Cross-Correlation Measurements with the EJ-299-33 Plastic Scintillator

Abstract:
New organic-plastic scintillation compositions have demonstrated pulse-shape discrimination (PSD) of neutrons and gamma rays. We present cross-correlation measurements of 252Cf and mixed uranium-plutonium oxide (MOX) with the EJ-299-33 plastic scintillator. For comparison, equivalent measurements were performed with an EJ-309 liquid scintillator. Offline, digital PSD was applied to each detector. These measurements show that EJ-299-33 sacrifices a factor of 5 in neutron-neutron efficiency relative to EJ-309, but could still utilize the difference in neutron-neutron efficiency and neutron singles-to-doubles ratio to distinguish 252Cf from MOX. These measurements were modeled with MCNPX-PoliMi, and MPPost was used to convert the detailed collision history into simulated cross-correlation distributions. MCNPX-PoliMi predicted the measured 252Cf cross-correlation distribution for EJ-309 to within 10%. Greater photon uncertainty in the MOX sample led to larger discrepancy in the simulated MOX cross-correlation distribution. The modeled EJ-299-33 plastic also gives reasonable agreement with measured cross-correlation distributions, although the MCNPX-PoliMi model appears to under-predict the neutron detection efficiency.

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Authors:
BOURNE Mark
WALEY Jeff
DOLAN Jennifer
POLACK K
FLASKA M.
CLARKE Shaun D.
TOMANIN Alice
PEERANI Paolo
POZZI Sara

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