Entanglement dynamics of discrete and continuous variable systems subjected to dissipation, attenuation, and amplification

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Any realistic entanglement-enabled experiment poses the question "What is the noise strength that impedes the successful experiment performance?" The answer depends on the particular noise model and the admissible degree (type) of entanglement in the noisy output state. We present the answer for particular local and global quantum channels acting on multipartite systems such as depolarization (for discrete variables) and attenuation/amplification (for continuous variables). We analyze the dynamics of entanglement structure for increasing noise levels and find the analogy with chemical processes [1]. Multipartite (genuine) entanglement behaves as a chemical compound, and the particles of environment play role of the solvent in which the entanglement compound dissociates. The solvent can act on the whole compound (global quantum noise) or particular elements of the compound (local quantum noise). The differences between these two mechanisms are in the presence of clustering stages in the case of global noise, when particles of the compound reassemble to form almost equal bipartitions, tripartions, etc. For a given quantum channel, we formulate operational sufficient conditions ensuring one or another entanglement behavior of the output. Finally, we consider the ultimate form of entanglement degradation and answer the question "What is the fundamental noise level beyond which all initial states become fully separable?" This question is complementary to the entanglement detection problem and identifies the situations when any form of entanglement is surely destroyed. The characterization of such entanglement annihilating channels is provided [2] and the crucial differences from entanglement breaking channels are discussed [3].

List of publications:
[1] S.N. Filippov, A.A. Melnikov, and M. Ziman. Dissociation and annihilation of multipartite entanglement structure in dissipative quantum dynamics. Phys. Rev. A 88, 062328 (2013).
[2] S.N. Filippov, M. Ziman. Bipartite entanglement-annihilating maps: Necessary and sufficient conditions. Phys. Rev. A 88, 032316 (2013).
[3] S.N. Filippov, T. Rybar, M. Ziman. Local two-qubit entanglement-annihilating channels. Phys. Rev. A 85, 012303 (2012).