HK 27: Structure and Dynamics of Nuclei V

Zeit: Dienstag 16:30–18:30 Raum: HS 14

Gruppenbericht HK 27.1 Di 16:30 HS 14

Proton-Hole states in ^{52,54}Ca: First Spectroscopy of ^{51,53}K — •Yelei Sun for the SEASTAR17-Collaboration — Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany

We report on the first in-beam γ-ray spectroscopy of the very neutron-rich potassium isotopes ^{51,53}K. The low-lying states of ^{51,53}K were populated using the $(p,2p)$ reactions from doubly magic nuclei ^{52,54}Ca. The $1/2^+_1 \rightarrow 3/2^+_1$ transitions in ^{51,53}K were clearly observed. For ^{53}K, a ground-state spin $I = 3/2$ was firmly established based on the measured individual parallel momentum distribution. The vertex tracker of MINOS plays an important role to preserve the momentum resolution when using a thick target. The energy splittings between the lowest $3/2^+$ and $1/2^+$ states in K isotopes were compared to shell model calculations with phenomenologically derived effective interactions and state-of-the-art *ab initio* calculations using the newly developed chiral effective field theory interactions. The results provide important information for a complete understanding of the single-particle drift and reinversion effect of the proton $1d_{3/2}$ and $2s_{1/2}$ orbitals along the K isotopic chain.

HK 27.2 Di 17:00 HS 14

How robust is the N = 34 subshell closure? First spectroscopy of ^{52}Ar — •Hongna Liu for the SEASTAR17-Collaboration — Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany

It is now well known that magic numbers are not universal across the nuclear landscape and that new shell closures may emerge in exotic nuclei. For example, a new N=34 subshell closure was predicted for neutron-rich pf-shell nuclei. However, on the experimental side, the N=34 subshell closure has been so far reported only in ^{54}Ca. The systematics of $E(2^+_1)$ along the Ti and Cr isotopes show no local maximum at N=34. It is thus very natural to ask how the N=34 subshell evolves below Z=20 towards more neutron-rich systems, such as ^{52}Ar.

In this talk, we will report on the first γ-ray spectroscopy of ^{52}Ar measured using the ^{53}K(p,2p) reaction at ∼210 MeV/u at RIBF. The 2^+_1 excitation energy was measured to be 1656(18) keV, the highest among the Ar isotopes with N>20, providing the first experimental signature of the persistence of the N = 34 subshell closure below Z=20. Shell-model calculations with phenomenological and the chiral interaction 1.8/2.0 (EM) both reproduce the measured 2^+_1 systematics of the neutron-rich Ar isotopes, and surpport a N=34 subshell closure in ^{52}Ar. However, coupled-cluster calculations based on the same chiral interaction underestimate $E(2^+_1)$ in ^{52}Ar. The data measured in current work serves as an important benchmark to understand the uncertainties of the employed many-body methods and chiral effective-field-theory interactions.

HK 27.3 Di 17:15 HS 14

Spectroscopy of neutron-rich Sc isotopes at RIKEN-RIBF — •P. Koseoglou[1,2], V. Werner[1], P.-A. Söderström[1,2], M. Lettmann[1], N. Pietralla[1], P. Doornenbal[3], and A. Obertelli[1,3,4] for the SEASTAR17-Collaboration — [1]Institut für Kernphysik, TU-Darmstadt, Darmstadt, Germany — [2]GSI Helmoltzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]RIKEN Nishina Center, Wako, Japan — [4]IRFU, CEA, Université Paris-Saclay, Paris, France

Evidence for the existence of a new "magic number", $N = 34$, are observed in ^{54}Ca [1] but not in Ti isotopes [2,3]. The magic number $N = 34$ was recently shown to vanish already in ^{55}Sc [4]. The evolution of proton orbitals on the $^{55-61}$Sc isotopes may reveal the mechanism of the disappearance of the $N = 34$ magicity, and further elucidate the early onset of collectivity at $N = 40$, which has so far been observed in Cr and Fe isotopes. The status of the analysis of $^{55-59}$Sc data from the 3rd SEASTAR campaign at RIKEN-RIBF will be presented. In this analysis, gamma rays previously reported for ^{55}Sc [4] were confirmed. For $^{57-59}$Sc gamma rays are shown here for the first time and possible level schemes will be proposed. This work was supported by the Helmholtz Graduate School for Hadron and Ion Research (HGS-HIRe) for FAIR though the HGS-HIRe abroad program.

[1] D. Steppenbeck, *et al.*, Nature 502, 207-210 (2013).
[2] D.-C. Dinca, *et al.,* Phys. Rev. C 71, 041302(R) (2005).
[3] S. N. Liddick, *et al.,* Phys. Rev. Lett. 92, 072502 (2004).
[4] D. Steppenbeck, *et al.* Phys. Rev. C 96 , 064310 (2017).

HK 27.4 Di 17:30 HS 14

Übergangswahrscheinlichkeiten angeregter Zustände der Yrast-Bande in ^{54}Ti — •Alina Goldkuhle für die AGATA-Kollaboration — Institut für Kernphysik, Universität zu Köln, Germany

Bisherige Untersuchungen der neutronenreichen Ti-Isotope deuten auf die Entwicklung eines Unterschalenabschlusses bei $N = 32$ hin. Schalenmodellrechnungen konnten dieses Verhalten jedoch bislang nicht erklären: der Verlauf der Anregungsenergien der tiefsten Yrast-Zustände in diesen Ti-Isotopen wird zwar reproduziert, jedoch nicht der Verlauf der $B(E2; 2^+_1 \rightarrow 0^+_{gs})$ Werte in Abhängigkeit der Neutronenzahl. Zusätzlich sind wenige Informationen über E2-Übergängsstärken zwischen höheren Yrast-Zuständen bekannt. Um diese zu messen, wurden in dieser Arbeit angeregte Zustände in $^{46-54}$Ti mit Hilfe von Multinukleonentransferreaktionen bevölkert und Zustandslebensdauern bestimmt, die mittels der Recoil-Distance Doppler-Shift Methode gemessen wurden. Das Experiment wurde am GANIL mit dem Detektorsystem AGATA und dem Spektrometer VAMOS++ zur Teilchenidentifikation sowie dem Kölner Kompakt-Plunger für tiefinelastische Reaktionen durchgeführt. Lebensdauern vom 2^+_1 und 4^+_1 Zustand sowie Ober- und Untergrenzen der Lebensdauern des 6^+_1 und 8^+_1 Zustands in ^{54}Ti konnten mit der differential decay curve method (DDCM) bestimmt und die $B(E2)$-Werte für die Übergänge zwischen diesen Zuständen ermittelt werden. Die Ergebnisse werden in diesem Vortrag vorgestellt und mit aktuellen Schalenmodellrechnungen verglichen. Teilförderung durch BMBF.

HK 27.5 Di 17:45 HS 14

Determination of exclusive (p,3p) cross sections for neutron-rich medium mass nuclei — •Axel Frotscher — TU Darmstadt, Darmstadt, Deutschland

The knockout of nucleons from nuclei is a powerful tool to investigate nuclear structure. In particular, the knockout of nucleons at energies above 200 MeV/nucleon from a hydrogen target, so called quasi free scattering, is believed to be a clean probe for nuclear structure and have led to several recent experimental programs and theoretical developments. In this work, we are interested to reactions that lead to the removal of two nucleons. Indeed, it was observed in several occurrences that a different states of a nucleus are populated when produced from one nucleon knockout (p,2p) or two nucleon knockout (p,3p). So far, there is no proper reaction theory for this second class of reactions. Understanding it might provide a new tool to investigate nuclear structure.

The analysis of two experimental campaigns conducted at the RIBF in RIKEN, Japan, is presented here. The (p,3p) cross sections from several neutron-rich medium-mass nuclei were analysed. The radioactive nuclei were impinging onto a 100-mm long liquid hydrogen target. The protons issued from the reaction were measured with the MINOS tine-projection chamber surrounding the target, giving access for the first time to angular correlations of the protons in the final state in such reactions. Inclusive and exclusive cross sections have been extracted.

This work is supported by the DFG through grant no. SFB1245.

HK 27.6 Di 18:00 HS 14

Recent studies of neutron-rich Kr isotopes with N≤60* — •Rosa-Belle Gerst, Kevin Moschner, Julia Litzinger, Andrey Blazhev, and Nigel Warr — IKP, Universität zu Köln

In the neutron-rich A = 100 region a sharp shape transition at N = 60 has been observed in the Sr and Zr isotopic chains. For Kr isotopes, a smooth onset of collectivity was established [1] and recent studies revealed further differences to the Sr and Zr isotopes [2,3]. Additionally, mean field calculations suggest the existence of a second minimum in potential energy surfaces for ^{96}Kr leading to low-lying shape-coexisting structures [1,2,4]. During the SEASTAR campaign at the RIBF at RIKEN, low lying excited states were measured in ^{94,95,96}Kr with the NaI DALI2 array. Due to the limited energy resolution of the array, further experiments were performed to investigate the level structure of the neutron rich Kr isotopes. At the MINIBALL array at HIE-ISOLDE, excited states in ^{96}Kr were populated using Coulomb-

nuclear excitation. At the IPN Orsay, a pulsed beam together with the fast neutron source LICORNE and the Nu-Ball array were used to study $^{90-96}$Kr after fission of ^{238}U. Preliminary results will be shown and compared to theoretical models.

*Supported by the DFG under Grant No. BL 1513/1-1 and the BMBF under Grant No. 05P18PKCIA

[1] M. Albers *et al.*, Nucl. Phys. A 899 (2013), 1
[2] F. Flavigny *et al.*, Phys. Rev. Lett. 118 (2017), 242501
[3] J. Dudouet *et al.*, Phys. Rev. Lett. 118 (2017), 162501
[4] K. Nomura *et al.*, Phys. Rev. C 96, 034310 (2017)

HK 27.7 Di 18:15 HS 14

Population in fragmentation reaction and properties of γ-decaying isomers in the ^{100}Sn region — •Guillaume Haefner[1,2], Andrey Blazhev[1], Kevin Moschner[1], Jan Jolie[1], Plamen Boutachkov[3], Paul John Davies[4], and Robert Wadsworth[4] — [1]IKP, Universität zu Köln, Deutschland — [2]CSNSM Orsay, Frankreich — [3]GSI Darmstadt, Deutschland — [4]University of York, Großbritannien

The study of nuclei around ^{100}Sn has been of long standing interest for the nuclear structure and nuclear astrophysics (see Ref. [1] for a recent review). Lately, results on properties of γ-decaying isomers in that region studied in a fragmentation reaction of a ^{124}Xe beam at 345 MeV/A at the RIBF of the RIKEN Nishina Center have been reported by Park *et al* [2]. This contribution presents results obtained in a similar experiment at the RIBF. Half-lives of isomeric states have been remeasured and are consistent with literature values while improving the uncertainty in some cases. Reduced transition probabilities are deduced and compared to shell-model calculations in various model spaces. The previously reported low-energy transitions in ^{92}Rh and ^{96}Ag were remeasured and their energies are given with better precision. Additionally, isomeric ratios have been remeasured and are compared to the previous study and the sharp cut-off model of fragmentation reaction.

[1] T. Faestermann, M. Górska and H. Grawe, Prog. Part. Nucl. Phys. 69, 85 (2013)
[2] J. Park et al., Phys. Rev. C 96, 044311 (2017)