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Interference and Coherence in 1-d Bose-Einstein-Condensates[1]

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Employing RF induced adiabatic potentials [1] on AtomChips [2] enables coherent manipulation of trapped matter waves with high precision. Using our exceptionally smooth AtomChip potentials [3] we study 1d condensates at strong transversal confinement (>10kHz) and extreme aspect ratio up to 10000, which can be coherently split along their long axis [4]. Bringing the two split clouds together we observe interference between the two ensembles. The interference pattern itself is sensitive probe of the order parameter in the 1d quantum gas and allows detailed studies of its coherence properties:

- It allows precise separation between 'condensed' and 'thermal' component
- Adjusting the barrier between the separated ensembles we can study tunnel coupling and phase locking between two 1d condensates and employ phase noise thermometry to measure the local temperature.
- Coherently splitting into two isolated systems with an initially fixed phase relation, we investigate the dynamics of the phase fluctuations of a 1d quantum gas, and their influence on the statistics of the interferences.
- The evolution of the interference of coherently split quantum gas can be compared to completely separated, independently created 1d condensates.

Furthermore the RF coupling allows many *different* potential shapes to be realized, including a 2d cylinder shaped trap. The later allows to create a 2d condensate with periodic boundary conditions which exhibits peculiar interference. In addition combining the AtomChip with a 1d optical lattice of 2d planes we observe coherent Blochoszillations close to the AtomChip surface [5], which gives us a new tool for coherent manipulation of 2d mesoscopic quantum gases.

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[5] D. Gallego, Diplomarbeit Univ. Heidelberg (2005).

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