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Tools for Discovery

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HANDBOOK OF EXPERIMENTS

SG6152E Environmental Radioactivity Outdoor

Human body radioactivity

Environmental radioactivity

EDUCATIONAL KIT

SP5640

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Human body radioactivity

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 **SP5640** educational kit.

Equipment: SP5640 – Backpack Detector

Model	**SP5640**
Description	Backpack Detector

Purpose of the experiment

The purpose of the experiment is to become aware of the radioactivity of the human body.

Fundamentals

Potassium is essential to all living beings, including humans, where it's found especially in the muscle tissue. It can be found in most soils, building materials, plants and animals and it is typically used in fertilizers.

In nature there are only three isotopes of potassium: ^{39}K (93.3% of weight abundance), ^{41}K (6.7%) and ^{40}K (0.0117%). While ^{39}K and ^{41}K are stable, ^{40}K is a radioactive isotope with a half-life of $1.28 \cdot 10^9$ years and it is one of the most common responsible for the so-called terrestrial radiation.

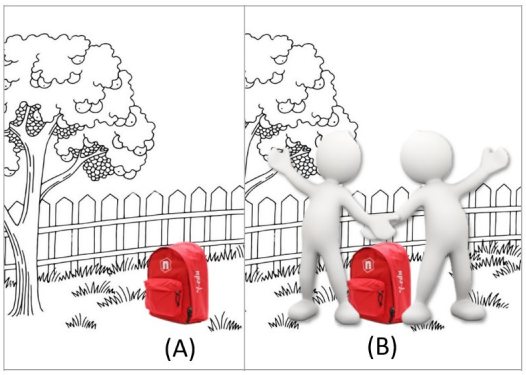
Considering the relative abundance, only twelve of a hundred thousand potassium atoms are actually radioactive, i.e. approximately for 1 *g* of potassium, 31 nuclei decay per second [~ 31 Bq/g]. This fact implies that one banana of 150 g contains about 525 mg of potassium which corresponds to ~16 Bq activity, and similarly, an adult man (70 kg) has about 140 g of potassium which corresponds to ~ 4400 Bq.

^{40}K decays 89.3% of the time to the ground state of ^{40}Ca by pure β-emission and 10.7% of the time by electron capture to an excited state of ^{40}Ar which then decays γ reaching the stability. The emitted photon has an energy of 1460.86 keV and can be used in order to identify and quantify the activity concentration of ^{40}K in sites of measurement and in the environmental samples.

Requirements

No other tool is needed.

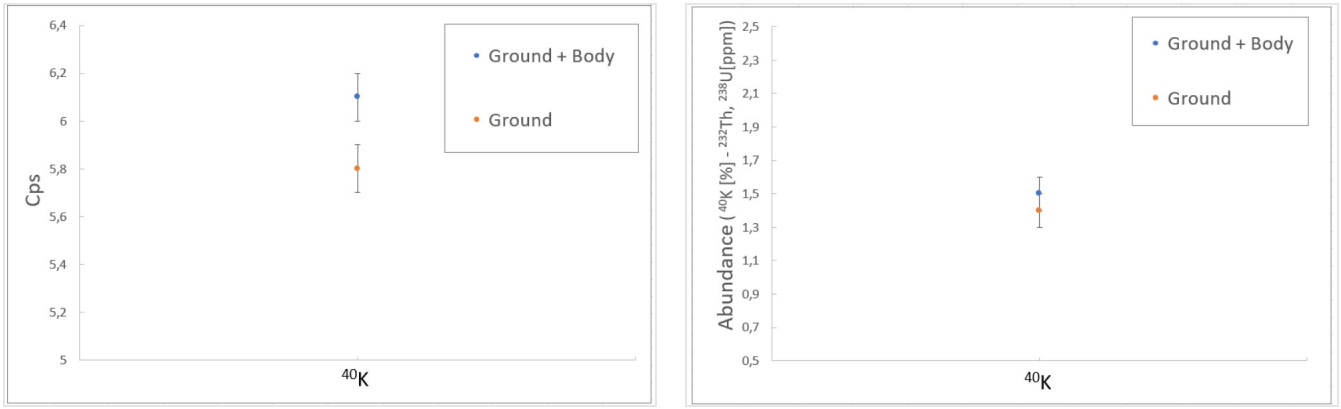
Carrying out the experiment



- Power on the γ-stream inside the red backpack.
- Power on the tablet and associate the two devices via Bluetooth.
- Take care that the γ-stream internal battery is charged, otherwise use the external power system.
- Start the experiment by placing the backpack on the ground and be sure that your presence is far enough from the measure point not to be revealed (A).
- Set the acquisition time to about 5 minutes and see the results. If the statistic is not enough increasing the acquisition time.
- Repeat the measurements leaving the backpack in the same position together with just your presence or more (B).

Results

The measurements results show how the detection of the ^{40}K in situ is dependent of the human presence weakly.



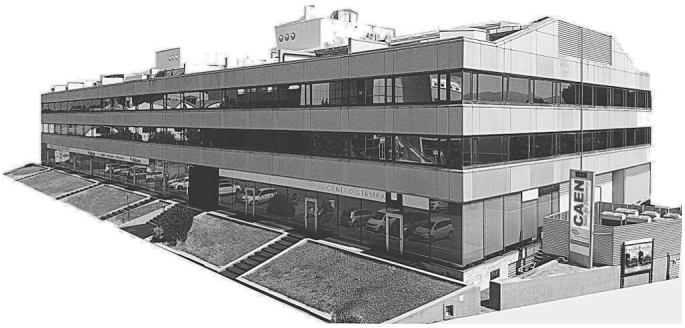
Experimental result of in-situ γ-ray coming from ^{40}K [1460 keV] with and without people presence.

HEADQUARTERS

CAEN S.p.A.

Via Vetraia 11
55049 - Viareggio
Italy

Phone +39 0584 388 398
Fax +39 0584 388 959
info@caen.it
www.caen.it



WORLDWIDE

CAEN GmbH

Brunnenweg 9
64331 Weiterstadt
Germany
Phone +49 212 254 40 77
Fax +49 212 254 40 79
info@caen-de.com
www.caen-de.com

CAEN Technologies, Inc.

1 Edgewater Street - Suite 101
Staten Island, NY 10305
USA
Phone: +1 (718) 981-0401
Fax: +1 (718) 556-9185
info@caentechnologies.com
www.caentechnologies.com

CAENspa INDIA Private Limited

B205, BLDG42, B Wing,
Azad Nagar Sangam CHS,
Mhada Layout, Azad Nagar, Andheri (W)
Mumbai, Mumbai City,
Maharashtra, India, 400053
info@caen-india.in
www.caen-india.in

CAENsn SAS

Gare du Nord Business Centre 14,
Rue De Dunkerque
75010 Paris
France
info@caen-sn.fr
www.caen-sn.fr