PhD position in experimental nuclear instrumentation

In-gas-jet laser spectroscopy optimization for high resolution measurement of actinides

Marie Curie Early Stage Research Position 2020

The objective of this PhD project is to work on the commissioning plan and the first experiment of the S3 Low Energy Branch (S3-LEB), currently under construction at the Equipex project S3 (Super Separator Spectrometer), as part of the SPIRAL2 facility at the GANIL (Grand Accélérateur National d'Ions Lourds) laboratory in Caen, France. S3-LEB will be a source for the production of new and pure radioactive ion beams at low energy as well as a laser spectroscopic tool to measure nuclear hyperfine interactions. It consists of a gas cell in which the reaction products from the S3 spectrometer will be stopped and neutralized, coupled to a laser system that assures a selective re-ionization of the atoms of interest. Owing to the unique combination of such device with radioactive heavy ion beams from S3, a new area of unknown isotopes at unusual isospin, and especially in the actinide region, will become accessible. S3-LEB will provide the Equipex project S3 with a unique tool and will become a world leading facility in laser spectroscopy of the heaviest radioactive isotopes providing essential results to validate contemporary nuclear and atomic physics models.

This project is supported by a large international collaboration (KU Leuven (Belgium), GANIL, LPC-Caen, IPN-Orsay (France), the university of Mainz (Germany), the university of Jyvaskyla (Finland), the TRIUMF laboratory (Canada) and ISOLDE at CERN) and the student will have the opportunity to contribute to scientific experiments in these laboratories and to benefit from the expertise of the partners in this network.

The student will work with the local GANIL team where the whole set-up is mounted off-line for commissioning experiments and in collaboration with all partners.

The objectives of the project are:
- Develop Ti:Sa based laser systems to cope with the atomic ionization schemes of the actinide elements
- Improve the overall efficiency of the gas cell to gain sensitivity for the shortest actinide isotopes
- Participate to the commissioning and first high-resolution on-line laser spectroscopy measurements at GANIL-S3.

The expected results are:
- Narrowband width, high power, high repetition rate Ti:Sa based laser system
- Difference frequency generation Ti:Sa laser system for nobelium ionization
- Optimized geometry of the entrance window of the gas cell for the very slow actinide
- New nuclear and atomic properties of actinides elements from the analysis of data from GANIL-S3 and comparison to state-of-the-art nuclear structure models

During the second year of PhD, the student will participate to secondments at partner institutions within the collaboration:
- JYU (Finland) and JGU (Germany): Training on the injection locked Ti:Sa cavity for high resolution laser and spectroscopy of stable isotopes in the Atomic Beam Unit
- Pantechnik (France): Design study of a vacuum-tight thin entrance window for actinide transmission in the gas cell.

Skills in the field of laser physics, atomic physics, ion manipulation and nuclear physics will be developed in the course of the PhD training.

The position is part of the LISA ITN network and will be hosted at GANIL for three years.

Contact at GANIL: Nathalie Lecesne
GANIL, BP 55027, 14076 Caen France
Phone: +33 (0)2 31 45 44 72
mail: lecesne_at_ganil.fr