Controlling transport and localization with an artificial gauge field

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For a long time a paradigm in condensed matter physics, Anderson localization 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 experimental results are available in this direction. Here we report the experimental realization of an artificial gauge field in a synthetic (temporal) dimension of a disordered, periodically driven (Floquet) quantum system. Our remarkably simple technique is used to control the Time-Reversal Symmetry properties, and leads to two novel experimental observations, representing 'smoking-gun' signatures of this symmetry breaking. The first consists in the observation of the "Coherent Forward Scattering" (CFS) [1], a genuine interferential signature of the onset of the (strong) Anderson localization. The second is the measurement of the $\beta(g)$ scaling function [2], with a direct test of the one-parameter scaling hypothesis, and of its universality in two different symmetry classes.

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[2] E. Abrahams, P. W. Anderson, D. C. Licciardello, and T. V. Ramakrishnan, Phys. Rev. Lett. **42**, 673 (1979)