Aberration for good use – a single-shot coherent imaging approach with the aid of a modulator

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Aberration has long been a limiting factor in lens based imaging. Coherent diffraction imaging (CDI) disposes the use of optics to avoid the use of optics entirely. CDI is under active development worldwide, especially in the x-ray imaging community. It has shown great potential of highly sensitive phase imaging at the diffraction-limited resolution. For the investigation of fast dynamics or dose sensitive samples, the ability of imaging from a single measurement is crucial. The current CDI methods using a single measurement are still limited to isolated, small or weak samples.

We have recently developed a snapshot modulation coherent imaging (MCI) technique which solves the issues with current CDIs by introducing a known modulator (see fig. 1) [1]. Fundamentally, the aberration in the modulation function transforms the underling phase problem to a more solvable one. The new phasing algorithm converges rapidly to the correct solution even for strong extended samples. It also exhibits robustness similar to the multiple measurement CDI method [2]. The use of a modulator greatly reduces the dynamic range requirement of detectors. Unlike lens-based imaging, there is no strict requirement on the form of modulators; any deviation due to fabrication is accounted for in the phasing algorithm. The illumination probe function doesn't need to know either.

Results from two x-ray experiments at I13 and cSAXS will be presented, along with some thoughts that aiming to implement the method with a free electron laser (xFEL).

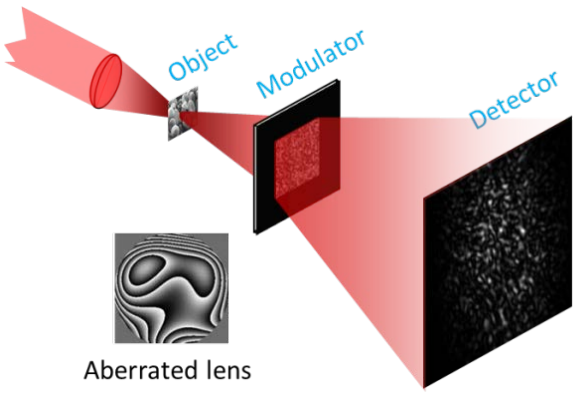

Figure 1. *Schematic of the setup of modulation coherent imaging (MCI) technique. Inset shows the phase of a possible modulator transmission function. The flatten diffraction pattern distribution is due to the strong modulation effect of modulator, which reduce the dynamic range requirement of a detector dramatically.*

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References

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