Capture cross section measurements for the astrophysical p-process

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The stable proton-rich heavy ($Z \geq 34$) nuclei not produced by the s- and r-processes are the so called p-nuclei. The stellar mechanism synthesizing these nuclei — the astrophysical p-process — involves mainly subsequent (γ,n) photodisintegration reactions on preexisting more neutron-rich seed nuclei [1]. As the neutron separation energy increases along this path towards more neutron deficient isotopes, charged particle emitting (γ,p) and (γ,α) reactions start to compete with (γ,n) influencing strongly the final p-isotope abundances [2].

Despite considerable experimental and theoretical efforts in recent years, the astrophysical p-process is still one of the least studied processes of nucleosynthesis. Model calculations involving thousands of reactions are not able to reproduce with sufficient accuracy the observed p-isotope abundances. One reason for this can be that the models have to rely on nuclear reaction rates obtained from statistical model calculations. These calculations are largely untested for reactions involving charged particles. Therefore, the experimental investigation of reactions involved in p-process models is highly needed.

In order to build up an experimental nuclear reaction database [3] we started a systematic investigation of proton- and α-capture reactions relevant for the p-process [4, and references therein] using the activation method. As a continuation of this study here the cross sections of the ^{70}Ge(p,γ)^{71}As, ^{76}Ge(p,n)^{76}As and ^{106,108}Cd(p,γ)^{107,109}In reactions measured in the astrophysically relevant energy region are presented. The experiments were carried out at the Van de Graaff and cyclotron accelerators of ATOMKI. The cross sections have been derived by measuring the decay γ-radiation of the reaction products. The results are compared with the predictions of Hauser-Feshbach statistical model calculations using the NON-SMOKER code [5]. The sensitivity of the model calculation to different input parameters is examined.

[1] M. Arnould *et al.*, Phys. Rep. **384** (2003) 1.
[2] T. Rauscher, Phys. Rev. **C73** (2006) 015804.
[3] I. Dillmann *et al.*, in proceedings of Nuclei In the Cosmos IX, PoS (NIC-IX) 090.
[4] Gy. Gyürky *et al.*, Phys. Rev, **C74**, (2006) 025805.
[5] T. Rauscher *et al.*, At. Data Nucl. Data Tables **75**, (2000) 1.