

Advanced Plastic Scintillators

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SAND2013-2192C

Goals and Technical Approach:

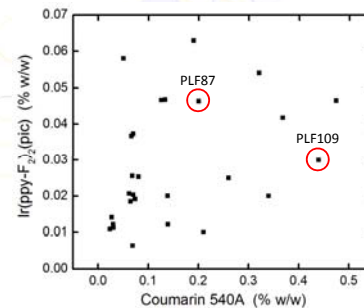
- Develop doped plastic scintillators for fast neutron detection and discrimination
- Employ triplet harvesting heavy-metal dopants
 - Improved luminosity
 - Particle discrimination via Timing (PSD) *and* spectral (SSD) methods
- Control prompt and delayed luminescence characteristics
 - Pulse shapes by design

Key Deliverables:

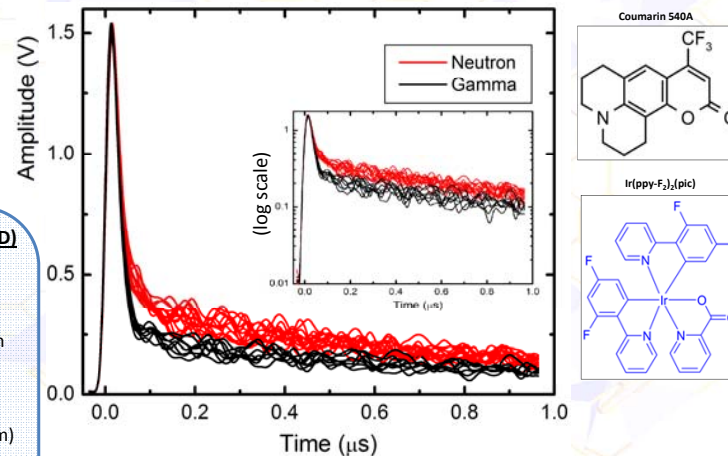
- Demonstrate PSD and SSD in bulk plastic scintillators



Composition Phase Space: Polystyrene Host



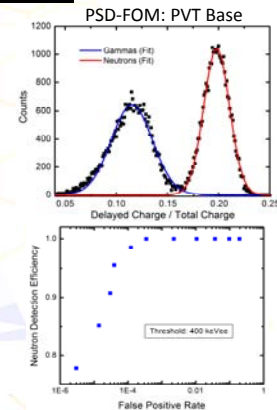
PLF87: AmBe Raw Pulses



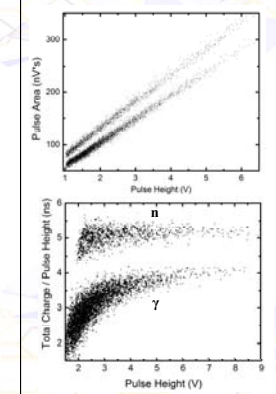
PSD Results

Common Parameters:

- Real-time pulse processing
- Trigger levels set at 100 mV
 - Same threshold value as PHS spectra below
- Hamamatsu R1828-01 PMT operated at 1600 V
- 8 gram (mL) sample size

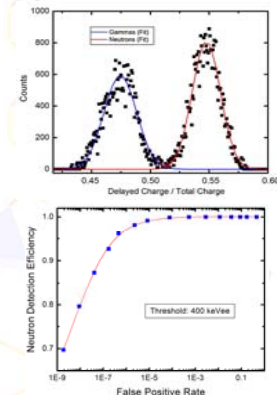


PLF 387 PSD Results

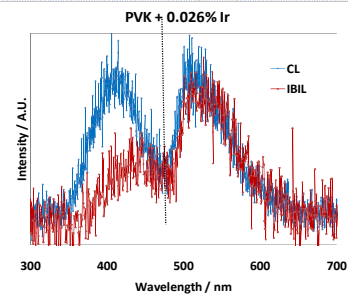


- 250 ns integration window,
- Prompt/delayed cut-off at 30 ns

PSD-FOM: Mixed Carbazole Base

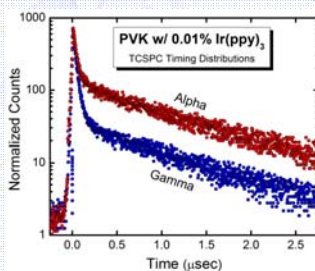
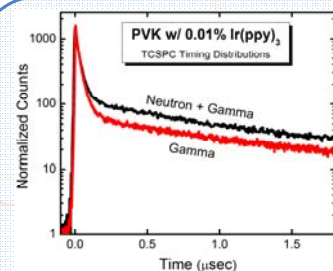


SSD and TCSPC Scintillation



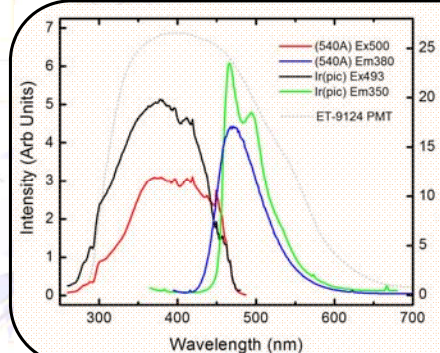
Spectral-Shape Discrimination (SSD)

- Excitation via 30 keV electrons or 3 MeV protons
- Polyvinylcarbazole (PVK) doped with 0.026% w/w Ir(ppy)₃ (~50 μm film)
- Differential ionization quenching of prompt (410 nm) vs. delayed (525 nm) components
- **Greater than two-fold luminosity enhancement over undoped polymer**

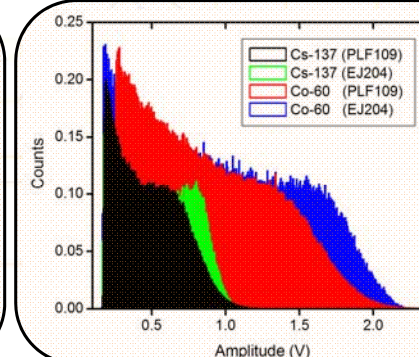


- Timing distributions collected on thin films using AmBe, Co-60, Am-241 sources
- Quenching of prompt decay for high dE/dX particles

Spectral Characteristics and Luminosity



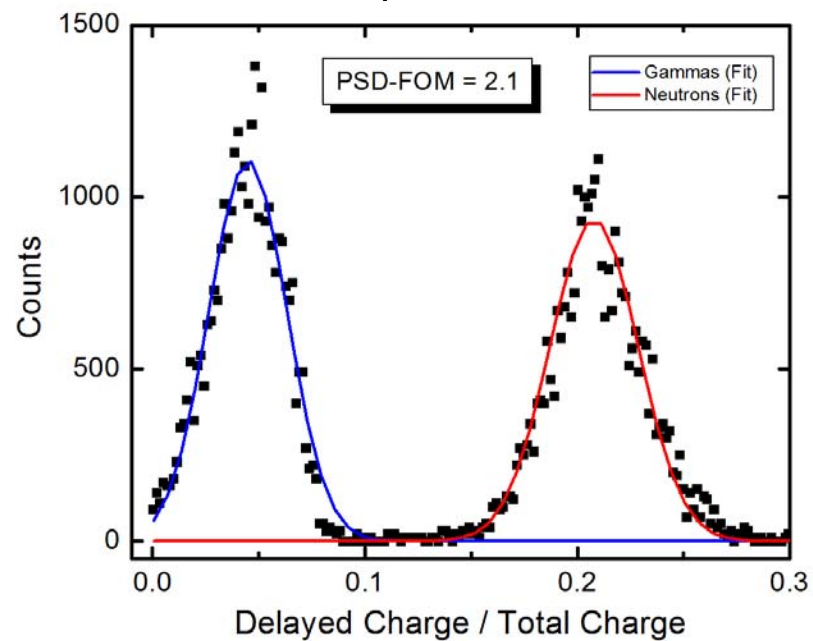
- Composition optimized for PSD: overlapping singlet and triplet emission
- Some reabsorption is still present (420-470 nm)
- **Employ new singlet and triplet complexes, wavelength shifting fluors**



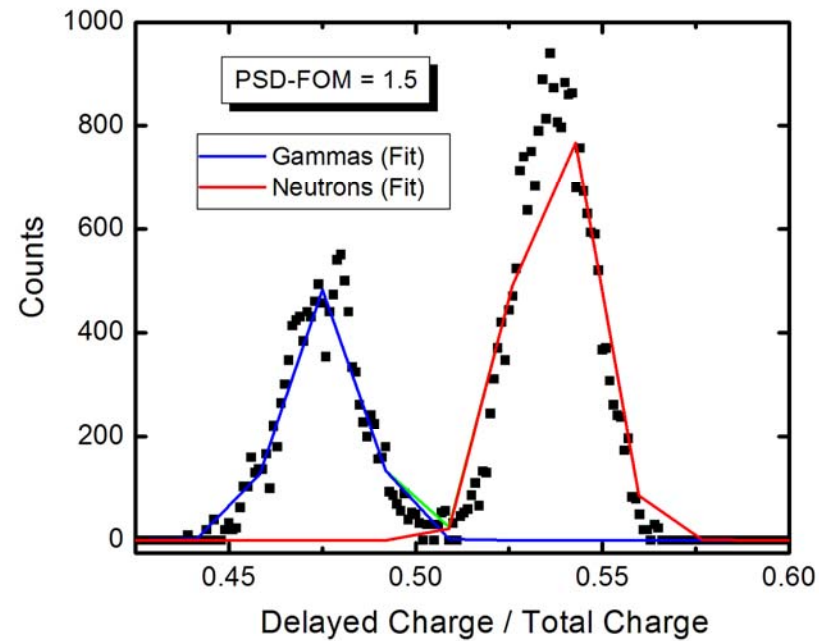
Pulse-Height Spectra

- Compare positions of Cs-137 and Co-60 Compton edge
- **PLF109 relative luminosity: 55-60% anthracene**
- Triplet light yield enhancement not yet fully realized

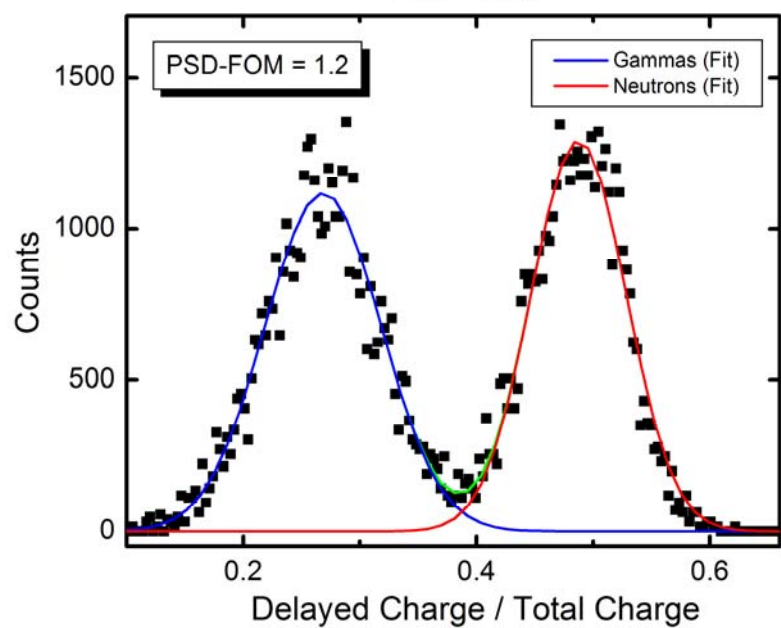
EJ-301 Liquid Scintillator



PLF 116



PLF 109



PLF 116

