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Nuclear shapes and the stability and consistency of the SU(3) symmetry

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Abstract

The different nuclear shapes, i.e. the shape isomers are usually determined from an energy-surface calculation. One applies a structure model, calculates the energy surface as a function of the deformation parameters, and its local minima correspond to the shape isomers. The absolute minimum contains the ground state region, and further local minima determine e.g. the superdeformed (SD) and the hyperdeformed (HD) states (with ratios of main axes 2:1:1, and 3:1:1, respectively).

Here we discuss an alternative way for the determination of the shape isomers. It is not based on the calculation of the energy surface, rather we investigate the stability and the self-consistency of the quadrupole deformation [1]. In fact we investigate the stability and the self-consistency of the SU(3) symmetry of the nucleus (therefore, we call it SCS-method), but this symmetry is uniquely related to the quadrupole deformation.

It turns out that SU(3) is a remarkably good symmetry for commensurable major axes. Similar results were found beforhand for the the simple harmonic oscillator interaction. Here we apply a Nilsson-Hamiltonian, and find that the symmetry is stable and self-consistent, thus defining the shape isomers of the nucleus.

In case of the ^{16}O, ^{20}Ne, and ^{24}Mg nuclei the results of the two different procedures are in good agreement with each other.

References

[1] J. Cseh, G. Riczu, J. Darai *Physics Letters B* **795** (2019) 160-164.