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Superconducting circuit optomechanics: from milli second quantum decoherence to topological lattice

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Quantum control and measurement of mechanical oscillators have been achieved by coupling mechanical oscillators to auxiliary degrees of freedom in the form of optical or microwave cavities, allowing numerous advances such as quantum state transfer or mechanical entanglement. An enduring challenge in constructing such hybrid systems is the dichotomy of engineered coupling to an auxiliary degree of freedom, while being mechanically well isolated from the environment, that is, low quantum decoherence – which consists of both thermal decoherence and dephasing. We overcome this challenge by introducing a superconducting circuit optomechanical platform with a directly measured thermal decoherence rate of 20.5 Hz (corresponding to 7.7 milli-second T1) as well as a pure dephasing rate of 0.09 Hz. This enables us to reach to 0.07 quanta motional ground state occupation (93% fidelity) and realize mechanical squeezing of -2.7 dB below zero-point-fluctuation.

Presenter: ,□□□□□ □□□□