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**Nanomechanical Measurement of the Brownian Force Noise in a Viscous Liquid**[1] ATAKAN ARI, Boston University, SELIM HANAY, Bilkent University, MARK PAUL, Virginia Tech, KAMIL EKINCI, Boston University — We study the spectral properties of the thermal noise force giving rise to Brownian fluctuations of a continuous mechanical system — namely, a doubly clamped nanomechanical beam resonator — immersed in a viscous liquid. To this end, we perform two separate sets of experiments. First, we measure the power spectral density (PSD) of the Brownian fluctuations of the resonator around its fundamental mode at its center by detecting the thermal fluctuations. Then, we measure the frequency-dependent linear response of the resonator, again at its center, by driving it with a harmonic force, via an electrothermal transducer, that couples well to the fundamental mode. These two separate measurements allow us to determine the PSD of the Brownian force acting on the structure in its fundamental mode. The PSD of the force noise extracted from multiple resonators with varied lengths spanning a broad frequency range displays a "colored spectrum" and follows the viscous dissipation of a cylinder oscillating in a viscous liquid by virtue of the fluctuation-dissipation theorem. The data are compared with a single-mode theory, with the deviations providing insight into the nature of the Brownian force acting on a multi-degree-of-freedom continuous system.

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Atakan Ari
Boston University

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