HK 38 Kernphysik/Spektroskopie

Zeit: Mittwoch 14:00–16:00 Raum: TU MA004

Gruppenbericht

HK 38.1 Mi 14:00 TU MA004

Structure studies of the neutron-rich isotopes ^{17}C, ^{16}C and ^{15}C — •H. G. Bohlen[1], W. von Oertzen[1,2], R. Kalpakchieva[3], T. N. Massey[4], A. A. Ogloblin[5], G. de Angelis[6], M. Milin[7], Ch. Schulz[1], Tz. Kokalova[1], and C. Wheldon[1] — [1]Hahn-Meitner-Institut, Berlin — [2]Freie Universität, Berlin — [3]FLNR, JINR, Dubna — [4]Dept. Phys. Astr, Ohio University — [5]Kurchatov Institute, Moscow — [6]INFN, LNL, Legnaro — [7]RBI, Zagreb

Nothing was known about excited states of ^{17}C above the neutron threshold (S_n= 0.729 MeV). We observed thirteen new states up to 16.3 MeV excitation energy with a resolution of 0.25 MeV using the three-neutron transfer reaction ^{14}C(^{12}C,^{9}C)^{17}C at 231 MeV incident energy (the reaction Q-value is Q_0= -46.930 MeV). The (^{12}C,^{9}C) reaction has also been used on ^{12}C and ^{13}C targets, and excited states of ^{15}C and ^{16}C have been populated up to 19 MeV and 17.4 MeV, respectively. In the comparison of excitation energies, widths and cross sections of states, a striking correspondence of states in the three isotopes is revealed for ten groups of states, when the spectra of ^{16}C and ^{15}C are shifted in excitation energy by a constant value. This behavior could be understood in the weak-coupling model, assuming an almost complete decoupling between cores and $(sd)^3$ neutron configurations populated in the three-neutron transfer. The structure of ^{17}C states is further investigated in shell-model calculations and by comparison to ^{19}O levels. The neutron decay of the observed resonances in the three carbon isotopes could be understood using the parentage between the structure of mother and daughter states as derived in the weak-coupling model.

HK 38.2 Mi 14:30 TU MA004

Ternary Fission from Hyper-deformed States in A=56-60 — •W. von Oertzen[1,2], G. Efimov[1,3,2], V. Zherebchevsky[1,2], D. Kamanin[1,3], B. Gebauer[1], S. Thummerrer[1], Tz. Kokalova[1], H.G. Bohlen[1], C. Schulz[1], C. Beck[4], M. Rousseau[4], P. Papka[4], G. Royer[5], G. de Angelis[6], and C. Wheldon [1] — [1]Hahn Meitner Institut D14109 Berlin, Glienickerstr.100 — [2]Freie Universität, Berlin — [3]FLNR, JINR-DUBNA, Russia — [4]IreS, Strasbourg, France — [5]Subatech, Nantes, France — [6]LNL, Legnaro, Padova, Italy

With a unique charged particle detector set-up for the registration of binary coincidences (BRS, Binary Reaction Spectrometer) we have studied two systems, ^{36}Ar+^{24}Mg, and ^{32}S+^{24}Mg at energies of 195 and 163 MeV, respectively. The BRS measures the reaction angles in and out of plane and gives through Bragg-peak and range spectroscopy a complete coverage of the total charge in the final channels. The yields of the binary and the non-binary (ternary) channels with missing mass up to A=16 are determined. We observe very narrow out-of-plane angular correlations for binary reactions but also for those ternary events, where the third missing charge is a multiple of α-particles. The result is explained by a ternary fission decay at high angular momentum from hyper-deformed shapes. From the energetics of the reaction and from the relative yields of the ternary fission events the formation of highly excited hyper-deformed nuclei ^{56}Ni and ^{60}Zn can be uniquely deduced, as described by the α-cluster model in ref.1, or by the Nilsson-Strutinsky method. 1)J. Zhang, A.C. Merchant and W.D.M. Rae, Phys.Rev. C49(1994) 562.

HK 38.3 Mi 14:45 TU MA004

Spectroscopy of light exotic nuclei using BRS+EUROBALL — •Tz. Kokalova[1,2], C. Wheldon[1], W. von Oertzen[1,2], G. Gebauer[2], S. Thummerer[2], C. Schulz[2], H.G. Bohlen[2], G. de Angelis[3], E. Farnea[3], D.R. Napoli[3], S.M. Lenzi[4], C. Beck[5], M. Rousseau[5], and P. Papka[5] — [1]Freie Universität Berlin, Germany — [2]Hahn-Meitner-Institut Berlin, Germany — [3]INFN-Laboratori Nazionali di Legnaro, Legnaro, Italy — [4]Dipartimento di Fisica and INFN, Padova, Italy — [5]Institut de Recherches Subatomiques, Strasbourg, France

An experiment was performed for the study of properties of neutron-rich beryllium (A=10-12) and carbon (A=13-16) isotopes in the vicinity of the particle-emission threshold, where strong clustering and large deformations are expected to be observed.

Measurements with an ^{18}O beam (E_L=90 MeV) and ^{9}Be- and ^{13}C- targets have been carried out at IReS, Strasbourg using the Binary Reaction Spectrometer (BRS) together with the EUROBALL array of germanium detectors. This combination enabled particle-particle-γ coincidences to be measured and the kinematics of the reaction to be reconstructed. Using this experimental technique light nuclei (Z=3 to 12) have been populated and investigated. A short report of the current analysis will be given.

HK 38.4 Mi 15:00 TU MA004

EUROBALL+BRS as a tool for uniquely identifying weakly populated structures in light nuclei. — •Carl Wheldon[1], Tzany Kokalova[1,2], Severin Thummerer[1], Burckhard Gebauer[1], Wolfram von Oertzen[1,2], Christian Schulz[1], Hans-Gerhard Bohlen[1], Giacomo de Angelis[3], Enrico Farnea[3], Daniel R. Napoli[3], Silvia M. Lenzi[4], Christian Beck[5], Marc Rousseau[5], and Paul Papka[5] — [1]SF7, Hahn-Meitner-Institut, Glienicker Straße 100, D-14109 Berlin, Germany — [2]Freie Universität Berlin, Germany — [3]INFN-Laboratori Nazionali di Legnaro, Legnaro, Italy — [4]Dipartimento di Fisica dell'Università and INFN, Sezione di Padova, Italy — [5]Institut de Recherches Subatomiques, Strasbourg, France

In order to search for highly-deformed nuclear cluster states based on α-particle structures in light nuclei, A<28, a reaction mechanism is required that makes use of pre-clustered target and/or projectile nuclei. Furthermore, the parity doublet structures that characterise asymmetrically deformed states, need to be cleanly extracted from the multitude of competing reaction channels.

To this end, an experiment was performed using the Berlin-Binary-Reaction-Spectrometer (BRS) in conjunction with the EUROBALL array, which in this instance comprised 15 cluster and 26 clover detectors. The 90 MeV D.C. ^{18}O beam was provided by the IReS, Strasburg Vivitron and incident on a thin, 98 $\mu g\,cm^{-2}$, ^{9}Be target. The BRS enables the charge, Z, of both binary products to be uniquely determined, in addition to providing millimetre position and precise energy information.

The $p-\gamma$ coincidence analysis method and results will be reported.

HK 38.5 Mi 15:15 TU MA004

Nachweis des natürlichen Alpha-Zerfalls von Wolfram — •Wolfgang Seidel[1] und Cristina Cozzini[2] für die CRESST-Kollaboration-Kollaboration — [1]Max-Planck-Institut für Physik — [2]University of Oxford

Zum ersten mal wurde der natürliche Alpha-Zerfall von ^{180}W eindeutig in einem Gamma- und Beta- untergrundsfreiem Spektrum nachgewiesen. Dies wurde durch den simultanen Nachweis von Phononen und Szintillationslichtsignalen in den CRESST Tieftemperaturdetektoren erreicht. Die Halbwertszeit wurde zu $T_{1/2} = (1.8 \pm 0.2) \times 10^{18} y$ und die Übergangsenergie zu $Q = (2516.4 \pm 1.1(stat.) \pm 1.2(sys.))keV$ bestimmt.

HK 38.6 Mi 15:30 TU MA004

Measurement of the nuclear matrix elements for $0\nu\beta\beta$ decay — •E.-W. Grewe, C. Bäumer, D. Frekers, S. Hollstein, and S. Rakers — Institut für Kernphysik, WWU Münster

The double beta decay is a rare second-order weak transition. A nucleus can undergo double beta decay with or without emission of neutrinos. The 0ν-mode is only possible if the neutrinos are massive Majorana particles or not purely left-handed. This mode is of great interest for neutrino-mass estimations, however the nuclear matrix element is needed to connect a measured half-life to the neutrino mass.

The nuclear matrix element can be calculated if the complete set of Gamow-Teller (GT) matrix elements for the two virutal transitions in the perturbative description are known. While for the 2ν mode only allowed GT transitions play a role, the 0ν mode rather proceeds through forbidden, i.e. higher multipole, transitions. An elegant way to experimentally obtain GT distributions are charge-exchange reactions. If transitions beyond the allowed GT ones have to be studied, high energy resolution spectra and angular distributions are necessary to precisely identify single excitations. We present new ^{48}Ca(^{3}He,t) data taken at RCNP (Osaka, Japan) [1] which have energy resolutions of 40 keV so that the multipolarity of all low-lying states can be studied. Comparisons with theoretical calculations are presented. The data is combined with high-resolution ^{48}Ti(d,^{2}He) data [2] to obtain $2\nu\beta\beta$ half-lives.

[1] H. Fujita *et al.*, Nucl. Instr. Meth. A 484, 17 (2002).
[2] S. Rakers *et al.*, Phys. Rev. C 70, 054302 (2004).

HK 38.7 Mi 15:45 TU MA004

Dipole-strength distributions below the giant dipole resonance in ^{92}Mo, ^{98}Mo and ^{100}Mo* — •G. Rusev[1], R. Schwengner[1], A. Wagner[1], K.D. Schilling[1], F. Dönau[1], S. Frauendorf[1,2], M. Erhard[1], A.R. Junghans[1], K. Kosev[1], N. Nankov[1], and E. Grosse[1,3] — [1]Institut für Kern- und Hadronenphysik, Forschungszentrum Rossendorf, Dresden, Germany — [2]University of Notre Dame, Notre Dame, USA — [3]Technische Universität Dresden, Dresden, Germany

Photon-scattering experiments with bremsstrahlung were performed on ^{92}Mo, ^{98}Mo and ^{100}Mo at electron energies up to 13.2 MeV. The measurements were carried out at the new bremsstrahlung facility of the Rossendorf ELBE accelerator. The highest end-point energies are above the neutron-separation energies of the three isotopes and allow the determination of the dipole strengths below the giant dipole resonance. The decay to intermediate levels was estimated with the constant-temperature level-density model and the dipole-strength distributions were reconstructed. The obtained results are completed with data from neutron-scattering experiments [1] and compared with predictions of RPA calculations.

[1] H. Beil et al., Nucl. Phys. A227 (1974) 427

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