Overview of Bimorph Mirrors at Diamond Light Source

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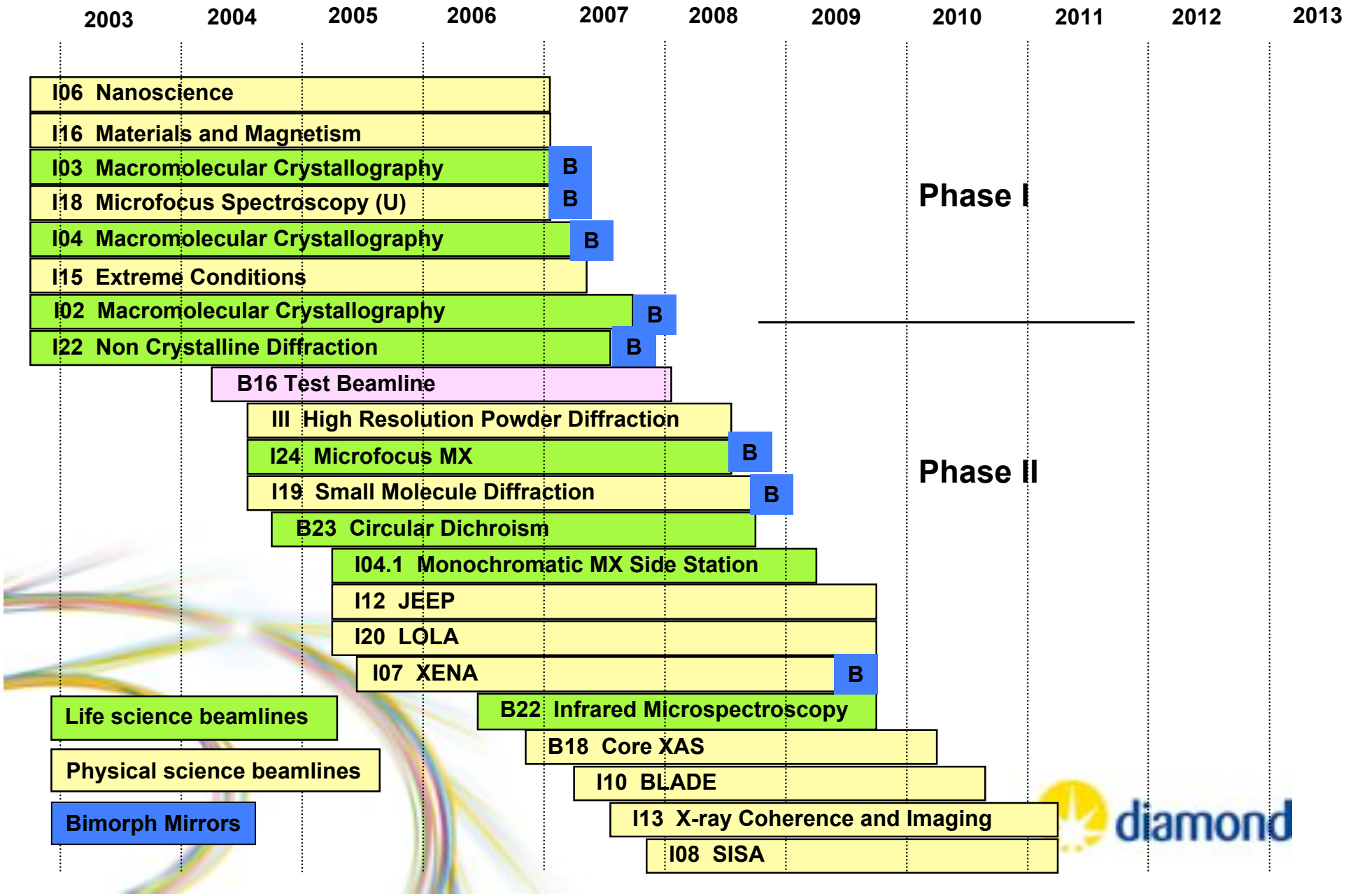
Beamline Programme



Bimorph or Conventional?

Require “clean” Gaussian shape with no long tails, especially in high demagnification regime.

Likely to move focal position or wish to ensure quality beam “off-focus” ie wish to focus on detector, but maintain regular beam at sample.

Correct for distortions eg heat bump from other optics.

Improve overall slope error of optic.

Beamlines with Bimorph Mirrors (1)

Beamline	Science	Length of mirror and no of electrodes
I02,I03,I04	Macromolecular Crystallography	1050 HFM (14) 600 VFM (8)
I07	Surfaces and Interfaces	600 VFM (32) 1050 HFM (16)
I18	Microfocus Spectroscopy	200mm VFM (8) 150mm HFM (8)

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Beamlines with Bimorph Mirrors (2)

Beamline	Science	Length of mirror and no of electrodes
I19	Small Molecule Crystalline Diffraction	600 VFM (16) 1050 HFM (32)
I22	Non-Crystalline Diffraction	900 HFM (12) 600 VFM (32)
I24	Microfocus MX	1050 HPFM (16) 600 VPFM (32) 220 VMFM (12) 280 HMFM (8)

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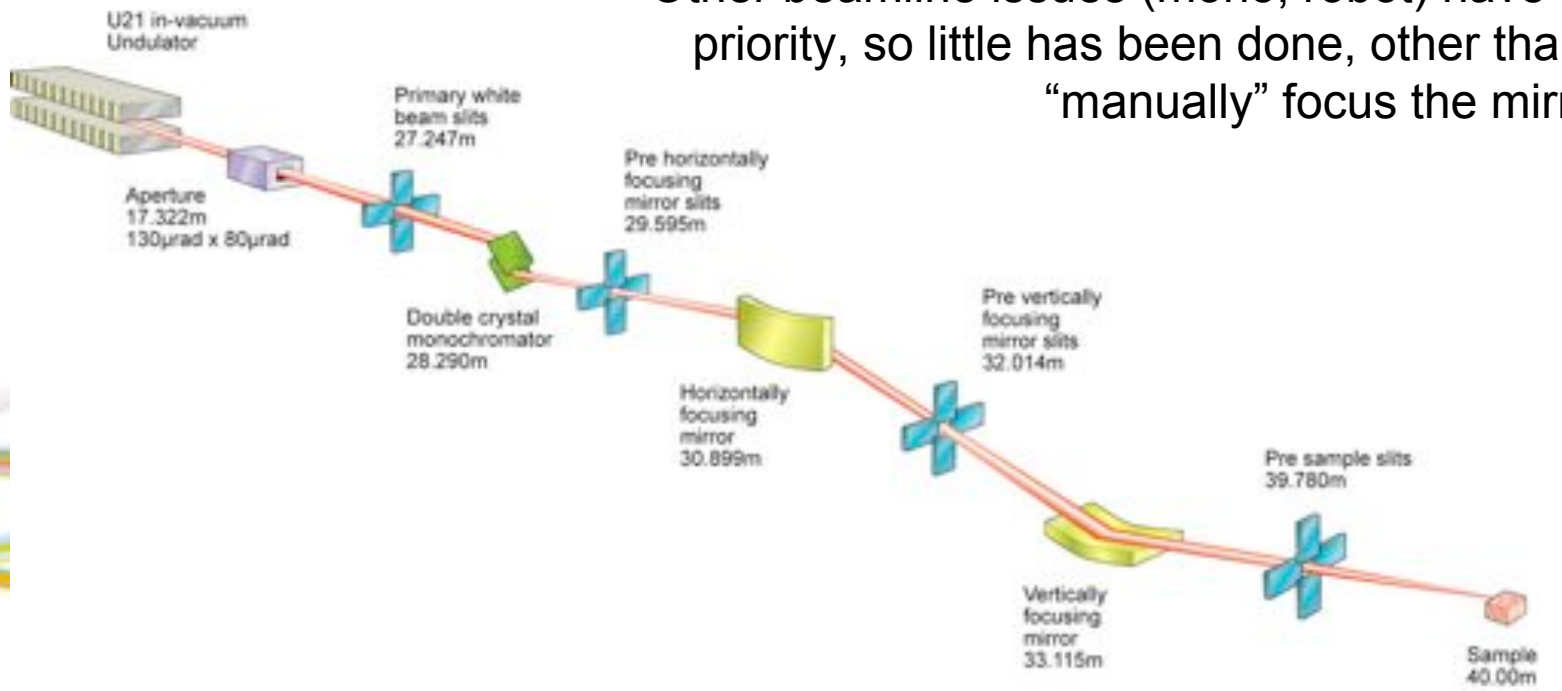
I02, I03, I04

Spot size ca 150x 120μm just using more or less the same voltages on each electrode – aiming for 150x20μm when fully commissioned

Other beamline issues (mono, robot) have had priority, so little has been done, other than to "manually" focus the mirrors



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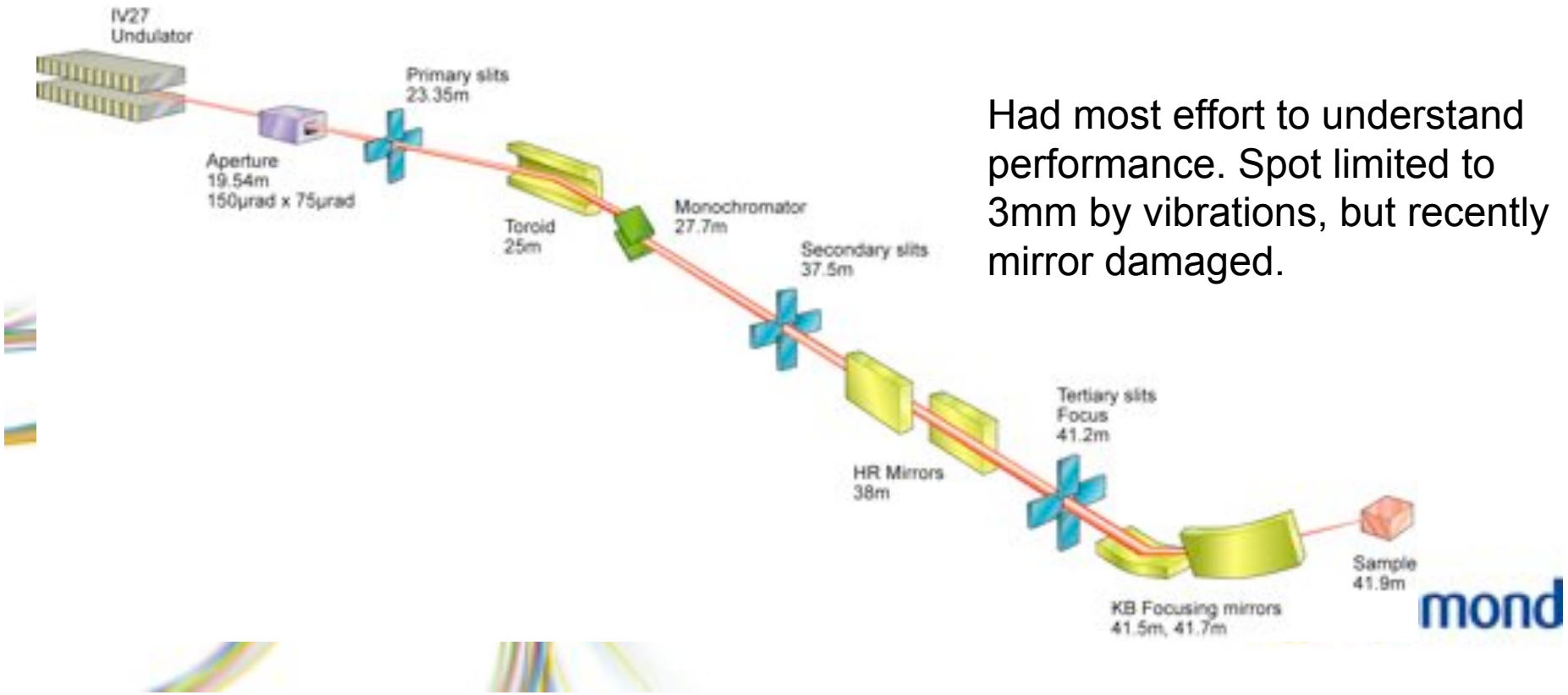
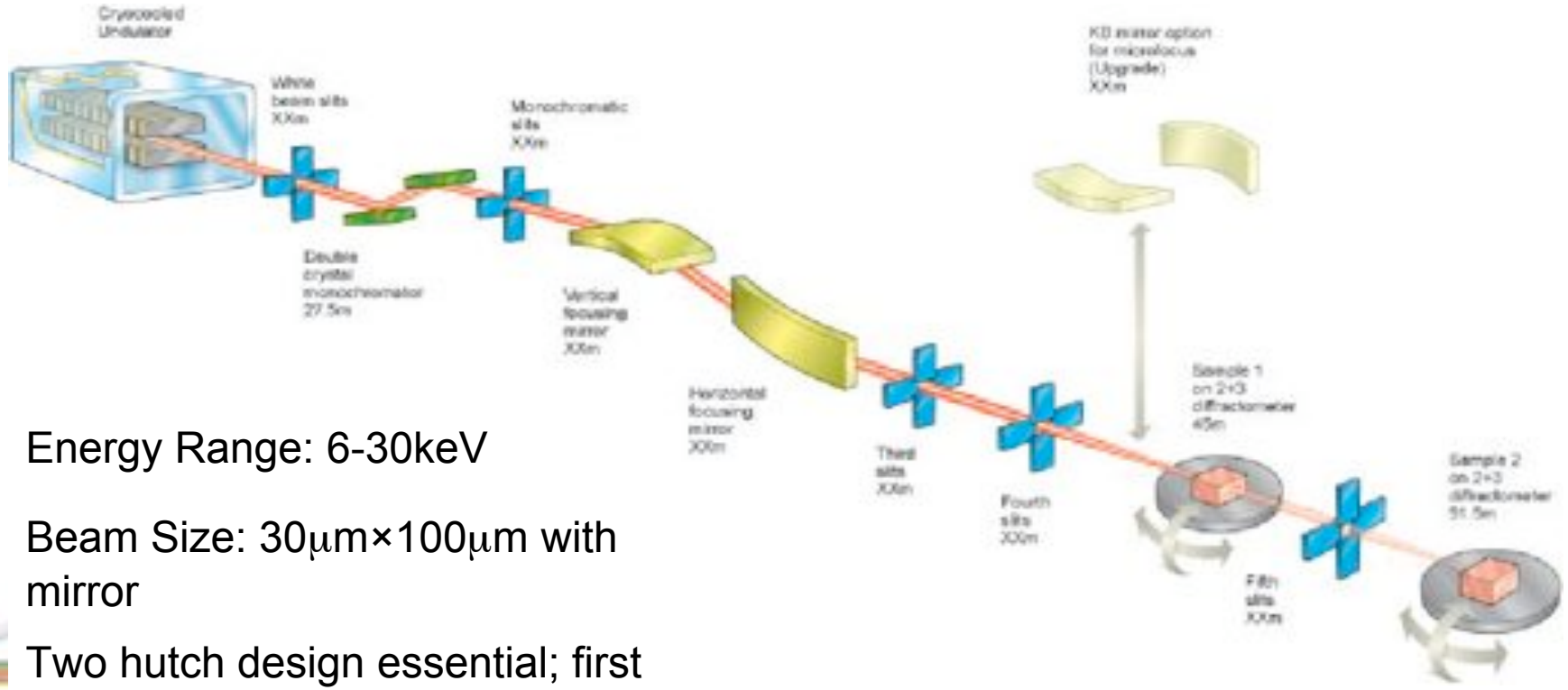
I18

Design features:
Beam is horizontally focussed (2:1) and vertically collimated by the first (conventional) mirror
Beam size at focus point (Secondary Slits) is virtual source for the KB pair and is used to control beam size
HR by separate mirror pairs
Bimorph KB's.



Had most effort to understand performance. Spot limited to 3mm by vibrations, but recently mirror damaged.

Beamline I07: Surface Diffraction



Energy Range: 6-30keV

Beam Size: 30μm×100μm with mirror

Two hutch design essential; first with fast flexible diffractometer (many sample environments) and second with large heavy duty diffractometer (e.g. UHV *in-situ*).

GISAXS experiments available.

Beamline being built. Mirrors measured in metrology lab and matrix used to correct shape.

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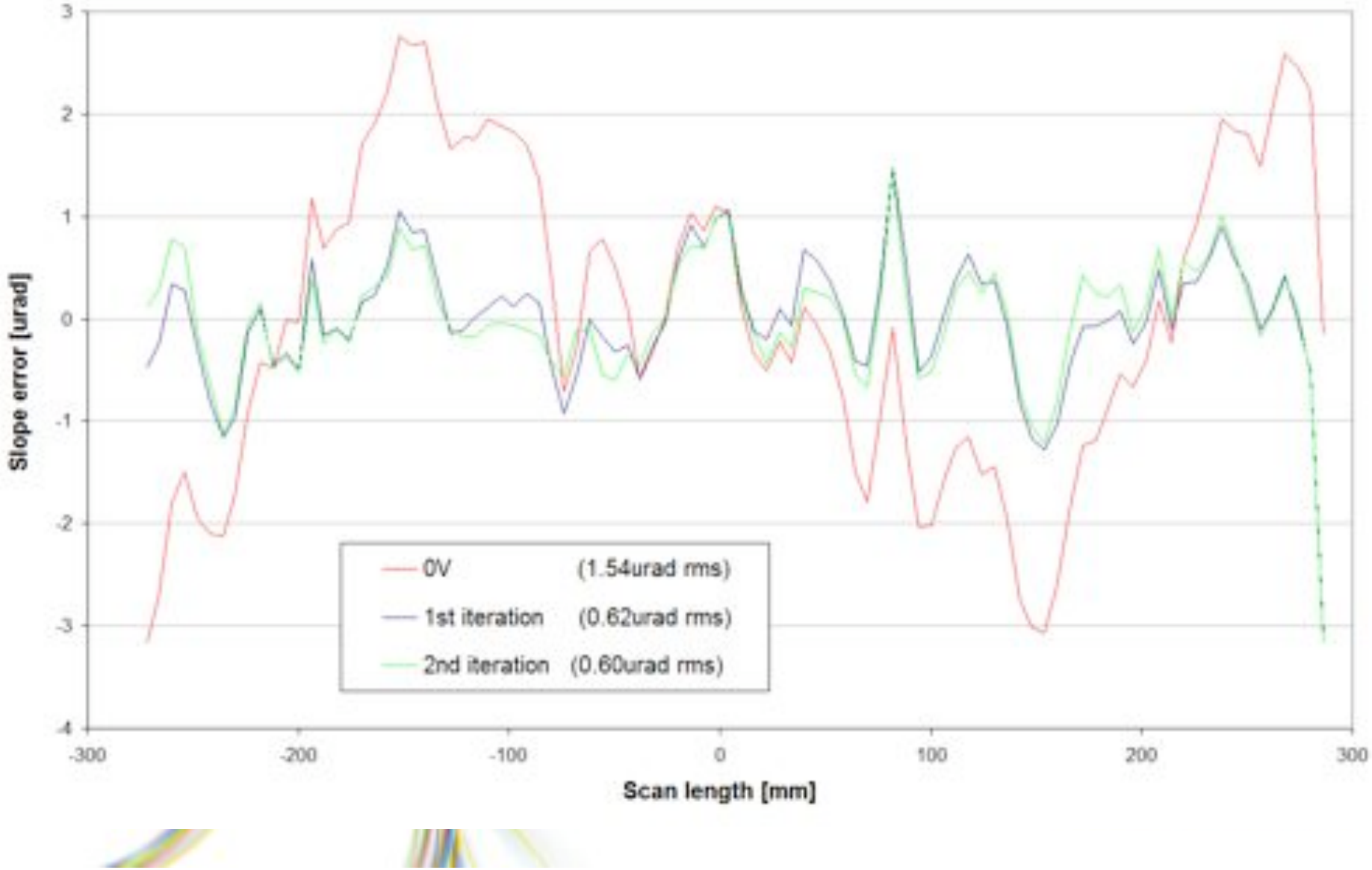
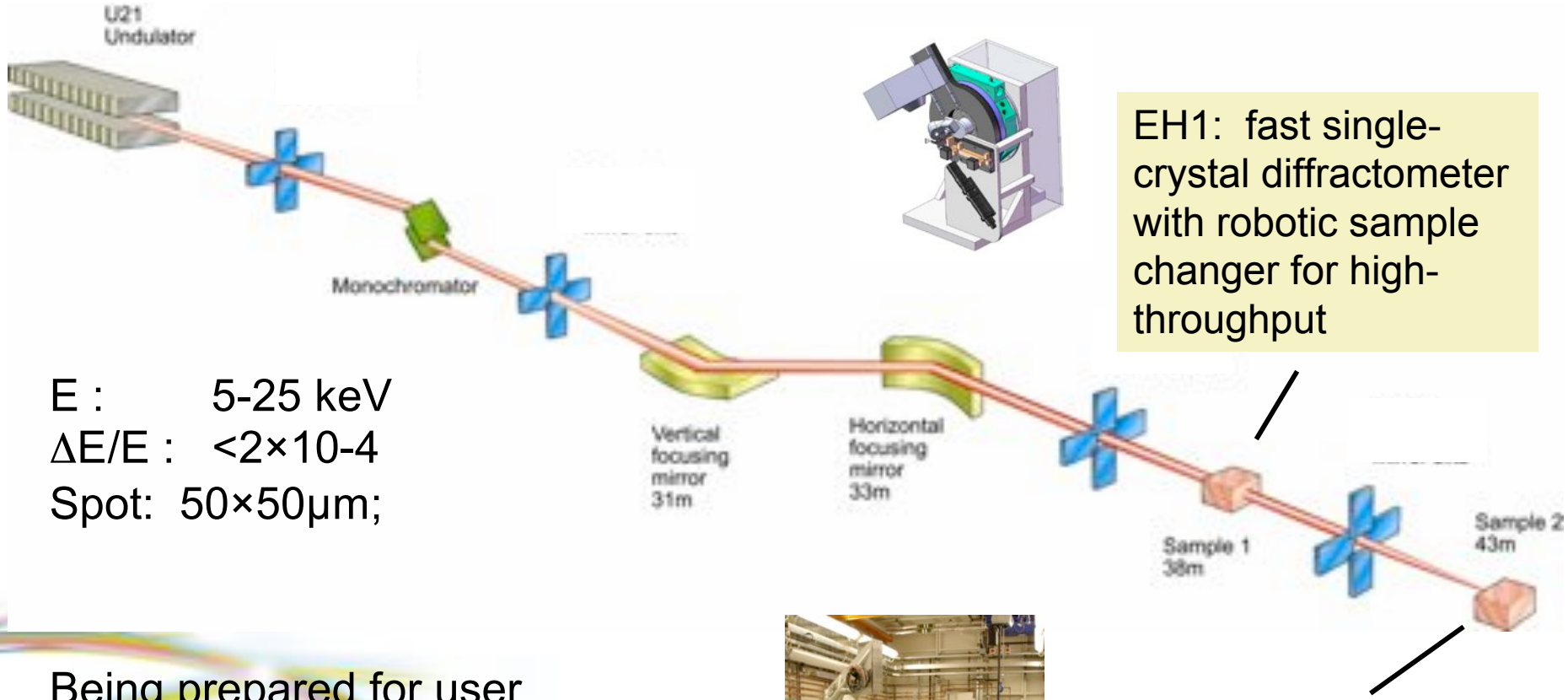
I07 Bimorph slope error



I19: Small Molecule Diffraction



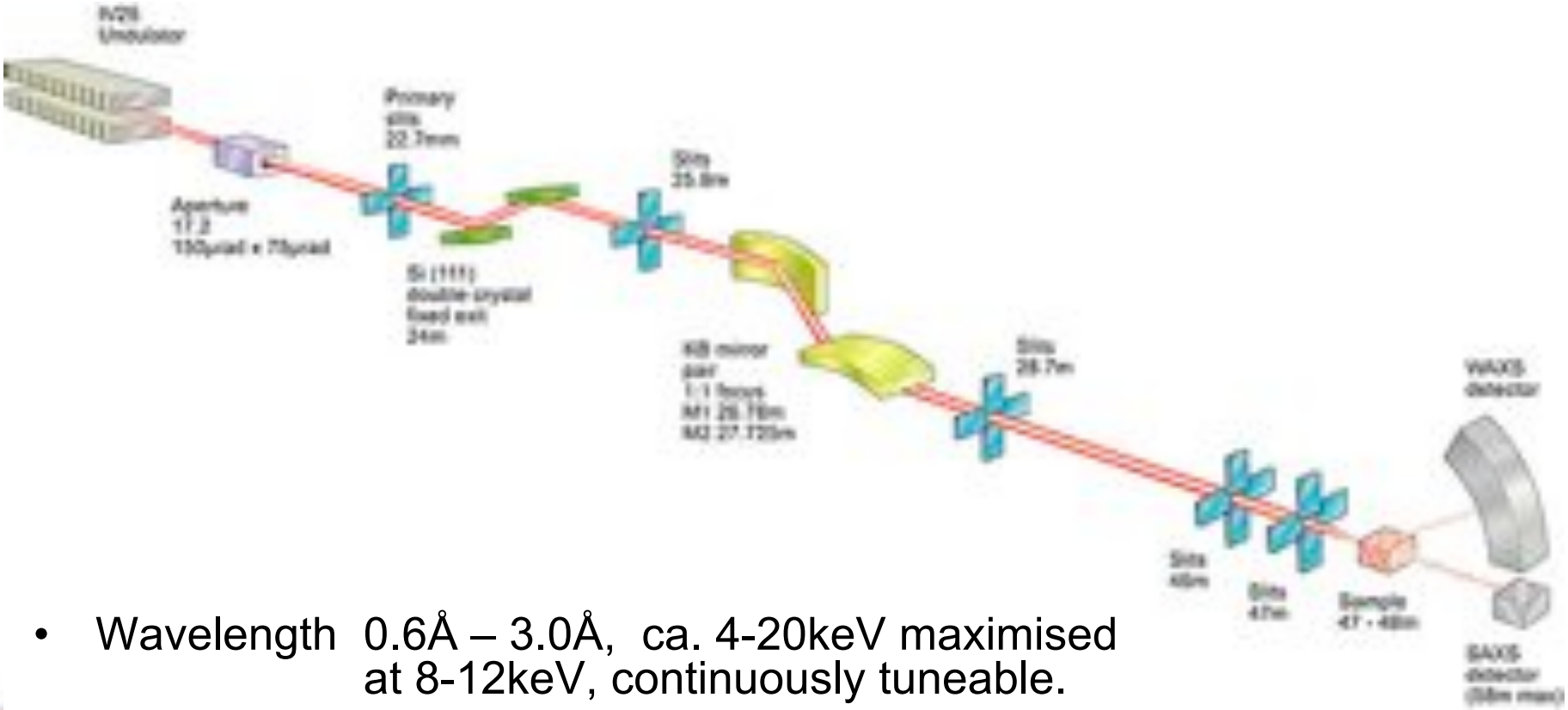
EH1: fast single-crystal diffractometer with robotic sample changer for high-throughput

E : 5-25 keV
ΔE/E : <2×10-4
Spot: 50×50μm;

Being prepared for user operation. The bimorph mirrors are not yet in the beam.

EH2: heavy duty diffractometer for long lead-time experiments and large sample-environment cells.

I22 for SAXS



- Wavelength 0.6Å – 3.0Å, ca. 4-20keV maximised at 8-12keV, continuously tuneable.
- Bandpass 10^{-2}, 10^{-4} selectable
- Beamsize at sample
  100μm (V) – 300μm(H), with standard focussing,
  1μm x 1μm with micro-focussing
- Length scale 10Å - 10000Å (1μm)

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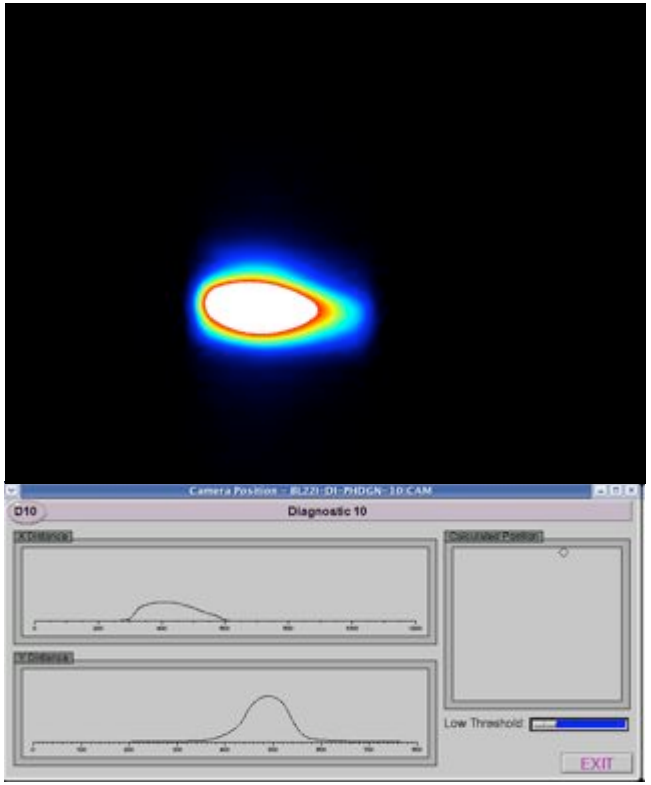
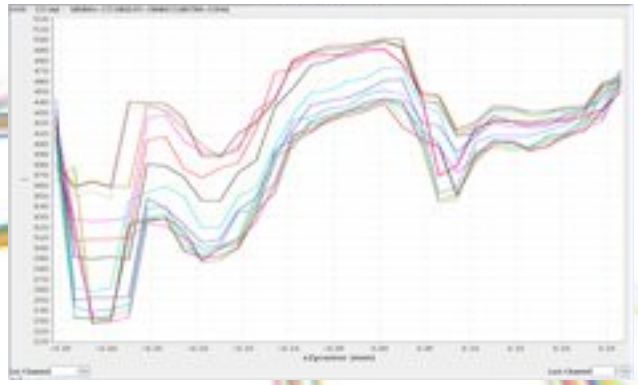
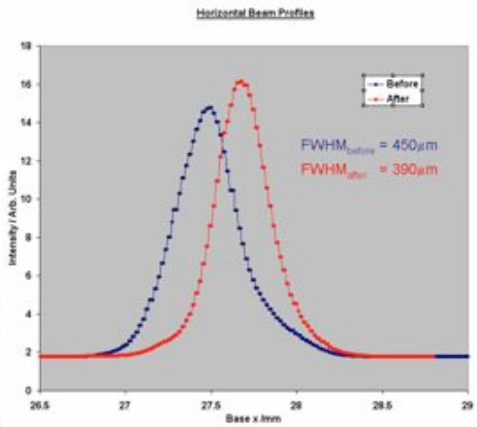
Bimorph Results for I22 – so far!

- Slit scans performed using in-house x-ray camera.
- Centroids of beamlets monitored.
- Results ported to Accel/Elettra software for correction matrix. Best result so far on I22 opposite.
- Problems with random vibrations elsewhere on beamline preventing improvement on this so far.



450μm x 250μm (h x v)





Horizontally currently at 390μm

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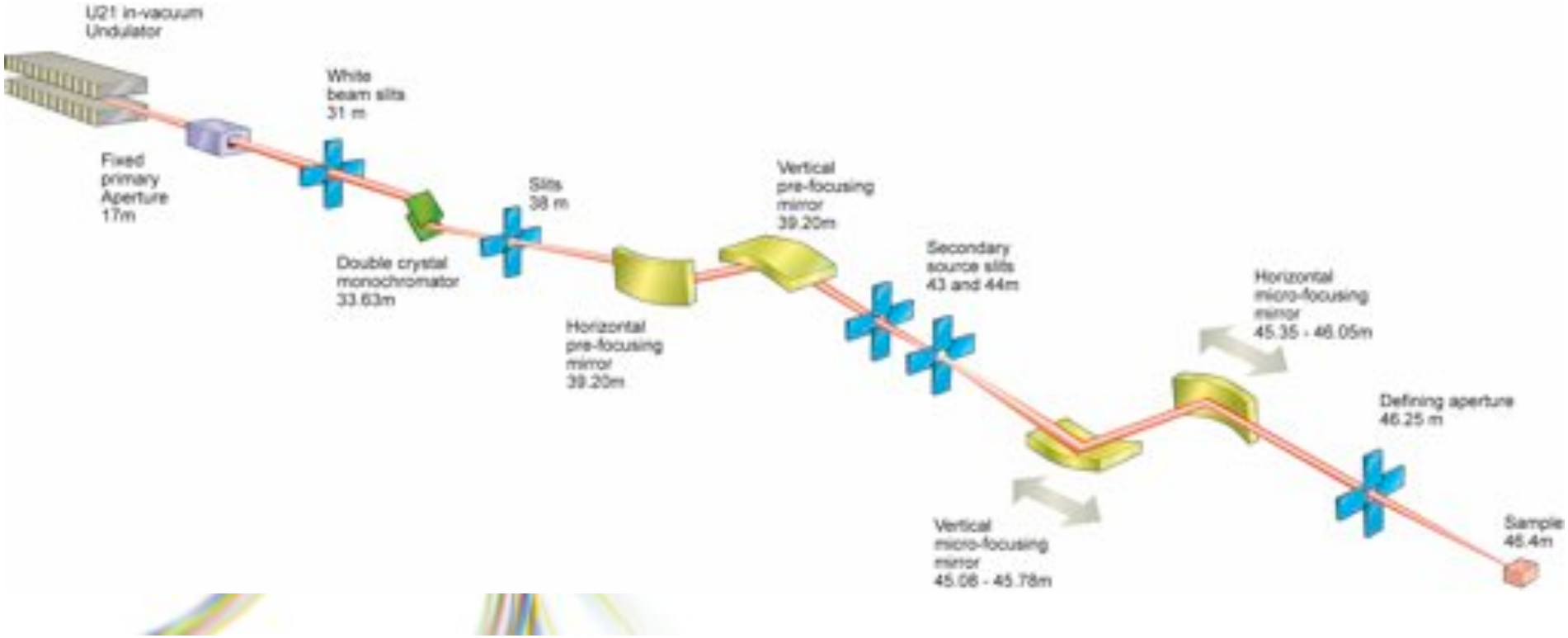
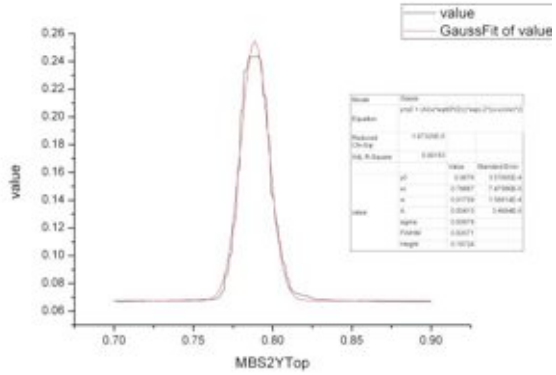
I24 Optical design

- 6.5 – 25keV energy range
- two stage demagnification
  - secondary source and slit at 42.7 – 44.0m from source
  - microfocus mirrors mounted on 700mm in vacuum translation
  - beam sizes of 5 – 50 μm required at sample position

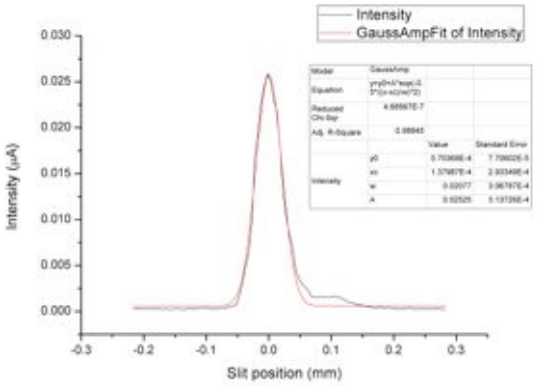


I24 Prefocusing Mirrors

- FMB Oxford
- VPFM –
  - 600mm
  - 32 electrodes paired using 16 power supplies
- HPFM
  - 1050mm
  - 7 electrodes and 7 power supplies
- 20μm × 48μm secondary source focal spot achieved with calculated elliptical bend but no additional corrections
- Very little work done on microfocus mirrors to date but a 20μm by 20μm beam has been achieved.



Vertical pre-focus (FWHM is 20μm)



Horizontal pre-focus (FWHM is 48μm)

Summary and Acknowledgements

NEED TO ENSURE REST OF BEAMLINE (AND SOURCE) STABLE AND OPTIMISED BEFORE CAN REALLY TAKE ADVANTAGE OF BIMORPHS.

Liz Duke I02,I03,I04

Chris Nicklin I07

Paul Quinn, Fred Mosselmans I18

Dave Allan I19

Nick Terrill, Marc Malfois I22

Gwyndaf Evans, Armin Wagner I24