Master 2 ICFP - Physics of Multicellular Systems

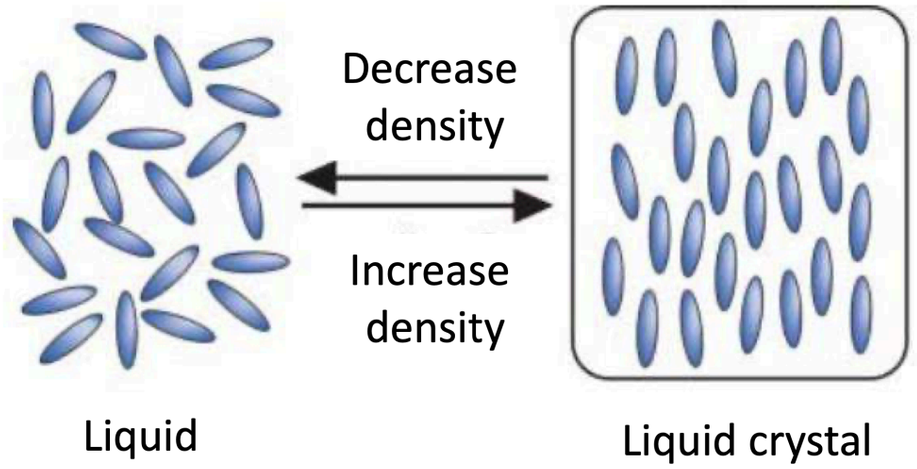
Lesson 7-8

Continuous models of tissues: cellular nematics

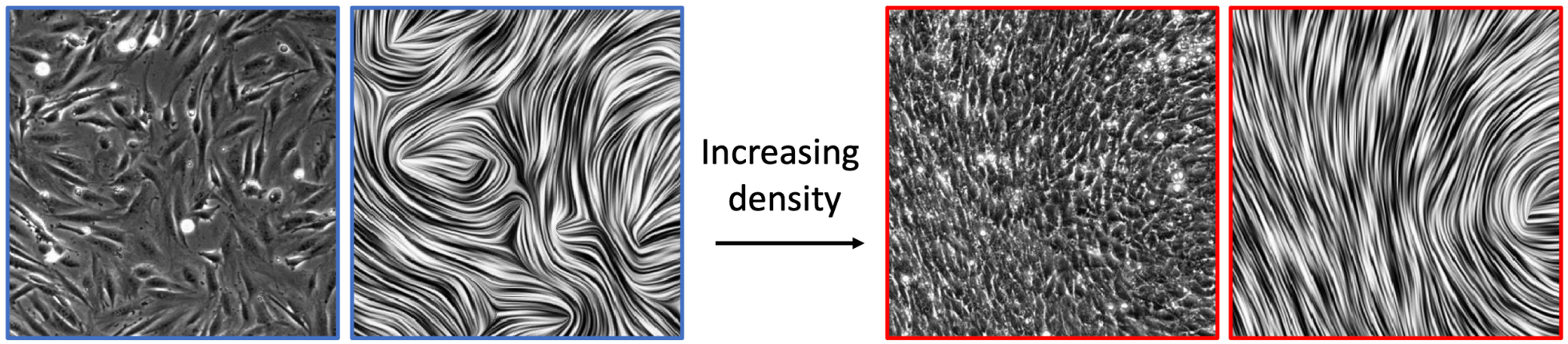
Hervé Turlier - March 13th and 20th 2023

Cellular nematics

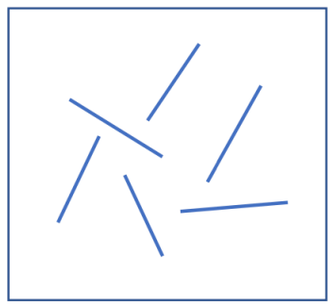
Liquid crystals



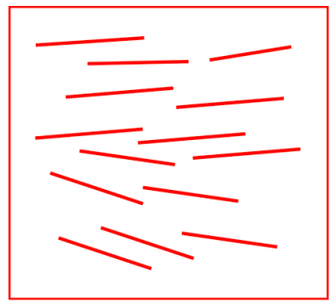
Prost, De Gennes
The physics of liquid crystals
1993



Low density
Low order

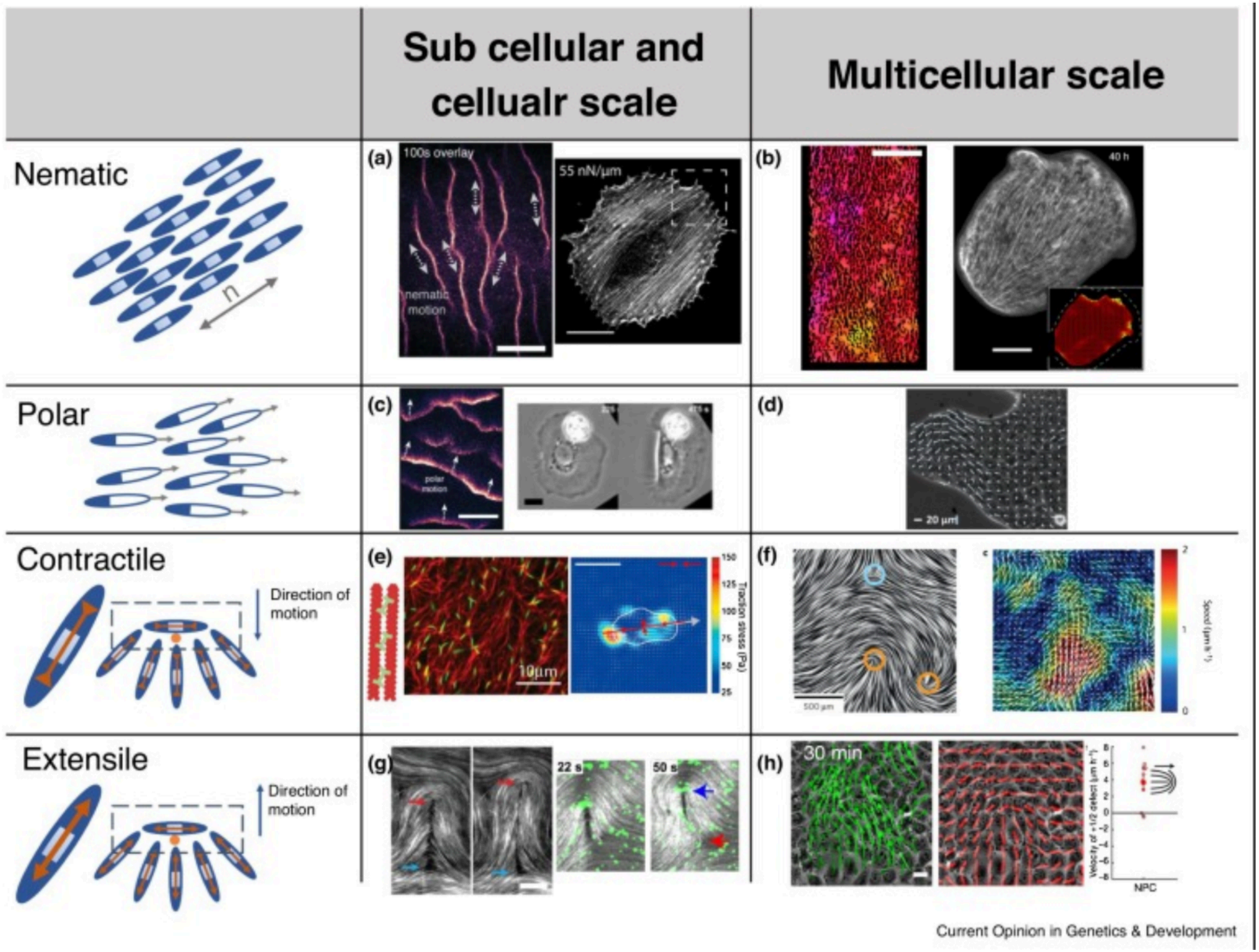


High density
High order



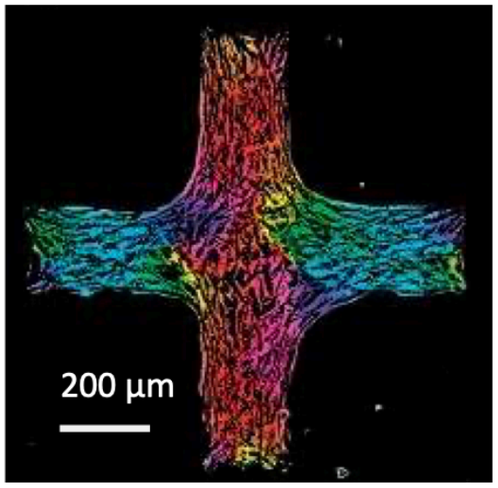
Duclos et al, *Soft Matter* 2014

Cellular nematics

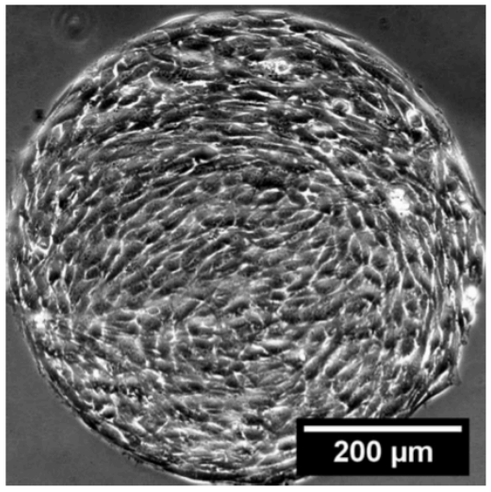


Cellular nematics

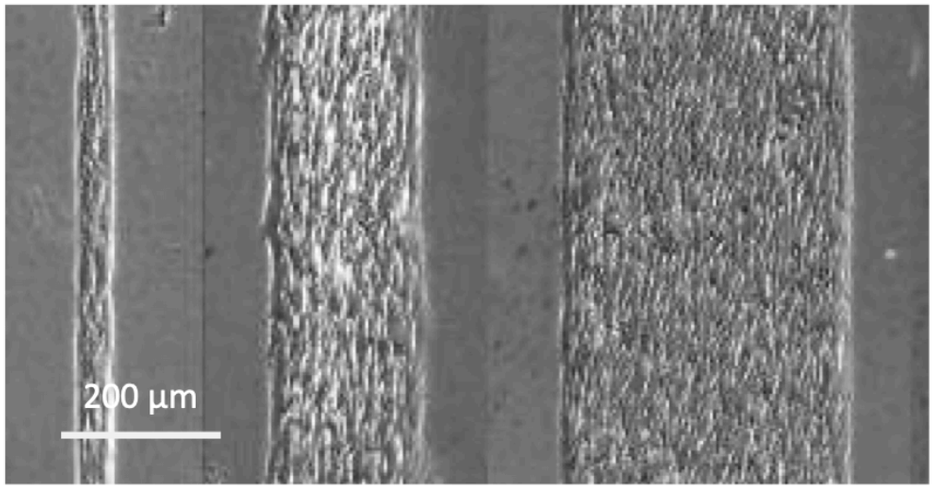
Topological confinement



Duclos et al., Soft Matter 2014



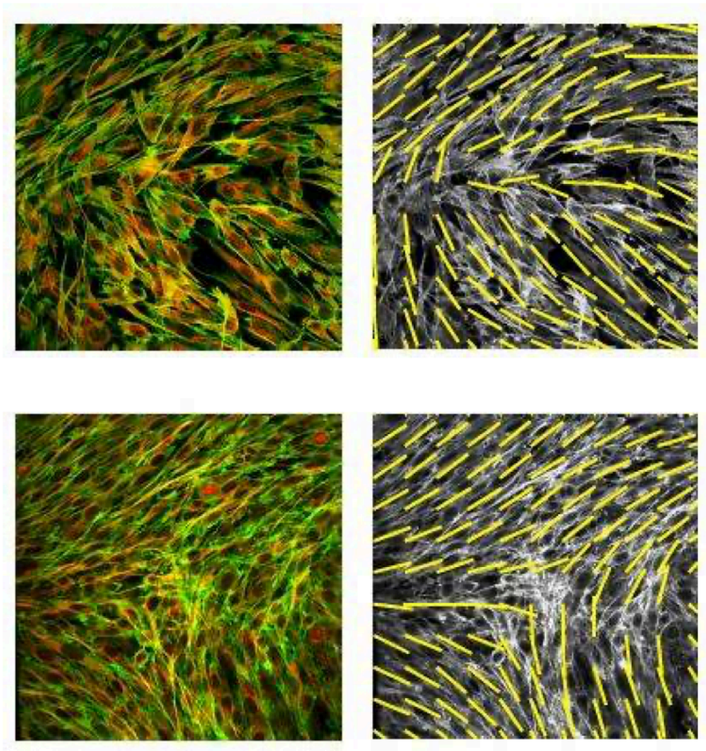
Duclos et al., Nat Phys 2017

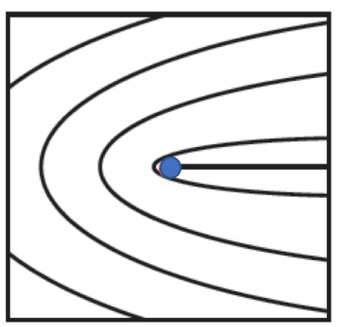


Duclos et al., Nat Phys 2018

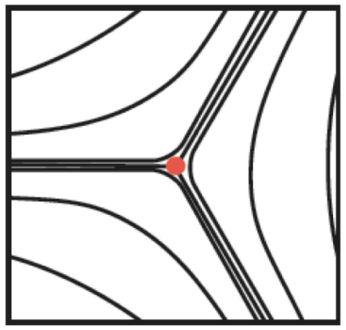
Topological defects

Actin
Tubulin





+1/2

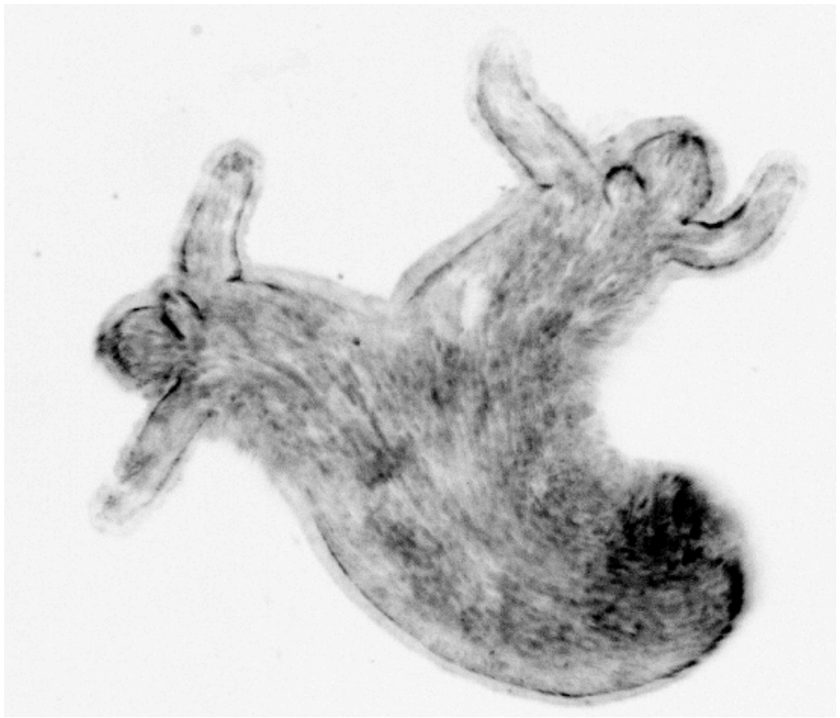


-1/2

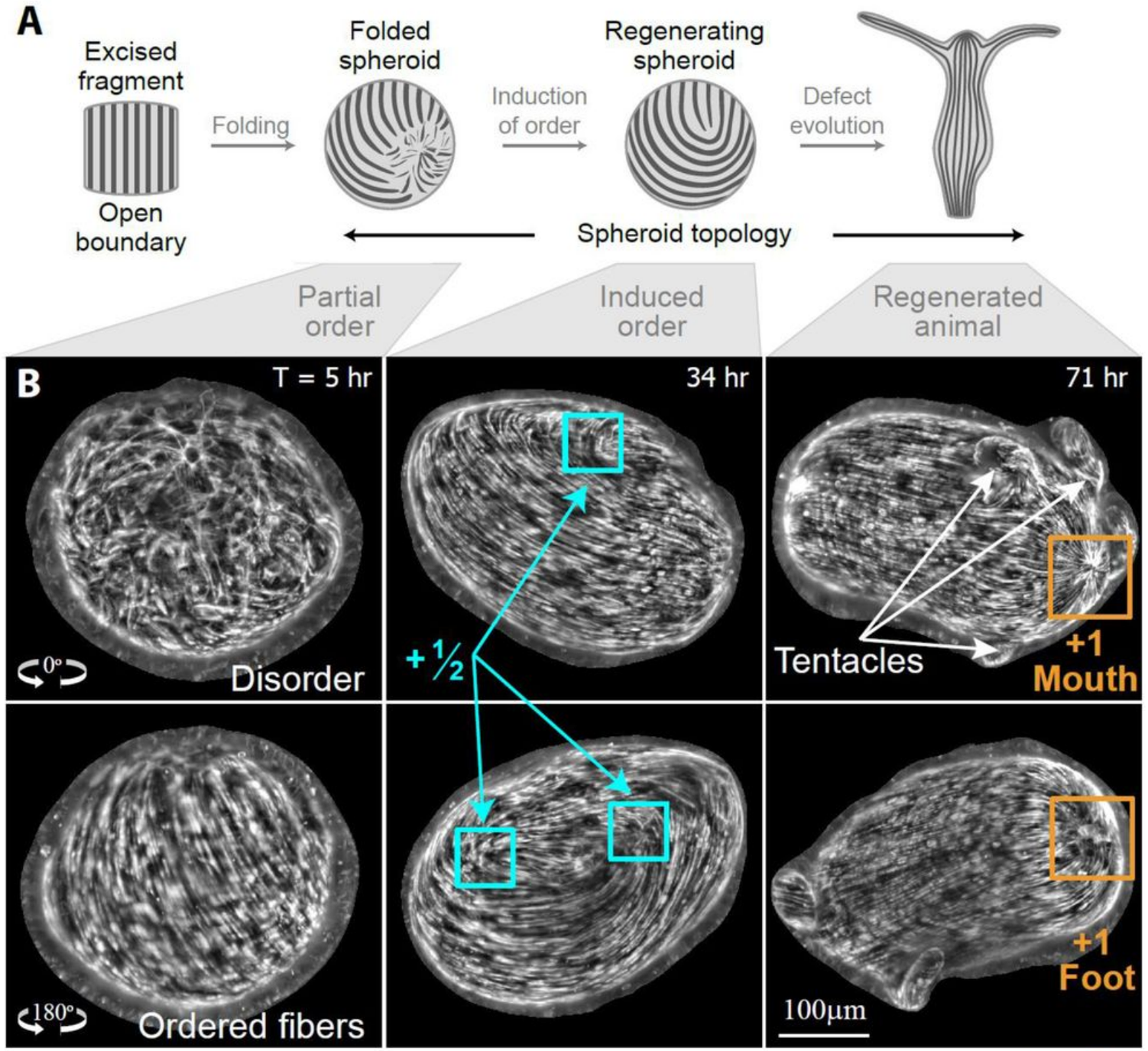
Duclos et al, *Nat Phys* 2017

Cellular nematics

In development and regenerescence



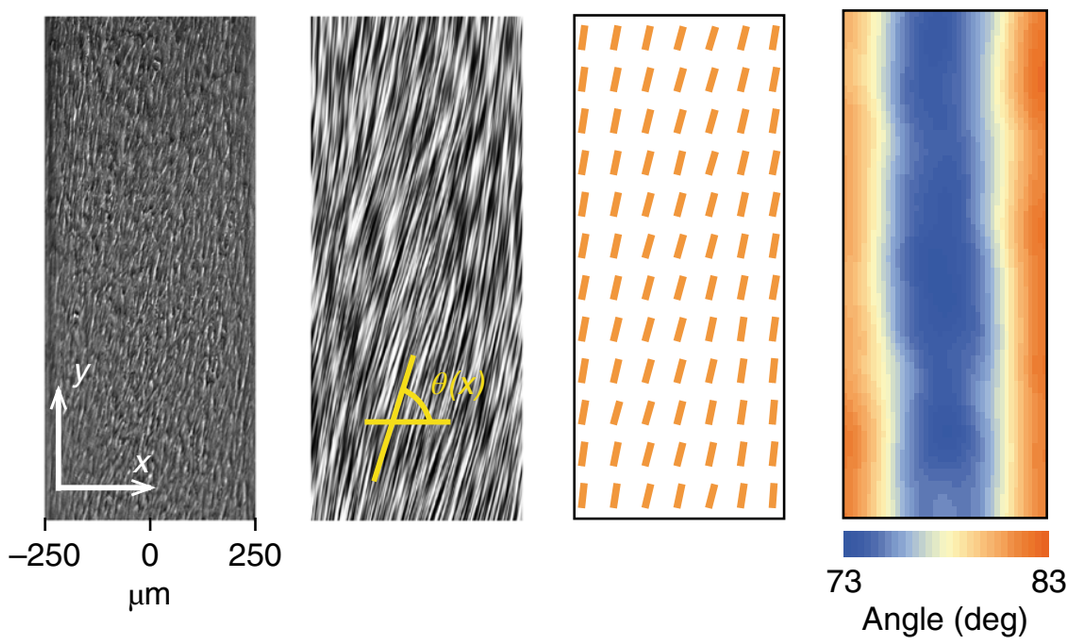
Hydra

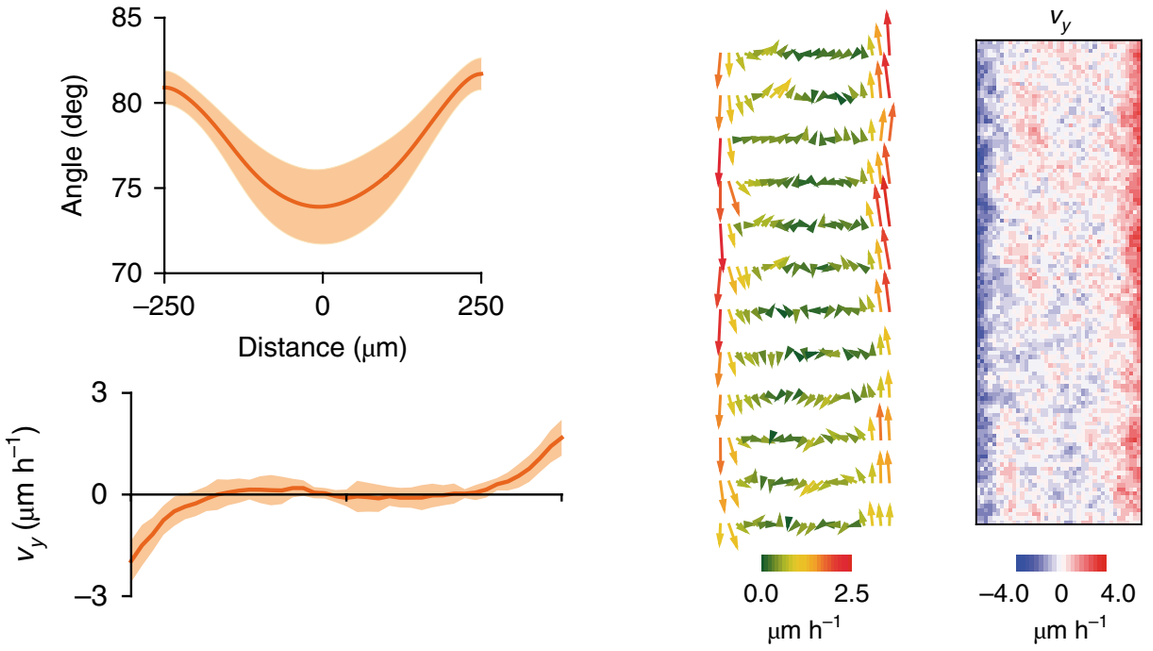


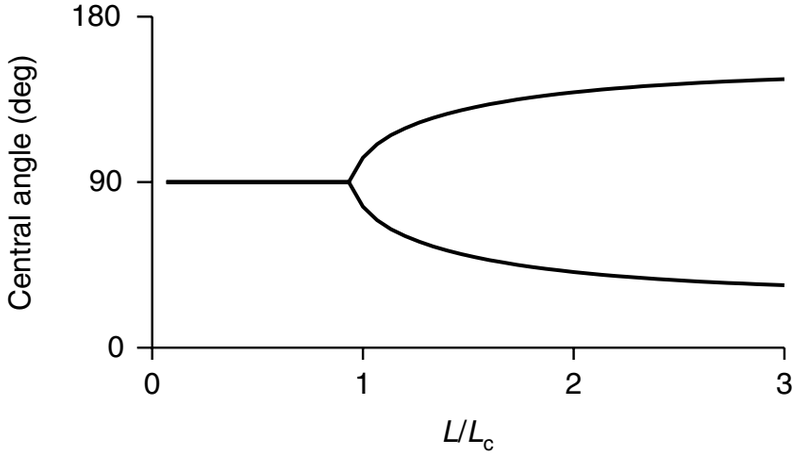
Maroudas-Sacks et al, *Nat Phys* 2021

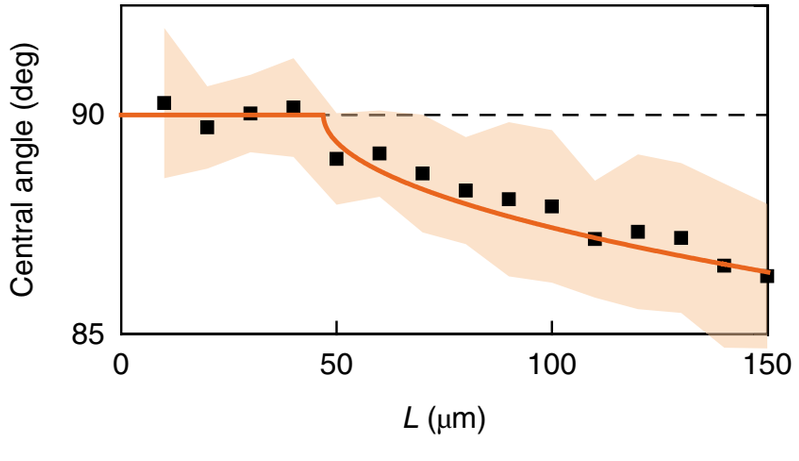
Cellular nematics

Spontaneous shear flow in confined cellular nematics
Duclos et al. *Nat Phys* 2018





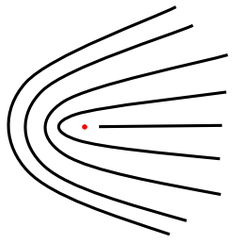




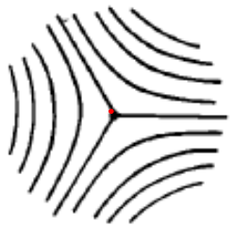
Cellular nematics

Topological defects

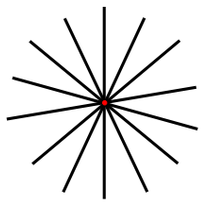
m=+1/2, ψ_0=0 (comet)



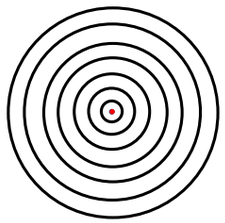
m=-1/2, ψ_0=0 (trefoil)



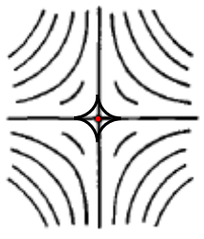
m=+1, ψ_0=0 (aster)



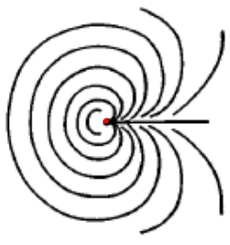
m=+1, ψ_0=π/2 (vortex)



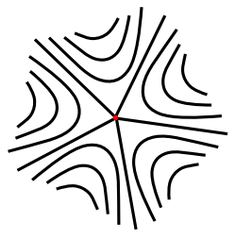
m=-1, ψ_0=0 (antiaster)



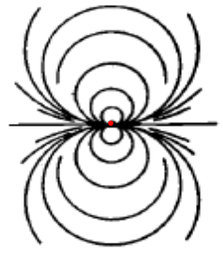
m=+3/2, ψ_0=0 (pineapple)



m=-3/2, ψ_0=0



m=+2, ψ_0=0



Cellular nematics

Topological defects

Duclos et al. *Nat Phys* 2016