Giuliano Benenti

Department of Science and High Technology, University of Insubria
Via Valleggio, 11 - 22100 Como, Italy
giuliano.benenti@uninsubria.it

Recovering Entanglement by Local Operations

G. Benenti, A. D'Arrigo, R. Lo Franco, E. Paladino, G. Falci

We discuss the occurrence of entanglement revivals in those situations in which a bipartite system is prepared in an entangled state and interacts with local environments. To be more specific, we suppose that the two subsystems are non-interacting, and only subjected to local and independent environments; moreover we suppose that these environments can be modeled as classical systems. Under these conditions, is not possible any entanglement creation due to the action of non-local operations, nor entanglement can be "transferred" to the environments and then "regained" (as in the case in which the system interact with quantum environments).
The subsystems are only subjected to local operations, due to the interaction with their respective classical environments. Since local operations cannot create entanglement, the increase of entanglement must be attributed to the manifestation of quantum correlations that were already present before the application of the local operation itself. These quantum correlations are in some sense hidden, since the density operator formalism does not capture their presence. In this perspective, we speak of "hidden entanglement" (HE), proposing a way to quantify it by describing the system dynamics in terms of an ensemble of pure state evolutions. HE indicates the entanglement that cannot be exploited as a resource due to the lack of knowledge about which state of the ensemble we are dealing with, and therefore it indicates the amount of entanglement that may be recovered without the help of any non-local operation.
We illustrate the usefulness of this concept by several examples. We show that the presence of HE allows to recover entanglement between two noninteracting qubits subject to a low-frequency stochastic environment by local pulses (acting only on single qubit). Moreover, we also discuss how hidden entanglement may provide new insights about entanglement revivals in non-Markovian dynamics.