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Characterization of Electron Orbital Angular Momentum Transfer to Nanoparticle Plasmon Modes TYLER HARVEY, JORDAN CHESS, JORDAN PIERCE, Univ of Oregon, PETER ERCIUS, National Center for Electron Microscopy, Lawrence Berkeley National Laboratory, BENJAMIN MCMORRAN, Univ of Oregon — We observed the decay of an electron vortex beam from a state with orbital angular momentum $m = 1\hbar$ to $m = 0\hbar$ by interaction with gold nanoparticle surface plasmon modes. We produced electron vortex beams with $m = 1\hbar$ orbital angular momentum in a transmission electron microscope at 300 kV. We observed an increase in the intensity of the zero orbital angular momentum component of the beam upon interaction with a gold nanopariticle. By conservation of orbital angular momentum, we see that we transferred orbital angular momentum to the nanoparticle. Because this scattered intensity peaked when the radius of the beam matched the radius of the nanoparticle, and because preliminary electron energy loss spectra show a peak at 2 eV, we speculate that orbital angular momentum was transferred to plasmon modes in the nanoparticle. Several optical studies have induced plasmon vortices using optical vortices and circularly polarized light and suggested their use in nanophotonic and plasmonic devices. Direct observation of angular momentum transfer from electron vortices allows for unique identification of the orbital angular momentum associated with localized plasmon excitations down to the nanometer scale.

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