Nuclear Structure Investigation of Some Deformed Even-Even Nuclei Using Covariant Density Functional Theory (CDFT)

Thesis

Submitted to physics department in the partial fulfillment of requirements for the degree of M.Sc.

in

theoritical physics, Physics Department, Faculty of Science, Fayoum university

By

Marwa Mostafa Abdelhafez Abdelkader

B.Sc. in Physics

Faculty of Science

Fayoum University

(20124)

APPROVAL SHEET

TITLE OF THE THESIS

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NAME OF THE candidate

Marwa Mostafa Abdelhafez

Supervision Committee

Assist. prof. Dr. Abdelmohsen Mohammed Basha

Assistant professor at Fayoum university, egypt.(Chief supervisor)

Assist. prof. Dr. Hany Mohammed Ali Elsharkawy

Assistant professor of theoretical Physics at Fayoum university, egypt.

Dr. Ahmed Lotfy Abdelfatah Ahmed

Lecturer of theoretical Physics at Fayoum university, egypt.

Abstract

In the framework of the Relativistic Hartree-Bogoliubov (RHB) mean-field model, a Covariant Density Functional Theory (CDFT) is used to systematically investigate the triaxial shape evolution of even–even polonium ($^{186\text{-}232}Po$), Radon isotopic chain ($^{190\text{-}236}Rn$) and Radium ($^{198\text{-}240}Ra$) isotopic chains. Two different effective interactions, i.e. the Density-Dependent Meson-Exchange (DD-ME2) and the new parameter set of Density-Dependent Point-Coupling (DD-PCX) interactions, are utilized in the current study. Besides, the new parameter free proxy-SU(3) model is used to investigate the ground state shapes of the considered three isotopic chains.

In chapter one we introduce an introduction to different theoretical nuclear models that describe nuclear matter. Some of these models come in comparison to our results, e.g. the liquid drop model and Finite-range droplet model. In this chapter we introduce a brief introduction about the density functional theory in the framework of mean field approximation.

Chapter two discusses in some detail the theory of self-consistent mean field considering relativistic effects. The Covariant Density Functional Theory (CDFT) is introduced in this chapter and two of its parameter sets, which are used in the current study, are introduced. These two effective interaction models are the Density-dependent meson-exchange (DD-ME2) and the Density-dependent point-coupling (DD-PCX) models.

The so-called Proxy-SU(3) model is introduced in chapter three. Due its success in prediction of shapes of heavy nuclei both axially and triaxially deformed we have used this approach to make a comparison with our CDFT calculations. Also, this approach can predict the shape coexistence possibility in deformed systems.

Chapter four presents the results of our calculations based on the covariant density functional theory with DD-ME2 and DD-PCX parametrization sets. Different ground state properties are investigated in this chapter besides the triaxial shape evolution of the considered isotopic chains. Our results are compared to other successful theoretical approaches as well as available experimental data.

In chapter five a general conclusion is addressed based on the results investigating the different ground state properties and to address which interaction model is in close agreement with experimental data and other theoretical models.