

# The TREK Project

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The Time Reversal Experiment with Kaons (TREK) is a kaon decay program at J-PARC in Japan [1, 2]. The program consists of two experiments, TREK/E36 and TREK/E06, which aim to search for physics beyond the Standard Model in various ways. The main goal of E36 is to measure the  $K_{e2}/K_{\mu2}$  ratio of decay widths to test the flavor universality of the lepton couplings to a level of 0.25-0.50% uncertainty. The experiment uses a beam of  $K^+$  stopped in an active target array of scintillating fibers. The setup allows for charged particle momentum and angle measurements, along with large-acceptance neutral particle detection and redundant particle identification systems. This allows to simultaneously search for heavy sterile neutrinos and new light neutral bosons or hidden photons in the mass region up to a few hundred  $\text{MeV}/c^2$ . As such E36 is complementary to other dedicated dark-photon searches in meson decays or fixed target experiments. In particular, a light boson with selective coupling to muons, as suggested for a solution of the proton charge radius puzzle, would be detectable in radiative leptonic kaon decays  $K^+ \rightarrow \mu^+ \nu A' \rightarrow \mu^+ \nu e^+ e^-$ . Other search channels are  $K^+ \rightarrow \pi^+ A'$  and  $\pi^0 \rightarrow \gamma A'$  with  $A' \rightarrow e^+ e^-$ . TREK/E36 has completed data taking in 2015 after being installed and commissioned from late 2014. The analysis is now at full swing. In a later phase upon realization of the Hadron Hall extension at J-PARC, experiment TREK/E06 is planned to be realized as the ultimate goal of TREK, i.e. to search for T-violation in the transverse muon polarization of  $K_{\mu3}$  decays, as a new source of CP violation beyond the SM. This work has been supported by DOE ECA DE-SC0003884 and DE-SC0013941.

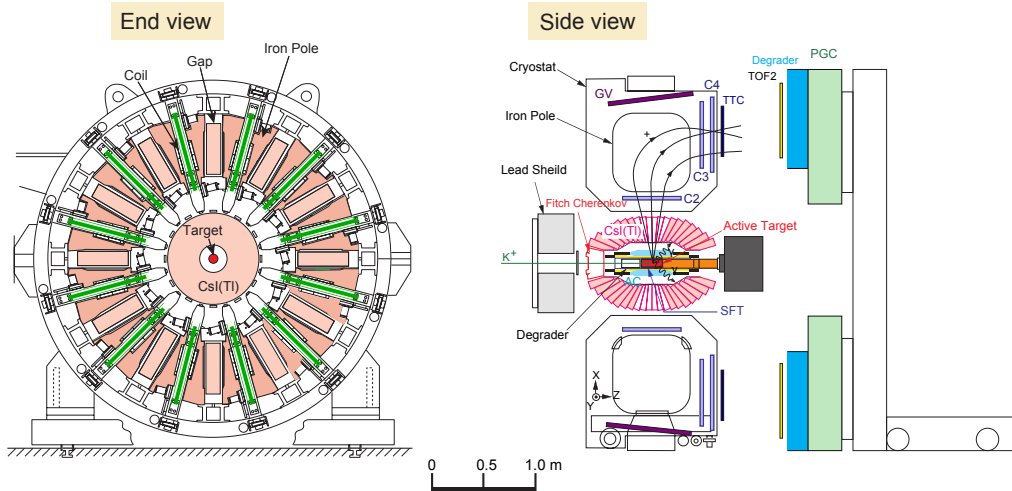


Figure 1: Schematic end and side views of the TREK/E36 setup.

[1] <http://trek.kek.jp>

[2] M. Kohl (for the TREK Collaboration), Proc. Int. Workshop on Physics with Neutral Kaon Beam at JLab (KL2016), February 1-3, 2016, Newport News, VA, USA, [arXiv:1604.02141](https://arxiv.org/abs/1604.02141)