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The Neutron Veto DAQ system for XENONnT experiment

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The aim of the XENONnT upgrade (at the INFN Laboratori Nazionali del Gran Sasso) is to increase the experimental sensitivity to Dark Matter detection by an order of magnitude with respect to the previous XENON1T. This goal can be achieved by means of some important improvements on detector and other systems: a three times larger target mass (~ 8.4 t LXe with respect to 3.2 t in XENON1T) and the enhanced background suppression. The latter relies on an upgraded purification system, a new online cryogenic Radon distillation column and, finally, the development of Neutron Veto (NV) sub-detector to tag the radiogenic neutrons especially those interacting once in the TPC which exactly mimic the WIMP signal.
NV sub-detector is made of an octagonal structure (3 m-high and 4 m-wide) inside the water tank around the cryostat. In order to improve the neutron detection efficiency, the water is loaded with gadolinium. A total of 120 Hamamatsu 8”high-QE PMTs with low-radioactivity windows are placed along the lateral walls to detect the Cherenkov photons.
A new generation Waveform Digitizer boards developed by CAEN are responsible for digitizing the 120 PMT signals. The NV DAQ is designed around a triggerless data collection scheme. The possibility to provide the pulse shape and the time stamp of each PMT signal allows to run without a hardware event trigger. In fact, the event building is completely implemented via software processes running on the online server. This architecture allows to lower the energy threshold and to have for each channel an independent data readout by means of an individual trigger threshold (self-trigger).
This paper describes the implementation and the performance of the NV DAQ system.

Collaboration

XENON Collaboration

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