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Dynamical and spectral properties of Bose-Einstein condensates

We consider systems of N bosons in the Gross-Pitaevskii regime. We present new techniques that allow us to prove the convergence towards the time-dependent Gross-Pitaevskii equation with optimal rate. Furthermore, we explain how, for small potentials, this approach can be used to show complete Bose-Einstein condensation (with a uniform bound on the number of excitations) for low energy states. For scaling limits interpolating between the mean-field and the Gross-Pitaevskii regime, the same method can also be used to establish the validity of Bogoliubov theory for the low-lying excitation spectrum. This talk is based on joint works with C. Boccato, C. Brennecke and S. Cenatiempo.