Absorption of a twisted photon by an electron in strong magnetic field

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The work investigates the absorption of a twisted photon, which is a photon possessing orbital angular momentum, by a relativistic electron with the Lorentz factor $\gamma \sim 1 - 10$ in a strong magnetic field up to the Schwinger limit, $H_c = 4.4 \cdot 10^{13}$ G. We examine the absorption cross sections and their dependence on the parameters of the incident photon and the initial Landau electron. It is found that total absorption cross sections decrease as angular momentum of the incident photon increases and increase as angular momentum of the initial electron grows. The process is also compared across different magnetic field strengths, and the contribution of various electron spin transitions to total absorption cross section is analyzed. We also find that the processes without an electron spin flip dominate and, on top of that, an asymmetry in the "spin-down" $\rightarrow$ "spin-up" and the "spin-up" $\rightarrow$ "spin-down" transitions is observed. Specifically, the cross sections for the "spin-down" $\rightarrow$ "spin-up" transition are larger, which can be interpreted as an analogy of the Sokolov-Ternov effect present for photon emission [1–3]. Finally, the cross sections are found to be almost constant as the transverse momentum of the photon varies from 0.1 eV to 100 keV. Our findings can help to improve the understanding of the QED processes in critical fields, typical for astrophysical environments, e.g. magnetospheres of neutron stars.

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