

Complex τ Electric Dipole Moment from GeV-Scale New Physics

Among the charged leptons, the τ electric dipole moment ($d\tau$) is the least constrained. We show that the $\text{Im}[d\tau]$ imposes strong constraints on new physics that have yet to be discussed. Motivated in particular by the Super Tau-Charm Facility (STCF), which will provide a uniquely clean environment for precision τ -physics, we study the momentum-transfer dependence of $d\tau(q^2)$ and compare the projected sensitivities of STCF and Belle II. Our analysis shows that an axion-like coupling of the τ lepton can induce sizable real and imaginary components of the EDM. The predicted EDM values may approach the present experimental sensitivities, making them accessible to future measurements at Belle II and the STCF.

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