

# Search for lepton-flavor-violating decays of the Tau lepton at a future muon collider

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Tau leptons can have lepton-flavor-violating (LFV) couplings to a muon or an electron and an Axion-Like Particle (ALP). ALPs are pseudo Nambu-Goldstone bosons associated with the spontaneously broken global  $U(1)_{PQ}$  symmetry. LFV ALPs have been of a great interest in the last several decades as they can solve some of the SM long-lasting problems. Assuming a future muon collider suggested by the Muon Accelerator Program (MAP), we search for LFV decays  $\tau \rightarrow \ell a$  ( $\ell = e, \mu$ ) of one of the tau leptons produced in the muon-anti muon annihilation. The ALP mass  $m_a$  is assumed to be in the range 100 eV to 1 MeV and three different chiral structures are considered for the LFV coupling. Using a multivariate technique and performing a realistic detector simulation, we obtain expected 95% confidence level upper limits on the LFV couplings  $c_{\tau e}$  and  $c_{\tau \mu}$ . Limits are computed assuming the center-of-mass energies of 126, 350 and 1500 GeV which the future muon collider is supposed to operate at. Furthermore, we study the two cases of unpolarized and polarized muon beams independently and show that taking advantage of tau polarization-induced effects in the polarized muon beams case can significantly suppress the main SM background  $\tau \rightarrow e/\mu + \nu\bar{\nu}$  which overwhelms the signal. The obtained results indicate that current experimental limits on the  $c_{\tau e}$  and  $c_{\tau \mu}$  couplings can be improved by roughly one order of magnitude with the help of the present analysis.

## What is your topic?

Physics beyond the Standard Model

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