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Scale-Dependent Viscosity in Ring and Linear Polymer Fluids WATEE SRININ, ALEXANDER GROSBERG, Department of Physics and Center for Soft Matter Research, New York University, JEAN-FRANCOIS JOANNY, Physico-Chimie Curie UMR 168, Institut Curie, PSL Research University, YITZHAK RABIN, Department of Physics and Institute for Nanotechnology and Advanced Materials, Bar Ilan University — Traditional polymer rheology considers the response of the polymer fluids caused by external forces applied on a macroscopic scale. By contrast, in live cells, and especially in the nucleus, one encounters the situation in which forces are applied on a molecular scale, for instance, by molecular motors or other active ATP-consuming molecules. The influence of these locally applied forces can cascade upwards and lead to large-scale motion of the surrounding fluids which can not be captured by the traditional notion of viscosity. In this work, we examine the response of polymer fluids to forces applied at finite wave vector and frequency. Using simple physical arguments we construct a "phase diagram" of various frequency and wave vector-dependent regimes of effective viscosity for polymer fluids, including non-entangled and entangled melts, semidilute solutions with and without hydrodynamic interactions, as well as the more exotic case of a melt of unconcatenated ring polymers.

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