Contribution ID: **391** Type: **Poster**

C1Po3C-02: Ensuring High-Purity Liquid Argon for the LBNF FDC: Collaborative Cryogenics Research Between UNICAMP and Fermilab

Monday 19 May 2025 14:00 (2 hours)

The Long-Baseline Neutrino Facility (LBNF) located at the Sanford Underground Research Facility (SURF) in Lead, South Dakota, hosts the Deep Underground Neutrino Experiment (DUNE). This experiment employs cryostats containing nearly 70,000 metric tons of high-purity liquid argon (LAr). Ensuring LAr purity is critical for achieving the required electron lifetime, which directly impacts the experiment's signal-to-noise ratio. The Horizontal Drift (HD) detector demands an electron lifetime exceeding 3 ms within its 3.5 m drift, equivalent to less than 100 parts-per-trillion (ppt) Oxygen contamination, while the Vertical Drift (VD) detector requires over 6 ms electron lifetime within its 6.0 m drift, corresponding to less than 50 ppt Oxygen contamination. To mitigate Nitrogen (N2) quenching of scintillation light, N2 contamination must remain below 1 ppm, as higher levels can result in up to a 20 % loss of light.

The Brazil State University of Campinas (UNICAMP) significantly contributes to LBNF FDC through the development of argon purification and regeneration systems for HD and VD cryostats.

UNICAMP designed and constructed the Purification Liquid Argon Cryostat (PuLArC), a small-scale test facility holding approximately 90 liters of LAr. Tests using PuLArC demonstrated that 1 kg of Li-FAU zeolite could reduce N_2 contamination from 20-50 ppm to 0.1-1.0 ppm within 1-2 hours. Tests at Fermilab's Iceberg cryostat (2,625 liters) confirmed scalability, with 3 kg of Li-FAU reducing N_2 contamination from ˜5 ppm to <1 ppm over 96 hours without active circulation.

This presentation will detail the research methods, test setups, and results, showcasing the potential of Li-FAU as an alternative to Molecular Sieve 4A for large-scale LAr systems. This advancement enhances DUNE's precision and demonstrates the impact of international collaboration on cryogenic research.

Author: DOUBNIK, Roza (Fermilab)

Co-authors: HAHN, Alan (Fermi National Accelerator Laboratory, PO Box 500, Batavia IL 60510, United States); B. MACHADO, Ana Amelia ("Gleb Wataghin"Institute of Physics, UNICAMP, Campinas-SP, 13083-859, Brazil.); ADRIANO, Cris ("Gleb Wataghin"Institute of Physics, UNICAMP, Campinas-SP, 13083-859, Brazil.); CORREIA, Daniel ("Gleb Wataghin"Institute of Physics, UNICAMP, Campinas-SP, 13083-859, Brazil.); MONTANARI, David (Fermi National Accelerator Laboratory, PO Box 500, Batavia IL 60510, United States); CARDOSO, Dilson (CPqMAE - The Research Center on Advanced Materials and Energy, Federal University of São Carlos (UFSCar), São Carlos, 13565-905, Brazil.); NORILER, Dirceu (School of Chemical Engineering, UNICAMP, Campinas-SP, 13083-859, Brazil.); M. ASSAF, Elisabete (São Carlos Institute of Chemistry at the University of São Paulo, 13566-590, São Carlos, SP, Brazil.); SEGRETO, Ettore ("Gleb Wataghin"Institute of Physics, UNICAMP, Campinas-SP, 13083-859, Brazil.); BLASZCZYK, Flor de Maria (Fermi National Accelerator Laboratory, PO Box 500, Batavia IL 60510, United States); DA MOTTA, Helio (The Brazilian Center for Research in Physics (CBPF), Rio de Janeiro-RJ, 22290-180, Brazil.); ASSAF, Jose Mansur (CPqMAE - The Research Center on Advanced Materials and Energy, Federal University of São Carlos (UFSCar), São Carlos, 13565-905, Brazil.); B. FONTES, Magda (The Brazilian Center for Research in Physics (CBPF), Rio de Janeiro-RJ, 22290-180, Brazil.); ADAMOWSKI, Mark (Fermi National Accelerator Laboratory, PO Box 500, Batavia IL 60510, United States); GIGLIO PAGLIUSO, Pascoal José ("Gleb Wataghin"Institute of Physics, UNICAMP, Campinas-SP, 13083-859, Brazil.); MROWCA, Robert (Fermi National Accelerator Laboratory, PO Box 500, Batavia IL 60510, United States); G. GONÇALVES, Rosembergue

(CPqMAE - The Research Center on Advanced Materials and Energy, Federal University of São Carlos (UFSCar), São Carlos, 13565-905, Brazil.); P.M. ALEGRE, Thiago ("Gleb Wataghin"Institute of Physics, UNICAMP, Campinas-SP, 13083-859, Brazil.); WEST, Zack (Fermi National Accelerator Laboratory, PO Box 500, Batavia IL 60510, United States)

Presenter: DOUBNIK, Roza (Fermilab)

Session Classification: C1Po3C - Liquid Air, CO2, Ar Liquefaction and Storage