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HIGHLIGHTING NEWS

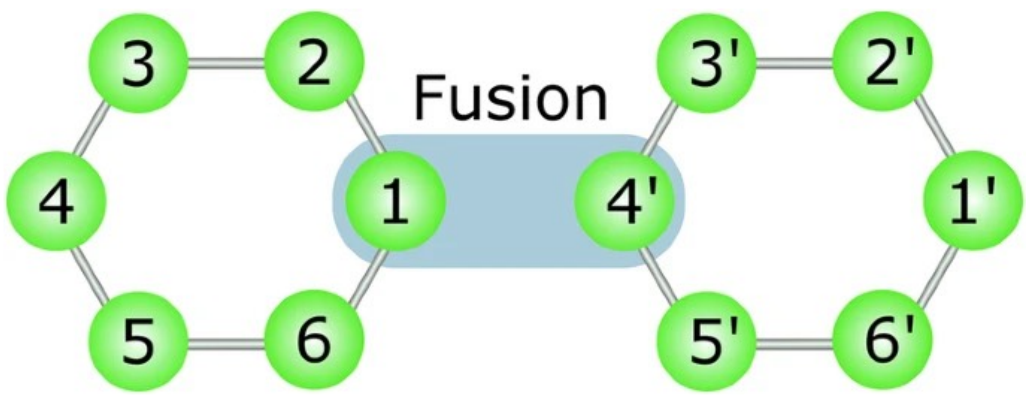
BOOSTED BELL-STATE MEASUREMENTS: A BREAKTHROUGH FOR PHOTONIC QUANTUM COMPUTING

Photonic quantum computing has emerged as a promising platform for scalable, fault-tolerant quantum computation. A crucial operation in this framework is the Bell-state measurement (BSM), which enables entangling measurements between photons. However, conventional BSMs relying on linear optics are fundamentally limited to a 50% success rate, hindering their effectiveness in large-scale quantum computations.

A recent study, *Boosted Bell-State Measurements for Photonic Quantum Computation* (npj Quantum Information, 2025), introduces an innovative approach to overcoming this limitation. The researchers demonstrate a "boosted" BSM using a **4×4 multiport splitter** combined with an **additional entangled photon pair**, significantly increasing the success probability to **69.3% experimentally** (with a theoretical upper bound of 75%).

This enhancement brings multiple advantages to fusion-based photonic quantum computing (FBQC), including **threefold improved robustness to photon loss** and **substantially reduced logical error rates.** The experiment is implemented using fiber-integrated components, making it more practical for real-world applications by eliminating the complexities of free-space optics.

This work represents a significant step toward the realization of fault-tolerant photonic quantum computers, providing a scalable method to enhance entangling operations crucial for quantum computation.



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NEURAL NETWORKS MEET QUANTUM COMPUTING: A NEW FRONTIER

Quantum computing is advancing rapidly, and a recent study explores how artificial intelligence can help solve complex quantum problems. The research, published in *Communications Physics*, investigates **Neural Quantum States (NQS)**—a machine learning-based approach to simulating quantum systems.

NQS are neural networks designed to represent quantum states efficiently. While they hold theoretical promise, their effectiveness depends on how well they scale with increasing complexity. The study focuses on the **quantum geometric tensor (QGT)**, a mathematical tool that measures the accuracy and efficiency of NQS in representing quantum ground states.

By analyzing the **spin-1 bilinear-biquadratic chain**, the researchers discovered that increasing network parameters enhances accuracy but eventually reaches a limit. This insight helps identify when additional neural network complexity **stops improving results**, which is crucial for optimizing quantum algorithms.

This work bridges machine learning and quantum physics, potentially leading to more efficient simulations of quantum materials and systems. As AI continues to integrate with quantum computing, breakthroughs like these could revolutionize the field, bringing us closer to practical quantum technologies.

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計畫補助單位： NSTC 國家科學及技術委員會 National Science and Technology Council

IBM Quantum Computer Hub at National Taiwan University

Rm.711, Dept. of Physics /Center for Condensed Building

No. 1, Sec.4 Roosevelt Rd., Da'an Dist. Taipei City 106319, Taiwan

ntuq2018@gmail.com :+886 2-33669928 http://quantum.ntu.edu.tw/