Experimental observation of the critical regime of the Anderson transition with cold atoms

Dominique Delande

Laboratoire Kastler-Brossel, Case 74, Université Pierre et Marie Curie, 4 Place Jussieu, F-75252 Paris Cedex 05, France

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We realize experimentally an atom-optics quantum chaotic system, the quasiperiodic kicked rotor, which is equivalent to a 3D disordered system, that allows us to demonstrate the Anderson metal-insulator transition. Sensitive measurements of the atomic wavefunction dynamics and the use of finite-size scaling techniques make it possible to extract the critical parameters and the critical exponent of the transition, experimentally measured for the first time for non-interacting matter waves. The critical exponent is universal, i.e. independent of the detailed values of the parameters, and equal to the one numerically obtained for the 3D Anderson model. We also study the spatio-temporal evolution of the wavefunction at the critical point, and show that it is well described by self-consistent theory of localization.