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Author: Mr. Sascha Kulas
ZARM University of Bremen, Germany, sascha.kulas@zarm.uni-bremen.de

Mr. Christian Vogt
ZARM University of Bremen, Germany, christian.vogt@zarm.uni-bremen.de
Mr. Andreas Resch
ZARM University of Bremen, Germany, andreas.resch@zarm.uni-bremen.de
Dr. Sven Herrmann
ZARM University of Bremen, Germany, sven.herrmann@zarm.uni-bremen.de
Dr. Claus Lämmerzahl
ZARM University of Bremen, Germany, laemmerzahl@zarm.uni-bremen.de

A PATHFINDER EXPERIMENT TOWARDS A TEST OF THE UNIVERSALITY OF FREE FALL IN MICROGRAVITY USING ATOM INTERFEROMETRY

Abstract

Today matter wave interferometry is an established tool to perform precision measurements in fundamental physics. One of the main limiting factors in such experiments is the finite free evolution time available for matter waves in a laboratory setup. Thus, the extended free fall time which can be achieved in a space mission is expected to be of great benefit to future matter wave precision measurements. First promising results towards this have been achieved by the QUANTUS collaboration in drop tower experiments. Within the PRIMUS project we aim to further explore this potential in a dedicated drop tower experiment. This experiment will consist of a dual species interferomer to compare the free fall of 87Rb and 39K. Ultimately it shall provide the opportunity to study the potential sensitivity and systematic effects of a future space mission to test the Einstein Equivalence Principle with ultra-cold atoms at enhanced precision. We are currently setting up a combined system of a 2D+ MOT and a 3D MOT to cool the atoms down below the Doppler limit. A miniaturized laser system provides the required laser frequencies and powers for preparing and manipulating the atoms. Later a weak hybrid trap will be implemented to realize evaporative cooling before the atoms enter the interferometer. This trap is an optical dipole trap combined with a weak magnetic field. The whole experiment has to fit into a drop capsule (ca. 170cm x 60cm) requiring a very compact setup. Here, we present the current status of our experiment in more detail and discuss the perspectives and attainable sensitivity of such a free fall test in the Bremen Drop Tower. The PRIMUS project is supported by the German Space Agency DLR with funds provided by the Federal Ministry of Economics and Technology (BMWi) under grant number DLR 50 WM 1142.