NUCLEAR SEMINAR SERIES

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1:00 pm - Rm 124 NSH

An investigation of the astrophysically important $^{14}N(p,\gamma)^{15}O$ reaction

The CNO cycle is the dominant energy source for main sequence stars and significantly contributes to the hydrogen burning in asymptotic giant branch stars. Of the reactions in the CNO cycle, the $^{14}N(p,\gamma)^{15}O$ reaction is the slowest and therefore it regulates the lifetime, energy production, and the abundance distribution of a given star. Due to its wide impact, understanding the behavior of this reaction cross section is highly important. This cross section has been measured at higher energies, but the extrapolations of the cross section to lower, astrophysical energies show large discrepancies. The issue lies with unknown threshold state and uncertainties associated with known states. For example, the width of the subthreshold state at 6.79 MeV is not known and the capture cross section to both the ground state and the 6.17 MeV state are discrepant below proton energy $E_p < 1$ MeV. In this talk, I will detail efforts to address these uncertainties from both sides, undertaken both at Notre Dame and CASPAR. CASPAR, the Compact Accelerator System for Performing Astrophysical Research, is the first deep underground accelerator facility in the U.S., located on the 4850 ft. level of the Sanford Underground Research Facility in Western South Dakota. There, we measured the $^{14}N(p,\gamma)^{15}O$ reaction at proton energies ranging from 270-1070 keV, while we measured the same reaction at energies 800-1200 keV above ground, at Notre Dame, using the 5U. I have developed a method to measure the lifetime of relevant nuclear levels using the 5U with the Doppler Shift Attenuation Method. My preliminary results will be presented along with the impact for the highly important 6.79 MeV state in ^{15}O.

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