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Fast Neutron and Gamma Ray Detection with Emerging Organic Scintillators

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The efficient and accurate detection of fast neutrons and gamma rays is essential in many instruments developed for nuclear nonproliferation and safeguards applications. Recent advances in silicon photomultiplier (SiPM) technology and new organic scintillator materials have enabled new capabilities for neutron and gamma ray detection with the potential to improve the current systems used in the field. Areas of application include multiplicity counters for fast neutrons emitted by spontaneous and induced fission of actinides, and imaging systems used for detecting, locating, and characterizing fission sources. Our group has demonstrated pulse shape discrimination (i.e., the ability to distinguish neutron-induced pulses from gamma ray-induced pulses) with stilbene detectors at low neutron energies (a few hundred keV). We also developed arrays of organic fast neutron and gamma ray detectors (up to 40 detectors) operated in time-coincidence. In this work, we show the application of these arrays for multiplicity, imaging, and nuclear fission studies.