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Frequency stabilization of single layer graphene oscillators through optical injection locking SAMER HOURI[1], SANTIAGO CARTAMIL BUENO, Delft University of Technology, WARNER VENSTRA[2], Quantified Air
— Single layer graphene (SLG) drum resonators offer exciting prospects as experimental testbeds for nonlinear dynamics. Recently, photo-thermal induced feedback effects leading to self-oscillations in graphene have been demonstrated [1]. In this paper we examine the phase jitter of self-oscillating SLG, and the means to improve the frequency stability through optical injection locking. The resonator consists of an SLG on top of a 10 micron diameter circular cavity with a cavity depth of 750 nm. By shining a 10 mW He-Ne laser the drum enters a regime of photo-thermally induced self-oscillation. The oscillating SLG suffers from a significant phase noise that can be directly observed in the time domain as random walk of the oscillation period. By applying a lock tone to the oscillator through the application of a modulated blue laser (405 nm), the SLG motion is then phase locked to the applied tone with more than an order of magnitude improvement in its coherence time. The injection locking is also studied as a function of lock signal detuning and power.
[1] Barton, Robert A., et al. "Photothermal self-oscillation and laser cooling of graphene optomechanical systems." *Nano letters* 12.9 (2012): 4681-4686.

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