Boulder Condensed Matter Summer School Theoretical Biophysics

> Active Living Matter + Tissue Mechanics July 15-19, 2019

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lecture notes:



What about cells in diseases like asthma?



Cells also interact with each other differently than particles or droplets:

The microscopic structure looks like a solid (very high density), but cells can change neighbors like in a fluid – why? Need a good model for how the cells interact with each other



Dense emulsion (Thijssen)





Cells (Schoetz Lab UCSD)

What mechanical forces act to regulate cell shapes?

- T. Nagai, H. Honda, Philos. Mag. B 81, 699 (2001) Hufnagel et al, PNAS vol. 104 (10) pp. 3835 (2007) Farhadifar et al, Current Biology (2007) Jülicher et al Phys. Rep. (2007) Hilgenfeldt et al, PNAS 105 3 907–911 (2008) **MLM** et al, PNAS (2010) Staple et al EPJE 33 (2) 117 (2010) Chiou et al PLOS Comp Bio 8 (5) e1002512 (2012)
- 1. Cell-cell adhesion: sticky molecules help cells stick together
- 2. Active cytoskeleton: cells have a dynamic internal "skeleton" that prevents them from changing shape too much
- 3. Fluid filled: many cell types do not change their volume easily.



Devries et al, Development **131**, 4435–4445 (2004)

Effect of tesselation disorder on transition point: Gonca Erdemci Tandogan

"temperature" is the parent temperature from which we identified an inherent state



with Matthias Merkel, Xun Wang, Leo Sutter, MLM, Karen Kasza

Surprise: model predicts two phases that depend on cell shape (instead of the density)



Fluid



Rubric: How do genetic perturbations to individual cells alter global tissue properties?

