Organization and dynamics of cell cultures as active nematic system

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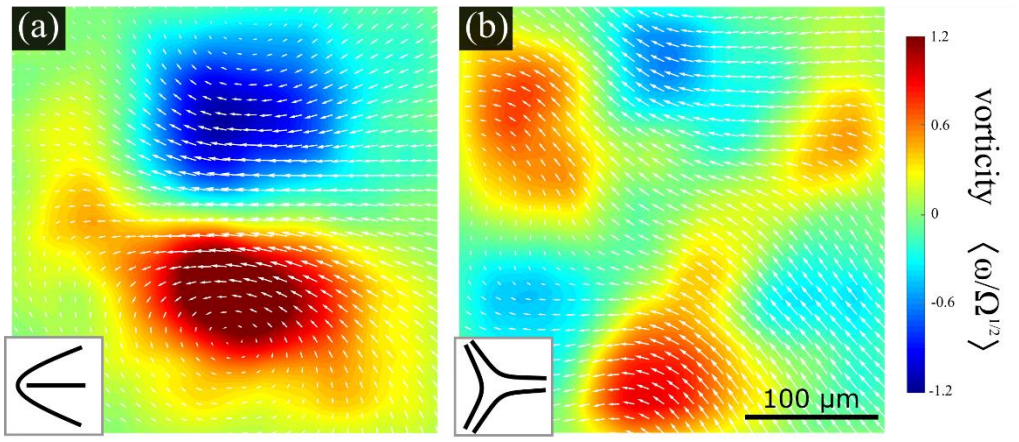
Cells exhibit rich repertoire of dynamical behaviors, which depend on cell phenotype and microenvironment. The collective dynamics of cells has gathered increasing attention inspiring experimental and theoretical studies in an attempt to unravel the underlying physical principles. Using *in vitro* experiments, we show that very different cell types self-organize in a bi-dimensional nematic phase with characteristic ±1/2 nematic defects. I will present examples of (1) spontaneous symmetry breaking and emergence of shear flows of spindle-shaped cells when confined in adhesive stripes; (2) existence of nematic turbulent phase driven by cell activity in epithelial cell monolayers; and (3) conditions for appearance of activity driven turbulence in confined environment. I will discuss physical mechanisms of these out of equilibrium phenomena and their effect on tissue organization and biological function.



Flow fields and vorticity map around ±1/2 defects in cell packings in epithelia