DIRECT (α, p) REACTION MEASUREMENTS WITH HELIOS AND THE STUDY OF ^{20}NE$(\alpha, p)^{23}$NA

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It has been shown that (α, p) reactions play a significant role in several stellar environments, including Type I X-ray bursts and Type Ia Supernovae (SNeIa). Specifically, sensitivity studies have found that ^{20}Ne$(\alpha, p)^{23}$Na is one of the most influential reactions in SNeIa; however, it has not been measured at astrophysical energies. Direct measurements of this and other (α, p) reactions are challenging as the Coulomb barrier results in low cross sections at astrophysically relevant energies. Further complicating matters, many of the most important (α, p) reactions involve unstable nuclei and therefore must be studied in inverse kinematics. As a result, radioactive ion beams, which typically have low intensities, and a helium gas target must be used, making direct measurements even more challenging. A method has been developed at the Argonne Tandem LINAC Accelerator System facility at Argonne National Laboratory using the HELIcal Orbit Spectrometer (HELIOS) to measure these (α, p) reactions directly. This method employs a cryogenically-cooled gas target and an ionization chamber that can withstand rates $\geq$ 500 kHz while maintaining Z resolution. In order to measure the ^{20}Ne$(\alpha, p)^{23}$Na directly, and provide a stable-beam proof-of-principle test of this experimental method, this reaction was measured directly at four beam energies using the complete setup. Results and the impacts on SNeIa will be presented and potential applications of this method will be discussed.

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