Anomalous Behaviour of Nuclear Moments of Inertia

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Macroscopic rigid-body and hydrodynamical models predict an increase of nuclear moments of inertia J with the axial quadrupole deformation β i.e. regime $dJ/d\beta > 0$. Here we show that in light nuclei there can exist an anomalous regime with $dJ/d\beta < 0$ [1]. Light nuclei ^{24}Mg and ^{20}Ne provide interesting opportunities to investigate dependence of J on pairing and mean-field features at extreme deformations. Using Skyrme forces SVbas, SkM* and SLy6, we explore pairing and mean-field impacts on J in the framework of different microscopic models: Inglis-Belyaev, Thouless-Valatin and linear Adiabatic Time-Dependent Hartree-Fock. The constrained calculations cover a wide deformation range $0 < \beta < 1.2$. All the models give the similar result: at large deformations close to experimental values (β=0.605 in ^{24}Mg and 0.720 in ^{20}Ne), there is a strong counterintuitive decrease of J with β. This anomalous behavior of J is explained by specific evolution of particular particle-hole (1ph) proton and neutron configurations with β. The experimental data for the ground-state bands in ^{24}Mg and ^{20}Ne support our predictions. We discuss the conditions for this effect and possible ways of its experimental search.

References

[1] V.O. Nesterenko, M.A. Mardyban, P.-G. Reinhard, A. Repko and J. Kvasil, arXiv:2304.10873 [nucl-th].