Mathematics > Probability

Universality of local spectral statistics of random matrices

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The Wigner-Gaudin-Mehta-Dyson conjecture asserts that the local eigenvalue statistics of large random matrices exhibit universal behavior depending only on the symmetry class of the matrix ensemble. For invariant matrix models, the eigenvalue distributions are given by a log-gas with inverse temperature $\beta = 1, 2, 4$, corresponding to the orthogonal, unitary and symplectic ensembles. For $\beta \not\in \{1, 2, 4\}$, there is no matrix model behind this model, but the statistical physics interpretation of the log-gas is still valid for all $\beta > 0$. The universality conjecture for invariant ensembles asserts that the local eigenvalue statistics are independent of V. In this article, we review our recent solution to the universality conjecture for both invariant and non-invariant ensembles. We will also demonstrate that the local ergodicity of the Dyson Brownian motion is the intrinsic mechanism behind the universality. Furthermore, we review the solution of Dyson's conjecture on the local relaxation time of the Dyson Brownian motion. Related questions such as delocalization of eigenvectors and local version of Wigner's semicircle law will also be discussed.

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