Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

EXZELLENZCLUSTER
CUI: ADVANCED
IMAGING OF MATTER

Master 2: *International Centre for Fundamental Physics*

INTERNSHIP PROPOSAL

Laboratory name: Institute for Quantum Physics
Internship director: Guillaume Salomon
Email: guillaume.salomon@physik.uni-hamburg.de
Phone number:+49 40428386321
Web page: www.aqmanybos.com
Internship location: Institute for Quantum Physics, Hamburg University, Hamburg, Germany

Thesis possibility after internship: YES

Engineering programmable atomic structures for quantum simulations

Research field

In our laboratory we use ultracold strontium atoms to study quantum many-body physics. We are particularly interested in strongly correlated quantum many-body systems where interactions are comparable to kinetic energy, a situation which often leads to fascinating emergent phenomena such as high-temperature superconductivity or the fractional quantum Hall effect. Using laser light, we engineer and probe quantum gases both in and out of equilibrium with a resolution down to the single particle and spin (Fig.1). Such detection method offers a new paradigm to study quantum many-body systems and we plan to use it to study highly entangled phases of matter.

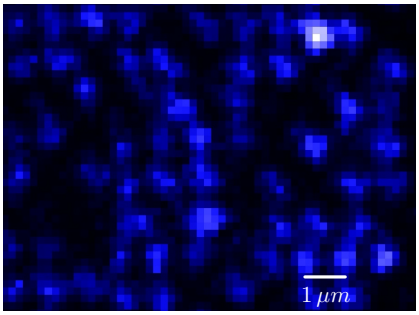

Figure 1: *Experimental picture obtained in a quantum gas microscope. Each blue dot is a single atom located on one site of a two-dimensional square optical lattice.*

Internship project

The goal of the experimental internship is to develop and implement a system for atom manipulation based on crossed acousto-optic deflectors (AOD). The first step of the project will be to program arbitrary waveform generators used to drive the AOD's in order to dynamically change the position of the generated optical traps. The optical system to move individual atoms will then be designed, build and characterized on the experiment. In the interesting case where the internship would be followed by a PhD in our group the student will join a motivated team of three PhD students to study highly frustrated magnetism using Rydberg atoms and the phase diagram of the SU(N) Hubbard model using a quantum gas microscope.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES
Quantum Physics: YES
Soft Matter and Biological Physics: NO
Theoretical Physics: YES