FROM CHIRAL EFT TO GIANT AND PYGMY RESONANCES VIA EXTENDED RPA

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A starting point with predictive power for nuclear structure theory ideally involves realistic two-plus-three nucleon potentials and, most consistently, nuclear Hamiltonians derived from quantum chromodynamics in the framework of chiral effective field theory. Strting from these interactions, unitary transformations can be employed, e.g. the Similarity Renormalization Group (SRG), to pre-diagonalize the Hamiltonian and to improve the convergence behavior of various many-body methods. This approach has been applied successfully to light and medium-mass nuclei using chiral interactions in the context of the No-Core Shell Model and in Coupled-Cluster Theory and related methods.

In order to reach computationally not only heavy nuclei but also higher-lying collective excitations, we have been exploring the performance of prediagonalized microscopic interactions within the Random Phase Approximation (RPA) and extensions thereof, in particular the Second RPA (SRPA). A two-body Hamiltonian based on the Argonne V18 potential was used before in large-scale SRPA calculations [1,2] with promising results for giant resonances, notwithstanding the insufficient treatment of three-body effects.

Thanks to the recent advances, we are now in a position to employ two and three-nucleon Hamiltonians, and in particular SRG-evolved chiral ones, to the study of giant and pygmy resonances throughout the nuclear chart. The presentation focuses on recent very promising results within RPA and Second RPA [3] and the relevance of utilizing a realistic three-nucleon interaction.

REFERENCES

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