

AG Zufallsmatrizen Seminar

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Universal Broadening of Zero Modes: A General Framework and Identification

We consider the smallest eigenvalues of perturbed Hermitian operators with zero modes, either topological or system specific. To leading order for small generic perturbation we show that the corresponding eigenvalues broaden to a Gaussian random matrix ensemble of size $\nu \times \nu$, where ν is the number of zero modes. This observation unifies and extends a number of results within chiral random matrix theory and effective field theory and clarifies under which conditions they apply. The scaling of the former zero modes with the volume differs from the eigenvalues in the bulk, which we propose as an indicator to identify them in experiments. These results hold for all ten symmetric spaces in the Altland-Zirnbauer classification and build on two facts. Firstly, the broadened zero modes decouple from the bulk eigenvalues and secondly, the mixing from eigenstates of the perturbation form a Central Limit Theorem argument for matrices.

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