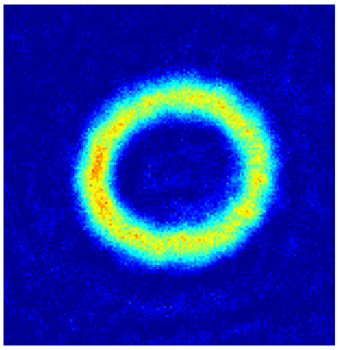
BEC group @ LPL / Paris 13 University SPC / CNRS / SIRTEQ

THESIS OFFER in ULTRA COLD ATOMS



Dynamics of quantum gases for quantum simulation

Twenty years after the first observation of Bose-Einstein condensation, quantum gases are one of the most fascinating quantum systems now available in the lab. Far beyond atomic physics, their applications include quantum metrology, superfluidity, quantum information and quantum simulation in the wider and developing frame of quantum technology.

In this context, the BEC group at Laser Physics Laboratory has developed a rubibium Bose-Einstein condensation machine devoted to the study of the superfluid properties of an ultracold quantum gas. Superfluid quantum gases in rotation (see figure) constitute a formal analogue of superconductors in the presence of a magnetic field, but with a much greater degree of control on the experimental parameters, opening the way to quantum simulate phenomena such as the Quantum Hall effect or the Josephson effect inherent to SQUIDs. In the group, we have recently achieved the preparation of a degenerate superfluid gas in a ring trap by means of combined magnetic and optical fields. The gas can be set into rotation, and interrupted by adjustable barriers created by laser beams. This device (ring and barriers) is the first step towards a quantum simulator of superconducting SQUIDs and more generally of few-coupled-superconducting islands, relevant for mesoscopic condensed matter physics. The PhD project aims at building a versatile experimental platform to investigate with a high resolution quantum dynamics in Bose-Einstein condensates and simulate future condensed matter devices with mesoscopic superconductors, including Coulomb interactions. A relevant scheme that will be studied consists in three condensates coupled by the Josephson effect and experiencing static or periodic drives. Newly predicted coherent modes involving simultaneously the phases of the three condensates will be studied. While simulating nontrivial models for non equilibrium quantum dynamics of interacting systems, this will also lead to propose new experiments with superconducting circuits.

The successful candidate will have a good background in quantum physics, and either in laser and optics or condensed matter physics. Good experimental skills in either lasers, electronics, instrumentation, data analysis or vacuum technology are valuable. He/she will participate in the various steps of the experiment, from running the experiment to the data analysis. He/she will work within the BEC group, benefitting from stimulating interaction with the larger ultra cold atom group of about fifteen people, including three other ultra cold atom experiments and a theory group. Our group is a member of SIRTEQ, a world-leading joint institute gathering all the groups in Paris area in the field of quantum technology.

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