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## Estimation of ground state energies in quantum circuits


The talk deals with the field of quantum computation. In particular, we focus on the Variational Quantum Eigensolver (VQE), a quantum-classic-hybrid algorithm, designed to find the ground state of a given Hamiltonian. We restrict our investigations to small systems (three qubits), to which we apply the VQE. The two main parts of this talk concern on running the VQE on a real quantum device and investigating unitaries that are optimized by recent simulations of the VQE on a classical machine (see Andreas Woitzik's talk).

The quantum devices we use are provided by IBM and consist of superconducting qubits based on Josephson Junctions. First we implement the optimized circuits (a series of quantum gates) of former simulations on one of these devices, and obtain energy expectation values that are significantly different from the theoretical predictions. Therefore we discuss the influence of noise on the current devices, especially for the task of finding the ground state. Furthermore, we run the VQE optimization process for up to 430 iterations on the quantum device, for which the algorithm fails to reach the ground state.

Secondly, we investigate properties of the optimal circuits (allowing us to transform the initial state into the ground state) in terms of unitary transformations, eigenvectors and entanglement. An analytical consideration allows us to find necessary conditions for the transformation of the input state into the target one.