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Finite amplitude instability in two layer viscosity-stratified plane Poiseuille flow PRIYANKA SHUKLA, GEETANJALI CHATTOPADHYAY, USHA R, Department of Mathematics, Indian Institute of Technology Madras, Chennai 600036, India — The weakly nonlinear analysis of two-layer viscosity stratified plane-Poiseuille flow (PPF) is examined using Stuart-Landau type order parameter equation. The amplitude expansion method is used to derive weakly nonlinear equations upto cubic order in amplitude. The resulting set of equations is then solved numerically using Chebyshev spectral collocation method and the results are validated from the limiting case of single layer PPF. We show that while in the case of single layer PPF subcritical region spans larger range in (Re, α)-plane with Re and α being the Reynolds number and wave number, respectively, the subcritical region is confined only to a narrow region around the neutral stability curve in the case of two-layer viscosity stratified PPF. Owing to this, there is a region below Re_c^{nl} where the flow is always nonlinealy stable. The linear stability of two-layer PPF predicts stability of the base flow for $\mathrm{Re} < \mathrm{Re}_c$, however, the weakly nonlinear analysis reveals the subcritical instability for $\mathrm{Re}_c^{nl} < \mathrm{Re} < \mathrm{Re}_c$ and the existence of supercritical region for $\mathrm{Re} > \mathrm{Re}_c$. It is found that there is a significant reduction in the critical Reynolds number.

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