

# Constraining the Astrophysical $\gamma$ Process: Cross Section Measurements of $(p,\gamma)$ Reactions in Inverse Kinematics

Wednesday 16 October 2024 14:30 (20 minutes)

Understanding the origin of the  $p$  nuclides has been an ongoing challenge within the astrophysics community for over 60 years. In the extensively researched  $\gamma$  process the reaction flow involves photodisintegration reactions on a vast network of mostly radioactive isotopes. However, as experimental cross sections of  $\gamma$ -process reactions are very limited, and almost entirely unknown when it comes to radioactive nuclei, the related reaction rates are based on Hauser-Feshbach (HF) theoretical calculations and therefore carry large uncertainties. Therefore, it is crucial to develop techniques to accurately 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.

This work focuses on two of the first measurements of  $(p,\gamma)$  reactions in inverse kinematics with this setup, namely the  $^{82}\text{Kr}(p,\gamma)^{83}\text{Rb}$  with a stable beam, and the  $^{73}\text{As}(p,\gamma)^{74}\text{Se}$  reaction in our first radioactive beam experiment. Specifically the latter reaction is found to be of significant importance to the final abundance of the lightest  $p$ -nucleus,  $^{74}\text{Se}$ , as the inverse reaction  $^{74}\text{Se}(\gamma,p)$  is the main destruction mechanism of  $^{74}\text{Se}$ . The experiments took place at Michigan State University using the ReA facility. The  $^{82}\text{Kr}$  and  $^{73}\text{As}$  beams were directed onto a hydrogen gas cell located in the center of the Summing NaI(Tl) (SuN) detector and the obtained spectra were analyzed using the  $\gamma$ -summing technique. In addition to the total cross section measurement of the particular reaction, statistical properties of the compound nucleus (nuclear level density and  $\gamma$ -ray strength function) can also be extracted. Results from the two experiments along with their comparison to standard statistical model calculations using the NON-SMOKER and TALYS codes will be presented.

## Length of presentation requested

Oral presentation: 17 min + 3 min questions

## Please select a keyword related to your abstract

Nuclear Theory and Experiments

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**Session Classification:** Afternoon session