α-CAPTURE AND α-ELASTIC SCATTERING ON P-NUCLEI TO PROBE THE HAUSER FESHBACH FRAMEWORK

Abstract

by

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The thirty five neutron deficient stable nuclei known as the p-nuclei are synthesized in a series of photodisintegration reactions of the (γ,n), (γ,p) and (γ,α) type in a hot γ-flux environment.

Abundance calculations involve an extended network of about 20,000 nuclear reactions of almost 2000 nuclei. The bulk of these rates are calculated theoretically with the statistical Hauser Feshbach Model (HF Model). Of particular importance in the process modeling are the (γ,α) branchings.

Even though in the astrophysical environment it is photodisintegration reactions that synthesize the p-nuclei, in the laboratory it is the inverse process that is generally measured. By detailed balance, it is possible to arrive at the relevant reactions. The experimental data for α-capture reactions is scarce since at the p-process temperatures (2-3 GK), the α-particle energies are typically of a few MeV and the corresponding cross sections very small. In addition, the results show a significant deviation compared to the model predictions.

The HF cross sections are governed by transmission coefficients. These are extracted from an appropriate optical model potential (OMP). The α-nucleus potential in particular is poorly known at low energies mainly due to the lack of relevant data. The observed inconsistencies between the predicted and measured (α,γ) rates may be due to problems with this α-potential parameter.

To explore the applicability of the Hauser Feshbach model, to extend the experimental database of α-capture reactions on p-nuclei, to test the global parameterizations that currently exist, and to constrain the α-nucleus potential, the α-capture cross section of ^{106}Cd$(\alpha,\gamma)^{110}$Sn and the local α-nucleus potentials of ^{106}Cd, ^{118}Sn, and $^{120,\ 124,\ 126,\ 128,130}$Te have been measured and extracted. The experiments have been carried out at the University of Notre Dame. The results are presented here.