Liquid crystals (LCs) are complex fluids having inherent anisotropic attributes. The nature of their physical properties are in contrast to the isotropic fluids which we typically employ for state-of-the-art microfluidic science and technology. The material anisotropy, which can be tuned by readily accessible external fields, allows us to explore LCs as functional materials for microfluidics. Harnessing the anisotropic coupling between the flow, the molecular orientation, and the spontaneous ordering or topology of the system has resulted in different novel concepts under microfluidic settings. A feature which is particularly promising for future applications is that topological defects in liquid crystals can serve as soft rails for colloidal particles, aqueous droplets or other microfluidic cargo. At a more fundamental level, topological singularities of hydrodynamic origin, provide a rich platform to study the dynamics between singularities of distinct origins (Figure 1, (a) - (c)). We shall discuss suggestive experiments to understand these interactions, and conclude the talk with some emerging concepts in Topological Microfluidics.

Figure 1: Topological Templates. a) Experimental observation of a $-1$ defect at the flow junction in a $90^\circ$ cross-channel. b) and c) show flow-induced generation of topological defects with increasing effective strengths: $-2$ and $-3$ respectively. The defects have been imaged between crossed-polars, scale bar: 50 $\mu$m.