PhD position in computing techniques (AI) for experimental physics

Artificial Intelligence for Mass Measurement of Exotic Isotopes

Description:
The PhD thesis consists in optimizing the precision of mass measurements of exotic isotopes by using states-of-the-art acquisition techniques, which include machine learning/Artificial Intelligence.
The Super Spectrometer Separator (S^3) facility at GANIL-SPIRAL2 will produce in the coming years unprecedented intensities of exotic isotopes by fusion reactions in the N=Z region around the doubly magic ^{100}Sn and in the Z>92 transactinide / superheavy region. With the S^3-Low Energy Branch (S^3 LEB) a number of isotopes will be available for precise laser spectroscopy and mass measurements. The Piège à Ions Linéaire du Ganil pour la Résolution des Isotopes en Masse (PILGRIM) is a Multi-Reflection time-of-flight Mass Spectrometer (MR-ToF-MS), which has demonstrated a relative accuracy of 10^{-7} and a resolving power above 10^5 with an off-line alkali ion source. These states-of-the-art performances were obtained with low ion detection rates (a few pps). A recently improved ion detection system permitting the generation of very short signals (<1.4ns FWHM) will enable to cope with higher rates. In order to benefit fully of this improvement, the FASTER data acquisition system needs to be upgraded with a high frequency sampling rate, from the present 500 MHz to 5 GHz. This upgrade is now being undertaken at LPC Caen. The new FASTER acquisition will have then to be adapted to the needs of PILGRIM, for the efficient and precise measurement of time-of-flights of individual ions within narrow bunches (10-20 ions in a bunch of ~100ns). Machine learning techniques will have to be employed for the pattern recognition of events, to account for pile-ups, gain deficit and baseline fluctuation for high rates that will affect the precise determination of the time-of-flights. The PhD student will assume responsibility in developing these techniques with the FASTER developers and the physicist in charge of PILGRIM. He/She will be involved in all the upgrades of PILGRIM for improving its resolution and accuracy. He/She will contribute the first data taking with on-line radioactive ion beams delivered by S^3 LEB, in order to probe the reliability of the upgraded acquisition system, and in order to probe nuclear physics models away from stability.

Expected skills:

- Computing techniques including machine learning / AI
- Familiar with techniques used in experimental physics for the detection of particles
- Basic knowledge of statistics for the analysis of experimental data
- Interested in basic science, nuclear physics models and theory
- Fluent in English

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