HK 29: Nuclear Astrophysics 2

Time: Tuesday 17:00–18:45 Location: K/HS2

Group Report HK 29.1 Tue 17:00 K/HS2

Underground nuclear astrophysics at the Dresden Felsenkeller — •Daniel Bemmerer[1], Thomas E. Cowan[1,2], Stefan Gohl[1,2], Marcel Grieger[1,2], Christoph Ilgner[1], Arnd R. Junghans[1], Stefan Müller[1], Tobias P. Reinhardt[2], Stefan Reinicke[1,2], Bernd Rimarzig[1], Marko Röder[1,2], Konrad Schmidt[1,2], Ronald Schwengner[1], Klaus Stöckel[1,2], Tamás Szücs[1], Marcell P. Takács[1,2], Andreas Wagner[1], Louis Wagner[1,2], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden — [2]Technische Universität Dresden

Favored by the low background underground, accelerator-based experiments are an important tool to study nuclear astrophysics reactions involving stable charged particles. This technique has been used with great success at the 0.4 MV LUNA accelerator in the Gran Sasso laboratory in Italy. However, the nuclear reactions of helium and carbon burning and the neutron source reactions for the astrophysical s-process require higher beam energies, as well as the continuation of solar fusion studies. As a result, NuPECC strongly recommended the installation of one or more higher-energy underground accelerators. Such a project is underway in Dresden. A 5 MV Pelletron accelerator is currently being refurbished by installing an ion source on the high voltage terminal, enabling intensive helium beams. The preparation of the underground site is funded, and the civil engineering project is being updated. The science case, operational strategy and project status will be reported. – Supported by NAVI (HGF VH-VI-417) and by DFG (TU Dresden Institutional Strategy, "support the best").

HK 29.2 Tue 17:30 K/HS2

Wirkungsquerschnitte von (γ,n)-Reaktionen mit quasimonoenergetischen Photonen — •Taniya Thomas[1], Anne Endres[1], Philipp Erbacher[1], Jan Glorius[1], Rene Reifarth[1], Deniz Savran[2] und Kerstin Sonnabend[1] — [1]Goethe Universität Frankfurt — [2]ExtreMe Matter Institute EMMI, GSI, Darmstadt

Der p-Prozess ist der Überbegriff für Prozesse zur Erzeugung protonenreicher Kerne schwerer als Eisen, die durch andere Nukleosyntheseprozesse nicht synthetisiert werden können. Einer dieser Prozesse ist der γ-Prozess, ein Photodesintegrationsprozess, der in Supernovaexplosionen stattfindet und für die Erzeugung schwerer p-Kerne verantwortlich ist. Dabei werden bereits vorhandene neutronenreiche Kerne photodesintegriert. Um diesen Prozess zu reproduzieren braucht man die Wirkungsquerschnitte der beteiligten Reaktionen. Fünf solcher Wirkungsquerschnitte wurden bei verschiedenen Strahlenergien mit einem Aktivierungsexperiment an der “High Intensity γ-Ray Source HIγS"der Duke University, USA, untersucht. Hierfür wurden natürlich zusammengesetzte Proben von Ytterbium, Thulium und Tellur mit quasimonoenergetischen Photonen aktiviert. Die aktivierten Proben wurden mit hochreinen Germaniumdetektoren spektroskopiert. Damit können die Wirkungsquerschnitte der Reaktionen ^{170,176}Yb(γ,n), ^{169}Tm(γ,n) und ^{128,130}Te(γ,n) bestimmt werden. Die vorläufigen Ergebnisse werden dazu vorgestellt. Dieses Projekt wird gefördert durch die DFG (SO907/2-1), HIC for FAIR und EMMI.

HK 29.3 Tue 17:45 K/HS2

Activation measurements of α-induced reactions at sub-Coulomb energies — •Philipp Scholz[1], Anne Endres[2], Alfred Dewald[1], Stefan Heinze[1], Jan Mayer[1], Claus Müller-Gatermann[1], Lars Netterdon[1], and Andreas Zilges[1] — [1]Institute for Nuclear Physics, University of Cologne — [2]Institute for Applied Physics, Goethe University Frankfurt am Main

Network calculations of the γ process rely almost completely on theoretically predicted reaction rates within the scope of the Hauser-Feshbach Statistical Model. Especially the prediction of cross sections for (γ,α)-reactions at energies within or close to the astrophysically relevant energy window remains a problem due to the uncertainties in the underlying α-optical-model potentials. Although experimental values far above the Coulomb-barrier are well reproduced, commonly used α-optical potentials often fail to describe the trend at energies comparable to those at astrophysical sites of the γ process. Improvements of the adopted optical-model potentials are hampered by the lack of experimental cross sections at sub-Coulomb energies. In order to enlarge the experimental data base, cross sections of the ^{187}Re(α,n) and ^{108}Cd(α,n) reactions were investigated using the activation technique with the Cologne Clover Counting Setup. Besides recent experimental results, future plans for more sensitive cross-section studies applying Accelerator Mass Spectrometry using CologneAMS will be presented.

Partly supported by the DFG (ZI 510/5-1 and INST 216/544-1) and the ULDETIS project within the UoC Excellence Initiative institutional strategy.

HK 29.4 Tue 18:00 K/HS2

S factor of ^{14}N(p,γ)^{15}O at 0.4 - 1.4 MeV — •Louis Wagner[1,2], Shavkat Akhmadaliev[1], Michael Anders[1,2], Daniel Bemmerer[1], Zoltan Elekes[1], Stefan Gohl[1,2], Arnd Junghans[1], Michele Marta[3], Frans Munnik[1], Tobias Reinhardt[2], Stefan Reinicke[1,2], Marko Röder[1,2], Konrad Schmidt[1,2], Ronald Schwengner[1], Martin Serfling[1,2], Tamas Szücs[1], Marcell Takacs[1,2], Andreas Wagner[1], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]TU Dresden, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

For solar model calculations precise knowledge of the relevant fusion cross sections is needed. In the solar core the rate of the CNO cycle is dominated by the bottleneck ^{14}N(p,γ)^{15}O reaction, because this is the slowest reaction of the cycle. A proton beam with energies of 0.4 - 1.4 MeV delivered by the 3 MV Tandetron of Helmholtz-Zentrum Dresden-Rossendorf was used to study the non-resonant cross section of ^{14}N(p,γ)^{15}O. The talk presents the characterisation of the used TiN targets with Elastic Recoil Detection Analysis (ERDA), new data for the S factor of ^{14}N(p,γ)^{15}O and a R-Matrix extraplolation for capture to the excited state at 6.79 MeV.

– Supported by the Helmholtz association through the Nuclear Astrophysics Virtual Institute (HGF VH-VI-417).

HK 29.5 Tue 18:15 K/HS2

S-factor measurement of ^{12}C(p,γ)^{13}N in inverse kinematics — •Klaus Stöckel[1,2], Tobias P. Reinhardt[2], Shavkat Akhmadaliev[1], Daniel Bemmerer[1], Stefan Gohl[1,2], Stefan Reinicke[1,2], Konrad Schmidt[1,2], Martin Serfling[1,2], Tamás Szücs[1], Marcell P. Takács[1,2], Louis Wagner[1,2], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]Technische Universität Dresden, Dresden, Germany

The ^{12}C(p,γ)^{13}N is the second slowest reaction in the CNO cycle. Hence, it affects the reaction rate in the outer parts of the solar core, where due to the lower temperature the CNO cycle has not yet reached its equilibrium. The last comprehensive study of the ^{12}C(p,γ)^{13}N reaction dates back to the 1970s. The reaction has been studied using a ^{12}C beam at the Dresden 3 MV Tandetron, solid hydrogen targets and a lead shielded 60 % HPGe detector. Hydrogen depth profiling with a ^{15}N beam was used for the determination of the target characteristics. The excitation function has been determined down to 152 keV. — Supported by BMBF (05P120DNUG) and by the Helmholtz Association through the Nuclear Astrophysics Virtual Institute NAVI, (HGF VH-VI-417).

HK 29.6 Tue 18:30 K/HS2

Measurement of the ^{26}Si(p,γ)^{27}P cross section via the Coulomb dissociation of ^{27}P. — •Justyna Marganiec[1,2,3], Saul Beceiro-Novo[4], Stefan Typel[3], Christine Wimmer[5], Thomas Aumann[1,3], Dolores Cortina Gil[4], Michael Heil[3], and Klaus Sümmerer[3] for the R3B-Collaboration — [1]TU Darmstadt, Germany — [2]EMMI-GSI Darmstadt, Germany — [3]GSI Darmstadt, Germany — [4]Universidade de Santiago de Compostela, Spain — [5]Goethe-Universität, Frankfurt am Main, Germany

The reaction ^{26}Si(p,γ)^{27}P can, under certain conditions, be significant in the context of the astrophysical *rp* process. Since ^{26}Si has a short half-life, the reaction was investigated via the time-reversed process, the Coulomb dissociation (CD) of ^{27}P into ^{26}Si and proton. The differential CD cross sections can be converted to radiative-capture cross sections via virtual-photon theory and detailed balance. The experiment was performed at the LAND/R^{3}B setup at GSI Darmstadt. The secondary ^{27}P beam was produced by fragmentation of ^{36}Ar and impinged onto a Pb target. The incoming beam particles and outgoing reaction products were identified and tracked event by event. Corrections were applied to select only transitions directly to the ^{26}Si ground state and to remove contributions from nuclear processes and reactions in layers outside the target. The results are compared to potential-model calculations of the CD of ^{27}P. Consequences for the astrophysical *rp* process will be discussed.

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