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Global modes in Taylor–Couette–Poiseuille Flow with a permeable inner cylinder[1] DENIS MARTINAND, Aix Marseille Univ, CNRS, Centrale Marseille, M2P2, Marseille, France, NILS TILTON, Department of Mechanical Engineering, Colorado School of Mines, Golden CO 80401 — The addition to a Taylor–Couette cell of an axial Poiseuille flow and a radial flow associated with a weakly permeable inner cylinder results, at a given rotation rate of the inner cylinder, in adjacent regions of the flow that are simultaneously stable, convectively unstable, and absolutely unstable, making this system fit for obtaining global modes of centrifugal instability. Critical conditions of the instabilities are obtained using the analytical frameworks of linear and non-linear global modes. Besides, dedicated Direct Numerical Simulations implementing the Darcy's condition on the permeable cylinder are performed to assess the validity of these analyses. Three different set-ups are considered. Fluid injection, in the first set-up, or extraction, in the second, occur along the full length of the inner cylinder. In the third, fluid flux through the inner cylinder evolves from extraction to injection as cross flow reversal occurs. Though correctly predicting the nature and location of the wavemakers governing the global instability, and their critical conditions, the analyses do not explain, however, that the instabilities observed in the numerical simulations take the form of axial stacks of wave-packets characterized by step-ups and step-downs of the temporal frequency.

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Denis Martinand
Aix Marseille Univ, CNRS, Centrale Marseille, M2P2, Marseille, France

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