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Configuration mixing and quantum phase transitions in odd-mass nuclei around ^{100}Zr

J.-M. Régis[1], A. Pfeil[1], J. Jolie[1], A. Esmaylzadeh[1], L. Knafla[1], M. Ley[1], U. Köster[2], Y. H. Kim[2], N. Gavrielov[3] and K. Nomura[4]

1: IKP, Universität zu Köln, Zülpicher Str. 77, 50937 Köln, Germany
2: ILL, 71 avenue des Martyrs CS 20156, 38042 Grenoble Ceknomura@phy.hrdex 9, France
3: Center for Theoretical Physics, Sloane Physics Laboratory, Yale University, New Haven, Connecticut 06520-8120, USA
4: Department of Physics, Faculty of Science, University of Zagreb, 10000 Zagreb, Croatia

Abstract

Several N = 60 isotones around ^{100}Zr show rotational structures based on a deformed ground state. The shape transition from spherical single-particle structures of the N = 50 closed-shell isotones to quadrupole deformation at N = 60 can be described in terms of Quantum Phase Transitions (QPT). Recently, calculations using the Interacting Boson Model with configuration mixing (IBM-CM) of the ground and the 2p-2h intruder states could very well describe the experimentally observed sudden (sharp) shape transition in the even-Zr isotopes going from N = 58 to N = 60 as an abrupt configuration crossing (type II QPT) [1]. The calculation revealed that the type II QPT is accompanied by a type I QPT of the intruder state as gradual spherical-to-deformed shape transition of this configuration [1]. The calculations have been extended to the odd-Nb isotopes with N = 52-64 using the IBFM-CM by coupling the $\pi(1g_{9/2})$ orbit to the Zr boson core [2]. Similarly to the even-Zr isotopic chain, the odd-Nb disclose a Type II QPT at N = 60 accompanied by a type I QPT of the intruder configuration and which is the feature of an intertwined QPT [1,2].

We are reporting on further investigation on QPTs by presenting results of γ-γ lifetime measurements of the lowest excited states in the odd ^{99}Zr and ^{99}Nb nuclei. Highly effective and precise γ-γ fast-timing experiments have been performed at the LOHENGRIN fission-fragment separator of the Institut Laue-Langevin [3]. The deduced transition rates are compared with newest calculations on ^{99}Nb within the IBFM-CM framework. Experimental results of transition rates in ^{99}Zr [3] have been used to investigate QPTs by comparing with the IBFM constructed with deformation constrained self-consistent mean-field calculations based on the relativistic Hartree-Bogoliubov model with a choice of a universal energy density functional and pairing interaction [4].

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Primary author: Dr RÉGIS, Jean-Marc (Institut für Kernphysik der Universität zu Köln)

Co-authors: Mr PFEIL, Aaron (Institut für Kernphysik der Universität zu Köln); Prof. JOLIE, Jan (Institut für Kernphysik der Universität zu Köln); Dr ESMAYLZADEH, Arwin (Institut für Kernphysik der Universität zu Köln); Mr KNAFLA, Lukas (Institut für Kernphysik der Universität zu Köln); Dr KÖSTER, Ulli (Institut Laue-Langevin); Mr LEY, Mario (Institut für Kernphysik der Universität zu Köln); Dr KIM, Yung Hee (Istitut Laue-Langevin); Dr GAVRIELOV, Noam (Center for Theoretical Physics, Sloane Physics Laboratory, Yale University); Prof. NOMURA, Kosuke (Department of Physics, Faculty of Science, University of Zagreb)

Presenter: Dr RÉGIS, Jean-Marc (Institut für Kernphysik der Universität zu Köln)

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