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Search for $\mu^+ \rightarrow e^+e^+e^-$ at the Mu3e experiment and the Commissioning of the Pixel Tracker.

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The Mu3e experiment is dedicated to observing charged lepton flavour violation through the neutrino-less decay of a muon to two positrons and an electron. The experiment is located around the Compact Muon Beam Line (CMBL) at the Paul Scherrer Institut, which produces muons at a rate of 10^8 Hz. The experiment aims to observe the decay or exclude a branching ratio greater than 10^{-16}. To achieve this, there must be $> 10^{17}$ muons stopped in the detector. This detector must have a minimum reconstruction efficiency of 20%. The physical background for this decay is the Standard Model approved decay with neutrinos. Our suppressible background comes from combinatorics. These sources of background must be suppressed to below the 10E-16 level. The first focus of this research is the pixel tracking detector of the experiment and understanding the effect the efficiency has on the physics output of the experiment. Initially, a tracking algorithm was used to measure and analyse the track reconstruction efficiency of the tracking detector. From this, an alternative tracking algorithm was designed to identify inefficiencies in the detector and reconstruct tracks that would otherwise be missed. Mu3e is a high-intensity experiment and thus, a high reconstruction efficiency is critical. By optimising both algorithms under realistic detector conditions, dead or noisy pixel sensors can be identified, and track reconstruction efficiency can be recovered. The results of these algorithms are presented. In addition to work on the efficiency of the pixel detector, a status of the University of Liverpool's contribution to the pixel sensor quality control is provided.

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