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A New Track Trigger for Characterizing the Antiproton-Induced Background in the Mu2e Experiment

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The Mu2e experiment at Fermilab will enable the search for the neutrinoless muon to electron conversion in the field of an Al nucleus, a charged lepton flavor violating process. If observed, there would be a clear indication of physics beyond the Standard Model. Mu2e aims to reach a single event sensitivity of 3×10^{-17}, improving from the previous limit by 4 orders of magnitude. This improvement relies on the development of trigger selection systems, designed to discard data from background-induced events by placing kinematic, topological cuts on a particle's reconstructed track. One of the largest sources of background Mu2e faces is proton-antiproton annihilation. These annihilations produce a 2 GeV shower of particles, among which there could be an electron that mimics the conversion electron signal, with an expected number of 0.010 ± 0.010. The large uncertainty on this number is dominated by the systematic uncertainty associated with the theoretical production model.

To better characterize this background, we have developed an antiproton trigger selection by taking advantage of the track multiplicity and topology of these events. We discuss the steps taken in this development and the first performance study of this trigger, evaluating the signal efficiency and background rate. This trigger is essential to enable a data-driven analysis targeting the reduction of the systematic uncertainty of the antiproton-induced background in the Mu2e experiment.

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