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Nuclear shape phase transition in even-even $^{158-168}$Hf isotopes

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Abstract

The interacting *sdf*-boson-approximation model is adopted to describe the low-lying positive and negative parity states in even-even $^{158-168}$Hf isotopes. The negative parity states are described using the *sdf*-IBM model by adding the L = 3 *f*-bosons nucleon pairs to the standard *sd*-boson model space. To determine the deformation of the nuclear structure of these isotopes the potential energy surfaces are calculated as functions of the deformation parameters. The reduced transition probabilities B(E2) in N = 94 are compared to the critical point symmetry X(5) predictions. In this chain, the *sdf*-boson interacting parameters are investigated and plotted against a number of neutrons. The shape phase transition from spherical ^{158}Hf to well-deformed ^{168}Hf nuclei is observed.

Keywords: Nuclear structure; Energy levels; Transitions; Interacting boson model; A = 158-168; Hf-isotopes

1. Introduction

The new critical point symmetries X(5), E(5) and Y(5) were first introduced by Iachello [1–3]. The X(5) and Y (5) were adopted to describe the phase shape transitions between the U(5) vibrator and the SU(3) rotor and between axial and triaxial deformed shapes, respectively [4,5]. Bonatsos et al. [6,7] investigated the sequence of potentials interpolating between U(5) and X(5) by separating the variables of the original Bohr Hamiltonian. The authors constructed the

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