



PhD position in experimental physics

Development of a helium-based stopping cell for laser spectroscopy experiments at S³

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 S³ 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 ANR funded PhD project, a cryogenic stopping cell to be placed at the S³ focal plane will be developed and coupled to the detection frontend of the LRC apparatus. Offline recoil sources such as radium-223 will be used to characterize ion extraction from this helium-based cell. Subsequently, the LRC apparatus will be used to study various actinium isotopes ($Z = 89$) in online spectroscopy experiments prior to studying 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 cryogenic stopping cell, including associated experiment control. Following the commissioning of the LRC apparatus, 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). Experience with SIMION and COMSOL simulation packages will be considered an added qualification.

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