Approaching the Gamow Window with Stored Ions: Direct Measurement of Xe-124(p,gamma) in the ESR Storage Ring

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We report the first measurement of low-energy proton-capture cross sections of Xe-124 in a heavy-ion storage ring. Xe-124(54+) ions of five different beam energies between 5.5 and 8 AMeV were stored to collide with a windowless hydrogen target. The Cs-125 reaction products were directly detected. The interaction energies are located on the high energy tail of the Gamow window for hot, explosive scenarios such as supernovae and x-ray binaries. The results serve as an important test of predicted astrophysical reaction rates in this mass range. Good agreement in the prediction of the astrophysically important proton width at low energy is found, with only a 30% difference between measurement and theory. Larger deviations are found above the neutron emission threshold, where also neutron and gamma widths significantly impact the cross sections. The newly established experimental method is a very powerful tool to investigate nuclear reactions on rare ion beams at low center-of-mass energies.
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