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High-NA hard X-ray in-line holography with advanced KB optics based on Wolter type-III geometry

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Hard X-ray imaging techniques employing bright-field images, such as bright-field microscopy and in-line holography, offer the benefit of capturing a wide field of view without the need to scan the sample. However, the spatial resolution of these techniques has been limited by the numerical aperture (NA) of hard X-ray optics.

Advanced KB optics based on Wolter type-III geometry is highly efficient and stable, with dramatically higher NA than conventional KB mirrors. This optical system uses multilayer mirrors to increase the NA and employs a Wolter type-III configuration to ensure robustness. By using this technology, the sub-10 nm focusing system at SACLA can attain a high NA of 0.01 and 40% efficiency while maintaining the sub-10 nm focusing for half a day.

Our research aims to develop a phase-contrast imaging technique with high spatial resolution and a wide field of view by combining in-line holography with the Advanced KB optics based on Wolter type-III geometry. To verify the efficacy of this approach, we conducted a proof-of-concept experiment employing the SACLA sub-10 nm focusing system. We used nanoparticles as test samples to evaluate the performance. The reconstructed data from this experiment confirmed a spatial resolution of 100nm. In this presentation, we will discuss findings from the simulation and demonstration experiments, and address the challenges identified for future work.

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no

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