SFB/TRR 21 - Kolloquium
30. Januar 2009, Ulm

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Quantum-gas physics beyond Gross-Pitaevskii

The necessity to go beyond the popular Gross-Pitaevskii theory to properly describe strongly-interacting cold bosonic atoms, and even weakly-interacting atoms in double- and multi-well traps has by now become well-accepted by the community. We present new theoretical and computational approaches going beyond standard mean-field (Gross-Pitaevskii). These have enabled us to predict new physical phenomena. We discuss fragmentation of attractive and repulsive condensates; a zoo of Mott-insulator phases in optical lattices (thereby going beyond the popular Bose-Hubbard model); demixing scenarios of bosonic mixtures in optical lattices on various length scales; the pathway to fermionization of trapped cold bosonic systems; interferences in the density of condensates consisting of identical or different atoms; and Fragmentons.

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