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Atom interferometry for geodetic applications

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Atom interferometry enables precise measurements for long-term observations of accelerations (1), differential accelerations (2), tilts (3), rotations (4), and for tests of fundamental physics (5). In these devices, three laser light pulses separated by a free evolution time coherently manipulate matter waves resembling the Mach-Zehnder geometry in optics. Atom gravimeters demonstrated an uncertainty of few 10^{-8} m/s^2 (1), rotations sensors a noise floor of 100 (nrad/s)/Hz$^{1/2}$ (4) and atom gradiometers a noise floor of $3 \cdot 10^{-8}$ $(1/\mathrm{s}^2)/\mathrm{Hz}^{1/2}$ (3).
Our projects target significant enhancements of atom interferometers in residual uncertainty and noise floor by the integration of novel source concepts providing a high flux of evaporated and well collimated atomic ensembles (6), extending the free-fall time of the atoms, and enabling enhanced techniques for coherent manipulation. Implementations of compact setups for mobile operation (7) or large-scale devices for high performance are investigated (8). These techniques are also explored for space borne applications of atom interferometers. Drop tower experiments (9) and more recently a sounding rocket mission (10) exploited the unique features of a microgravity environment to serve as pathfinders for proposed satellite missions for fundamental physics (11) and geodetic applications (12).
This contribution will report about our projects.
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