

Electric quantum walks with individual atoms

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We report on the experimental realization of electric quantum walks, which mimic the effect of an electric field on a charged particle in a lattice. Starting from a textbook implementation of discrete-time quantum walks, we introduce an extra operation in each step to implement the effect of the field. The recorded dynamics of such a quantum particle exhibits features closely related to Bloch oscillations and interband tunneling. In particular, we explore the regime of strong fields, demonstrating contrasting quantum behaviors: quantum resonances versus dynamical localization depending on whether the accumulated Bloch phase is a rational or irrational fraction of 2π .

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