Helicity Transfer Associated with Electron g-Factor in Ultraintense Laser Fields

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The development of modern ultraintense laser facilities brings about new possibilities for testing predictions of strong-field quantum electrodynamics (QED) theory. We provide a method for testing QED predictions on radiative corrections [1]. Electron beam longitudinal polarization during the interaction with counterpropagating circularly polarized ultraintense laser pulses is investigated while accounting for the anomalous magnetic moment of the electron. Although it is known that the helicity transfer from the laser photons to the electron beam is suppressed in linear and nonlinear Compton scattering processes, we show that the helicity transfer nevertheless can happen via an intermediate step of the electron radiative transverse polarization, phase matched with the driving field, followed up by spin rotation into the longitudinal direction as induced by the anomalous magnetic moment of the electron. With spin-resolved QED Monte Carlo simulations [2], we demonstrate the consequent helicity transfer from laser photons to the electron beam with a degree up to 10%, along with an electron radial polarization up to 65% after multiple photon emissions in a femtosecond timescale. This signature is robust with respect to the laser and electron parameters and measurable with currently available experimental technology. It could serve for testing QED predictions on radiative corrections.

References

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