**Title**: *Local Fluctuations in Cavity Control of Ferroelectricity*

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**Abstract**: Control of quantum materials through resonant electromagnetic cavities is a promising route towards establishing control over equilibrium quantum phases of matter. Some of the most appealing candidate systems are quantum paraelectrics, which are essentially insulators with a strongly fluctuating soft polar phonon mode. Due to the soft-mode's strong light-matter coupling, these systems present ideal platforms to demonstrate that electromagnetic cavities may be used to control fluctuations a material. First, we derive a general relation between the electromagnetic Greens' function and the phonon fluctuations which allows us to consider spatially inhomogeneous profiles of the fluctuations, as realized by the interface between a quantum paraelectric and metal mirror. In doing so, we show that coupling to the electromagnetic field is generically beneficial for establishing ferroelectric order, as the electromagnetic field serves to reduce detrimental phonon fluctuations via screening. We then explore the spatially resolved fluctuation profile in a hypothetical Fabry-Perot type geometry and show that the primary impact of cavity is limited to the boundaries, where it can lead to enhanced phonon fluctuations. Our results are then analyzed in a more general context, where we discuss possible implications for experiments looking for signatures of cavity quantum-electrodynamic effects. In particular, our results point towards potential applications in the emerging field of two-dimensional quantum materials and metamaterials, where electromagnetic properties of different materials can be combined in layered structures.