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Ferrofluidic wavy Taylor vortices under alternating magnetic field

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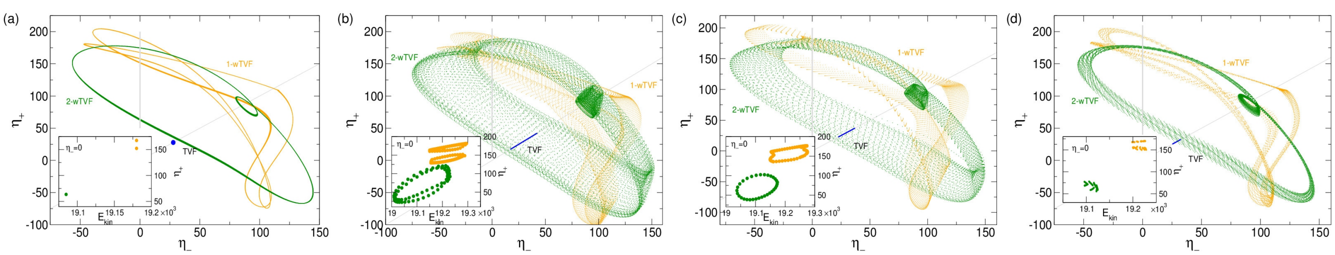
Many natural and industrial flows are subject to time-dependent boundary conditions and temporal modulations (e.g. driving frequency), which significantly modify the dynamics compared with their static ounterparts. The present problem addresses ferrofluidic [1] wavy vortex flow in Taylor-Couette geometry [2], with the outer cylinder at rest in a spatially homogeneous magnetic field subject to an alternating modulation. Using a modified Niklas approximation, the effect of frequency modulation on non-linear flow dynamics and appearing resonance phenomena are investigated in the context of either period doubling or inverse period doubling. Flow structures of particular interest in the present work are wavy Taylor vortex flows (wTVFs) [3] (which already have a natural frequency) with main focus on resonance phenomena when the modulation frequency reaches multiples or ratios of the natural, that is characteristic, frequency of the studied flow states.



Phase portrait of 1-wTVF and 2-wTVF under axial magnetic field and different driving frequencies: (a) ΩH=0, (b) ΩH=15, (c) ΩH=30, and (a) ΩH=100.

References

[1] R. E. Rosensweig, Ferrohydrodynamics. *Cambridge University Press, Cambridge* (1985).

[2] G. I. Taylor, Stability of a viscous liquid contained between two rotating cylinders, *Philos. Trans. R. Soc. Lond. A* **223** 289 (1923).

[3] S. T. Wereley, and R. M. Lueptow, Spatio-temporal character of non-wavy and wavy Taylor-Couette flow, *J. Fluid Mech.* **364**, 59 (1998).