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Bogoliubov corrections and trace norm convergence for the Hartree dynamics. (English) [Zbl 1435.35321]

Authors’ abstract: We consider the dynamics of a large number \( N \) of nonrelativistic bosons in the mean field limit for a class of interaction potentials that includes Coulomb interaction. In order to describe the fluctuations around the mean field Hartree state, we introduce an auxiliary Hamiltonian on the \( N \)-particle space that is similar to the one obtained from Bogoliubov theory. We show convergence of the auxiliary time evolution to the fully interacting dynamics in the norm of the \( N \)-particle space. This result allows us to prove several other results: convergence of reduced density matrices in trace norm with optimal rate, convergence in energy trace norm, and convergence to a time evolution obtained from the Bogoliubov Hamiltonian on Fock space with expected optimal rate. We thus extend and quantify several previous results, e.g., by providing the physically important convergence rates, including time-dependent external fields and singular interactions, and allowing for more general initial states, e.g., those that are expected to be ground states of interacting systems.

Reviewer: Alessandro Selvitella (Fort Wayne)

MSC:
35Q40 PDEs in connection with quantum mechanics
35Q55 NLS equations (nonlinear Schrödinger equations)
81Q05 Quantum dynamics and nonequilibrium statistical mechanics (general)
82C22 Interacting particle systems in time-dependent statistical mechanics

Keywords:
weakly interacting bosons; Hartree theory; Bogoliubov theory

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References:


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