

Derivation of the nonlinear Schrödinger equation with Coulomb potential

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We consider the time evolution of N bosonic particles interacting via a mean field Coulomb potential. Suppose the initial state is a product wavefunction. We show that at any finite time the correlation functions factorize in the limit $N \rightarrow \infty$. Furthermore, the limiting one particle density matrix satisfies the nonlinear Hartree equation. The key ingredients are the uniqueness of the BBGKY hierarchy for the correlation functions and a new apriori estimate for the many-body Schrödinger equations.