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Implementations on local quantum friction

We propose three distinct schemes for implementing local \textit{quantum friction} (QF) within the Hartree-Fock-Bogoliubov (HFB) approximation to efficiently dissipate energy in fermionic many-body systems. The first scheme introduces a local current-dependent potential in the Hamiltonian, the second incorporates an external pairing potential that conserves particle number, and the third employs a pairing potential that does not. Combining these potentials optimizes the cooling process. Unlike traditional methods that modify the density matrix, local quantum friction directly influences the unitary evolution of wavefunctions, making it particularly suitable for cooling fermionic many-body systems while preserving orthogonality. By integrating these frictional potentials into time evolution, our approach accelerates convergence to ground states compared to conventional stationary methods. We also explore applications to spin-imbalanced systems, demonstrating the versatility of this framework.

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