# Abstract

The thesis presents a series of results on a dynamical description of quantum mixtures. The historical overview of the realization of phase-separated state in an ultracold atomic gas is followed by the short review of theoretical tools utilized throughout the work. The results are divided into three parts—Fermi-Fermi mixtures, Bose-Fermi mixtures and fermionic quantum carpets. The first one provides an analysis of ground-state densities of a repulsive two-component Fermi gas in both two and three dimensions. Furthermore, collective oscillations of a three-dimensional mixture are investigated, with a special focus on recent experimental realizations. To account for a dimer formation in the repulsive system, one-dimensional model with the three-delta interatomic potential is studied from the many-body perspective. The second part pertains to the ultracold Bose-Fermi mixture, exploring the breathing mode of a Bose-Einstein condensate immersed in a spin-polarized Fermi sea. The last part examines a novel phenomenon of a fermionic quantum carpet—aesthetically pleasing spatiotemporal representation of a many-body fermionic system. Its analysis starts from the ideal gas to finish with a two-component Fermi mixture and strongly interacting bosons.