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Imaging the Quantum Berry Phase[1] C.R. MOON, L.S. MATTOS, B.K. FOSTER, H.C. MANOHARAN, Department of Physics, Stanford University
— Geometric phase operations are attractive to quantum information technology because they are time-independent and relatively insensitive to topological perturbations. However, in most coherent devices where these operations could be performed, electron wave functions are inaccessible to local probes. Here, we demonstrate Berry phase rotations on two-dimensional electron wave functions by using atomic manipulation to adiabatically alter their confinement potential. By consecutively changing the boundary of a quantum corral, we traverse a closed circuit in deformation space that engenders a net π phase shift in two electron eigenstates. With scanning tunneling microscopy, we trace both the energetic and spatial evolution of these states and directly track their accrual of geometric phase, revealing information that would be obscured in other two-dimensional electron devices. This enables the determination of the two-point transconductance through the device, thus making contact to other nanostructures such as semiconductor quantum dots, where this promising technique for phase control can be implemented using only voltages controlling appropriately patterned gates.

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