Quantum Physics

Coherent Transport of Atomic Quantum States in a Scalable Shift Register

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The coherent storage and transport of atomic quantum systems in versatile potential geometries are key elements for the investigation of quantum information processing and quantum degenerate gases. In this work we present the controlled coherent transport of two-dimensional arrays of small ensembles of neutral atoms in a register-type geometry based on two-dimensional arrays of microlenses. We show the scalability of our architecture and of the transport process by demonstrating the repeated hand-over of atoms from trap to trap. We investigate the processes of transport and reloading in detail and demonstrate the conservation of coherence during transport.

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