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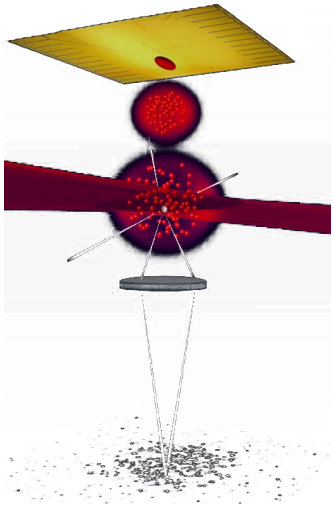
High-resolution single atom imaging using an optical lattice

Call for a diploma student



A unique single-atom-sensitive imaging system has paved the way for new kinds of measurement on our atom chip experiment. It allows for imaging of extremely dilute clouds in the one-dimensional regime and correlation measurements that give deep insight into the structure of the ultracold systems considered (see: *New Journal of Physics* 11 (2009), 103039).
Its working principle is depicted: the cloud released from the chip trap falls down and expands, and after a time of typically 50 ms it crosses a thin sheet of light, that excites the atoms. The fluorescence light is then collected by an external objective and imaged on a high-sensitivity EMCCD camera.
The resolution of the system is currently limited to about 10 µm by diffusion of atoms while being imaged, which undergo the recoil of ~1000 absorption-emission cycles. However, especially for the study of one-dimensional Bose systems, which is currently a very exciting topic within the cold atom community, it would be highly desirable to improve this, in order to study the dynamics of excitation and thermalization in such systems.
The idea to accomplish this is to add an optical lattice and an optical molasses to the detector, which 'pins' the atoms to their initial position along one direction an cools them. In a next step, a new imaging objective that is optimized to accurately image the cloud with the resolution now attainable has to be designed and built.
The goal of the project is to design and implement the laser, lattice, molasses and imaging optics, to include it into an existing and running experiment, to test and characterize this unique next-generation imaging system and finally to apply it to the study of current questions in cold atoms research. At the same time, the project includes active participation in the daily lab work at a state-of-the-art cold atoms experiment.

We offer

- A hands-on lab experience and the opportunity to learn various modern techniques in experimental physics, including imaging optics, laser optics, laser spectroscopy, optomechanics, electronics, computer control,...
- An international research environment in a leading group within a highly exciting field of physics, including the opportunity to visit international conferences and for soft-skill training in scientific writing and presentation
- A project that promises a significant impact on the research field
- A lot of fun

We expect

- Someone who is motivated to learn and is interested in quantum physics, laser cooling, and atomic physics
- A team-player who is willing to work hard and to integrate into academic life
- Basic knowledge of quantum and atomic physics

Interested? Please contact:
Prof. Jörg Schmiedmayer, schmiedmayer@atomchip.org
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