Elastohydrodynamics of wet bristles, carpets and brushes
LAKSHMINARAYANAN MAHADEVAN, SEAS, Harvard University, ARVIND GOPINATH, Mechanical Engineering, MIT — We present an effective field theory for the elastohydrodynamics of ordered brushes and disordered carpets. These soft beds are comprised of elastic filamentous units, interspersed in a fluid and grafted on a substrate. Our formulation leads naturally to a set of constitutive equations coupling bed deformation to fluid flow, accounts for anisotropic properties of the medium, and generalizes poroelasticity to these systems. These effective medium equations are then used to study two canonical problems - the normal settling of a rigid sphere onto a carpet, and the tangential shearing motion of a rigid sphere over the carpet, both problems of much relevance in mechanosensation in biology.

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