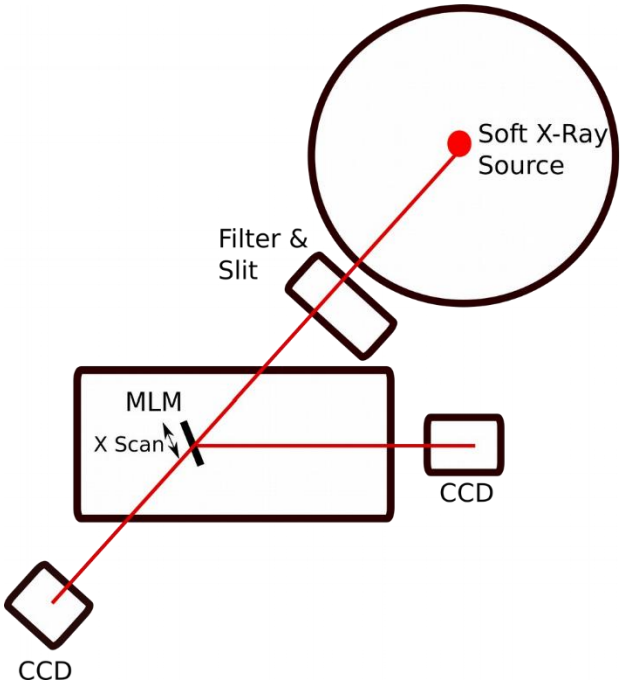




Photons after Multilayer
~2E9/sec

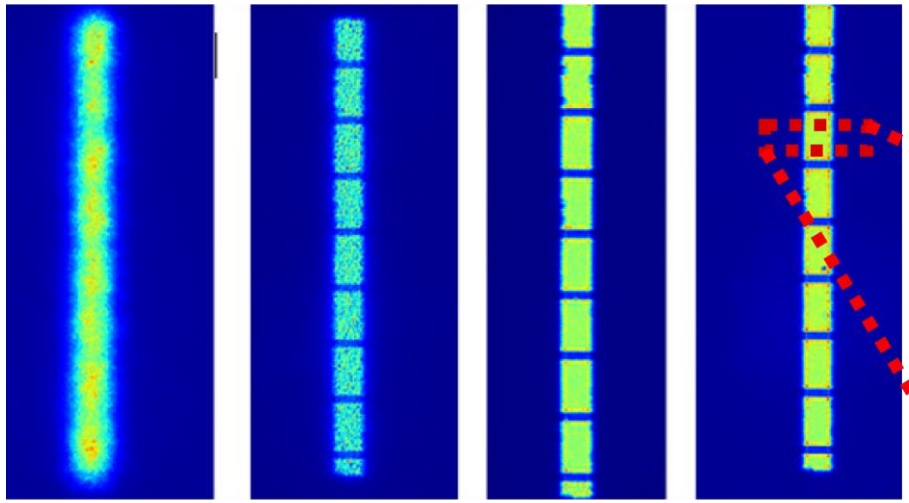
Uses graded MLM to maintain
$\lambda/\Delta\lambda > 300$

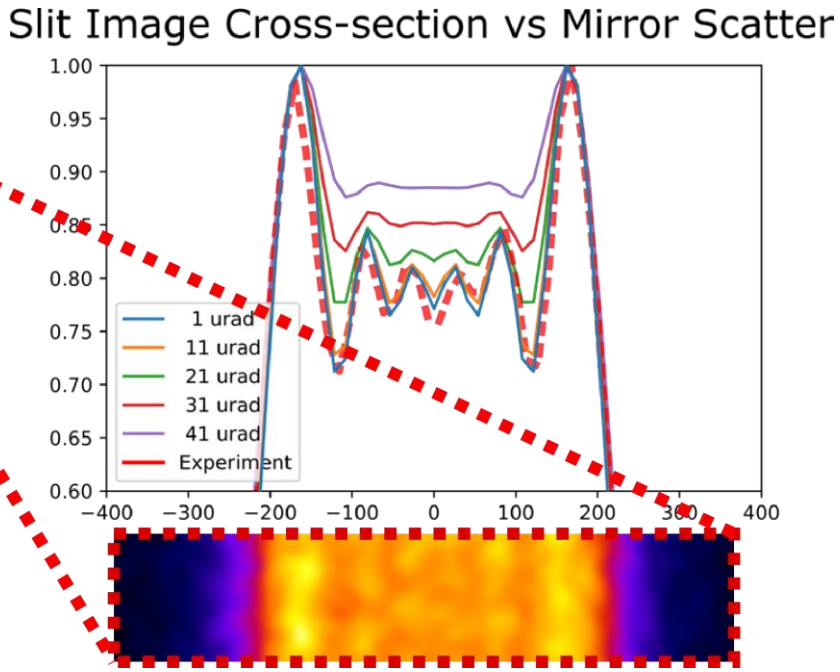
Mirror Scatter Metrology



Element	Distance (mm)	Detail
Source	0	Braodband Mo plasma
Filter	730	0.3 um Cr
Slit	740	200 um wide
MLM	1440	
Cam 1	2040	Andor 13.5 um Pixel
Cam 2	2040	Andor, 13 um Pixel

MLM Substrate Selection



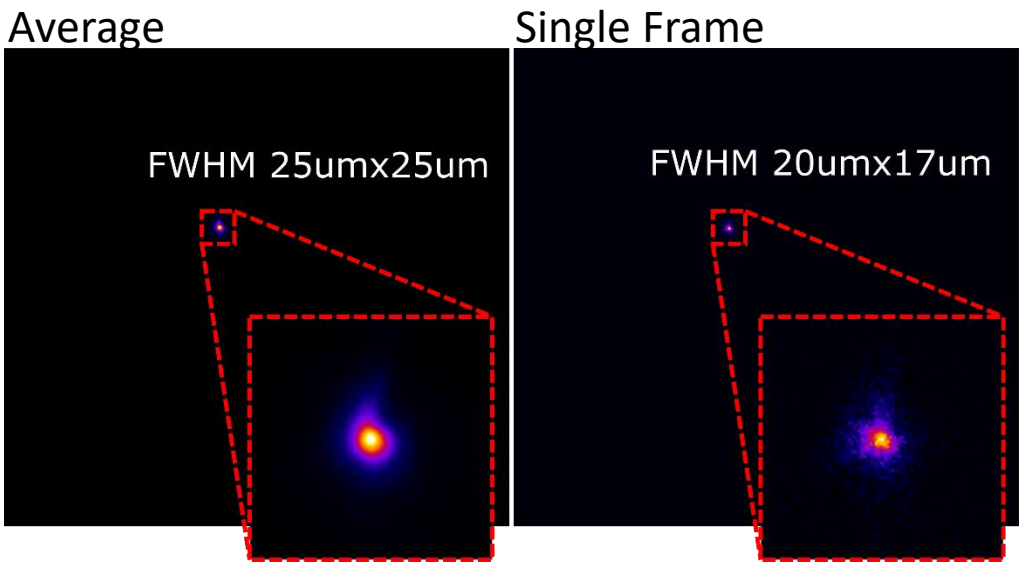


Sample Plane

Photons at Sample Plane:
~8E8 ph/sec (2.73nm – 20% MLM)

Condenser Focus:
Best 20µmx17µm FWHM
Average 25µmx25µm FWHM
(Stdev 1.6µm, 2µm X,Y)

> 7.5% of photons in 10µmX10µm on average



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Acknowledgements

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