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Cavity optomechanics with silicon nitride sub-wavelength grating membranes UTKU KEMIKTARAK, MATHIEU DURAND, MICHAEL METCALFE, Joint Quantum Institute, University of Maryland and National Institute of Standards and Technology, JOHN LAWALL, National Institute of Standards and Technology — In the interest of developing a high frequency, low mass, and high reflectivity optomechanical system, we pattern silicon nitride membranes as sub-wavelength diffraction gratings. This allows us to achieve mechanical quality factors reaching $Q = 10^6$, at room temperature, and reflectivities close to $R = 99.8\%$, while simultaneously decreasing the mass of the membrane. We explore the optomechanical interactions, both in the self-oscillation and cooling regimes. In the former regime, we observe a number of mechanical modes competing for self-oscillation and the dynamics of mode competition is determined by the intrinsic damping rates of the mechanical modes and their coupling strengths to the optical mode. In the latter regime, we cool a mechanical mode at 190 kHz from room temperature to below 1 K.

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