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Development of a Muon Polarimeter for the T-violation Search Experiment at J-PARC

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TREK is a precision-frontier experiment, planned at J-PARC (Tokai, Japan), for a T-violation search in Kaon decays into the $\pi^0 \mu^+ \nu$ final state. The signature is a non-zero transverse polarization (P_T) of muons in the direction perpendicular to the decay plane. Using the same process the E246 experiment at KEK has set an upper limit on $|P_T| < 0.0050$ at the 90% confidence level. TREK is an upgrade of E246 with the goal of achieving more than a factor of 20 higher sensitivity using high intensity Kaon beam from J-PARC and the detector with major upgrades that include a new GEM tracker, new photon device for the CsI(Tl) calorimeter and a new magnet system providing uniform field. The most important element of TREK is the new muon polarimeter of novel design, incorporating an active muon stopper instrumented by an array of drift tubes for tracking. This design allows the tracks of muons and positrons to be reconstructed, providing a large acceptance for positrons with higher analyzing power, background suppression, and handles for controlling systematic uncertainties such as those arising from uncertainty on the decay position and its distribution. We present an overview of the TREK experiment and detail of the muon polarimeter R&D with results of studies using Monte Carlo simulation and beam tests of the full size prototype.

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