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Innovative media for the purification of liquid argon from nitrogen contaminations

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Liquid argon (Large) is used as active media in several neutrino and dark matter experiments (DUNE, SBND, Microboone, Icarus, DarkSide, DEAP, ...). Ionization particles in liquid argon produce free charges and scintillation photons. Both signals are used to perform calorimetric measurements, particle identification and three dimensional reconstruction. LAr scintillation light can be quenched and absorbed by the presence of nitrogen contaminations. In neutrino detectors electronegative contaminants, like oxygen and water, are continuously filtered, while nitrogen is not. This can lead to a reduction of the scintillation signal in case of air leaks in the detector. Dark matter experiments typically filter nitrogen in gas phase at room temperature.
A new innovative media for the purification of argon from nitrogen in liquid phase will be presented.
The innovative molecular sieve is the zeolites Li-FAU. Purification tests have been performed using the Liquid Argon (LAr) Purification Cryostat (PuLArC) at IFGW/Unicamp. Previous studies performed with nitrogen gas at T=89 K, revealed a strong interaction of nitrogen with the lithium cations present in the zeolite LiX. The tests performed in PuLArC have unequivocally shown that the Li-FAU adsorbent is capable of capturing N2 recirculating argon in liquid phase. The Li-FAU was able to reduce a N2 contamination of 20-50 ppm (part per million) to 0.1-1.0 ppm in 1-2 hours of circulation time. The test was repeated several times. These results invoke further investigations in larger scale LAr cryostats at Fermilab and CERN in order to support the possible use of Li-FAU molecular sieve, in replacement of Molecular Sieve 4A, in LBNF-DUNE and other LAr experiments.

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