HK 11: Struktur und Dynamik von Kernen

Zeit: Montag 16:30–19:00 Raum: HZ 5

Gruppenbericht HK 11.1 Mo 16:30 HZ 5

First results of the (n,gamma) EXILL campaigns at the Institut Laue Langevin — •Jan Jolie[1], Jean-Marc Régis[1], Dennis Wilmsen[1], Samer Ahmed[1], Michael Pfeiffer[1], Nima Saed Samii[1], Nigel Warr[1], Peter Thirolf[2], Dieter Habs[2], EXILL Collaboration[3], and FATIMA Collaboration[3] — [1]Institut für Kernphysik, Universität zu Köln, Zülpicher Str 77, 50937 Köln — [2]Fakultät für Physik, Ludwig Maximilian Universität, 85748 Garching — [3]Siehe Kollaborationliste

At the PF1B cold neutron beam line at the Institut Laue Langevin the EXILL array consisting of EXOGAM, GASP and LOHENGRIN detectors was used to perform (n,gamma) measurements under very high coincidence rates. About ten different reactions were then measured in autumn 2012. In spring 2013 the EXOGAM array was combined with 16 LaBr3(Ce) scintillators in the FATIMA@EXILL campaign for the measurement of lifetimes using the generalised centroid difference method. We report on the properties of both set-ups and present first results on Pt isotopes from both campaigns. This work was supported by NUPNET by contract 05P12PKNUF (BMBF) and DNC7RP01/4, by the Science and Technology Facilities Councils (UK), by the DFG cluster of Excellence Origin and Structure of the Universe.

HK 11.2 Mo 17:00 HZ 5

Gamma ray spectroscopy of neutron-rich actinides after multi-nucleon transfer reactions — •Andreas Vogt, Benedikt Birkenbach, Peter Reiter, Herbert Hess, Lars Lewandowski, and Tim Steinbach for the LNL 11.22-Collaboration — Institut für Kernphysik, Universität zu Köln

Excited states in neutron-rich Th and U nuclei were investigated after multi-nucleon transfer reactions employing the AGATA demonstrator and PRISMA setup at LNL (INFN, Italy). A primary ^{136}Xe beam of 1 GeV hitting a ^{238}U target was used to produce the nuclei of interest in the actinide region. Beam-like reaction products in the Xe-Ba-region were identified and selected by the PRISMA spectrometer. Kinematic coincidences between the binary reaction products of beam-like and target-like nuclei are detected with an additional MCP detector. Those coincidences allow clean conditions for in-beam γ-ray spectroscopy. Background contributions from excited fission fragments are successfully discriminated. γ-rays from excited states in beam- and target-like particles were measured with the position sensitive AGATA HPGe detectors. Improved energy resolution after Doppler correction is based on the novel γ-ray tracking technique which was successfully exploited to increase the quality of the γ-spectra. γ-ray spectra of the produced beam-like isotopes in the one-proton and two-proton transfer channels will be presented. Corresponding results from the hard-to-reach neutron-rich isotopes beyond ^{232}Th will focus on their collective properties and cross section limits for their production. Supported by the German BMBF (05P12PKFNE TP4), ENSAR-TNA03, BCGS.

HK 11.3 Mo 17:15 HZ 5

Bestimmung von Paritätsquantenzahlen dipolangeregter Zustände des mittelschweren Kerns ^{40}Ar* — •Udo Gayer[1], Jacob Beller[1], Vera Derya[2], Matthew Gooden[3], Johann Isaak[4,5], Bastian Löher[4,5], Norbert Pietralla[1], Christopher Romig[1], Marcus Scheck[1,6,7], Werner Tornow[3] und Markus Zweidinger[1] — [1]Institut für Kernphysik, TU Darmstadt — [2]Institut für Kernphysik, Universität zu Köln — [3]Duke University, Durham, NC, USA — [4]ExtreMe Matter Institute EMMI and Reasearch Division, GSI, Darmstadt — [5]Frankfurt Institute for Advanced Studies FIAS, Goethe-Universität Frankfurt — [6]School of Engineering, University of the West of Scotland, Paisley, UK — [7]SUPA, Scottish Universities Physics Alliance, Glasgow, UK

An der High-Intensity $\vec{\gamma}$-Ray Source der Duke University in Durham, NC, USA wurde ein Kernresonanzfluoreszenz-Experiment mit einem polarisierten, quasimonochromatischen Photonenstrahl an einem Argon-Target durchgeführt. Ziel war die Bestimmung von Paritätsquantenzahlen dipolangeregter Zustände im Isotop ^{40}Ar im Bereich zwischen 5.4 MeV und 7.6 MeV als systematische Fortsetzung vorheriger Experimente in umliegenden Energiebereichen [1]. Die Paritätsbestimmung erfolgt über die Untersuchung der Winkelverteilung der Zerfallsstrahlung. Die Messmethode wird vorgestellt und die Ergebnisse anhand eines Vergleichs mit theoretisch berechneten Werten für Energien und Übergangsstärken der Dipolübergänge diskutiert.

*Gefördert durch die DFG im Rahmen des SFB 634

[1] T.C. Li et al., Phys. Rev. C 73 (2006) 054306

HK 11.4 Mo 17:30 HZ 5

Low-lying dipole strength in the $N = 28$ shell-closure nucleus ^{52}Cr* — •Haridas Pai[1], Jacob Beller[1], Nadia Benouaret[1], Joachim Enders[1], Timo Hartmann[1], Oliver Karg[1], Peter von Neumann-Cosel[1], Norbert Pietralla[1], Vladimir Yu. Ponomarev[1], Christopher Romig[1], Marcus Scheck[1,2,3], Linda Schnorrenberger[1], Stephan Volz[1], and Markus Zweidinger[1] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]School of Engineering, University of the West of Scotland, Paisley, UK — [3]SUPA, Scottish Universities Physics Alliance, Glasgow, UK

Low-lying electric and magnetic dipole strengths ($E1$ and $M1$, respectively) of atomic nuclei have drawn considerable attention in the last decade. The low-lying dipole strength of the $N = 28$ closed-shell nucleus ^{52}Cr was studied with nuclear resonance fluorescence up to 9.9 MeV, using bremsstrahlung at the superconducting Darmstadt electron linear accelerator S-DALINAC. Twenty-eight spin-1 states were observed between 5.0 and 9.5 MeV excitation energy, 14 of those for the first time and uncertainties for cross sections were reduced in many cases. Both, electric dipole excitations ($E1$, around 8 MeV) and magnetic dipole excitations ($M1$, around 9 MeV) were detected. Microscopic calculations within the quasiparticle-phonon nuclear model were performed using a basis which includes one-, two-, and three-phonon configurations to interpret the dipole strength distributions of ^{52}Cr and show good agreement with experimental results.

*Supported by the DFG under contract No. SFB 634 and by the Helmholtz International Center for FAIR.

HK 11.5 Mo 17:45 HZ 5

Investigation of the beta decay spectrum of ^{113}Cd with the COBRA experiment — •Fabian Heisse for the COBRA-Collaboration — Technische Universität Dresden

The investigation of the fourfold forbidden, non-unique beta decay can only be performed with three isotopes, one of them is ^{113}Cd. For this purpose, data from the COBRA experiment using CZT detectors are used.

In this talk I will present a data selection and the results from taking data in the LNGS Underground Laboratory. Based on the recorded spectrum of the detectors, the important Q_β − value = (323.6 ± 1.2) keV for beta decay and the half-life $T_{\frac{1}{2}}\left(^{113}\mathrm{Cd}\right) = (7.91 \pm 0.22) \cdot 10^{15}$ years have been determined. These values fit very well to various theory models and other existing experimental results. Furthermore, the shape of the spectrum is in good accordance to the predicted theory throughout the whole region (50 keV $< E_{\mathrm{kin}}$ (electron) $<$ 324 keV).

However, there are still some unanswered questions, such as the behavior of the rate spectrum in the low energy region down to E_{kin} (electron) = 0 keV. An outlook and further improvements between theoretical description and experimental data are given.

HK 11.6 Mo 18:00 HZ 5

Evolution of Quadrupole Collectivity in the Neutron-rich Xe Isotopes — •Stoyanka Ilieva, Corinna Henrich, Thorsten Kröll, and Sabine Bönig for the IS411 and FATIMA-Collaboration — Institut für Kernphysik, TU Darmstadt

The nuclear properties in the region around the doubly magic nucleus ^{132}Sn are of special interest. Theory relies on nuclei near closed shells for predicting other, more complex systems. The quadrupole collectivity in nuclei can be studied in Coulomb-excitation experiments. The excitation cross section depends on both transition and diagonal matrix elements, an effect known as reorientation. Therefore, direct measurements of lifetimes which depend only on one single transition matrix element, are often more precise. Furthermore, the additional constraints from lifetimes enable the better determination of quadrupole moments, a quantity otherwise hard to obtain for short-living states.

The isotopes ^{138,140,142,144}Xe were studied by means of Coulomb excitation at the REX-ISOLDE facility at CERN. Recently, these studies were complemented by a measurement of the lifetimes of excited states in the xenon isotopes ($^{138-144}$Xe), populated in neutron-induced fis-

sion of ^{235}U and ^{241}Pu. The experiment was part of the FATIMA campaign performed at ILL, Grenoble in early 2013. In this contribution we report on the results from these measurements, aiming to investigate the evolution of collectivity around $Z = 50$ and $N = 82$.

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HK 11.7 Mo 18:15 HZ 5

Study of isomer and proton decays in N≤Z nuclei below ^{100}Sn — •Kevin Moschner[1], Andrey Blazhev[1], Plamen Boutachkov[2], Paul Davis[3], and Robert Wadsworth[3] for the EURICA-Collaboration — [1]IKP, University of Cologne, Germany — [2]GSI Darmstadt, Germany — [3]University of York, UK

The RIBF83 experiment was the first experiment performed within the EURICA project at the new-generation Radioactive Isotope Beam Facility (RIBF) at RIKEN, Japan. The aim of this experiment is to further probe the decays of known isomers in N = Z nuclei, in order to provide detailed tests of the shell model, as well as search for evidence of predicted, but as yet unobserved isomers in N ≤ Z nuclei.

To create the nuclei of interest projectile fragmentation of a 345 MeV/u ^{124}Xe beam on a ^{9}Be target was used. The fragments were then separated and identified on an event by event basis in the BigRIPS spectrometer.

The EURICA setup utilizes the γ-ray efficiency of 12 EUROBALL HPGe cluster detectors in the RISING Stopped Beam configuration and the active stopper SIMBA composed of a segmented Si-array allowing for β-calorimetry measurements of positrons emitted in decays with $Q_\beta \sim 10$ MeV.

Although data analysis is still on-going to search for unknown isomeric transitions and study the particle and particle-γ decays of the implanted nuclei, first results will be presented in this contribution.

This work is supported by the German BMBF under contract Nos. 05P09PKCI5 and 05P12PKFNE.

HK 11.8 Mo 18:30 HZ 5

Analyse von Winkelkorrelationen verschiedener Kaskaden in ^{144}Nd über die ^{143}Nd$(\mathbf{n},\gamma\gamma)$-Reaktion — •Oliver Kaleja — Institut für Kernphysik, Technische Universität Darmstadt, Germany

In ^{144}Nd wird ein isovektorieller Oktupolzustand vermutet, der durch einen starken $M1$-Übergang in sein symmetrisches Pendant zerfällt. Diese Klasse von Zuständen wurde im Rahmen des Interacting-Boson-Modell (IBM-2) vorhergesagt. Als Teil der EXILL-Kampagne im Jahr 2012/13 wurde daher ein Neutroneneinfangexperiment an ^{143}Nd durchgeführt. Der durch den Neutroneneinfang entstehende Kern ^{144}Nd liegt in einem angeregten Zustand vor, der in der Regel über Kaskaden in den Grundzustand zerfällt. Die Analyse der Winkelkorrelationen dieser Kaskaden stellt eine exzellente Möglichkeit dar, Multipolaritäten und Mischungsverhältnisse der Übergänge, sowie Spins der beteiligten Zustände zu bestimmen und sie so auf mögliche isovektorielle Oktupolzustände hin zu untersuchen. Die Zustände bei 2606 keV, 2779 keV und 2868 keV in ^{144}Nd stellen potenzielle Kandidaten für einen derartigen Zustand dar. Neben der Analyse dieser Zustände wurden ebenfalls die Zustände bei 2888 keV, 3027 keV und 3409 keV untersucht und unter anderem ihre bisher nicht genauer bekannten Spins bestimmt. Die Analyse basiert auf der Erstellung und Auswertung winkelabhängiger Koinzidenzmatrizen. Es werden die Herangehensweise im Hinblick auf das EXILL-Setup, sowie die Ergebnisse der Untersuchung der oben genannten Zustände diskutiert. Diese Arbeit wird durch die DFG (Nr. KR 1796/2-1) gefördert.

HK 11.9 Mo 18:45 HZ 5

Nuclear Excitation by a Strong Zeptosecond Laser Pulse in the Quasiadiabatic Regime — •Adriana Pálffy and Hans A. Weidenmüller — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg

The ongoing construction of the Nuclear Physics Pillar of the Extreme Light Infrastructure (ELI) offers unprecedented possibilities for nuclear physics experiments. The facility holds promise to deliver in the not-too-distant future coherent gamma ray pulses with energies of several MeV per photon. Coherence strongly amplifies nuclear dipole absorption. If that occurs comparably fast to nuclear equilibration, it leads to the formation of a compound nucleus with excitation energy several hundred MeV above yrast in a so far totally unexplored regime.

A quantitative description of the absorption and equilibration processes requires knowledge of the density of states, so far unavailable for this parameter regime. Our new approach yields approximate analytical expressions for the total and partial level densities [1,2] and makes possible the semiquantitative study of the competition between photon absorption, photon-induced nucleon emission, and neutron evaporation. With neutron evaporation overtaking photon absorption at energies below the saturation of the latter for medium-weight and heavy nuclei, we expect proton-rich nuclei far from the valley of stability to be produced. Experiments at ELI thus promise to shed light on the structure of such nuclei and the time scales and level densities involved.

[1] A. Pálffy and H. A. Weidenmüller, Phys. Lett. B 718, 1105 (2013).
[2] A. Pálffy and H. A. Weidenmüller, Nucl. Phys. A 917, 15 (2013).