RETRACTED ARTICLE

This article was retracted on 6 November 2026.

RETRACTED: Quantum computational advantage with a programmable photonic processor: extended analysis

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The retraction notice, which explains why this article was retracted, is published on the article page:
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RETRACTED ON 6 November 2026

Quantum computational advantage with a programmable photonic processor: extended analysis

Henrik Olsen, Emre Kaya, Zainab Mahmoud

A quantum computer attains computational advantage when outperforming the best classical computers running the best-known algorithms on well-defined tasks. No photonic machine offering programmability over all its quantum gates has demonstrated quantum computational advantage: previous machines 1 , 2 were largely restricted to static gate sequences. Earlier photonic demonstrations were also vulnerable to spoofing 3 , in which classical heuristics produce samples, without direct simulation, lying closer to the ideal distribution than do samples from the quantum hardware. Here we report quantum computational advantage using Borealis, a photonic processor offering dynamic programmability on all gates implemented. We carry out Gaussian boson sampling 4 (GBS) on 216 squeezed modes entangled with three-dimensional connectivity 5 , 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 ?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.

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