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Macroscopic Entangled State Generation with Optomechanical Coupling of Two Mechanical Modes MATTHEW WEAVER, FERNANDO LUNA, Univ of California - Santa Barbara, FRANK BUTERS, KIER HEECK, SVEN DE MAN, Leiden University, DIRK BOUWMEESTER, Univ of California - Santa Barbara, Leiden University — Mechanical resonators with a large quantum position uncertainty are an excellent test system for proposed decoherence mechanisms in massive systems. We present a scheme to optomechanically entangle two mechanical resonators with large frequency separation via two tone driving and single photon projection measurements. The quantum position uncertainty can be tuned with a variable optical pulse displacement operation, and independent single photon readout of the two resonators provides robust verification of the quantum states of the system. This scheme is currently experimentally feasible in a number of high mass opto- and electro-mechanical systems. We demonstrate one such system with two spatially and frequency separated Si_3N_4 trampoline resonators. We also show how the resonators can be coupled with two tone driving and the single photon optomechanical coupling rates can be tuned.

Matthew Weaver
Univ of California - Santa Barbara

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