An introduction to boson-sampling

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I. INTRODUCTION

II. MOTIVATION FOR LINEAR OPTICS QUANTUM COMPUTING

III. INTRODUCTION TO LINEAR OPTICAS QUANTUM COMPUTING

IV. WHY IS LINEAR OPTICS QUANTUM COMPUTING HARD?

V. INTRODUCTION TO BOSON-SAMPLING

A. The model

B. Sampling problems vs. decision problems

C. Why is boson-sampling so much easier than linear optics quantum computing?

VI. WHY IS BOSON-SAMPLING COMPUTATIONALLY HARD?

A. The connection with matrix permanents

B. The complexity of matrix permanents

C. Errors in boson-sampling

Discuss the 1/poly(n) bound

VII. BOSON-SAMPLING AND THE EXTENDED CHURCH-TURING THESIS

Why experimental boson-sampling will not elucidate the ECT thesis

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VIII. BOSON-SAMPLING WITH OTHER CLASSES OF QUANTUM OPTICAL STATES

IX. HOW TO BUILD A BOSON-SAMPLING DEVICE (KEITH)

In this section we explain what components are required to build a boson-sampling device. There are three basic components to building this device which are single-photon sources, linear optical networks, and photon detectors. In the lab these components have multiple options

have their own issues to overcome, which are described below. There are various ways to piece together these components to make a boson-sampling device and in this section we describe many of the various possibilities. Although easier than LOQC it is still extremely challenging to build.

A. Photon sources

- Spontaneous Parametric Down Conversion (SPDC); List problems; insert equation;
- Quantum Dot

B. Linear optics networks

- Reck et al.
- Waveguides; cite Alberto Peruzzo
- Discrete elements; beam-splitters and phase shifters; give general equation of beam-splitter from Knight book.
- in case of other types of bosons it need to be optical.
- alignment.

C. Photo-detection

- List different types of detectors
- don't need to be number resolving.

X. CONCLUSION

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