

Kolloquium Mathematische Physik

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Hartree and Hartree-Fock equations as limits of many body quantum dynamics

We discuss mathematically rigorous derivations of effective evolution equations from many-body quantum mechanics. For bosonic systems, we will show that the Hartree equation approximates the dynamics of condensates in the mean field regime. If the interaction varies on very short scales, the mean field limit becomes singular; in this case, we will prove that the dynamics can be described by the Gross-Pitaevskii equation. For fermionic systems, on the other hand, we will consider the evolution of antisymmetric Slater determinants, and prove that it can be approximated by the Hartree-Fock equation. In this case, the mean field regime is naturally linked with a semiclassical limit, so that the Hartree-Fock dynamics converges asymptotically towards the classical Vlasov evolution.

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