

Study of background radiation during low-level gamma spectroscopy measurements



Laboratory / Team	Institute of Nuclear Physics, Orsay (IPNO) – Noyaux Exotiques Structure et Réactions (NESTER) http://ipnwww.in2p3.fr/NESTER-Noyaux-Exotiques-Structure-et-Reaction
Contact	Nikola Jovancevic: jovancevic@ipno.in2p3.fr
Main topics	Experimental nuclear physics
Objectives/context	Analysis of background activity during gamma spectroscopic measurements with HPGe detectors
Equipment / resources / tools / software used	Good knowledge of C++ required LINUX environment – ROOT data analysis software
Level / Duration / Period	Master 1/ 2 to 5 months / April 2019 - July 2019
Number of trainees	1 student / course period

Course description / main tasks

Gamma spectroscopy using high-resolution HPGe detectors is a commonly used method in many research areas such as nuclear and particle physics, geophysics, environmental science and astrophysics. One of the most important tasks in the gamma spectroscopy measurements is to discriminate certain events from all kinds of background events. Hence, background reduction is one of the most significant ways to improve the sensitivity of an experiment, for example in the search for dark matter or neutrinoless double beta decay. It is then necessary to understand the origin of the background radiation in the used gamma spectroscopic system. The background activity is due to the activity from natural radionuclides and cosmic radiation. The cosmic radiation (mostly muons at sea level and at shallow depths) can produce measurable activity by interactions with detectors and surrounding materials. In those processes, neutrons are created and their interactions give a new component of background radiation. Different approaches can be used to reduce the level of background activity such as the construction of passive shield (usually from lead), the use of active veto shield detectors or building deep underground laboratories.

The student will proceed to the data analysis for the collected gamma spectra during long time low-background gamma spectroscopic measurements. The measured data will be analyzed by different HPGe detector systems with different kind of shield. The different sources of background radiation will be identified; the flux of thermal and fast of the neutron in the detector system will be calculated as well as the contribution of the cosmic radiation to the resulting background radiation. The characteristics of various detectors systems and different background reduction strategies will also be analyzed.

Skills acquired on completion of the course

- Detection of particles and their interaction with the material.
- Gamma spectroscopy.
- Instrumentation for gamma detection.
- Understanding of the software for gamma spectra analysis.
- Understanding of different source of background gamma activity.