Matter waves in random optical potentials

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Abstract

Using carefully crafted laser beams, it is possible to create complex effective potentials for the motion of cold atoms, and to study experimentally quantum transport in disordered/chaotic systems, with a good control of the system parameters. In the lecture, I will explain how this made it possible to observe several hallmarks of coherent quantum transport such as Coherent Back Scattering and the Enhanced Return to Origin (also known as Mescoscopic Echo), Anderson localization and Coherent Forward Scattering (a signature of localized dynamics). Unambiguous signatures of these effects can be observed through a controlled breaking of the quantum coherence, e.g. by adding an effective gauge field or by selectively breaking the phase coherence of the atomic wavefunction.

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