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Unified picture of nucleon pairs playing leading roles in nuclear collectivity

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Abstract

Proxy-SU(3) symmetry is an approximation scheme extending the Elliott SU(3) algebra of the sd shell to heavier shells. When introduced [1] in 2017, the approximation had been justified by calculations carried out within the Nilsson model, with nucleon pairs differing by $\Delta K[\Delta N \Delta n_z \Delta \Lambda] = 0[110]$ in the Nilsson quantum numbers playing a major role in the approximation. Recently our group managed [2] to map the cartesian basis of the Elliott SU(3) model onto the spherical shell model basis, fully clarifying the approximations used within the proxy-SU(3) scheme and paving the way for using the proxy-SU(3) approximation in shell model calculations for heavy nuclei. As a by-product, the relation of the 0[110] Nilsson pairs used in proxy-SU(3) to the earlier used de Shalit-Goldhaber pairs $|\Delta n \Delta l \Delta j \Delta m_j\rangle = |0110\rangle$ in spherical shell model notation is clarified, while the Federman-Pittel (FP) pairs known to play a major role at the onset of deformation are identified as $|0010\rangle$ pairs, and the FP pairs further increasing the deformation after its onset are found to be $|0110\rangle$ pairs, i.e. identical to the de-Shalit-Goldhaber pairs. The connection between the proxy-SU(3) scheme and the spherical shell model has also been worked out [3] in the original framework of the Nilsson model, with identical results.

References

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