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Interplay between pairing and quadrupole interactions in the microscopic shell model

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We explore the symmetry adapted Pairing-Plus-Quadrupole Model /PQM/ in the framework of the Elliott's SU(3) Model, with the aim to obtain the complementary and competing features of the pairing and quadrupole interactions in the model Hamiltonian, containing both of them as limiting cases. We establish a correspondence between the SO(8) pairing basis and the Elliott's SU(3) basis, that describes collective rotation of nuclear systems with quadrupole deformation. It is derived from their complementarity to the same LS coupling chain of the shell model number conserving algebra. Examples of complete classification of the basis states of different number of particles in both limiting cases with their correspondence are given for some of the light shells. The probability distribution of the SU(3) basis states within the SO(8) pairing states is also obtained through a numerical diagonalisation of the PQM Hamiltonian. In an application of the model for the description of the 20Ne spectra, we investigate systematically the relative strengths of dynamically symmetric quadrupole–quadrupole interaction with the isoscalar, isovector and total pairing interactions by introducing a control parameter. In the case of considering all the three types of interactions 2 control parameters are considered. These parameters define the phase diagram of the model and the role of each term of the Hamiltonian in the correct reproduction of the experimental data for the considered nuclei. The approach allows for an extension of the model space for two oscillator shells and introduction of more elaborate pairing interaction.

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