ABSTRACT

Nucleosynthesis in the p process: Cross section measurements and abundances

This work aims at the improvement of the basic nuclear physics data for describing nucleosynthesis in the astrophysical p process associated with explosive Ne/O-burning in supernovae. In this context the role of crucial α-induced reactions was investigated by measuring a number of reaction cross sections in the astrophysically relevant energy range. This study includes the ^{95}Mo(n,α)-cross section for neutron energies from 1 eV to 500 keV, the cross sections of the (α,n)-reactions on ^{92}Mo and ^{94}Mo, as well as the (a,γ)-reaction on ^{112}Sn, for a energies from 8 MeV to 11 MeV, respectively. The experimental results show that previous theoretical calculations were overestimating these data by more than a factor of two on average.

Based on these results, the parameters of the α-nucleus-potentials could be substantially improved, providing now a consistent description of the known α-induced reactions in this mass range by means of the statistical model. The influence of the remaining uncertainties of the nuclear input on the p-process abundances obtained with astrophysical models was investigated in detail by simulations of explosive Ne/O burning in type II supernovae. After constructing an extensive reaction network it could be shown that the p abundances are influenced by n-, p-, and α-induced reactions reaction in a very particular way. These simulations show also that the remaining nuclear physics uncertainties are not responsible for the inherent underproduction of the p abundances in the mass range $90 < A < 98$, which is common to all models, but must be ascribed to different origins.