



CAEN Educational Handbook

Nuclear and Particle Physics Experiments



<https://edu.caen.it>

SP5640 - GAMMAEDU

Difficulty



Execution Time



Purpose of the experiment

Increase of the familiarity with environmental radioactivity topic via measurements in field which combine nuclear engineering and computer science for a better comprehension of basic physics concepts.

Fundamentals

Potassium is a natural element whose radioactive isotope ^{40}K is widely available on Earth, especially in food and in human bodies. Radioactivity is a physical phenomenon occurring when an unstable nucleus undergoes a transition from one energy state to another. In addition to the cosmogenic radionuclides, natural sources include the so-called primordial radionuclides existing since the

Earth formed and that have not completely decayed due to their long half-life ($\sim 10^9$ years and longer). The most common isotopes in the Earth responsible for the so-called terrestrial radiation are Uranium (^{238}U), Thorium (^{232}Th), and Potassium (^{40}K), together with their multiple daughter products. It is estimated that 80% of the average annual dose for the world's population comes from natural background radiation. While ^{40}K undergoes one single decay, ^{238}U and ^{232}Th produce decay chains that comprise α , β , and/or γ decays.

Requirements

No other tools or instruments are needed.

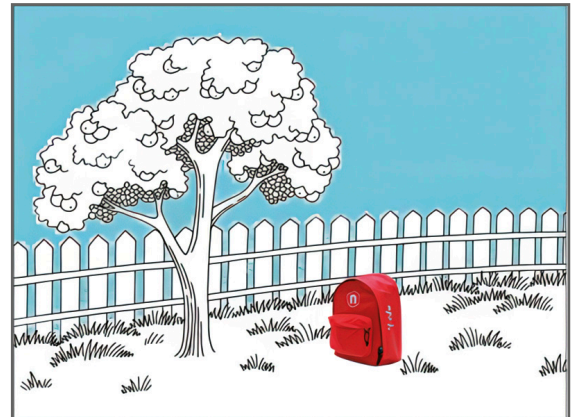
Carrying out the experiment

Power on the ystream inside the red backpack. Power on the tablet and associate the two devices via Bluetooth.

Take care that the ystream internal battery is charged, otherwise use the external power system.

Start the measurement campaign in land field and place the backpack on the floor almost 1m far from the trees, manhole or other construction. Set the acquisition time to about 5 minutes and see the results. If the statistic is not enough increasing the acquisition time.

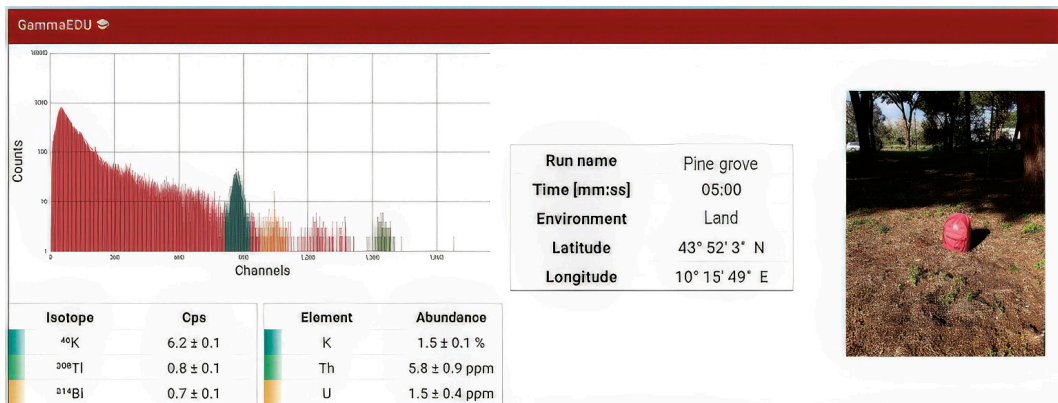
It is good practice to repeat the measurement in order to obtain the mean and standard deviation of the result.



Experimental setup block diagram.

Results

The measurement results are compared to the reference values in the terrestrial crust. The discrepancy in the reference levels can be explained by the building material, distance from soil and more. This kind of measurement is important for the evaluation of natural radiation exposure from building materials [2013/59/Euratom Directive and by UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation)].



Experimental result of in-situ γ -ray spectroscopy taken place in Viareggio, Italy.