BOSON SAMPLING WITH CONTINUOUS-WAVE DETECTION

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Non-universal quantum computing addresses specific problems, which cannot be solved with classical computers. An example is Boson sampling, cf. Refs. [1, 2], demonstrating supremacy of quantum computations. This method is considered as highly attractive due to its clearness and possibilities of implementation with current technologies. For this scenario, the resource of quantum supremacy is the fact that phase-space quasi-probability distributions are not positive-semidefinite [3]. Boson sampling applies to computation of permanent—a matrix function defined as a sum of its so-called diagonal products [4]. This task, despite the permanent is similar to the determinant, is computationally hard for traditional classical calculations but can be successfully resolved with quantum devices.

The key element of the boson-sampling circuit is a linear multi-port interferometer. This device is associated with a set of matrices, which permanents should be evaluated. Also it includes single-photon sources and single-photon detectors. The difficulty we have to face with this scheme is the fact that realistic detectors can not discriminate adjacent photon numbers. A way to resolve this problem is the technique of so-called continuous-wave detection. Within this method one counts the pulses of photocurrent during a time interval. With an acceptable probability each pulse can be associated with one absorbed photon. However, after the pulses there exist time intervals during which detectors cannot register photons—so-called dead time. This fact may significantly destroy photocounting statistics and, as a result, lead to wrong values of permanents.

In this contribution we report about theoretical consideration of this problem. It turns out that permanents can still be successfully reconstructed from the statistics of pulses registered with the technique of continuous-wave detection. However, the standard method should be reconsidered by applying the obtained correction factors. The result can find its application for practical implementations of boson-sampling technique.

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