Photon-induced reactions in the lab and under stellar conditions

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Photon-induced reactions like (γ,α) and (γ,p) are the basis for the nucleosynthesis of neutron-deficient p-nuclei in the γ-process. A sufficient intensity of several-MeV γ-rays can be found in the tail of the thermal Planck distribution at temperatures above $T_9 > 1$. Furthermore, already at lower temperatures e.g. in the *s*-process, thermal photons may affect the effective half-life of isomers (like the famous example of ^{180}Ta [1]).

The availability of monochromatic photon beams from Compton backscattering opens a window for nuclear astrophysics experiments which have been performed e.g. at AIST [2], at HIγS [3], and at the upcoming ELI-NP [4]. However, the thermal excitation of the target nuclei in the hot stellar plasma leads to significant differences between laboratory experiments and stellar conditions in particular for photon-induced reactions.

This talk discusses the relations between stellar reaction rates for capture and photodisintegration reactions and the underlying cross sections. It will be illustrated that laboratory experiments can only provide the ground state contribution to the stellar (γ,X) reaction rate which often is only a minor contribution to the total stellar reaction rate.

In conclusion, the determination of stellar reaction rates for photon-induced reactions from experimental (γ,X) data is a very complicated task, but experimental (γ,X) data will be essential to constrain the required theoretical models. Additionally, under certain circumstances, experimental (γ,X) photodisintegration data can be used to estimate the inverse (X,γ) capture cross sections and reaction rates.

[1] P. Mohr *et al.*, Phys. Rev. C **75**, 012802(R) (2007).
[2] S. Goko *et al.*, Phys. Rev. Lett. **96**, 192501 (2006).
[3] K. Matei, presentation at this workshop.
[4] L. Trache, presentation at this workshop.