HK 10 Kernphysik/Spektroskopie

Zeit: Montag 16:30–18:45 Raum: C

Gruppenbericht

HK 10.1 Mo 16:30 C

Nuclear moments and charge radii of n-rich Mg isotopes — •M. Kowalska[1], K. Blaum[1], K. Flanagan[2], P. Himpe[2], P. Lievens[2], S. Mallion[2], R. Neugart[1], G. Neyens[2], N. Vermeulen[2], and D. Yordanov[2] — [1]Universität Mainz, Germany — [2]K.U. Leuven, Belgium

Among other observables, ground state properties of nuclei, such as moments and charge radii, contribute widely to our understanding of nuclear structure, particularly in the context of shell closures. Of special interest is the 'island of inversion' around Z=10-12, where data shows that N=20 is not a magic number. Mg isotopes in this region were studied via laser and β-NMR spectroscopy at ISOLDE, CERN. For laser spectroscopy ($^{24-27}$Mg), the ion velocity is Doppler-tuned into resonance with laser light and resonances are observed in fluorescence. To obtain magnetic and quadrupole moments, we measure the hyperfine structure (HFS), and for charge radii, we determine the isotope shift for an atomic transition. β-NMR (^{29,31,33}Mg) requires optical polarization and implantation into a crystal. The HFS is seen in β-decay asymmetry, using Doppler tuning, and NMR measurements are performed for the laser at resonance, with changing radio-frequency. Disappearance of asymmetry yields the Larmor frequency, and thus the g-factor. Recently we measured changes in mean square charge radii for $^{24-27}$Mg, which we plan extending to more n-rich isotopes, thus reaching the 'island of inversion'. We measured HFS for ^{27,29,31}Mg, and β-NMR resonances of ^{29,31}Mg yielding their g-factors and the unknown spin of ^{31}Mg. Recently we also obtained β-asymmetry signals of ^{33}Mg. We will present experimental techniques, results and their discussion.

HK 10.2 Mo 17:00 C

Low-level structure of ^{70}Ge from lifetime measurements following α-transfer to ^{66}Zn ion beams^{+} — •J. Leske[1], K.-H. Speidel[1], S. Schielke[1], J. Gerber[2], P. Maier-Komor[3], S.J.Q. Robinson[4], Y.Y. Sharon[5], and L. Zamick[5] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Univ. of Bonn, Bonn, Germany — [2]Institut de Recherches Subatomiques, Strasbourg, France — [3]Physik.-Dept. TU München, Garching, Germany — [4]Phys. Dept. Univ. of Southern Indiana, Evansville, IN, USA — [5]Rutgers Univ., New Brunswick, NJ, USA

The g factor of the 2_1^+ state in ^{70}Ge has been remeasured employing the α-transfer reaction to ^{66}Zn projectiles in combination with the technique of transient magnetic fields. Ion beams of 180 MeV were provided by the Munich tandem accelerator bombarding a multilayered target which consisted of carbon on thin Gd and Cu layers. The de-excitation γ rays were measured with NaI(Tl) scintillators and a Ge detector in coincidence with forward emitted α particles (from the decay of ^{8}Be) being registered in a 0° Si detector. Lifetimes of several excited states were measured using the Doppler-Shift-Attenuation method. In the analysis of the 2_1^+ precession, requiring corrections for feeding from the 4_1^+ state, a negative g factor of the 4_1^+ state has to be assumed. This result would be consistent with a recent g factor measurement on the isotonic ^{68}Zn(4_1^+) [1]: the negative g factor was attributed to a dominant $g_{9/2}$ neutron component in the nuclear wave function. The results are interpreted in the framework of large-scale fp shell model calculations.

$^{+}$supported by the BMBF and DFG

[1] J. Leske et al., Phys. Rev. C72 (2005) 044301

HK 10.3 Mo 17:15 C

Spin- and Parity-Resolved Level Densities from High-Resolution Hadron and Electron Scattering Experiments — •Y. Kalmykov[1], J. Carter[2], R.W. Fearick[3], H. Fujita[2], Y. Fujita[4], P. von Neumann-Cosel[1], I. Poltoratska[1], V.Yu. Ponomarev[1], A. Richter[1], A. Shevchenko[1], and J. Wambach[1] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]School of Physics, University of the Witwatersrand, South Africa — [3]Physics Department, University of Cape Town, South Africa — [4]Department of Physics, Osaka University, Japan

Modern experiments allow to unravel the fine structure of giant resonances even in heavy nuclei. High energy resolution along with excellent selectivity achieved by a proper choice of the kinematics give a possibility to extract spin- and parity-separated level densities by means of an autocorrelation analysis. A novel method [1] using the discrete wavelet transform provides a nearly model-independent determination of the non-resonant background which is crucial for the applicability of this technique. Results for 1^+ states in ^{58}Cu and ^{90}Nb, 2^- states in ^{48}Ca, ^{58}Ni and ^{90}Zr as well as 2^+ states in a broad range of nuclei are presented in comparison with the predictions of state-of-the-art theoretical models applied in astrophysical network calculations.

[1] Y. Kalmykov et al., Phys. Rev. Lett., in press.

* Supported by the DFG through SFB 634 and Ne 679/2-1.

HK 10.4 Mo 17:30 C

Lifetime and g factor measurements of radioactive ^{52}Ti nuclei following α-transfer to ^{48}Ca beams in inverse kinematics^{+} — •K.-H. Speidel[1], S. Schielke[1], J. Leske[1], S.C. Bedi[2], O. Zell[3], P. Maier-Komor[4], S.J.Q. Robinson[5], Y.Y. Sharon[6], and L. Zamick[6] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Univ. of Bonn, Bonn, Germany — [2]Dept. of Physics, Panjab Univ., Chandigarh, India — [3]Inst. für Kernphysik, Univ. zu Köln, Köln, Germany — [4]Physik-Dept. TU München, Garching, Germany — [5]Univ. of Southern Indiana, Evansville, IN, USA — [6]Rutgers Univ., New Brunswick, NJ, USA

The g factors and lifetimes of the 2_1^+ and 4_1^+ states in ^{52}Ti have been measured for the first time using the technique of transient magnetic fields and the Doppler-Shift-Attenuation method. The excited states were populated in the α-transfer reaction to a ^{48}Ca beam of 100 MeV, provided by the Cologne tandem accelerator, in collisions with carbon of a multilayered target including Gd und Cu layers. The de-excitation γ rays were measured in coincidence with forward emitted α particles (from the decay of ^{8}Be) being registered in a 0° Si detector. For the spin precession and angular correlation measurements NaI(Tl) scintillators were used, whereas for the lifetime determinations a Ge detector was placed at 0° for detecting the Doppler-broadened lineshapes. The g factor and B(E2) values which have been interpreted in the framework of fp shell model calculations provide sensitive tests of effective NN interactions. The results are discussed in the context of neighbouring Ti isotopes and Cr isotones and the $N = 28$ neutron shell closure.

$^{+}$ supported by the BMBF and DFG

HK 10.5 Mo 17:45 C

The g factor and $B(E2)$ of the 4_1^+ state of Coulomb excited ^{66}Zn compared to shell model predictions^{+} — •J. Leske[1], K.-H. Speidel[1], S. Schielke[1], J. Gerber[2], P. Maier-Komor[3], T. Engeland[4], and M. Hjorth-Jensen[4] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Univ. of Bonn, Bonn — [2]Institut de Recherches Subatomiques, Strasbourg, France — [3]Physik-Dept. TU München, Garching, Germany — [4]Dept. of Phys. and Center of Math., Univ. of Oslo, Oslo, Norway

The g factor of the 4_1^+ state in ^{66}Zn has been measured for the first time employing the technique of projectile Coulomb excitation in inverse kinematics combined with transient magnetic fields. The lifetime of this state was remeasured to be τ=1.1(2)ps, being twice as large as a previously determined value. For these measurements 180 MeV ^{66}Zn ion beams were provided by the Munich tandem accelerator. The target consisted of carbon on thin Gd and Cu layers. The de-excitation γ rays were measured in coincidence with forward scattered carbon ions being registered in a 0° Si detector. Lifetimes of several excited states were determined using the Doppler-Shift-Attenuation method. The $B(E2)$'s and the g factors of the 2_1^+ and 4_1^+ states were discussed together with corresponding data of neighbouring ^{64}Zn and ^{68}Zn [1,2] in the framework of full fp shell model calculations. There are distinct discrepancies between experiment and theory which are not yet fully understood.

$^{+}$ supported by the BMBF and DFG

[1] J. Leske et al., Phys. Rev. C71 (2005) 034303
[2] J. Leske et al., Phys. Rev. C72 (2005) 044301

HK 10.6 Mo 18:00 C

Results from Transfer Reactions at REX-ISOLDE and future plans* — •Vinzenz Bildstein[1], Thorsten Kröll[1], Reiner Krücken[1], Thomas Nilsson[2], Heiko Scheit[3], and Gerhard Schrieder[2] for the REX-MINIBALL collaboration — [1]Physikdepartment E12, TU München, Germany — [2]Institut für Kernphysik, TU Darmstadt, Germany — [3]MPI für Kernphysik, Heidelberg, Germany

With the advent of rare isotope beams, in particular low energy beams of ISOL facilities, transfer reactions which yield important spectroscopic information about isotopes, including spin and parity assignments to nuclear levels and spectroscopic factors are possible for nuclei far from stability for which the corresponding information is still lacking.

The results from transfer experiments with neutron rich Na and Mg isotopes in inverse kinematic with the MINIBALL setup at REX-ISOLDE will be presented, including a new level in ^{31}Mg. These results and the encountered difficulties with the existing setup will be discussed and plans for a new setup for transfer experiments with MINIBALL will be shown.

*supported by BMBF 06DA115 and 06MT190

HK 10.7 Mo 18:15 C

Two-neutron transfer reaction using a Tritium target* — •M. Mahgoub[1], V. Bildstein[1], H.G. Bohlen[2], T. Dorsch[1,2], Th. Faestermann[1], R. Gernhäuser[1], Th. Kröll[1], R. Krücken[1], Tz. Kokalova[2], L. Maier[1], W.von Oertzen[2], and C. Wheldon[2] — [1]Physik-Department E12, TU München, 85748 Garching, Germany — [2]HMI-Berlin, 14109 Berlin, Germany

Two neutron transfer reactions enable the investigation of pairing correlations, as well as the study of shape coexistence and shape transitions. They can also be effectively used to populate exotic nuclei, for which low production cross-sections do not allow their use as an accelerated radioactive beam. For short-lived nuclei the reactions have to be performed in inverse kinematics, thus calling in case of (t,p) reactions for a tritium target. Here we report on a first pioneering experiment using a tritium loaded Ti foil for the reaction ^{40}Ar(t,p)^{42}Ar at an energy of 2.25 MeV/u at the Cyclotron of the HMI Berlin. First results will be presented and compared to DWBA calculations. Future possibilities for the use of (t,p) reactions at radioactive beam facilities will be discussed.

* Supported by MLL, and DFG under contract KR2326/1-1.

HK 10.8 Mo 18:30 C

High-accuracy mass measurements of neutron rich Sn and Zn isotopes for the — •A. Herlert[1], S. Baruah[2], K. Blaum[3,4], P. Delahaye[1], M. Dworschak[5], S. George[3,4], C. Guénaut[6], U. Hager[7], F. Herfurth[3], H.-J. Kluge[3], M. Marie-Jeanne[1], L. Schweikhard[2], and C. Yazidjian[3,1] for the ISOLTRAP collaboration — [1]CERN, Physics Department, 1211 Geneva 23, Switzerland — [2]Inst. f. Physik, Universität Greifswald, 17487 Greifswald, Germany — [3]GSI, 64291 Darmstadt, Germany — [4]Inst. f. Physik, Universität Mainz, 55099 Mainz, Germany — [5]Physiaklisches Institut, Universität Würzburg, 97074 Würzburg Germany — [6]CSNSM-IN2P3-CNRS, 91405 Orsay-Campus, France — [7]University of Jyväskylä, Department of Physics, 40014 Jyväskylä, Finland

The atomic masses of neutron rich short-lived isotopes of the elements Zn and Sn have been measured with the triple-trap Penning-trap mass spectrometer ISOLTRAP at ISOLDE/CERN. The zink isotopes have bean measured in a mass range $^{71-81}$Zn and thus new data is available for nuclides in the vicinity of the shell closure $N = 50$. For tin, the isotopes with masses $A = 127, 128, 131 - 134$ have been investigated, where the isotope ^{131}Sn is of special interest, since there is a discrepancy between theoretical predictions and experimental data on the energy of the first isomeric state. The preliminary results are presented and discussed.