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A Call for New Physics : The Muon Anomalous Magnetic Moment and Lepton Flavor Violation

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Abstract

We review how the muon anomalous magnetic moment $(g-2)$ and the quest for lepton flavor violation are intimately correlated. Indeed the decay $\mu \to e\gamma$ is induced by the same amplitude for different choices of in- and outgoing leptons. In this work, we try to address some intriguing questions such as: *Which hierarchy in the charged lepton sector one should have in order to reconcile possible signals coming simultaneously from* $g-2$ *and lepton flavor violation? What can we learn if the* $g-2$ *anomaly is confirmed by the upcoming flagship experiments at FERMILAB and J-PARC, and no signal is seen in the decay* $\mu \to e\gamma$ *in the foreseeable future? On the other hand, if the* $\mu \to e\gamma$ *decay is seen in the upcoming years, do we need to necessarily observe a signal also in* $g-2$*?*. In this attempt, we generally study the correlation between these observables in a detailed analysis of simplified models. We derive master integrals and fully analytical and exact expressions for both phenomena, and adress other flavor violating signals. We investigate under which conditions the observations can be made compatible and discuss their implications. Lastly, we discuss in this context several extensions of the SM, such as the Minimal Supersymmetric Standard Model, Left-Right symmetric model, $B-L$ model, scotogenic model, two Higgs doublet model, Zee-Babu model, 331 model, and $L_\mu - L_\tau$, dark photon, seesaw models type I, II and III, and also address the interplay with

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