$K=0^+$ Bands in Gd nuclei

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The recent ^{160}Gd(p,t) experiment[1], has raised again the question about the nature of the low-lying excited 0^+ states in deformed nuclei. New (p,t) experiments have resolved typically about ten low-lying excited 0^+ states[2]. Calculations using the IBA model [3], the projected shell model[4] and the quasiparticle-phonon model [5] have answered partially this question and showed the complicated nature of these states.

We study the energy levels, their wave function contents, and the corresponding B(E2) transitions in $^{156\text{-}160}$Gd nuclei, in the framework of the pseudo-SU(3) model. The theory uses a realistic Hamiltonian with experimental single-particle energies and monopole pairing interactions in addition to the usual quadrupole-quadrupole term, with the pairing and quadrupole-quadrupole strengths taken from systematics. The calculations are carried out with three sets of basis states, the first with only pseudo-spin zero proton and neutron configurations, the second with the subset of even-even pseudo-spin zero configurations used in the first case, and the third with pseudo-spin zero and one proton and neutron configurations. The results show that the inclusion of pseudo-spin one configurations has little effect on the predicted energies and improve slightly the B(E2) transition strengths. The calculated B(E2) values suggest that the first excited 0^+ state might have a mixed nature of collective vibration, possible with quasiparticle excitations that are not considered in this calculation.

References:

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