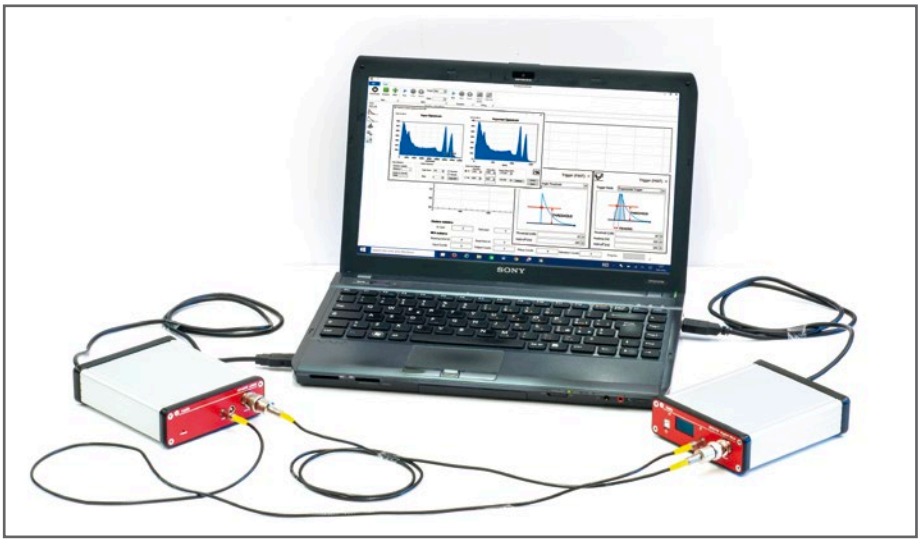
B.1.9 SG6119B Activity of the ^{60}Co



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 γ1 and γ2 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 γ1 departs in a particular direction, γ2 can go in any direction that it wishes. There is a certain probability that γ2 will go in the same direction as γ1. If this occurs the energies of γ1 and γ2 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 ∑. For the case of ^{60}Co, we have that the counts under the sum peak can be evaluated as

$$\sum(SUM) = \frac{\sum 1 \sum 2}{A\,t}$$

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, it is possible to estimate the activity of the ^{60}Co source used to record the available spectrum.

Ordering Options

Equipment A	
Code	**Description**
WK5600XEMUAA	SP5600EMU - Emulation Kit

Equipment B	
Code	**Description**
WK5600XCAAAA	SP5600C - Educational Gamma Kit
or the all inclusive Premium Version	
WK5600XANAAA	SP5600AN - Educational Kit - Premium Version

Equipment C	
Code	**Description**
WK5640XAAAAA	SP5640 - GammaEDU

Equipment D	
Code	**Description**
WK5630ENAAAA	SP5630EN - Environmental Kit
or the Kit Plus	
WK5630XENAAA	SP5630ENP - Environmental Kit Plus

Equipment E	
Code	**Description**
WK5650XAAAAA	SP5650 - Open FPGA Kit

Marie Skłodowska Curie was a Polish and naturalized-French physicist and chemist who conducted pioneering research on radioactivity. She was the first woman to win a Nobel Prize, the first person and only woman to win twice in multiple sciences. Together with her husband, she was awarded half of the Nobel Prize for Physics in 1903, for their study into the spontaneous radiation discovered by Becquerel, who was awarded the other half of the Prize. In 1911 she received a second Nobel Prize, this time in Chemistry, in recognition of her work in radioactivity. Radium discovery opened the door to deep changes in the way scientists think about matter and energy. She also led the way to a new era for medical knowledge and the treatment of diseases.

https://www.aip.org/history/exhibits/curie/brief/index.html

Equipment

SP5600EMU - Emulation Kit

Model	DT4800	DT5770
Description	Digital Detector Emulator	Digital Multi-Channel Analyzer
		
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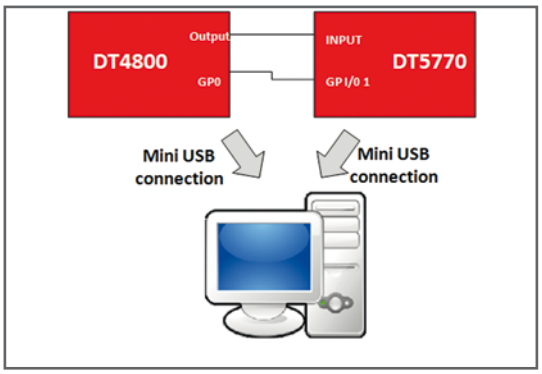
Requirements

No other tools or instruments are needed.



Experimental setup block diagram for the experiment.

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 ^{137}CsI radioactive. The spectrum can be recorded and analyzed by the MCA.

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 de 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 DT5770 and plotted by the Emulation Software