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Heavy and superheavy nuclei in covariant density functional theory

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The questions of the existence limits and the properties of shell-stabilized superheavy nuclei have been a driving force behind experimental and theoretical efforts to investigate such nuclei. Unfortunately, theoretical predictions for superheavy nuclei differ considerably. In such a situation, heavy nuclei of actinide region play a role of testing ground for many theoretical approaches. Systematic study of these nuclei allows to put the error bars on theoretical description of the properties of superheavy nuclei. The present status of our understanding of heavy and superheavy nuclei within covariant density functional theory will be presented. I will concentrate on several aspects which define the shell structure and the stability of superheavy nuclei, such as (i) single-particle degrees of freedom, (ii) role of pairing, and (iii) the fission barriers.

Single-particle degrees of freedom define the shell structure. Thus, the differences in model description of the single-particle energies are important when extrapolating to superheavy nuclei. Following our initial analysis of the single-particle spectra in a few actinide nuclei [1], the systematic analysis of
the accuracy of the description of the energies of deformed quasiparticle states has been carried out in relativistic Hartree-Bogolibov (RHB) approach in rare-earth and actinide regions [2] with the goal to better understand the accuracy of the extrapolation of single-particle energies to superheavy nuclei. Impact of particle-vibration coupling on the single-particle structure of superheavy nuclei [3] will also be discussed. Special attention will be paid to self-consistency
effects [4].

The fission barriers play an important role in the physics of heavy and superheavy nuclei; they are intimately connected with the existence and stability of superheavy nuclei. The role of treatment of pairing on the fission barriers has been investigated and new results were obtained [5]. The RHB and RMF+BCS calculations show that calculated fission barrier heights substantially depend on employed pairing force and treatment of pairing window even in the case when the pairing strengths are adjusted to the same value of the pairing gap at the ground state. The consequences of a different treatment of pairing for the stability of superheavy nuclei will be discussed. In addition, we performed systematic study of the impact of triaxiality on the fission barrier height [6]; in many cases it substantially decreases the fission barrier.

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[1] A.V.Afanasjev, T.L.Khoo, S.Frauendorf, G.A.Lalazissis, and I.Ahmad, Phys. Rev. C67, 024309 (2003).

[2] S.A. Shawaqfeh and A.V.Afanasjev, in preparation

[3] E. Litvinova and A.V. Afanasjev, in preparation

[4] A.V. Afanasjev and S.Frauendorf, Phys. Rev. C 71, 024308 (2005).

[5] S. Karatzikos, A.V. Afanasjev, G.A. Lalazissis, and P.Ring, submitted to Physics Letters B and arXiv: 0909.1233[nucl-th]

[6] H. Abusara and A.V.Afanasjev, in preparation

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