From unitary to open quantum walks

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Open quantum walks (OQWs) [1] were introduced as quantum analogues to classical Markov chains. In contrast to unitary quantum walks [2], OQWs are driven by the dissipative interaction with the environment and are formulated in the language of open quantum systems [3]. OQWs demonstrate rich dynamical behaviour [1,4] and can be used to perform efficient dissipative quantum computation and state engineering [5]. Another benefit of OQWs is in the well-defined classical limit [6]. The unitary quantum walks are gaining computational power from the quantum interference between the nodes of a walk and the asymptotic behaviour of them is highly non-gaussian [2].

In this talk, we will introduce a generalization of the QWs, which includes OQWs and unitary quantum walks as limiting cases. In this generalization, one can naturally identify an order parameter ξ = (characteristic time)/(characteristic length) and perform characteristic length a "thermodynamic" limit in the characteristic parameters while keeping ξ a constant. As a result, the asymptotic distribution of the position of the walker for the small values of ξ corresponds to a unitary quantum walk and for the large values of ξ to an OQWs, respectively.

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