



PhD position in experimental nuclear physics

Target Ion Source System for the Development of the $^{39}\text{Ca}^+$ Beam for the MORA Experiment

Description:

The *Matter's Origin from RadioActivity* (MORA [1, 2]) experiment aims to search for signatures of CP violation in the nuclear beta decay that could help explain the matter-antimatter asymmetry observed in the Universe. The most sensitive and complementary isotopes for this search for physics beyond the Standard Model are ^{23}Mg and ^{39}Ca .

MORA is currently taking data at the University of Jyväskylä, where both isotopes are produced with beam intensities of approximately 10^5 particles per second (pps). At GANIL, where the experiment is expected to reach its highest sensitivity, beam intensities exceeding 10^7 pps are anticipated. While such intensities have already been achieved for ^{23}Mg , they remain out of reach for ^{39}Ca due to the chemical reactivity of calcium, which makes it a particularly challenging element to handle.

The objective of the PhD thesis is to develop a Target Ion Source System (TISS) optimized for the production of a $^{39}\text{Ca}^+$ beam. The design will be based on the highly innovative TULIP system [3], which has demonstrated excellent performances in producing short-lived exotic isotopes of Rb. Adapting TULIP to operate with fragmentation targets will open promising new avenues for the production of intense exotic beams at GANIL.

The work will be conducted within the Radioactive Beam R&D team at GANIL, in close collaboration with experts in target and ion source development. It will combine experimental studies, modelling, and system design, with encouraged participation in data-taking campaigns at Jyväskylä, where an alternative isotope production technique is employed.

The PhD thesis is funded by the ANR ACCLAIM MORA project and will contribute to advancing the beam production capabilities essential for next-generation precision measurements in fundamental physics, see <https://mora.ganil-spiral2.eu/>.

Expected skills:

The PhD student has to be interested in experimental physics, solving engineering problems in challenging contexts, and knowledgeable in programming (python, C, C++ or other languages). The PhD student will be part of the TISS development group and of the MORA team at GANIL

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- [1] P. Delahaye, E. Liénard, I. Moore, M. Benali, M. L. Bissel, L. Canete, T. Eronen, A. Falkowski, X. Fléchar, M. Gonzalez-Alonso, W. Gins, R. P. D. Groote, A. Jokinen, A. Kankainen, M. Kowalska, N. Lecesne, R. Leroy, Y. Merrer, G. Neyens et al., “The MORA project,” *Hyperfine Interact.*, no. 240, pp. 63 - 75, 2019.
- [2] N. Goyal, A. Singh, S. Daumas-Tschopp, L. M. Motilla Martinez, G. Ban, V. Bosquet, J. F. Cam, P. Chauveau, S. K. Chinthakayala, G. Fremont, R. P. De Groote, F. de Oliveira Santos, T. Eronen, A. Falkowski, X. Flechard et al., “Performance of the MORA Apparatus for Testing Time-Reversal Invariance,” *Eur. Phys. J. A* (2025) 61: 221, 2025.
- [3] P. Jardin, M. MacCormick, V. Bosquet, P. Chauveau, S. Damoy, P. Delahaye, M. Dubois, M. Fadil, M. Lalande, C. Michel and J. C. Thomas, “Sub-millisecond atom-to-ion transformation in the TULIP ISOL system,” *Nucl. Instrum. Meth. A*, vol. 1055, p. 168332, 2023.