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The multi-shell connection between the fundamental structure models

Content

The multiconfigurational dynamical symmetry (MUSY) is the common intersection of the shell, collective and cluster models for the multi-shell problem [1]. It is an extension of the U(3) connection between these fundamental structure models, found in 1958 by Elliott, Wildermuth, Kanellopoulos, Bayman and Bohr, for the single shell problem.

One can formulate each of the three (multi-shell) models in a semimicroscopic way: by combining microscopic model spaces (with UST (4) ⊗ U(3) basis) and symmetry-governed (phenomenological) interactions. In particular, they are as follows. From the shell side: the symmetry-adapted no-core shell model (with model interactions) [2], or its simplified version of the semimicroscopic algebraic quartet model [3]. From the collective side: the no-core symplectic [1], or contracted symplectic model [4]. From the cluster side it is the semimicro- scopic algebraic cluster model [5].

The intersection of the three fundamental models turnes out to be a Us(4) ⊗ Ux(3) ⊃ U(3) dynamical symmetry, where Us refers to the valence shell in the shell and collective picture, while it is the symmetry of the internal structure for the clusters. Ux stands for major shell excitation in each case.

Due to the connecting nature MUSY can give a unified description (of the gross features) of phenomena related to different configurations (or reactions), small and large energies, and deformations. The early applications so far addressed the questions, like: (i) unified spectra in different energy valleys, including predictions [6], (ii) coexistense of moderate, super- and hyperdeformations [7], (iii) systematics of shape isomers and their possible clusterizations (reactions) [8,9].

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