Controlling symmetry and localization properties with an artificial gauge field in a disordered Floquet system

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Anderson localization, which has long been a paradigm of condensed matter physics [1], has been observed and studied in the last decades in many different disordered systems, both classical and quantum. The symmetry characteristics of the disordered system are expected to greatly affect its localization and transport properties, yet few experiments are available in this direction. Here we report upon the experimental realization of an artificial gauge field in a synthetic (temporal) dimension of a disordered, periodically driven (Floquet) quantum system [2]. Our remarkably simple technique is used to control the Time-Reversal Symmetry (TRS) properties, and leads to two experimental observations representing smoking-gun signatures of this symmetry breaking. The first consists in the first observation of the Coherent Forward Scattering (CFS), a novel genuine interferential signature of the onset of the (strong) Anderson localization, recently predicted [3]. The second is a measurement of the celebrated β(g) function [4], with a direct test of the one-parameter scaling hypothesis, and its universality in two different symmetry classes.

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