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Photodissociation as a Tool for Nuclear Astrophysics

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Photodissociation cross sections play an important role in our understanding of nucleosynthesis in the mass region above A > 60. The bulk of these heavy nuclei is produced by neutron capture reactions during the s- and r-process.

The so-called branching points of the s-process have typical half-lives of the order of a few days up to a few hundred years. The direct measurement of neutron capture cross sections of the short-living is not feasible. However, some of the long-living ones were measured successfully [1,2].

We try to constrain theoretical predictions of the capture cross section by measuring the inverse (γ,n) cross section directly above the neutron threshold. A current result, the cross section of ^{186}Re(n,γ) will be shown and its influence on the Re/Os-chronometer will be discussed [3].

About neutron deficient nuclei with masses A > 60 cannot be produced by neutron capture reactionS. These so-called p-nuclei are produced by photodisintegration reactions during the p-process. The p-process takes place at temperatures of about 2.5GK. At this temperature the photons stemming from the thermal photon bath induce (γ,n), (γ,α), and (γ,p) reactions. We can emulate thermal photon spectra in the needed energy range to deduce directly the ground state reaction rates [4]. We will show recent results for neutron deficient nuclei with Z > 78 [5].

One of the remaining puzzles is the abundance of the neutron deficient Molybdenum isotopes. These abundances are underestimated by all network calculations by at least one order of magnitude. We measured the coulomb dissociation cross section of ^{92,93,94,100}Mo at the LAND setup at GSI. This cross section can be converted into a photodissociation cross section. For comparison, the photodisscociation cross section of ^{100}Mo will be measured at the S-DALINAC using real photons.

The last part of this presentation will be about the status of the quasi-monochromatic photon source NEPTUN at the S-DALINAC. The high resolution photon tagger NEPTUM at the S-DALINAC is designed to measure (γ,n) cross sections with an energy resolution of about 0.25% in the energy range between 8 MeV and 20 MeV.

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