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Nonlinearity-induced synchronization enhancement in micromechanical oscillators JEFFREY R. GUEST, DARIO ANTONIO, DAVID A. CZAPLEWSKI, DANIEL LÓPEZ, Center for Nanoscale Materials, Argonne National Laboratory, Argonne, IL, USA, SEBASTIÁN I. ARROYO, DAMIÁN H. ZANETTE, Centro Atómico Bariloche and Instituto Balseiro, 8400 Bariloche, Río Negro, Argentina — An autonomous oscillator synchronizes to an external harmonic force only when the forcing frequency lies within a certain interval around the oscillator's natural frequency. Under ordinary conditions, the width of this "synchronization range" decreases when the oscillator's self-sustained amplitude grows, constraining synchronized motion of micro- and nanomechanical resonators to narrow frequency and amplitude bounds. In this talk, we will show that *nonlinearity* in the oscillator can be exploited to manifest a regime where the synchronization range *increases* with increasing oscillation amplitude. We demonstrate this regime experimentally with a self-sustained micromechanical oscillator, revealing an increase in the synchronization range by orders of magnitude over that expected for a linear oscillator. We provide analytical results which show that nonlinearities are the key determinants of this enhancement. Our results suggest a new strategy to enhance synchronization of micromechanical oscillators by capitalizing on their intrinsic nonlinear dynamics.

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