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New Physics Search with Experiment TREK/E36 at J-PARC

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We are potentially standing at the precipice in the quest for discovery of New Physics (NP) beyond the Standard Model (SM) by performing a precision test of lepton universality. Experiment E36 conducted at J-PARC in Japan is testing lepton universality in the $R_K = \Gamma(K\ell^2)/\Gamma(K\mu^2)$ ratio. In the SM, the ratio of leptonic K^+ decays is highly precise with an uncertainty of $\delta R_K / R_K = 4 \cdot 10^{-4}$. Any observed deviation from the SM prediction would break the universality of the lepton couplings and provide a clear indication of NP beyond the SM. The E36 detector apparatus allows sensitivity to search for sterile neutrinos and light $U(1)$ gauge bosons below $300 \text{ MeV}/c^2$, 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. E36 data taking was completed in 2015. A scintillating fiber target was used to stop a beam of up to 1.2 Million K^+ per spill. The K^+ decay products were detected with a large-acceptance toroidal spectrometer capable of tracking charged particles with high resolution, combined with a CsI(Tl) photon calorimeter with large solid angle covering about 75% of 4π and particle identification systems. The status of the data analysis will be presented. This work has been supported by DOE Early Career Award DE-SC0003884 and DOE DE-SC0013941.

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