Large-Volume Scintillator Detectors for Nuclear Nonproliferation

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Abstract:

Nuclear fuel cycle monitoring is essential for the mission of nuclear nonproliferation and security. This presentation explores the use of large-volume organic scintillator detectors for detection of Cherenkov and scintillation light for particle physics and the potential of this technology for sources of ionizing radiation. The first approach discussed is the fabrication and characterization of 3D printable organic scintillators with mechanical properties suitable for use as structural components in unmanned vehicle applications. Scintillator compositions were fabricated using cross-linkable polyvinyltoluene, Bi-containing compositions for improved capture cross-section, and dyes exhibiting thermally-activated delayed fluorescence (TADF). The mechanical properties of the scintillators were characterized, showing uniaxial yield strength up to 66 MPa while maintaining high optical transparency. The scintillator's performance for detection of ionizing radiation was benchmarked using a Cs-137 source in comparison to a commercially-available plastic scintillator. The second part of this presentation focuses on the ongoing development of a large volume kton water-based liquid scintillator (WbLS) designed for high-energy physics. The current status of the detector and muon detection capabilities is discussed. Ongoing work to explore application to remote monitoring of nuclear fuel cycles is presented, including time and spectral analysis of signals.