



Contribution ID: 423

Type: **Poster**

Online Data Processing and monitoring for DarkSide-20k

Liquid Argon (LAr) Time Projection Chambers (TPC)s are promising detectors for dark matter search, due to their response uniformity, scalability to large target masses, and suitability for extremely low background operations. The Darkside-20k (DS-20k) experiment is a new dark matter detector under construction at INFN LNGS that aims to push the sensitivity for Weakly Interacting Massive Particles (WIMP) detection down to the neutrino floor.

DS-20k will employ a triggerless Data Acquisition system (DAQ) that continuously captures signals from SiPMs-based photosensors. The expected interaction rate is about 100 Hz, with a dark count rate of approximately 20 Hz per channel (2720 in total).

The DS-20k Data Acquisition System must be able to identify signals as small as 1 photoelectron with event rates as large as 200 Hz. Signals are digitized by the VME VX2745 CAEN module 16 bit, 125 MS/s ADC). The Waveform Digitizer (WFD) data are read out by a set of Frontend Processors (FEP), which filter signal waveforms and reduce them by identifying hits before passing the data to the Time Slice Processor (TSP).

Live data monitoring is crucial during the detector run phase for ensuring data integrity, identifying anomalies, and optimizing detector performance. This talk will cover the analysis performed using a prototype of the DS-20k monitoring system called “vertical slice” and developed at TRIUMF laboratory. The system consists of 10 machines, and will allow us to stress-test a fraction of the DAQ architecture, to test the digitizers readout, and the same diagnostics tools that will be used for DS-20k.

Additionally, the talk will cover a proposal for an online prompt analysis based on 1s time slices to address peculiar events like S2-only events, multiple scatterings and Supernova neutrino bursts.

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Session Classification: Poster session

Track Classification: Track 2 - Online and real-time computing