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Extreme value statistics of work done in stretching a polymer in a gradient flow MARIJA VUCELJA, Center for Studies in Physics and Biology, The Rockefeller University, 1230 York Avenue, New York, NY 10065, USA, KONSTANTIN TURITSYN, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA, 02139, US, MICHAEL CHERTKOV, Theory Division & Center for Nonlinear Studies at LANL and with New Mexico Consortium, Los Alamos, NM 87545, US — We study the statistics of work on a finitely extensible polymer subjected to a gradient flow and thermal fluctuations. The flow breaks the detailed balance and stretches the polymer, the work to stretch the molecule is stored as elastic energy, which later dissipates with fluctuations of the molecule's elongation. The whole system is in a non-equilibrium dynamical state, which is sustained by the energy flow from the fluid to the molecule and back. We obtain the Large Deviation Function (LDF) of the work in the full range of appropriate flow, elasticity and thermal noise parameters by combining analytical and numerical tools. The LDF shows two distinct asymptotes: "near tails" are linear in work and dominated by coiled polymer configurations, while "far tails" are quadratic in work and correspond to preferentially fully stretched polymers. We find the extreme value statistics of work for several elastic potentials, as well as the mean and the dispersion of work near the coil-stretch transition. The dispersion shows a maximum at the transition. In our work, we use non-equilibrium work relations to study the extension of a polymer in a flow. Relations like these are becoming instrumental in studies of soft matter materials.

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