FROM OPEN QUANTUM WALKS TO OPEN QUANTUM BROWIAN MOTION

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ABSTRACT:

Recently, a formalism for discrete time open quantum walks (OQWs) was introduced [S. Attal et al., J. Stat. Phys., 147 (2012) 832]. This formalism is exclusively based on the non-unitary dynamics induced by the environment. This approach rests upon the implementation of appropriate completely positive maps. Open quantum walks include the classical random walk and through a realization procedure a connection to the Hadamard quantum walk is established. OQWs allow for an unravelling in terms of quantum trajectories. The microscopic derivation of an OQW as some reduced system dynamics explains the dependence of the dynamical behavior of the OQW on the temperature and coupling to the environment.

OQWs have found fruitful application. It was shown that open quantum walks can perform universal quantum computation and can be used for quantum state engineering. Also, OQWs have been applied to the modelling of quantum effects in biological systems. In a particular scaling limit OQWs give raise to Open Quantum Brownian Motion (OQBM), which describes a Brownian particle with an additional internal quantum degree of freedom.