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Tools for Discovery

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HANDBOOK OF EXPERIMENTS

SG6142C Environmental Radioactivity Indoor

Fertilizer and photopeak identification

Environmental radioactivity

EDUCATIONAL KIT

SP5630EN

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Fertilizer and photopeak identification

Categories: CAEN Experiments, Environmental radioactivity | Tags: Gamma detection, Gamma rays, Nuclear Physics, γ Spectroscopy

Difficult	Execution Time	Data Analysis	Radioactive Sources
		Yes	No

Hardware setup

This experiment guide is referred to the **SP5630EN** educational kit.

Equipment: SP5630EN – Environmental kit

Model	i-Spector – S2570B	Samples
Description	Intelligent Silicon Photomultiplier Tube	Empty Beaker & Test Sample, Fertilizer and Rock, Canisters of Activated Carbon, Calibration Crystal

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

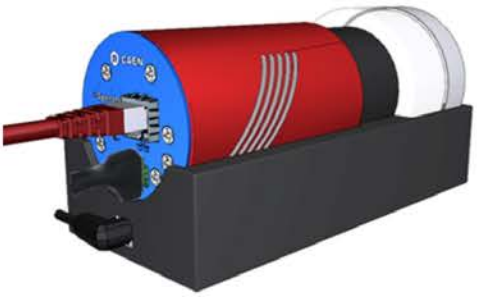
Potassium is a natural element whose radioactive isotope ^{40}K is widely available on Earth, especially in food and in human bodies. It plays a key role in geologic fields for the dating samples and rocks. Indeed, one of the main decay is in ^{40}Ar, which remains locked up in minerals. Knowing the decay time of ^{40}K into ^{40}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}K and 1 BED corresponds to 0.1 mSi 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.

Requirements

No other tool is needed.

Carrying out the experiment



Experimental setup

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).

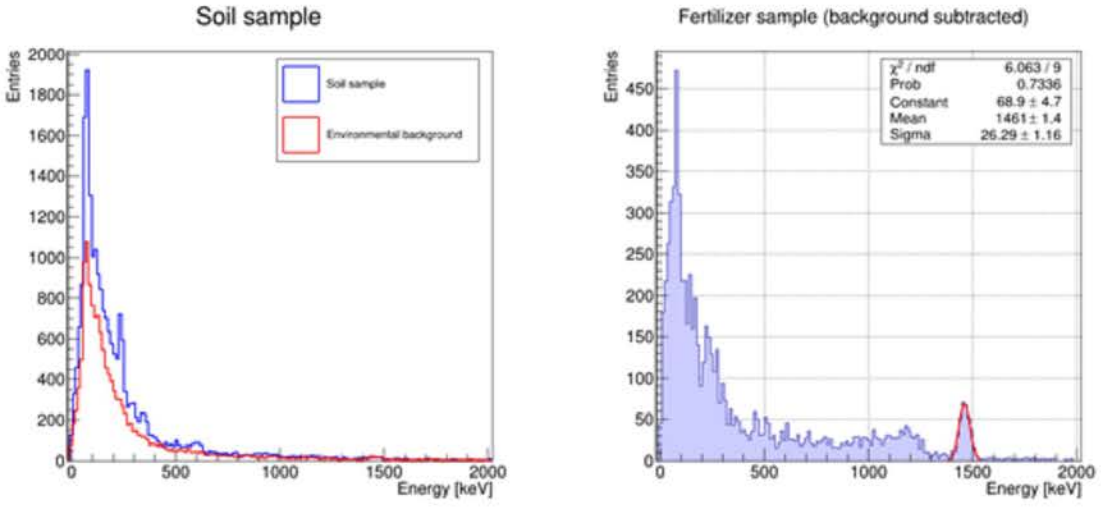
Check the waveform, modify the threshold and gate width, if needed, then start the measurement of the energy spectrum.

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}K peak can be seen in the background spectrum too. The ^{40}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 (SG6140C).



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

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