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Constraining the Astrophysical γ Process: Cross Section Measurements of (p,γ) Reactions in Inverse Kinematics

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One of the main questions in nuclear astrophysics is understanding how the elements heavier than iron are forged in the stars. Heavy element nucleosynthesis is largely governed by the slow and rapid neutron capture processes. However, a relatively small group of naturally occurring, neutron-deficient isotopes, the so called *p* nuclei, cannot be formed by either of those processes. These ~30 stable nuclei are believed to be formed in the so called *γ* process from the "burning" of preexisting *r* and *s* process seeds through a sequence of photodisintegration reactions. Reproducing the solar *p*-nuclei abundances using nuclear reaction networks requires input on a vast network of mostly radioactive isotopes. However, as experimental cross sections of *γ* process reactions are almost entirely unknown, the related reaction rates are based on Hauser-Feshbach theoretical calculations and therefore carry large uncertainties. For this purpose it is of crucial importance to develop techniques to measure these important reactions within the astrophysically relevant Gamow window with radioactive beams.

The SuN group at FRIB has been developing such a program for the past decade. The present work focuses on one of the first measurements of a (p,γ) reaction with stable beams, namely the ^{82}Kr(p,γ)^{83}Rb reaction, as well as the very first measurement using a radioactive beam for the ^{73}As(p,γ)^{74}Se reaction. Specifically the latter reaction is found to be of significant importance to the final abundance of the lightest p-nucleus, ^{74}Se, as the inverse reaction ^{74}Se(γ,p)^{73}As is the main destruction mechanism of ^{74}Se.

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