Highlights

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Ultracold atoms: A topological charge pump

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The quantum pump, originally proposed by David Thouless in 1983, is one of the most intriguing effects in quantum mechanics. It entails the transport of charge, in the absence of a net external electric or magnetic field, through an adiabatic cyclic evolution of the underlying Hamiltonian. In contrast with the classical case, the transported charge is quantized and purely determined by the topology of the pump cycle, which makes it robust against perturbations, such as interaction effects or disorder. As a representative example, we have reported about a topological charge pump realized with ultracold fermions and bosons in a optical superlattice.

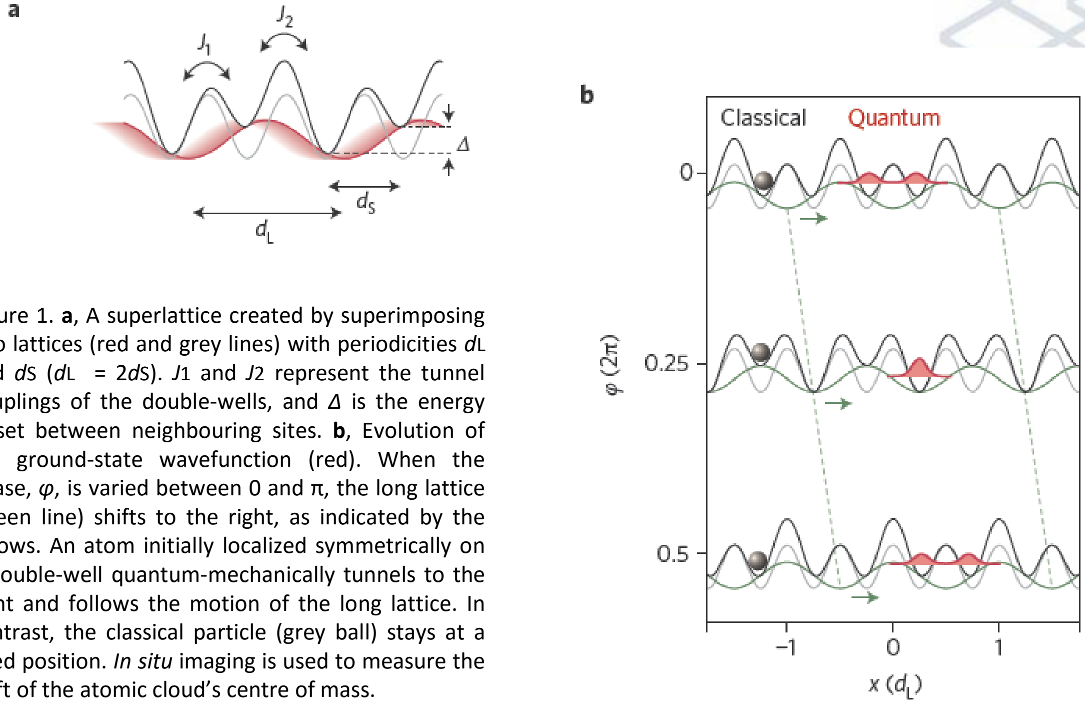

Figure 1. **a**, A superlattice created by superimposing two lattices (red and grey lines) with periodicities d_L and d_S ($d_L = 2d_S$). J_1 and J_2 represent the tunnel couplings of the double-wells, and Δ is the energy offset between neighbouring sites. **b**, Evolution of the ground-state wavefunction (red). When the phase, φ, is varied between 0 and π, the long lattice (green line) shifts to the right, as indicated by the arrows. An atom initially localized symmetrically on a double-well quantum-mechanically tunnels to the right and follows the motion of the long lattice. In contrast, the classical particle (grey ball) stays at a fixed position. *In situ* imaging is used to measure the shift of the atomic cloud's centre of mass.