Hybrid Quantum Systems Composed of Superconducting Qubits, Nanomechanics, and Transmission Line Metamaterials

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Hybrid quantum interconnects and processor components are likely to play an important role in future scalable quantum communication and computation networks. In this talk, I will outline several nascent ideas for a new type of hybrid system, composed of mechanical elements, superconducting metamaterials, and superconducting qubits, which could be applicable to quantum transduction and memory functions. Before introducing these new ideas, I will start with a summary of recent incipient work at Syracuse that has inspired them. My summary will include a brief overview of efforts in the LaHaye group to investigate interactions between a superconducting transmon qubit and UHF nanomechanical element\textsuperscript{1}; as well, I will highlight work conducted concomitantly and independently by the Plourde group to study the mode structure\textsuperscript{2} and cQED interactions of a superconducting metamaterial transmission line. The talk will then conclude with an overview of related ideas to utilize qubit-coupled nanoresonator architectures as platforms for quantum simulation\textsuperscript{3,4}.

\textsuperscript{3} J. Lozada-Vera, A. Carrillo, O. P. de Sá Neto, J. Khatibi Moqadam, M. D. LaHaye, M. C. de Oliveira. EPJ Quantum Technology 3, 1 (2016).