HK 10: Struktur und Dynamik von Kernen III

Time: Monday 16:30–18:30 Location: A-1

Group Report HK 10.1 Mon 16:30 A-1

Neutrino nucleus reactions at high energies — •Olga Lalakulich, Kai Gallmeister, Tina Leitner, and Ulrich Mosel — Institut für Theoretische Physik, Universität Giessen, Germany

Modern long baseline neutrino experiments, aiming at measuring the neutrino oscillation parameters, base their analysis on models for neutrino-nucleus interactions. Theoretical understanding of nuclear effects is essential for the interpretation of the experimental data. Within the Giessen Boltzmann–Uehling–Uhlenberck (GiBUU) coupled channel transport model we examine neutrino and antineutrino interactions with nuclei. The neutrino first interacts with a bound nucleon, moving within the Fermi sphere in a hadronic potential. After the initial interaction, the outgoing hadrons undergo complex hadronic final state interactions with all kinds of coupled channel effects included. Calculations of the total cross sections are compared with the recent data of the MINOS and NOMAD Collaborations for neutrino beam energies from 4 to 45 GeV. Predictions for kinetic energy distributions of the outgoing nucleons, pions and kaons, as well as for other differential cross sections, are made for the Minerνa experiment.
Supported by DFG.

HK 10.2 Mon 17:00 A-1

Neutron Bound β- Decay- BOB — •M. Gabriel[1], M. Berger[1], R. Emmerich[1], R. Engels[2], T. Faestermann[1], P. Fierlinger[3], E. Gutsmiedl[1], F.J. Hartmann[1], R. Hertenberger[4], S. Paul[1], R. Röhrmoser[5], S. Ruschel[1], J. Schön[1], W. Schott[1], U. Schubert[1], A. Trautner[1], and T. Udem[6] — [1]Physik-Department, TUM, 85748 Garching — [2]Institut für Kernphysik, Forschungszentrum Jülich, 52425 Jülich — [3]Excellence Cluster Universe, TUM, 85748 Garching — [4]Sektion Physik, LMU,85748 Garching, Germany — [5]FRM2, TUM, 85748 Garching,Germany — [6]Max- Planck- Institut für Quantenphysik, 85748 Garching, Germany

The bound neutron β-decay(BOB) into a hydrogen atom and an electron antineutrino is investigated.The hyper-fine-state population of the monoenergetic hydrogen atoms (326.3 eV) yields the neutrino left-handed-ness or a possible right-handed admixture and possible small scalar and tensor contributions to the weak force. Preexperiments to measure the BOB H(2s) atoms have been done or are being set up using ionizer and RF discharge proton sources, a Wien filter, Cs and Ar cells, a spin filter, electric counter and accelerating fields, a double focusing magnet and a solar blind PM for the Lyman-α photons. In a first experiment, the charge exchange of the H(2s) atoms into H^-, offering a selective method to discrimiate these states against background, is investigated. In a second step the number of background H(2s) resulting from protons interacting with the walls of the experimental setup are determined. For this a quenching E field and a solar blind PM are used.

HK 10.3 Mon 17:15 A-1

Energietrennung des 1+/1- Paritätsdupletts in Ne-20* — •Jacob Beller[1], M. Ahmed[2], J. Isaak[1], J. Kelley[3], N. Pietralla[1], C. Romig[1], M. Scheck[1], A. Tonchev[2], W. Tornow[2], J. Wagner[1], H.R. Weller[2] und M. Zweidinger[1] — [1]Institut für Kernphysik, TU Darmstadt — [2]Duke University, Durham, USA — [3]North Carolina State University, Raleigh, USA

Das Paritätsduplett von $1^+/1^-$ Zuständen in ^{20}Ne bei 11.26 MeV ist eines der besten bekannten Testfälle, um Paritätsverletzung in Atomkernen z.B. mittels Streuung zirkular polarisierter Photonen zu studieren. Die Durchführbarkeit eines solchen Experiments hängt von dem so genannten *effective nuclear enhancement factor* $|R_N/\Delta E|$ ab, der proportional zu dem Verhältnis des Matrixelements der schwachen Wechselwirkung zu der Energieaufspaltung ist. Für das Duplett in ^{20}Ne ist ein extrem großer Wert von $|R_N/\Delta E| = (670 \pm 7000)$ bekannt [1]. Die große Unsicherheit hängt im wesentlichen von der Unsicherheit von $\Delta E = 7.7 \pm 5.5$ keV des 1^- und 1^+ Paritätsduplets ab. Ein Kernresonanzfluoreszenz-Experiment unter Verwendung von linear polarisierten Photonen an der High Intensity γ-Ray Source (HIγS) soll eine präzisere Bestimmung der Energien durch die unterschiedliche Winkelverteilung der $0^+ \to 1^- \to 0^+$ und $0^+ \to 1^+ \to 0^+$ Kaskaden erlauben. Die Messmethode wird vorgestellt und das Ergebnis diskutiert.
*Gefördert durch die DFG (SFB 634).

[1] A. I. Titov *et al.*, J. Phys. G: Nucl. Part. Phys. **32** (2006) 1097.

HK 10.4 Mon 17:30 A-1

Charge Exchange Excitation in Nuclei — •Abdul A. Ataie and Horst Lenske — Institut für Theoretische Physik, Universität Giessen

We study charge-exchange transitions in stable and exotic nuclei. These reactions are of interest to study electron capture process during the collapse of massive stars. The charge exchange excitations are calculated by QRPA from a self-consisting HFB ground state. We use an extended QRPA ansatz which, besides pairing effects, also accounts for the coupling to the continuum and dissipative contributions. The spectral distributions and transition probabilities are extracted from the polarization propagator. The polarization propagator is calculated by solving directly the Dyson-equation. For studying the Ikeda sum rule the analysis of the continuum region is of importance. Results of different nuclei in the carbon and in the Fe-Ni region for natural and unnatural parity excitations are discussed.
Supported by DFG, HIC for FAIR and GSI.

HK 10.5 Mon 17:45 A-1

Knockout and charge-exchange reactions from relativistic carbon beams — •Vasily Volkov and Matthias Holl for the S341-Collaboration — Technische Universität Darmstadt, Germany

Abstract: Cross-sections of one- and two-nucleon knockout reactions as well as charge-exchange reactions from relativistic proton-rich carbon beams obtained during experiment S341 at the fragment separator FRS at GSI will be presented. In one-nucleon knockout a reduction of the spectroscopic factors extracted from these reactions with increasing binding energy of the removed nucleon [1-3] is corroborated. Two-neutron and two-proton knockout reactions from ^{11}C have been compared with each other, and in charge-exchange reactions we observe the excitation of the Δ resonance. Beams of ^{9,10,11,12}C were produced in fragmentation reactions. The secondary beam impinged on a beryllium target at the second focus (S2) of the FRS. To maximize transmission, the reaction residues were measured at the third focus (S3) of the FRS. Supported in part by the BMBF, contracts 06DA9040I and 06MT9156, and through the GSI-TU-Darmstadt cooperation contract.

[1] B. A. Brown et al., Phys. Rev. C 65, 061601 (R) (2002)
[2] A. Gade et al., Phys. Rev. Lett. 93, 042501 (2004)
[3] A. Gade et al., Phys. Rev. C 77, 044306 (2008)

HK 10.6 Mon 18:00 A-1

Quasi-free scattering off ^{12}C in inverse kinematics at the R3B/LAND-setup — •Valerii Panin[1], Thomas Aumann[1], and Jonathan Taylor[2] for the R3B-Collaboration — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]Department of Physics, University of Liverpool, UK

An important part of the physics program at the future R3B (Reactions with Relativistic Radioactive Beams) experiment at FAIR will be based on the study of proton-induced reactions in a kinematical complete measurement. These are in particular the quasi-free scattering processes of the type (p,2p), (p,pn), (p,pα) etc, which will be used to investigate the single-particle and cluster structure of neutron-proton asymmetric nuclei and the role of nucleon-nucleon correlations in nuclei. A prototype setup for the detection of high-energy protons in (p,2p) reactions in coincidence with forward emitted light particles and heavy fragments has been built based on an array of Si micro-strip detectors for tracking and thick NaI scintilators for energy measurements. A ^{12}C beam has been chosen for the bench-mark experiment since its structure is well known, and results from proton- as well as electron-induced knockout reactions are available. First results on two-proton angular correlations and momentum distributions of the knocked-out protons inside ^{12}C will be discussed as well as the excitation energy spectrum of the residual ^{11}B nuclei.

HK 10.7 Mon 18:15 A-1

Erste Messungen mit dem vielfach segmentierten Implantations- und β-Detektor CAITEN in RIKEN* — •Konrad Steiger, Thomas Faestermann, Roman Gernhäuser, Christoph Hinke und Reiner Krücken für die CAITEN-Kollaboration —

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Ende 2010 wurden an der Radioactive Ion Beam Facility (RIKEN, Tokio) durch relativistische Projektil-Fragmentation eines $345 \cdot A$ MeV ^{48}Ca Primärstrahls neutronenreiche Kerne in der Nachbarschaft von ^{38}Mg produziert, im BigRIPS Fragmentseparator separiert und mit Messung von Energieverlust, Flugzeit und magnetischer Steifigkeit eindeutig identifziert. Die Fragmente wurden in den CAITEN-Aufbau (Cylindrical Active Implantation Target for Efficient Nuclear-decay study) implantiert. Hauptbestandteil davon ist ein 20 mm dicker $4{\cdot}10^5$-fach segmentierter Plastikszintillator in Form eines Hohlzylinders. Durch eine Orts- und Zeitkorrelation von Implantationen mit darauf folgenden Zerfällen konnten unter anderem die β-Halbwertszeiten der Kerne ^{37,38}Mg und ^{39,40}Al bestimmt werden. Die Rotation und axiale Bewegung des Szintillators reduzierte dabei Untergrundzerfälle. β-verzögerte Neutronen und γ-Zerfälle wurden mit Flüssig-Szintillator- bzw. Germanium-Clover-Detektoren nachgewiesen.

In diesem Vortrag wird der aktuelle Stand der Analyse des Experiments präsentiert.

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