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Optomechanical Quantum Correlation Thermometry T. P. PURDY, Joint Quantum Institute/NIST, K. E. GRUTTER, M. I. DAVANCO, K. SRINIVASAN, Center for Nanoscale Science and Technology/NIST, J. M. TAYLOR, Joint Quantum Institute/NIST; Joint Center for Quantum Information and Computer Science/UMD — We present an optomechanical approach for producing accurate thermometry over a wide temperature range using quantum Brownian motion. Optical measurements induce quantum correlations in an optomechanical system when quantum-limited intensity fluctuations of a probe laser drive mechanical motion. The size of the correlations in the weak probe limit are dictated by the scale of individual phonons. We have recently measured optomechanical quantum correlations in the cross correlation spectrum between the amplitude and phase fluctuations of a single probe laser interacting with a silicon nitride optomechanical crystal. These correlations are independent of thermally-induced Brownian motion. However, Brownian motion does simultaneously produce much larger correlation signals between other optical quadratures. A comparison of the size of thermally-induced correlations to quantum correlations allows us to absolutely calibrate Brownian motion thermometry to the mechanical energy quantization scale.

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