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Scaling up quantum computing and its verification on photonic systems

Date: **2024/12/16 (Mon)**

Venue: **S4-625**

Time: **14:00-15:00**

Abstract:

Scalable quantum computing requires tunability and stability in underlying physical platforms. On-chip quantum processing units (QPUs) balance tunability and stability. However, scaling up a single on-chip QPU to a large scale introduces challenges, such as crosstalk among qubits, which degrades the fidelity of quantum operations. This limitation highlights the need for alternative approaches to achieve scalable quantum computing. One promising solution is entanglement-assisted distributed quantum computing (DQC), which employs multiple small-scale QPUs interconnected via entanglement. In the first part of this talk, I will present entanglement-efficient DQC protocols that address the scalability challenge.

Photonic linear optical networks stand out as a promising platform for scalable quantum computing, leveraging their natural communication capabilities. By distributing entangled photonic states across multiple QPUs, photonic quantum computing can be scaled effectively through entanglement-assisted DQC. In such a system, measurement-based quantum computing is the primary computational paradigm, relying on precise state preparation and measurement. For high-fidelity photonic quantum computing, robust and efficient state verification techniques are therefore essential. In the second part of the talk, I will introduce a method for efficient reconstruction of multiphoton states in large-scale linear optical networks using only two bucket photon-number-resolving (PNR) detectors. It paves the way for reliable and scalable photonic quantum computing.

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