INPC 2025
May 25-30, 2025
DCC, Daejeon, Korea

Contribution ID: **172**

Type: **Contributed Oral Presentation**

Constraining a key s-process branching point through the ^{85g}Kr(d,pγ) reaction

Tuesday, 27 May 2025 11:40 (15 minutes)

About 50% of the elements heavier than iron are produced in the so-called s-process, where the lifetime for neutron capture of the nuclei involved is typically longer than their β-decay lifetimes. In the modeling of the s-process, great uncertainty derives from the competition between neutron capture and β-decay, in particular in some isotopes called "branching points". ^{85}Kr is an important branching point of the s-process, that influences both the ^{86}Kr/^{82}Kr ratio in presolar grains and the abundances of heavy Sr isotopes that are produced also by r-process. A better understanding of this branching point can be achieved only if the neutron capture cross section on ^{85}Kr is sufficiently well constrained, but a direct measurement of this cross section is extremely challenging due to the radioactivity of the sample ($T_{1/2}$ = 10.7 yr). However, ^{85}Kr can be accelerated as a pure beam, and the (d,pγ) reaction has been demonstrated to be a reliable indirect probe of the (n,γ)-reaction cross section.

The ^{85}Kr(d,pγ)^{86}Kr reaction has been carried out at 10 MeV/u in inverse kinematics at Argonne's ATLAS facility using the HELIOS spectrometer and the Apollo array. Neutron excitations from around 2-14 MeV in ^{86}Kr were populated, where S_n=9.86 MeV, with a Q-value resolution of about 150 keV. The coupling between Apollo and HELIOS allows to observe the γ-rays in coincidence with the protons, to determine the γ-ray emission probabilities as a function of excitation energy [$P_{p\gamma}(E_{ex})$]. The $2^+ \rightarrow 0^+$ and $4^+ \rightarrow 2^+$ γ-rays are clearly observed, showing the characteristic constant value of $P_{p\gamma}$ below S_n and a decrease above S_n. These data are used to extract the cross sections for ^{85}Kr(n,γ) reaction, complementing recent direct, high-precision measurements on the stable Kr isotopes. This technique demonstrates significant potential for future indirect studies of the (n,γ) reaction.

This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics, under Contract No. DE-AC02- 06CH11357 and by the National Science Foundation, USA under Grant No. PHY-2012522 (Florida State University's John D. Fox Laboratory). This research used resources of ANL's ATLAS facility, which is a DOE Office of Science User Facility.

Primary authors: CAROLLO, Sara (University of Padova and INFN Padova); Dr WATWOOD, Nate (Physics Division, Argonne National Laboratory, Argonne, IL 60439); Dr KAY, Benjamin (Physics Division, Argonne National Laboratory, Argonne, IL 60439); Dr RECCHIA, Francesco (University of Padova and INFN Padova); Dr DE ANGELIS, Giacomo (INFN-LNL)

Co-authors: RATKIEWICZ, A. (Lawrence Livermore National Laboratory); Dr COUTURE, Aaron (Los Alamos National Laboratory); Dr HALL-SMITH, Alexander (University of York); GOTTARDO, Andrea (INFN, Laboratori Nazionali di Legnaro); Dr ERTOPRAK, Aysegul (Physics Division, Argonne National Laboratory, Argonne, IL 60439); Mr GONGORA SERVIN, Benito (INFN-LNL); Dr HOFFMAN, Caleb (Physics Division, Argonne National Laboratory, Argonne, IL 60439); Dr BRUGNARA, Daniele (INFN-LNL); MENGONI, Daniele (Università degli Studi di Padova and INFN); Dr SHARP, David (University of Manchester); Dr GALTAROSSA, Franco (INFN-LNL); Dr WENDELL MISCH, Gordon (Los Alamos National Laboratory); Dr JAYATISSA, Heshani (Los Alamos National Laboratory); Dr TOLSTUKHIN, Ivan (Physics Division, Argonne National Laboratory, Argonne, IL 60439); Dr HENDERSON, Jack (University of Surrey); Dr BENITO GARCIA, Jaime (INFN-LNL); Dr PELLUMAJ, Julgen (INFN-LNL); CHIPPS, Kelly (Oak Ridge National Laboratory); Dr BHATT, Khushi (Physics Division, Argonne National Laboratory, Argonne, IL 60439); REZYNKINA, Kseniia (INFN sezione de Padova); Dr MUMPOWER, Matthew Ryan (Los Alamos National Laboratory); Dr WILLIAMS, Matthew (University of Surrey); Dr AVILA, Melina (Physics Division, Argonne National Laboratory, Argonne, IL 60439); Dr PAUL, Michael (Racah Institute of Physics, Hebrew University, Jerusalem); Dr AGUILERA, Pablo (University of Padova and INFN Padova); Dr ESCUDEIRO, Rafael (KTH Stockholm); Dr HUGHES, Richard (Lawrence Livermore National Laboratory); Dr PEREZ VIDAL, Rosa Maria (IFIC Valencia); Dr PIGLIAPOCO, Sara (University of Padova and INFN Padova); Dr DUTTA, Saumi (Department of Physics, Shanghai Jiao Tong University,); FREEMAN, Sean (CERN (Switzerland) /University of Manchester (UK)); Dr LENZI, Silvia (University of Padova and INFN Padova); Dr TANG, Tsz Leung (Florida State University); Dr ONG, Wei Jia (Lawrence Livermore National Laboratory); Dr SUN, Yang (Department of Physics, Shanghai Jiao Tong University,)

Presenter: CAROLLO, Sara (University of Padova and INFN Padova)

Session Classification: Parallel Session

Track Classification: Nuclear Astrophysics