

Quantum Monte-Carlo methods applied to ultracold gases

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In these two tutorial lectures I will give a brief introduction to quantum Monte-Carlo methods and discuss applications to ultracold gases.

Lecture 1: Quantum Monte-Carlo methods as a powerful tool to investigate equilibrium properties of many-body systems. Introduction to variational Monte-Carlo and diffusion Monte-Carlo techniques for many-particle systems. Calculation of observables and simulations of infinite systems. The sign problem in fermionic simulations and possible approximation schemes.

Lecture 2: I will review some particularly interesting applications of the diffusion Monte-Carlo method applied to ultracold gases. In particular, I will discuss the ground-state properties of the unitary Fermi gas with resonant interactions, the strongly interacting two-dimensional Fermi gas of dipoles and its transition to a Wigner crystal and the Bose polaron problem corresponding to a single impurity atom coupled to a quantum degenerate Bose gas.