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Low-energy spectra of nobelium isotopes

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The low-energy multipole spectra in isotopes 250-262No are investigated in the framework of fully self-consistent Quasiparticle-Random-Phase-Approximation (QRPA) method with Skyrme forces SLy4, SLy6, SkM* and SVbas [1] . The main attention is paid to nuclei 252No and 254No, where we have most of the experimental spectroscopic information [2,3]. The calculations confirm the prediction [4] of a significant shell gap in the neutron single-particle spectrum of these two isotopes. It is shown that, in the chain 250−260No, features of 252No and 254No exhibit essential irregularities caused by this neutron shell gap and corresponding drop of the neutron pairing.

The observed K-isomers (K⊠ = 2-,8-,3+) are reasonably described. We confirm the assignment of 8− state at 1.254 MeV in 252No as the neutron 2qp configuration nn[624↓,734↑]. The 2qp 8− isomer in 254No was earlier investigated within various models and alternative assignments nn[734↑, 613↑] and pp[514↓,624↑] were disputed. Our calculations support the neutron assignment based on the complete decay scheme proposed in the experimental paper [5].

We predict in 252No and 254No low-energy pairing vibrational Kπ = 0+ states with basically proton structure. The recently observed Kπ = 0+ state at 0.888 MeV in 254No [6, 7] was previously treated as a result of coexistence of the normal deformation and superdeformation or/and coexistence of axial and triaxial shapes. Instead, our calculations show that this state should be the pairing vibration. Such low-energy 0+ pairing vibrations are typical for rare-earth and actinide deformed nuclei. Note that low-energy 0+ states were earlier predicted in Fl and Cn (Z=112) isotopes.

The low-energy quadrupole, octupole and hexadecapole (lm=20,22,30,31,32,43,44) one-phonon states were also explored. The hexadecapole counterparts Kπ = 3+ and 4+ with a similar 2qp structure and close excitation energies were predicted. In general, the calculations predict rich multipole spectra below 2MeV in 252,254No. The Skyrme forces Sly6 and Sly4 demonstrate the best performance.

Further measurements of low-energy states in 252,254No are very desirable. Spectroscopy of nobelium isotopes could be a crucial test for the theory pretending for description of even heavier nuclei, first of all, of superheavy elements.

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