

First results from HECTOR: High Efficiency TOtal absorption spectrometeR for p-process nucleosynthesis studies

A. Simon,^{1,*} R. Kelmar,¹ O. Olivás-Gómez,¹ P. Millican,¹ E. Churchman,¹ C. S. Reingold,¹ S. Kelly,¹ S. L. Henderson,¹ A. Spyrou,² F. Naqvi,¹ A. Dombos,¹ A. Palmisano,² M. K. Smith,¹ D. Robertson,² E. Stech,¹ W. P. Tan,¹ T. Anderson,¹ A. M. Clark,¹ S. L. Henderson,¹ C. Seymour,¹ M. A. Skulski,¹ S.Y. Strauss,¹ and B. Vande Kolk¹

¹*Department of Physics and The Joint Institute for Nuclear Astrophysics,
University of Notre Dame, IN 46556-5670, USA*

²*NSCL, Michigan State University, East Lansing, MI 48824, USA*

The p-process is a nucleosynthesis scenario that occurs during an explosion of a supernova and produces the proton-rich isotopes of elements between Se and Hg. The p-process involves series of (γ, n) , (γ, p) and (γ, α) reactions on pre-existing s-process seed nuclei. The reactions relevant for the p-process can be studied in the laboratory via the inverse ones: the capture of protons or α -particles. For these measurements, the High Efficiency TOtal Absorption SpectrometeR (HECTOR) was developed at the University of Notre Dame.

HECTOR is a NaI(Tl) summing detector comprised of 16 separate NaI(Tl) crystals, each read by 2 photomultipliers. The array is designed for precision cross section measurements for (p, γ) and (α, γ) reactions across the p-process Gamow window. The summing efficiency is a function of the total γ -ray energy and the average γ -ray multiplicity: for the ^{60}Co source it is 52.7 (2.0)% and for typical cross section measurements it ranges between 20-30%. The first measurements of the p- and α -capture reactions on Pd and Cd proton-rich isotopes will be presented in this talk. The results will be compared to the cross sections obtained with other techniques, when available, and to the Hauser-Feshbach model calculations using the Talys code.

This work is supported by the NSF under grants number: PHY-1614442 (Simon), PHY-1713857 (NSL), PHY-1430152 (JINA-CEE).

* anna.simon@nd.edu