Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Bubbles dancing in a vortex: trapping air at a T-junction DANIELE VIGOLO, NATHAN TYRELL, Princeton University, STEFAN RADL, Graz University of Technology, HOWARD STONE, Princeton University — We present an unusual phenomenon that occurs to low density material, and in particular air bubbles, entrained in a fluid when flowing through a T-junction. For a range of Reynolds numbers, the flow develops two symmetric vortices. Air bubbles are forced to the center of the vortex due to the centrifugal force and, for Reynolds number, Re, greater than ≈ 220, are then "trapped", i.e. they accumulate inside the vortex. Bubbles eventually oscillate (i.e. "dance") in the vortex when the flow becomes unsteady for $Re > 550$. Experiments were conducted by generating H_2, O_2 or simply air bubbles in the range $Re = 100$ to $\approx 6,000$ in a variety of T-junction devices. We have also observed a size dependence of the trapping phenomenon. In addition, our 3D numerical simulations have revealed a gradient of pressure, similar to vortex breakdown, that drives the flow towards the center of the T-junction creating two recirculating zones, which trap air bubbles. The presence of light material or air trapped in a flow could be relevant to industrial systems and biological flows, such as blood vessels, and may contribute to unexpected complications and/or failures in these systems.

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Date submitted: 01 Aug 2012 Electronic form version 1.4