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Spectral Decomposition of Entropy Production in Acto-Myosin Gels ALEXANDRU BACANU, TODD GINGRICH, JUNANG LI, JORDAN HOROWITZ, NIKTA FAKHRI, Massachusetts Institute of Technology — Active force generation at the molecular scale in living systems can result in stochastic non-equilibrium dynamics on mesoscopic scales. A characteristic feature of such non-equilibrium systems is the emergence of steady-state currents. Constant dissipation of energy is required to maintain these currents. Here, we introduce a non-invasive technique to probe non-equilibrium dynamics in active gels using single-walled carbon nanotubes (SWNTs). SWNTs are semi-flexible polymers with intrinsic fluorescence in the near infrared. We see breaking of detailed balance in the phase space spanned by the normal mode amplitudes of SWNT shape fluctuations, manifested through closed current cycles. These cycles imply a transfer of energy between different length scales. Using the fluctuations of phase space currents, we extract bounds on the local energy dissipation rate. The spectral decomposition of entropy production allows detailed examination of the spatial structure and correlations that underlie departures from thermal equilibrium.

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