Asymptotic dynamics of quantum systems under random unitary uvolution

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We investigate the asymptotic dynamics of quantum systems resulting from large numbers of iterations of randomly aplied unitary quantum operations. Despite the fact that in general the evolution superoperator of such random unitary operations cannot be diagolanlized it is shown that the resulting iterated asymptotic dynamics is discribed by a diagonalizable superoperator. As a consequence it turns out that tipically the resulting iterated asymptotic dynamics is governed by a low dimensional attractor space which is determined completely by the unitary transformations involved and which is independent of the probability distributions with which these unitary transformations are selected. Based on this general approach analytical results are presented for the asymptotic dynamics of large qubit networks whose nodes are coupled by randomly applied unitary operations. These networks appear to be a good tool for studying phenomens like decoherence, thermalization or quantum homogenization.