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Expected Direct Search Charged Lepton Flavor Violation Sensitivity in μ^+ and π^+ Decays at Rest

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The ability of the Mu2e experiment to probe direct Charged Lepton Flavor Violation (CLFV) μ^+ and π^+ decay modes is estimated. These direct modes complement the Mu2e indirect search for $\mu^- \rightarrow e^-$ conversion accomplished using proposed detector validation runs. The μ^+ validation run operates at 50% magnetic field and reduced beam intensity, to observe the e^+ spectrum from μ^+ decay, at and below the Michel edge $E_e \leq 53$ MeV. The validation is used to correct systematic errors by mapping the theoretical Michel spectrum, known to O(α^2), to the observed spectrum. Simultaneously, searches for two-body CLFV $\mu^+ \rightarrow e^+ + X$ decay, where X is a light new physics particle can be undertaken. In two weeks of data-taking, Mu2e can achieve 90% C.L. branching ratio limits of $BR_{90} = 10^{-7}$ in the mass range 20 ≤ mX ≤ 50 MeV, improving the current experimental limit by two orders of magnitude. In the mass range mX ≤ 20 MeV, if assuming systematic error corrections can be made, it is estimated, using two weeks of data collection, $BR_{90}(m_X = 0) = 3 \times 10^{-7}$, an order of magnitude improvement over the current best limit, for the case of V+A or an isotropic coupling. In addition, a two-week π^+ validation run measuring the e^+ in the decay $\pi^+ \rightarrow e^+ + \nu$, at 76% magnetic field and introduction of a momentum degrader, allows searching for $\pi^+ \rightarrow e^+ + N$ decay, where N is a spin 1/2 particle, in the mass region 20 ≤ m_N ≤ 65 MeV. A branching ratio limit at 90% C.L. of 3×10^{-8} can be achieved, an improvement of the current search sensitivity limit by an order of magnitude.

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