Recent developments at the 20-ID microprobe

- miniXS detector development
- New low temperature stage
- Three applications of a polycapillary collimator
  - Confocal mapping
  - Background reduction
  - Fluorescence analyzer

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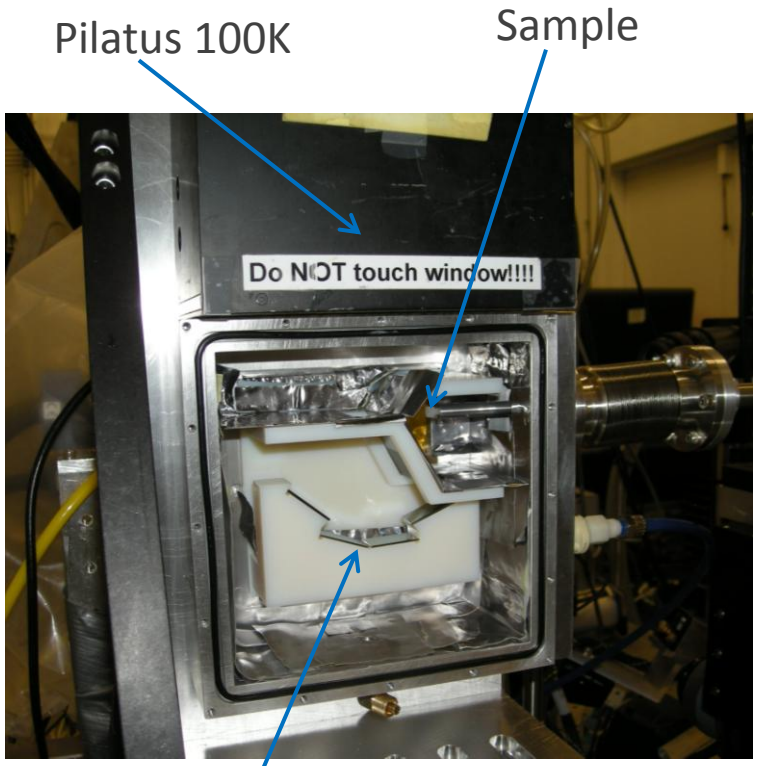
The Advanced Photon Source is an Office of Science User Facility operated for the U.S. Department of Energy Office of Science by Argonne National Laboratory

Miniature X-ray Spectrometer (miniXS) Basics

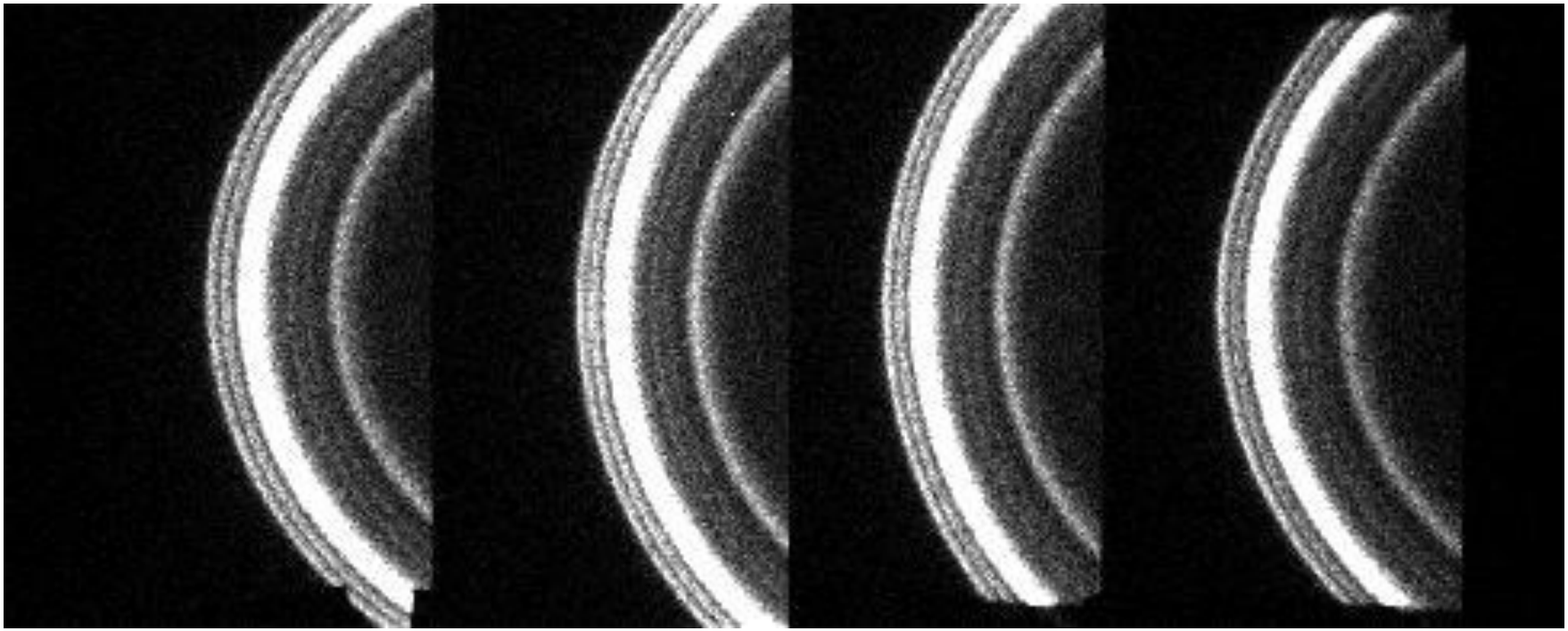
- Flat crystal approximation to bent crystal optics
- Small beams allows for compact (mini) arrangement
- Replace precision alignment with area detector and calibration procedure
- PAD detectors (Pilatus) have essentially no noise allowing for detection of weak signals
- Collection efficiency equivalent to several typical bent crystal analyzers

Ce L_α miniXS

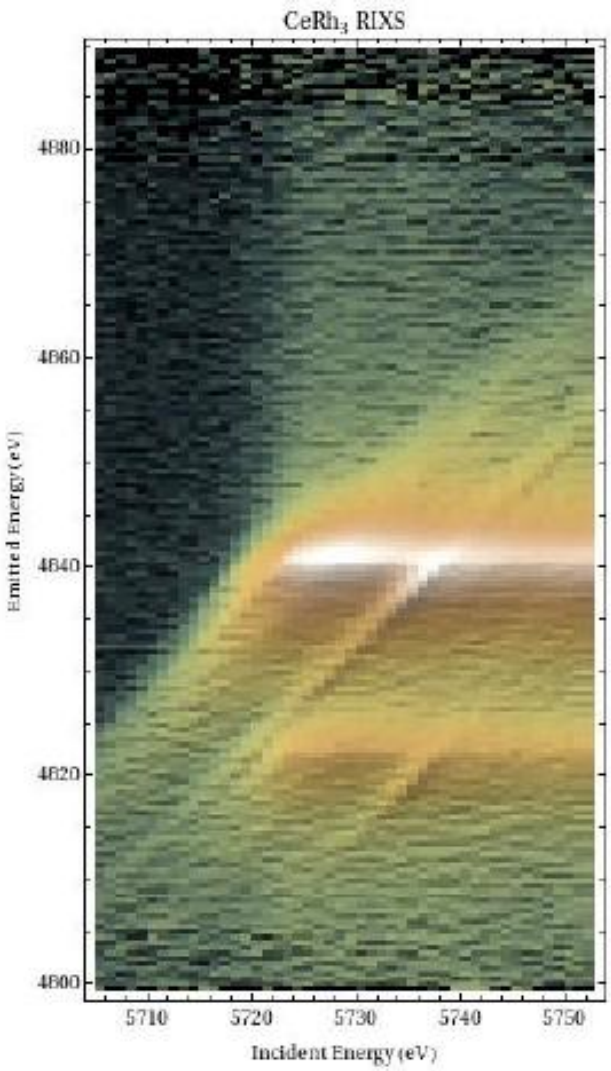


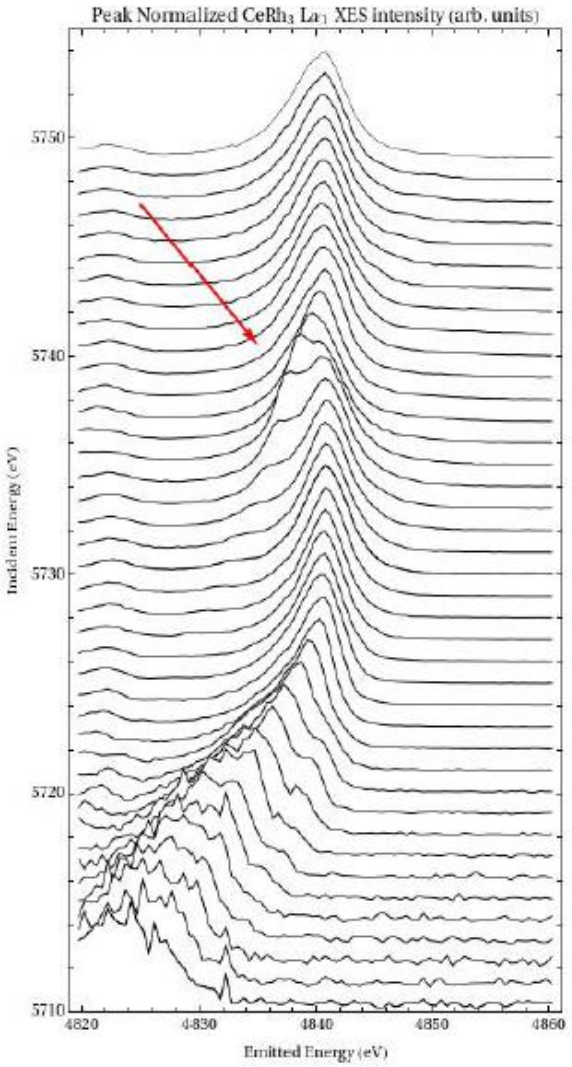
Easy optimization and customization using rapid prototype printing at APS

CeF_3 Lα XES
4 minute exposure
500k counts in Lα1, 2M counts in entire energy range



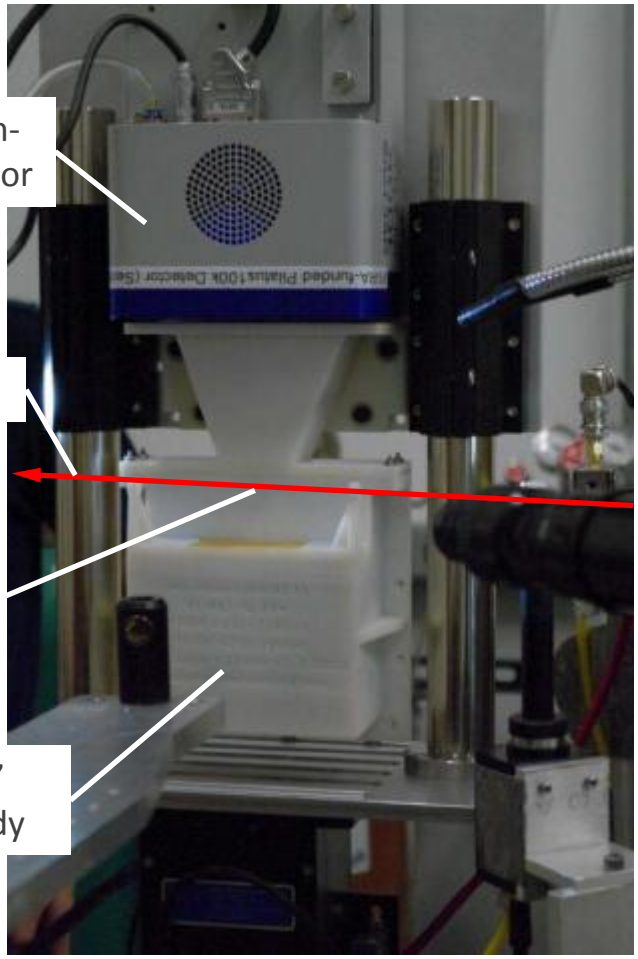
After using elastic line to calibrate pixels…

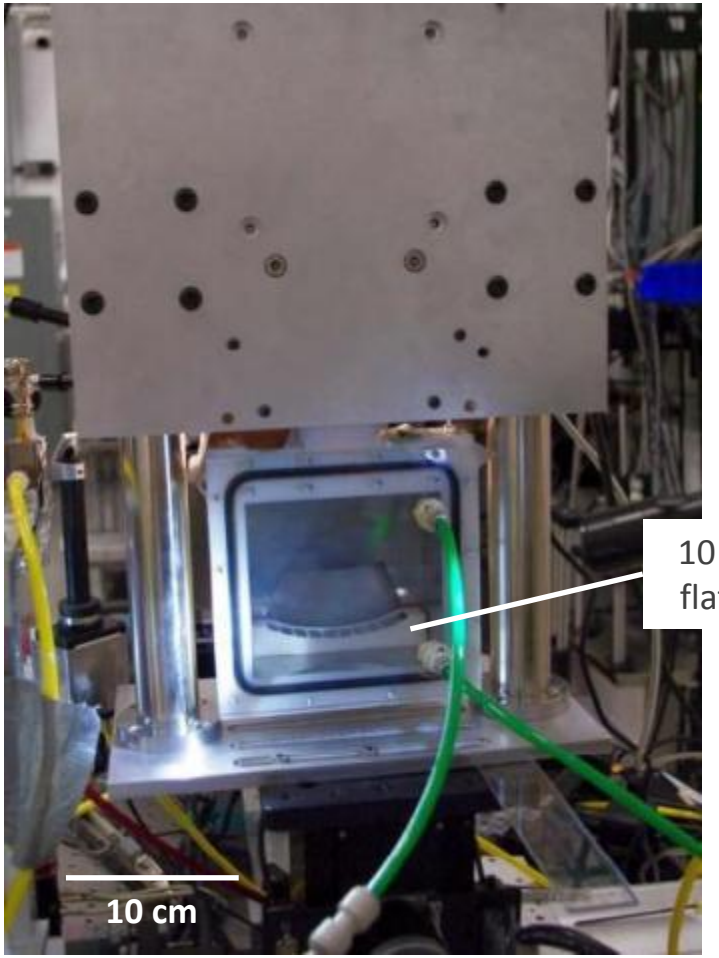




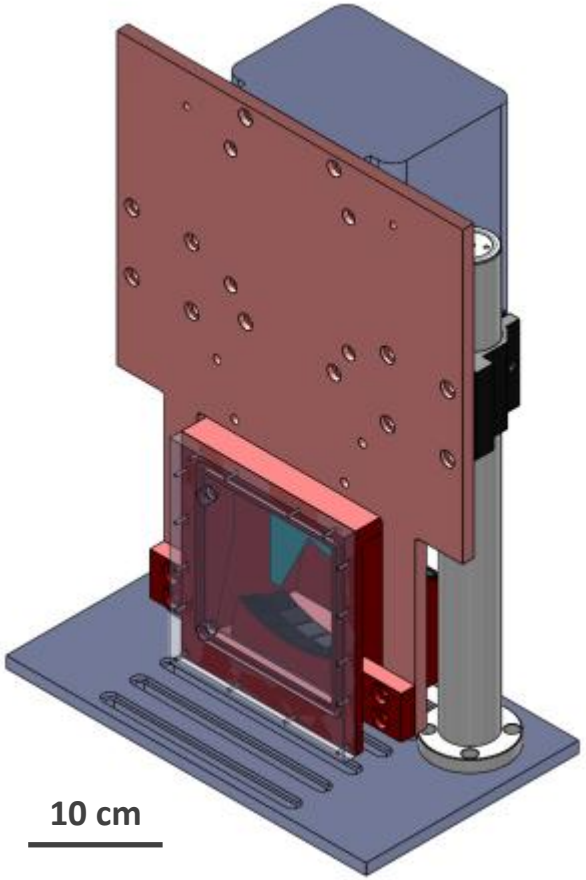
Fe Kβ miniXES

Approx. van Hamos geometry – better access to sample

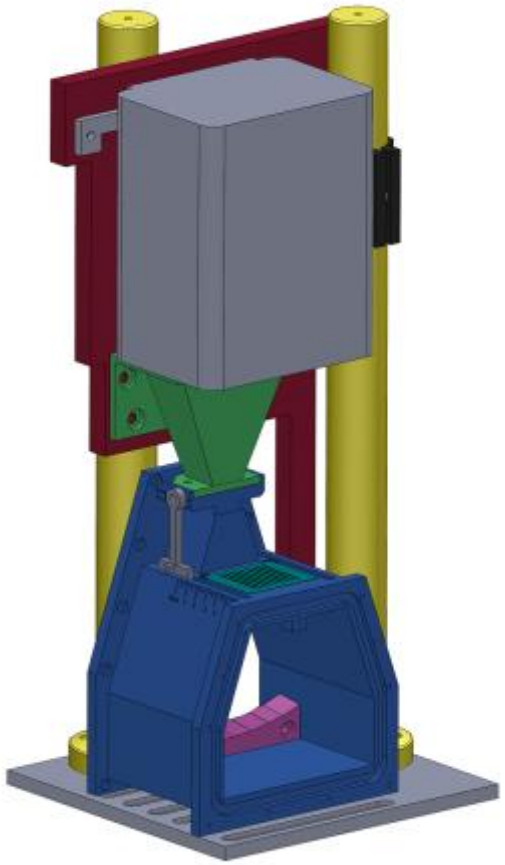




Other miniXES instruments (under development)



Pt Lα



"Modular" miniXES:
adjustable Bragg angles

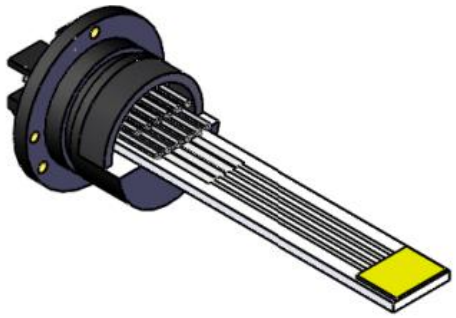
miniXS spectrometers

U M4	3330 eV
Ce Lα	4830
Pr Lα	5030
V Kβ, Cr Kα	5420
Mn Kβ (2 versions)	6490
Fe Kβ	7060
Co Kβ	7650
Pt Lα	9400

Joule Thompson micro-refrigerator

(MMR technologies)

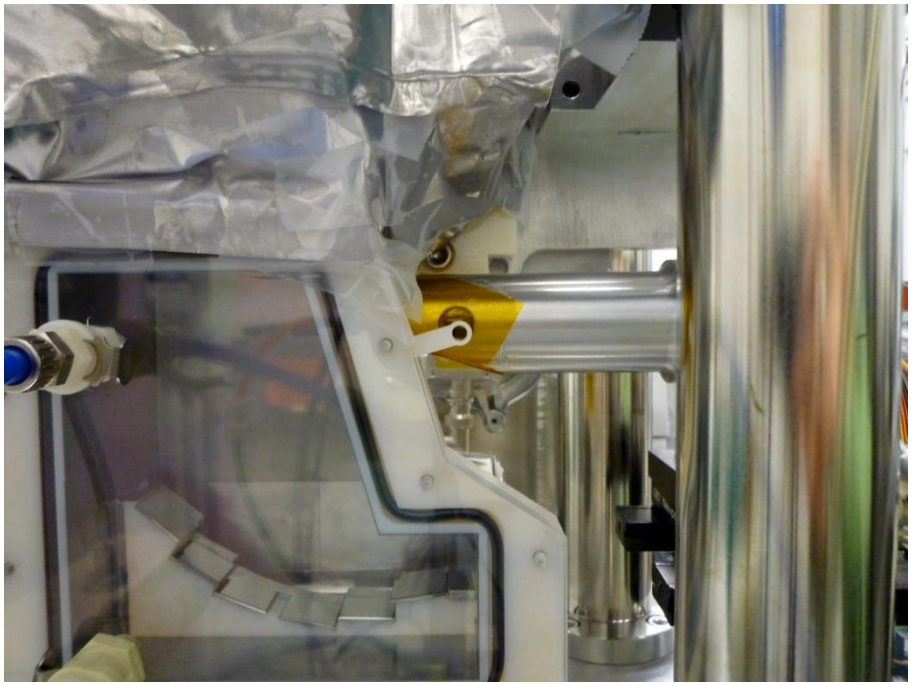
- 80 to 580K
- 20 minute cool down for small samples
- Low vibration
- High pressure (1500 psi) N2
- 6000 psi tank lasts 3-4 days



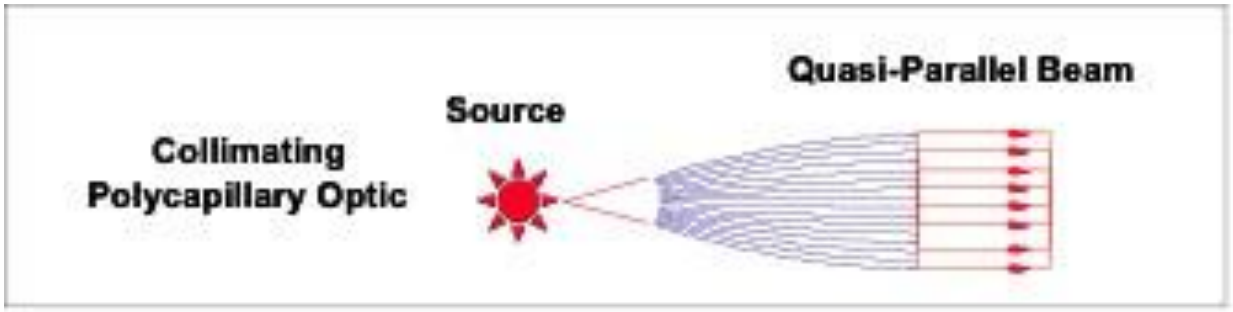
Compatible with miniXS and microprobe

Micro-refrigerator with miniXS

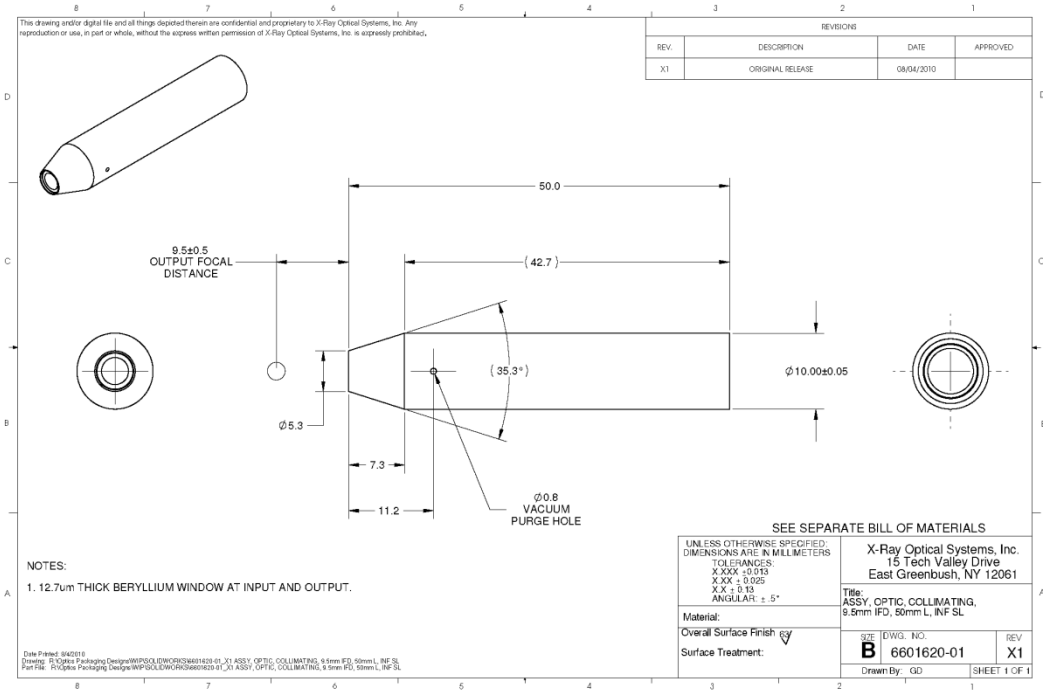
Mn emission from Photosystem II



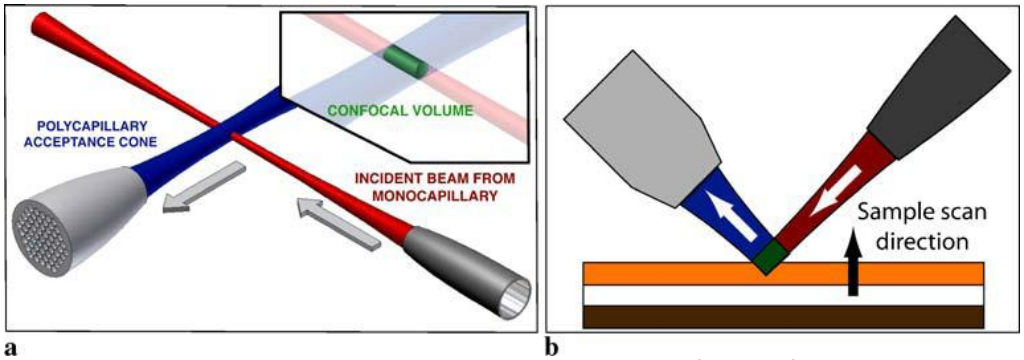
Polycapillary collimator



Working distance:	10 mm
Focal spot:	25 micron
Collimation:	8 keV
Efficiency:	20-30%
Collection angle:	20°
Output size:	6 mm

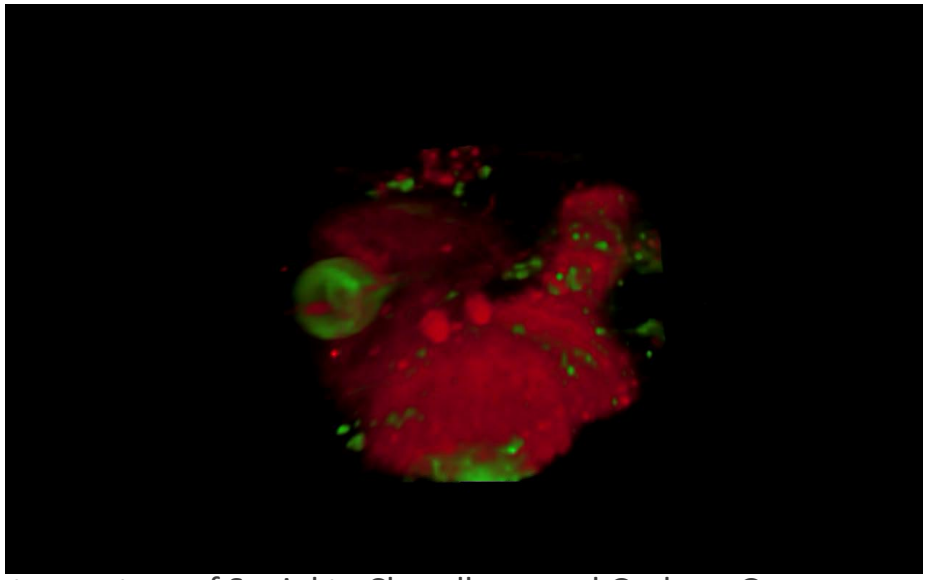


Confocal Microscopy



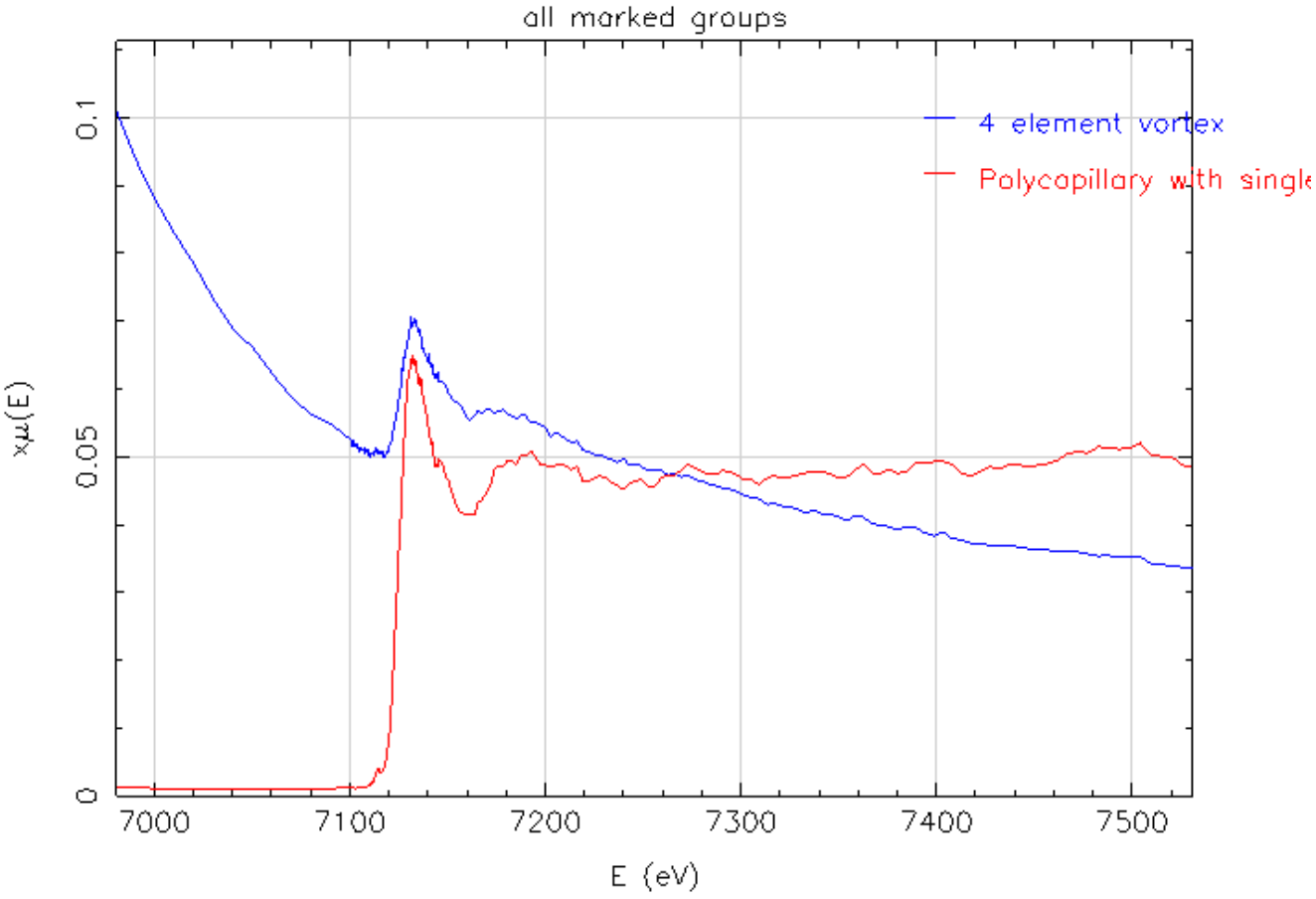
From: Woll etal, Appl. Phys. A, 83, 235 (2006)

Zebrafish example:
600 x 400 x 400 microns



Data courtesy of Sanjukta Choudhury and Graham George, Univ. of Saskatchewan

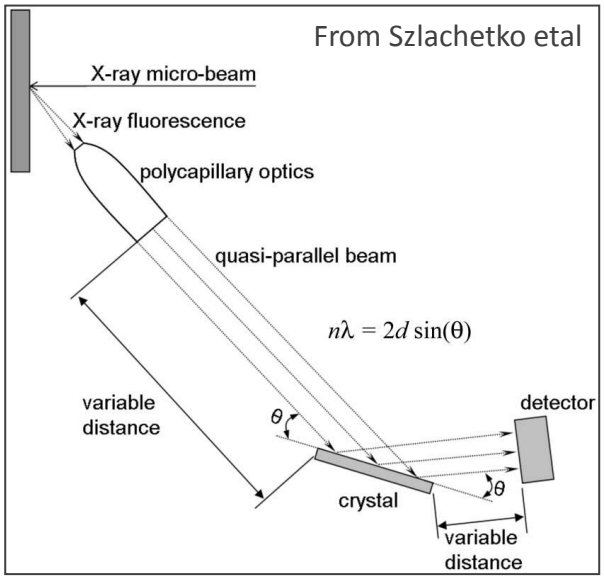
Background reduction with polycapillary



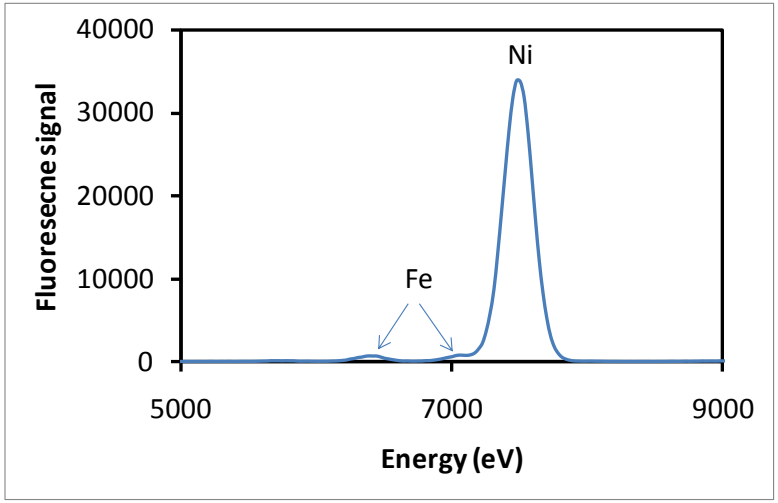
Polycapillary Based Analyzers - initial results promising

Past work: Kirkland etal, RSI, 66, 1410 (1995); Szlachetko etal, JSR, 17, 400(2010).

- Combine analyzer with energy dispersive detector
  - Large collection angle (~20°acceptance cone)
  - Reasonable efficiency
  - Each stage provides >10^3 background reduction



Spectrum from Vortex using graphite analyzer set for Ni Kα



Recent test for sample with 110 ppm Ni and 8.4% Fe – background reduced by > 10^6

In Ni ROI: Ni signal 10K and Fe background <5 Hz (3x enhancement possible by removing air path)