HK 53: Nuclear Astrophysics VII

Time: Thursday 15:45–17:00 Location: SR 0.03 Erw. Physik

Group Report HK 53.1 Thu 15:45 SR 0.03 Erw. Physik

Activation experiments for nuclear astrophysics — •Martin Müller, Benedikt Machliner, Darius Schneider, Svenja Wilden, and Andreas Zilges — University of Cologne

Nuclear astrophysics is a highly interdisciplinary field and the modelling of nucleosynthesis processes requires input from all of its constituents. On the nuclear physics site, reaction rates and cross sections rank among the most important inputs, especially for p-process calculations. This is primarily due to the fact, that in the vast reaction networks that make up the γ process, different reaction channels can compete with each other at many different branching or deflection points. In order to improve the underlying models used to calculate cross sections - typically within the Hauser-Feshbach statistical model - even for nuclei far away from stability, a large experimental database is needed to test and adjust theoretical models. One of the most effective techniques in building these databases throughout the last decades has been the activation method. In this work, recent experiments performed using the activation method as well as the stacked target technique to determine cross sections for both α- and p-induced reactions will be presented. These will include ^{170,172}Yb(α,γ), ^{170,172}Yb(p,γ), ^{55}Mn$(\alpha,(2)n)$, ^{58}Fe(p,n), ^{nat}Dy(p,γ), and ^{nat}Dy(α,γ).
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HK 53.2 Thu 16:15 SR 0.03 Erw. Physik

Measurement of ^{87}Rb$(p,\gamma)^{88}$Sr total reaction cross sections — •Svenja Wilden, Benedikt Machliner, Martin Müller, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

The origin of the p nuclei - a group of stable proton-rich nuclei - cannot be attributed to neutron - capture processes [1]. Instead, their synthesis involves a network of photodisintegration reactions, known as the γ process. Statistical model calculations are essential for predicting reaction rates and cross sections for reactions involved in this process.

An in-beam experiment was conducted to study the ^{87}Rb$(p,\gamma)^{88}$Sr reaction using the high-efficiency HPGe γ-ray spectrometer HORUS at the University of Cologne. Proton beams with energies between $E_p = 2$ and 5 MeV were supplied by a 10 MV FN Tandem accelerator. Cross-section values were determined for six proton-beam energies. These measurements provide the first experimental cross sections for the ^{87}Rb$(p,\gamma)^{88}$Sr reaction, offering constraints on nuclear physics inputs for statistical model calculations.

[1] M. Arnould and S. Gorieley, Prog. Part. Nucl. Phys. **112** (2020) 103766.
Supported by the DFG (ZI 510/8-2).

HK 53.3 Thu 16:30 SR 0.03 Erw. Physik

Sensitivity study of μ and τ neutrino on νr-process — •Heamin Ko[1], Zewei Xiong[2], and Gabriel Martínez-Pinedo[1,2] — [1]Institut für Kernphysik, Fachbereich Physik, TU Darmstadt, Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

In neutron-rich environments, large neutron fluxes can be absorbed by nuclei, which means that neutron-nucleus reactions can push matter beyond the stability line through charge-current reactions and produce p-nuclei. This new process is called the νr-process. In this work, we study the sensitivity of the heavier neutrinos (μ and τ neutrinos). In this talk, we will show the contribution of the heavier neutrinos to the neutral current reaction by varying the parameters of the heavier neutrinos, such as flux and temperature.

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HK 53.4 Thu 16:45 SR 0.03 Erw. Physik

Neutron capture cross section, (n,γ), of natural Krypton in the s-process — •Jan Butz — Goethe Universität, Frankfurt am Main, Germany

An important step in understanding the origin of life is to study stellar nucleosynthesis. The abundance of elements up to iron is produced almost exclusively through nuclear fusion, whereas most heavy elements are formed via neutron capture in the s- and r-processes. The s-process occurs inside the shell burning of massive stars, while the r-process, however, requires extreme conditions, like type II supernovae or neutron star mergers.

Krypton plays a vital role in the s-process due to the branching points of ^{81}Kr and ^{85}Kr. These branching points are nuclei where the decay rate is in the order of the neutron capture rate, $r_\beta \approx r_n$. To gain insight into these points, it is crucial to study the (n,γ)-reaction and the behavior of these nuclei under stellar conditions. Using the activation method, the neutron capture cross section for natural krypton was determined at stellar temperatures for the corresponding s-process components.