Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Maximal Success Probabilities of Linear-Optical Quantum Gates

AMOS MATTHEW SMITH, Tualne University, DMITRY USKOV, LEV KAPLAN, Tulane university — We apply numerical optimization techniques to obtain optimal implementations of generic linear-optical KLM-type two-qubit entangling gates, and we extend our techniques to the three-qubit Toffoli gate. We find that direct implementations of generic two-qubit gates and of the Toffoli gate have higher success rates and require lower ancilla resources than the conventional schemes of decomposing the gates into universal gates such as CNOT. A generic two-qubit gate constructed using three CNOT gates has a maximum success rate of $S \approx 0.0004$. We find a lower bound for the success of any generic two-qubit gate implemented directly with perfect fidelity to be $S > 0.0063$, an improvement of an order of magnitude. At the same time, our implementation uses only half the resources of the CNOT decomposition. We then examine the Toffoli gate, and again find a direct implementation that has a higher success rate while requiring fewer ancilla resources than the previous best known implementation.

Amos Matthew Smith
Tulane University

Date submitted: 23 Nov 2009 Electronic form version 1.4