

# B.2.3 Fertilizer and photopeak identification

SG6142C



### Ordering Options

Equipment	
Code	Description
WK5630ENAAAA	SP5630EN - Environmental Kit

or the Kit Plus

WK5630XENAAA	SP5630ENP - Environmental Kit Plus
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### Purpose of the experiment

Record the energy spectrum of Fertilizer sample and identify the Potassium peak. The experience will guide the user to select a ROI and perform a Gaussian fit on the peak. This sample can be used also as a reference for the spectrum calibration.

### Fundamentals

Potassium is a natural element whose radioactive isotope  $^{40}\text{K}$  is widely available on Earth, especially in food and in human bodies. It plays a key role in geologic fields for the dating samples and rocks. Indeed, one of the main decay is in  $^{40}\text{Ar}$ , which remains locked up in minerals. Knowing the decay time of  $^{40}\text{K}$  into  $^{40}\text{Ar}$ , and measuring the ratio between the two elements, it is possible to give a precise estimate about the origin of that material.

Another interesting application is the so-called Banana Equivalent Dose (BED), a “user-friendly” unit to measure radioactivity. Bananas naturally contains  $^{40}\text{K}$  and 1 BED corresponds to 0.1  $\mu\text{Si}$  of equivalent dose. To understand the proportions, consider that a dental X-ray corresponds to eating 50 bananas, an average daily dose of natural background is 100 BED, a fatal dose is 100 million bananas. This quantity has been introduced to get users familiar with natural low-radioactive objects.



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

SP5630EN - Environmental Kit

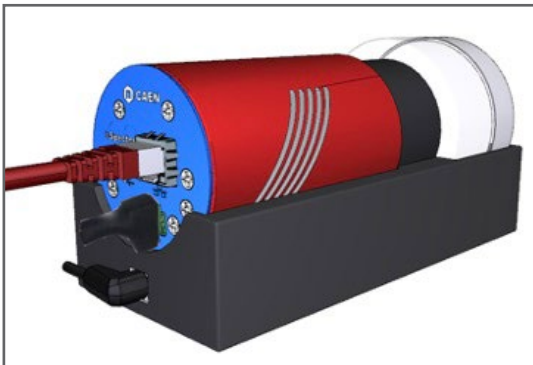
Model	i-Spector - S2570B	Samples
Description	Intelligent Silicon Photomultiplier Tube 	Samples 

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## Requirements

No other tool is needed.



Experimental setup block diagram

## Carrying out the experiment

Put the i-Spector digital into the base and place the Fertilizer box into the place-holder. Power on the i-Spector and connect the Ethernet cable. Wait until the temperature is stable from the web interface (it can take half an hour from power on).

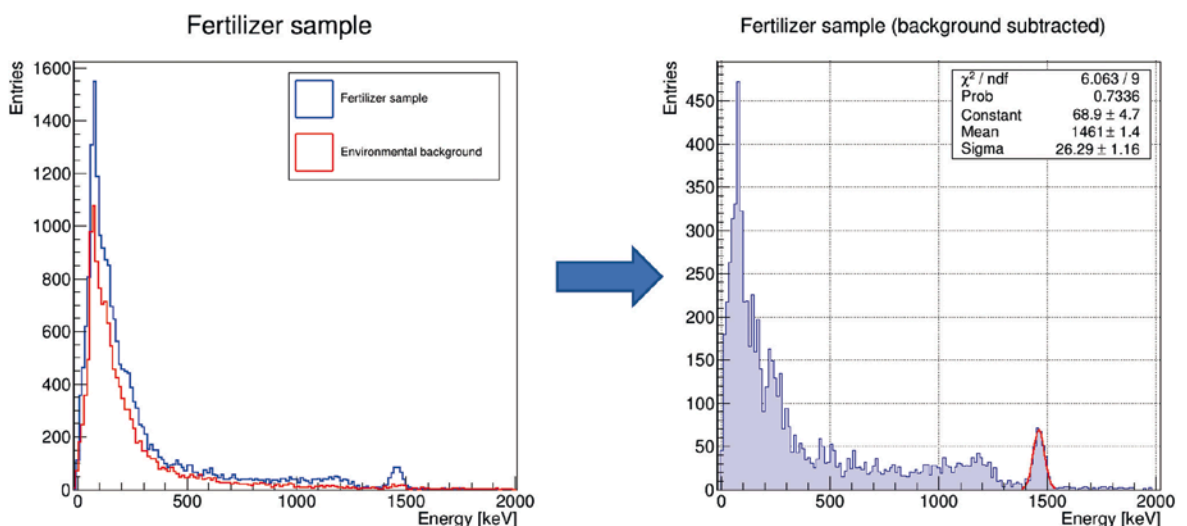
Check the waveform, modify the threshold and gate width, if needed, then start the measurement of the energy spectrum.

Take 30 minutes of acquisition with the Fertilizer.

NOTE: in case of background measurement, settings and acquisition time must be the same. Lead blocks could help in distinguish a clearer peak but they must be used if just employed in background measurement only.

## Results

Several steps can be done in this experiment. First, the background subtraction by saving the .csv of the two and by making a bin-by-bin subtraction of the two spectra. A small portion of the  $^{40}\text{K}$  peak can be seen in the background spectrum too. The  $^{40}\text{K}$  peak can be then selected through a ROI and fitted by means of a Gaussian function. The peak can be used together with the LYSO crystal for the energy calibration of the system (ID.6140).



Fertilizer sample: total contribution and background on the left; background subtracted on the right with a Gaussian fit on the  $^{40}\text{K}$  peak. The mean value is in agreement with the expected value of 1460.8 keV