Abstract Submitted
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Superpositions of Free Electron Vortices and Measurement of Matter Wave Gouy Phase[1] BENJAMIN MCMORRAN, TYLER HARVEY, JORDAN PIERCE, University of Oregon, MARTIN LINCK[2], National Center for Electron Microscopy, Lawrence Berkeley National Lab — We demonstrate superpositions of free electron matter wave orbital states using nanofabricated diffraction holograms. The orbital superposition is comprised of an electron beam that is a coherent mixture of two overlapped, co-propagating vortex beam modes with different topological charge. Whereas a pure mode electron vortex beam forms an annular spot when projected onto an imaging detector, the superposition has an intensity profile that is broken into azimuthal lobes. The number of lobes is given by the absolute difference in topological charge between the two orbital components. We created superpositions of vortices with various topological charges, from $m_\ell = 0$ to 15. We use these superposition states to measure the Gouy phase measurement for matter waves. We discuss the possibility of using these beams to measure magnetic fields.

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