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Cold electronics development for the LBNE LArTPC

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The LBNE Project is developing a design for 20 kiloton liquid argon (LAr) time projection chambers to be used as the far detector for the Long Baseline Neutrino Experiment. An essential component of this design is a complete electronic readout system designed to operate in LAr (at 87 K). This system is being implemented in mainstream commercial CMOS technology that will provide low-noise readout of the signals induced on the TPC wires, digitization of those signals at an appropriate sampling frequency (1-2 MS/s), zero-suppression, buffering and output multiplexing to a small number of cryostat feedthroughs. A resolution better than 1000 rms electrons at 200 pF input capacitance for an input range of 300 fC is required, along with low power (<15mW/channel) and operation in LAr with a lifetime greater than 15 years. An analog-only frontend ASIC in 180 nm technology has been successfully completed and fully evaluated, and is available for use in the MicroBooNE LArTPC. A prototype of a novel ADC has been fabricated and is being tested. All circuits have been designed using rules to ensure a long lifetime at cryogenic temperatures. The results demonstrate that CMOS transistors have lower noise and much improved DC characteristics at LAr temperature. We will describe the progress to date and plans for the remaining development.

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