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Title: Unifying the Anderson transitions in Hermitian and non-Hermitian systems

Abstract: The Anderson transition (AT) is a ubiquitous phenomenon observed in random systems, where waves undergo a localization-delocalization transition. In the case of Hermitian Hamiltonians, this transition is classified by the 10-fold Altland-Zirnbauer (AZ) symmetry classes. Non-Hermiticity enriches the AZ symmetry classes into the 38-fold symmetry classes [1], leading to changes in the critical behavior of the Anderson transitions, as demonstrated by finite size scaling analyses of the energy level statistics and localization length [2].

In this work, we propose a correspondence between the universality classes of the Anderson transitions in Hermitian and non-Hermitian systems [3]. Our analysis shows that critical exponents of length scales in non-Hermitian systems are identical to those in the corresponding Hermitian systems. This correspondence leads to a remarkable consequence of superuniversality, where the ATs in different symmetry classes of non-Hermitian systems are characterized by the same critical exponent. We compare the known critical exponents for non-Hermitian systems with their Hermitian counterparts, and numerically estimate the critical exponents in several symmetry classes in two and three dimensions, which are consistent with the proposed correspondence. Our correspondence explains why the magnon-Hall effect, described by the pseudo-Hermitian Hamiltonian, shows the same critical exponent as the quantum Hall effect in Hermitian systems. Furthermore, we predict the unknown exponents of the Hermitian universality classes from this correspondence.

References:

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