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A First Look at the NOvA Far Detector Data Driven Trigger System

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The NOvA experiment is unique in its stream readout and triggering design. The experiment utilizes a sophisticated software triggering system that is able to select portions of the raw data stream to be extracted for storage, in a manner completely asynchronous to the actual readout of the detector. This asynchronous design permits NOvA to tolerate trigger decision latencies ranging from milliseconds to minutes and allows the experiment to reconstruct data in real time to search for phenomena outside of the neutrino beam window. The NOvA data driven trigger (DDT) is a high speed, low overhead, modular system based upon the ARTDAQ analysis framework. It is capable of dynamically managing the execution of complex pattern recognition and physics reconstruction algorithms as well as interfacing seamlessly with the primary DAQ readout chain and the NOvA offline processing and Monte Carlo chains.

The DDT system has been deployed to the NOvA trigger farms for the near and far detector, where it has been used successfully to detect neutrino interactions associated with the NuMI beam, acquire "rare"event topologies for detector calibration, search for supernova neutrino bursts, and perform searches for exotic physics signatures in the NOvA far detector.

The NOvA far detector and DDT system started commissioning in February 2013. This paper presents the overall design of the data driven triggering system and examines the performance of the trigger over the first six months of detector operations. It examines the scaling of the real time analysis system in both the distributed environment of the NOvA data acquisition clusters and in the multi-core environment of the buffer nodes under which the core algorithms run.

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