Calibration and Characterization of a CsI(Tl) Scintillator Detector with Gamma Sources

Laboratory and group:

JINR Flerov Laboratory of Nuclear Reactions, Sector 6.

Supervisors:
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Overview:
This summer student project offers an introduction to fundamental experimental techniques in nuclear physics, with a focus on gamma-ray detection using scintillation detectors. Through the context of a 1"×1" CsI(Tl) scintillator, students will explore essential concepts such as detector response, energy calibration, and gamma interaction mechanisms. While the hands-on component is limited, the project emphasizes simulation and data analysis as tools to understand and optimize detector performance—skills that are increasingly important in experiments involving exotic nuclei and radioactive ion beams (RIBs).
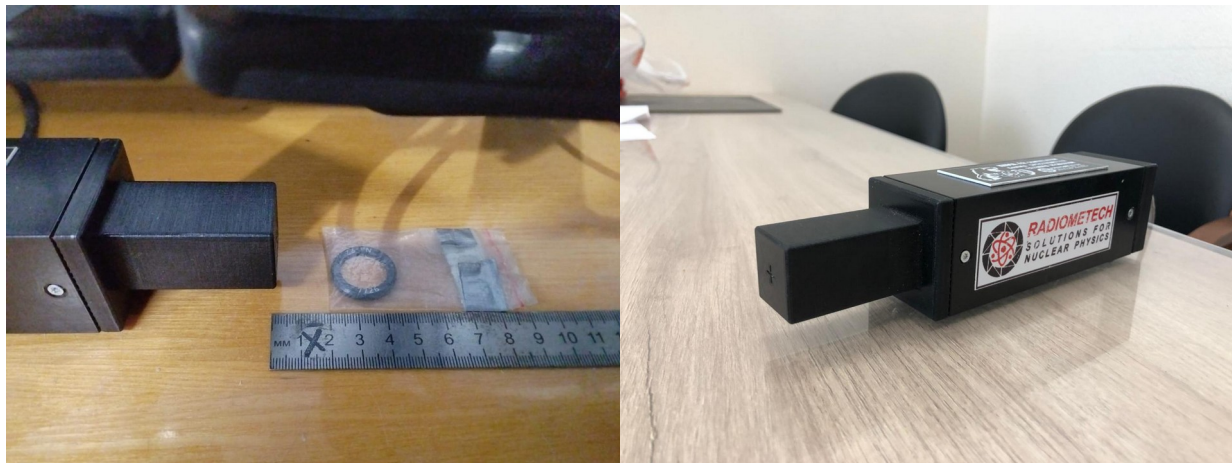
Objectives:

- Develop an understanding of gamma-ray interactions with matter and their relevance to scintillation detection.
- Learn to set up and operate a CsI(Tl) scintillation detector.
- Gain practical experience using standard gamma sources for detector calibration.
- Understand and apply basic procedures for radiation safety.
- Acquire and analyze calibration spectra using CERN ROOT.

Key Activities:

- Develop and run simulations to study gamma-ray interactions with a CsI(Tl) scintillation detector.

- Setting up a basic measurement system using standard gamma sources for energy calibration.

- Analyze simulated or experimental spectra to extract peak positions and determine energy resolution using CERN ROOT.

- Perform energy calibration and construct the energy resolution curve for the CsI(Tl) detector based on analysis results.

Expected Outcomes:

- Practical knowledge of gamma spectroscopy techniques.

- Familiarity with CsI(Tl) detector characteristics (light output, resolution, timing).

- Experience with analysis tools used in nuclear physics.

- Preparation for future involvement in full-scale detector systems.

Duration:
2–3 weeks (September 22 – October 10 2025)

Requirements:

- Basic understanding of how gamma radiation interacts with matter.

- Willingness to learn about scintillation detectors and safety protocols.

- Introductory programming skills in C++.

- Some familiarity with CERN ROOT (or readiness to learn during the project).
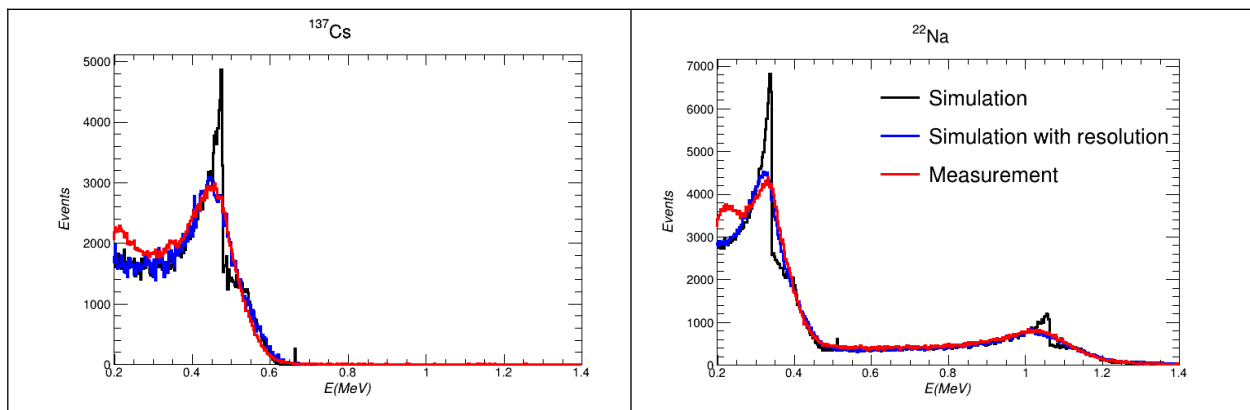
Notes:

This practice is part of the broader effort to prepare knowledge and practical skills necessary for setting up detection systems for studies of exotic nuclei at facilities such as ACCULINNA-2. It is well-suited for students new to experimental nuclear physics who

wish to gain foundational laboratory experience. The project can be organized for 1-2 student(s).

Literature for preparation:

W. R. Leo, Techniques for Nuclear and Particle Physics Experiments.