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Mode competition and destabilization of microfluidic channel flows by the Coriolis force SAUNAK SENGUPTA, SANDEEP SAHA, SUMAN CHAKRABORTY, IIT Kharagpur — Understanding flow stability in inertial microfluidics is very important due to its increased application in medical and chemical engineering. On a steady rotating platform centrifugal actuation drives fluid flow but Coriolis force can destabilize the flow and enhance mixing in a short span. We investigate the role of Coriolis force in micro-mixing and the structure of the roll-cells formed in rotating channel flow using linear stability theory. We conduct a parametric study at different rotation numbers, Reynolds number, axial and spanwise wavenumbers. Our results reveal existence of multiple competing unstable modes (Types I to IV) due to Coriolis force: Types I and II have been reported in literature and are responsible for the formation of evenly-spaced roll-cells. We find new instabilities (Types III and IV) which contribute to the formation of twisted roll cells. The existence of the instabilities is clearly demarcated on a regime map to assist future experiments to identify them. The kinetic energy budget has been analyzed to gain insight into the mechanism of energy transfer by Coriolis force from the mean flow to the perturbations. We make a qualitative comparison of roll-cells predicted by linear stability with previously reported experiments.

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