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A mechanism for shape coexistence

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Abstract

The selection rules of the quadrupole-quadrupole (qq) interaction indicate, that this type of long-range, attractive interaction binds together the orbitals with the same total number of oscillator quanta n, i.e. orbitals between the 3D, harmonic, isotropic oscillator magic numbers. In spherical nuclei the common n orbitals are divided into two sets, due to the large single-particle energy gaps at the major magic numbers 28, 50, 82, 126. Thus in this case the two sets are isolated from each other and the qq interaction cannot be applied in the whole harmonic oscillator shell. But in deformed nuclei there are no major magic numbers [1]. As a consequence the qq interaction automatically unifies the valence nuclear shells 6-14, 14-28, 28-50, 50-82, 82-126 with the harmonic oscillator shells 2-8, 8-20, 20-40, 40-70, 70-112 respectively [2]. The unified shell reproduces an excited 0_2^+ band, which is the excited 0_2^+ band of nuclei with shape coexistence. The mechanism is proposed in the context of the Proxy SU(3) Symmetry [3–5]. The islands of shape coexistence and of inversion of states on the nuclear map are reproduced without any parameters [2]. Specifically the inversion of states appears as a side effect of shape coexistence.

References

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