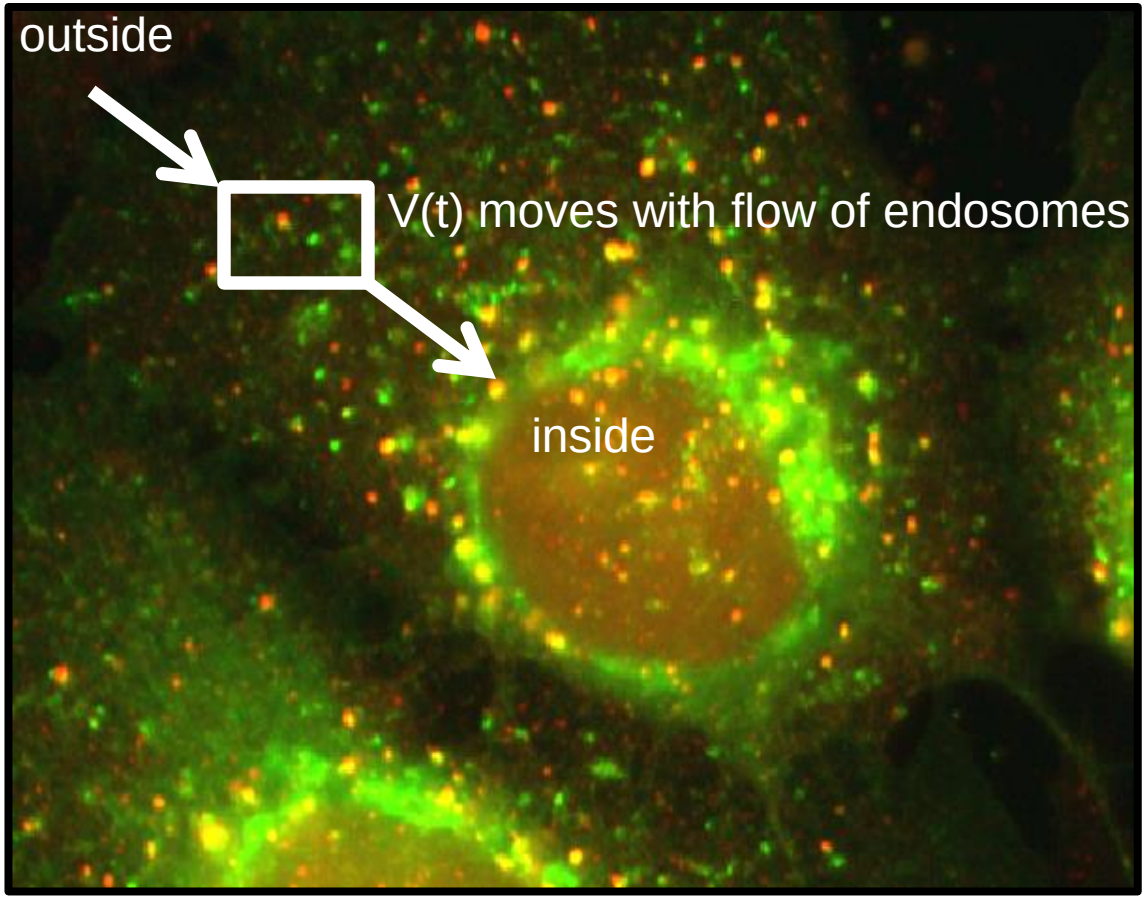
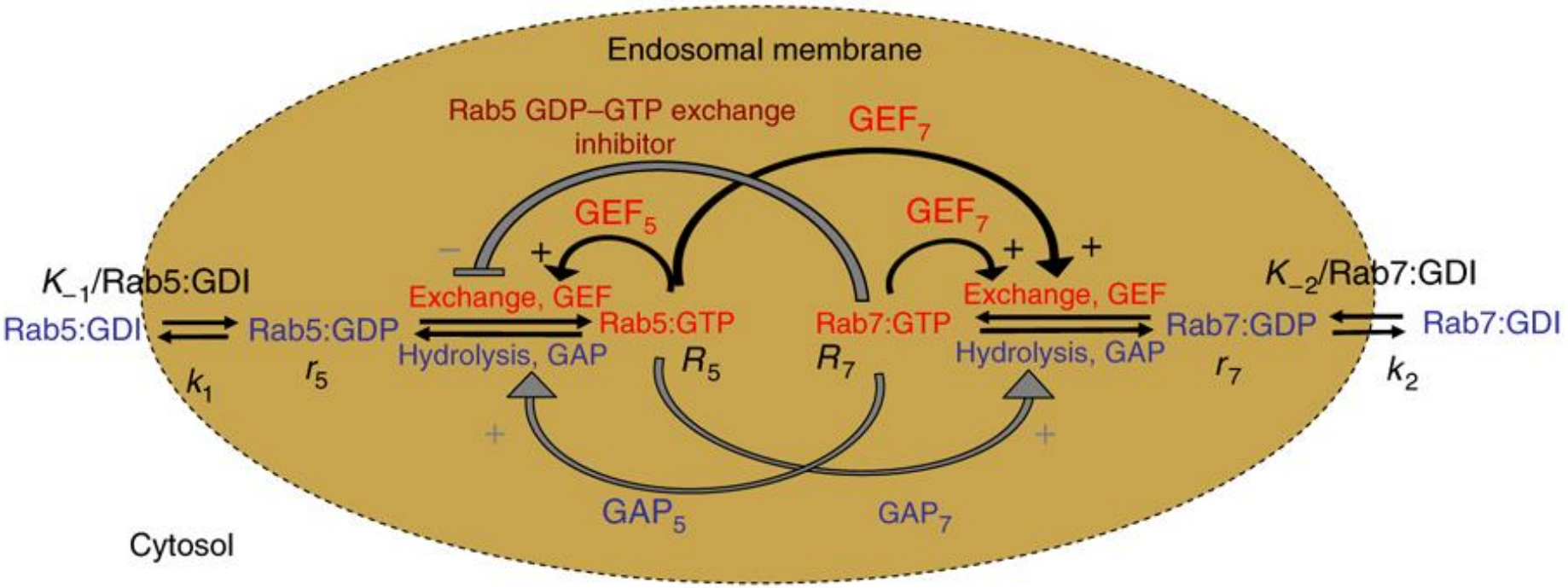
Spatiotemporal models

Lutz Brusch, 13 August 2018



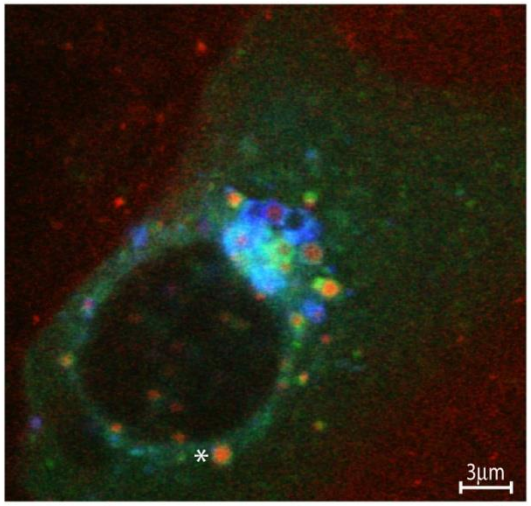
Protein dynamics on individual endosome

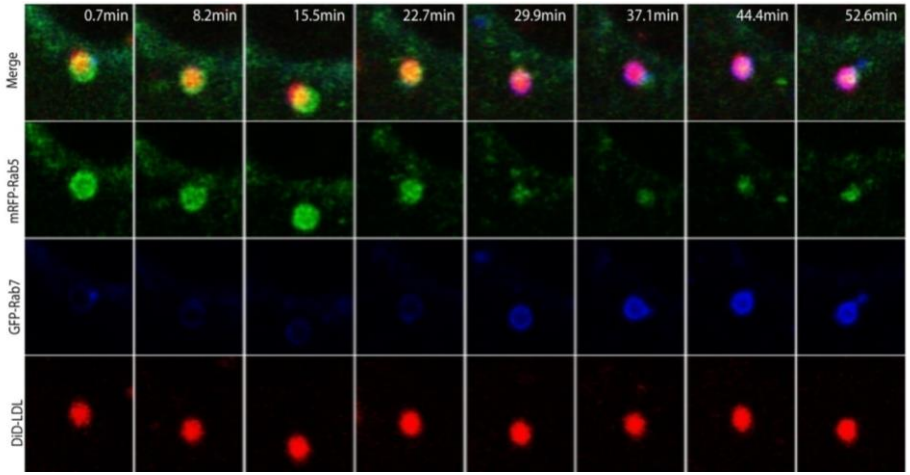


Del Conte-Zerial et al., Mol. Syst. Biol. 2008

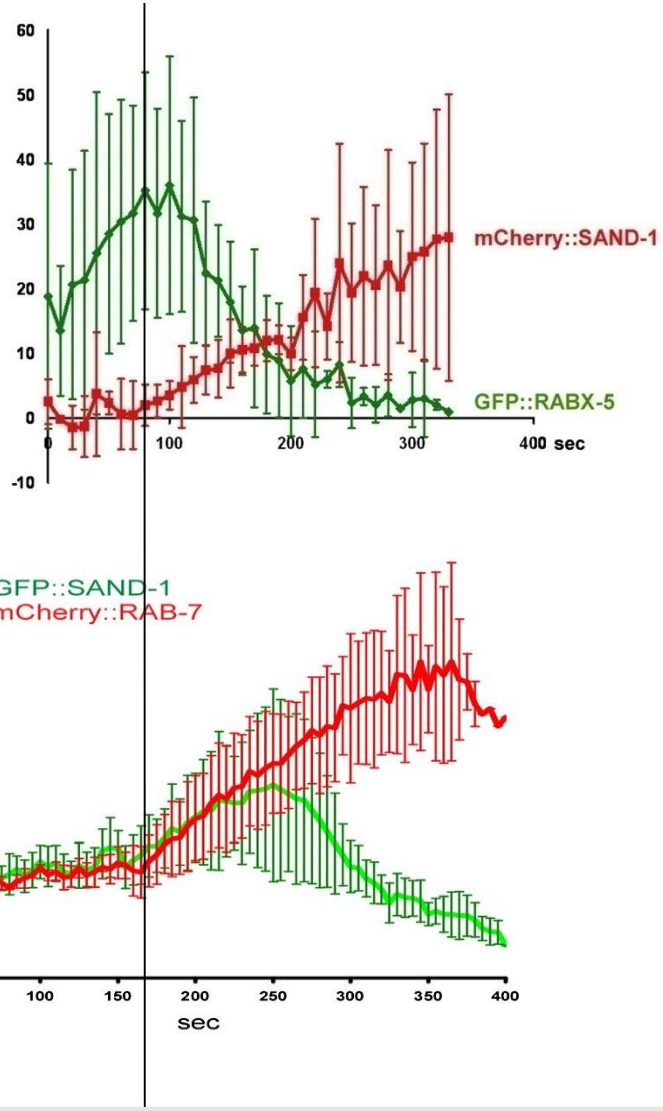
Single endosome in Lagrangian formalism

Rink et al., Cell 122, 735 (2005)

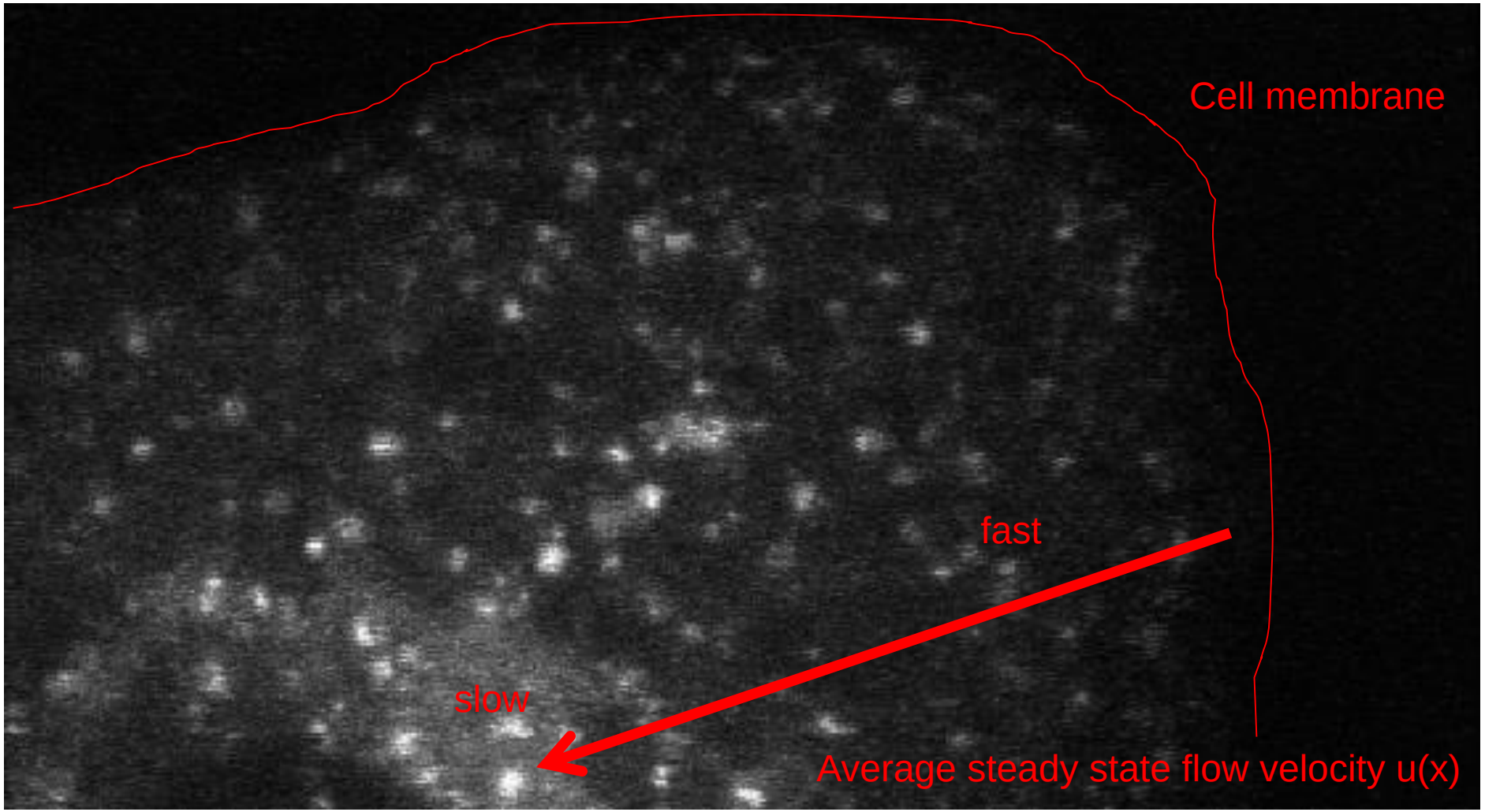




Poteryaev et al., Cell 141, 497-508 (2010)

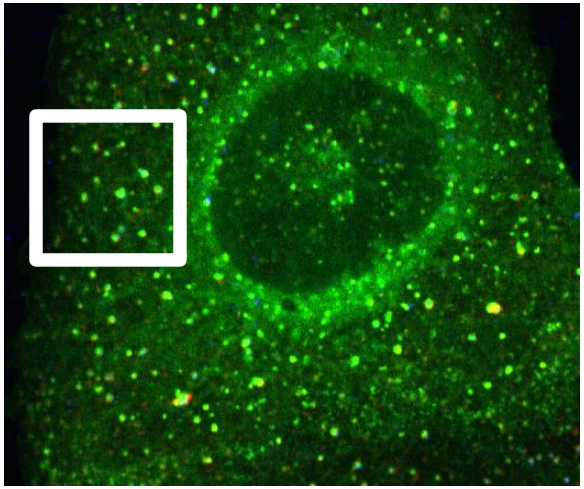


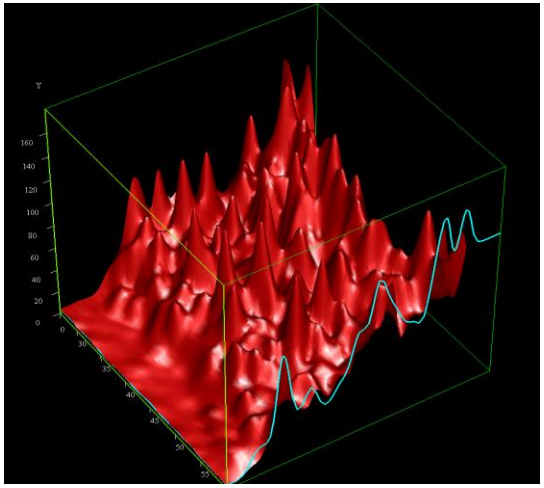
Endosomes move in Eulerian formalism

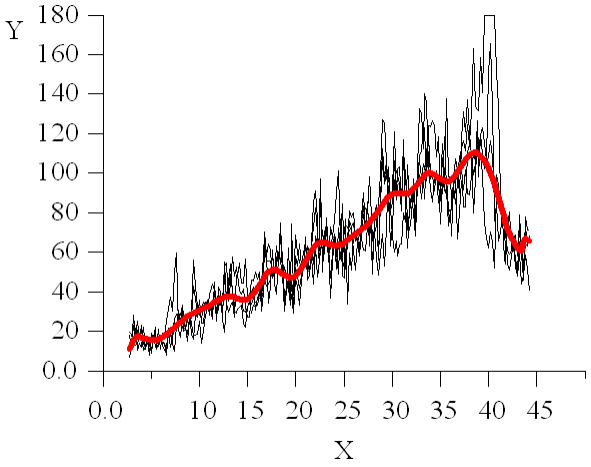


Marino Zerial

Spatial protein concentration profile







Rab5:GDP + Rab5:GTP

Not uniform!
Concentric Rab5 gradient as a result of flow

Bacteria as mathematicians:

- Bacteria are too small to search for nutrients by looking into different directions. Only noisy nutrient differences across cell diameter.

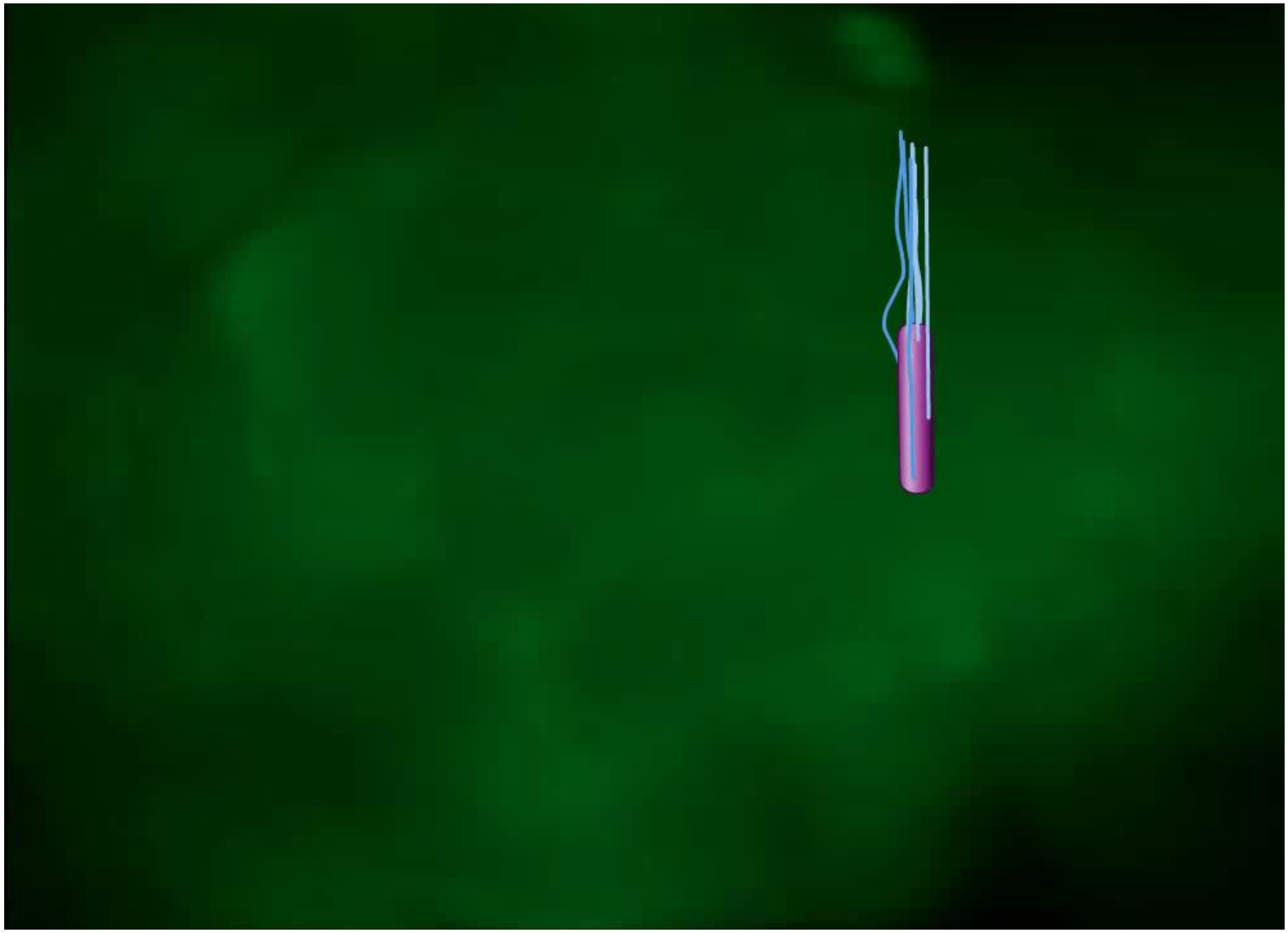
- They have to walk (run and tumble) around to check out nutrient landscape!

- But how to infer right spatial direction towards nutrient maximum given only temporal data?

-> Lagrangian formalism!

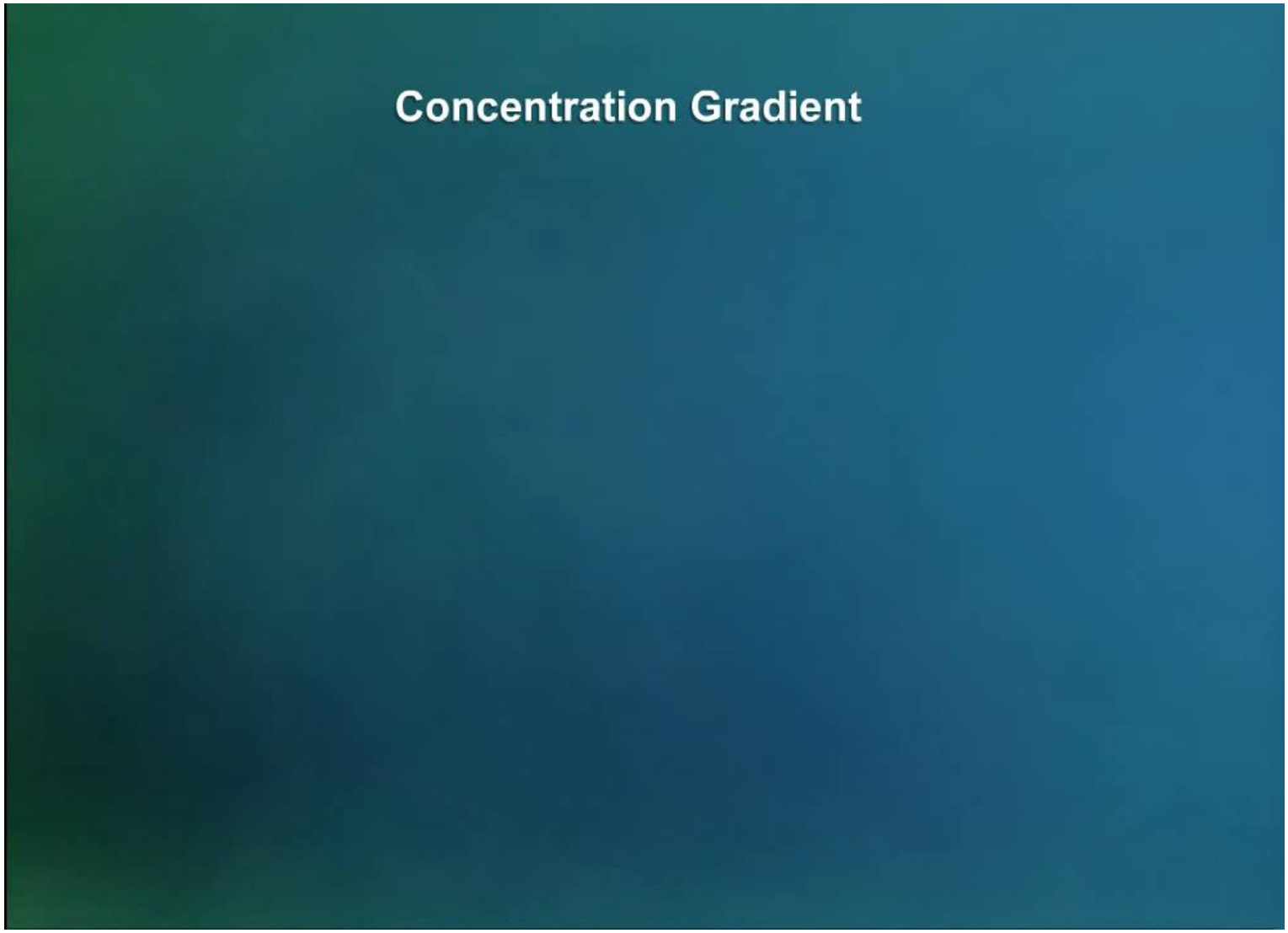
- Keep running when concentration increases temporally, else tumble

Bacterial chemotaxis in uniform space



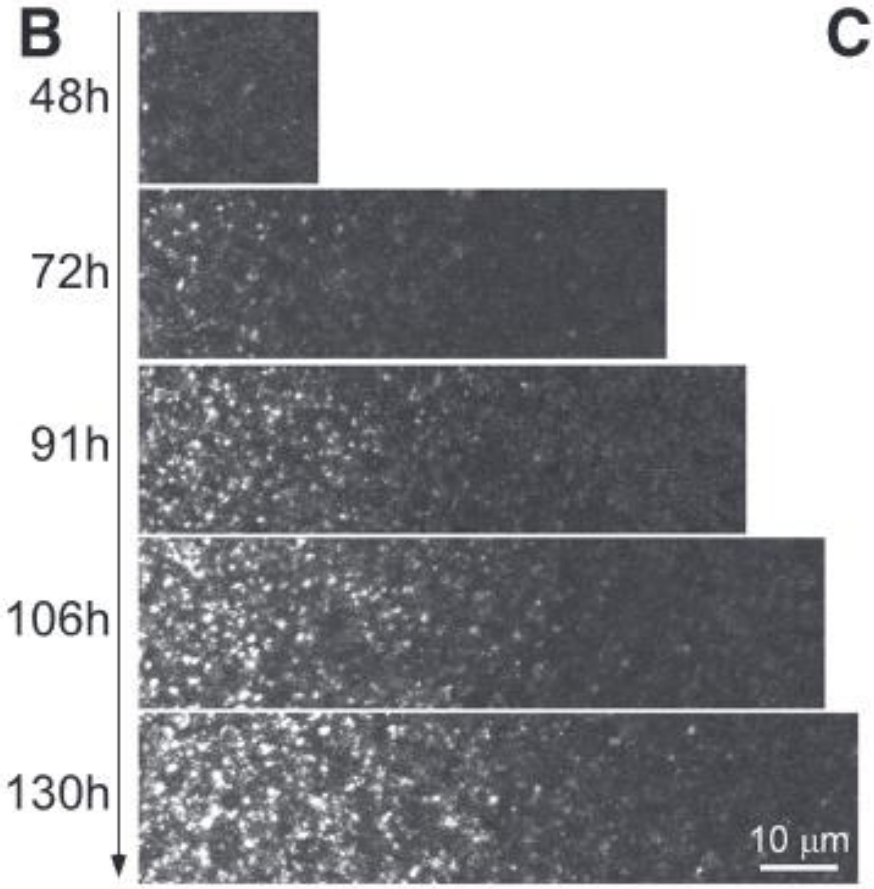
http://doctorprodigious.wordpress.com

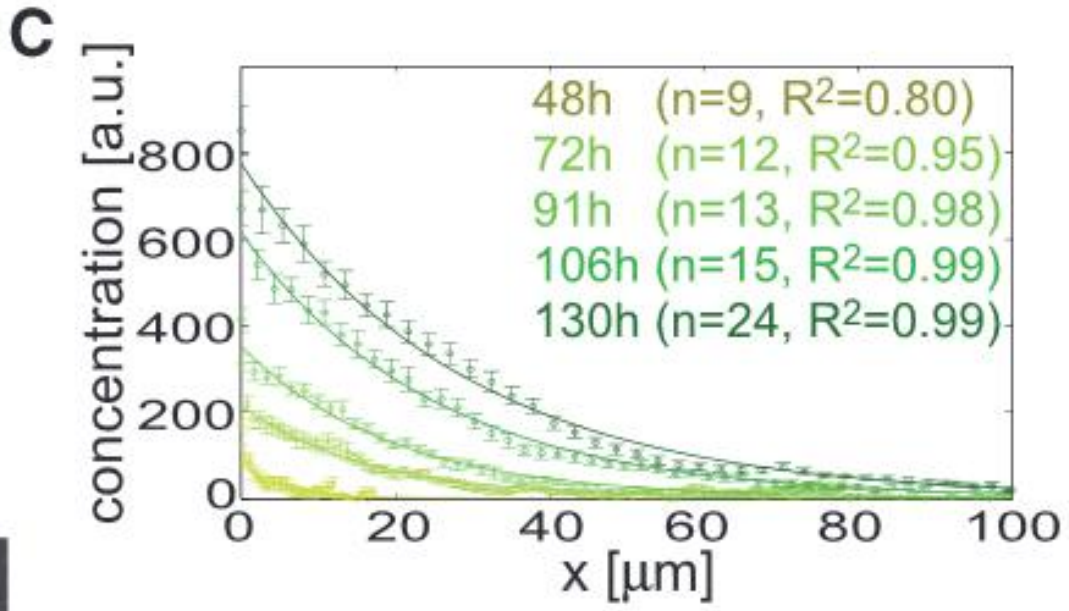
Bacterial chemotaxis in gradient



http://doctorprodigious.wordpress.com

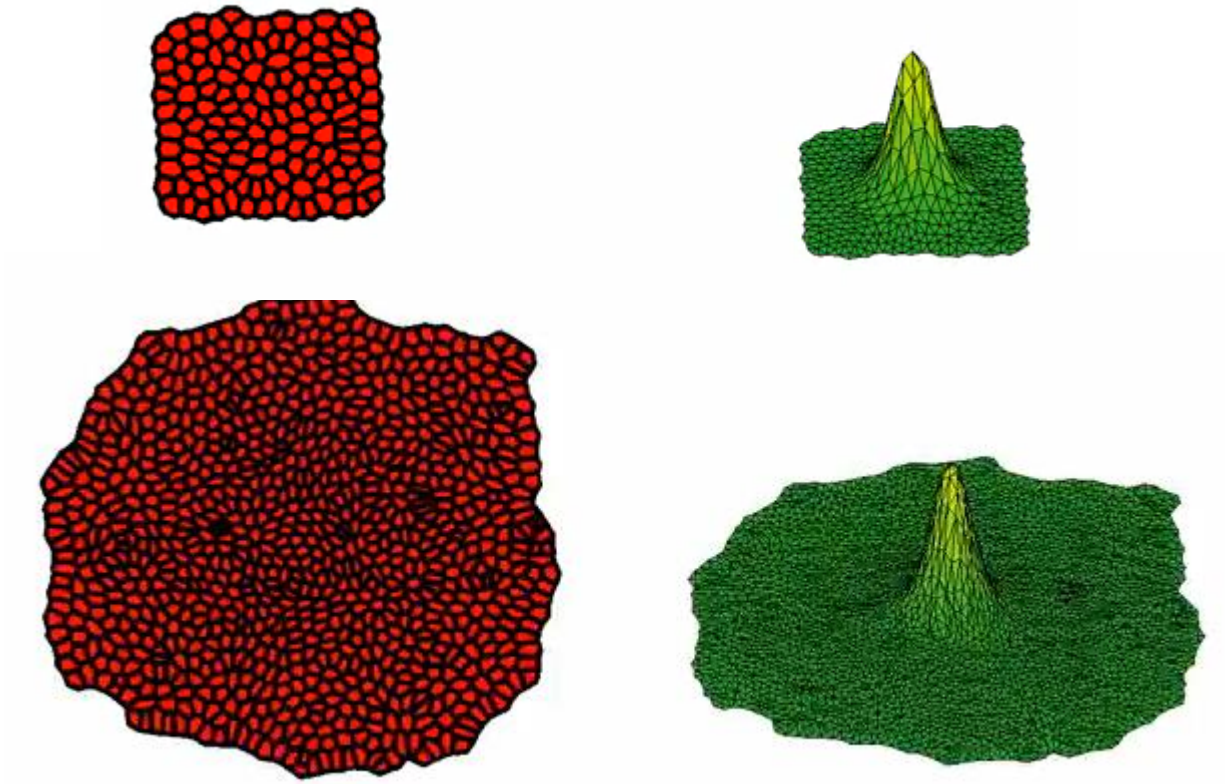
Morphogen gradients ↔ tissue growth





Wartlick et al., Science 331, 1154 (2011)

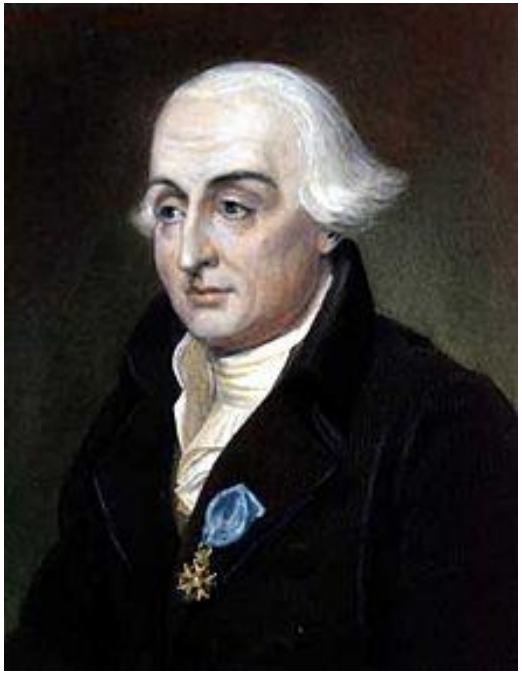
Tissue growth ↔ Morphogen gradient



Aaron M. Smith

Cell flow through morphogen gradient

Joseph-Louis de Lagrange

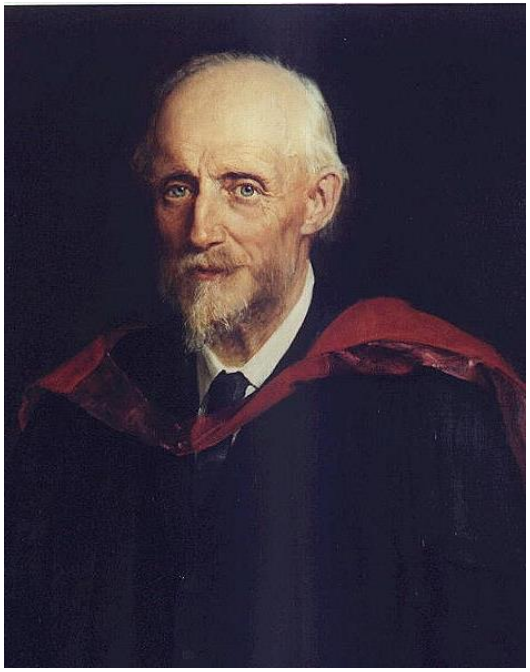


* 25. January 1736 in Turin, Italy
† 10. April 1813 in Paris, France

Leonhard Euler

* 15. April 1707 in Basel, Switzerland
† 7. September1783 in Sankt Petersburg

Osborne Reynolds



* 23. August 1842 in Belfast, Northern Irland
† 21. February 1912 in Somerset, England