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Light and Heavy Fragment Mass Correlation in the 197Au+130Te Transfer Reaction

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The production of neutron-rich nuclei in the mass region A ~ 200, in particular along the neutron closed shell N = 126, has recently received strong attention since these nuclei are fundamental to understand different physical aspects, from the shell evolution far from stability to the investigation of the path chosen by the r-process to synthesize the heavy elements.
Multinucleon transfer (MNT) reactions between neutron-rich projectile and target have been indicated as a promising tool to produce heavy neutron-rich nuclei but a complete understanding of the reaction mechanism and a precise measurement of the production cross sections are hindered by the difficulties in identifying nuclei with A ~ 200 in mass and nuclear charge with the present techniques.
In this context we performed an experiment to study MNT reactions at near-barrier energies in the 197Au+130Te system employing a method which consists of the simultaneous detection of light and heavy transfer products where one of the reaction partners (the light one) is identified with high resolution. We exploited the performance of the PRISMA spectrometer to identify isotopes in the tellurium region, while the coincident Au-like partners were detected with a dedicated set-up specifically built and coupled to PRISMA.
We reconstructed the mass and charge of the light reaction partner through an event-by-event trajectory reconstruction in PRISMA and compared the extracted cross sections for neutron transfer channels with the ones calculated with the GRAZING code. Thanks to the kinematic coincidence we determined the mass of the heavy partner assuming a binary character of the reaction. For each Te ion identified in PRISMA we obtained the coincident mass distribution of the heavy partner through a mass-mass correlation matrix. Comparing these mass distributions with those obtained with Monte Carlo simulations of the scattering process and the subsequent de-excitation, we could quantitatively infer about the behavior of the heavy partner and the contribution of evaporative effects on the population of neutron-rich heavy nuclei.
The analysis and main results of the experiment will be presented. The possibility to employ a similar method in forthcoming experiments with radioactive ion beams will be critically discussed.

Selected session

Nuclear Structure and Dynamics

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