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Capillary Levelling of Cylindrical Holes in Freestanding Polymer Films JOHN NIVEN, PAUL FOWLER, McMaster University, THOMAS SALEZ, ESPCI, HOWARD STONE, Princeton University, LIE RAPHAL, ESPCI, KARI DALNOKI-VERESS, McMaster University — Studying nano-scale flow in thin viscous films is of both practical and theoretical interest, particularly when considering the role of the hydrodynamic boundary conditions. Here, thin bilayer polystyrene films were prepared freestanding in air, with one of the two films having micrometer scale cylindrical holes. Because of the free interfaces, such films flow without interfacial friction at either surface. The viscoelastic relaxation of the holes was studied using atomic force microscopy. The temporal evolution of the holes shows three distinct regimes: an early time regime where the film undergoes an elastic response; an intermediate regime where the hole undergoes viscoelastic symmetrization to equilibrate internal Laplace pressure; and a late time regime where the film undergoes capillary driven flow.

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