Abstract Submitted
for the DAMOP18 Meeting of
The American Physical Society

**Amplification of Vacuum Fluctuations in the Deep Strong Coupling Regime** BELTER E ORDAZ MENDOZA, Univ of Connecticut - Storrs, SUSANNE F YELIN, Harvard University/ Univ of Connecticut - Storrs — Optomechanics in the deep strong coupling regime is when the mechanical displacement produced by a single photon is more that its zero-point fluctuation. Recently, theoretical works have elucidated that the deep strong coupling regime could be achieved in quantum systems. In this work, we study amplification of vacuum fluctuations in the deep strong coupling regime, where the single-photon coupling rate is on the same order of magnitude of the lowest cavity frequency. Our model consists of a cavity field with one mirror fixed and the other movable in the presence of cavity loss and mechanical damping. Our model requires the cavity decay rate to be smaller than the cavity frequency, such that a single photon present in the cavity can be long enough to influence the dynamics of the mechanical oscillator. By starting with no photons and phonons, the mirror's motion follows from vacuum fluctuations. We calculate the time evolution of the average number of photons and phonons using the Heisenberg-Langevin approach, and find that amplification of vacuum fluctuation of both degrees of freedom occur when the model operates in the deep strong coupling regime.

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Date submitted: 06 Feb 2018 Electronic form version 1.4