Supercritical Bifurcation Cascade of Travelling Waves in Pipe Flow

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ABSTRACT

A succession of transitions leading to temporal chaos of a family of travelling-wave-type solutions in pipe Poiseuille flow is studied numerically. As the Reynolds number (*Re*) is increased, these waves, which belong in the 2-fold azimuthally-periodic subspace and are initially stable within their subspace [1], lose stability to increasingly complex flows. Along the way, we report a vast array of new time-dependent solutions, including spiralling, modulated-travelling, modulated-spiralling, doubly-modulated-spiralling and mildly chaotic waves. The formation of a chaotic set, albeit seemingly unrelated to pipe flow fully-fledged turbulence, illustrates a mechanism whereby the flow structures required for turbulent dynamics might be created elsewhere in phase space.

REFERENCES

[1] Fernando Mellibovsky, Bruno Eckhardt *Takens-Bogdanov Bifurcation of Travelling Waves in Pipe Flow*, J. Fluid Mech. **670**, 96-129, 2011.