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Synchronization of a the 14 kTon Neutrino Detector with the Fermilab Beam

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The NOvA detector utilizes not only a high speed streaming readout system which capable of reading out the waveforms of over 368,000 detector cells, but a distributed timing system that is able drive and program the frontend clock systems of each of these readout to allow each hit in the detector to be time stamped with a universal wall clock time. This system is used to perform an absolute synchronization of the time across the entire far detector to a timing resolution of better than 10ns. This fine timing resolution allows for the data taken with the far detector to be precisely correlated with the extraction of beam from the Fermilab Main Injector and allows for precise determination of the time at which the neutrino beam cross the far detector.

The NOvA Timing and Synchronization system began production operations in January 2013 and has been used to drive the front end data acquisition system to synchronize the detector readout with the newly upgrade NuMI (Neutrinos at the Main Injector) neutrino beamline. This paper will cover the performance of the timing system during the first six months of detector operations and will cover the specialized diagnostic system that were put in place to validate and monitor offsets and drifts in the master clocks and GPS system that are used as reference sources for the time transfers between the detector sites.

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