Radiative capture reactions and α-elastic scattering on ^{106}Cd for the astrophysical p-process

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The modeling of the astrophysical p-process requires the knowledge of the reaction rates of the thousands of reactions taking place in the course of the p-process nucleosynthesis. In the intense γ-flux of explosive stellar environments needed for the p-process, subsequent (γ,n) reactions are the most important ones leading to more and more neutron-deficient isotopes. As the neutron separation energy increases, (γ,α) and (γ,p) reactions play decisive role in the network calculations.

In the lack of experimental data, the rates of reactions involving charged particles are calculated using the Hauser-Feshbach theory. For the calculations, several input parameters such as optical model potentials, nuclear level densities, ground state properties, etc. are needed. Different input parameters lead to different cross sections and consequently different reaction rates making the p-process network calculations ambiguous. Therefore it is important to determine the relevant cross sections experimentally testing the reliability of the model calculations.

In the present work both the (α,γ) and (p,γ) cross sections on the p-nucleus ^{106}Cd have been measured in the energy range relevant to the p-process. From the measured charged particle induced reactions, the rate of the inverse γ-induced reactions can be calculated using the detailed balance theory. The results are compared with the predictions of the statistical model calculations implemented with the NON-SMOKER code using different input parameters.

The α + ^{106}Cd optical potential, an important input parameter for the ^{106}Cd(γ,α) reaction rate determination, can be determined directly by measuring the deviation from the Rutherford scattering in the ^{106}Cd(α,α)^{106}Cd elastic scattering experiment. This experiment has also been performed in a wide angular range and the results are compared with different global optical potentials.