HK 31: Structure and Dynamics of Nuclei IV

Zeit: Mittwoch 16:45–19:00 Raum: F 2

HK 31.1 Mi 16:45 F 2

Präzise Bestimmung von Kernzustandsbreiten mittels relativer Selbstabsorption* — •Marcel Schilling, Carsten Albe, Tobias Beck, Udo Gayer, Norbert Pietralla, Philipp C. Ries, Jochen Rohrer, Christopher Romig, Volker Werner und Markus Zweidinger — TU Darmstadt

Eine Hochpräzisionsmessung der Kernzustandsbreite Γ des ersten 0^+-Zustands von ^{6}Li in $^6Li_2CO_3$ wurde mit der Methode der relativen Selbstabsorption (RSA) durchgeführt. Hierbei ist die Geschwindigkeitsverteilung der Lithiumatome im Compound eine entscheidende Größe zur korrekten Bestimmung von Γ. Die klassische Vorgehensweise zur Beschreibung dieser Geschwindigkeitsverteilung über die Debye-Näherung ist aufgrund des Compounds nicht möglich. Die Berechnung der Phononendichte ermöglicht eine wesentlich genauere Beschreibung der effektiven Temperatur des Lithiums als über die Debye-Theorie. Dies führt zu einem Kalibrierungspunkt mit einer kleineren Unsicherheit zur genauen Bestimmung von Photonenflüssen bei niederenergetischen Kernresonanzfluoreszenzexperimenten im Vergleich zu dem aktuellen Literaturwert.

In einem RSA-Experiment an ^{11}B soll ein weiterer präziser Kalibrierungspunkt bei höherer Energie bestimmt werden.

* gefördert durch SFB1245

HK 31.2 Mi 17:00 F 2

NeuLAND Demonstrator at SAMURAI and first Experiments — •Julian Kahlbow for the NeuLAND-SAMURAI-Collaboration — Institut für Kernphysik, TU Darmstadt, Germany — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

The high-resolution neutron time-of-flight spectrometer with large acceptance NeuLAND is the new neutron detector being developed for the R^{3}B setup (Reactions with Relativistic Radioactive Beams) at FAIR. NeuLAND is dedicated to the detection of high-energy neutrons up to 1GeV. The NeuLAND Demonstrator (400 out of finally 3000 scintillator bars) is currently part of the SAMURAI setup (Superconducting Analyzer for Multi-particle from Radio Isotope Beams) at the RI Beam Factory in Japan.

The machine study experiment of the NeuLAND Demonstrator will be discussed in detail. In this experiment, quasi-monoenergetic neutrons were applied in order to determine the specific one-neutron detection efficiency of the detector at two different energies, in particular 110 MeV and 250 MeV. The NeuLAND Demonstrator together with NEBULA (Neutron-detection system for Breakup of Unstable-Nuclei with Large Acceptance) leads to a large multi-neutron detection efficiency at the SAMURAI experimental setup. An illustrative example applying the invariant-mass spectroscopy to neutron-unbound states of fluorine isotopes will be introduced.

This work is supported by the BMBF project 05P15RDFN1 and the GSI-TU Darmstadt cooperation agreement.

HK 31.3 Mi 17:15 F 2

Lifetime Measurement of Higher-Lying Excited States in ^{16}C — •Michael Mathy[1] and Marina Petri[2,1] — [1]IKP, TU Darmstadt, Germany — [2]DoP, University of York, United Kingdom

Electromagnetic properties of the neutron-rich carbon isotopes provide an exciting opportunity to directly test theoretical models using NN+3N Hamiltonians derived from chiral EFT. Indeed, the EM properties of ^{16}C are particularly sensitive to the inclusion of 3N forces in the calculations [1]. However, the experimental information on ^{16}C are limited to the lifetime of the first excited state and an upper limit of 4 ps for the higher-lying states [2,3]. To investigate lifetimes and branching ratios of the higher-lying states (2_2^+, 3^+, 4^+) a fusion-evaporation reaction has been performed at the Argonne National Laboratory. Evaporated charged particles were identified using the μ-Ball detector and emitted gamma rays were identified using the Gammasphere array. Lifetimes of the excited states can be extracted using the doppler shift attenuation method. In the talk the measurement techniques and preliminary gamma spectra of ^{16}C, which can be used to give a first approximation of the magnitude of the lifetime, will be presented. This work was supported by the DFG under contract No. SFB 1245.

[1] C. Forssén, et al., Nucl. Part. Phys. 40, 055105 (2013). [2] M. Wiedeking et al., PRL 100 152501 (2008). [3] M. Petri et al., Phys. Rev. C 86 044329 (2012).

HK 31.4 Mi 17:30 F 2

Proton Knockout Reactions from Neutron-Rich N Isotopes at R^{3}B — •Ina Syndikus[1,2] and Marina Petri[3] for the R3B-Collaboration — [1]IKP, TU Darmstadt, Germany — [2]GSI, Germany — [3]University of York, UK

The R^{3}B/LAND setup at GSI was used to measure the proton-knockout reaction on neutron-rich N isotopes in a kinematically complete way.

The aim of this study is to determine the proton amplitude of the first 2^+ excited state of ^{16,18,20}C isotopes. This can be achieved by studying the proton-knockout reaction from ^{17,19,21}N to ^{16,18,20}C. By measuring the ratio of the cross sections for the population of the first excited 2^+ state and the ground state the proton amplitude can be determined.

An increase in the proton amplitude approaching the dripline can be explained by the reduction of the spin-orbit splitting between the proton $p_{3/2}$ and $p_{1/2}$ orbits due to the tensor and two-body spin-orbit components of the force between the protons and the added neutrons in the sd-shell [1]. This would explain the increase in the transition strength as observed in previous studies [2].

This work is supported by HIC for FAIR, GSI-TU Darmstadt cooperation and the BMBF project 05P15RDFN1.

[1] A. O. Macchiavelli et al., Phys. Rev. C **90** 067305 (2014)
[2] M. Petri et al., Phys. Rev. Lett. **107**, 102501 (2011)

HK 31.5 Mi 17:45 F 2

Electromagnetic transition rates in ^{21}O — •Sebastian Heil[1] and Marina Petri[2] — [1]IKP, TU Darmstadt, Germany — [2]University of York, UK

Experimental studies of electromagnetic transition rates in neutron-rich nuclei are very important for testing NN+3N calculations. The case of ^{21}O is particularly interesting because calculations show that the transition strengths from the first $\frac{1}{2}^+$ and second $\frac{3}{2}^+$ excited states to the ground state $\frac{5}{2}^+$ will discriminate between the NN+3N and USDB interactions.

An experiment at NSCL was performed, producing ^{21}O. The usage of the TRIPLEX plunger allows the determination of the lifetime of the state of interest. The S800 spectrometer and GRETINA were used for the fragment identification and gamma-ray detection. This presentation will report on the experiment as well as the current status of the analysis.

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HK 31.6 Mi 18:00 F 2

The investigation of quasi-free scattering reactions with the two-proton-halo nucleus ^{17}Ne — •Christopher Lehr[1], Thomas Aumann[1], Felix Wamers[2], and Justyna Marganiec[1] for the R3B-Collaboration — [1]TU Darmstadt — [2]GSI Helmholtzzentrum

^{17}Ne is a Borromean two-proton-halo nucleus located at the proton-dripline and therefore an interesting candidate for nuclear-structure studies.

Reactions of the nucleus ^{17}Ne have been measured in complete kinematics at the R3B/LAND setup at GSI in Darmstadt. The experimental method is based on exclusive measurements of one-proton-removal reactions. Polyethylene (CH_2) and carbon (C) were used as targets. Thus it is possible to reconstruct the pure hydrogen (H) contribution of the CH_2 data by subtracting the carbon background.

The resulting events are clean quasi-free-scattering (p,2p) reactions showing the typical angular correlations known from p-p scattering. Thereby quasi-free (p,2p) and carbon-induced one-proton removal reactions are studied separately.

Quasi-free-scattering reactions are compared with carbon-induced one-proton removal reactions and shown to be a clean tool for nuclear-structure studies.

This work is supported by HIC for FAIR, the GSI-TU Darmstadt cooperation and the BMBF project 05P15RDFN1.

HK 31.7 Mi 18:15 F 2

Lifetime measurements in neutron-rich Mn isotopes — •Thomas Braunroth[1], Alfred Dewald[1], Christoph Fransen[1], Hironori Iwasaki[2], and Jan Jolie[1] — [1]Institut für Kernphysik, Universität zu Köln, Germany — [2]National Superconducting Cyclotron Laboratory, MSU, USA

The observation of a sudden increase in collective behavior along neutron-rich even-even chromium and iron isotopes toward $N = 40$ triggered several studies in recent years. Within the shell-model this sudden increase can only be reproduced by choosing an expanded valence space which allows excitations beyond $N = 40$ and into the $g_{9/2}$ and $d_{5/2}$ orbitals [1].

Less attention has been spent on neighboring odd-mass manganese isotopes with $Z = 25$, although they are able to provide complementary sensitivity to state-of-the-art (shell model) interactions. Within this talk we will present lifetimes of low-lying excited states in ^{59,61,63}Mn, which were deduced from a recoil distance Doppler-shift measurement. These isotopes were produced in side reactions of an experiment whose central aim was the determination of level-lifetimes in ^{58,60,62}Cr [2].

This work is supported by the BMBF under contract number 05P15PKFNA.

[1] S. M. Lenzi *et al.*, Phys. Rev. C **82**, 054301 (2010).
[2] T. Braunroth *et al.*, Phys. Rev. C **92**, 034306 (2015).

HK 31.8 Mi 18:30 F 2

Constraining nuclear matrix elements for $0\nu\beta\beta$ decay between ^{82}Se and ^{82}Kr* — •Udo Gayer[1], T. Beck[1], J. Kleemann[1], Fnu Krishichayan[3], B. Löher[2], O. Papst[1], N. Pietralla[1], P. C. Ries[1], D. Savran[2], W. Tornow[3], and V. Werner[1] — [1]Institut fuer Kernphysik, TU Darmstadt, Darmstadt, Germany — [2]GSI Helmholtzzentrum fuer Schwerionenforschung GmbH, Darmstadt, Germany — [3]Duke University, Durham NC, USA

The nuclei ^{82}Se and ^{82}Kr are candidates for the hypothetic exotic neutrinoless double-beta ($0\nu\beta\beta$) decay process, and a precise knowledge of their nuclear structure is necessary to estimate decay rates [1] and - should it be detected - to extract neutrino masses from this quantity. In a study of Gd isotopes [2], a connection between the decay behavior of the M1 scissors mode and $0\nu\beta\beta$ decay rates was established. We intend to study decay properties of low-lying magnetic dipole excitations in the $0\nu\beta\beta$ candidates ^{82}Se and ^{82}Kr in nuclear resonance fluorescence experiments with quasi-monochromatic, polarized photons at the High-Intensity Gamma-Ray Source (HIγS) in Durham, NC, USA. In a first experiment, the γ^3 setup [3] was used to identify magnetic dipole states of ^{82}Se and to study branching transitions. Preliminary results of this experiment will be presented and discussed.

*Supported by DFG research grant CRC 1245

[1] T. R. Rodriguez, G. Martínez-Pinedo, Phys. Rev. Lett. **105** (2010) 252503
[2] J. Beller et al., Phys. Rev. Lett. **111** (2013) 172501
[3] B. Löher et al., NIMA **723** (2013) 136-142

HK 31.9 Mi 18:45 F 2

Zerfallsverhalten der Scherenmode in der $0\nu\beta\beta$-Tochter ^{150}Sm* — •J. Kleemann[1], T. Beck[1], U. Gayer[1], J. Isaak[2,3], B. Löher[1,2], L. Mertes[1], H. Pai[1,4], O. Papst[1], N. Pietralla[1], P. C. Ries[1], C. Romig[1], D. Savran[2], M. Schilling[1], W. Tornow[5], V. Werner[1] und M. Zweidinger[1] — [1]IKP, TU Darmstadt — [2]GSI, Darmstadt — [3]RCNP, Osaka, Japan — [4]SINP, Kalkutta, Indien — [5]Duke University, Durham NC, USA

Zur Untersuchung des Zerfallsverhaltens der Scherenmode in ^{150}Sm wurde 2015 ein Kernresonanzfluoreszenz-Experiment am γ^3-Messaufbau [1] an der High Intensity γ-Ray Source (HIγS) des Triangle Universities Nuclear Laboratory durchgeführt. Dabei war eine mögliche Verzweigung des Zerfalls der Scherenmode in den 0_2^+ Zustand und deren Stärke relativ zur Grundzustandsübergangsstärke von besonderem Interesse, da sich aus dieser Modellparameter festlegen lassen, die sensitiv auf die nuklearen Matrixelemente und somit auf die Zerfallsrate eines potentiellen neutrinolosen doppelten β-Zerfalls von ^{150}Nd zu ^{150}Sm sind [2]. Mittels der durch HIγS erzeugten, linear polarisierten, quasi-monochromatischen γ-Strahlung wurden die Paritäten beobachteter Zustände direkt aus der Winkelverteilung ihres Grundzustandsübergangs bestimmt und somit Scherenmodenzustände identifiziert. Des Weiteren konnten Verzweigungsverhältnisse und Übergangsstärken ermittelt werden. Die Ergebnisse werden vorgestellt und diskutiert.

*Gefördert durch die DFG im Rahmen des SFB 1245

[1] B. Löher *et al.* Nucl. Instr. Meth. Phys. Res. A **723**, 136 (2013)
[2] J. Beller *et al.* Phys. Rev. Lett. **111**, 172501 (2013)