Application of the FOX2D CU INF_12P focusing optics on a white beam synchrotron beamline.

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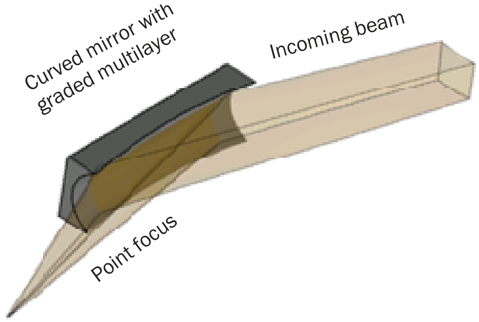
We have tested the FOX2D focussing optics at the energy-dispersive reflectometer (EDR) at BESSY II. The beamline with a source size of v =45μm (vertical) and h =55μm (horizontal) delivers an energy range of about 5keV—20keV.



FOX2D CU INF_12P single reflection optic

A energy spectrum measured in single bunch mode is shown in figure 1. The FOX optics was mounted d=25m downstream the source in vertical deflection direction. The entrance slits were set to 100μm x 100µm. Energy spectra were recorded with a Röntec XFlash energy dispersive detector (Röntec, Germany).
To align the mirror several energy spectra were recorded for different angles of incident as can be seen in figure 1. The angle of incidence leading to a peak intensity at 8.05keV was set to be 1.3°. In order to measure the energy spectra without attenuators, the energy dispersive detector was placed perpendicular to the beam direction, measuring the air scattered signal.

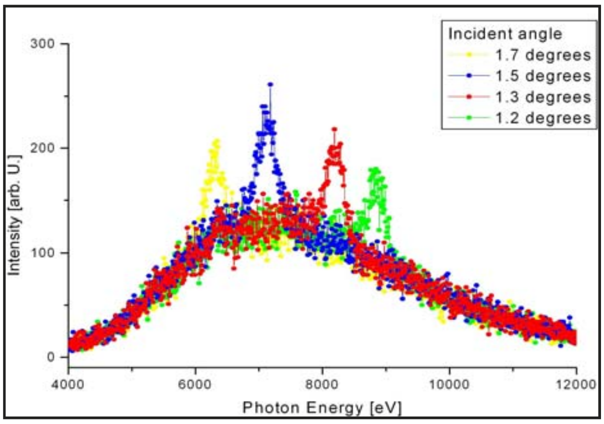


Figure.1: Energy spectrum behind the FOX mirror during alignment for different angles of incidence. The spectra were measured from air scattering 90 degrees with respect to the beam direction. The shown spectra are not corrected for air attenuation and the energy distribution of the bending magnet.

In order to reduce spurious unfocussed transmissions through the mirror and to determine the focal spot size of the mirror, a Pt-Pinhole with 25μm diameter was placed behind the mirror.
The energy dispersive detector was placed slightly off the maximum beam intensity looking upstream and was set to integrate from 7500eV to 9000eV. Using the pinhole as knife-edge the minimal spot size was found at f=120mm from the mirror center.
The scans (see figure 3 on page 2) were analyzed by fitting their derivative with a lorentzian function. The full width at half maximum (FWHM) values of 6.5 μm and 13.8 μm then correspond to the vertical and horizontal dimensions of the focal spot, assuming a pinhole with perfectly shaped edges. This leads to a geometrical gain value of about 110.

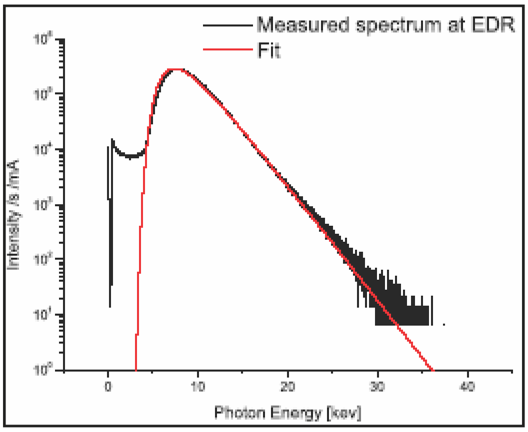


Figure 2: Typical spectrum of the primary beam at EDR measured in single bunch mode. The constant intensity at low energy is due to a detector artifact.

After alignment of the pinhole the energy distribution of the mirror far-field was measured again and is shown in figure 3 on page 2. The detector is again placed slightly off the maximum intensity. With this set up it is possible to determine the spectral content of the beam without harming the detector itself and without the need of any attenuator, which might contaminate the beam (e.g. by fluorescence).

A lorentzian fit to the first harmonic gives a FWHM of 370eV corresponding to a band pass of about $\Delta E/E \approx 4.5\ 10^{-2}$ (see inset in figure 4). After correcting the mirror spectrum for the incoming energy distribution a factor of about 30 in intensity remains between first and second harmonic.

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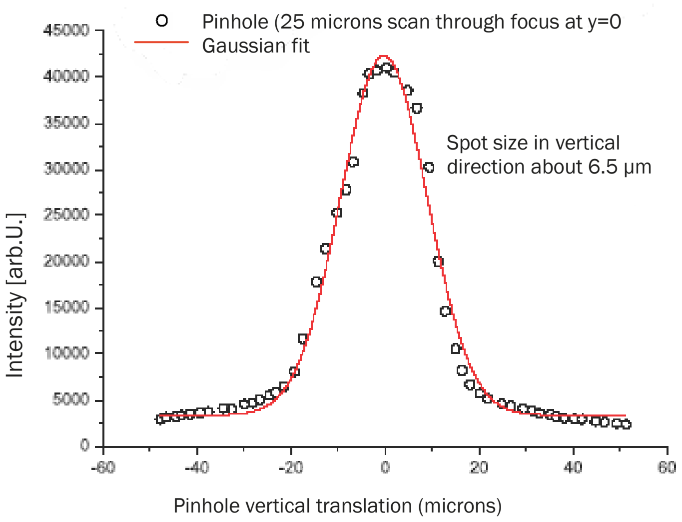


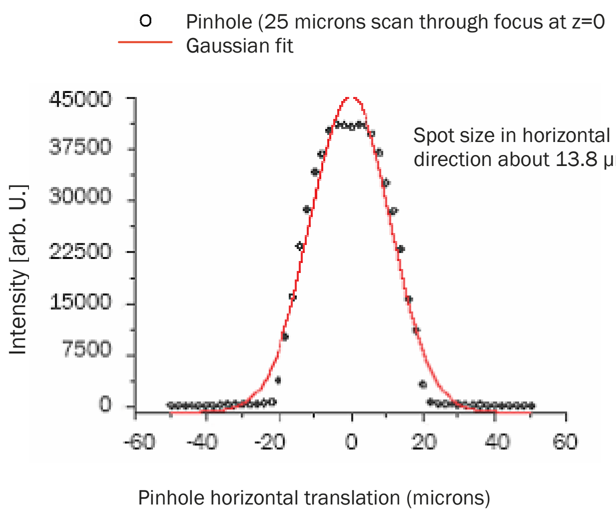
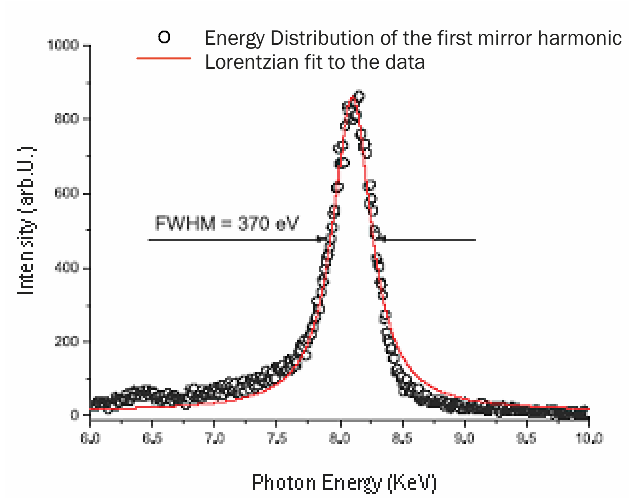


Figure 3
Left: Pinhole scans through the focal spot of the FOX mirror measured 120mm behind optics integrating 7500eV-9000eV in vertical.
A beam size of 6:5µm is determined for the focal spot
Right: Pinhole scans through the focal spot of the FOX mirror measured 120mm behind optics integrating 7500eV-9000eV in horizontal.
A beam size of 13,8µm is determined for the focal spot



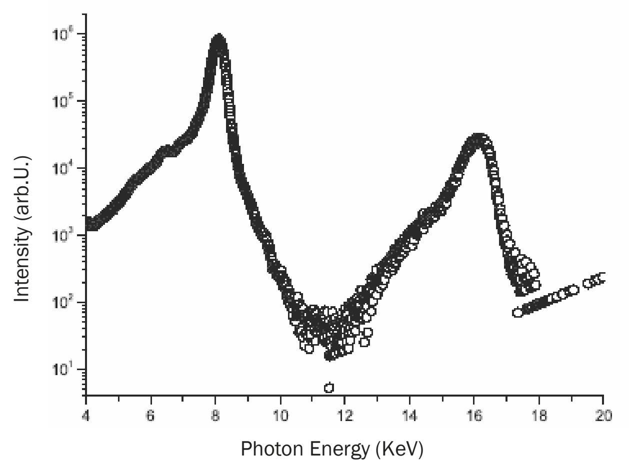


Figure 4:
Left: Energy spectrum behind the FOX mirror after alignment. It shows an energetic width of 370eV (FWHM) corresponding to a band pass of $\Delta E/E \approx 4.5\ 10^{-2}$. The spectrum was measured from air scattering 90 degrees with respect to the beam.
Right: Full spectrum behind the FOX mirror after correction for the incoming energy distribution. The second harmonic is reduced by a factor 30 in intensity with respect to the first.

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