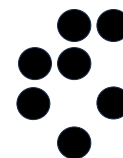# Calibration of HPGe detector and usage of prompt γ rays to extend its efficiency curve in above 2 MeV range

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Motivation

- No decay calibration source with emission lines above 2 MeV available for energy and efficiency calibration.

Method

- 2 step approach:
  - Calibration with decay sources
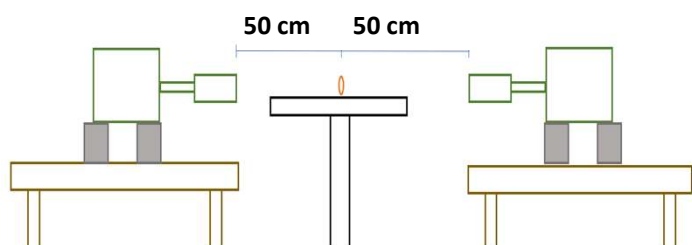 - Use of neutron induced prompt γ rays for above 2 MeV calibration.

Conclusion

- Valid method for extending the energy and efficiency calibration in the energy range above 2 MeV.
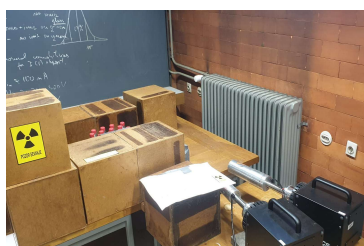
Certified source calibration

Calibration Sources: Europium-152, Barium-133
Setup: The detectors were set up centrally at a distance of 50 cm from the calibration source.

50 cm   50 cm

Prompt γ experiment

Setup: An Am-Be neutron source induced prompt γ-rays in an Fe-56 target, with detectors 63 cm away and a 30 cm of water moderator to slow down the neutrons.


Calibration Points: 691 keV, 7631 keV and 7645 keV were selected for accurate calibration. The 691 keV anchors the lower spectrum and allows a smooth extension of the efficiency curve to higher energies.

Conclusion

- Prompt γ measurements are a viable method to extend the efficiency calibration range of HPGe detectors.
- To increase the calibration accuracy at higher energies, further improvements of the experimental setup and longer measurement times are required.

Results

Energy Calibration: Achieved high linearity in energy determination across the γ spectrum.

Channel to Energy relation - OF84
- meas. data
- Fit eq.: 0.0006·E + 1.175 keV; R^2 = 0.993
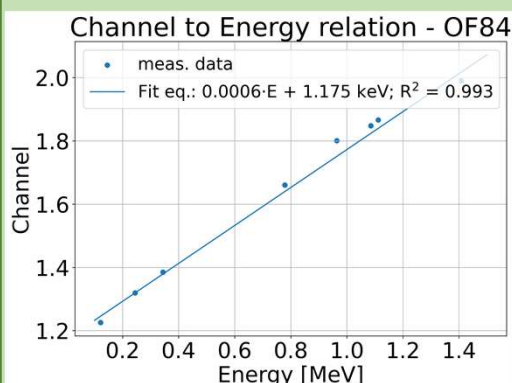
Resolution Calibration: FWHM measurements showed minimal deviation from manufacturer specification.

FWHM-energy relation - OF84
Fit: 0.00060 + 0.00089 · sqrt(E + 0.05515·E^2)
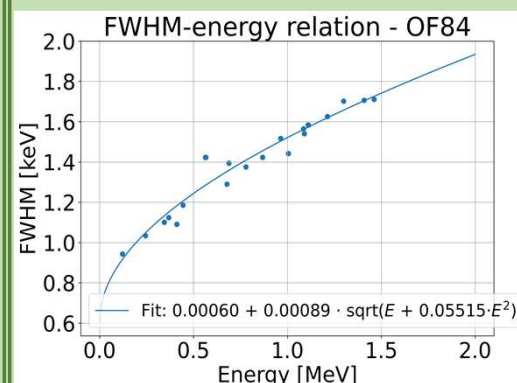
Efficiency Calibration: Extended efficiency curve up to 7.65 MeV using a sixth-order polynomial model with good agreement (chi-squared = 0.946).

Absolute efficiency - OF84
- Fitted to meas.
- ^{133}Ba
- ^{152}Eu
- ^{56}Fe prompt γ

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