In this paper we study quality of three types of organic scintillators - stilbene, pterphenyl and EJ-299-33A. We used monoenergetic neutron fields with a wide range of neutron energies in PTB Braunschweig. All the tests were carried out with NGA-01 spectrometer. The results of the measurements are evaluated spectra from the spectrometer. We discuss the quality of each scintillator, such as the FWHM of the peaks.
Experimental setup

- **PTB** - 1.5; 2.5; 19 MeV
- **NGA-01** 12-bit; 1 GS/s
- **Evaluation neutron spectral flux density**

<table>
<thead>
<tr>
<th>$E_n$ [MeV]</th>
<th>stilbene 45 mm</th>
<th>EJ-299-33</th>
<th>p-terphenyl</th>
<th>stilbene 10 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 MeV</td>
<td>0.216</td>
<td>0.361</td>
<td>0.280</td>
<td>0.232</td>
</tr>
<tr>
<td>19 MeV</td>
<td>0.102</td>
<td>0.184</td>
<td>0.184</td>
<td>0.063</td>
</tr>
</tbody>
</table>

**Table:** The energy resolution $FWHM/E$ for neutron energies 2.5 and 19 MeV.
Abstract

In this paper we study quality of three types of organic scintillators - stilbene, p-terphenyl and EJ-299-33. We used monoenergetic neutron fields with a wide range of neutron energies in PTB Braunschweig. All the tests were carried out with NGA-01 spectrometer. The results of the measurements are evaluated spectra from the spectrometer. We discuss the quality of each scintillator, such as the FWHM of the peaks.

Experimental Setup

The irradiations were performed at the PTB ion Accelerator Facility, where monoenergetic neutron fields are produced via selected reactions of proton and deuteron beams. The reaction is a 7Li(p,n)7Be reaction, which in open geometry in the low-scattering hall where the contribution of room-return neutrons is minimized by having grid floors. The three neutron energies considered in this campaign 1.5, 2.5 and 19 MeV, see Tab. 1.

Evaluation

NGA-01 has been used for the measurements of the apparatus spectra. For the evaluation of the measurements we developed the spectrometric software. MCNP simulations of response functions using ENDF/B-VII.1 nuclear data were used. Neutron spectral flux densities are displayed.

Results

Stilbene scintillator of the sizes of 50x50 mm and 15x15 mm have been used for measurements of neutron energies of 1.5, 2.5 and 19 MeV in all measurements corresponding peaks are identified in evaluated spectra. Fig. 1 - 14. Measurements with neutron energies of 1.5 and 19 MeV were carried out with EJ-299-33 scintillator (Fig. 11 - 14) and with p-terphenyl scintillator (Fig. 15 - 18). We compared spectra from EJ-299-33 and p-terphenyl scintillators with 45x45 mm stilbene scintillator shown in dotted gray line in Fig. 17/18/22. Arbitrary units have been used for the y-axis in the graphs of evaluated spectra. Tab. 2 shows resolution calculated from evaluated spectra.

Table 2: The energy resolution (%) of three energy spectra 1.5, 2.5 and 19 MeV.

Fig. 5: Neutron gamma-spectrogram NGA-01.

Fig. 6: Position of the detector (on the right-front) and the beam target (on the left-measuring) in between there is a shadow cone.

Fig. 7: Measurement with stilbene PSD matrix for 2.5 MeV measurement with stilbene.

Fig. 8: Measured neutron flux density for 50x50 mm stilbene for 2.5 MeV measurement with stilbene.

Fig. 9: Measured neutron flux density for 45x45 mm stilbene.

Fig. 10: Measured neutron flux density for 10x10 mm stilbene for 2.5 MeV.

Fig. 11: Measurement with stilbene PSD matrix for 2.5 MeV.

Fig. 12: Measurement with stilbene PSD matrix for 2.5 MeV.

Fig. 13: Measurement with stilbene PSD matrix for 2.5 MeV.

Fig. 14: Measurement with stilbene PSD matrix for 2.5 MeV.

Fig. 15: Measurement with stilbene PSD matrix for 2.5 MeV.

Fig. 16: Measurement with stilbene PSD matrix for 2.5 MeV.

Fig. 17: Measurement with stilbene PSD matrix for 2.5 MeV.

Fig. 18: Measurement with stilbene PSD matrix for 2.5 MeV.

Fig. 19: Measurement with stilbene PSD matrix for 2.5 MeV.

Fig. 20: Measurement with stilbene PSD matrix for 2.5 MeV.

Fig. 21: Measurement with stilbene PSD matrix for 2.5 MeV.

Fig. 22: Measurement with stilbene PSD matrix for 2.5 MeV.

Acknowledgements

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