HK 37: Nuclear Structure and Dynamics II

Time: Tuesday 16:30–19:00 Location: H-ZO 50

Invited Group Report HK 37.1 Tu 16:30 H-ZO 50
Two-proton radioactivity and nuclear structure — •Marek Pfützner — Institute of Experimental Physics, University of Warsaw, 00-681 Warszawa, Poland

The detailed decay study of two-proton (2p) emitter ^{45}Fe has been performed at the A1900 separator at NSCL/MSU. A novel type of a gaseous detector employing digital imaging has been used [1]. Clear images unambiguously identifying the two-proton radioactivity channel were obtained which allowed the full reconstruction of decay events in three-dimensions [2]. For the first time, the angular and energy correlations between two protons emitted from the nuclear ground state could be determined. Results were found to be in good agreement with a three-body model of the two-proton radioactivity [3] which predicts a sensitivity of angular correlation to the structure of the initial nuclear state. Moreover, the same value of a structure parameter consistently reproduces the p-p angular correlation as well as the partial 2p half-life value. Thus, the 2p radioactivity offers a new tool to investigate the structure of extremely neutron-deficient nuclei.

Current status of the 2p decay studies, improvements of our detection technique, and plans to investigate other 2p emitters in vicinity of ^{48}Ni will be discussed.

1. K. Miernik et al., Nucl. Instr. and Methods in Phys. Res. A581, 194 (2007). 2. K. Miernik et al., Phys. Rev. Lett. 99, 192501 (2007). 3. L.V. Grigorenko and M.V. Zhukov, Phys. Rev. C 68, 054005 (2003).

Group Report HK 37.2 Tu 17:00 H-ZO 50
Spectroscopy in the neighbourhood of ^{100}Sn [*] — •Ch. Hinke, M. Böhmer, K. Eppinger, T. Faestermann, R. Gernhäuser, R. Krücken, and L. Maier for the Sn100-Collaboration — Physik Department E12, TU München

The investigation of the shell structure far from the valley of stability is a major task in modern nuclear structure physics, especially close to the drip lines.
By fragmentation of a 1.0 A GeV ^{124}Xe beam from the GSI accelerators ^{100}Sn and neighbouring nuclei have been produced, separated in the FRS and identified by multiple deltaE, Brho and ToF measurements. The nuclei were stopped in an implantation detector with high spatial resolution in order to correlate implantations with succeeding decays. The device was surrounded by the "Stopped Beam"Rising array of 15x7 Ge-detectors in close geometry. In this configuration the setup enabled us to do nearly 4π spectroscopy of the emitted gamma and particle decay radiation.
In our contribution we focus on new results concerning the particle stability of exotic nuclides in the vicinity of ^{100}Sn. We also present the results of isomer spectroscopy in the ^{100}Sn region e.g. the first observation of the 6^+ to 4^+ transition from the already known ^{102}Sn isomer. A brief preliminary status of the ongoing ^{100}Sn beta-gamma decay analysis will also be given.
[*] supported by the MLL, BMBF (06MT238), DFG (EXC153), EPSRC, STFC (UK), and EURONS

HK 37.3 Tu 17:30 H-ZO 50
High-energy excited states in ^{98}Cd — •Norbert Braun[1], Andrey Blazhev[1], Plamen Boutachkov[3], Tim Brock[2], Magda Gorska[3], Hubert Grawe[3], Jan Jolie[1], Zhong Liu[4], B. S. Nara Singh[2], Stephane Pietri[3], and Robert Wadsworth[2] for the RISING S352-Collaboration — [1]Institut für Kernphysik, Universität zu Köln, Germany — [2]Department of Physics, University of York, York, UK — [3]GSI, Darmstadt, Germany — [4]University of Edinburgh, Edinburgh, UK

Studies of isomerism in the proton-rich $N \simeq Z$ nuclei around ^{100}Sn give important insights into the role of proton-neutron pairing and also serve as testing grounds for nuclear models. In summer 2008, an experiment on ^{96,97,98}Cd was performed using the FRS fragment separator and the RISING germanium array at GSI. These exotic nuclei of interest were produced using fragmentation of a 850 MeV/u ^{124}Xe beam on a 4 g/cm^2 ^{9}Be target and finally implanted into an active stopper consisting of 9 double-sided silicon strip detectors.

In ^{98}Cd, a new high-energy isomeric transition was identified. Preliminary results on ^{98}Cd will be presented and their implications for the high-excitation level scheme will be discussed.

HK 37.4 Tu 17:45 H-ZO 50
Sub-barrier Coulomb excitation of ^{104,102,100}Cd — Andreas Ekström, Joakim Cederkall, •Douglas DiJulio, and Claes Fahlander — Physics Department, Lund University, Sweden

Sub-barrier Coulomb excitation experiments in inverse kinematics have been carried out to measure the reduced transition probabilities from the first excited 2_1^+ state to the 0^+ ground state in the neutron deficient ^{104,102,100}Cd isotopes at the REX-ISOLDE facility. Radioactive ion beams, containing either of the isotopes ^{104,102,100}Cd at an energy of about 2.9 MeV per nucleon, were used during the experiments. In addition the static quadrupole moment for the 2_1^+ state has been measured using different targets. De-excitation γ-rays were detected with the highly segmented Ge-array MINIBALL. A Double Sided Silicon Strip Detector (DSSSD) was used to detect the recoils and ejectiles. By combining the measurements from the different targets with results from previous lifetime measurements, new values for the B(E2) and the Q(2_1^+) values can be deduced. The Cd isotopes are only two proton-holes away from the proton shell closure at ^{100}Sn. The measurements are directed towards a better understanding of shell evolution in this region. Preliminary results from the experiment will be presented and discussed.

HK 37.5 Tu 18:00 H-ZO 50
Comparison of $T_z = \pm 1 \rightarrow 0$ Gamow-Teller Transitions for the study of Isospin Symmetry in pf-shell nuclei — •Francisco Molina[1], Yoshitaka Fujita[2], Berta Rubio[1], and William Gelletly[3] for the GSI-Leuven-Osaka-Valencia-Surrey-Collaboration — [1]Instituto de Física Corpuscular, CSIC-Universidad de Valencia, E-46071 Valencia, Spain — [2]Department of Physics, Osaka University, Toyonaka, Osaka 560-0043, Japan — [3]Department of Physics, University of Surrey, Guildford GU2 7XH, Surrey, UK

Gamow-Teller (GT) transitions are caused by the Weak interaction in nuclei. However, they can be studied in both β decay and charge-exchange (CE) reactions. If isospin is a good quantum number in nuclei, then the $T_z = -1 \rightarrow 0$ and $+1 \rightarrow 0$ GT transitions, are identical. Therefore, a comparison of the results from studies of β decay and CE should shed light on isospin symmetry in nuclei. Rapid technical development has greatly enhanced the production and detection efficiency of exotic nuclei. Thus we can now study the β decay of $T_z = -1$ pf-shell nuclei, ^{54}Ni, ^{50}Fe, ^{46}Cr, and ^{42}Ti, in both fragmentation and the classical ISOL technique. Two experiments were performed, one at the Louvain-la-Neuve ISOL facility and the other as part of the STOPPED beam RISING campaign at GSI. Although the Fermi function strongly reduces the β feeding to highly excited states, we could study the feeding to the states up to 5 MeV by measuring the β-delayed γ rays. The results are compared with the spectra from CE (^{3}He, t) measurements for the mirror $T_z = +1$ target nuclei studied in high resolution at RCNP, Osaka.

HK 37.6 Tu 18:15 H-ZO 50
New beta-delayed particle emission studies — •Ricardo Domínguez-Reyes[1], Nassima Adimi[2], María José García Borge[1], Beltran Blank[2], and Luis Mario Fraile[3] — [1]Instituto de Estructura de la Materia, Madrid, Spain — [2]Centre d'Etudes Nucléaires de Bordeaux-Gradignan (CENBG), Bordeaux, France — [3]Univ. Complutense de Madrid, Madrid, Spain

Beta delayed particle emission is a wonderfull tool to study nuclear structure near the drip-line. The main advantage of these studies is the higher detection efficiency of charged particles allowing us to characterize exotic nuclei with very low production.

New studies are motivated by the improvement of the facilities and/or the new generation of detectors.

These advances have allowed us to re-visit the beta-delayed proton and gamma emission in ^{33}Ar and ^{32}Ar with an improve proton-gamma coincidence spectrum that leads us to a better knowledge of the B(GT) distribution on a wider excitation energy range.The experiment made at IBE (GANIL) has allowed us to reassign some known p-transitions to higher excited states in ^{33}Cl due to good pγ coincidences.

Furthermore the β-decay of 17Ne was visited using ISOLDE's Si-Ball, studying βp and $\beta\alpha$ processes by Time-of-Flight techniques. ToF was used to separate both processes and to beta-clean the spectra. This study will allow us to determine wich process occurs first.

HK 37.7 Tu 18:30 H-ZO 50

Are spectroscopic factors in mirror states the same? — •Natalia Timofeyuk — Department of Physics University of Surrey Guildford Surrey GU2 7XH United Kingdom

The spectroscopic factors for a specific class of mirror pairs, where the proton-rich partner has one-proton decay threshold just below the two-proton decay threshold and both are lower than in usual nuclei, have been studied within a three-body model core+N+N. The choice of this model is justified by strong NN correlations between the two valence protons. It has been found that, because the core+p binding energy is small, the geometrical mismatch between the core+p two-body wave function, stretched towards the classically forbidden region, and the spatially confined three-body functions of the core+p+p reduces the norm of the <core+p|core+p+p> overlap. For mirror overlap <core+n|core+n+n>, this mismatch is much weaker. As a result, the spectroscopic factors in mirror core+p+p and core+n+n system may differ. For example, the spectroscopic factors in the mirror pair 9C-9Li this difference can reach 7%. For another mirror pair, 18Ne-18O, appart from this mismatch, the situation is complicated by different mixing between the configurations with different proton orbital momentum, l=0 and l=2. The resulting mirror symmetry breaking in large component is about 2-5% but can reach 25% in the small 1s component of the 0+ ground state in 18O-18Ne. Understanding mirror symmetry in spectroscopic factors is important for predicting astrophysically revelant cross sections using available information about mirror analogs.

HK 37.8 Tu 18:45 H-ZO 50

the 12C(16O,γ)28Si reaction: structural and statistical aspects of the gamma decay — •dorothee lebhertz[1], sandrine courtin[1], florent haas[1], david jenkins[2], and david hutcheon[3] — [1]IPHC, University of Strasbourg, CNRS, Strasbourg, France — [2]Department of Physics, University of York, York, UK — [3]TRIUMF, Vancouver, Canada

The 28Si nucleus is a microlaboratory where oblate, prolate and octupole shapes coexist at low excitation energies. At higher excitations, a 12C-16O cluster band has been observed in breakup experiments for which the band head should lie around 25 MeV. It is also around this energy that narrow (Γ around 200 keV) resonances were found in the radiative capture reaction to the 0+ and 2+ members of the g.s. band. The radiative capture is a powerful tool to study the interplay between reaction mechanisms and structural effects. The aim of our recent experiment performed at Triumf using the highly selective Dragon 0° spectrometer and its associated BGO array was to measure the complete γ-decay of the radiative capture 12C(16O,γ)28Si reaction. For the first time, we observed important feeding of doorway states around 11 MeV and also direct decay to the 3- octupole state at 6.9 MeV and to the 4+ member of the prolate band at 9.2 MeV. Results of this experimental programme will be presented, discussed in terms of an interplay between statistical and structural effects in 28Si and compared to similar results in the 12C+12C system.