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Developing a vortex electron beam source for nuclear physics

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Electron vortex beams provides an entirely new and unexplored degree of freedom for use in nuclear and particle physics- namely quantized orbital angular momentum (OAM). For example it may be used to explore the fundamental question of the contribution of of the orbital angular momentum of quarks and gluons to the spin of the proton. Such a source is under development at Jefferson Lab. However, such a source would require a electron scattering based observable to verify that the electrons carry OAM. Recent theoretical calculations predict that there are significant differences in the Mott scattering cross sections for plane wave electrons compared to vortex electrons. If Mott scattering measurement can verify these predictions it would provide a scattering based tool for monitoring vortex electrons. Such a tool would allow us to verify the OAM preserving acceleration of vortex electrons and eventually lead to high electron beams carrying quantized OAM. We will discuss simulations of Mott scattering with vortex electrons and the effort underway at Jefferson Lab to verify the theory predictions for Mott scattering.

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