Nuclear Seminar

Monday

April 20

4 P.M.

Rm 124 NSH

Covariant density functional theory: the journey across three-dimensional nuclear landscape

Prof. Anatoli Afanasjev, Mississippi State University

Covariant density functional theory (CDFT) is well established theoretical tool for the description of nuclear systems. In CDFT, the nucleus is described as a system of nucleons which interact via the exchange of different mesons. In my talk, I will concentrate on a number of topics which have been addressed or satisfactorily resolved within its framework only recently.

First, I will start from the global assessment of the description of ground state observables of even-even nuclei in the CDFT framework in the (proton number Z, isospin) plane of nuclear landscape [1]. Calculated binding energies, the deformations, radii, neutron skins, two-neutron separation energies and the positions of the proton-drip line will be compared in a systematic way with available experimental data. Such comparison allows to establish theoretical uncertainties in the description of physical observables in known regions of nuclear chart and extrapolate them towards neutron-drip line. I will also discuss the uncertainties in the position of two-neutron drip line and their sources [1,2]. A recent reassessment of the situation in the region of superheavy nuclei will also be presented.

The physics is not limited to spin zero and ground state observables of even-even nuclei. Single-particle degrees of freedom, rotational excitations and fission are examples which go beyond that limit. The analysis of the single-particle properties in spherical and deformed nuclei will be presented. The angular momentum represents the third dimension of nuclear landscape. Thus, the rotational response of nuclei will be illustrated by a recent detailed study of even-even and odd-mass actinides [3]. Finally, the results of the study of fission barriers in actinides and superheavy nuclei will be presented.

It is clear that the current generation of covariant energy density functionals has some limitations. The possibilities of their extension and thus the improvement of the description of experimental data and the decrease of theoretical uncertainties will be discussed.

[1] S. E. Agbemava, A. V. Afanasjev, D. Ray and P. Ring, Phys. Rev. C89, 054320 (2014).
[2] A. V. Afanasjev, S. E. Agbemava, D. Ray and P. Ring, Phys. Lett. B 726, 680 (2013). [3] A. V. Afanasjev and O. Abdurazakov, Phys. Rev. C88, 014320 (2013).

Refreshments served prior to the seminar in Rm 124.

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