HK 32: Struktur und Dynamik von Kernen

Zeit: Dienstag 14:00–16:15 Raum: HSZ-401

Gruppenbericht HK 32.1 Di 14:00 HSZ-401

Decay spectroscopy of neutron-rich nuclei around ^{37,38}Al — •Konrad Steiger for the CAITEN-Collaboration — Physik-Department E12, Technische Universität München

An experiment at RIBF (Radioactive Isotope Beam Factory at RIKEN, Japan) investigated N=20 nuclei above ^{29}F and the midshell region around ^{37}Al. These nuclei were produced by relativistic projectile fragmentation of a 345 AMeV ^{48}Ca primary beam from the superconducting ring cyclotron SRC with an average intensity of 70 pnA. The secondary cocktail beam was separated and identified with the BigRIPS fragment separator and the ZeroDegree spectrometer. The identified fragments were implanted in the CAITEN detector (Cylindrical Active Implantation Target for Efficient Nuclear-decay study). The main part of this detector is a highly segmented plastic scintillator with the shape of a hollow cylinder. To reduce background decay events the scintillator was moved axially and vertically similar to a tape-transport system. Implantations and decays were correlated in time and space. For the first time β-delayed γ-rays were measured in the neutron-rich isotopes ^{37,38}Si (with three germanium clover detectors). From β-γ-γ coincidences partial level schemes could be constructed. The results were compared to shell model calculations and a tentative assignment for spins and parities of the experimental level schemes was possible. Significantly more precise half-lives for the implanted nuclei were measured.

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HK 32.2 Di 14:30 HSZ-401

Three-nucleon forces at neutron-rich extremes* — Jason D. Holt[1,2], Javier Menéndez[1,2], Achim Schwenk[2,1], and •Johannes Simonis[1,2] — [1]Institut für Kernphysik, Technische Universität Darmstadt, Germany — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

In the framework of chiral effective field theory, a systematic expansion for nuclear forces, it is possible to obtain valence shell interactions for nuclear structure calculations. In this approach three-nucleon forces are included naturally, contributing to effective single-particle energies as well as two-body matrix elements. We will apply this to the O and Ca chain. In addition, we investigate contributions from residual three-nucleon forces, which are expected to become more important with valence nucleons, so for the most neutron-rich isotopes. The theoretical findings are compared to recent experiments at CERN, GSI and TRIUMF.

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HK 32.3 Di 14:45 HSZ-401

Study of shape transitions in the neutron-rich Os isotopes — •Philipp R. John[1,2], Victor Modamio[3], Jose Javier Valiente-Dobón[3], Daniele Mengoni[1], and Santo Lunardi[1,2] — [1]Dipartimento di Fisica e Astronomia, Universitá degli Studi di Padova, Padua, Italy — [2]INFN Sezione di Padova, Padua, Italy — [3]INFN Laboratori Nazionali di Legnaro, Legnaro (Pd), Italy

The nuclei with A≈190 between Hf and Pt exhibit a great variety of nuclear phenomena, including K-isomeric states, triaxiality and shape transitions across isotopic and isotonic chains. Of particular interest is the transition from axially symmetric deformed, prolate ($\gamma = 0°$) to oblate ($\gamma = 60°$) shapes in the Os isotopic chain. While a study of the neutron-rich ^{194}Os nucleus populated via deep-inelastic reactions suggests a prolate shape for its yrast states, an other study proposed an oblate shape for the ground state of ^{198}Os by comparing the excitation energies of the first and second 2^+ states. For ^{196}Os, the even-even isotope lying between the two, both an oblate and a prolate shape were predicted by microscopic many-body and Total Routhian Surface calculations, respectively. To further elucidate this shape transition and to refine the nuclear models, the key nucleus ^{196}Os was investigated through gamma-spectroscopy using the AGATA demonstrator and the large acceptance heavy ion spectrometer PRISMA at LNL, Italy. A two nucleon transfer from a ^{198}Pt target to a stable ^{82}Se beam was utilized to populate medium-high spin states of ^{196}Os. The current status of the analysis including preliminary results will be presented.

HK 32.4 Di 15:00 HSZ-401

Evolution of Deformation in neutron-rich Cr-Isoptopes — •Thomas Braunroth for the e10021-Collaboration — Institut für Kernphysik, Universität zu Köln

The emerging new region of deformation around the $N = 40$ subshell closure is one of many observable effects in nuclei at extreme isospin conditions. Although level schemes in neutron-rich Cr-isotopes suggest an increase in collectivity, the experimental data are sparse and motivate further experimental efforts to shed more light on the evolution of deformation in this region of the nuclear landscape. For this purpose lifetime measurements on ^{58,60,62}Cr with a dedicated differential plunger device were performed at the NSCL to deduce model-independent B(E2)-values. A ^{82}Se beam at 140 MeV/u was fragmented on a primary ^{9}Be target. The corresponding cocktail beam was filtered in the A1900 fragment separator, which then delivered the high purity ^{59,61,63}Mn-beams at $E \sim 95$ AMeV to the secondary target. Low lying yrast states in the above mentioned Cr-isotopes were then populated in 1p-knockout reactions. The employment of the S800 spectrograph allowed a clear recoil identification, which then lead to clean γ-spectra as measured by the Segmented Germanium Array (SeGA). Preliminary results of this experiment will be shown.

HK 32.5 Di 15:15 HSZ-401

Coulombanregung neutronenreicher Xe-Isotope — •Corinna Henrich, Thorsten Kröll, Sabine Bönig, Stoyanka Ilieva, Markus Scheck und Michael Thürauf für die IS411Xe-Kollaboration — Institut für Kernphysik, TU Darmstadt, Germany

Nach Grodzins Regel hat das Produkt aus Übergangsstärke und Anregungsenergie (B(E2; $0_1^+ \rightarrow 2_1^+$) · E(2_1^+)) von gg-Kernen im Tal der Stabilität einen glatten Verlauf. Untersuchungen an Sn und Te bei N>82 folgen nicht dieser einfachen Systematik. Stattdessen werden B(E2; $0_1^+ \rightarrow 2_1^+$)-Werte gefunden, welche kleiner sind als erwartet. Um die experimentelle Datenlage im Bereich dieser Isotope zu verbessern, wurden im Rahmen der IS411 Kampagne an REX-ISOLDE (CERN, Genf) Coulombanregungen an neutronenreichen Xe-Isotopen durchgeführt. Die emittierten γ-Quanten wurden mit dem MINIBALL-Spektrometer detektiert. Der aktuelle Stand der Analysen zu ^{138,140,142,144}Xe wird vorgestellt.

Dieses Projekt wird unterstützt vom BMBF (06DA9036I, 05P12RDCIA), HIC for FAIR und ENSAR (262010).

HK 32.6 Di 15:30 HSZ-401

Quadrupole collectivity in the Cd isotopic chain investigated with Coulomb excitation — •Sabine Bönig, Thorsten Kröll, and Marcus Scheck for the IS477-Collaboration — Technische Universität Darmstadt

The cadmium isotopic chain with a proton number of Z=48 is one of the most interesting in nuclear structure physics due to the proximity to the proton shell closure at Z=50. Performed Coulomb excitation experiments on $^{122-126}$Cd exhibit high excitation strengths for the $0_{gs}^+ \rightarrow 2_1^+$ transition. Shell model calculations are not able to reproduce the experimentally found values although the shell closure is near. However, Beyond-Mean-Field calculations agree with the experimental results, taking a prolate deformation into account. In this contribution, the latest results on the investigation of the B(E2, $0^+ \rightarrow 2_1^+$) value of ^{128}Cd via Coulomb excitation with MINIBALL at REX-ISOLDE will be presented. We will discuss the experimentally found transition strength considering a non-vanishing quadrupole moment and place it in the overall picture of the behaviour of the B(E2, $0^+ \rightarrow 2_1^+$) values of this isotopic chain. This project is supported by BMBF (No. 06 DA 9036I and No. 05 P12 RDCIA), HIC for FAIR and EU through ENSAR (No. 262010).

HK 32.7 Di 15:45 HSZ-401

Do we understand gamma strength functions? The case of ^{96}Mo * — •Dirk Martin[1], Andreas Krugmann[1], Anna Maria Krumbholz[1], Peter von Neumann-Cosel[1], Norbert Pietralla[1], Iryna Poltoratska[1], Vladimir Ponomarev[1], and Atsushi Tamii[2] for the E376-Collaboration — [1]Institut für Kernphysik, TU Darmstadt — [2]Research Center for Nuclear Physics, Osaka, Japan

The gamma strength function of ^{96}Mo derived from a variety of experimental methods show quite severe disagreement, in particular near the neutron threshold. A new experimental method is discussed, viz. relativistic proton scattering under extreme forward angles at RCNP Osaka, Japan [1], which allows a consistent analysis of data below and above the particle threshold. Here, intermediate-energy proton beams are used in combination with a high energy resolution of the order $\Delta E/E \approx 8 \cdot 10^{-5}$. E1 and M1 strength distributions can be determined by a multipole decomposition of angular distributions utilizing DWBA calculations [2]. The additional measurement of polarization transfer observables provides an independent check of the method. First results from a recent experiment are presented.

[1] A. Tamii et al., Nucl. Inst. Meth. A 605, 326 (2009).
[2] A. Tamii et al., Phys. Rev. Lett. 107, 062502 (2011).

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HK 32.8 Di 16:00 HSZ-401

Bestimmung von Multipolmischungsverhältnissen von $3_i^- \rightarrow 3_1^-$ Übergängen zur Identifikation niederenergetischer isovektorieller Oktupol-Zustände in ^{144}Nd — •Michael Thürauf für die EXILL-144Nd-Kollaboration — Technische Universität Darmstadt

Kürzlich wurden erste Kandidaten für tiefliegende isovektorielle Anregungen, sog. „mixed-symmetry“ Zustände, im Oktupolsektor vorgeschlagen. Die sichere Identifikation liefert einen wesentlichen Beitrag zur Dekomposition der oktupol-oktupol Restwechselwirkung in einen isoskalaren und isovektoriellen Anteil. Dies trägt wesentlich zum Verständnis des Oktupolfreiheitsgrades bei. In ^{144}Nd ist der 3^--Zustand bei 2778 keV ein guter Kandidat für einen solchen oktupol „mixed-symmetry“ Zustand. Diese Klasse an Zuständen wurde im Rahmen des Interacting-Boson-Modell (IBM-2) vorhergesagt. Um die Natur dieses Zustandes zu klären, wurde 2012 im Verlauf der (n,γ)-Kampagne am EX@ILL-Aufbau am ILL, Grenoble, ein Experiment ^{143}Nd$(n,\gamma)^{144}$Nd durchgeführt. Folgend dem Einfang eines Neutrons werden 3^--Zustände durch $M1$-Übergänge vom Einfangszustand aus bevölkert. EX@ILL bietet die Möglichkeit, die Multipolmischungsverhältnisse der Übergänge $3_i^- \rightarrow 3_1^-$ zu bestimmen und damit die Natur der 3_i^--Zustände festzulegen. Erste vorläufige Spektren werden hierzu gezeigt. Dieses Experiment ist der erste Schritt einer Kampagne der Arbeitsgruppe zur Untersuchung von Oktupolkorrelationen an FAIR.

Gefördert durch HIC for FAIR.