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Suppression of extraneous thermal noise in cavity optomechanics[1]

YI ZHAO, DALZIEL WILSON, K.-K. NI, H.J. KIMBLE, Norman Bridge Laboratory of Physics, 12-33, California Institute of Technology, Pasadena, California 91125. — Extraneous thermal motion can limit displacement sensitivity and radiation pressure effects, such as optical cooling, in a cavity-optomechanical system. Here we present an active noise suppression scheme and its experimental implementation. Our technique involves mapping a measurement of the extraneous noise onto the frequency of the incident laser field to stabilize the associated laser-cavity detuning. The main challenge is to selectively sense and suppress extraneous thermal noise without affecting motion of the oscillator. Our solution is to monitor two modes of the optical cavity, each with different sensitivity to the oscillator's motion but similar sensitivity to the extraneous thermal motion. This information is used to imprint "anti-noise" onto the frequency of the incident laser field. In our system, based on a nano-mechanical membrane coupled to a Fabry-Pérot cavity, simulation and experiment demonstrate that extraneous thermal noise can be selectively suppressed without substantially affecting motion of the oscillator and that the associated limit on optical cooling can be reduced. Details of this work are presented in [1].

[1] Y. Zhao, D. J. Wilson, K.-K. Ni, and H. J. Kimble, Optics Express (in press); arXiv:1112.3362.

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Yi Zhao
California Institute of Technology

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