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Position-Sensitive Organic Scintillation Detectors for Nuclear Material Accountancy

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Recent years have seen renewed interest in fast organic scintillators with pulse shape properties that enable neutron-gamma discrimination, in part because of the present shortage of He-3, but primarily because of the diagnostic value of timing and pulse height information available from such scintillators. Effort at Oak Ridge National Laboratory (ORNL) associated with fast organic scintillators has concentrated on development of position-sensitive fast-neutron detectors for imaging applications. Two aspects of this effort are of interest. First, the development has revisited the fundamental limitations on pulse-shape measurement imposed by photon counting statistics, properties of the scintillator, and properties of photomultiplier amplification. This idealized limit can then be used to evaluate the performance of the detector combined with data acquisition and analysis such as free-running digitizers with embedded algorithms. Second, the development of position-sensitive detectors has enabled a new generation of fast-neutron imaging instruments and techniques with sufficient resolution to give new capabilities relevant to safeguards. Toward this end, ORNL has built and demonstrated a number of passive and active fast-neutron imagers, including a proof-of-concept passive imager capable of resolving individual fuel pins in an assembly via their neutron emanations. This presentation will describe the performance and construction of position-sensing fast-neutron detectors and present results of imaging measurements.

Country or International Organization

United States of America

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