Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Geometric scaling of purely elastic instability in viscoelastic Taylor-Couette flow CHRISTOF SCHAEFER, Saarland University, Experimental Physics Department, ALEXANDER MOROZOV, University of Edinburgh, School of Physics and Astronomy, CHRISTIAN WAGNER, Saarland University, Experimental Physics Department — The behavior of viscoelastic Taylor-Couette flow, the flow of, e.g., a polymeric fluid between two concentric, rotating cylinders, has been extensively investigated for many years in experiments as well as in theory. In the most simple case of an outer beaker at rest and a rotating inner cylinder with radii R_2 and R_1, respectively, even at negligible Taylor number $Ta = 2\mathrm{Re}^2(\mathrm{R}_2 - \mathrm{R}_1)/\mathrm{R}_1$, the circular Couette (base) flow gets linearly unstable at a critical Weissenberg number $Wi_c = \lambda\dot{\gamma}$, the product of the characteristic polymer relaxation time λ and the (critical) shear rate $\dot{\gamma}_c$. This non-inertial transition to complex flow patterns is purely elastic by nature and the dimensionless criterion by P. Pakdel and G.H. McKinley (JNNFM 67 (1996)) gives a simple, critical condition for its onset. It pictures the competition between viscous shear and elastic normal stresses as well as the influence of polymer relaxation length and curvature of the streamlines. We present a comparative study of the explicit curvature scaling of the onset of elastic instability in the Taylor-Couette flow, including experimental data as well as linear stability analyses and theoretical examinations.

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Date submitted: 27 Jul 2013 Electronic form version 1.4