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Optical generation of vibrational entanglement in a membrane[1]

DAN GOLDBAUM, PIERRE MEYSTRE, The University of Arizona — We study the entanglement of different vibrational modes of the central membrane in a membrane-in-the-middle optomechanical setup. One attractive feature of this system is that one can tune the optomechanical coupling so that it should eventually be possible to measure the membrane's vibrational eigenstate, and to observe quantum jumps. Another attractive feature of the system, which we focus on in this study, is that the vibrational modes of the central membrane are well described by the classical theory of the vibrating drumhead. Subsequently, one can control the relative optomechanical coupling strengths for different drumhead modes by strategic positioning of the cavity field beam spot on the membrane. We show how different vibration modes become entangled through their mutual interaction with the coherent cavity field, and highlight how this entanglement can be engineered through strategic beam spot placement. In addition, we will discuss these results in the context of earlier studies of multi-mechanical-mode optomechanical systems that consisted of multiple mechanical elements rather than multiple vibrational modes of the same mechanical element, as described here.

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