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Optical circular polarization induced by axion-like particles in blazars

We propose that the interaction between the axion-like particles (ALPs) and photons can be a possible origin of the optical circular polarization (CP) in blazars. Given that there is no deterministic detection of the optical CP at $\sim 0.1\%$ level, a rough limit on ALP-photon coupling can be obtained, specifically $g_{a\gamma} \cdot B_{\rm T0} < 7.9 \times 10^{-12}\ {\rm G} \cdot {\rm GeV}^{-1}$ for $m_a < 10^{-13}$ eV, depending on the magnetic field configuration of the blazar jet. Obviously, for the blazar models with a larger magnetic field strength, such as hadronic radiation models, this constraint could be more stringent. We also perform a specific analysis for the possible observations of the optical CP in two blazars, namely 3C 66A and OJ 287, and we find that these results could be explained by the ALP-photon mixing with $g_{a\gamma} \sim 10^{-12}\ {\rm GeV}^{-1}$. As an outlook, our analysis can be improved by further researches on the radiation models of blazars and high-precision joint measurements of the optical CP and linear polarization.

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