Permanent of a Linear-Law Circulant Matrix and Its Large-Size Asymptotics

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Quantum statistics of many-body Bose systems is intimately related to an #P-hard problem of computing a matrix permanent, as is known from the theory of quantum fields, quantum information processing and, in particular, a widely discussed nowadays boson-sampling problem. This fact acquired even a deeper meaning due to a recent reduction of the calculation of an order parameter and various correlation functions in a microscopic theory of phase transitions in a critical region to computing the permanents of certain matrices given by the well-known mean-field equations [1,2].

In general, the #P-hard problem of the permanent's computation can't be solved by a classical computer in a polynomial time. Thus, finding asymptotics of the permanent is of great importance. Here, we present our recent results on the large-size asymptotics of the linear-law circulant matrices obtained via the McCullagh asymptotics for doubly-stochastic matrices with a moderate variation of entries and compare them with a random-phase approximation and known results on the exponential-law circulant matrices.

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