Spatial Bloch oscillations of a quantum gas in a “beat-note” superlattice

In this work I report the realization of a novel optical lattice for the manipulation of ultra-cold atoms, where arbitrarily large separation between the sites can be achieved without renouncing to the stability of retro-reflected lattices. Superimposing two short-wavelength optical lattices with commensurated wavelengths, about 1μm each, I realize an intensity periodic pattern with a beat-note like profile where the regions with high amplitude modulation provide the potential minima for the atoms, which experience an effective lattice period around 10 μm. I employ a Bose Einstein condensate to measure the energy gaps between the first three bands and study in-trap Bloch oscillation with negligible interaction in presence of small external forces. The long lasting (1 second) oscillations between sites separated by 10 μm I report prove the high stability of this potential and it is a valuable tool for the precise manipulation of atoms at large distances in a wide range of applications, for example trapped atom interferometry.

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