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SCINTILLATION DETECTORS ARRAY GADAST FOR THE INVESTIGATION OF PROTON RADIOACTIVITY REACTIONS

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Scintillation detectors based on CsI(Tl) crystals are a widely used instrument in nuclear physics,especially in the field of gamma-ray spectrometry and/or fast light charged particles. Large CsI(Tl) crystals like ours with a volume of ~370 cm³ , are used in many collaborations [1-3].
GADAST (GAmma-ray Detector Around the Secondary Target) is a compact detector array as a part of EXPERT setup [3], intended to be located in the middle of the Super-conducting FRagment Separator (Super-FRS) facility, situated at the Facility for Antiproton and Ion Research (FAIR), Darmstadt, Germany. The array consists of 128 CsI(Tl) and 32 LaBr₃ scintillators coupled with photomultipliers and is designed mainly to detect gamma radiation from the de-excitation of secondary beam heavy fragments, produced in two-proton radioactivity processes. Such processes are of great interest because the mechanisms of their formation are poorly understood, and many of the isotopes that possess this phenomenon are either insufficiently studied or completely undiscovered. An example of an experiment with GADAST is a study of properties and potential proton radioactivity of an exotic isotopes ⁵Be, ⁶B, ⁷C and ⁹N.
In this work the properties of CsI(Tl) based detectors were investigated. Characteristics that were measured are energy resolution and non-uniformity of the light output. ExpertRoot package [4], which uses Monte Carlo methods for simulating particle interactions, was employed to simulate the experimental setup, in order to study the influence of various parameters on the final spectrum. We implemented an original algorithm for modeling the signal overlaps observed due to the high intensity of the gamma-ray sources. In the future, we plan to use the pulse pile-up algorithm when GADAST modules will be located in the region of a target bombarded by a heavy ion beam with high intensity. We also modeled the non-uniformity of the light output, as it may be necessary to consider it when working with large-size crystals like those used in GADAST.

References

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3. https://edms.cern.ch/document/1865700/2, Technical Report for the Design, Construction and Commissioning of the setup EXPERT: Exotic Particle Emission and Radioactivity by Tracking
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