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The Role of Light Possessing Orbital Angular Momentum in Ptychographic Imaging Experiments

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The use of light beams possessing orbital angular momentum (OAM) is rapidly becoming a way for probing condensed-matter systems, even in the XUV range [1]. The wavefronts of such beams are characterized by an azimuthal angular dependence of the electric field phase, associated with an OAM topological charge $\ell \neq 0$. For imaging purposes, it has been shown that OAM beams can overcome the Rayleigh criterion limit, so enhancing the theoretical resolution with respect to gaussian illumination ($\ell = 0$) [2]. We tested this feature at the DiProI beamline of the FERMI FEL by performing ptychographic experiments with a standard sample [3,4]. As predicted, the ptychographic reconstructions with OAM beams showed a higher image resolution, and the retrieved illumination functions proved to be very sensitive to optical aberrations. This study will potentially provide the basis for new characterization and diagnostic tools, since the extra degree of freedom ℓ can be exploited for tuning the light-matter interaction even during pump-probe experiments.

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Yes

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