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## *Quantum Markov processes and applications in many-body systems*

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ABSTRACT

The aim of this thesis is to investigate the properties of quantum Markov processes, i.e. Markov processes taking place in a quantum mechanical state space, and to gain a better insight into complex many-body systems by means thereof. We formulate a novel quantum algorithm which allows for the computation of the thermal and ground states of quantum many-body systems. The quantum algorithm can be seen as the natural generalization of the ubiquitous Metropolis algorithm to simulate quantum many-body Hamiltonians. By this we intend to provide further evidence that a quantum computer can serve as a fully-fledged quantum simulator, which is not only capable of describing the dynamical evolution of quantum systems, but also gives access to the computation of their static properties. Moreover, we find bounds on the convergence rate of quantum Markov processes by generalizing geometric bounds found for classical processes. After this, we turn to an investigation of classical non-equilibrium steady states with methods derived from quantum information theory. We construct a special class of matrix product states that exhibit correlations which can best be understood in terms of classical Markov processes. Finally, we investigate the transport properties of special class non-equilibriumsteady states.