Information storage capacity of an open quantum Hopfield network

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Nowadays classical artificial Neural Networks (NNs) show their great power and versatility in information processing tasks. Early instances of NNs are given by associative NNs, which have the ability to retrieve a stored state, starting from a compromised initial one. Such dynamics can be engineered via a stochastic evolution, where stored configurations are minima of an energy landscape. One of the first examples of associative NNs is the Hopfield NN, which is an Ising-type system featuring all-to-all interactions. Motivated by the fast progress in controlling quantum systems, as well as in quantum computation, a question that is currently explored is whether a Hopfield-type associative memory could be hosted in quantum systems [1]. Our goal is to understand what role quantum effects play in such a quantum-Hopfield network with regard to store information. To this end, we calculate the maximum information storage capacity at finite temperature i.e., the maximum number of stored states given a certain system size, by generalising an approach that was previously introduced and applied to classical neural networks [2,3].

References

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Figures

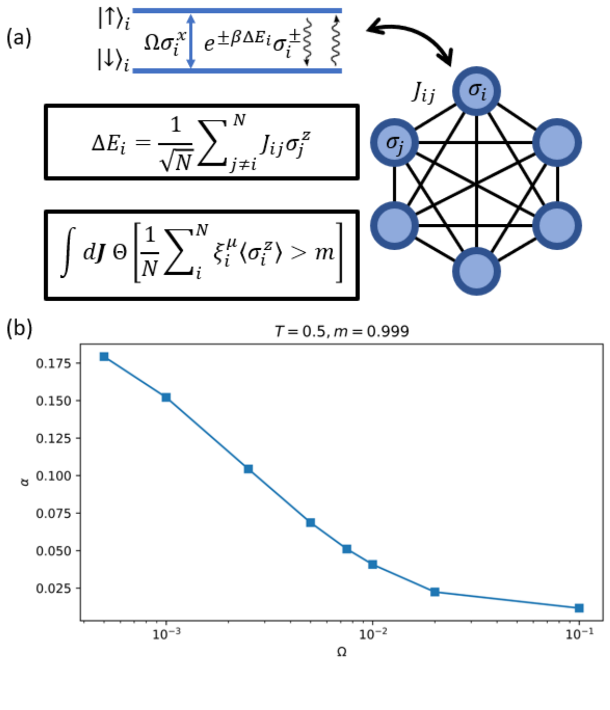

Figure 1: (a) Schematic illustration of the dissipative Hopfield model with quantum drive and the volume of attractive network configurations with regard to stored patterns. (b) Maximal capacity at finite temperature T=0.5 and large minimal overlap upon varying the quantum drive.