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Development of the Trigger system for the Mu2e experiment at Fermilab

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The Mu2e experiment at Fermilab searches for the μ^- conversion in the Coulomb field of an Al nucleus. The kinematics of this process is well-modelled by a two-body decay, resulting in a mono-energetic electron with the recoil of the atomic nucleus and with no neutrinos in the final state. The conversion electron (CE) has the energy of about the muon rest mass (104.967 MeV).

After three years of data taking, Mu2e will reach the sensitivity level of $R_{\mu e} \leq 6 \times 10^{-17}$ (@ 90% C.L.), improving the current limit on μ^- conversion by four orders of magnitude. A very intense pulsed muon beam ($\sim 10^{10} \mu/s$) is stopped on a target inside a very long, curved solenoid where the detector is. The Mu2e detector consists of a 3.2 m long straw-tube tracker and an electromagnetic crystal calorimeter.

The TDAQ (Trigger and Data Acquisition) system provides a continuous data stream from the readout controller boards to the TDAQ farm, which performs the online event reconstruction. The events are then selected based on the decision of dedicated software filters. The bulk of the trigger lines use the tracking information to perform the event selection; these include lines for the CE candidate search and other lines for calibration, background characterization and monitoring. The trigger system needs to deliver a signal efficiency $> 90\%$ and a processing time ≤ 5 -ms/event while providing > 99

The TDAQ group recently installed a large-scale prototype that provides advanced testing capabilities. The prototype consists of 20 detector-transfer-control units in 10 servers. We will present the track reconstruction algorithms and the expected performance of the trigger system, in terms of signal selection efficiency and trigger rate, as well as the expected timing performance obtained with the prototype.

Collaboration

Mu2e TDAQ group

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