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The shell model and the nuclear rotation, after seven decades

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The shell model as a quantum-many-body approach with various correlations due to nucleon-nucleon interactions has shown the shell evolution phenomena in exotic nuclei. I will survey what consequences the same interactions produce for various collective properties. Type II shell evolution in a long chain of Ni isotopes, and the first-order phase transition in Zr isotopes will be mentioned as examples.
The shapes and rotations of heavy deformed nuclei, such as 154Sm and 166Er, are discussed in the quantum-many-body framework, to which the shell model belongs. Without resorting to the quantization of rotational kinetic energy of a free rigid body, the rotational excitation energies are shown to appear as a consequence of the Hamiltonian for multi-nucleon systems. The prevailing triaxiality is pointed out with two robust mechanisms. A prospect for the Interacting Boson Model is presented as a tool to simulate the afore-mentioned quantum-many-body properties.

The work behind this has been posted to the arXiv as arXiv:2303.11299v4 [nucl-th].

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