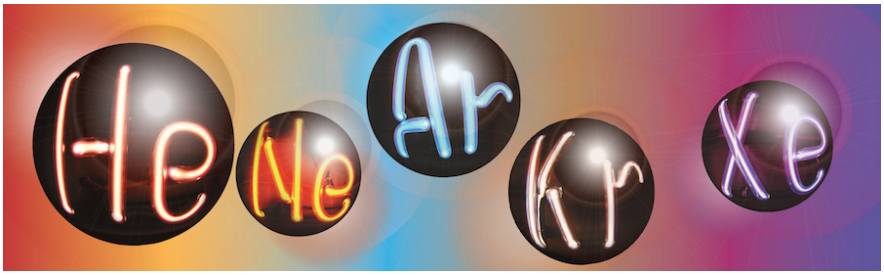

Contribution ID: **44** Type: **Talk**

Development of Poly(ethylene naphthalate) Components for Next-Generation Liquid Noble Gas Detectors

Liquid noble gas detectors for neutrino and rare-event searches rely on efficient detection of vacuum-ultraviolet (VUV) scintillation light while minimizing radioactive backgrounds from nearby materials. To improve the detection of VUV photons, wavelength shifters are required to convert scintillation light into the visible range. At the scale of next-generation experiments such as DUNE, DarkSide-20k, and LEGEND-1000, replacing components with optically active materials that contribute directly to light conversion or scintillation becomes necessary. Among these, poly(ethylene naphthalate) (PEN) is a particularly promising candidate due to its intrinsic wavelength-shifting and scintillation properties, mechanical robustness, and long-term stability at cryogenic temperatures such as liquid argon.

In addition to components injection-molded from commercial PEN granulate, successfully implemented in LEGEND-200, custom-synthesized PEN offers a route to improved material performance for next-generation detectors. We report on the latest efforts to synthesize PEN using pre-purified reagents.

Further, commercial PEN thin films are explored for their use in low-background environments. We present the achieved levels of radio-impurities and optical performance after extensive cleaning. Finally, new developments in 3D printing of optically active components using PEN filament and their potential for on-demand part production are presented.

This work is supported by the U.S. DOE, and the NSF, the LANL, ORNL and LBNL LDRD programs; the European ERC and Horizon programs; the German DFG, BMBF, and MPG; the Italian INFN; the Polish NCN and MNiSW; the Czech MEYS; the Slovak RDA; the Swiss SNF; the UK STFC; the Canadian NSERC and CFI; the LNGS and SURF facilities.

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