HK 11: Nuclear Astrophysics II

Zeit: Montag 16:30–18:30 Raum: S1/01 A02

Gruppenbericht HK 11.1 Mo 16:30 S1/01 A02

Constraining nuclear physics input-parameters for the synthesis of heavy elements via cross-section measurements of charged-particle induced reactions — •Philipp Scholz, Felix Heim, Jan Mayer, Lars Netterdon, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne

Nuclear physics plays an important role in the nucleosynthesis of elements in stars. Especially for the production mechanisms of heavy elements in the γ process, the rapid proton-capture process or the weak r-process, cross sections are calculated in the scope of the Hauser-Feshbach statistical model. The obtained values crucially depend on input-parameters like the γ-ray strength functions or particle+nucleus optical-model potentials.
Constraining or excluding different adopted models for these nuclear physics input-parameters is achieved by precise cross-section measurements and their comparison to theory. During the last years, different charged-particle induced reaction cross sections at sub-Coulomb energies have been measured in Cologne by means of either the in-beam method with HPGe detectors or the actiation technique.
This talk is going to present the experimental setups as well as recent results for the ^{92}Mo(p,γ) and ^{98}Ru(α,γ) reactions and α-induced reactions on ^{108}Cd.
Supported by the DFG (INST 216/544-1) and the "ULDETIS" project within the UoC Excellence Initiative institutional strategy. P.S. and J.M. are supported by the Bonn-Cologne Graduate School for Physics and Astronomy.

HK 11.2 Mo 17:00 S1/01 A02

Cross-section measurement of the ^{108}Cd(α,n)^{111}Sn reaction at the Cologne Clover Counting Setup — •Felix Heim, Jan Mayer, Lars Netterdon, Philipp Scholz, and Andreas Zilges — Institute of Nuclear Physics, University of Cologne

About 30 to 35 neutron deficient nuclei cannot be synthesized via neutron capture processes. The main mechanism that is used to describe their origin is the so-called γ-process, i.e. a photodesintegration reaction network on stable seed nuclei in explosive stellar environments. The network of this process includes so many different reactions and nuclei that cross-section values are predominantly calculated in the scope of the Hauser-Feshbach statistical model. The obtained values heavily depend on the input-parameters like the γ-ray strength function or particle+nucleus optical-model-potential (OMPs). In order to extend the available experimental database the ^{108}Cd(α,n)^{111}Sn reaction cross section was investigated at ten energies between 10.2 MeV and 13.5 MeV via the activation technique using the Cologne Clover Counting Setup. As this reaction is almost completely sensitive to the α-decay width, the results were compared to statistical model calculations using different models of the α-OMP. In this talk the experimental setup, the results of the cross-section measurement as well as the results from the statistical model calculations will be presented.
Supported by the DFG (INST 216/544-1) and the ULDETIS project within the UoC Excellence Initiative institutional strategy. P.S. and J.M. are supported by the Bonn-Cologne Graduate School for Physics and Astronomy.

HK 11.3 Mo 17:15 S1/01 A02

Partial cross sections of the ^{92}Mo(p,γ) reaction and the γ-strength in ^{93}Tc — •Jan Mayer, Lars Netterdon, Philipp Scholz, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne

With an isotopic abundance of more than 14 %, ^{92}Mo is the most abundant p nucleus. The γ-process nucleosynthesis is believed to produce ^{92}Mo, but fails to explain its large abundance. Further studies require an accurate description of nuclear physics input parameters for the calculation of reaction cross sections in the scope of the Hauser-Feshbach statistical model.

In order to improve these parameters, total and partial cross-section values of the ^{92}Mo(p,γ)^{93}Tc reaction were measured by means of the in-beam method at seven different proton energies between 3.7 MeV and 5.3 MeV. The γ-rays emitted during the irradiation were detected by the high-purity germanium detector array HORUS at the Institute for Nuclear Physics, University of Cologne. The $\gamma\gamma$-coincidence method was applied to correlate γ-ray cascades in ^{93}Tc with their origin in the ^{92}Mo+p compound state.

In this talk, the final results for the measured total and partial cross sections are presented and compared to Hauser-Feshbach calculations using the statistical model code TALYS.

This project was supported by the ULDETIS project within the UoC Excellence Initiative institutional strategy. J.M. and P.S. are supported by the Bonn-Cologne Graduate School of Physics and Astronomy.

HK 11.4 Mo 17:30 S1/01 A02

Nuclear resonance fluorescence on ^{87}Rb* — •Benjamin Brückner[1], Jan Glorius[1,2], René Reifarth[1], Kerstin Sonnabend[1], Deniz Savran[2], Johann Isaak[2], and Ronald Schwengner[3] — [1]Goethe Universität Frankfurt am Main, 60438 Frankfurt am Main, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, 64291 Darmstadt, Germany — [3]Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden, Germany

The aim of the nuclear resonance fluorescence (NRF) investigation of ^{87}Rb is the determination of the γ-strength function. For the astrophysical s-process, the γ-strength function of this specific nucleus can be used to calculate the cross section of neutron capture on the branching point nucleus ^{86}Rb. This branching point together with ^{85}Kr determines the abundance ratio of strontium isotopes, which could be used to probe stellar models. As one part of the ^{87}Rb campaign, an NRF experiment on ^{87}Rb has been carried out using bremsstrahlung at 13.2 MeV at ELBE@HZDR. An overview of the experimental setup as well as of the preliminary results will be given. *supported by DFG(SO907/2-1)

HK 11.5 Mo 17:45 S1/01 A02

^{91}Nb(p,γ) or There and back again — •Benedikt Thomas[1], Andrey Blazhev[2], Rugard Dressler[3], Ulrich Giesen[4], Jan Glorius[1], Milan Kritčka[5], Markus Reich[1], René Reifarth[1], Dorothea Schumann[3], Kerstin Sonnabend[1], and Karl-Oscar Zell[2] — [1]Goethe University Frankfurt a. M., Germany — [2]University of Cologne, Germany — [3]Paul-Scherrer Institute, Villigen, Switzerland — [4]Physikalisch-Technische Bundesanstalt, Braunschweig, Germany — [5]Charles University, Prague, Czech Republic

The cross section of the reaction ^{91}Nb(p,γ)^{92}Mo is of special interest to answer questions about the production of the most abundant p nucleus ^{92}Mo. With ^{91}Nb being a radioactive nucleus the measurement of this reaction in standard kinematics is a big challenge.

To produce a sufficent number of ^{91}Nb isotopes an enriched ^{92}Mo target was activated by protons at $E_p = 19$ MeV. Afterwards the produced ^{91}Nb isotopes will be separated chemically and applied onto a tungsten backing. This will lead to approximately 10^{16} ^{91}Nb isotopes.

The high proton current delivered by the HF-linear-accelerator FRANZ currently built at Goethe University Frankfurt, Germany, enables the execution of measurement with such limited amount of target material. The goal of our investigation is the determination of the cross section of the ^{91}Nb(p,γ)^{92}Mo reaction at 2 MeV proton energy and thereby in the astrophysical relevant energy region. We will present the current status and the next steps towards the measurement of this cross section.

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HK 11.6 Mo 18:00 S1/01 A02

Bestimmung des ^{10}Be(n,γ) - Wirkungsquerschnitts — •Meiko Volknandt[1], Klaus Eberhardt[2], Anne Endres[1], Matthias Fix[1], Tanja Heftrich[1], Stefan Heinitz[3], Enno Hrivula[1], Arnd Junghans[4], Franz Käppeler[5], Alberto Mengoni[6], Rene Reifarth[1], Stefan Schmidt[1], Dorothea Schumann[3], Mario Weigand[1] und Norbert Wiehl[2] — [1]Goethe Universität Frankfurt, Frankfurt, Germany — [2]Johannes Gutenberg-Universität Mainz, Mainz, Germany — [3]Paul Scherrer Institut, Villigen, Switzerland — [4]Helmholtzzentrum Dresden-Rossendorf, Dresden, Germany — [5]Karlsruhe Institute of Technology, Karlsruhe, Germany — [6]CERN, Geneva, Switzerland

Um die beobachtete solare Elementhäufigkeitsverteilung mit theoretischen Modellen rekonstruieren zu können und ein umfassendes Verständnis der primordialen und stellaren Nukleosynthese zu erlangen, ist eine genaue Kenntnis der Reaktionsraten der einzelnen Nuklide notwendig.

Über eine Aktivierung im Neutronenfluss des TRIGA-Forschungsreaktors in Mainz wurden Messungen zur Bestimmung des Neutroneneinfangwirkungsquerschnitts von ^{10}Be für den thermischen und epithermischen Bereich durchgeführt. Die Aktivität des erzeugten, kurzlebigen ($t_{1/2}$ = 13,8 s) ^{11}Be wurde mit Hilfe von $LaBr_3$ Szintillationsdetektoren gemessen. Der ^{10}Be(n,γ) - Wirkungsquerschnitt wurde erstmalig bestimmt.

Dieses Projekt wurde gefördert durch das FP/2007-2013 des *European Research Council Grant Agreement n. 615126*.

HK 11.7 Mo 18:15 S1/01 A02

The investigation of quasi-free scatering reactions with the two-proton-halo nucleus ^{17}Ne — •Christopher Lehr[1], Thomas Aumann[1], Felix Wamers[2], and Justyna Marganiec[1] — [1]TU Darmstadt — [2]GSI Helmholtzzentrum

^{17}Ne is a Borromean two-proton-halo nucleus located at the proton-dripline and therefore an interesting candidate for nuclear-structure studies.

Reactions of the nucleus ^{17}Ne have been measured in complete kinematics at the R3B/LAND setup at GSI in Darmstadt. It was studied in exclusive measurements of one-pronton-removal reactions. Polyethylene (CH_2) and carbon (C) were used as targets. Thus it is possible to reconstruct the pure H contribution of the CH_2 data by subtracting the carbon background.

The resulting events are clean (p,2p) reactions showing the typical angular correlations known from p-p scattering. Thereby quasi-free (p,2p) and carbon-induced one-proton removal reactions are studied separatly.

Quasi-free scattering reactions are compared with carbon-induced one-proton removal reactions and shown to be a clean tool for nuclear-structure studies.

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