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QUANTUS I – PERFORMING ATOM OPTICAL EXPERIMENTS IN THE DROP TOWER BREMEN

Abstract

We report on the current status of the QUANTUS I atom interferometer at the ZARM drop tower in Bremen, Germany.

After studying the free evolution of a Bose-Einstein-Condensate (BEC) in the first BEC experiment in microgravity on an unprecedented time-scale (up to 1 s) [1], we have now implemented an atom interferometer based on Bragg-diffraction via laser pulses into our setup. An off-resonant laser beam is applied to the cloud of atoms for a certain time and transfers momentum to a fraction of the cloud. Thus, adjusting the interaction time, "mirrors" and "beam splitters" can be realized, allowing for the implementation of various interferometer schemes. Splitting the BEC, letting the parts evolve along different paths and recombining them later leads to an interference pattern which holds information of the potential differences between those paths. This enables the implementation of accelerometers and gyroscopes based on atom interferometry, which in the future could measure gravitational fields with highest precision.

Until now, we have studied coherence properties of our BEC with a Ramsey- and a Mach-Zehnder type interferometer with interrogation times of several hundred ms. We plan to extend this time further by applying a "magnetical lense" to the BEC, thus slowing or even stopping its expansion.

In our talk we will give an overview of the QUANTUS I apparatus and recent results from drop campaigns addressing the characterization of our setup with regard to the feasibility of operating such delicate experiments in rough environments like the drop tower.

The QUANTUS project is a collaboration of LU Hannover, HU Berlin, U Hamburg, U Ulm, TU Darmstadt, MPQ Munich, FBH Berlin, U Birmingham, Laboratoire Kastler Brossel Paris, DLR-RY Bremen and ZARM at U Bremen. It is supported by the German Space Agency DLR with funds provided by the Federal Ministry of Economics and Technology (BMWi) under grant number 50WM1135.

[1] T. van Zoest et al., Science 328 (2010)