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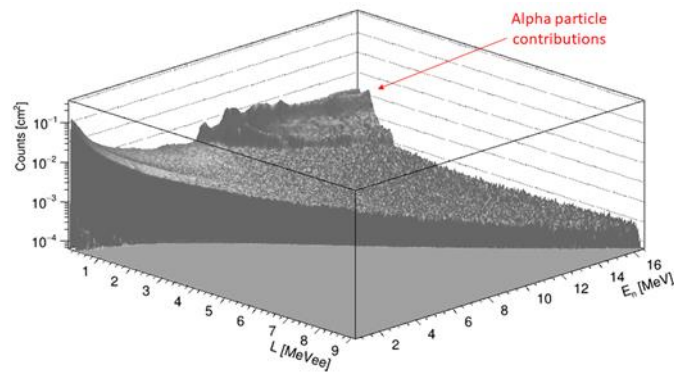
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## Characterization of a stilbene organic scintillator for use as a broadband neutron spectrometer in mixed radiation fields

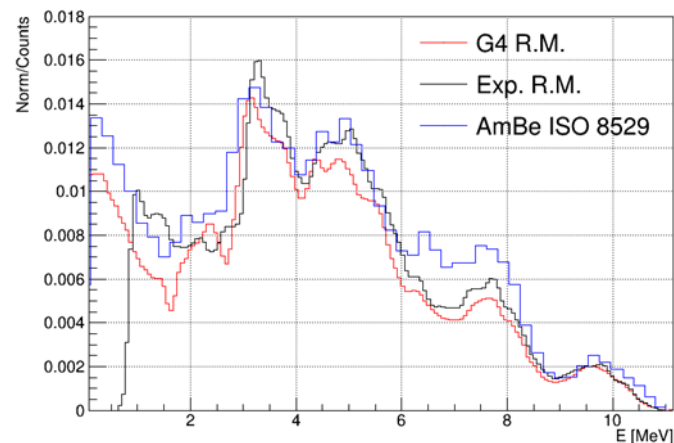
The main objective of this work was to establish the neutron response matrix of a  $\varnothing 25.4 \times 25.4$  mm<sup>3</sup> stilbene crystal to determine its suitability as a broadband neutron spectrometer in mixed radiation fields. First, the photon response of the detector between 0.059 MeV and 4.5 MeV was determined using two methods: (i) a series of direct irradiations, and (ii) coincidence measurements. The two techniques gave consistent calibration results.

The neutron characterization of the detector in the energy range 0.5 MeV and 17 MeV was then carried out using three different neutron-field production facilities. The data obtained with the mono-energetic neutron beams produced by the AMANDE facility and the PTB Tandetron showed that the stilbene detector has excellent neutron-gamma discrimination capabilities over a broad energy range. From these data, it was possible to parametrize a Geant4-based stochastic model of the detector neutron response. Additional data obtained at the PTB cyclotron, which produced a poly-energetic neutron field up to 16.5 MeV for this study, made it possible to construct the detector experimental response matrix.



Experimental neutron response matrix of the stilbene detector

As a validation test of the Geant4 and experimental response matrices, mono and poly-energetic spectra of well-known neutron sources were measured with the stilbene detector and unfolded. The unfolded results were found to be consistent with the expected spectra, despite discrepancies in some energy domains. Further investigation is required to explain these discrepancies. Overall, it was concluded that the stilbene detector can be used as a broadband neutron spectrometer down to 0.7 MeV.



Comparison between experimental and unfolded AmBe neutron spectra

Ref.: "Gamma-response characterization of a solution-grown stilbene based detector assembly in the 59 keV–4.44 MeV energy range; an alternative low-resolution gamma spectrometer," Augusto Di Chicco, Alix Sardet, Michaël Petit, Robert Jacqmin, Vincent Gressier, Brian Stout, *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, Volume 1034, 1 July 2022, 166740