

Description of backbending in even Pu nuclei

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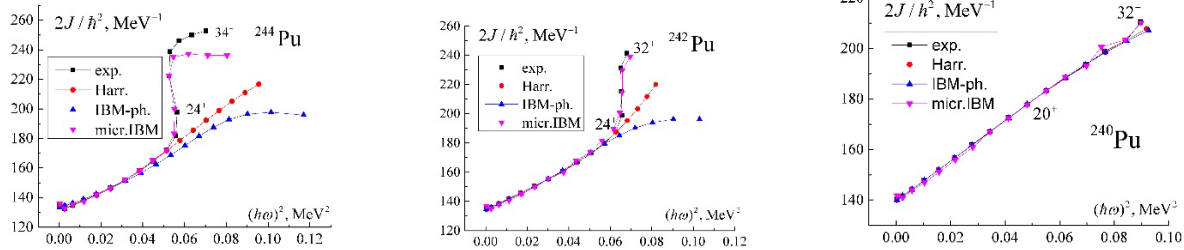
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For even–even nuclei in the actinide region, a clear backbending effect in the moment of inertia as a function of the square of the nuclear rotation frequency is observed only for two isotopes, $^{242,244}\text{Pu}$. For ^{240}Pu , a distinct influence of high-spin modes is manifested only in the last observed state with spin 32_1^+ . For ^{238}Pu , there is a small irregularity in the behavior of the moment of inertia, which can also be assumed to be related to high-spin modes. To test these assumptions, calculations were performed based on the microscopic or semimicroscopic version of the Interacting Boson Model (IBM) [1,2]. In this approach, the boson space is extended to include bosons with spin $J = 14^+$, and the parameters of the boson Hamiltonian are calculated on the basis of factorized internucleon forces. Due to the extreme sensitivity of the calculated energies to the parameters of the IBM Hamiltonian in the mass region under consideration, the boson parameters were slightly varied around their calculated values. It is in this sense that the present approach can be considered semimicroscopic for nuclei in the actinide region. Below, figures showing the moments of inertia are presented sequentially for $^{244,242,240}\text{Pu}$. For the first and second nuclei, a clear backbending is observed. For the third nucleus, it turned out to be very difficult to describe the situation with a sharp upbending. An assumption had to be made about a significant weakening of the coupling of collective states with quasiparticle pairs $(j_{15/2}j_{15/2})^{(12+,14+)}$, which is implemented in third-order perturbation theory.



In this case, the component of the states determined solely by the d -boson composition, i.e., the collective component, is found to be 47% and 38% for the states with spins 22_1^+ and 24_1^+ in ^{244}Pu , respectively. For ^{242}Pu , the corresponding values are 57% and 47% for the states with spins 24_1^+ and 26_1^+ , respectively. In ^{240}Pu , the collective component in the state with spin 32_1^+ is 75%. This leads to the suggestion that the backbending effect should not be expected in the lighter plutonium isotopes, whereas it might occur in ^{246}Pu .

References

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2. A. D. Efimov, I. N. Izosimov, I. V. Koval Nucl. Phys. A **1070**, 123370 (2026).