GR 4: Main talk: Experimental Gravitation

Time: Monday 14:00–14:45 Location: SPA SR220

Invited Talk GR 4.1 Mon 14:00 SPA SR220

Fundamental Physics with Matter Waves — •Ernst M. Rasel — IQO, Leibniz Universität Hannover

Experimental tests of gravity with matter waves started as early as 1975 with neutrons. Today, atom interferometers offer new opportunities to probe the propagation of matter waves in gravity. The coherent evolution of quantum objects delocalized in space-time, the verification of the Einstein principle of equivalence with quantum objects and the detection of gravitational waves constitute only three of many timely quests motivating experiments with atom interfometers in extended free fall. The overarching aim is to enhance the sensitivity of these devices, which increases linearly with the momentum difference between the two matter waves emerging from a beam splitter and quadratically with the time of free fall as experienced in fountains, drop towers, parabolic flights and space. These scaling laws imply constraints with respect to the atomic source. Thanks to their slow spreading and their excellent mode properties, Bose-Einstein condensates represent a promising source for high-resolution interferometers. We will present experiments on ground and in microgravity aiming to test Einsteins principle of equivalence with matter waves.

The microgravity experiments are pursued by the QUANTUS cooperation comprising the group of K. Bongs (Univ. of Birmingham), C. Lämmerzahl (Univ. Bremen), A. Peters (Humboldt Univ. Berlin/Ferdinand Braun Institut), T. Hänsch/J.Reichel (MPQ/ENS), K. Sengstock/P. Windpassinger (Univ. Hamburg/Univ. Mainz), R. Walser (TU Darmstadt), and W.P. Schleich (Univ. Ulm). This project is supported by the German Space Agency Deutsches Zentrum für Luft- und Raumfahrt (DLR) with funds provided by the Federal Ministry of Economics and Technology (BMWI) under grant number DLR 50 WM 0346. We thank the German Research Foundation for funding the Cluster of Excellence QUEST Centre for Quantum Engineering and Space-Time Research