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Precision measurements for the cosmic rp-process.

The explosive nuclear burning of hydrogen at high temperatures and densities on the surface of accreting white dwarfs and neutron stars, known as rp-process, gives rise to a number of observable phenomena like Novae or X-ray bursts. Recent astronomical observations provide unprecedented information, for example on atomic abundances in Nova ejecta and time structure in X-ray bursts. The interpretation of these data requires the understanding of the nuclear processes during the explosive events and therefore information on the structure of unstable, proton-rich nuclei.

Network model calculations show that the dominant burning processes, after breakout from the hot CNO cycles at sufficiently high temperatures, proceed via proton- and alpha-induced reactions. Since the reaction rates are very sensitive to the nuclear structure involved, shell- and statistical-model calculations are often not sufficient to predict the exact reaction paths of the rp-process.

Therefore, we have been conducting experiments using high-resolution spectrometers to search for possible reaction resonances that play a role in the rp-process and determine the nuclear-structure information, in particular the excitation energy, accurately above the proton- and alpha-thresholds. The techniques involving high resolution spectrometers at forward angles including 0 degree and examples of experimental results will be presented and discussed in the contexts of efforts to measure the reactions rates directly by applying measurements in inverse kinematics using existing and planned recoil separators.

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