

Ab Initio No-Core Shell Model Calculations in SU(3)-scheme Basis

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The predictive power of ab initio no-core shell model (NCSM) depends critically on the choice of a realistic nuclear interaction, and on the adequacy of basis to describe a system of strongly interacting nucleons. Due to the combinatorial growth of many-body harmonic oscillator basis that comes with the addition of oscillator shells to a model space, it is challenging to account for the structure of low-lying collective and cluster states in the NCSM framework. To include many-body correlations important for the description of nuclear collective dynamics and geometry, we embedded the SU(3) coupling scheme of the Elliot SU(3) model into the NCSM framework. The SU(3)-scheme basis provides a microscopic description of nuclei in terms of mixed shape configurations, and offers a symmetry-guided framework for winnowing a model space while retaining the ability to remove center-of-mass spurious excitations exactly. The resulting SU(3) no-core shell model (SU3-NCSM) harnesses powerful computational techniques of the group theory while taking the advantage of massively parallel computing systems. The foundation principles of SU(3)-NCSM will be discussed and the results for some p-shell nuclei will be presented.