Microwave Quantum Photonics Based on Superconducting Circuits

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Abstract— As one of the leading platforms to build a quantum computer, superconducting quantum circuits provide an important platform for manipulating microwave photons. Circuit quantum electrodynamics promises a strong interaction between microwave photons and superconducting quantum circuits, thus enabling rich possibilities to generate, control, and measure the quantum state of microwave photons. Meanwhile, with microwave photons as carriers of quantum information, microwave quantum photonics could facilitate coherent connections among remote quantum chips and empower distributed quantum computing.

In this talk, I will introduce some of our recent works in realizing various microwave quantum photonic devices, including quantum light sources, quantum switches, and quantum memory. With superconducting quantum circuits, we generate nonclassical microwave emissions such as propagating single photons, time-bin encoded photonic qubits, and qudits [1]. We also demonstrate a highly scalable approach to deterministically create flying multipartite Schrödinger cat states and generalized cat states [2]. Using a superconducting qubit to coherently switch the output path of microwave photons, we realize a quantum switch that connects the input to a superposition of several outputs in a controllable way [3]. In terms of quantum storage, we realize on-demand storage and retrieval of weak coherent microwave photon pulses at the single-photon level with superconducting quantum circuits [4]. Those devices provide a rich toolbox for superconducting quantum information processing.

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