HK 38: Nuclear Astrophysics

Time: Tuesday 16:30–18:45 Location: H-ZO 60

Invited Group Report HK 38.1 Tu 16:30 H-ZO 60

Photon-induced experiments for nuclear astrophysics* — •Kerstin Sonnabend — Institut für Kernphysik, Technische Universität Darmstadt, D-64289 Darmstadt, Germany

Photon-induced experiments play an important role in the solution of the puzzle about the production of the heavy elements in different nucleosynthesis scenarios. The most direct impact can be seen in the production of the so-called p nuclei by photodisintegration reactions like (γ,n), (γ,p), and (γ,α). Complete network calculations include several hundred mainly unstable isotopes with the corresponding reactions rates and, therefore, rely on theoretical predictions of these rates normally performed in the framework of Hauser-Feshbach theory. Thus, the reliability of these calculations should be tested experimentally for selected isotopes [1].

In addition, the knowledge of the photo-response of an isotope below the particle-emission thresholds yields worthwhile information on the according photon-strength function which is besides the level density and the particle-optical potentials the main input for predictions in the Hauser-Feshbach model. Photon-scattering and photon-absorption experiments are ideal tools to study the most important contributions of the dipole strength functions [2].

Recent studies on astrophysically relevant isotopes below and above the neutron separation threshold will be presented.

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[1] J. Hasper *et al.*, Phys. Rev. C **77** (2008) 015803.
[2] U. Kneissl *et al.*, J. Phys. G **32** (2006) R217.

Invited Group Report HK 38.2 Tu 17:00 H-ZO 60

Nuclear physics aspects of the nucleosynthetic p process: where do we stand ? — •S. V. Harissopulos — TANDEM Lab, Inst. of Nuclear Physics, NCSR Demokritos, Athens, Greece

The study of capture reactions at energies well below the Coulomb barrier is quite challenging both in terms of scientific motivation and experimental approach. These reactions are interesting as they are associated with a long-standing astrophysical problem, i.e. how certain heavy-isotopes (p nuclei) observed, so far, only in the solar system, are formed in the Universe (p process). Moreover, p-nuclei abundances are the signatures of the creation mechanism(s)of our solar system, an issue that still remains open. Existing p-process models are still unable to reproduce the observed p-nuclei solar abundances and certain nuclear physics models describing global parameters entering the calculations are inaccurate and unreliable. It is therefore of paramount importance, on top of any astrophysical model improvements, to check the reliability of nuclear physics predictions related to the understanding of the p-nuclei abundance pattern. For this purpose, a new method (4π γ-summing) was developed by "Demokritos"and Bochum which enabled us to study more than 20 (p,γ) and (α,γ) reactions at energies well-below the Coulomb barrier. The paper presents a review of recent theoretical and experimental developments including first attempts to measure cross sections of capture reactions in inverse kinematics using the JUROGAM array. Finally, the question of whether there is sufficient experimental information to put constraints on the theory and draw final conclusions will be discussed.

HK 38.3 Tu 17:30 H-ZO 60

Constraining Nucleosynthesis in Type I X-Ray Bursts through Mass Measurements — •Anuj Parikh[1,2], Jordi José[2,3], Christian Iliadis[4,5], Fermin Moreno[2], and Thomas Rauscher[6] — [1]Physik Department E12, Technische Universität München, D-85748 Garching, Germany — [2]Departament de Física i Enginyeria Nuclear, EUETIB, Universitat Politècnica de Catalunya, E-08036 Barcelona, Spain — [3]Institut d'Estudis Espacials de Catalunya (IEEC), E-08034 Barcelona, Spain — [4]Department of Physics and Astronomy, University of North Carolina, Chapel Hill, NC 27599-3255, USA — [5]Triangle Universities Nuclear Laboratory, Durham, NC 27708-0308, USA — [6]Department of Physics, University of Basel, CH-4056 Basel, Switzerland

Type I X-ray bursts are explosive stellar events resulting from thermonuclear ignition in the H/He-rich envelopes of accreting neutron stars. Nucleosynthesis in these phenomena may involve up to several thousand nuclear processes. Those reactions with small Q-values (less than 1 MeV) are of particular interest in these environments as they may represent waiting points for a continuous abundance flow towards heavier-mass nuclei. We have performed a comprehensive series of post-processing calculations which examine the sensitivity of nucleosynthesis in type I X-ray bursts to uncertainties in both reaction rates and reaction Q-values. We discuss the relatively few critical masses for which measurements could better constrain the results of our studies. In particular, we stress the importance of measuring the masses of ^{65}As and ^{66}Se.

HK 38.4 Tu 17:45 H-ZO 60

Coulomb Dissociation experiments with proton rich isotopes at LAND/R^{3}B setup — •Christine Wimmer — Universität Frankfurt, Deutschland

After the implementation of the proton arm at the LAND/R^{3}B setup at GSI in Darmstadt it is possible to extend the experimental programme to proton rich nuclei of astrophysical relevance. Coulomb dissociation induced reactions with secondary ion beams consisting of short-lived proton-rich isotopes produced at the fragment separator (FRS) have been investigated. This contribution offers an overview over the application of this method to determine (p, γ) cross sections from (γ, p) reactions and presents analysis strategies at the example of the ^{27}Si(γ, p)^{26}P experiment.

HK 38.5 Tu 18:00 H-ZO 60

a new calculation for primordial li reaction rates — •gokhan kocak[1,2] and akif baha balantekin[2] — [1]erciyes university department of physics, kayseri, turkey — [2]wisconsin university department of physics, wisconsin, usa

in nuclear astrophysics, one of the most important problem is the difference between the theoretical standard big bang nucleosynthesis (sbbn) results and the observational values for primordial li abundance and reaction rate. to solve this problem, m. pospelov [1] has recently suggested to take into account the effect of using a negatively-charged particle in the calculations, which might be also a possible solution of li magnitude/abundance problem in bbn. in this study, we have calculated the s-factor and the reaction rates for 3he(4he,γ)7li system by using the optical model and these results are in very good agreement with the results of sbbn prediction. after that, we have included the effect of a negatively-charged particle for 3he(4he,γ)7li reaction and have investigated the s-factor and reaction rates. this effect have shown that the magnitude of the reaction rate for 3he(4he, γ)7li system has been increased 8 or 9 order, which is in a better agreement with the observational value.

[1] m. pospelov phys. rev. lett. 98 231301 (2007).

HK 38.6 Tu 18:15 H-ZO 60

Extended pool of stellar electron capture rates on nuclei — •Andrius Juodagalvis[1], Karlheinz Langanke[2], William R. Hix[3], Gabriel Martinez-Pinedo[2], and Jorge M. Sampaio[4] — [1]VU ITPA, Vilnius, Lithuania — [2]GSI, Darmstadt, Germany — [3]ORNL, Oak Ridge TN, USA — [4]CFNUL, Lisboa, Portugal

Nuclear physics input plays an important role in core-collapse supernova simulation. Nuclear shell model based methods reliably predict the capture rates, however, the feasibility cuts the method short. Earlier we reported on the extension of the pool of hybrid rates to 250 nuclei of pf+gds model space [1]. Here we present even more enlarged pool based on a schematic Fermi-Dirac approximation to the parent nucleus ground state occupation numbers. More than 2500 nuclei with Z = 28-70 and N = 40-160 are calculated within the schematic hybrid model. The NSE-averaged electron capture rate and the emitted neutrino spectra are calculated. The screening effects are taken into account both in calculation of the nuclear abundances and calculating the capture rates as well as neutrino spectra.

[1] A.Juodagalvis *et al*, Journ. Phys. G 35, 014031 (2008).

HK 38.7 Tu 18:30 H-ZO 60

A new and improved measurement of 8Li(4He,n)11B reaction at the EXCYT RIB facility: the cross section value at the Big-Bang temperature — •Marco La Cognata[1], Rosa Alba[1], Silvio Cherubini[1,2], Nicola Colonna[5], Luigi Cosentino[1], Vincenzo Crucillà[1,2], Antonio Del Zoppo[1], Alessia Di Pietro[1], Pierpaolo Figuera[1], Marisa Gulino[1,2], Livio Lamia[1], Agatino

Musumarra[1,2], Maria Grazia Pellegriti[1,4], Rosario G. Pizzone[1], Sebastiana M. R. Puglia[1,2], Giuseppe G. Rapisarda[1,2], Claus Rolfs[3], Stefano Romano[1,2], Maria Letizia Sergi[1,2], Claudio Spitaleri[1,2], Salvatore Tudisco[1], and Aurora Tumino[1,2] — [1]INFN-Laboratori Nazionali del Sud, Catania, Italy — [2]Dipartimento di Metodologie Fisiche e Chimiche per l'Ingegneria, Università di Catania, Italy — [3]Institut fur Physik mit Ionenstrahlen, Ruhr-Universitaet Bochum, Germany — [4]Dipartimento di Fisica e Astronomia, Università di Catania, Italy — [5]INFN-Sezione di Bari, Italy

A new neutron-inclusive measurement of the 8Li(4He,n)11B at the energies relevant for astrophysics is presented. The radioactive 8Li beam was delivered by the EXCYT facility at LNS-Catania. The cross section was determined by a low-background measurement of the time correlation between the 8Li projectile arrival to the target and the neutron capture in a threshold-less 4pi thermalization counter. This new data confirm complementary inclusive 11B measurement and are consistent with a significant population of 11B levels at high excitation energy. A large experimental discrepancy between all the inclusive and the exclusive cross section shows up.