Department of Mathematics
City University of Hong Kong

Colloquium

Organised by Dr Weifeng QIU and Dr Xianpeng HU

New observations of hydrodynamic instabilities around junctions by using microfluidics

By

Professor Amy Shen
Micro/Bio/Nanofluidics Unit
Okinawa Institute of Science and Technology Graduate University

Abstract:

Despite their simple geometries, flow around junctions exhibit complex hydrodynamic behaviors such as the formation of vortices due to Dean instability or spontaneous symmetry breaking. By utilizing new microfabrication methods and imaging techniques, we developed glass microfluidic devices containing junctions to study several hydrodynamic problems.

1. In the first example, we present a clear and unambiguous visualization of the full structure of vortex breakdown for flow within a T-junction, and examine how small outflow imbalances (relevant to real-life systems) affect the vortex breakdown structure. Flow recirculation occurs in the outlets of a dividing T-junction of square cross-section when the inlet Reynolds number Re exceeds a critical value Rec ≈ 350. We demonstrate that even slight outflow imbalances can significantly alter both Rec and the structures of the recirculation zones [1].

2. In the second example, we examine fluid flow through micro-cross-slot devices with various aspect ratios, and investigate how weakly elastic fluids can influence an inertially-driven flow instability. Our experimental configuration allows direct examination of a single steady vortex, shedding new insight into the competing effects of inertial and elastic instabilities on vortex formation and dynamics at small length scales [2].

1. Chan S T et al., Microscopic Investigation of Vortex Breakdown in a Dividing T-Junction Flow, Physical Review Fluids 3: 072201(R), 2018.
2. N. Burshtein, et al, Inertioelastic flow instability at a stagnation point, Physical Review X, 7, 041039-18, (2017).

Date: 19 February 2019 (Tuesday)
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Venue: 2208, Li Dak Sum Yip Yio Chin Academic Building (LI)
City University of Hong Kong

** All interested are welcome **

For enquiry : 3442-5488

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