

# Study of the $^{85}\text{gKr}(d,p\gamma)$ reaction for astrophysics at ANL

Friday, 21 June 2024 14:40 (20 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  $\beta$ -decay lifetimes. In the modeling of the s-process, great uncertainty derives from the competition between neutron capture and  $\beta$ -decay, in particular in some isotopes called “branching points”.  $^{85}\text{Kr}$  is an important branching point of the s-process, that influences both the  $^{86}\text{Kr}/^{82}\text{Kr}$  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  $^{85}\text{Kr}$  is sufficiently well constrained, but a direct measurement of this cross section is extremely complicated due to the radioactivity of the sample.

The  $(d,p\gamma)$  reaction has been demonstrated to be a reliable indirect probe of the  $(n,\gamma)$ -reaction cross section, and  $^{85}\text{Kr}$  can be accelerated as a pure beam. For this reason, the  $^{85}\text{Kr}(d,p\gamma)^{86}\text{Kr}$  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. Excited state at energies from around 2-14 MeV in  $^{86}\text{Kr}$  were populated, where  $S_n=9.86$  MeV, with a Q-value resolution of about 150 keV. The  $2^+ \rightarrow 0^+$  and  $4^+ \rightarrow 2^+$   $\gamma$ -rays are clearly observed, from which the  $\gamma$ -ray emission probabilities as a function of excitation energy [ $P_p(E_{ex})$ ] can be determined.  $P_p$  shows the characteristic behaviour with a constant value below  $S_n$  and a decrease at higher excitation energies. These data are used to extract the cross sections for  $^{85}\text{Kr}(n,\gamma)$  reaction, complementing recent direct, high-precision measurements on the stable Kr isotopes. The technique has significant potential for future indirect  $(n,\gamma)$ -reaction studies.

**Primary author:** CAROLLO, Sara (Istituto Nazionale di Fisica Nucleare)

**Presenter:** CAROLLO, Sara (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** On-going analysis