



PhD position in experimental physics and Machine Learning

Towards Intelligent VAMOS++: Physics-Informed AI for Adaptive and Reproducible Nuclear Instrumentation

Description:

Recent developments at GANIL have demonstrated the opportunities opened by AI methods for trajectory reconstruction, particle identification and self-supervised detector calibration in the VAMOS++ magnetic spectrometer and associated detectors for fission studies.

This PhD project will extend these advances into an integrated framework for **intelligent instrumentation**, combining calibration, reconstruction, and performance monitoring. The objective is to develop robust, scalable and transferable methods that adapt to changing experimental conditions while preserving the reliability of physical observables. The candidate will:

- Develop joint calibration and reconstruction methods using physical constraints and complementary detector measurements.
- Address detector drifts, nonlinear responses, saturated signals and transfer between experimental campaigns.
- Quantify uncertainties and detect anomalies, with validation against independent experimental references.
- Implement the methods for online data acquisition of VAMOS++ and assess transferability.

The work will combine AI development, analysis of existing datasets and experimental validation.

The project will support fission studies from fundamental mechanisms to nuclear-data needs, improving the reliability of isotopic yields, fragment kinematics and fission probabilities. A standardized, reproducible framework will enable systematic reprocessing and harmonization of existing and future datasets, supporting consistent normalization across campaigns through documented references and corrections.

Expected outcomes include new physics-informed learning methods, an integrated VAMOS++ demonstrator and reusable scientific software.

Expected skills:

- Strong foundations in quantitative methods, statistics and scientific computing.
- Advanced Programming experience in Python and experience in machine learning techniques.
- An interest and experimental instrumentation and nuclear physics.
- The ability to work independently and collaboratively, with careful attention to validation and reproducibility.
- Good scientific communication skills in English.

Experience with neural-network frameworks, detector-data analysis or ROOT would be beneficial.

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