



CAEN Educational Handbook

Nuclear and Particle Physics Experiments



<https://edu.caen.it>

SP5600EMU - EMULATION KIT

Difficulty



Execution Time

**Purpose of the experiment**

Determine the activity of a ^{60}Co source from its gamma spectrum. Learn about the meaning of the sum peak, visible in the spectrum of some radioactive sources.

Fundamentals

The ^{60}Co spectrum presents two distinct gamma photopeak in its spectrum, respectively corresponding to photons γ_1 and γ_2 at 1.17 MeV and 1.33 MeV. For the purpose of this experiment, we can assume that each of these gamma rays are isotropically distributed. In other words, if γ_1 departs in a particular direction, γ_2 can go in any direction that it wishes. There is a certain probability that γ_2 will go in the same direction as γ_1 . If this occurs the energies of γ_1 and γ_2 will be summed in the detector. Hence a sum peak will show up in the spectrum, at nearly 2.5 MeV.

We can estimate the activity of the source by calculating the counts under the two main peaks and under the sum peak, i.e. calculating their area Σ . For the case of ^{60}Co , we have that the counts under the sum peak can be evaluated as

$$\Sigma_{\text{SUM}} = \frac{\Sigma_1 \Sigma_2}{At}$$

Where A is the activity of the source and t is the acquisition time.

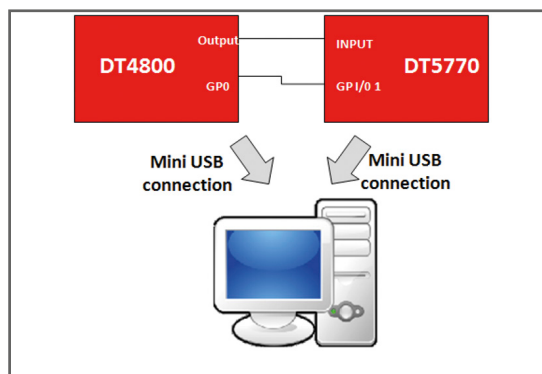
Therefore, fitting the peaks with a gaussian and calculating their area Σ , it is possible to estimate the activity of the ^{60}Co source used to record the available spectrum.

Requirements

No other tool is needed.

Carrying out the experiment

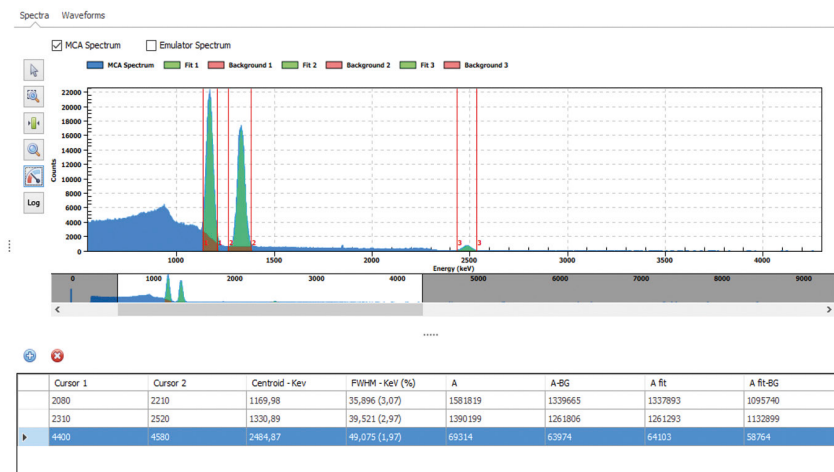
To perform the experiment, connect the DT4800 output to the input channel of the MCA DT5770 and use the DT4800 GP0 as digitizer “trigger IN”. The Emulation Control Software Interface allows user to generate exponential decay signals with programmable rise time and fall time and it is possible to emulate signals from C0-60 radioactive source. The spectrum can be recorded and analyzed by the MCA.



Experimental setup block diagram for the experiment.

Results

The student should verify that, after the spectrum calibration, the sum peak is nearly at 2.5 MeV. From the formula given above, using the live time in seconds, the student can estimate the activity of ^{60}Co directly in Bq. A calculation made for a spectrum acquired in 100 seconds gives an activity of nearly 264 kBq.



The ^{60}Co complete spectrum acquired by the MCA and plotted by the Emulation Software.