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A random hermitian matrix representation for two-dimensional percolation model

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Abstract

In this letter, the random matrix theory representation of a bond-percolation model on square lattice is presented. The behavior of random matrix model can be determined only by its two largest eigenvalues. The second largest eigenvalue sits exactly on the edge of semicircle part of eigenvalue's distribution and its position is a function of p, on the other hand the first largest eigenvalue is disjointed from other eigenvalues and its distribution is Gaussian. Also the first largest eigenvalue is responsible for scaling properties near criticality. Numerical simulations show power-law divergences emerged from coalescence of two largest eigenvalues near critical point at the thermodynamic limit. In this letter a scaling formalism is presented which describes complete scaling behavior of largest eigenvalue's fluctuations with a set of scaling exponents in finite-size systems.

Keywords: random matrix theory, percolation theory, Tracy-Widom distribution, universality

For full article, refer to the Persian section