Phase transitions and metastability in the distribution of the bipartite entanglement of a large quantum system

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We study the distribution of the Schmidt coefficients of the reduced density matrix of a quantum system in a pure state. By applying general methods of statistical mechanics, we introduce a fictitious temperature and a partition function and translate the problem in terms of the distribution of the eigenvalues of random matrices.We investigate the appearance of two phase transitions, one at a positive temperature, associated with very entangled states, and one at a negative temperature, signaling the appearance of a significant factorization in the many-body wave function. We also focus on the presence of metastable states (related to two-dimensional quantum gravity) and study the finite size corrections to the saddle point solution.