HK 15: Nuclear Structure and Dynamics I

Time: Monday 16:30–19:00 Location: H-ZO 40

HK 15.1 Mo 16:30 H-ZO 40

Characterization of the 101 keV isomeric state in ^{72}Br — •José Antonio Briz Monago for the IS398-Collaboration — IEM-CSIC, Madrid, Spain

Far from stability the main part of the Gamow-Teller (GT) strength is within the Q_β-window. Theoretical calculations [1] predict very different GT strength distributions for different deformations of the parent nucleus ground state (prolate-spherical-oblate) for neutron deficient nuclei in the mass region around A=70. This gives the opportunity to determine the deformation of a nucleus by the study of the beta decay with a highly sensitive setup.

Measurements of the β-decay of ^{72}Kr were performed at ISOLDE with a Total Absorption Gamma Spectrometer (TAGS) but the analysis of the data has revealed the need for additional information. For this reason, complementary measurements have been performed in order to determine the conversion electron coefficients of the low energy transitions following the decay of ^{72}Kr. Of particular interest is the precise determination of the half-life of the 101 keV isomeric state and the multipolarity of the γ-transition connecting this state to the ground state as the spin of the latter one has been debated [2,3]. In this contribution, we will report the results obtained in this work.

[1] P. Sarriguren et al., Nucl. Phys. A658, 13 (1999)
[2] W.E. Collins et al., Phys. Rev. C9, 1457 (1974)
[3] I. Piqueras et al., Eur. Phys. J. A16, 313-329 (2003)

HK 15.2 Mo 16:45 H-ZO 40

Study of collectivity in ^{62}Zn — •Michael Albers, Dennis Mücher, Jan Jolie, Christoph Fransen, Andrey Blazhev, Pavel Petkov, Désirée Radeck, and Christian Bernards — Institut für Kernphysik, Universität zu Köln

The experimental proof for the existence of proton-neutron mixed symmetry states has been shown in several, mostly stable nuclei in the 50<A<150 mass region in the last years by analysing M1 transitions to fully symmetric states, which are the main experimental signatures for the existence of these states. Since information about mixed symmetry states in unstable nuclei is very sparse, experiments have been performed at the Tandem accelerator of the Institut für Kernphysik in Cologne to identify the first mixed symmetry state $2^+_{ms,1}$ in several unstable N=48,52 isotones, but absolute transition strengths could not be obtained until now. An additional experiment was performed at the IKP in Cologne using the ^{61}Ni(^{3}He, 2nγ)^{62}Zn reaction to identify the first mixed symmetry state in ^{62}Zn. Utilizing the high efficiency HORUS cube spectrometer, which allows the analysis of $\gamma\gamma$ angular correlations and the determination of lifetimes via the DSA Method, absolute transition strengths in ^{62}Zn could be obtained, by which a fragmentation of the mixed symmetry state $2^+_{ms,1}$ turned out to be the case.

The results have been complemented to the systematical trends in the Z=30 Zinc isotopes and a predicted loss of collectivity in the lighter Zn isotopes up to ^{58}Zn could be verified.

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Invited Group Report HK 15.3 Mo 17:00 H-ZO 40

The structure of moderately neutron-rich nuclei studied with the CLARA-PRISMA setup and perspectives for the AGATA Demonstrator coupled to PRISMA. — •Andres Gadea — CSIC-Instituto Fisica Corpuscular, Valencia, Spain and INFN-Laboratori Nazionali di Legnaro, Italy

The study of neutron-rich nuclei, in particular large isospin values, is one of the most challenging problems in nuclear structure. Among the open questions is of special interest the evolution of the nuclear effective interactions, in particular of the monopole term, with consequences in the quenching of the known shell gaps and development of new ones. Recently it was developed a new setup at LNL by coupling the CLARA array to the magnetic spectrometer PRISMA This setup aims at measuring in-beam prompt coincidences of gamma-rays detected with CLARA in coincidence with the products of multinucleon-transfer reactions and deep-inelastic collisions, detected by PRISMA. In this contribution we will briefly describe the capabilities of the setup as well as the results obtained for nuclei in the vicinity of 78Ni, populated in the 238U + 82Se at 505 MeV reaction, in the vicinity of 132Sn where the nuclear species had been populated in the 238U + 136Xe at 940 MeV reaction and in the vicinity of 48Ca populated in the 238U and 208Pb + 48Ca reactions at 330 MeV and 310 MeV respectively. A lifetime RDDS technique, developed in collaboration with IKP Cologne, and result in the 48Ca region will be also presented. During 2009 the upcoming setup with the AGATA Demonstrator and PRISMA will start the experimental campaign at LNL.

Invited Group Report HK 15.4 Mo 17:30 H-ZO 40

Coulomb excitation and Transfer Experiments at REX-ISOLDE* — •Thorsten Kröll — TU Darmstadt — TU München

The aim of recent research in nuclear physics is the understanding of the structure of nuclei far off stability. In this contribution, the highly successful experimental programme in this field based on the use of post-accelerated radioactive ion beams (RIBs) obtained from the REX-ISOLDE facility at CERN will be presented. The beams utilised range from Li up to Rn comprising more than 60 isotopes from both the proton- and neutron-rich side of the nuclear chart.

The research programme covers a wide range of topics like the evolution of magic numbers, the intriguing phenomenon of shape coexistence, and reactions of astrophysical interest. The experimental methods are "safe" Coulomb excitation and one- and two-nucleon transfer (or capture) reactions investigated by high-resolution γ-ray spectroscopy with the MINIBALL spectrometer as well as particle spectroscopy with a Si detector array.

The status and recent results of the programme as well as perspectives for future experiments and the upgrade to HIE-ISOLDE will be presented and discussed.

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HK 15.5 Mo 18:00 H-ZO 40

Nuclear structure studies in the area around the valence maximum of ^{170}Dy with CLARA + PRISMA — •Pär-Anders Söderström for the 170Dy-Collaboration — Uppsala University

While the existence of shell closures and the search for exotic "doubly magic" nuclei is a cornerstone of our understanding of the atomic nucleus, their even-even, "doubly-mid-shell" counterparts are arguably even more rare. Above the *sd* shell, the corresponding doubly mid-shell, even-even systems which are particle bound are limited to ^{28}Si, ^{38}Si, ^{48}Cr and ^{170}Dy. Assuming the standard spherical shell gaps, ^{170}Dy might naively be expected to be amongst the most collective of all nuclei. The double mid-shell at ^{170}Dy may also represent the single best hope in the entire Segré chart for the empirical realization of the SU(3) dynamical symmetry of the interacting boson model.

An experiment for nuclear structure studies of ^{170}Dy and its neighbors has been performed at Laboratori Nazionali di Legnaro. Multi-nucleon transfer reactions with a ^{82}Se beam on a ^{170}Er target were used to reach the neutron-rich isotopes. The reaction fragments were identified using the magnetic spectrometer PRISMA and the gamma-ray spectra were recorded using the CLARA germanium detector array. The analysis of this data is ongoing. Preliminary gamma-ray spectra for neutron rich isotopes in this area will be presented as well as relative cross sections for production of these isotopes in multi-nucleon transfer reactions.

HK 15.6 Mo 18:15 H-ZO 40

Results from d(^{30}Mg, ^{31}Mg)p at REX-ISOLDE — •Vinzenz Bildstein, Roman Gernhäuser, Thorsten Kröll, Reiner Krücken, and Kathrin Winter for the Is 454-Collaboration — Physik-Department E12, TU München, Germany

Thirty years after the discovery of the "island of inversion" [1] the borders of the island are still not well determined and in particular the evolution of the single-particle structure is not well investigated.

Transfer reactions yield important spectroscopic information, i.e. spin and parity assignments as well as spectroscopic factors. Since the transfered nucleon can occupy excited states, the properties of these states can be studied as well.

In order to study transfer reactions in inverse kinematics at REX-ISOLDE with MINIBALL a new setup was built covering a large solid angle. This new setup overcomes the limitations of previous transfer experiments performed at REX-ISOLDE [2].

In the first experiment the nucleus ^{31}Mg which is right on the edge of the "island of inversion" was studied via the d(^{30}Mg, ^{31}Mg)p reaction.

Preliminary results of this beam time will be shown as well as future plans for transfer experiments at REX-ISOLDE.

[1] C. Thibault et al., Phys. Rev. C 12, 644 (1975)

[2] M. Pantea, PhD Thesis, TU Darmstadt, Germany (2005)

*supported by BMBF 06MT238, DFG Cluster of Excellence "Origin of the Universe" and the EU through RII3-EURONS (contract no. 506065).

HK 15.7 Mo 18:30 H-ZO 40

Shape coexistence in the "Island of inversion": Search for the 0_2^+ state in ^{32}Mg applying a two-neutron transfer reaction — •Kathrin Wimmer, Vinzenz Bildstein, Roman Gernhäuser, Thorsten Kröll, and Reiner Krücken — Physik-Department E12, Technische Universität München

The "Island of inversion" is a region in the nuclear chart around the neutron rich $N = 20$ isotopes of Na, Mg and Al isotopes, where intruder fp-orbitals favoring deformed shapes compete with the normal spherical sd configurations. The two-neutron transfer reaction starting from the normal ground state of ^{30}Mg is expected to favor the population of its analogue in ^{32}Mg, the excited 0_2^+ state which has a similar particle-hole structure. This state is practically not reachable in Coulomb excitation and its population has neither been observed in the β decay of ^{32}Na nor in heavy-ion induced reactions. We populated states in ^{32}Mg by a (t,p) two-neutron transfer reaction in inverse kinematics with a ^{30}Mg beam at 1.83 MeV/u from REX-ISOLDE impinging on a tritium-loaded Ti target. Recoiling light particles, like protons and tritons, were detected in the new segmented Silicon detector array especially designed for transfer reactions surrounded by the MINIBALL γ-ray detector.

First results of this beam time which took place in October 2008 will be presented.

This work is supported by BMBF 06MT238, EURONS (contract No. RII3-CT-2004-506065) and the DFG Cluster of Excellence "Origin and Structure of the Universe"(www.universe-cluster.de)

HK 15.8 Mo 18:45 H-ZO 40

Coulomb excitation at the border of the island of inversion – the case of ^{31}Mg — •Michael Seidlitz, Peter Reiter, and Dennis Mücher for the IS410-Collaboration — Institut für Kernphysik, Universität zu Köln

The ground state properties of ^{31}Mg indicate a dramatic change of nuclear shape at $N = 19$ with a highly deformed $J^\pi = 1/2^+$ ground state, implying that ^{31}Mg is part of the *island of inversion* [1]. The unknown collective properties of excited states were subject of a Coulomb excitation experiment at REX-ISOLDE, CERN, employing a radioactive ^{31}Mg beam. De-excitation γ-rays were detected by the MINIBALL γ-spectrometer in coincidence with scattered particles in a segmented Si-detector. The level scheme of ^{31}Mg was extended. Spin and parity assignment of the 945 keV state yielded a $(3/2^+, 5/2^+)$ value. De-excitation of this state is dominated by a strong collective $M1$ transition to the $(3/2_1^+)$ state. The deduced $B(E2)$ and $B(M1) > 0.145\mu_N^2$ values are in good agreement with the properties of a rotational band built on the $1/2^+$ ground state [2].

[1] G. Neyens *et al.*, Phys.Rev.Lett **94**, 022501 (2005)

[2] F. Marechal *et al.*, Phys.Rev. C **72**, 044314 (2005)

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