A neural-network approach to the many-body problem in open quantum system

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In spite of the tremendous experimental progress in the isolation of quantum systems, a finite coupling to the environment [1] is unavoidable and certainly plays a crucial role in the practical implementation of quantum information and quantum simulation protocols [2]. In this context, the many-body problem has to account for the exponential growth of the underlying Hilbert space and the emergence of mixed-state dynamics due to the coupling to an external environment. In this talk I will review recent developments in the simulation of this class of systems with particular emphasis on numerical methods. In particular, I will discuss recent applications of neural network tools to simulate the behaviour of an open many-body quantum system [3] describing results and open challenges [4]. Next, I will describe how these techniques allow the study of the phase-diagram of paradigmatic strongly-interacting dissipative spin [5, 6] and bosonic [7] systems. Particular attention will be devoted to the stabilization of exotic phases (without an equilibrium counterpart) and to the characterization of criticalities.

References

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