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P1.6: The Influence of Parallax Effects in Thick Silicon Sensors in Coherent Diffraction Imaging

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Structure determination is one of the most important application areas of 4th generation light sources, which in particular can fully exploit the coherent properties and pulsed nature of the X-ray radiation delivered by X-ray free-electron lasers (XFEL) as the European XFEL. The focus of scientific interest in this area is understanding the physical, biological, and chemical properties of samples on the nanometer scale. The properties of the X-rays provided by the FEL enable Coherent X-ray Diffraction Imaging (CXDI), an experimental technique where a sample is irradiated with coherent X-rays and a far-field diffraction pattern is registered with an imaging detector.

In this contribution, we discuss the influence of the parallax effect inherent in a detector with a 500 μm thick silicon sensor with a pixel size of 50 μm x 50 μm on the resolution of a CXDI experiment. To mathematically describe the imaging properties of the detector, we use the generalized concept of the Point Spread Function (PSF), considering its dependence on the photon energy and scattering angle.

The distorted and elongated shape of the PSF at scattering angles > 30° and photon energies > 12 keV significantly reduces the achievable signal-to-noise per pixel at high q. It can become a resolution-limiting factor in CXDI experiments. We further elaborate on the influence of the PSF on the signal-to-noise depending on energy, scattering pattern, and the position resolution of the detector.

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