

SEMINAR

Wednesday, 13th of April 2011 at 11:30

Departament de Física i Enginyeria Nuclear, Universitat Politècnica de Catalunya

Abstract

"Monte Carlo study of quantum phase diagram of Rydberg atoms with repulsive $1/r^6$ interaction."

Recently the methods of laser cooling of atoms have given rise to a new wave of experiments on ultracold (~ 100 ÅK) Rydberg atoms [1,2], in particular on alkali bosonic atoms as Rb87. These experiments revealed a suppression of excitations, called "van der Waals blockade", that was proposed as a perspective means to implement quantum gates between atom qubits. We study the quantum phase diagram of bosons interacting via repulsive van der Waals $1/r^6$ potential. The critical density for zero temperature gas-crystal phase transition is obtained from diffusion Monte Carlo calculations. If effective mass entering in the kinetic energy were taken to be of the order of the mass of a Rb atom, then the typical experimental conditions would correspond to being deeply in the phase of a classical crystal. Effects of the temperature are studied in the classical crystal using path integral Monte Carlo and classical Monte Carlo methods.

[1] Axel Grabowski, Rolf Heidemann, Robert Löw, Jürgen Stuhler, Tilman Pfau "High resolution Rydberg spectroscopy of ultracold Rubidium atoms", Fortschr. Phys., 54, 765, (2005).

[2] Vera Bendkowsky, Birn Butscher, Johannes Nipper, James P. Shaffer, Robert Löw, Tilman Pfau "Observation of ultralong-range Rydberg molecules", Nature, 458, 1005 (2009).