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X-ray/XUV Coherence Isolated Diffraction Imaging

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Coherent X-ray imaging is widely used to image nanoscale structures with high spatial resolution [1], and more recently to spatiotemporal dynamics [2]. However additional stochastic dynamics or birefringence of the sample lead to secondary scattering terms in diffractive signals. At high intensities in pump-probe experiments it is even possible to generate additional non-linear frequency shifted signals. Due to mutual incoherence of the probe signal and these additional components, these kinds of signals do not appear in the reconstructions of Fourier Transform Holography (FTH) and Coherent Diffraction Imaging (CDI) but can be of great significance to understanding the material properties. Recent efforts have shown the possibility of tracking fluctuations [3] to improve reconstruction or isolate the additional components through multi-wavelength CDI [4–6].

Here we present a framework called Coherence Isolated Diffraction Imaging (CIDI) to address these issues [7]. Leveraging the property of mutual incoherence, CIDI is capable of isolating additional signals from the diffracted probe and reconstructing both components separately from a single dataset. We demonstrate the working principle of CIDI and show the applicability of the method to isolate stochastic dynamics in nanoscale quantum materials, birefringent systems and ultrafast nonlinear processes in the X-ray domain.

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