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Lepton flavour violation in muon decays

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Lepton flavour violation is prohibited in the Standard Model of particle physics, thus its observation would clearly spot out the existence of physics beyond it. The muon sector is the most promising in this field. Muon properties, such as lifetime and mass, enable to construct very high intense and low energy μ -beams to be then transported on a target of a dedicated experimental apparatus and measure the emerging decay products. The lepton flavour violating decays under study are $\mu \rightarrow e\gamma$ and $\mu \rightarrow eee$; in addition the μ to e conversion is very promising channel as well. In the intensity frontier physics four experiments are in the commissioning phase aiming at searching for deviations from the Standard Model predictions in the range $10^{-14} \div 10^{-17}$, depending on the process under study, thanks to innovative detector and beam line technologies. Currently two experiments for the measurement of the μ to e transitions are in preparation, Mu2e @FNAL and COMET @J-PARC; the MEG II experiment @Paul Scherrer Institut will measure the $\mu \rightarrow e\gamma$ decay and the Mu3e the $\mu \rightarrow eee$ also @PSI. In the talk I will review possible Standard Model extensions from a phenomenological point of view and how future experiments results are complementary to define the nature of new physics, in case any evidence arises. I will show the technological challenges for any of the searches with focus on the recent progresses of the MEG II and Mu3e experiments at the Paul Scherrer Institut.