

Robert König

Topological order and shallow quantum circuits

Abstract

I give an introduction to basic concepts of quantum computing focusing on two proposed applications of shallow circuits. I first discuss limitations of the Quantum Approximate Optimization Algorithm (QAOA) for certain instances of the MaxCut problem. A symmetry-protected version of the No Low-energy trivial states (NLTS) property for a family of local Hamiltonians implies that the Goemans-Williamson algorithm outperforms QAOA. The NLTS property captures a strong form of topological order: any low-energy state cannot be prepared by a shallow quantum circuit. I then discuss how topological quantum error-correcting codes can be used to demonstrate an unconditional computational advantage of noisy shallow quantum circuits compared to ideal classical shallow circuits.

The talk is based on joint work with Sergey Bravyi, David Gosset, Alexander Kliesch and Marco Tomamichel.