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Exploring quantum gases for terrestrial and space-borne interferometry

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Abstract

Ultra-cold quantum gases promise to boost the sensitivity of inertial matter-wave interferometers, open the avenue to achieve higher accuracies and allow to conceive new devices. Exploiting quantum gases for high-precision interferometry places high demands on their control and manipulation. The talk presents latest experiments to lower the expansion energies of atomic ensembles and new possibilities arising from twin-lattice interferometry. They are fascinating tools for ground and space-borne interferometry. Our research to advance the necessary methods and achieve the targeted resolution benefits of various platforms such as the very-long-baseline atom interferometer, the Bremen drop tower, the Einstein elevator in Hannover, sounding rockets and the international space station. The DLR-mission MAIUS-1 demonstrated Bose-Einstein condensation and performed first interferometry experiments during the space travel of a sounding rocket. NASA's Cold Atom Laboratory as well as the NASA-DLR funded BECCAL facility continue this research in orbit on the ISS. These experiments explore methods needed for high-precision interferometry as proposed for Earth observation or fundamental physics experiments.

E.M.R. for the QUANTUS, MAIUS and BECCAL cooperation, dq-mat, terra-Q and quantum frontiers