QUANTUM INFORMATION PROCESSING WITH MECHANICAL SYSTEMS

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Mechanical resonators are emerging as an important new platform for quantum science and technologies. Proposals for using them to store, process, and transduce quantum information motivate the development of increasingly sophisticated techniques for controlling mechanical motion in the quantum regime. By interfacing mechanical resonators with superconducting circuits, circuit quantum acoustodynamics (cQAD) can make a variety of important tools available for manipulating and measuring motional quantum states. In this talk, I will give an overview of the field and present our recent work on measuring the phonon number distributions, parities, and Wigner functions of nonclassical mechanical states [1]. We do this by operating our system in the strong dispersive regime, where a superconducting qubit can be used to spectroscopically resolve phonon Fock states. These measurements are some of the basic building blocks for constructing more complex devices such as acoustic quantum memories and processors.

[1] U. von Lüpke, Y. Yang, M. Bild, L. Michaud, M. Fadel, and Y. Chu, arXiv:2110.00263 (2021).