Spécialité de Master « Optique, Matière, Plasmas »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage

Date de la proposition : 05.12.2013

Responsable du stage / *internship supervisor*:

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Nom du Laboratoire / *laboratory name*:

Code d'identification : Organisme : Universität Ulm

Site Internet / *web site*: http://www.uni-ulm.de/en/nawi/qm.html

Adresse / *address:* Albert-Einstein-Allee 45, 89081 Ulm, Germany

Lieu du stage / *internship place*: Institute for Quantum Matter, Universität Ulm

Titre du stage / *internship title*: **Laser cooling of lithium in a gray molasses**

Résumé / *summary*

In recent years, ultracold quantum gases have demonstrated impressive results in the quantum simulation of condensed matter phenomena, *e.g.* the Superfluid to Mott insulator transition, or Anderson localization of matter waves in a random potential. As a result, ultracold quantum gases are considered ideal in order to investigate systems that cannot easily be simulated numerically. A particularly interesting system in which many interesting phenomena are predicted to occur is fermions in a honeycomb lattice, which is the underlying geometry of graphene (Nobel prize 2010).
At half filling, the band structure of a honeycomb lattice features a linear dispersion relation, as for massless particles described by the Dirac equation. As a consequence, relativistic effects such as Klein tunneling (lossless transmission through a barrier) or Zitterbewegung (a rapid motion that arises from the interference of positive and negative energy states) are expected to occur. While these effects were predicted over 80 years ago, they have yet to be directly and unambiguously observed.

We are currently setting up an experiment with fermionic lithium atoms with which we want to study such relativistic effects. In order to have large, cold clouds of atoms to transfer to a dipole trap for further evaporative cooling, we want to employ the gray molasses technique which was recently demonstrated for lithium. In order to achieve this, a new laser system must be set up, along with the spectroscopy for laser frequency stabilization. This experimental work will be the main objective of the internship. The gray molasses can then be realized in the working experiment. During the internship, the student will work with lasers, optics, electronics and ultra-high vacuum components, and will have the support of a team of Ph.D. students as well as senior staff.

Our group has connections with the European Training Network COMIQ (http://itn-comiq.eu/welcome-to-comiq) and is part of the SFB/TRR 21 CO.CO.MAT.

A magneto-optical trap of around 10^9 ^{6}Li atoms in our vacuum chamber

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : OUI**

Si oui, financement de thèse envisagé/ *financial support for the PhD***: SFB/TRR 21**

Lasers, Optique, Matière	**X**	Lumière, Matière : Mesures Extrêmes	**X**
Plasmas : de l'espace au laboratoire			