Nuclear tetrahedral shapes from multidimensionally-constrained covariant density functional theories

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Many different shape degrees of freedom play crucial roles in determining the nuclear ground state and saddle point properties and the fission path. For the study of nuclear potential energy surfaces, it is desirable to have microscopic and self-consistent models in which all known important shape degrees of freedom are included. By breaking both the axial and the spatial reflection symmetries simultaneously, we developed multi-dimensionally constrained covariant density functional theories (MDC-CDFTs) [1-4]. The nuclear shape is assumed to be invariant under the reversion of x and y axes, i.e., the intrinsic symmetry group is V_4 and all shape degrees of freedom $\beta_{\lambda\mu}$ with even μ, such as β_{20}, β_{22}, β_{30}, β_{32}, β_{40}, etc., are included self-consistently. The MDC-CDFT's have been applied to the study of fission barriers and potential energy surfaces of actinide nuclei [1,2,5,6], third minima in potential energy surfaces of light actinides [7], shapes and potential energy surfaces of superheavy nuclei [8], the Y_{32} correlations in N = 150 isotones [9] and Zr isotopes [3], and the shape of hypernuclei [10,11]. In this talk I will introduce MDC-CDFT's and applications on exotic nuclear shapes, particularly the tetrahedral shape.

[1] B. N. Lu, E. G. Zhao, and S. G. Zhou, Phys. Rev. C85 (2012) 011301(R).
[2] B. N. Lu, J. Zhao, E. G. Zhao, and S. G. Zhou, Phys. Rev. C89 (2014) 014323.
[3] J. Zhao, et al., in preparation.
[4] S. G. Zhou, Phys. Scr. 91 (2016) 063008.
[5] J. Zhao, B. N. Lu, T. Nikšić, and D. Vretenar, Phys. Rev. C92 (2015) 064315.
[6] J. Zhao J, B. N. Lu, T. Nikšić, D. Vretenar, and S. G. Zhou, Phys. Rev. C93 (2016) 044315.
[7] J. Zhao, B. N. Lu, D. Vretenar, E. G. Zhao, and S. G. Zhou, Phys. Rev. C91 (2015) 014321.
[8] X. Meng, et al., in preparation.
[9] J. Zhao, B. N. Lu, E. G. Zhao, and S. G. Zhou, Phys. Rev. C86 (2012) 057304.
[10] B. N. Lu, E. G. Zhao, and S. G. Zhou, Phys. Rev. C84 (2011) 014328.
[11] B. N. Lu, E. Hiyama, H. Sagawa, and S. G. Zhou, Phys. Rev. C89 (2014) 044307.