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DEAP-3600 Data Acquisition System

DEAP-3600 is a dark matter experiment located at SNOLAB in Ontario, Canada. The DEAP detector uses 3600kg of liquid argon to search for the interactions of Weakly Interacting Massive Particles (WIMPs), a dark matter candidate. Light from the WIMP interactions is imaged using an array of 255 PMTs. A critical challenge for the DEAP experiment is the large background from 39Argon beta decays which occur at a rate of 3.6kHz. Beta decays are efficiently eliminated by pulse shape discrimination.

The DEAP Data AcQuisition (DAQ) system has been designed to handle the very large 39Ar event rate without compromising the detection of other interaction occurring at a much lower rate. Key features of the DEAP DAQ include: i) factor of 5 to 10 online 39Ar event rejection using a custom trigger board by analyzing 22 waveforms sampled at 45MS/s in an FPGA housed in a custom board, ii) digitization and pulse processing of the PMT signals using commercial CAEN 250MS/s FADCs iii) Data acquisition software designed using MIDAS DAQ toolkit providing online pulse feature extraction and event filtering capabilities. The full DAQ is capable of providing a factor of 50 to 100 data rate reduction by filtering out beta decays during regular data taking and the capability to handling data rates of 200-300MB/s during calibration runs

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