DVR 0065528

Seminar

Nicholas Chancellor

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Continuous time quantum computing beyond adiabatic: quantum walks and fast quenches

Wednesday, October 9, 2019

at 14:00 h

ESI, Boltzman Lecture Hall

Abstract: While the adiabatic theorem provides a useful theoretical handle to understand quantum computing in continuous time, solving hard problems adiabatically would require an exponentially long runtime and therefore unless P=NP will require either an exponentially long coherence time or a mechanism to restore coherence. On the other hand, algorithms which only succeed with an exponentially small probability may still be useful on more realistic devices, for which coherence time either does not scale, or scales only mildly. One example of such an algorithm is a continuous time quantum walk applied to hard optimization problems, where a system is evolved with a fixed (in time) Hamiltonian. We find that for small Sherrington-Kirkpatrick spin glasses, such an algorithm delivers a scaling which is less than the square root of the system size expected from Grover like simple search dynamics, we attribute this superior performance to the fact that the energy landscape of real optimization problems is correlated, and provide evidence that these correlations are crucial to being able to build practical algorithms, and argue why our quantum walk algorithm. In hindsight this is somewhat unsurprising, since these correlations are necessary for any classical algorithm to perform better than random guessing. We also discuss the underlying dynamics which allow this and other far-from-adiabatic algorithms to work. Finally we discuss extensions of the work, which include a technique we have called pre-annealing for which we observe scaling of our continuous time quantum algorithm which is competitive with a cutting edge gate based hybrid quantum/classical gate model algorithms. It is likely that by adding a hybrid component these algorithms could be made more efficient and beat the current state of the art.

T. Calarco

October 8, 2019