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Level statistics and localization transitions of Lévy matrices. (English) Zbl 1356.15018

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Summary: This work provides a thorough study of Lévy, or heavy-tailed, random matrices (LMs). By analyzing the self-consistent equation on the probability distribution of the diagonal elements of the resolvent we establish the equation determining the localization transition and obtain the phase diagram. Using arguments based on supersymmetric field theory and Dyson Brownian motion we show that the eigenvalue statistics is the same one as of the Gaussian orthogonal ensemble in the whole delocalized phase and is Poisson-like in the localized phase. Our numerics confirm these findings, valid in the limit of infinitely large LMs, but also reveal that the characteristic scale governing finite size effects diverges much faster than a power law approaching the transition and is already very large far from it. This leads to a very wide crossover region in which the system looks as if it were in a mixed phase. Our results, together with the ones obtained previously, now provide a complete theory of Lévy matrices.

MSC:

15B52 Random matrices (algebraic aspects)
81V35 Nuclear physics
81V70 Many-body theory; quantum Hall effect

Full Text: DOI

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