Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Heat transfer enhancement in a cross-slot micro-geometry[1]
ALLYSSON DOMINGUES, WALEED ABED, ROBERT POOLE, DAVID DENNIS, University of Liverpool — The cross-slot geometry is a common geometric shape in microfluidic applications. In this work we investigate, numerically and experimentally, the influence of a purely-inertial flow instability on the enhancement of heat transfer in a cross-slot micro-geometry where symmetry is broken but the flow remains steady. The cross-slot comprises two crossed square channels with opposed inlets and outlets, which generate a stagnation point at the geometric centre. The flow of a Newtonian fluid is steady, two-dimensional and produces a sharp symmetric boundary between fluid streams entering the cross-slot from opposite directions at low Reynolds numbers (Re). Therefore, only conduction heat transfer occurs between the fluid streams as there is virtually no mixing between them. Beyond a certain critical value of Re, approximately 40, a steady symmetry-breaking bifurcation occurs and convective heat transfer arises because an axially oriented spiral vortex is created in the outlet arms. The effects of this purely-inertial instability suggest it is an effective method of enhancing mixing and heat transfer in microfluidic devices that can be exploited in applications such as lab-on-chip and micro chemical-reaction devices at relatively low Reynolds numbers (i.e. $Re < 100$).

[1]Work supported by CNPq grant 203195/2014-0

Allysson Domingues
University of Liverpool

Date submitted: 01 Aug 2016 Electronic form version 1.4