HK 53: Structure and Dynamics of Nuclei XI

Time: Wednesday 17:30–19:00 Location: HBR 19: C 5b

Group Report HK 53.1 Wed 17:30 HBR 19: C 5b

The lowest-lying mixed-symmetry 2^+ state in the N=80 isotones — •T. Stetz[1], H. Mayr[1], N. Pietralla[1], G. Rainovski[2], V. Werner[1], and R. Zidarova[1] — [1]Technische Universität Darmstadt, Germany — [2]Sofia University St. Kliment Ohridski, Bulgaria

Quadrupole collectivity near closed shells manifests in the known 2_1^+ proton-neutron symmetric one quadrupole-phonon excitation of the valence shell and its isovector proton-neutron mixed-symmetric $2^+_{\mathrm{ms},1}$ counterpart. Their respective character is quantified by the F-spin quantum number. A direct influence of subshell structure on the properties of the $2^+_{\mathrm{ms},1}$ state has first been observed in ^{138}Ce by Rainovski *et al.* [1]. This lack of shell stabilization leads to a distribution of the M1 strength of the $2^+_{\mathrm{ms},1}$ configuration to the 2_1^+ state over several excited 2^+ states of ^{138}Ce. In contrast, the B(M1;$2_i^+ \to 2_1^+$) strength in other N=80 isotones below the $g_{7/2}$ subshell closure is isolated in a single 2^+ state [2,3]. A recent two neutron-transfer experiment to determine the B(M1;$2_2^+ \to 2_1^+$) of ^{132}Te supports these observations. Furthermore, a single pronounced one-quadrupole phonon $2^+_{\mathrm{ms},1}$ state has been found in ^{140}Nd and ^{142}Sm through Coulomb-excitation experiments, showing a restoration of F-spin symmetry above ^{138}Ce [4,5].

[1] G. Rainovski *et al.*, Phys. Rev. Lett. 96 (2006) 122501
[2] T. Ahn *et al.*, Phys. Lett. B 679 (2009) 1
[3] N. Pietralla *et al.*, Phys. Rev. C 58 (1998) 796
[4] R. Kern *et al.*, Phys. Rev. C 102 (2020) 041304(R)
[5] R. Kern *et al.*, J. Phys.: Conf. Ser. 1555 (2020) 012027
*Supported by BMBF 05P18RDCIA and 05P21RDCI2

HK 53.2 Wed 18:00 HBR 19: C 5b

Sub-picosecond lifetimes of excited states in ^{116,118}Sn — •Sarah Prill, Anna Bohn, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

In recent years, lifetimes of excited states of various nuclei in the mass region A=100 and above have been determined with the well established coincidence Doppler-shift attenuation method (CDSAM) in Cologne [1,2]. Following the study of ^{112,114}Sn [3], four experiments were performed on ^{116,118}Sn to determine sub-picosecond lifetimes. Inelastic scattering experiments with both alpha particles and protons were employed. The resulting coincidence data was recorded with the SONIC@HORUS detector array [4] at the University of Cologne. Herein, the emitted Doppler-shifted photons were detected in HORUS in coincidence with the back-scattered beam particles, recorded by SONIC. From these coincidences, the reaction kinematics can be reconstructed. Single levels can be targeted directly in the analysis via energy constraints which enables feeding exclusion. Numerous level lifetimes in ^{116,118}Sn were determined with the CDSA method and the results will be presented in this contribution.
Supported by the DFG (ZI 510/9-2).
[1] A. Hennig *et al.*, Nucl. Instr. Meth. A **758**, 171 (2015).
[2] S. Prill *et al.*, Phys. Rev. C **105**, 034319 (2022).
[3] M. Spieker *et al.*, Phys. Rev. C **97**, 054319 (2018).
[4] S. G. Pickstone *et al.*, Nucl. Instr. Meth. A **875**, 104 (2017).

HK 53.3 Wed 18:15 HBR 19: C 5b

Excited states in 56Ti, 58Ti populated in one proton knockout — •Wiktor Poklepa and Martha Reece for the HiCARI-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The neutron-rich Ti isotopes lie within the interests of nuclear physicists for several reasons. One of the reasons studied in previous works is the region of validity of the new neutron magic numbers N=32,34. The other one is approaching the island of inversion around N=40 with the most exotic Ti isotopes. The E(2_1^+) energies for even-even Ti isotopes have been measured up to N=40 and in contrast to Ca and Ar isotopes, there is no enhancement of E(2_1^+) for ^{56}Ti. At the same time the B(E2) values for this set of isotopes have been established only up to N=34. The currently known trend in B(E2) values in Ti isotopes shows a staggering behaviour, but experimental uncertainties are too large to draw conclusions. Thus further investigation is needed. In this experiment, B(E2) values and lifetimes of states in ^{56,58}Ti were studied employing proton knockout reactions from ^{57,59}V at the RIBF facility in Japan. Secondary beams produced from ^{70}Zn at 345 MeV/u were transported through the BigRIPS spectrometer. Gamma rays emitted by the reaction products were detected by the HiCARI HPGe detector array. The reaction products were identified using the ZeroDegree spectrometer. In this talk, the first preliminary results on the spectroscopy and lifetime measurements for ^{56,58}Ti will be presented.

HK 53.4 Wed 18:30 HBR 19: C 5b

Lifetime measurement of the 4_1^+ state of ^{132}Te — •H. Mayr[1], T. Stetz[1], V. Werner[1], M. Beckers[2], A. Blazhev[2], A. Esmaylzadeh[2], B. Falk[2], J. Fischer[2], R.-B. Gerst[2], K. Gladnishki[3], K.E. Ide[1], V. Karayonchev[4], E. Kleis[2], H. Kleis[2], L. Klöckner[2], P. Koch[2], D. Kocheva[3], C.M. Nickel[1], A. Pfeil[2], N. Pietralla[1], G. Rainovski[3], F. Spee[2], M. Stoyanova[3], and R. Zidarova[1] — [1]TU Darmstadt — [2]U Cologne — [3]U Sofia, Bulgaria — [4]TRIUMF Vancouver, Canada

Valuable information on the structure of atomic nuclei can be obtained from comparatively simple experimental information, such as ratios of excitation energies ($R_{4/2}$) or $E2$ transition rates ($B_{4/2}$) of the first 2^+ and 4^+ states of even-even nuclei. The measurement of lifetimes of the 2_1^+ and 4_1^+ states is necessary to calculate the $B_{4/2}$ ratio. Experimental data for the lifetimes of the 4_1^+ states in the tellurium isotopes towards $N = 82$ is scarce. The measurement of the lifetime of the 4_1^+ state of ^{132}Te would yield its $B_{4/2}$ ratio. It would expand the data on the evolution of this quantity in the chain of tellurium isotopes. Therefore, an experiment was performed at the IKP Cologne to produce ^{132}Te in the two-neutron transfer reaction ^{130}Te(^{18}O, ^{16}O)^{132}Te and determine the desired 4_1^+ lifetime via the Recoil Distance Doppler-Shift method. The results will be presented and compared to a recent publication that obtained the lifetime of the 4_1^+ state with the γ-γ fast-timing approach [1].

[1] D. Kumar *et al.* In: *Phys. Rev. C* 106 (3 2022).
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HK 53.5 Wed 18:45 HBR 19: C 5b

Resolving discrepancies in $E2$-excitation strengths of mid-shell tin isotopes — •M. Beuschlein[1], O. Papst[1], J. Kleemann[1], N. Pietralla[1], V. Werner[1], U. Ahmed[1], T. Beck[1,2], M. Berger[1], I. Brandherm[1], M.L. Cortes[1], A. D'Alessio[1], U. Friman-Gayer[1,3], I. Jurosevic[1], J. Hauf[1], M. Hilcker[1], K. E. Ide[1], J. Isaak[1], R. Kern[1], P. Koseoglou[1], C.M. Nickel[1], F. Niederschuh[1], K. Prifti[1], P. C. Ries[1], G. Steinhilber[1], T. Stetz[1], J. Vogel[1], J. Wiederhold[1], and R. Zidarova[1] — [1]IKP, TU Darmstadt, Germany — [2]FRIB, East Lansing, MI, USA — [3]ESS, Lund, Sweden

Data and theory for the electric quadrupole excitation strength of the proton closed-shell Sn isotopes show an enhancement of the $B(E2, 0_1^+ \to 2_1^+)$ values towards $N = 50$, and a seniority-type behavior towards $N = 82$. However, in the transitional region around $N = 66$ various sets of data and theory differ significantly. In particular, lifetime data using the Doppler-shift attenuation method [1] are at variance with data from Coulomb excitation. In this work we present final results of a series of experiments on ^{112,116,120}Sn, utilizing the nuclear resonance fluorescence (NRF) technique, which offers a model-independent way of measuring $E2$ strengths. The new data generally support the trend measured in Coulomb excitation experiments, and is in favor of a smooth transition between the different regions.
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[1] A. Jungclaus *et al.*, Phys. Lett. B **695**, 110 (2011)