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QUANTUS I - ATOM INTERFEROMETRY IN THE BREMEN DROP TOWER

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 implemented an atom interferometer based on Bragg-diffraction via laser pulses into our setup. We were able to show the coherence of our condensate on the timescale of several hundreds of milliseconds and have combined this with a delta kick cooling scheme to slow down the expansion of the atomic cloud.

The interferometer is realized by applying two counterpropagating laser beams to the cloud of atoms for a certain time which transfer 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.

To circumvent limitations caused by the expansion of the atomic cloud, we apply a delta kick cooling scheme to the atoms before they enter the interferometer. With this technique we can slow down the expansion, thus paving the way for even longer time scales.

In our talk we will give an overview of the QUANTUS I apparatus and recent results from drop campaigns addressing the extension of the interrogation time of our interferometer to the realm of seconds.

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 Institute of Space Systems 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] van Zoest et al...