Anderson transition of cold atoms with synthetic spin-orbit coupling in two-dimensional speckle potentials

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We present our recent work [1] on the Anderson transition occurring in two dimensional (2D) systems of ultra-cold atoms in the presence of artificial Rashba and Dresselhauss spin-orbit couplings. Based on a high order discretization scheme, we calculate the precise position of the critical point (mobility edge) for a spatially correlated disorder generated by laser speckles and verify that the transition belongs to the symplectic universality class. We show that the mobility edge depends strongly on the mixing angle between Rashba and Dresselhaus couplings. For equal strengths, where the system possesses a hidden spin-rotational symmetry [2], the transition disappears, signaling the crossover to the orthogonal class. We also find that, for strong disorder, the mobility edge behaves linearly as a function of the speckle strength, with a slope controlled by the value of the spin-orbit coupling.

[1] G. Orso, Phys. Rev. Lett. **118**, 105301 (2017).

[2] J. D. Koralek, C. P. Weber, J. Orenstein, B. A. Bernevig, S.-C. Zhang, S. Mack, and D. D. Awschalom, Nature **458**, 610 (2009).