PhD position in Radioactive Ion Beam development

Target development and new radioactive beams for SPIRAL1 - GANIL

Description:
GANIL (Grand Accélérateur National d'Ions Lourds) is an accelerator providing high energy ion beams to an international scientific community. These beams are used in physics research (nuclear and atomic physics, astrophysics). They are especially interesting for nuclear phsicists, as they allow to probe the current models of the nuclear interaction in exotic nuclei. They are also used for industrial R&D (e.g. testing materials for nuclear industry or space applications).
Within GANIL, the SPIRAL1 facility (Système de Production d'Ions Radioactifs Accélérés en Ligne) can produce radioactive ions through the ISOL method (Isotope Separation On-Line). Radioactive atoms are produced by fragmentation of the high-energy projectiles from the primary beam in a thick target. These atoms then diffuse outside the target and effuse towards an ion source, where they become radioactive ions, hence forming a secondary ion beam. During the 2010s, SPIRAL1 went through a major upgrade, allowing it to produce ion beams from metallic elements. SPIRAL1 has already provided several such beams for experiments, but many more could be produced. However, the production of each radioactive ion beam is a complex multiphysics problem, as the intensity of a given beam depends on the primary beam (nature, intensity, energy), on the target (material, density, structure, temperature), on the ion source (type, temperature, materials), on the required isotope (half-life, physical and chemical properties of the element) and the secondary beam characteristics (energy, purity).

Thesis Work

This thesis aims at developing new radioactive ion beams through 2 axes of R&D:

- Producing iron-like ion beams (Fe, Ni, Co) with the production of ^{56}Ni as an ultimate goal, as this beam is strongly requested in nuclear structure studies. Iron-like elements have high melting and boiling points slowing considerably their diffusion in the target and effusion towards the source. Producing those ions requires heating the target/ion-source system (whose temperature is currently limited to 1700-1800°C). The PhD candidate will participate to online production tests, will be in charge of data analysis and, following the results, will suggest design changes.
- Design, production and test of a new target and of its container in order to increase the production rate of several isotopes in the neutron deficient Cr to Sr region. The PhD candidate will work with a postdoc student on the study of the target material, on the design of the target to reach a temperature up to 2000°C, on its production and on off-line tests. The candidate will then be responsible for an on-line test and the subsequent data analysis and will quantify the gain brought by the new target for different isotopes.
- The PhD candidate will also participate to the activities of the Target/Ion-source group, such as mounting, testing and exploiting existing Target Ion Source Systems (TISS), performing on-line studies and data analysis.

Expected skills:

Knowledge:

- Solid engineering background (in particular mechanical, electrical, vacuum systems)
- General physics (in particular Heat transfer, electromagnetism, radioactivity, basics of chemistry)
- Programming: experience with at least one language or software relevant for data analysis (C/C++/Python/Matlab…)
- English, spoken and written
- Experience with modeling a physical phenomenon (numerical simulations, Monte Carlo methods, finite element calculation, etc) would be appreciated.

Practical Skills:

- Interested in instrumentation and practical science. Experience with an engineering project from design to test (for school or personal project) will be greatly appreciated.
- Writing/summarizing skills
- Capable of independent learning (books, scientific literature)
- Capable of teamwork

Contact: Pierre Chauveau
Phone: +33 (0)2 31 45 49 89
mail: pierre.chauveau@ganil.fr