Creation of a Box-Shaped Potential for Ultracold Lithium Atoms Using a Digital Micromirror Device

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We report on the implementation of a box-shaped optical potential with hard walls for ultracold lithium atoms using a Digital Micromirror Device (DMD). The DMD enables high-resolution spatial shaping of laser light, allowing us to design and dynamically control potential landscapes with unprecedented flexibility. In our setup, a set of telescopes are used to project a structured intensity pattern onto the atoms system, achieving a resolution of approximately $2\,\mu m$. With this system we can create a uniform potential region with sharp boundaries that closely mimics an idealized box potential, a key tool for studying homogeneous quantum gases. Unlike conventional harmonic traps, which introduce inhomogeneities due to their curvature, box potentials enable the study of bulk properties without density-dependent effects. A major advantage of the DMD-based technique is its versatility in real-time potential engineering. By dynamically reprogramming the micromirror configuration, we can modify the shape and depth of the potential on demand, allowing for the investigation of time-dependent quantum phenomena. Furthermore, this flexibility also improves the loading mechanism of the box. By varying the box dimensions from $50\,\mu m$ to $5\,\mu m$ we can maximize the number of trapped atoms. This mechanism is fundamental for achieving a good signal-to-noise ratio and enabling the observation of fine effects, that would be extremely valuable to develop atomtronic circuits.