Abstract Submitted
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Intrinsic mode-coupling and thermalization in nanomechanical graphene drums DANIEL MIDTVEDT, Chalmers Univ of Tech, ZENAN QI, Boston University, ALEXANDER CROY, Chalmers Univ of Tech, HAROLD S. PARK, Boston University, ANDREAS ISACSSON, Chalmers Univ of Tech — Nanomechanical graphene resonators display strong nonlinear behavior, which leads to coupling between normal modes. This coupling allows for intermodal energy-transfer, which facilitates the redistribution of energy initially localized in a single mode. Further, the mode-coupling intrinsically limits the quality factor of the device. We study the mode-coupling in a circular graphene resonator using molecular dynamics and continuum mechanics. Mimicking a ring-down setup, the fundamental mode is excited with a given energy, and the time-evolution of this energy is computed. At $T > 0$, we find a relaxation rate independent of system size and proportional to $T^*/\epsilon_{\rm pre}^2$, where T^* is the effective temperature and $\epsilon_{\rm pre}$ is the pre-strain of the system [1]. At low temperatures, the system enters a metastable state where only very few low-frequency modes are excited, the life-time of which increases exponentially with decreasing excitation energy. This is similar to what is seen in the much studied Fermi-Pasta-Ulam (FPU) problem. We make a detailed comparison between the dynamics of a graphene drum and the FPU system, and propose to use graphene drums as test beds for FPU physics.

[1]D. Midtvedt, Z. Qi, A. Croy, H. S. Park, A. Isacsson,arXiv:1309.1622

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