

Neutron Shielding Materials and Detectors

- **Shielding materials:** HDPE, UHMWPE, Borated rubber sheets
- **Applications:** Nuclear reactor safety, Medical imaging
- **Neutron detectors:** BC501A, B_4C , $LaCl_3$, $LaBr_3$, GGAG, CLYC, LiI, GSO, CWO

Geant4 Simulations for Thickness Optimization:

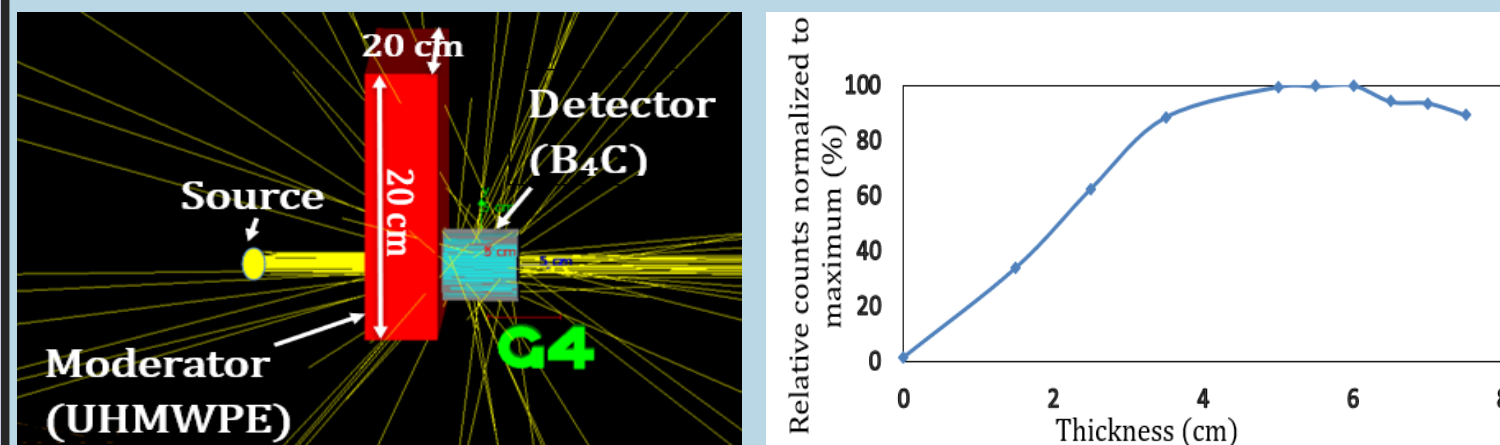


Figure 1. Moderation of neutrons using UHMWPE.

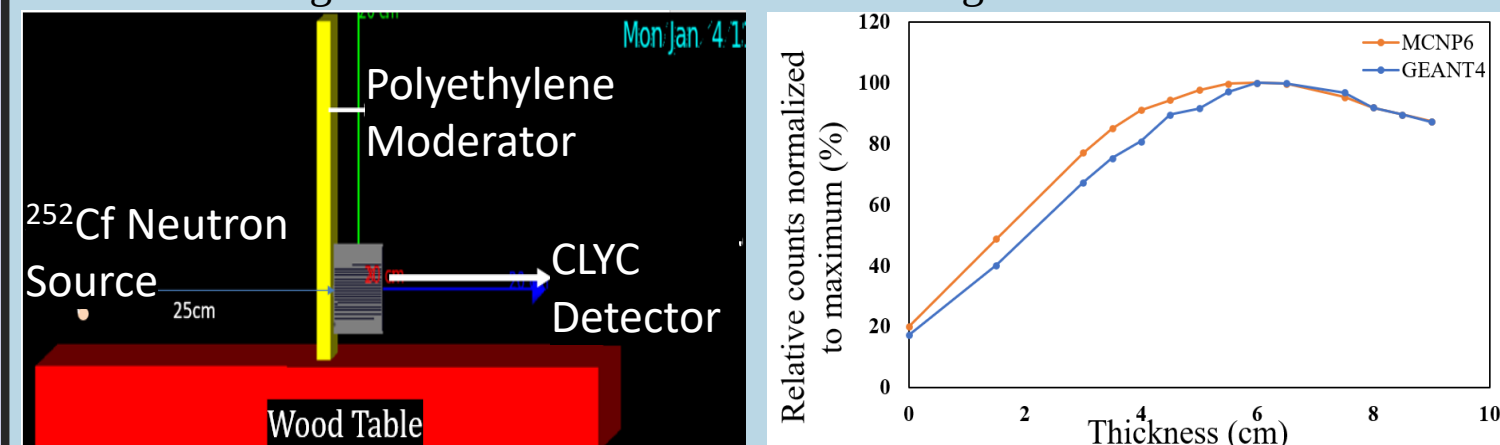


Figure 2. Moderation of neutrons using PE.

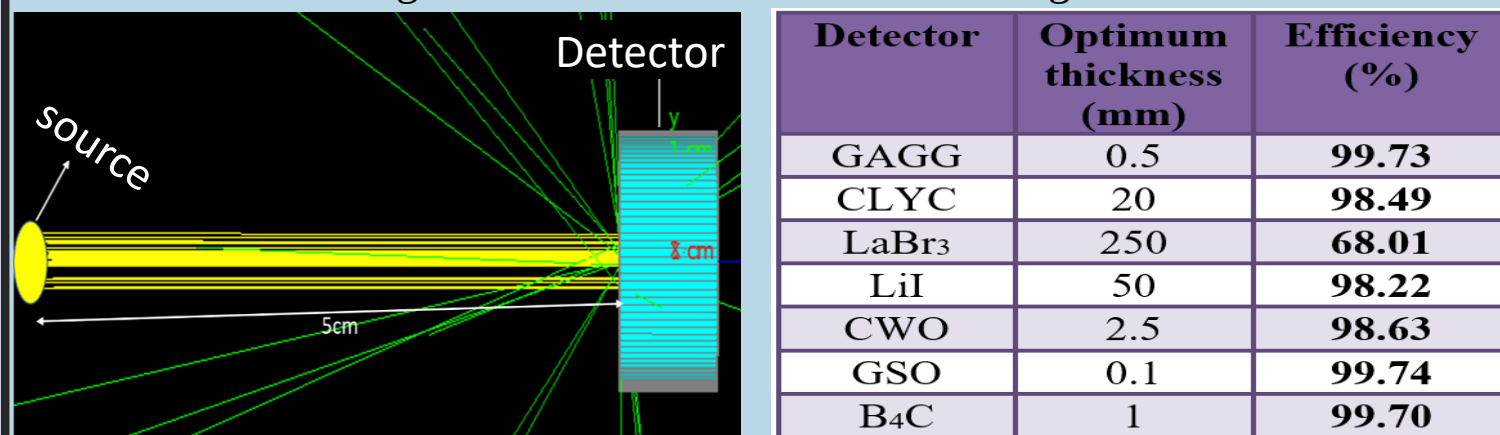


Figure 3. Optimizing thickness of different detectors for maximum thermal neutron detection efficiency.

Experimental Setup:

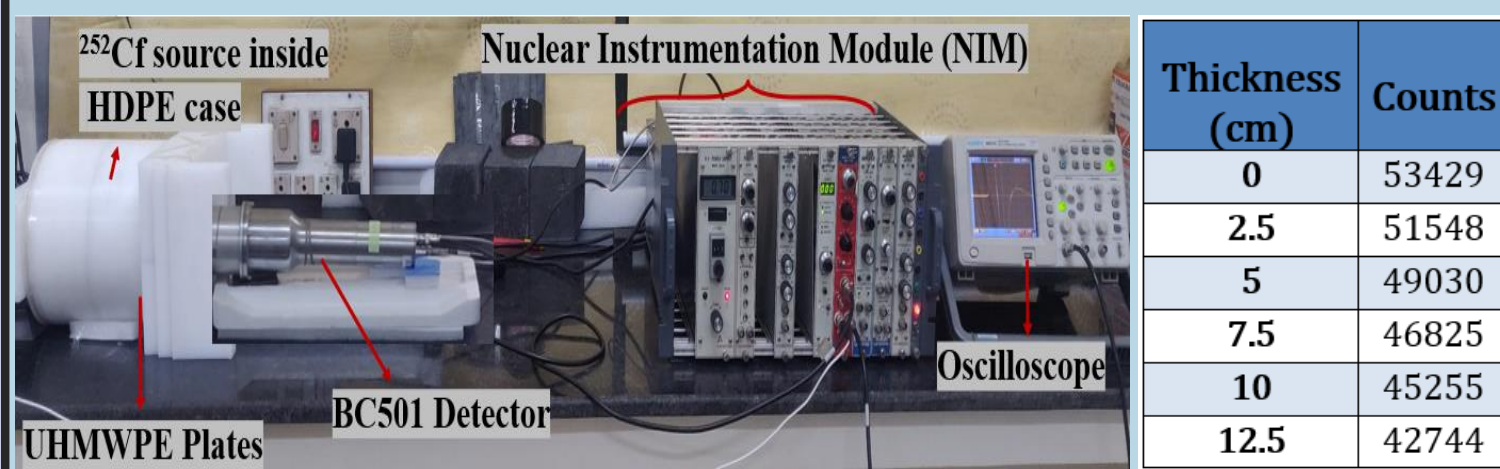
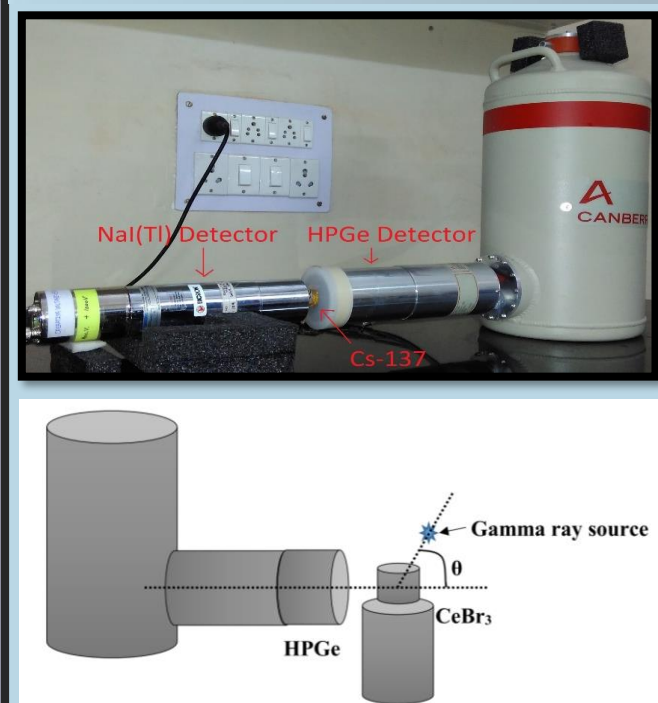
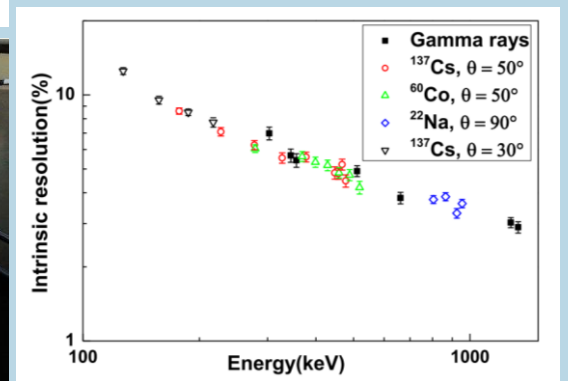
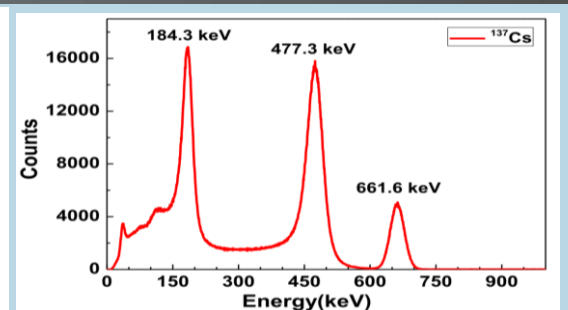
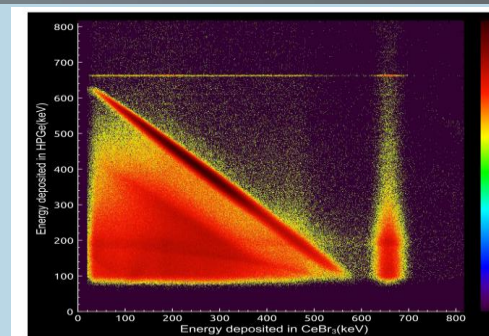


Figure 4. Exp. setup for moderation of fast neutrons using UHMWPE plates.

Compton Coincidence Technique (CCT)



- CCT is used to measure response of monoenergetic Compton electrons generated inside scintillators.
- CCT is based on registering coincident signals from scattering of γ -rays inside the test detector($CeBr_3$) followed by absorption of the scattered γ -ray in the reference detector(HPGe).
- PIXIE-4 multichannel digital gamma processor was used for measurement of Compton electrons
- Intrinsic energy resolution arises mostly due to the scattering of electrons inside the scintillator.



References

1. S. Agostinelli, *et al.*, NIM A, 506 (2003) 250.
2. Measurement and Detection of Radiation, 4th ed. Tsoufanidis, Landsberger: CRC Press, 2015.
3. H. S. Kim, *et al.*, J. Radiat. Prot. Res. 42 (2017) 48.
4. V. Ranga *et al.*, IEEE Transactions on Nuclear Science, 65 (2018) 616.

Pulse Shape Discrimination (PSD)

- PSD is used to discriminate among different kinds of radiation.
- PSD exploits difference in shape of pulse generated by the detector for different radiation.
- Charge Integration method was used for PSD.
- CAEN DT5751 desktop digitizer with 1 GS/s was used for digital pulse processing.
- ^{252}Cf neutron source was used for n - γ discrimination.
- Internal α -activity of $LaBr_3:Ce$ was used for α - γ discrimination.

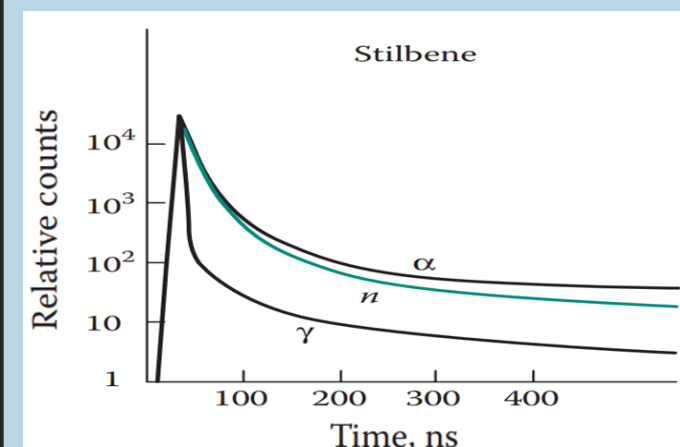


Figure 5. Pulse shapes of different radiations in organic scintillator, Stilbene.

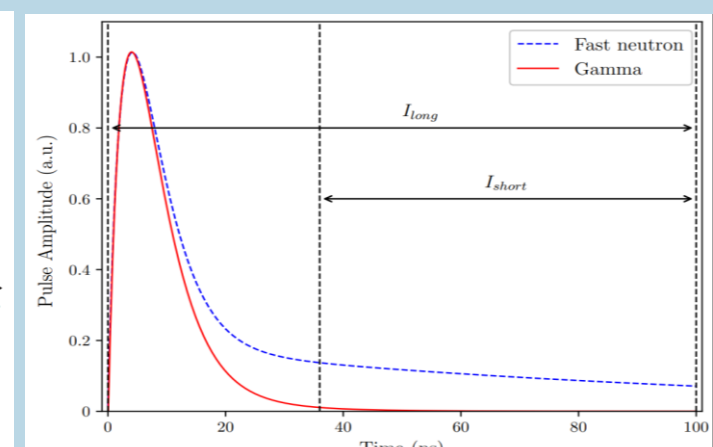


Figure 6. Long and short gate for Charge Integration method.

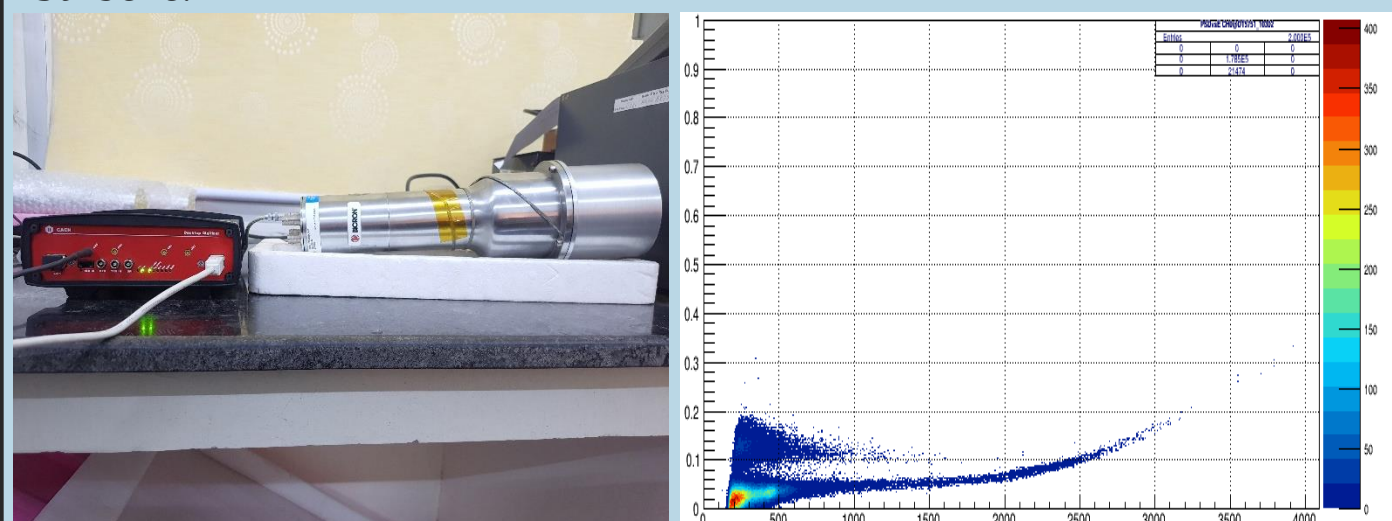


Figure 7. n - γ discrimination in BC501A detector using digitizer.

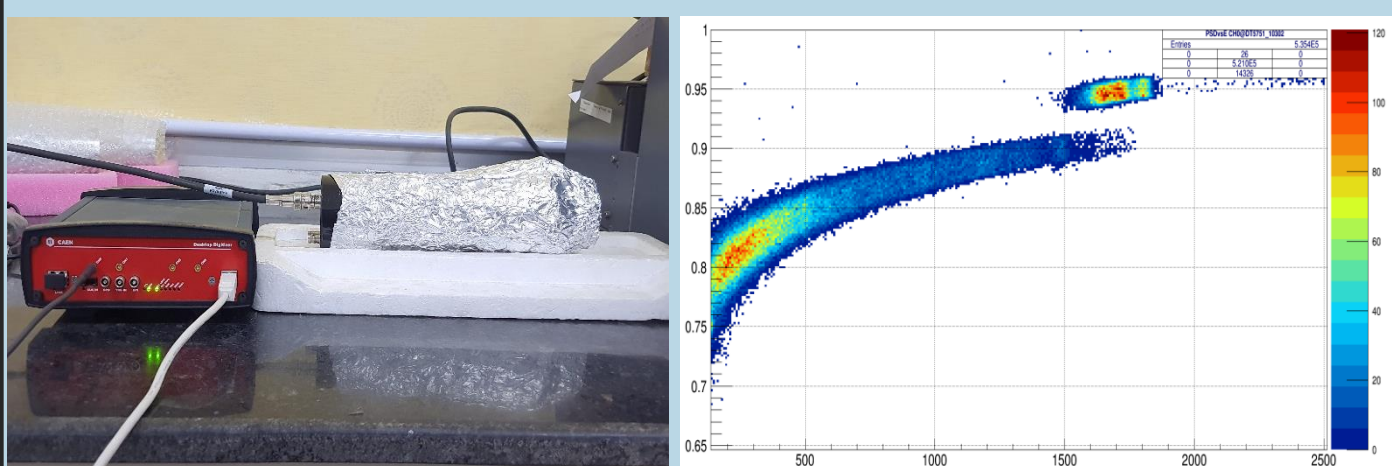


Figure 8. α - γ discrimination for internal activity in $LaBr_3:Ce$ using digitizer.

Acknowledgements

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