TECHNISCHE UNIVERSITÄT WIEN

ATOMINSTITUT

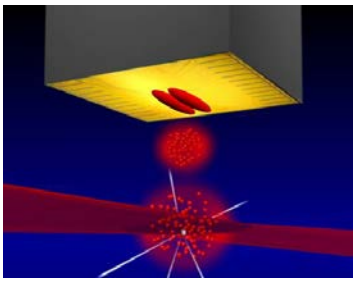
PhD opportunity in experimental physics:

Optimal generation of non-classical atomic states on an atom chip

Engineering correlations between particles allows generating non-classical states, where each particle cannot be described independently from the others. Such states are key resources for quantum information. For instance, entangled photons are now commonly used for quantum cryptography. While production of non-classical states of light is now a mature technology, development of protocols for generating non-classical states of atoms has been the center of a large effort in the last years. As a part of this effort, we are interested in the preparation of atoms in non-classical states of their external degrees of freedom (position, momentum, motional state).

The proposed PhD project will take place on the "Rb2" atomchip experimental setup (http://atomchip.org/rubidium-ii/). Atomchips are microstructured surfaces allowing cooling atoms to the quantum regime and trapping them in a well-controlled magnetic potential. Performing specific transformations of this trapping potential leads to generation of correlations between the atoms and production of non-classical states. Some of the required transformation sequences are highly non-trivial, and are optimized numerically using quantum optimal control.

Thanks to the versatility of the trapping potential, we can study generation of various non-classical states, from the production of squeezed states using a double-well potential [1] to the emission of twin atoms from excited motional states of a single-well potential [2]. Recent improvement of the motional state preparation [3,4] will allow us to further study the dynamics of this out-of-equilibrium system. Furthermore, we will investigate the emission of twin atoms in a double-well potential, a configuration for which the atoms are expected to be pairwise entangled in momentum.



We are looking for a team-worker, motivated by experimental work as well as by data analysis. The PhD student will join the atomchip group of Prof. Schmiedmayer at TU Wien. This group has cutting-edge expertise for manipulation and characterization of quantum atomic gases on atomchips, which places it at the forefront of research concerning 1D systems and out-of-equilibrium dynamics. The atomchip group offers students an international and stimulating environment. It is part of the CoQuS doctoral school and of the Vienna Center for Quantum science and technology (VCQ), and students have the opportunity to meet many top level scientists visiting the group, to attend conferences and to be involved in collaborations with several theoretical and experimental groups.

Interested students are invited to contact Dr. Bonneau, mbonneau@ati.ac.at
or Prof. Schmiedmayer, schmiedmayer@atomchip.org

References:

[1] Berrada et al., *Nat. Commun.* **4**, 2077 (2013) *; arXiv*:1303.1030.
[2] Bücker et al., *Nat. Phys.* **7**, 608–611 (2011) ; *arXiv*:1012.2348.
[3] Van Frank et al., *Nat. Commun.* **5**, 4009 (2014) ; *arXiv*:1402.0377.
[4] Van Frank et al., *arXiv:1511.02247* (2015).