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Calorimeter Clustering Studies for the Mu2e Experiment at Fermilab

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Mu2e (muon-to-electron-conversion), an Intensity Frontier experiment at Fermilab set to begin data taking in 2022, will search for flavor violation in charged leptons with a muon decaying to only an electron without any neutrinos. Protons will be accelerated by the 8GeV proton beam before reaching Mu2e's production target. From there, pions enter an S-shaped Transport Solenoid and travel through a series of absorbers and collimators to select low-energy negatively charged muons from pion decay that will hit the stopping target. Downstream from the stopping target are a curved straw tracker and two annular disk crystal calorimeters. The signal will be a mono-energetic e^- with an energy close to the rest mass of a muon. The Mu2e expected single event sensitivity is $2.87e^{-17}$. The complimentary trigger strategy will take advantage of both online track searches from the tracker and calorimeter reconstruction. The trigger requires a rejection factor greater than 100 and must make its decision within a 3ms time budget. In order to provide high efficiency on signal events, our calorimeter clustering algorithms must be accurate and meet the timing performance.

I will discuss the expected performance of two clustering algorithms: a fast algorithm to be used at the trigger level and a more accurate clustering algorithm to be used in the offline reconstruction. The fast algorithm defines clusters by only selecting crystals adjacent to a high energy crystal seed. The full-blown algorithm can find smaller clusters separated from the main cluster, within a distance and timing window, and combine them into one cluster. We have analyzed the topology of the reconstructed clusters by the two algorithms on events with only a conversion electron and combined signal and background events. The goal of these studies is to improve the performance of the fast algorithm to better reconstruct the cluster energy and work within the strict timing budget.

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