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On the extreme value statistics of normal random matrices

In this work, we extend the approach of orthogonal polynomials for extreme value calculations of Hermitian random matrices, developed by Nadal and Majumdar, to normal random matrices and 2D Coulomb gases in general. Firstly, we show that this approach provides an alternative derivation of results in the literature. More precisely, we show convergence of the rescaled eigenvalue with largest modulus of a Ginibre ensemble to a Gumbel distribution, as well as universality for an arbitrary radially symmetric potential. Secondly, it is shown that this approach can be generalised to obtain convergence of the eigenvalue with smallest modulus and its universality for ring distributions. Furthermore, the here presented techniques can be used to compute finite N expressions of the above distributions, which is important for practical applications, given the slow convergence. One interesting aspect of this work is the fact that we can use standard techniques from Hermitian random matrices to obtain the extreme value statistics of non-Hermitian random matrices. Furthermore, the calculation resembles the large N expansion used in context of the double scaling limit of Hermitian matrix models in string theory.

Wednesday, 13.12.2017, 14:15 Uhr
V3-201