Dynamical formation of correlations in a Bose–Einstein condensate

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Abstract

We consider the evolution of N bosons interacting with a repulsive short range pair potential in three dimensions. The potential is scaled according to the Gross–Pitaevskii scaling, i.e. it is given by $N^2 V\big(N(x_i - x_j)\big)$. We monitor the behavior of the solution to the N-particle Schrödinger equation in a spatial window where two particles are close to each other. We prove that within this window a short scale interparticle structure emerges dynamically. The local correlation between the particles is given by the two-body zero energy scattering mode. This is the characteristic structure that was expected to form within a very short initial time layer and to persist for all later times, on the basis of the validity of the Gross–Pitaevskii equation for the evolution of the Bose–Einstein condensate. The zero energy scattering mode emerges after an initial time layer where all higher energy modes disperse out of the spatial window.

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