PhD position in experimental nuclear physics

Development of an alpha-decay detection system for laser spectroscopy of superheavy elements

Description:
Superheavy element (SHE) research has an enormous impact on nuclear physics, cosmology and relativity. Although the synthesis of a new element is in itself a milestone in human history, the impact on fundamental concepts requires a detailed physical and chemical characterisation of an element. Spectroscopic characterisation is the most precise means of deciphering information about the electronic structure of an element, and thus provides a fertile ground for advancing our understanding of how these atoms work, in addition to the classic advantage of hyperfine spectroscopy, which bridges atomic and nuclear physics. Research in this field is currently focusing on the heaviest actinide element lawrencium (Z = 103), which has so far eluded optical spectroscopy [1,2]. To make this possible, a novel way of optical spectroscopy, the so-called Laser Resonance Chromatography (LRC), is being prepared for first online experiments at the S^3 facility of GANIL/SPIRAL2. The new technique is simple, efficient, and sensitive enough to identify the spectral lines of the elements, even when they are synthesised on an atom at a time scale and decay within seconds of their production.

In this PhD project, an assembly of an ion steerer and a double-sided silicon strip detector (DSSD) will be developed and used as the detection front-end of a laser spectroscopy instrument at S^3. A radium-225 offline source (Z = 88) will be used to provide a proof of principle for background free ion detection. Subsequently, the LRC technique will be applied to spectroscopy various actinium isotopes (Z = 89) prior to studying the superheavy elements.

The successful candidate will assist in the design, construction, and assembly of the LRC instrument, with particular emphasis on the development of the detection front-end, including associated data acquisition and experiment control. Following the commissioning of the steerer-DSSD assembly, the candidate is expected to participate in laser spectroscopic investigations and publish the results in peer-reviewed journals.

[1] M. Laatiaoui *et al.*, Phys. Rev. Lett., **125** (2020) 023002.
[2] E. Kim *et al.*, Nucl. Instrum. Methods Phys. Res. B, **555** (2024) 165461.

Expected skills:
Very good level in atomic and nuclear physics academic knowledge. Affinity for experimental work. Teamwork capabilities. Good communication skills in English (verbal and written). Knowledge of scientific programming (C++, ROOT, Python).

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