Alpha and gamma spectroscopy using semiconductor detectors based on Ge and Si. Determination of the main characteristics of detectors with standard OSGI and OSAI sources.

Laboratory and group:

JINR Flerov Laboratory of Nuclear Reactions, Sector 7.

Supervisors:

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Overview:

Preparation of measurement systems and calibration of detectors with calibration sources is a mandatory part of each experiment, whether it is working with experimental beams or subsequent activation measurements. Accurate calibration and known characteristics of the detectors are essential. This summer workshop offers a practical approach to understanding gamma and alpha radiation, the use of semiconductor detectors based on Ge and Si crystals



Ge(Li)-Gamma detector

Si-Alpha detector

Objectives:

1. Gaining skills in working with semiconductor detectors and electronics for a basic data acquisition system. Gain practical experience using standard gamma sources for detector calibration.

- 2. Understand and apply basic procedures for radiation safety.
- 3. Study the principles of operation of electronics for data entry systems.
- 4. Learn to analyze the obtained spectra using Gamma-MCA, OriginLab, rootCERN programs, LISE++.

Practical orders

1. Setting up basic electronics circuits for data acquisition

2. Measure the energy spectra of standard γ - sources and α - sources, process the spectra by determining the average values of

the total absorption peak positions, their widths, areas under the peaks, etc. Plot the functions (linear and second-degree polynomial) of the energy calibration using the tecnique of least squares. Determine the range of application of the linear calibration. Measure the energy spectra of the γ -sources studied. Determine the energies of γ transitions of the investigated sources by the positions of the total absorption peaks in the energy scale, which has been received in the energy calibration of the spectrometer. According to table of characteristic γ -transitions identify the investigated source.

Determine the thickness of a substance by the method of specific energy losses of α -particles

3. Analyze the measured spectra and determine the parameters of the spectrometer:

- detector resolution;

- detection efficiency in the total absorption peak;

- energy resolution.

Expected Outcomes:

- 1 Skills in working with semiconductor detectors and sources of ionizing radiation.
- 2 Experience in working with measuring electronics, skills in setting up experimental equipment.
- 3 Experience in processing the obtained data in the rootCERN, OriginLab programs.
- 4 Understanding of the problems associated with measurement methods and experimental techniques.

Duration:

2-3 weeks (June-July 2025)

Requirements:

- 1. Basic knowledge of the physics of ionizing radiation.
- 2. Basic knowledge of C++

Notes:

The description only lists the most basic tasks. The practice may optionally include: Semiconductor X-ray spectrometer and Mosseley's law. Comparison of the characteristics of scintillation detectors (CeBr3) and semiconductor (HPGe). The project can be organized for 2-3 student(s).



recommended for review:

 $https://drive.google.com/file/d/1 hvRntIdeaKnhvsfaV9BLn3zGSBHcz_yW/view?usp=sharing$