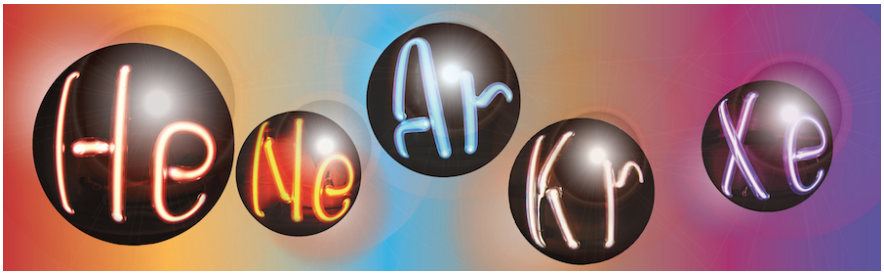

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Investigating Materials and Contaminants as Sources of Delayed Photon and Electron Backgrounds in Liquid Xenon TPCs

Delayed photon and electron signals in dual-phase xenon time projection chambers (TPCs) are a significant source of instrumental background in searches for sub-GeV dark matter candidate particles and solar neutrinos. Possible origins of delayed signals include detector materials, contaminants on detector surfaces, and impurities in the bulk of xenon.

In order to investigate the origins of delayed signals, we perform a series of lab measurements on samples collected from, or representative of, the XENONnT TPC. The composition of particulate samples is studied using elemental composition techniques, including EDX (energy-dispersive X-ray spectroscopy) and LIBS (laser-induced breakdown spectroscopy). In addition, through measurements under VUV excitation in the 120 nm – 190 nm range, we demonstrate the presence of nuisance photoluminescence (PL) emission from detector-relevant materials. We also perform temperature-dependent and time-resolved measurements of nuisance PL. These results are then compared with detector data and TPC behaviour to identify the underlying physical origins of the delayed signals.

Our studies motivate systematic material screening, improved cleaning procedures, and the incorporation of nuisance photoluminescence and photoionization mechanisms into background models for future liquid-xenon TPCs.

Primary author: HURHINA, Anna

Presenter: HURHINA, Anna