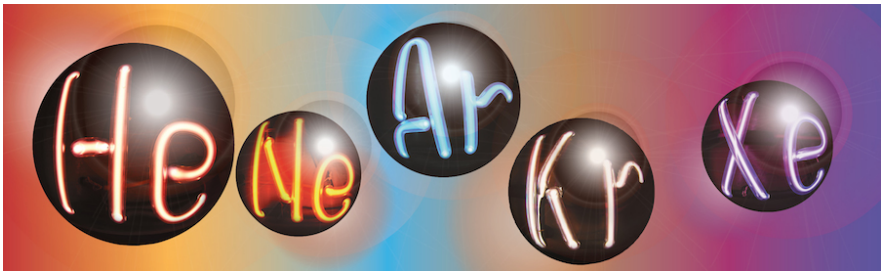

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X-ARAPUCA PDE FOR DUNE FD-VD

Tuesday 27 August 2024 15:20 (20 minutes)

DUNE is a long-baseline (1300 km) neutrino experiment hosted at FNAL aimed at measuring neutrino mass ordering and CP violation by observing neutrino oscillations. DUNE will deploy four Liquid-Argon Time-Projection-Chamber (LArTPC) detectors with a combined mass of approximately 70 kT. The reconstruction of particle interactions, both from the beam and other sources, is achieved by collecting ionization electrons and scintillation photons (128 nm) with the TPC and the Photon Detection System (PDS). In order to fulfill the physics requirements of the experiment, the PDS needs to efficiently and uniformly collect light across the 62 x 15 x 14 m^3 detector volume, achieving an average yield of at least 20 PE/MeV. For the case of DUNE's 1st far detector module with vertical drift direction (FD-VD), the system relies on 672 (60 x 60 cm^2) X-ARAPUCA (XA) sensors, which trap photons inside a highly reflective box by shifting VUV light to the visible regime. The trapped photons are then guided by a wavelength-shifting bar to a surrounding silicon photomultiplier array for detection. An intensive R&D campaign, involving multiple international institutions, has optimized the design and component selection for the next-generation XA. The XA has been characterized using a dedicated cryogenic setup at CIEMAT, which liquefies gaseous argon inside a vessel containing all necessary components. The design contemplates a set of 6 calibrated reference sensors, 3 light fibers that connect to an external laser, and 3 radioactive 241Am sources strategically connected to the device to independently measure the absolute Photon Detection Efficiency (PDE). Several configurations for FD-VD have been studied, including single and double-sided XAs and pTP-coated substrates.

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