

Abstract Submitted
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New insights into the nature of the asymmetrical flow of shear-thinning polymer solutions in transitional pipe flow CHAOFAN WEN, ROBERT POOLE, DAVID DENNIS, University of Liverpool — Previous studies of shear-thinning fluids in pipe flow discovered that, although the time-averaged velocity profile was axisymmetric when the flow was laminar or fully turbulent, contrary to expectations it was asymmetric in the laminar-turbulent transition regime. The general consensus of these previous experiments was that the location of the peak velocity remained at a fixed point in space. We present new experimental data which demonstrates that this is in fact not the case. The experiment was performed using an aqueous solution of Xanthan Gum (0.15wt%), a shear-thinning polymer solution. Stereoscopic particle image velocimetry (SPIV) was used to measure the 3C velocity vectors over the entire circular cross-section of the pipe, 220 pipe diameters downstream of the inlet. The exhibition of significant departures from axisymmetry in transitional flows of shear-thinning fluids was observed and in addition it was discovered that the asymmetric flow pattern is not stationary, although the peak velocity does preferentially arise at certain azimuthal locations. The ensemble average of all the SPIV data results in the recovery of the velocity profile measured using laser Doppler velocimetry in previous studies: still asymmetric but to a lesser extent than the instantaneous flow.

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