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Atom-chip-based interferometry with Bose-Einstein condensates[1]

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— Due to their small spatial and momentum width ultracold Bose-Einstein condensates (BEC) or even delta-kick collimated (DKC) atomic ensembles are very well suited for high precision atom interferometry and measure, for example, inertial forces with high accuracy. We generate such an ensemble in a miniaturized atom-chip setup, where BEC generation and DKC can be performed in a fast and reliable way. Using the chip as a retroreflector we have realized the first atom-chip-based gravimeter. All atom-optical operations including detection take place inside a volume of a one centimeter cube. In order to investigate new geometries we studied symmetric double Bragg diffraction as well as the coherent acceleration of atoms with Bloch oscillations. By combining both techniques we developed a novel relaunch mechanism, which we use to span a fountain geometry within our gravimeter. The relaunch increases the free fall time and, thus, enhances the device's sensitivity. Additionally, we employ these techniques to implement symmetric scalable large momentum beam splitters.

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