

# PhotonMEADOW 2023

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## Correction of X-ray wavefront errors using adaptable refractive correctors

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Imperfection in X-ray focusing optical elements result in phase errors which when propagated to the focal plane cause broadening of the focused beam profile. A useful concept is the X-ray wavefront which is a surface of constant phase and for ideal focusing this is a spherical surface centred on the focal point. Aberrations in optical elements cause a deviation of the wavefront from this ideal surface and give rise to loss of spatial resolution at the focus.

For 4th generation X-ray sources emitting X-rays with high spatial coherence, the requirement for achieving close to diffraction limited focusing is that the rms wavefront error should be a small fraction of the X-ray wavelength. This implies rms wavefront errors at the picometre level, which is highly demanding, and often this is beyond the limits of fabrication.

X-ray wavefront correction is a developing field in which special optical elements are inserted into the optical path to compensate the X-ray wavefront errors introduced by imperfect optics. I will describe design, fabrication and testing of wavefront correcting optical elements that use the weak refraction of X-rays to advance the X-ray phase with a variation in refractor thickness along one transverse direction giving a position dependent phase correction. Using a pair of refractors, the correction can be made adaptable to dynamically match the optical element allowing compensation for time dependent changes and for an X-ray energy independent correction. A pair of correctors can be used to separately correct the wavelength along two orthogonal directions.

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yes

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