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Quantum mixing of time-dependent Hartree-Fock(-Bogoliubov) trajectories and its application to atomic nuclei

The microscopic description of large-amplitude collective nuclear motion is typically performed through one of the two distinct types of models. On the one hand, the time-dependent generator coordinate method (TDGCM) describes the collective nuclear motion as a wave packet propagation in low-dimensional collective spaces spanned by many time-independent HFB states. On the other hand, the time-dependent Hartree-Fock-Bogoliubov (TDHFB) theory simulates the diabatic evolution of a nucleus via population of single-quasiparticle orbitals along a single time-dependent HFB trajectory. Combining the two models in a unified multi-configurational time-dependent Hartree-Fock-Bogoliubov (MCTDHFB) framework is highly desirable since it should enable us to overcome their respective limitations (the lack of dissipation effects for the former and the lack of quantum fluctuations for the latter). Consequently, it could eventually provide a superior description of phenomena such as nuclear vibrations, heavy-ion collisions, and nuclear fission. In [1], a toy MCTDHFB model was applied in a study of the particle transfer between two superfluid systems interacting with a pairing Hamiltonian. Over the past year, we have been working to extend the MCTDHFB model to atomic nuclei with Skyrme-like mean-field interactions. In this talk, I will discuss the progress that was made, the encountered obstacles, as well as the perspectives of such a model. I will also show some preliminary results for the case of quadrupole vibrations in light doubly-magic nuclei.

[1] D. Regnier and D. Lacroix, Phys. Rev. C 99, 064615 (2019).

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