EXPLAINING QUANTUM PHASE KICKBACK TO ESTIMATE EIGENVALUES

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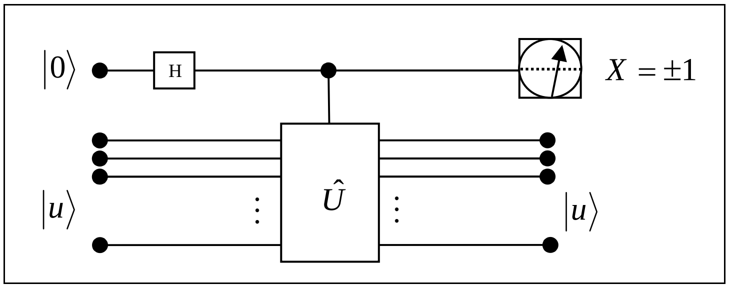

The topic of this presentation will be complemented by presenting a formal report.

Abstract: Quantum information theory is presented by describing single qubits and some basic operations like measurement in terms of the language of observables[5]. Phase estimation is then introduced, the key ingredient in quantum eigenvalue and eigenvector estimation [1,2]. Phase estimation helped pave the way for the very famous factoring and search algorithms in quantum computing. We note that unfortunately for search and AI algorithms[6] to have practical application most estimate that several thousand qubits will be needed. In addition to this, it is not clear how or to what level the artificial problem of cryptography will have as an impact on science, although interesting. Yet there are many natural problems that arise in quantum scattering theory, quantum mechanics[3] and chemistry that are not solvable on classical computers due to the number of computational steps needed. Most estimate that as few as 100 qubits will be needed for very meaningful results[1,2,3]. Most of these algorithms are known as numerical since they give a decimal approximation of some unknown quantity with accuracy improved iteratively.

[1] Daniel S. Abrams and Seth Lloyd, "A quantum algorithm providing exponential speed increase for finding eigenvalues and eigenvectors", http://arxiv.org/abs/quant-ph/9807070

[2] Thomas Szkopek, Vwani Roychowdhury, Eli Yablonovitch, Daniel S. Abrams, Efficient Quantum Solution of Differential Equations, http://arxiv.org/abs/quant-ph/0408137

[3] Daniel S. Abrams and Seth Lloyd, Simulation of Many-Body Fermi Systems on a Universal Quantum Computer, *PHY S I CAL REV I EW LETTERS VOLUME 79, NUMBER 1*

[4] Michele Mosca, Sildes 11-14, http://www.iqc.ca/~qipcourse/

[5] David Deutsch, the Quantum Computation Lectures video collection, free online at http://www.quiprocone.org/Protected/DD_lectures.htm

[6] Mark Oskin, Quantum Computing - Lecture Notes, http://www.cs.washington.edu/homes/oskin/quantum-tutorial/