Calibration of the E Si detector in a DE-E telescope with a $^{212}$Pb pin source

By placing a pin source close (~2.5 mm) to a two sided 2mm pitch Si strip detector and inserting an $^{212}$Pb activated dowel pin between the DE and E detectors, we can calibrate and determine the front dead layer thickness of the E detector without disturbing the stability of the electronics.

Pin source of HiRA telescope

- By inserting an $^{212}$Pb activated dowel pin between the DE and E detectors, we can calibrate and determine the front dead layer thickness of the E detector without dismounting the DE detector which may damage the detectors and disturb the stability of the electronics.

Dead-layer thickness determination

- Dead-layer is the non-depleted region and metallic electrodes on the surface of a silicon detector.
- The energy of alpha particles lost in the dead-layer can not be measured.
- However, the energy loss in the dead-layer varies with on the entrance angles.

Calculation

Based on the energy of all telescopes, assume $|A-1|<0.05$.

$E_{\text{init}} = E_{\text{sys}} + X_{\text{DE}} + B$

$E_{\text{sys}} = 8.785$ MeV - energy loss in DL

Position of the pin as an example

Fitting method

The alpha peaks from the pin source can be used to provide calibrations of the E detectors and compared to initial alpha source calibrations before the experiments.

Results

Dead-layer thickness

How good are the initial calibrations done before experiments

Conclusion

- A pin source is relatively easy to make and convenient to use. It provides accurate calibrations to the E Si detectors placed behind a thin DE detector with minimum disturbance to the mechanical and electronic setup in nuclear physics experiments.
- By placing a pin source close (~2.5 mm) to a two sided 2mm pitch Si strip detector, the deadlayer thickness of the Si detector is determined to be about 0.5 ±0.10 μm.
- In the example we studied, the pin source was used to both check and correct the initial calibrations of the HIRA detectors. This is particular useful in experiments that run for a long time.

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