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From Unitary to Open Quantum Walks: generalization and unification

Open quantum walks (OQWs)[1] were introduced as quantum analogs 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 systems3. OQWs demonstrates 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 behavior of them is highly non-gaussian[2]. In this talk, I 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 the 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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