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Charged lepton flavor violation processes in the extended standard model with operators of dimension six

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The standard model (SM)theory is considered as a low energy approximation of some more fundamental theory. In this theory lepton flavor is conserved. Here we investigate the possibility of charged lepton flavor violation for the decay of $\mu \to e\gamma$ and $\mu \to eee$ in the extended SM, including dimension six.

Summary

The standard model of strong and electroweak interaction is the most successful theory to explain and predict the elementary particles phenomenology. It is only valid up to a certain energy scale of order the mass of W boson. In the SM, the number of leptons of each family (lepton flavor)is conserved. On the other hand, the discovery of flavor violation or neutrino oscillations provides a possible hint of new physics beyond the SM. It is possible to extend the SM while keeping its gauge symmetry, the particle content and the pattern of spontaneously symmetry breaking, by adding new higher dimension operators constructed of SM fields but supressed by heavy mass scale.
The new operators of dimension five violate lepton number and gives Majorana mass to neutrinos. Operators of dimension six violate charged lepton number. We investigated the decay of $\mu \to e\gamma$ and $\mu \to eee$ in the extended SM with general set of operator dimension five and six. We obtained the new vertices and diagrams which contribute to such decays. Then we calculated the decay ratios and compared with experiment.\\
The MEG experiment at Paul Scherrer Institute (PSI)is in operation to search for the decay of $\mu \to e\gamma$ since 2007, with maximal sensitivity down to 10^{-13}. The current searches yields an upper limit on the branching ratio of $Br(\mu \to e\gamma) < 2.4 * 10^{-12}(90\%C.L.)$. For the decay of $\mu^+ \to e^+e^-e^+$ the uppper limit with the SINDRUM is 1.0×10^{-12}.Observation of such decays would be a clear evidence for physics beyond the SM, possibly at scales far from the reach of direct observation like the large hadron collider (LHC).

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