Dr. Stephanie Manz

Density correlations of expanding one-dimensional Bose gases

Supervisor: Jörg Schmiedmayer

ABSTRACT

Interacting Bose gases confined in strongly elongated traps exhibit unique properties and quantum phases related to the one-dimensional character of the underlying physics. They also represent one of the few complex many-body systems which allow a direct comparison with exact and often analytical theoretical description. For such gases, the smooth transition from a fully decoherent system to a finite size Bose-Einstein condensate is characterized by an intermediate

Atomchips allow studying ultra-cold atoms in miniaturized magnetic traps. In static traps atoms can be cooled to quantum degeneracy to create Bose- Einstein condensates. In addition, atom optical elements for matter wave manipulation, e.g. beam splitters, can be implemented by combining static and oscillating magnetic fields.

The typical elongated geometry of wire traps on an atom chip can provide direct access to ultra-cold one-dimensional systems. The possibilities of preparing such one-dimensional systems in static magnetic traps with our set-up will be discussed.

Within this thesis, these different regimes of one-dimensional Bose gases will be probed. As a measure of the coherence of the trapped system, density correlations in expansion will be employed. This method is related to Hanbury-Brown & Twiss – like experiments, and allows studying the coherence properties of the trapped cold quantum gases. The applicability of this method in terms of thermometry will be discussed. Furthermore, we examine the one-dimensional Bose gases out of equilibrium.

quasi-condensate regime where density fluctuations are suppressed, whereas axial phonon-like excitations are thermally populated. As a result the gas displays 1D phase fluctuations along its axial direction, strongly affecting its coherence properties.