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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 ^{39}Ar 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 ^{39}Ar 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 ^{39}Ar 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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