HK 28: Nuclear Astrophysics

Time: Tuesday 14:00–16:00 Location: H-ZO 60

Invited Group Report HK 28.1 Tu 14:00 H-ZO 60

Proton and alpha induced reactions relevant for the astrophysical p-process — •György Gyürky — Institute of Nuclear Research (ATOMKI), H-4001 Debrecen, POB.51., Hungary

The astrophysical p-process is the nucleosynthetic mechanism responsible for the production of the so called p-nuclei; the heavy, proton rich isotopes which are not produced by neutron capture reactions in the s- and r-processes. The modeling of the p-process requires the knowledge of the astrophysical site where the process takes place as well as the rates of the thousands of reactions involved in a p-process network. The limited accuracy of p-process models in calculating the p-isotope abundances can in part be attributed to the uncertainties in the reaction rates. These uncertainties are especially high for reactions involving charged particles. Therefore, the experimental investigation of charged particle induced reactions in the relevant mass and energy range is crucial in the development of more accurate p-process models. The measured cross sections can, on one hand, be directly used in the models, and, on the other hand, they can be used to test the statistical model calculations which are widely employed in p-process network calculations.

Recently, the cross section of several proton and alpha-induced reactions has been measured using the activation technique. Some details of the experiments and the results will be shown, the comparison with statistical model predictions and the implication to p-process network calculations will be discussed.

Group Report HK 28.2 Tu 14:30 H-ZO 60

Photon strength functions and cosmic nucleosynthesis. — •Chithra Nair[1], Arnd R. Junghans[1], Martin Erhard[1], Roland Beyer[1], Klaus D. Schilling[1], Ronald Schwengner[1], Andreas Wagner[1], and Eckart Grosse[1,2] — [1]Institut für Strahlenphysik, Forschungszentrum Dresden-Rossendorf, Germany — [2]Institut für Kern- und Teilchenphysik, Technische Universität Dresden, Germany

In network calculations for the cosmic nucleosynthesis the electromagnetic dissociation occurring in hot environments strongly depends on the low energy tail of the photon strength function peaking in the isovector giant dipole resonance (GDR). The widely used procedure of adjusting a single Lorentzian to the (gamma,n) cross section in the GDR maximum is clearly inadequate in various cases. Photodissociation studies of the p-rich nuclei 92Mo and 144Sm into several different exit channels show that competing processes are surprisingly strong, in particular in the tail region. Strength functions derived from a systematic study of many nuclei with A>80 were used in Hauser-Feshbach calculations performed with the code TALYS. They render a consistent description of the GDR for (gamma,n) and for the other observed channels. This study is based on droplet model results for the GDR-energy and on hydrodynamic considerations about its width as well as on nuclear shape parameters. For nuclei with A>80 these are sufficiently well known from nuclear structure studies resulting in a reliable prediction of photon strength functions also for deformed nuclei which can be used in calculations for the cosmic nucleosynthesis.

HK 28.3 Tu 15:00 H-ZO 60

In-beam experiments on (p,γ) and(α,γ) reactions for the astrophysical *p* process — •Jens Hasper, Marc Büssing, Michael Elvers, Janis Endres, and Andreas Zilges — Institut für Kernphysik, Universität zu Köln

Whereas most nuclei heavier than iron can be produced by neutron-capture processes, 35 proton-rich nuclei are believed to be synthesized exclusively by the *p* process in the explosive scenario of supernovae type II. This process involves an extensive reaction network consisting of about ten thousand (γ,n), (γ,p) and (γ,α) reactions on more than thousand nuclei. Due to the absence of experimental data, *p*-process network calculations are based almost completely on theoretically predicted reaction rates, which are subject to rather large uncertainties. A comprehensive experimental data base for these reaction rates is strongly required to improve the accuracy of *p*-process models. In the last decade increasing effort has been made to provide experimental data on (p,γ) and (α,γ) reactions at astrophysically relevant energies. Most of these experiments have been based on the activation technique which is restricted to the investigation of a very limited number of nuclei. This limitation can be overcome by measuring (p,γ) and (α,γ) reactions directly in in-beam experiments. A particularly suited experimental tool for these measurements is provided by the highly-efficient HPGe detector array HORUS at the ion TANDEM accelerator at the University of Cologne. We will present first results of experiments performed at HORUS on (p,γ) reactions of relevance for the *p* process.

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HK 28.4 Tu 15:15 H-ZO 60

Astrophysical S factor for α-capture on ^{115}Sn — D. Filipescu[1], I. Cata-Danil[1], M. Ivascu[1], D. Bucurescu[1], N.V. Zamfir[1], T. Glodariu[1], L. Stroe[1], C. Mihai[1], N. Marginean[1], G. Cata-Danil[2], D.G. Ghita[1], R. Marginean[1], G. Suliman[1], T. Sava[1], and •S. Pascu[1] — [1]Horia-Hulubei National Institute for Physics and Nuclear Engineering, Magurele-Ilfov, Romania — [2]Physics Department, University Politehnica of Bucharest, Romania

The *s* and *r* processes calculations can only account for 50% of the ^{115}Sn abundance, and recent *p* process calculations cannot explain the remaining fraction. For this reason, the experimental measurement of the *S* factor of α capture on ^{115}Sn is of high importance in explaining the origin of ^{115}Sn. The cross section of $^{115}\mathrm{Sn}(\alpha,\gamma)^{119}$Te reaction has been measured in the effective center of mass energy from 9.5 to 14.7 MeV. Enriched self-supporting ^{115}Sn (56%) foils were bombarded with α beam delivered by the Bucharest IFIN-HH Tandem Accelerator. The induced activity of ^{119}Te was measured with two large volume GeHP detectors in close geometry to maximize the detector efficiency. The experimental cross section and astrophysical *S* factor are compared with statistical model predictions for different global α-nucleus optical potential.

HK 28.5 Tu 15:30 H-ZO 60

Photodisintegration of p-process nuclei — •A. Wagner[1], C. Nair[1], M. Erhard[1], D. Bemmerer[1], R. Beyer[1], E. Grosse[1,2], A. Junghans[1], K. Kosev[1], G. Rusev[1], K.D. Schilling[1], and R. Schwengner[1] — [1]Forschungszentrum Dresden-Rossendorf, 01314 Dresden — [2]Technische Universität Dresden, 01062 Dresden

The neutron deficient p-nuclei are shielded from the s- or r-process by stable isotopes. P-nuclei are likely to be formed in high temperature cosmic scenarios like exploding supernovae by photodisintegration reactions on heavy r- or s- seed nuclei. The lack of experimental information on energy-dependent cross sections especially for (γ,p) and (γ,α) reactions reduces the applicability of nucleosynthesis models. Using intense bremsstrahlung produced at the superconducting electron linear accelereator ELBE at Forschungszentrum Dresden-Rossendorf we investigated (γ,n), (γ,p) and (γ,α) reactions for the medium-mass p-nuclei ^{92}Mo and ^{144}Sm, as well as (γ,n) reactions for ^{100}Mo and ^{154}Sm by photo-activation. The lowest photoactivation yields have been measured in an underground laboratory. The photodisintegration of ^{197}Au serves as a benchmark and it is compared to data measured previously with the positron annihilation technique.

HK 28.6 Tu 15:45 H-ZO 60

First direct mass measurement of the proton rich nuclides ^{85,86,87}Mo and ^{87}Tc — •Emma Haettner for the SHIPTRAP-Collaboration — Justus-Liebig Universität, Gießen — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

The masses of proton rich nuclides in the vicinity of $N = Z = 43$ were measured with the Penning trap mass spectrometer SHIPTRAP at GSI. These nuclei were produced in the fusion-evaporation reaction ^{36}Ar+^{54}Fe at energies of 5.0 and 5.9 MeV/u and separated at the velocity filter SHIP. The data are of astrophysical interest since these nuclei are believed to be a part of the rp and νp process paths.

The masses of ^{85}Mo and ^{87}Tc were measured for the first time. The masses of another two nuclides, ^{86,87}Mo, were determined for the first time in a direct mass measurement. For these nuclides the mass excess deviates from values of the 2003 Atomic Mass Evaluation by up to 1.5 MeV, indicating a systematic shift of the mass surface in this region of the nuclear chart. Additionally, the masses of ^{86}Zr and ^{85}Nb were measured and found to be in agreement with the values obtained at JYFLTRAP. The experiment as well as preliminary data on mass values, separation energies and their impact on network calculations of the rp and νp processes will be presented.