Bose-Einstein Condensates on a Printed Circuit Board

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We are interested in equilibrium and non-equilibrium dynamics in Bose-Einstein Condensates (BEC) in particular their phase evolution. The non-equilibrium dynamics will be induced by rapidly switching from 3D to 1D regimes; a process called dimensional quenching. Despite a wealth of theoretical activity, experimental studies are still lacking [1]. In a broader context, studies of this type will contribute to our understanding of the difference between classical and quantum thermodynamics.

The experimental realisation of BEC is in progress. The stages of work include the setting up of frequency-stabilised lasers, assembling an ultra-high vacuum chamber, capturing and laser cooling atoms in a magneto-optical trap (MOT), evaporative cooling to BEC with magnetic traps, and optimisation of the control sequence.

A successful experiment would efficiently transfer atoms from a MOT to a BEC quickly, with minimal loss of atoms. A common problem in this transfer is the mismatch in trap and cloud properties, e.g. location and shape. Utilising state-of-the-art printed circuit board (PCB) technology we have designed trapping structures that will address these problems and allow for precise control when manipulating atoms.

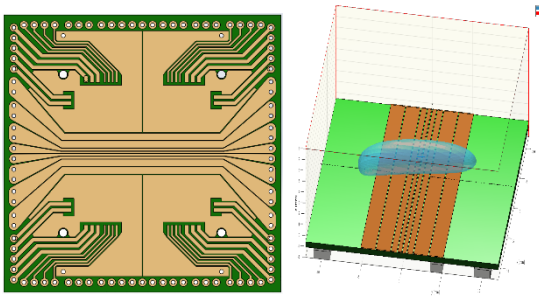

Figure 1 - PCB (left) has current carrying wire structure capable of producing a trapping magnetic potential for the atoms. Simulation (right) shows the resulting shape of the trapped atomic cloud (blue).

We will use the PCB in conjunction with a micro-fabricated structure (known as an atom chip [2]) to give access to a broad range of trapping geometries for the atomic clouds. This provides a flexible tool to test non-equilibrium dynamics in different dimensional states.

Keywords: Bose-Einstein Condensate, Printed Circuit Board, Quantum thermodynamics.

References

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