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Buckling of a thin, viscous film in an axisymmetric geometry[1]

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By adapting the Föppl-von Kàrmàn equation, which describes the deformation of an elastic membrane, we consider the buckling pattern of a thin, very viscous fluid layer subject to shear in an axisymmetric geometry. A linear stability analysis yields a differential eigenvalue problem, whose solution by spectral methods, yields the most unstable azimuthal wave-number, m^*. Contrary to the discussion of Slim et al. (*J. Fluid Mech.*, **694**, pp. 5-28, 2012), we argue that the axisymmetric problem shares the same degeneracy as its rectilinear counterpart so that at the onset of instability, m^* is indefinitely large. Away from this point, however, a comparison with analogue experimental measurements is both possible and generally favorable. In this vein, we describe the laboratory apparatus used to make new measurements of m^*, the phase speed and the wave amplitude; no prediction concerning the latter two quantities can be made using the present (self-adjoint) theory. Experiments reveal a limited range of angular velocities where waves of either small or large amplitude may be excited. In contrast to the analogue problem from solid mechanics, transition from one to the other regime does not appear to be associated with a notable change in m^*.

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