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C1Po2C-01 [14]: Recovery of Ultra-High Purity Liquid Argon Systems after Disruption of Filtration

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The principal design requirement of cryogenic systems used for liquid argon neutrino detectors is ultra-high purity. The primary impurities that affect operation of the detector are electronegative types such as oxygen and water, or light quenching varieties such as nitrogen. It is the electronegative property of oxygen and water that causes reduced rates in the detection of neutrino interactions with the argon atoms. Fermilab designs and installs systems that include filtration equipment that facilitates passive removal of both oxygen and water. Nitrogen reduces the efficiency of the light collection system; however, no method for removing nitrogen is being utilized currently. Instead, it is expected that the argon from the supplier is below the purity threshold set by the detector operational requirements.

The longest-running liquid argon detector experiment at Fermilab, MicroBooNE, has been in operation since mid-2015. There is substantial interest in monitoring the rate at which the purity decreases during a disruption in the operation of the filtration equipment relative to the rate at which purity is recovered. It has been observed that in the event of a disruption, purity will rapidly reach a level below that which is needed for detector operation but will subsequently require a longer period to recover. This system behavior is significant due to the loss of neutrino interactions while the liquid argon is purified to the level required for the detector. Therefore, this analysis seeks to develop an improved understanding of this behavior to lend insight into future designs and operation of these cryogenic systems.

Primary authors: ZUCKERBROT, Mike (FNAL); FRITZ, Schwartz (FNAL)

Presenters: ZUCKERBROT, Mike (FNAL); FRITZ, Schwartz (FNAL)

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