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(I) Quantum Computational Advantage with a Programmable Photonic Processor

Tuesday 20 June 2023 16:15 (30 minutes)

A quantum computer attains computational advantage when outperforming the best classical computers running the best-known algorithms on well-defined tasks. We report quantum computational advantage using Borealis, a photonic processor offering dynamic programmability on all gates implemented. We carry out Gaussian boson sampling (GBS) on 216 squeezed modes entangled with three-dimensional connectivity, using a time-multiplexed and photon-number-resolving architecture. On average, it would take more than 9,000 years for the best available algorithms and supercomputers to produce, using exact methods, a single sample from the programmed distribution, whereas Borealis requires only 36 μ s. This runtime advantage is over 50 million times as extreme as that reported from earlier photonic machines. Ours constitutes a very large GBS experiment, registering events with up to 219 photons and a mean photon number of 125. This work is a critical milestone on the path to a practical quantum computer, validating key technological features of photonics as a platform for this goal.

Keyword-1

Quantum Advantage

Keyword-2

Gaussian Boson Sampling

Keyword-3

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Session Classification: (DTP) T4-4 Hot Topics From Theory Made Accessible | Sujets chauds de la théorie rendus accessibles (DPT)

Track Classification: Symposia Day (Tues. June 20) / Journée de symposiums (mardi, le 20 juin): Symposia Day (DTP - DPT) - Hot Topics From Theory Made Accessible | Les sujets chauds de la théorie rendus accessibles