

Classical Statistical Mechanics Approach to Multipartite Entanglement

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We characterize the multipartite entanglement of a system of n qubits in terms of the distribution function of the bipartite purity over balanced bipartitions. We search for maximally multipartite entangled states, whose average purity is minimal, and recast this optimization problem into a problem of statistical mechanics, by introducing a cost function, a fictitious temperature and a partition function. By investigating the high-temperature expansion, we obtain the first three moments of the distribution [1]. On the other hand, when many bipartitions are considered, the requirement that purity be minimal for all bipartitions can engender conflicts and frustration arises. This unearths an interesting link between frustration and multipartite entanglement [2].

[1] J. Phys. A: Math. Theor. 43, 225303 (2010)

[2] New Journal of Physics 12, 025015 (2010)