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Visualization of the Flow Field induced by an Oscillating Post in a 2D Fluid Membrane[1] Z. QI, K. FERGUSON, J. PAPAIOANNOU, Y. SECHREST, T. MUNSAT, C.S. PARK, M.A. GLASER, J.E. MACLENNAN, N.A. CLARK, Physics, University of Colorado, T. KURIABOVA, Physics Department, California Polytechnic State University, T.R. POWERS, School of Engineering and Department of Physics — Thin fluid membranes immersed in a less viscous, bulk fluid are of fundamental interest as approximations of true two-dimensional (2D) fluids and as models of biological membranes. Many previous studies of such fluid membranes have focused on 2D macroscopic hydrodynamic effects such as the diffusion and interaction of inclusions, with fewer experimental investigations of microscopic properties such as the flow field. We have measured the 2D flow field generated by a rigid, oscillating post inserted in a freely suspended smectic liquid crystal film surrounded by air by analyzing the motion of tracer particles in the film. Our experiments confirm Saffman's prediction that the far-field flow velocity decays as 1/r (where r is the distance from the post) in the longitudinal direction, and as 1/r^2 in the tangential direction. The measurements are in good agreement with flow fields computed using a model that generalizes the Levine/MacKintosh point-force response function. We have also investigated confinement effects that arise when the post is located near the film boundary.

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