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Efficient and stringent certification of boson sampling in symmetric waveguide lattices ROBERT KEIL, CHRISTOPH DITTEL, THOMAS KAUTEN, GREGOR WEIHS, University of Innsbruck, ARMANDO PEREZ-LEIJA, STEFFEN WEIMANN, MAXIME LEBUGLE, ALEXANDER SZAMEIT, Friedrich-Schiller-University Jena, MALTE TICHY, University of Aarhus — Non-universal quantum computers dedicated to specific tasks, such as boson-sampling, are envisioned to outperform the classically computable limit much sooner than universal quantum computers. However, once this regime is reached, the very hardness of boson sampling excludes any straightforward efficient verification of the results. A computationally accessible while physically non-trivial instance of the problem based on Fourier matrices was recently proposed to prove many-particle interference and thereby benchmark the functionality of a candidate device. Yet, this is singular case remains challenging to implement experimentally. Here, we greatly generalize this approach by formulating a certification criterion based uniquely on mirror symmetry of the network, leaving the exact form of the scattering matrix open. For mirror symmetric inputs, the symmetry of the system enforces the suppression of around 50% of a priori possible output states. Since this suppression relies on genuine multi-particle interference, it represents a stringent certification criterion that can be used to ensure the functionality of boson-samplers. This certification method is efficient and scalable to very large particle numbers and system sizes. As an optical network adhering to this symmetry, we propose to implement a J_x photonic lattice, as introduced in Phys. Rev. A 87, 022303, with an engineered coupling distribution.

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