Experimental studies of nuclear clusterisation & fragmentation in heavy-ion collisions

Experimental nuclear physics internship

Over the last two decades, the study of heavy-ion collisions with the INDRA charged particle multidetector has produced major advances in the understanding of nuclear matter dynamics and thermodynamics. Nevertheless, most of the experimental results lack a crucial dimension: as INDRA can only provide Z identification for all but the lightest elements, we still do not know how neutrons are shared between the many intermediate mass fragments (Z=5~20) produced in the reactions. The relative number of neutrons and protons in such fragments is sensitive to the symmetry energy component of the nuclear equation of state, a quantity whose density dependence is still poorly constrained, and is a crucial ingredient for the understanding of neutron stars and supernova explosions.

This is why the FAZIA and INDRA collaborations intend to couple these two detector arrays at GANIL in order to perform the most complete measurements to date of the formation and decay of hot nuclei in intermediate energy heavy-ion collisions. FAZIA is a new modular array composed of blocks of 16 telescopes which allow Z and mass identification for fragments with Z up to 25: the isotopic resolution achieved is that of a magnetic spectrometer, but without the attendant limits in acceptance. 12 blocks of FAZIA (192 telescopes) will be placed at the most forward angles in place of the first 5 rings of INDRA (leaving the remaining 241 telescopes in place) in order to perform these experiments. The installation and testing of FAZIA in the INDRA reaction chamber will begin in summer 2018. Experimental proposals will be submitted at the next PAC meeting, hopefully for the first experiments to be performed in 2019.

The candidate will be able to participate in setting up and testing the coupled FAZIA@INDRA arrays; perform simulations of the expected performances of the device in order to test the feasibility of proposed experiments; and participate in analysis of the existing INDRA and FAZIA data.

Skills required : solid background in nuclear physics; good knowledge of thermodynamics and statistical physics could be useful; computer skills, familiarity with C++ would be an advantage.

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