Building quantum networks of superconducting circuits mediated by telecom photons

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Quantum networks consist of several nodes of quantum processors that can communicate over long-distances, for example through commercial telecom fibers. Superconducting circuits are one of the most advanced technologies to construct the quantum processors at the nodes. However, these processors operate at microwave frequencies and cannot directly make use of the existing telecommunication infrastructure to be linked to one another. The only piece still missing for quantum networks to become a reality is a device that entangles superconducting circuits with travelling telecom photons.
In this talk, I will first review the working principles of superconducting circuits as well as recent progress towards making practical quantum processors. I will then show how my simultaneous expertise in solid-state physics, atomic physics, and quantum control led to a practical design for this desired device. I will explore the challenges of fabricating such a device, as well as state-of-the-art techniques to overcome them.

Figures

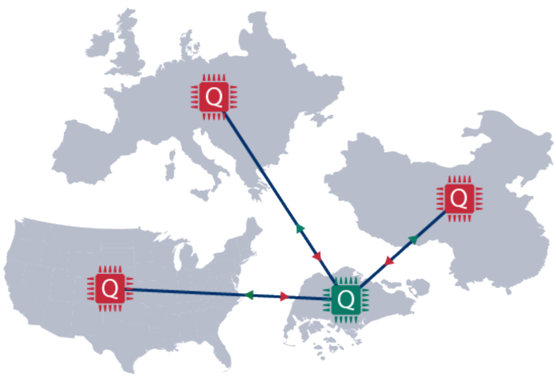

Figure 1: Schematic of a large-scale quantum network. A controlled quantum processor (green) is entangled with independent quantum processors (red) through telecommunication fibers (blue).

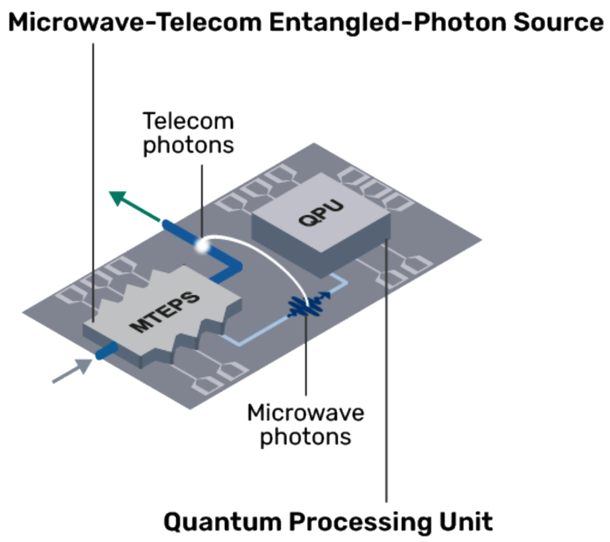

Figure 2: Schematic of the proposed device. The MTEPS sends entangled coherent states to a commercial telecommunication fiber and a QPU.