Constraining the density-dependence of the symmetry energy by cross section measurements at R3B

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The R3B (Reactions with Relativistic Radioactive Beams) experiment, a flagship instrument of the NUSTAR collaboration at the GSI/FAIR facility in Darmstadt, is designed for kinematically complete reactions studies. Part of the R3B physics program is to constrain the asymmetry term of the nuclear equation of state, improving our understanding of highly asymmetric nuclear matter, such as in neutron stars.

One approach to probe the density dependence of the symmetry energy near saturation density is the measurement of the neutron-skin thickness via total interaction or neutron-removal cross sections. These measurements allow for a direct comparison with reaction model predictions.

During the FAIR Phase-0 campaign, total interaction cross sections for 12C+12C collisions and charge-changing cross sections of tin isotopes were measured, serving as a stringent test of the reaction model. Building on this, the experiment was extended to 120,124,132Sn+12C collisions at relativistic energies to study the total interaction and neutron-removal cross sections of neutron-rich systems.

In this talk, I will give an overview of the experimental campaign and present results from the finalized and ongoing analyses, including dipole polarizability studies as an additional observable.