HK 8: Nukleare Astrophysik

Zeit: Montag 11:00–12:45 Raum: HSZ-403

Gruppenbericht HK 8.1 Mo 11:00 HSZ-403
Nuclear Astrophysics at the R^3B/LAND setup* — •Tanja Heftrich for the R3B-Collaboration — Goethe-Universität Frankfurt a. M., Germany — GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany

One aim of nuclear astrophysics is the understanding of the nuclear processes leading to the synthesis of elements. Isotopic abundances up to iron mainly result from fusion in stars, whereas heavier nuclei are synthesized by the slow and the rapid neutron capture processes. The synthesis of the rare p nuclei remains an interesting puzzle.
The nuclear physics of stellar nucleosynthesis can be studied using the R^3B/LAND setup. Important astrophysical reactions on radioactive nuclei can be constrained using Coulomb excitation at beam energies around 500 MeV/u. Furthermore, it is possible to determine the corresponding inverse reactions using the detailed balance theorem.
This contribution will present the experimental setup including the different detectors as well as the procedure of analysis of the kinematically complete measurements at the R^3B/LAND setup and some recent results relevant for different astrophysical scenarios.
*supported by Helmholtz International Center for FAIR, DFG (SO907/1-2), Helmholtz Graduate School for Hadron and Ion Research "HGS-HIRe for FAIR", Helmholtznachwuchsgruppe VH-NG-327 and BMBF (06FY71051)

HK 8.2 Mo 11:30 HSZ-403
Neutron-Capture Reactions with the R^3B-CaveC Setup — •Marcel Heine for the R3B-Collaboration — IKP, TU Darmstadt

Recent research has shown that the (n,γ) transition-rates on light nuclei can have an influence on the neutron-balance during the r-process. Especially neutron rich carbon isotopes play an important role in r-process nucleosynthesis network calculations which include light nuclei, since these nuclei are aligned along major flow-paths. In particular ^{18}C is of interest, because it can be interpreted as a waiting point. The ^{17}C(n,γ)^{18}C rate could so far only be estimated theoretically and has an uncertainty of a factor of ten [1]. At the R^3B-CaveC setup at GSI we have measured the (n,γ) time reversed reaction, i.e. ^{18}C(γ,n)^{17}C for the above mentioned nucleus, via the Coulomb-breakup of ^{18}C beam. The kinematically complete measurement allows extracting the energy dependent neutron-capture cross section with respect to the excitation energy by using the invariant-mass method. Results and the strategy for further analysis will be presented.

This work is supported by the HIC for FAIR project.
[1] T. Sasaqui et al., APJ 634 (2005) 1173

HK 8.3 Mo 11:45 HSZ-403
Proton-induced knockout reactions with light radioactive beams at R^3B — •Leyla Atar for the R3B-Collaboration — TUD, Schlossgartenstr.9, 64289 Darmstadt, Germany

Proton-induced knockout reactions are one of the main goal of the experimental program at the future R3B (Reactions with Relativistic Radioactive Bemas) Experiment at FAIR. It allows us to obtain spectroscopic information about valence and deeply bound single-nucleon states and to study their evolution over a large variation in isospin. Recent studies have shown that the occupancies of loosely bound valence nucleons in neutron- or proton-rich nuclei have a spectroscopic factor close to unity, whereas single-particle strength for deeply bound nucleons is suppressed in isospin asymmetric systems compared to the predictions of the many-body shell model. Further experimental and theoretical studies are needed for a qualitative and quantitative understanding. For this aim a series of measurements have been performed on the complete oxygen isotopic chain using the existing experimental setup LAND/R3B at GSI. We will present the main scientific goals, the concepts of the experiment and the preliminary results.
This work is supported by GSI F&E, HIC for FAIR and the BMBF project 06DA70471.

HK 8.4 Mo 12:00 HSZ-403
The ^{152}Sm(p,n) reaction measurements in inverse kinematics — •Moritz Pohl for the S405-Collaboration — Goethe Universität Frankfurt

Under stellar conditions, low-lying excited states in nuclei are in thermal equlibrium with the ground state. If those excited states undergo β-decays with a higher rate than the ground state, the β-decay half-life of this nucleus is dominated by the excited state. The corresponding life-times are extremly difficult to measure directly on earth, since the de-excitation occurs mostly via internal transition.

If the β-decay occurs via the Gamow-Teller transition, charge exchange reactions allow to investigate the decay strength. In order to verify the method of measuring the B(GT) strength of unstable heavy nuclei via inverse kinematics, the reaction p(^{152}Sm,^{152}Eu)n was used as a test case. This measurement allows to set constraints on the temperature dependent electron capture of ^{152}Eu, which is an important s-process branching point. The s405 experiment took place at the R^3B/LAND setup at GSI. A newly developed Low Energy Neutron detector Array (LENA) was used to measure the recoil neutrons, which are emitted at large angles relatively to the incoming beam. To determine the detector response, a GEANT3 simulation was performed. Preliminary results will be presented. This project was supported by the Helmholtz International Center for FAIR, the Helmholtz Young Investigator Group VH-NG-327 and HGS-HIRE.

HK 8.5 Mo 12:15 HSZ-403
Die s-Prozess Verzweigung am Isotop ^{85}Kr* — •Benedikt Thomas[1], Jan Glorius[1], Alexander Koloczek[1], Ralf Plag[1], Marco Pignatari[2], Rene Reifarth[1] und Kerstin Sonnabend[1] für die NuGrid-Kollaboration — [1]Goethe Universität Frankfurt, Deutschland — [2]Universität Basel, Schweiz

Bei Nukleosyntheseprozessen in Sternen sind immer wieder Isotope beteiligt, die metastabile Zustände besitzen. Diese Isomere können die Bildungswahrscheinlichkeiten der nachfolgenden Isotope stark beeinflussen. In aktuellen Simulationen sind Isomere nicht oder nur sehr vereinfacht eingebaut. Dadurch können zum Teil große Fehler für die relativen Häufigkeiten der Isotope auftreten. Um solche Isomere zu implementieren, benötigt man zusätzliche Raten für die thermische Anregung und den internen Zerfall, sowie alle anderen Reaktionsraten, die das Isomer betreffen. Sind diese Raten bekannt oder können ermittelt werden, kann durch die entsprechende Programmierung dieser Raten die Genauigkeit der Simulation von Nukleosyntheseprozessen deutlich verbessert werden. Die Auswirkungen einer solchen Implementierung wird am Beispiel des Verzweigungskerns ^{85}Kr im s-Prozess und dessen Isomer ^{85m}Kr gezeigt.

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HK 8.6 Mo 12:30 HSZ-403
Sensitivitätsstudien für den s-Prozess — •Alexander Koloczek[1], Benedikt Thomas[1], Rene Reifarth[1], Kerstin Sonnabend[1], Marco Pignatari[2] und Christian Ritter[1] für die NuGrid-Kollaboration — [1]Goethe Universität Frankfurt a. M. — [2]Universität Basel

Um die Nukleosynthese während des s-Prozess zu simulieren, benötigt man einerseits Sternmodelle und andererseits ein vollständiges Reaktionsnetzwerk, das mit experimentellen Daten untermauert werden sollte. Die NuGrid Kollaboration hat Programme entwickelt, mit denen zuerst die Sternmodelle und nachträglich die Nukleosyntheseprozesse berechnet werden. Auf diese Weise wird der Rechenaufwand reduziert und der Einfluss unterschiedlicher Reaktionsnetzwerke leicht für das gleiche Sternmodell untersucht werden.

Hier werden systematische Sensitivitätsstudien präsentiert, welche die Auswirkungen von Änderungen des Reaktionsnetzwerks auf die Elementverteilung in Sternen zeigen. Dies hilft dabei entscheidende Reaktionsraten zu identifizieren, die mit hoher Priorität in zukünftigen Experimenten gemessen werden sollten.

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