Theoretical Calculations of Cross Section and Asymmetry of Charged Lepton Flavor Violation Using an Effective Field Theory Approach

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Abstract

The Standard Model conserves lepton flavor in the charged leptons, meaning that the scattering $e^+e^- \to \ell_i^+\ell_j^-$ is forbidden, where ℓ_i and ℓ_j are different flavors of leptons. Examples include $e^+e^- \to \tau^+e^-$ and $e^+e^- \to \tau^+\mu^-$. Various Beyond Standard Model (BSM) theories predict charged lepton flavor violation (CLFV), and experimental collaborations are actively searching for CLFV. In this paper, we present theoretical calculations of CLFV cross sections including resonance effects using an effective field theory approach. Three types of Beyond Standard Model (BSM) operators are considered: leptonic operators and radiative operators leading to tree-level CLFV and quark-lepton operators leading to one-loop CLFV. The one-loop diagram was treated in two ways: perturbatively using Feynman Rules and non-perturbatively using dispersion relations. The perturbative calculation serves as a check for the non-perturbative calculation, as the perturbative result should agree with the non-perturbative result in the limit of no resonances. Future colliders such as Belle II and BES III can use our calculations in their searches for charged lepton flavor violation. [a]

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