HK 48: Nuclear Structure and Dynamics I

Time: Wednesday 14:00–16:00 Location: H-ZO 40

HK 48.1 We 14:00 H-ZO 40

E0 Transition strengths from X(5) to the Rigid Rotor * — •A. Krugmann[1], J. Bonnet[1], N. Pietralla[1], and R. V. Jolos[2] — [1]Institut für Kernphysik, Technische Universität Darmstadt, Germany — [2]Joint Institute for Nuclear Research, Dubna, Russia

Relative and absolute $E0$ transition strengths $[\rho^2(E0)]$ on the transitional path between the X(5) solution and the Rigid Rotor Limit have been evaluated within the framework of the Confined β-Soft (CBS) rotor model. Relative $E0$ transition strengths between the β-vibrational band and the ground state band decrease with increasing angular momentum for a given potential stiffness. Absolute $E0$ transition strengths drop with increasing potential stiffness towards zero in the Rigid Rotor Limit. The Z-independent quantity $X \propto \rho^2(E0; 0_2^+ \rightarrow 0_1^+)/B(E2; 0_2^+ \rightarrow 2_1^+)$ has been traced between X(5) and the Rigid Rotor. It reaches the value $4\beta_M^2$ at the Rigid Rotor Limit, as previously derived by Rasmussen [1]. A new Inter-Band $E0 - E2$ correlation observable $Y \propto \rho^2(E0; 0_2^+ \rightarrow 0_1^+)/B(E2; 0_2^+ \rightarrow 2_1^+)^2$ has been proposed [2], which is independent on the absolute nuclear deformation and solely depends on the nuclear stiffness. Available data for X and Y are in satisfactory agreement with the CBS model.

[1] J.O. Rasmussen, Nucl. Phys. **19** (1960) 85-93.

[2] J. Bonnet, A. Krugmann, J. Beller, N. Pietralla, R.V. Jolos, submitted to Phys. Rev. C.

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HK 48.2 We 14:15 H-ZO 40

Shape Phase Transitions in even and odd systems — •Lorenzo Fortunato[1], Andrea Vitturi[1], Clara Alonso[2], and Josè Arias[2] — [1]Dip. Fisica "G.Galiei", Università di Padova and INFN (Italy) — [2]Departamento FAMN, Universidad de Sevilla (Spain)

The onset of shape phase transitions in even as well as odd systems are reviewed. We discuss the case of an odd j = 3/2 particle coupled to an even-even boson core that undergoes a transition from spherical limit (U(5)) to the γ-unstable limit (O(6)). Energy spectrum and electromagnetic transitions, in correspondence of the critical point, display behaviors qualitatively similar to those of the even core and they agree qualitatively with the model based on the E(5/4) boson-fermion symmetry. Then we describe two-particle transfer reactions: the evolution of the transfer spectroscopic intensities within the interacting boson model is analyzed as a possible signature of shape-phase transitions. In correspondence to the critical points characterizing the phase transitions, the two-particle transfer matrix elements to both ground and excited 0^+ states display a rapid discontinuity that might help validating the experimental search for the critical point.

HK 48.3 We 14:30 H-ZO 40

Determination of absolute transition probabilities in ^{128}Xe via projectile Coulomb excitation — •M. Hackstein[1], A. Dewald[1], W. Rother[1], Th. Pissulla[1], H. Iwasaki[1], D. Mücher[1], N. Warr[1], A. Blazhev[1], J. Jolie[1], K.-O. Zell[1], and S. Harissopulos[2] — [1]IKP Köln, Germany — [2]INP, NCSR, Demokritos, Athens, Greece

Recently, lifetimes of low-lying excited states in ^{128}Xe were measured using the plunger technique after projectile Coulomb excitation. This experiment was performed at the JYFL, Jyväskylä using the JUROGAM Ge-detector array and the Cologne coincidence plunger device equipped with an array of 32 small Si-detectors. The Si-detectors were used to measure the reaction kinematics by registering target-like nuclei scattered in forward direction. In order to cross-check the results obtained from the recoil distance Doppler shift analysis an evaluation of the measured excitation cross-sections was performed with the computer code GOSIA. In addition deorientation effects were investigated and effort was made to extract absolute quadrupole moments. Details of the experiment and the calculations will be presented. The obtained results will be discussed. Supported by: DFG, contr.n. DE1516/1.

HK 48.4 We 14:45 H-ZO 40

New Interpretation of Pair Transfer Reactions Between Collective 0^+ States — •Linus Bettermann[1], Rod M. Clark[2], Richard F. Casten[3,1], and Ryan Winkler[3] — [1]Institut für Kernphysik, Universität zu Köln, Cologne, Germany — [2]Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley, CA — [3]Wright Nuclear Structure Laboratory, Yale University, New Haven, Conneticut

It is experimentally known, that in nearly all cases ground state cross sections dominate in nucleon pair transfer reactions in collective nuclei. Exceptions of this behavior in which cross sections to excited 0^+ states are comparable to the ground state cross sections can be found in the phase transitional region. In this regions rapid changes from spherical to deformed nuclei appear. This has led to a correlation of the phase transitional region to large cross sections to excited 0^+ states in pair transfer reactions in the past. We performed IBM calculations throughout the entire symmetry triangel, which leads to a new, more general interpretation. This includes the experimentaly known small cross sections to excited 0^+ states in most regions of the nuclear chart and larger in transitional regions. Additionaly our interpretation predicts large cross sections in regions of large structural change that occur without passing through a phase transition. We will present results of the IBM calculations and show cases in which our predictions can be tested experimentally. Work supported in part by USDOE under grant No. DE-FG02-91ER-40609, DFG under grant No. Jo391/3-2 and through a Mercator Guest Professorship at University of Cologne.

HK 48.5 We 15:00 H-ZO 40

Study of ^{133}Ba with the $(\vec{d}, p)$ reaction — •G. Suliman[1], D. Bucurescu[1], C. Rusu[2], R. Hertenberger[3], H.-F. Wirth[3], T. Faestermann[4], R. Krücken[4], T. Behrens[4], V. Bildstein[4], K. Eppinger[4], C. Hinke[4], M. Mahgoub[4], P. Meierbeck[4], M. Reithner[4], S. Schwertel[4], and N. Chauvin[5] — [1]IFIN-HH, Bucharest, Romania — [2]University of Texas at Dallas, USA — [3]LMU, Garching, Germany — [4]TUM, Garching, Germany — [5]CSNSM, Orsay, France

Shape phase transitions were mainly studied in even-even nuclei, and less in odd-mass nuclei where the structure is more complex. The Ba isotopes with N<80 form a transitional region from vibrators (U(5) IBM limit) to γ-soft nuclei (O(6) limit), with ^{134}Ba showing features of the E(5) symmetry, the critical point of the U(5) to O(6) transition. Studies of the odd-mass neighbors of ^{134}Ba are of interest to see how criticality is changed by the coupling of the odd particle. Different critical point solutions have been proposed for this region, like E(5/4) or E(5/12).

We present a study of the ^{133}Ba nucleus with the direct $(\vec{d}, p)$ reaction at 24 MeV. The experiment was performed at the Munich tandem with polarized deuteron beam, and the Q3D spectrometer. A DWBA analysis of the measured angular distributions and analyzing powers provided unambiguous J^π assignments for most of the observed levels up to 2.2 MeV excitation. The results are discussed in comparison with the predictions of critical point models, IBFM, and spherical shell model calculations.

HK 48.6 We 15:15 H-ZO 40

Quantum chaos in the collective dynamics of nuclei — •Pavel Cejnar, Pavel Stransky, and Michal Macek — Institute of Particle and Nuclear Physics, Charles University, Prague, Czech Republic

Simple models of nuclear collective dynamics - the geometric collective model (GCM) and the interacting boson model (IBM) - exhibit very complex interplay of regular and chaotic motions [1,2]. The competition between both types of dynamics sensitively depends on control parameters as well as on energy. We present results of our recent analyses of classical and quantum signatures of chaos in both GCM and IBM [3-5]. Apart from standard measures of chaos we also study so-called Peres lattices [6], which provide a very efficient way to distinguish ordered and disordered parts of spectra and to reveal main ordering principles of quantum states. Correspondence with the classical dynamics is demonstrated.

References: [1] Y. Alhassid, N.Whelan, Phys. Rev. Lett. 67, 816 (1991). [2] P. Cejnar, P. Stransky, Phys. Rev. Lett. 93 (2004) 102502. [3] P. Stransky, M. Kurian, P. Cejnar, Phys. Rev. C 74 (2006) 014306. [4] M. Macek, P. Stransky, P. Cejnar, S. Heinze, J. Jolie, J. Dobes, Phys. Rev. C 75 (2007) 064318. [5] P. Stransky, P. Hruska, P. Cejnar, submitted to Phys. Rev. E. [6] A. Peres, Phys. Rev. Lett. 53 (1984) 1711.

HK 48.7 We 15:30 H-ZO 40

Lifetime measurement in ^{168}Yb using the Recoil Distance Doppler Shift (RDDS) Method — •Michael Reese[1], Alfred Dewald[2], Oliver Möller[1], Pavel Petkov[2,3], Norbert Pietralla[1], and Thomas Pissulla[2] — [1]TU Darmstadt, Germany — [2]Universität zu Köln, Germany — [3]INRNE, Bulgarian Academy of Sciences, Sofia

In the analysis of coincidence RDDS experiments one uses the Differential Decay Curve (DDC) Method to determine lifetimes of excited states. Experiments with small recoil velocities, thus small Doppler shifts, enforce the use of narrow coincidence gates to determine peak intensities. This results in a loss of statistics. As an alternative to the application of gates, we present the fit of 2-dimensional functions to the $\gamma\gamma$ coincidence data. This approach has been studied on data taken in a RDDS measurement for the ground state band of ^{168}Yb. The ^{18}O(^{154}Sm,4n)^{168}Yb* fusion evaporation reaction was induced by an 80 MeV ion beam of the tandem accelerator facility in Cologne. The target was mounted in the Cologne coincidence plunger device. Lifetimes from the 4_1^+ to the 10_1^+ states have been extracted. The method will be discussed and the results are compared to the CBS rotor model in the context of centrifugal stretching.

HK 48.8 We 15:45 H-ZO 40

The even-even nucleus ^{196}Hg and its relation to the "magical quartet" around ^{194}Pt — •Christian Bernards, Michael Albers, Christoph Fransen, Stefan Heinze, Jan Jolie, Désirée Radeck, and Tim Thomas — Institute for Nuclear Physics, University of Cologne

The investigation of ^{196}Hg – especially the determination of level spins and multipole mixing ratios of γ transitions between low-energy states – is of great interest for testing the existence of a relation between the nucleus ^{196}Hg and the so-called "magical quartet" around ^{194}Pt. Within the $U_\nu(6/12)\otimes U_\pi(6/4)$ extended supersymmetry, this quartet is supposed to be the supermultiplet being described the best. Similar to the quartet members ^{194,195}Pt and ^{195,196}Au, the nucleus ^{196}Hg can be described theoretically by seven IBA-2 particles to the shell closure, in particular by two $j = 3/2$ proton fermions and five *sd* neutron bosons as a two-fermions – five-bosons supermultiplet member.

In order to obtain experimental data on ^{196}Hg a $\gamma\gamma$ angular correlation experiment was performed at the Tandem accelerator of the Institute for Nuclear Physics in Cologne. Using a ^{4}He beam with an energy of 28 MeV impinging a ^{194}Pt target the reaction ^{194}Pt$(\alpha, 2n)^{196}$Hg was induced. To analyze the γ decays of yrast and non-yrast ^{196}Hg states 13 high purity germanium detectors were mounted in the Horus cube γ-ray spectrometer, which allows the determination of level spins and multipole mixing ratios by the analysis of $\gamma\gamma$ angular correlations. We will discuss first results of the experiment.