# HK 38: Nuclear Astrophysics III

Zeit: Mittwoch 14:00–15:45 Raum: HS 18

**Gruppenbericht** HK 38.1 Mi 14:00 HS 18

**Direkte Reaktionen für die Astrophysik** — •Philipp Erbacher, Lukas Bott, Benjamin Brückner, Stefan Fiebiger, Kathrin Göbel, Tanja Heftrich, Christoph Langer, Markus Reich, René Reifarth, Zuzanna Slavkovská, Benedikt Thomas, Meiko Volknandt, Kafa Khasawneh, Deniz Kurtulgil, Fabian Hebermehl, Sabina Krasilovska, Ozan Dogan, Christian Schwarz und Mario Weigand — Goethe-Universität Frankfurt a. M., Germany

Die Häufigkeitsverteilung der Elemente im Sonnensystem bildet einen Forschungsschwerpunkt der Nuklearen Astrophysik. Für das Verständnis der zugrunde liegenden Nukleosynthese in Sternen werden Daten über eine Vielzahl von Reaktionsraten benötigt. Sukzessive Neutroneneinfänge und Betazerfälle in Sternen verschiedener Stadien erzeugen die Elemente schwerer als Eisen. Dabei sind für den s-Prozess vor allem die Maxwell-gemittelten Neutroneneinfangsquerschnitte bei Temperaturen von 25 keV und 90 keV von Interesse. Eine etablierte Methode zur Erzeugung eines 25 keV Maxwell-Boltzmann-Spektrums ist die Reaktion $^{7}$Li(p,n) bei einer Protonenenergie von $E_{\mathrm{p}}$=1912 keV.
Wir haben eine Methode entwickelt um ein Maxwell-Boltzmann Spektrum bei 90 keV und höheren Energien mit der Reaktion $^{7}$Li(p,n) zu reproduzieren. Der Beitrag stellt die Methode vor und zeigt erste Ergebnisse für 25 keV und 90 keV.
Gefördert durch: DFG-Projekt GAIN (RE 3461/4-1)

HK 38.2 Mi 14:30 HS 18

**Messung der Neutronentransmission von $^{20}$Ne an ELBE** — •Erik Borris[1], Roland Beyer[3], Toni Kögler[3], Sebastian Urlass[3], Jan Glorius[2], Arnd Junghans[3], Axel Frotscher[3], Marcel Grieger[3], Daniel Bemmerer[3], Daniel Veltum[1], Mario Weigand[1], Joachim Görres[4], Rene Reifarth[1] und Hye Young Lee[5] — [1]Goethe Universität Frankfurt — [2]GSI Helmholtzzentrum f. Schwerionenforschung — [3]Helmholtzzentrum Dresden Rossendorf — [4]University of Notre Dame — [5]Los Alamos National Laboratory

Aufgrund der hohen Häufigkeit des $^{16}$O Isotopes während des schwachen s-Prozesses, kommt es durch die Reaktion $^{16}$O(n,$\gamma$)$^{17}$O dabei vermehrt zu Neutroneneinfängen. Im darauffolgenden Reaktionspfad entscheidet das Verhältnis der Reaktionen $^{17}$O($\alpha$,$\gamma$) zu $^{17}$O($\alpha$,n)$^{20}$Ne, ob die vorher eingefangenen Neutronen an $^{16}$O wieder frei gesetzt werden können oder endgültig nicht mehr zur Nukleosynthese der schweren Elemente zur Verfügung stehen. Entsprechend müssen beide Reaktionen an $^{17}$O gut bekannt sein. Um die Reaktionsrate von $^{17}$O($\alpha$,n)$^{20}$Ne besser zu verstehen und um mögliche niedrig-liegende Resonanzen aufzulösen, wurde eine hochaufgelöste Neutronentransmissionsmessung am $^{20}$Ne durchgeführt. Dabei wird derselbe Zwischkern, $^{21}$Ne, bevölkert. Das Experiment fand am nELBE Elektronenbeschleuniger statt. In dieser Studie wurde die Neutronentransmission an einer mit natürlichem Neon gefüllten Gaszelle im Energiebereich von 0.5 bis 1.5 MeV durch die Flugzeitmethode untersucht.

HK 38.3 Mi 14:45 HS 18

**Measurement of $^{69,71}$Ga(n,g) at astrophysical energies using time of flight** — •D. Kurtulgil[1], K. Göbel[1], S. Fiebiger[1], F. Käppeler[2], C. Lederer-Woods[3], S.-J. Lonsdale[3], R. Reifarth[1], M. Weigand[1], and P. Woods[3] for the nTOF-Collaboration — [1]Goethe University Frankfurt, Germany — [2]Karlsruhe Institute of Technology, Karlsruhe, Germany — [3]University of Edinburgh, Edinburgh, United Kingdom

The origin of elements heavier than iron in stellar nucleosynthesis can in large parts be explained by neutron capture reactions, namely the r- and s-process. In order to reproduce the observed isotopic abundances in nucleosynthesis simulations, an exact knowledge of the involved reaction rates at astrophysical energies is necessary.

The stable isotopes $^{69}$Ga and $^{71}$Ga play an important role in the weak s-process, but experimental data for these reactions are scarce.

The cross-section of neutron capture onto isotopically enriched $^{69}$Ga and $^{71}$Ga samples was measured at the n_TOF experiment's EAR1 beamline at CERN, Geneva, using the time of flight technique to cover a neutron energy range of eV to several hundred keV.

We will present the current status of the analysis.

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HK 38.4 Mi 15:00 HS 18

**Investigation of total cross sections of the $^{93}$Nb(p,$\gamma$)$^{94}$Mo reaction** — •M. Müller, F. Heim, E. Hoemann, M. Körschgen, J. Mayer, P. Scholz, and A. Zilges — Institute for Nuclear Physics, University of Cologne

The nucleosynthesis of p-nuclei is an important field of research in the area of nuclear astrophysics and a lot of questions remain unanswered. One example is the observed relative abundance of the $^{94}$Mo nucleus, which is higher than the predicted one by orders of magnitude [1]. To extend experimental data, total cross sections of the $^{93}$Nb(p,$\gamma$)$^{94}$Mo reaction have been measured at three beam energies between 3 MeV and 4.5 MeV. The measurements have been performed using the HORUS $\gamma$-spectrometer consisting of up to 14 high purity germanium detectors [2]. The beam was provided by the 10 MV FN Tandem accelerator, located at the University of Cologne's Institute for nuclear physics.
Preliminary results and their comparison to Hauser Feshbach statistical model calculations will be presented [3].

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[1] M. Arnould and S. Goriely, Phys. Rep. **384**, 1 (2003).
[2] L. Netterdon *et al.*, Nucl. Instr. Meth. **754**, 94 (2014).
[3] W. Hauser and H. Feshbach, Phys. Rev. **87**, 366 (1952).

HK 38.5 Mi 15:15 HS 18

**Investigating total and partial cross sections of the $^{107}$Ag($p,\gamma$)$^{108}$Cd reaction** — •F. Heim, M. Körschgen, J. Mayer, M. Müller, P. Scholz, and A. Zilges — University of Cologne, Institute for Nuclear Physics

For many nucleosynthesis processes in various astrophysical scenarios cross sections and reaction rates need to be predicted by statistical model calculations. One of those processes is the $\gamma$ process, which plays an important role in the nucleosynthesis of the majority of the $p$ nuclei. The calulated values depend heavily on nuclear physics input-parameters like nuclear level densities (NLD), $\gamma$-ray strength functions ($\gamma$-ray SF) and nucleon+nucleus optical model potentials (OMPs). Precise cross-section measurements at astrophysical energies can be used to test and validate microscopic theoretical approaches for these nuclear physics models. For this reason, total and partial cross-sections of the $^{107}$Ag(p,$\gamma$)$^{108}$Cd reaction were measured via the in-beam method at the high-efficiency HPGe $\gamma$-ray spectrometer HORUS at the University of Cologne. Proton beams with energies between 2.0 and 5.0 MeV were provided by the 10 MV FN-Tandem accelerator. Microscopic models for the NLD and $\gamma$-ray SF have been adjusted in a way, that they do not only agree with the total and partial cross-section results but also preserve physical reliability.
Supported by the DFG (ZI 510/8-1) and the "ULDETIS" project within the UoC Excellence Initiative institutional strategy.

HK 38.6 Mi 15:30 HS 18

**Investigation of ($\alpha$,$\gamma$) reaction cross sections of ruthenium isotopes** — •M. Koerschgen, F. Heim, E. Hoemann, J. Mayer, M. Mueller, P. Scholz, and A. Zilges — Institute for Nuclear Physics, University of Cologne

Photodesintegration networks are one of the main processes in the nucleosynthesis of p-nuclei. Especially ($\gamma$,$\alpha$) reactions play a crucial role in the production of the heaviest p-nuclei [1]. Practically they are obtained by the measurement of inverse ($\alpha$,$\gamma$) reaction cross sections at sub coulomb energies and statistical model calculations. The latter requires fundamental knowledge of optical model potentials (OMPs), nuclear level densities (NLDs) and the $\gamma$-ray strength functions ($\gamma$-ray SFs).
This talk will cover a project aiming to measure ($\alpha$,$\gamma$) reaction cross sections on ruthenium isotopes applying the $4\pi$ summing method [2]. The measurements take place at the Dynamitron Tandem Laboratorium of the Ruhr-Universität Bochum, Germany, using a 12 by 12 inch NaI(Tl) crystal.
This work is supported by the DFG (ZI-510/8-1).
[1] M. Arnould and S. Goriely, Phys. Rep. **384** (2003) 1.
[2] A. Spyrou, H.W. Becker, A. Lagoyannis, S. Harrisopulos, and C. Rolfs, Phys. Rev. C **76** (2007) 1.