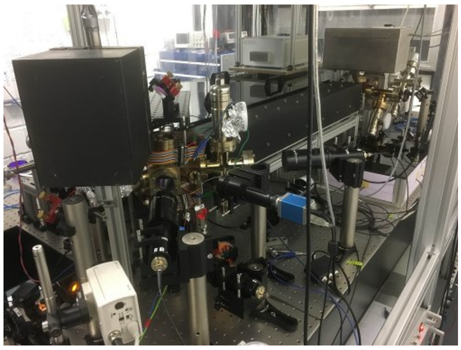
BEC group @ LPL / Paris 13 University SPC / CNRS / IFRAF

THESIS POSITION in ULTRA COLD ATOMS

Deadline for application: **December 5$^{\text{th}}$, 2016**



One-dimensional Bose gases in the strongly interacting regime

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. Limiting the number of degrees of freedom for these systems often gives rise to novel and rich phenomena. For one-dimensional (1D) Bose gases with contact interactions, the wave function of the system can surprisingly mimic the one of an ideal Fermi gas. This happens in the strongly interacting limit, at low temperatures and densities and for large scattering lengths. While this so-called Tonks-Girardeau regime has been reached in a series of parallel 1D gases confined in optical lattices, a complete characterization of its energy spectrum and density correlations still represents an experimental challenge. As an outlook, such study could prove useful to help exploring superconductivity in so-called ladder materials.

In this context, this experimental thesis will focus on the equilibrium phase diagram and the out-of-equilibrium dynamics of a ultracold dilute gas of sodium atoms tightly confined on top of an atom chip. The experiment will include state-of-the-art techniques for controlling the gas, imaging the sample, exciting it and exploring the response to sudden quenches. In particular we propose to demonstrate a new technique to tune the atomic interactions, which is required to explore the full phase diagram of the 1D Bose gas and enter the strongly interacting regime. This will be done by taking advantage of a micro-wave induced Fano-Feshbach resonance (FFR) which has been predicted for alkali atoms but never observed so far.

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 the 1D gas production 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 IFRAF, a world-leading joint institute gathering all the groups in Paris area in the field of ultra cold atoms. Non-French candidates are eligible for an international grant of Sorbonne Paris Cité University, funded by EU.

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