PhD position in experimental nuclear structure

Exploring magicity and nuclear forces in ^{68}Ni

Description:

We propose to study the magic versus superfluid character of ^{68}Ni by means of neutron adding (d,p) and neutron removal (p,d) transfer reactions. This way, we get unique access to the occupancy of the normally occupied orbits and the vacancy of the valence ones. If a sharp transition in occupancy is found, the nucleus is considered as magic, otherwise rather superfluid. Furthermore, this study also allows to study the spin-orbit and tensor forces, essential to the modeling of atomic nuclei.

The ^{68}Ni nucleus is produced by means of fragmentation reaction, selected by the LISE spectrometer at GANIL and identified by means of position-sensitive gas detectors, ionization chambers and plastic scintillators. Protons or deuterons arising from transfer reactions in CD_2 or CH_2 targets for the (d,p) or (p,d) transfer reactions, respectively are detected in the highly-segmented Si-CsI array (MUST2). When the ^{69}Ni or ^{67}Ni are produced in an excited state, their in-flight gamma-rays are detected with the segmented clover Ge detectors of the EXOGAM2 array. This way, the full kinematics of the reactions is obtained.

These two objectives of studying magicity/superfluidity and the spin-orbit/tensor forces in atomic nuclei far from stability are at the forefront of international researches. It is proposed to answer to an unresolved question for 20 years for the first item. The second is a rather new field of research that I initiated some years ago to use spin-orbit splitting's as probes of the different components of the nuclear force. In particular, the role and amplitude of the tensor force is still a major puzzle: claimed to be absolutely essential in some theoretical approaches, it is not considered at all by others. Reaching a better understand of the role of nuclear forces is essential to reach a predictability for so far unknown nuclei, such as those produced in explosive stellar burnings.

During his/her PhD, the student will participate to several experiments planned at the LISE spectrometer in an international collaborative work, dealing with topics on nuclear clustering, nuclear astrophysics, or fundamental symmetries, thus enriching his/her experimental skills and nuclear physics background over the years, while working on his/her own project.

Expected skills:

root software analysis, detectors such as Ge, Si or/and gas-filled detectors, ability and pleasure to work in a team.

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