Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Coupling of vortex breakdown and stability in a vortex T-mixer flow SAN TO CHAN, Okinawa Institute of Science and Technology Graduate University, JESSE AULT, Biomedical Sciences, Engineering, and Computing Group, Oak Ridge National Laboratory, SIMON HAWARD, Okinawa Institute of Science and Technology Graduate University, ECKART MEIBURG, Department of Mechanical Engineering, University of California, Santa Barbara, AMY SHEN, Okinawa Institute of Science and Technology Graduate University — We use microfluidic experiments and numerical simulations to study the flow in a vortex T-mixer: a T-shaped channel with staggered, offset inlets. The vortex T-mixer flow is characterized by a single dominant vortex, the stability of which is closely coupled to the appearance of vortex breakdown. Specifically, at a flow Reynolds number of Re $\sim$ 90, a first vortex breakdown region appears in the steady state solution, rendering the vortex pulsatively unstable. A second vortex breakdown region appears at Re $\sim$ 120, which restabilizes the vortex. Finally, a third vortex breakdown region appears at Re $\sim$ 180, which renders the vortex helically unstable. Thus, a counter-intuitive flow regime exists for the vortex T-mixer in which increasing the flow Reynolds number has a stabilizing effect on the steady state flow. Our study showcases microfluidics as an effective new tool to study vortex dynamics and provides experimental and numerical evidence of the close coupling between vortex breakdown and flow stability.

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Date submitted: 25 Jul 2019 Electronic form version 1.4