

RAPORT ȘTIINȚIFIC 2023

PN-III-P4-PCE-2021-0595

Rezumat executiv

For the theoretical part of the project the work on the EDF+QPM model has continued especially with focus on ^{56}Fe . In addition to this work, an extensive review effort has been undertaken for a detailed overview on available photonuclear data as well as a complete overview of the existing experimental and theoretical status on the light nuclei that will be critical for the PANDORA project.

From the experimental side, at the IFIN-HH facilities, we have finalized the complementary experimental setup including large-volume $\text{LaBr}_3\text{:Ce}$ detectors and the $\Delta E - E$ telescope setup for charge-particle identification. This setup has been successfully used to collect data and the details of this work has been published in an ISI journal as well as in a Bachelor's Thesis, as reported below. The complimentary experiments at the IFIN-HH facilities focusing on ^{10}B , ^{12}C , and ^{19}F that will be used to benchmark *ab initio* calculations are in the final stages of analysis.

For iThemba LABS the scheduling of the experiments are experiencing a delay which has been discussed in the Technical status report of this project. To compensate for this delay, a proposal has been submitted to, and accepted by, the Krakow CCB PAC, where 200 MeV proton beams are also available. Instead of magnetic spectrometers, however, the inelastic proton identification and the energy measurements will be performed by the KRATTA array that has been used successfully for this kind of measurements there before. The experiment is expected to be scheduled for late spring in 2024. In addition to KRATTA, the setup will contain the PARIS detectors for high-energy γ -rays and the ELISSA endcap detectors that will fulfill the role of the CAKE silicon array at iThemba LABS. The complimentary experiment carried out in 2022 using the $^{19}\text{F}(p, \alpha)$ reaction at the 3MV Tandem facility at IFIN-HH is almost complete in the analysis and a publication from this work is expected in 2024.

At Research Center for Nuclear Physics (RCNP), the analysis of the first experiments combining the SAKRA silicon detector and the Grand Raiden spectrometer have been completed by the PhD student attached to the project. The results from this analysis is currently in a manuscript under preparation. Furthermore, the first full experiment of the PANDORA project has been carried out where data was collected on ^{10}B , ^{11}B , ^{12}C , ^{13}C , ^{27}Al , ^{24}Mg , and ^{26}Mg at zero degrees and at finite angles, 4.5 and 6.6 degrees with proton energies of 392 MeV. This data includes, in addition to the Grand Raiden spectrometer, also the SAKRA silicon detector array for emitted protons and α particles and the SC γ LLA $\text{LaBr}_3\text{:Ce}$ detector array for emitted γ -rays during the decay of the compound nucleus. The data is currently under analysis.

The following scientific articles have been published, or are in the process of being published, during this phase of the project:

- S. Aogaki, D. L. Balabanski, R. Borcea, P. Constantin, C. Costache, M. Cuciuc, A. Kuşoğlu, C. Mihai, R. E. Mihai, L. Stan, et al., A setup for high-energy γ -ray spectroscopy with the ELI-NP large-volume $\text{LaBr}_3\text{:Ce}$ and CeBr_3 detectors at the 9 MV Tandem accelerator at IFIN-HH, *Nucl. Instrum. Methods Phys. Res. A*, **1056**:168628, 2023.
- P.-A. Söderström, A. Kuşoğlu, and D. Testov, Prospect for measurements of (γ, n) reaction cross-sections of p -nuclei at ELI-NP, *Front. Astron. Space Sci.*, **10**:1248834, 2023.
- A. Kuşoğlu, and D. L. Balabanski. Renewed Interest in Spectroscopy of the Lightest Doubly-Odd $N = Z$ Nuclei, *Quantum Beam Sci.* **7**:20, 2023
- R. A. Guțoiu, Possible Giant Dipole Resonance studies at ELI-NP, Bachelor Thesis, Universitatea din București, 2023. Supervisors: Dr. P.-A. Söderström and Dr. M. Pârvu