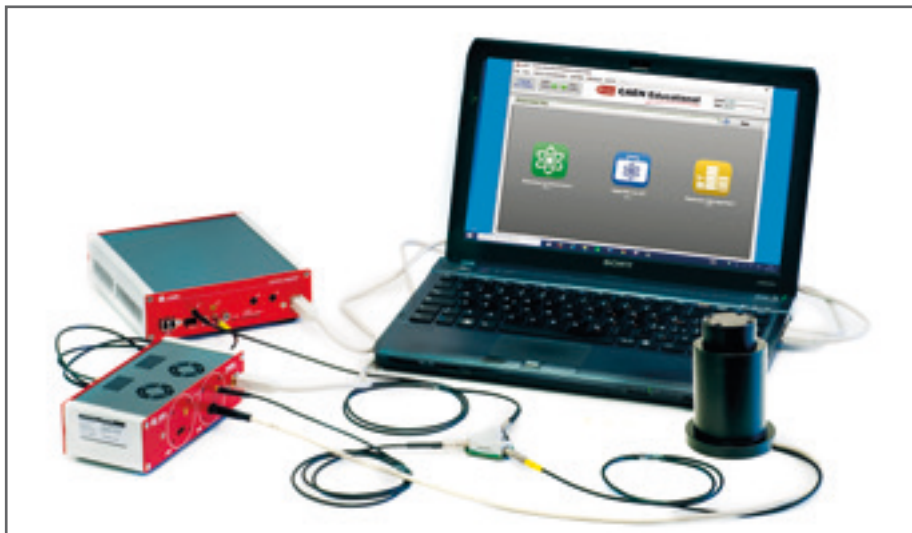


B.1.4 System Calibration: Linearity and Resolution

SG6114



Dedicated kit	
Description	pp.
SP5600C Educational Gamma Kit	179



Difficulty	Execution Time	Data Analysis	Radioactive Sources
		YES	YES

Requirements

Gamma Radioactive Source

Equipment

SP5600C - Educational Gamma Kit

Model	SP5600	DT5720A	A315	SP5606	SP5607
Description	Power Supply and Amplification Unit	Desktop Digitizer 250 MS/s	Splitter	Mini-Spectrometer	Absorption tool
	p. 190	p. 190	p. 192	p. 192	p. 193

Purpose of the experiment

Recording and comparing the γ energy spectra of several radioactive sources is the main goal of the experiment. The photo-peaks are used to calibrate the response of the system and to measure the energy resolution.

See the
Application



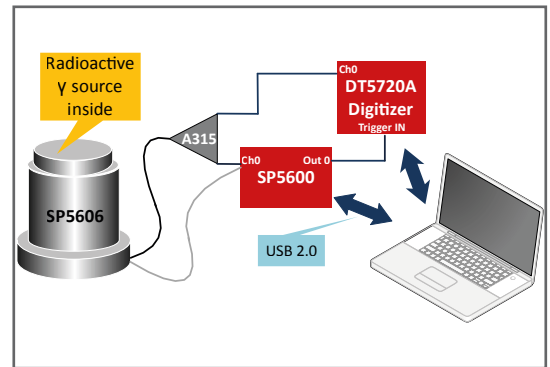
Fundamentals

Linearity and energy resolution are the main figures of merit of a spectrometric system. In the proposed experiment, based on a scintillating crystal coupled to a Silicon Photomultiplier, deviations in the linearity may be due to the sensor or the front-end electronics saturation. The student is guided through the analysis of the response curve using a series of isotopes up to the MeV energy by a ^{60}Co source and to disentangle the different effects. At the same time, the energy resolution of the system is measured by the width of the photo-peaks and the results compared to what is expected by the fluctuations in the number of detected scintillation photons, the system noise, the sensor stochastic effects, the intrinsic resolution of the scintillator.

This is following an initial activity on the optimization of the operating parameters by an analysis of the photo-peak position and the resolution for a single isotope. The scintillation light and, last but not least, cost. The choice of the scintillator is essentially dependent on the specific targeted application.

Carrying out the experiment

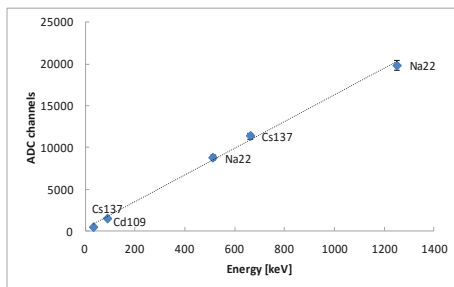
The scintillator crystal shall be coupled to the SiPM in the SP5607, through a thin layer of index matching grease to maximize the light collection. In order to avoid saturation, the output of the SiPM is divided using the A315 splitter: one branch is connected to the DT5720A and will be digitized. The other branch will be amplified by the SP5600 module, generating the trigger for the integration signal by the on-board leading-edge discriminator. The discriminator threshold shall be defined looking at the spectrum and evaluating the dark count rate. Once this is set and the radioactive source is properly positioned, the spectrum can be recorded.



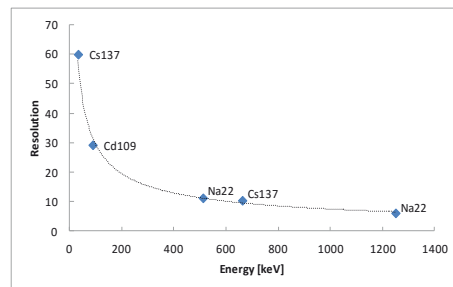
Block diagram of the experimental setup that makes use of the "Educational Gamma Kit".

Results

By fitting the photo-peaks with a Gaussian curve, the system linearity as a function of energy is verified. The peak widths is determining the energy resolution. At more advanced level, the interpretation of the results accounting for the system properties may be performed.



Energy Calibration



Energy dependence of the system resolution

This experiment is also possible with the following kits

B SP5600AN
Educational kits
PREMIUM



see
p. 179

C SP5640
GammaEDU



see
p. 183

D SP5630EN
Environmental kit



see
p. 181

E SP5630ENP
Environmental kit Plus



see
p. 181

F SP5600EMU
Emulation kit



see
p. 180