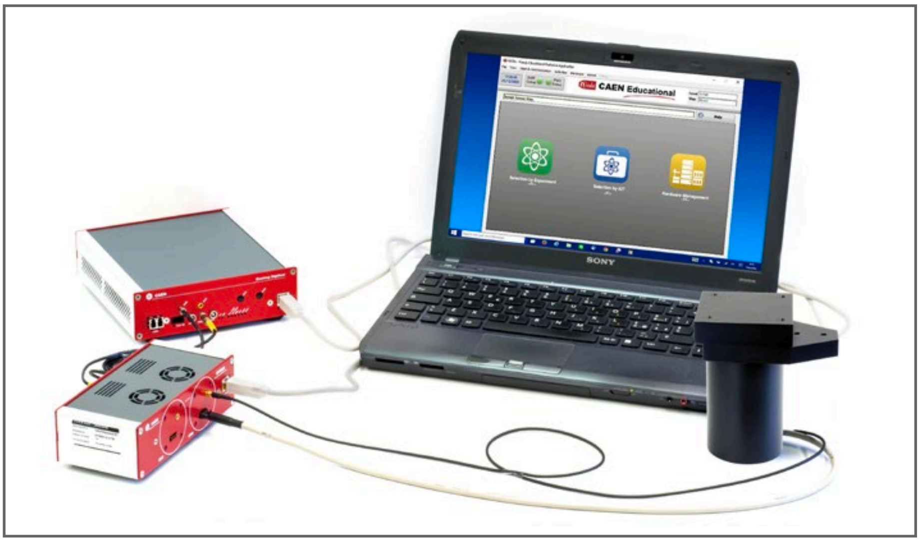
B.4.1 Response of a Plastic Scintillating Tile

SG6121



Ordering Options

Equipment	
Code	**Description**
WK5600XDAAAA	SP5600D - Educational Beta Kit
or the all inclusive Premium Version	
WK5600XANAAA	SP5600AN - Educational Kit - Premium Version

Purpose of the experiment

To get acquainted with a set-up based on a plastic scintillator tile coupled to a Silicon Photo-multiplier.

Fundamentals

Particle detectors based on scintillating material coupled to a photosensor are in common use in nuclear and particle physics, medical, industrial and environmental applications. The choice of the scintillator is dependent on the end-user specifications but for a large set of applications plastic scintillators represent a cost effective viable solution. The CAEN kit comprises a plastic scintillator tile of 5 x 5 x 1 cm^3 volume, directly coupled to a 6 x 6 mm^2 SiPM. The sensitive area is a trade off between the requests for some of applications (e.g. cosmic ray detection or inspection of thin layers or filters) and the homogeneity of the response of the system.

Before addressing a variety of lab applications, the student is guided through the basics of the system.

One hundred years ago, amidst glowing glass tubes and the hum of electricity, the British physicist J.J. Thomson was venturing into the interior of the atom. At the Cavendish Laboratory at Cambridge University, Thomson was experimenting with currents of electricity inside empty glass tubes. He was investigating a long-standing puzzle known as "cathode rays." His experiments prompted him to make a bold proposal: these mysterious rays are streams of particles much smaller than atoms, they are in fact minuscule pieces of atoms. He called these particles "corpuscles," and suggested that they might make up all of the matter in atoms. It was startling to imagine a particle residing inside the atom--most people thought that the atom was indivisible, the most fundamental unit of matter.

https://www.aip.org/history/exhibits/electron/

Equipment

SP5600D - Educational Beta Kit

Model	**SP5600**	**SP5608**	**DT5720A**
Description	Power Supply and Amplification Unit 	Scintillating tile 	Desktop Digitizer 250 MS/s 
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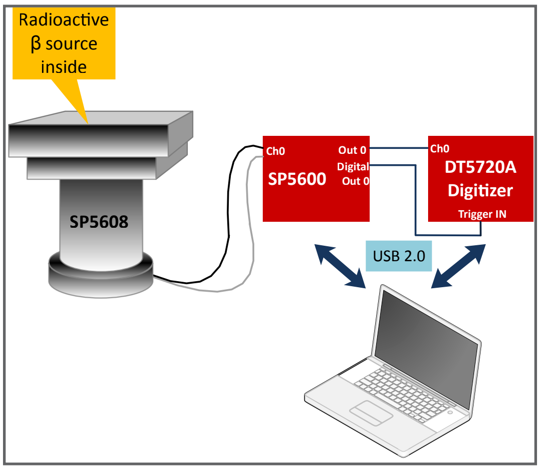
Requirements

Beta Radioactive Source



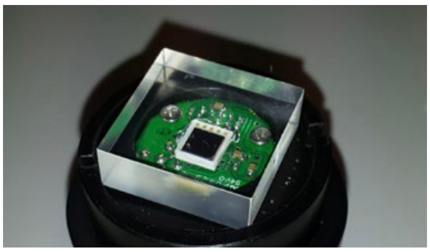
Experimental setup block diagram.

Carrying out the experiment

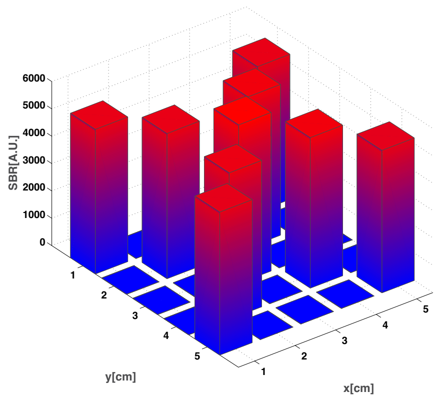
Connect the power and the MCX cables of the SP5608 tile to one channel of the SP5600. Connect the two channel outputs to DT5720A: the analog output to the channel 0 and the digital output to "trigger IN" of the digitizer. Use the GUI to optimize the system parameters (bias, gain, discriminator threshold). Once this is done, switch off the power supply, open the SP5608 top cover and position the beta source on the scintillating tile in the center. Close the support top, switch ON the power supply and measure the counting rate. Repeat the measurement moving the source in several positions over the tile and acquiring the signal/ background ratio.

Results

In response to the incoming beta particles, the system is designed to deliver a high signal. However, the student shall consider the optimal setting of the discriminator threshold, taking into account the dark count rate, the variation in the beta source counts, the signal to noise ratio and the quality of the recorded beta spectrum. Moreover, for the optimal setting it is significant to monitor the homogeneity of the response as the source is moved across the tile.



Scintillating tile coupled to a sensor.



Homogeneity of tile response to a beta source.