# Generation of Relativistic Vortex Electrons Using Ultra-Intense Circularly Polarized Lasers

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Relativistic vortex particles possessing intrinsic orbital angular momentum offer new pathways for research in high-energy and nuclear physics. However, generating and detecting these high-energy vortex particles remains a major challenge. In this study, we propose a method to produce high-energy electrons with twisted quantum waveform by colliding relativistic electrons with circularly polarized laser pulses. By utilizing laser-dressed vortex states, we developed the nonlinear vortex Compton scattering QED theory. This theory unveils the transfer of spin angular momentum to the intrinsic orbital angular momentum of final-state particles in multiphoton processes. Our findings indicate that as the radiation reaction becomes significant, vortex state electrons carry more orbital angular momentum, with the central value linearly correlated to the ratio of the emitted gamma photon to the radiating electron. This provides a viable approach to generate high-energy vortex electron beams using existing laser conditions. Furthermore, our theoretical analysis reveals that the radiation spectrum of vortex electrons exhibits multimodal characteristics, enabling clear differentiation from plane wave electrons. These particles could be employed to probe nuclear structures and create exotic states in colliders.