



Gamma Spectroscopy with Germanium Detectors

Purpose

Familiarize the student with the use of germanium detectors to learn the basic aspects of gamma spectrometry, such as energy and efficiency calibrations of the detector, to determine the energy and intensity of gamma rays detected.

Bibliography

G.F. Knoll: "Radiation detection and measurement". Chapters 2, 3, 4, 12, 16, 17 y 18.

K. Debertin & R.G. Helmer: "Gamma and X-ray spectrometry with semiconductor detectors"

<http://www.ortec-online.com/application-notes/an34/an34-content.htm>

Materials

1. High-Purity Germanium (HPGe) Detector with Preamplifier included (PA)
2. High Voltage Power Supply (HV)
3. Spectroscopic Amplifier (A)
4. Multichannel Analyzer (MCA) or Analog to Digital Converter (ADC)
5. Oscilloscope
6. Gamma radioactive sources (^{137}Cs , ^{60}Co , ^{152}Eu)

Procedure

1. Determine the main physical properties of Germanium detectors and the electronic components.
2. After applying the proper voltage to the detector (in the proper way, see IMPORTANT NOTE), student have to characterize the signals produced by a ^{137}Cs source using the oscilloscope.

IMPORTANT NOTE: When applying the voltage to the detector, you must increase it slowly and under supervision in order not to damage the FET component of the preamplifier.

3. Adjust the Spectroscopic Amplifier constants such as Gain, Shaping Time, Pole zero and Base-line Restorer to obtain the proper dynamic range (up to 2000 keV) and an optimum energy resolution using the oscilloscope.
4. Perform a measurement of the energy spectra of ^{137}Cs y ^{60}Co sources to obtain a preliminary energy calibration.
5. Perform a final energy and efficiency calibration using ^{152}Eu source in a well-known geometrical configuration with the Multichannel Analyzer over a fixed time period. Identify the peaks, calculate

the centroids, widths and areas of each one to obtain the energy and efficiency calibrations with the appropriate functions (see Bibliography for more details).

6. Measure a background spectrum with enough statistics. With the help of data tables, identify the isotopes that appear in the background.

7. Take the spectrum of an unknown source and try to identify which one it is from the standard table of gamma radiation sources.

8. Draw the electronic scheme of the set-up below.

Lab Report

You need to prepare a report and send it by e-mail to the following addresses: olof@iem.cfmac.csic.es. Deadline date to submit the report is 15/05/2010. The minimum content should be the one detailed in the part "Procedure" of this guide.

Figure: Equipment to be used during the practice.

