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Secondary Floquet modes of instability in Taylor-Couette flow with axial and radial through-flows DENIS MARTINAND, ERIC SERRE, LM2P2, Aix Marseille Université - CNRS - Centrale Marseille, RICHARD LUEPTOW, Department of Mechanical Engineering, Northwestern University — Injecting a fluid between a fixed outer impermeable cylinder and concentric rotating permeable inner one and driving it axially is a set-up used in some filtration devices or enzymatic reactors, where the rotation of the inner cylinder promotes mixing or prevents accumulation processes. This set-up can be seen as a Taylor-Couette flow with superimposed axial and radial through-flows and a precise knowledge of the flow structures at stake is a prerequisite for improving these devices. We address the instabilities observed after the laminar flow of a pure, Newtonian solvent has undergone its first two transitions. Previous linear stability analysis has shown that critical convective instabilities take the form of travelling toroidal vortices, turning to helical vortices as the axial flow is increased. Moreover, a weakly non-linear analysis have shown that this primary transition can be subcritical as the radial flow is increased. Based on these previous results, the stability of these primary modes is studied by Floquet analysis. Depending on the strength of the axial and radial flows, harmonic or subharmonic secondary modes are found to be the most dangerous ones. The analytical results are compared to direct numerical simulations using a pseudo-spectral method.

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