The TREK/E36 experiment at J-PARC

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Abstract

The Standard Model (SM) represents our best description of the subatomic world and has been very successful in explaining how elementary particles interact under the influence of the fundamental forces. Despite its far reaching success in describing the building blocks of matter, the SM is still incomplete; falling short to explain dark matter, baryogenesis, neutrino masses and much more. The E36 experiment conducted at J-PARC in Japan aims to test lepton universality in the $R_K = \Gamma(K_{e2})/\Gamma(K_{\mu 2})$ ratio. In the SM, the ratio of leptonic K^+ decays is highly precise with an uncertainty of $\triangle R_K/R_K = 4 \cdot 10^{-4}$. Any observed deviation from the SM prediction would break the universality of the lepton couplings and provide a clear indication of New Physics (NP) beyond the SM. Furthermore, the E36 detector apparatus allows sensitivity to search for light $U(1)$ gauge bosons, which could be associated with dark matter or explain established muon-related anomalies such as the muon $g-2$ value, and perhaps the proton radius puzzle. A realistic simulation study is needed for these rare searches and as such verification of the Geant4/ROOT based simulation will be presented along with preliminary results.

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