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Spin and Orbital Rotation of Electrons and Photons via Spin-Orbit Interaction[1] CODY LEARY, MICHAEL RAYMER, STEVEN VAN ENK, University of Oregon — We show that when an electron or photon propagates in a cylindrically symmetric waveguide, its spin angular momentum (SAM) and its orbital angular momentum (OAM) interact. Remarkably, we find that the dynamics resulting from this spin- orbit interaction are quantitatively described by a single expression applying to both electrons and photons. This leads to the prediction of several novel rotational effects: the spatial or time evolution of either particle's spin/polarization vector is controlled by its OAM quantum number, or conversely, its spatial wavefunction is controlled by its SAM. We show that the common origin of these effects in electrons and photons is a universal geometric phase. We demonstrate how these phenomena can be used to reversibly transfer entanglement between the SAM and OAM degrees of freedom of two-particle states.

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