PhD thesis announcement

The **experimental nuclear physics group** of the IP2I laboratory is seeking qualified applicants for a **PhD position in nuclear astrophysics** funded by the LIO LabEx. The Lyon Institute of Origins (LIO) is a long-term project gathering four laboratories of the University of Lyon, in a «Laboratory of Excellence (LabEx)» created in 2011 to investigate the topics of the origins, from the origin of matter to the origins of cosmic structures and life. It funds technical facilities, positions for young researchers, training and valorization. The research conducted at IP2I is at the crossroads of two infinities, ranging from the study of the elementary components of matter – the infinitely small – to the exploration of the cosmos – the infinitely large – including also the gravitational waves researches: our activities aim to connect experimentally and theoretically these infinities by studying the complexity of substructures such as nuclear states.

Title of the thesis : **Optical alpha-nucleus potentials and explosive nucleosynthesis**

Short description of the thesis:

Various nucleosynthesis processes are involved in the chemical composition of the Universe. Our work is focused on the **p-process nucleosynthesis**, that produces isotopes on the proton-rich side of the stability valley, and is expected to occur during **explosive stellar events**. The modeling of this process involves **extended reaction networks**, and massively resorts to theoretical cross-section calculations. However, experimental results are essential in order to adjust nuclear model parameters. **One of the main sources of uncertainties to calculate the astrophysical reaction rates is the modeling of alpha-nucleus optical potentials**. It is widely recognized that the lack of experimental data at energies below Coulomb barrier is an obstacle to the progress hoped for in this domain.

Our objective is to perform experimental campaigns to improve the knowledge of alpha-nucleus optical potentials at low energy, mainly through the study of alpha-capture reactions. This project takes place in the framework of a collaboration with other national and European laboratories, principally GANIL, IJCLab, NCSR-Demokritos (Greece) and ULB (Belgium). It is focused on the future use of high-intensity alpha beams that will be available at the NFS-SPIRAL2 facility. Such high intensities are needed to evaluate very low cross sections in the astrophysical energy domain. The IP2I group, expert in **gamma spectroscopy**, is especially involved in the development of **in-beam techniques** for cross-sections measurements. **Nuclear structure and detection system response** have to be under control. To ensure the success of the challenging NFS campaigns, realistic simulations and preparatory experiments are crucial.

The work of the LIO PhD student will be first to **improve simulation tools developed in our group, apply them to the preparation of specific experiments** at NFS (using e.g. EXOGAM or PARIS gamma detectors) and other European facilities, and also to **analyze the new data and evaluate their impact on the modeling of alpha potentials**. In this framework, collaborations could be developed with theoreticians working on alpha potentials. A stimulating perspective is also to build exchanges with a team performing numerical simulations of explosive stellar environments to better evaluate the impact of new data on the possible p-process scenarios.

Application:

The thesis is under the supervision of Dr. Olivier Stézowski (CR CNRS/IP2I, HDR, supervisor) and Dr. Camille Ducoin (MCF University Lyon 1/IP2I, co-supervisor). Salary and social benefits will be proposed in accordance to French laws and regulations. An annual 3000 € package is provided for equipment and travels.

Submit you application with your **academic achievements in the last three years**, **a letter of motivation**, and a **letter of recommendation** to Dr. Olivier Stézowski and Dr. Camille Ducoin (o.stezowski@ip2i.in2p3.fr and c.ducoin@ip2i.in2p3.fr) with a copy to Mrs Souad Lafehal (souad.lafehal@univ-lyon1.fr) **before June the 2nd, 2020**. Candidates on the short list will be **interviewed on June the 9th or 10th**, **via videoconference**. The candidate will be selected in partnership with the Doctoral School « Physics and Astrophysics ».