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Optomechanical entanglement via reservoir engineering

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A mechanical resonator could serve as an ideal system for transferring quantum states and mediating interactions between very different kinds of photons. To this end, recent experiments have realized three-mode optomechanical systems, where a single mechanical resonator simultaneously interacts with both an optical and a microwave cavity. In this talk I will discuss different strategies which use reservoir engineering in such a system as a powerful tool to generate robust, stationary entanglement between the two cavity fields. By manipulating the mechanical resonator to effectively cool delocalized Bogoliubov modes, we find that large intracavity entanglement can be achieved [1], at a level which is well above the maximum achievable via a coherent two-mode interaction. We have also analyzed the entanglement of the output fields of the two cavities. While there are significant differences from the intra-cavity fields, we again find that with proper parameter choices, large amounts of entanglement can be achieved. While the emphasis is on optomechanics, our results can also be applied directly to other 3-mode bosonic systems (e.g., as could be realized with superconducting microwave circuits).

[1] Ying-Dan Wang and A. A. Clerk, Phys. Rev. Lett. 110, 253601 (2013).