Research and Development for the Liquid Argon Time Projection Chamber

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ABSTRACT

When cosmic rays interact with Earth's atmosphere, particles, most of which are pions, are emitted which decay into muons. These can be detected on the surface with scintillation counters attached to photomultiplier tubes. Eighteen different plastic scintillation counters will be used for this purpose for use in the Liquid Argon Purity Demonstrator (LAPD). In Phase I of the LAPD, it was shown that required purity of the liquid argon can be obtained without first evacuating the vessel. In Phase II, this purity will be used to measure cosmic rays. Phase II consists of the "Long-Bo" Time Projection Chamber. The time projection chamber is 2 m tall and 30 cm in diameter. A voltage of 100 000 V is applied to cause electrons excited by the cosmic ray muons to drift up to a wire array. Scintillation counters will be placed on the outside of the tank to directly measure the muons before and after they pass through the liquid argon. When the scintillation counters were tested, it was seen that the scintillation counters have efficiency consistent with 100%, but can appear to have lower efficiencies due to air showers. Primary operating voltage was determined based on peak performance. A system for mounting the scintillators was designed, fabricated, and installed. The counters are arranged in groups of three every 60° around the tank. Additionally, resistive temperature devices were tested at temperatures ranging from -160 to 70 °C, and it was seen that the resistance changes at about 0.4 ohms per degree Celsius. These will be used in the LAPD to determine and monitor temperature gradients. Finally, a model time projection chamber was fabricated with which to model insertion of the real unit. Liquid argon represents the future of neutrino experiments and the intensity frontier, and work on the LAPD will show that this is a viable option for continuing experiments.