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The Kapitza-Dirac effect in the relativistic regime

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The Kapitza-Dirac effect is the diffraction of electrons at a standing wave of light [1]. We solve the relativistic quantum dynamics of this electron diffraction by integrating the Dirac equation numerically and perturbatively in momentum space and demonstrate that spin-flips can be observed in the Kapitza-Dirac effect with three interacting photons [2]. Our recent work shows that significant spin effects may also appear in the well known Kapitza-Dirac effect with two interacting photons [3,4] and we describe the spin dynamics as a rotation of the spin of the diffracted electron [5]. Furthermore, our numerical solution allows us to analyze the in-field quantum dynamics of the diffraction process and to verify a generalized Rabi theory for the description of the Bragg condition of the Kapitza-Dirac effect.

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