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Enhancing optomechanical coupling via the Josephson effect JANI TUORILA, University of Oulu, TERO HEIKKILÄ, University of Jyväskylä, FRANSESCO MASSEL, University of Helsinki, RAPHAËL KHAN, MIKA SILLANPÄÄ, Aalto University — Cavity optomechanics offers one of the most promising prospects for studying large systems in the quantum limit. The key element within this approach is to employ strong radiation-pressure coupling between mechanical motion and electromagnetic field. However, challenges arise because such a coupling is far too weak in typical systems. We show that the charge tuning of the non-linear Josephson inductance in a single-Cooper-pair transistor can be exploited to create a radiation pressure -type coupling between mechanical and microwave resonators. With experimentally achievable parameters, we find that the usually measured bare coupling can be amplified by a large factor, up to a strength required of the quantum limit. Instead of the non-linearity arising from the strong radiation pressure, we show that the main non-linearity in this setup originates rather from a cross-Kerr type of coupling between the resonators, allowing the access to individual phonon numbers via the measurement of the cavity. Our predictions can be readily tested in the state of the art circuit optomechanical devices.

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