High-K ground states & isomers in superheavy nuclei

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Isomeric states in superheavy nuclei (SHN) present a considerable interest not only regarding clues they provide about single-particle spectra, but also because half-lives of some of them could be longer than those of respective ground states [1]. Several high-K isomeric states are known in the $Z \geq 100$ region [2,3,4], mostly in even-even nuclei, with ^{255}Lr [5,6] and ^{249}Md, ^{251}Md [7] being the few known odd-even cases.

Previously, using the Woods-Saxon (WS) microscopic-macroscopic model we studied some configurations in heavy and SH nuclei which could live longer owing to hindrance to fission and/or α-decay [8,9]. Recently, within the same model, we systematically studied candidates for 3qp high-K isomers in odd-even Md-Rg nuclei. As the prediction of hindrance factors f_ν for transitions de-exciting isomer (experimental $f_\nu > 30$ for isomers) is beyond the scope of the current theory, the predicted lowest-lying high-K configurations are considered as the likely candidates. Their predicted excitation above the collective rotational 1qp proton band may be used as an additional indicator of possible isomerism.

Energies for ground-states, $1\pi{-}2\nu$ and 3π 3qp configurations were found by minimization with respect to four axially- and reflection-symmetric deformations. Pairing was included in three ways: within the BCS method with blocking, by the quasiparticle approximation, and within the particle-number-conserving formalism (a variant of the minimization after particle-number projection). The results point to particular isotopes in which the presence of isomers is most likely and to the specific lowest-lying high-K configurations. They reflect primarily the characteristics of the WS spectrum, in particular, the deformed subshell gaps at $N = 152, 162$ and $Z = 108$. Excitation energies of the candidate configurations depend on the pairing treatment. We also make some qualitative predictions regarding the stability of the supposed isomers with respect to fission/α-decay.

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