Contribution ID: **123** Type: **Contributed Talk**

Investigating explosive nucleosynthesis through measurements of (α,n) and (p,n) reactions using SECAR

Thursday 19 June 2025 18:00 (15 minutes)

Heavy element synthesis in explosive stellar environments, such as core-collapse supernovae, is influenced by key nuclear reactions involving unstable nuclei. In neutron-rich conditions, the α-process, which involves a sequence of (α,xn) reactions, plays a significant part in nucleosynthesis, whereas (p,n) reactions influence element formation during explosive silicon burning and the νp-process. However, experimental data on these reactions remain scarce, introducing significant uncertainties in astrophysical models.

Although SECAR (SEparator for CApture Reactions) is primarily designed for capture reactions, it can be utilized to measure the heavy recoils from other reactions. A new technique has been developed for direct measurements of both (α,n) and (p,n) reactions in inverse kinematics with SECAR. The development of machine learning-assisted ion-optics rendered the study of (p,n) reactions using a separator feasible. The ^{58}Fe(p,n) reaction measurement served as a validation of the method. Additionally, SECAR's capabilities have been extended to include (α,n) reaction measurements. The first case studied was the ^{86}Kr(α,n) reaction, which influences α-process nucleosynthesis and metal-poor star abundances.

In this contribution I will present the recent (α,n) and (p,n) reaction measurements with SECAR, highlighting their astrophysical significance and the experimental advancements that enable these studies. These results pave the way for future direct measurements of reaction rates on short-lived nuclei, which will significantly improve our understanding of heavy-element nucleosynthesis.

Author: TSINTARI, Pelagia (Facility for Rare Isotope Beams, Michigan State University)

Co-authors: VILLARI, Antonio (Facility for Rare Isotope Beams); MARSHALL, Caleb (University of North Carolina); BRUNE, Carl R. (Ohio University); DEIBEL, Catherine (Louisiana State University); TINSON, Cierra (Facility for Rare Isotope Beams, Michigan State University); MONTES, Fernando (Facility for Rare Isotope Beams, Michigan State University); BERG, Georg P. A. (University of Notre Dame); Prof. PERDIKAKIS, Georgios (Central Michigan University); SCHATZ, Hendrik (Facility for Rare Isotope Beams, Michigan State University); BLACKMON, Jeffery (Louisiana State University); PEREIRA, Jorge (Facility for Rare Isotope Beams); CHIPPS, Kelly (Oak Ridge National Laboratory); SETOODEHNIA, Kiana (Duke University); HERMANSEN, Kirby (Facility for Rare Isotope Beams, Michigan State University); WAGNER, Louis (Facility for Rare Isotope Beams); COUDER, Manoel (University of Notre Dame); SMITH, Michael (Oak Ridge National Laboratory); DIMITRAKOPOULOS, Nikolaos (Central Michigan University); ZEGERS, Remco G. T. (Facility for Rare Isotope Beams, Michigan State University); GARG, Ruchi (Facility for Rare Isotope Beams, Michigan State University); GREIFE, Uwe (Colorado School of Mines); MEISEL, Zach (U.S. Air Force Institute of Technology)

Presenter: TSINTARI, Pelagia (Facility for Rare Isotope Beams, Michigan State University)

Session Classification: New Facilities and Techniques