



Physical Sciences Seminar

Collective oscillations of a trapped atomic gas in low dimensions & thermodynamics of one-dimensional Bose gas

Giulia De Rosi

Università degli Studi di Trento Trento

Host: Mikhail Lemeshko

Ultracold atoms are exceptional tools to explore the physics of quantum matter. In fact, the high degree of tunability of ultracold Bose and Fermi gases makes them ideal systems for quantum simulation and for investigating macroscopic manifestations of quantum effects, such as superfluidity. In ultracold gas research, a central role is played by collective oscillations. They can be used to study different dynamical regimes, such as superfluid, collisional, or collisionless limits or to test the equation of state of the system. In this talk, I will present a unified description of collective oscillations in low dimensions covering both Bose and Fermi statistics, different trap geometries and zero as well as finite temperature, based on the formalism of hydrodynamics and sum rules. I will discuss the different behaviour exhibited by the second excited breathing mode in the collisional regime at low temperature and in the collisionless limit at high temperature in a one-dimensional (1D) trapped Bose gas with repulsive contact interaction. I will show how this mode exhibits a single-valued excitation spectrum in the collisional regime and two different frequencies in the collisionless limit. Our predictions could be important for future research related to the thermalization and damping phenomena in this low-dimensional system. I will show that 1D uniform Bose gases exhibit a non-monotonic temperature dependence of the chemical potential characterized by an increasing-with-temperature behaviour at low temperature. This is due to the thermal excitation of phonons and reveals an interesting analogy with the behaviour of superfluids. Finally, I will discuss our research on a gas with a finite number N of atoms in a ring geometry at zero temperature. I will discuss explicitly the deviations of the thermodynamic behaviour in the ring from the one in the large N limit.

Tuesday, November 28, 2017 11:00am - 12:30pm

Big Seminar room Ground floor / Office Bldg West (I21.EG.101)



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