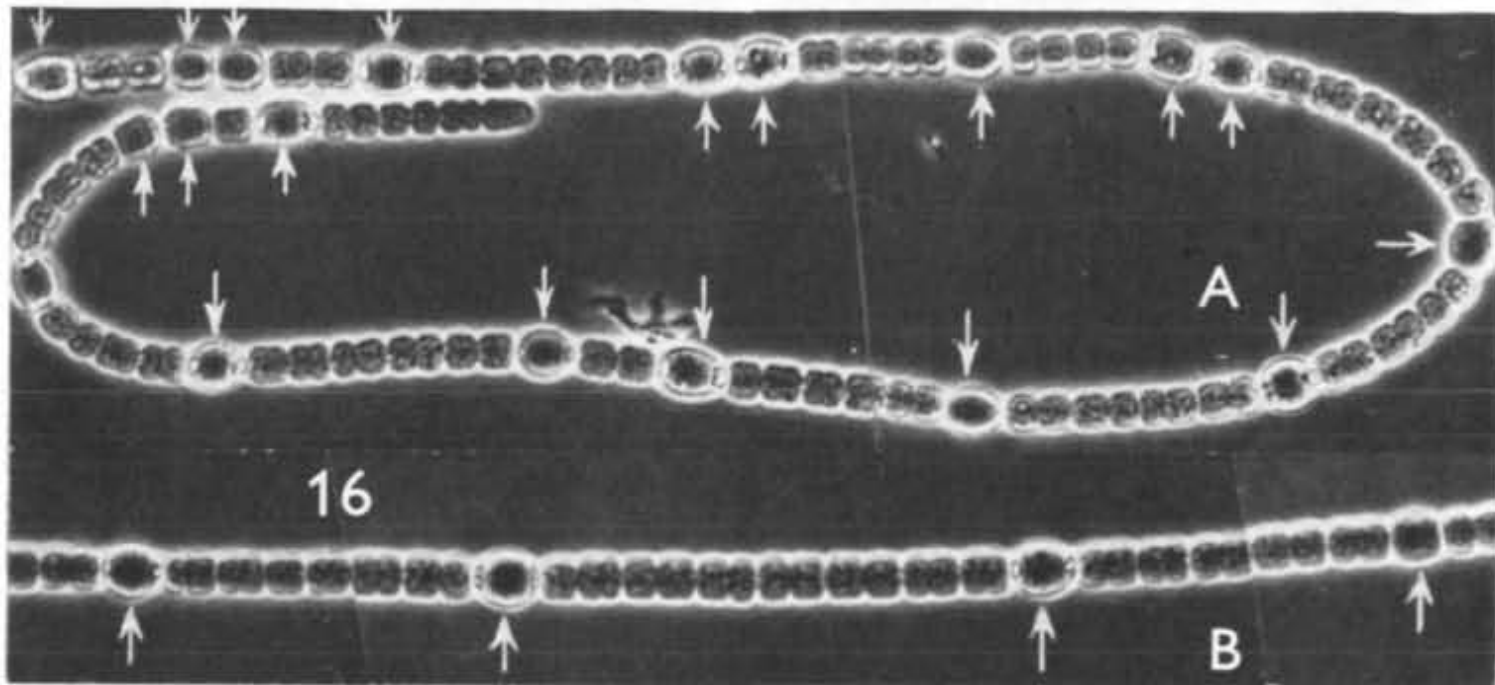




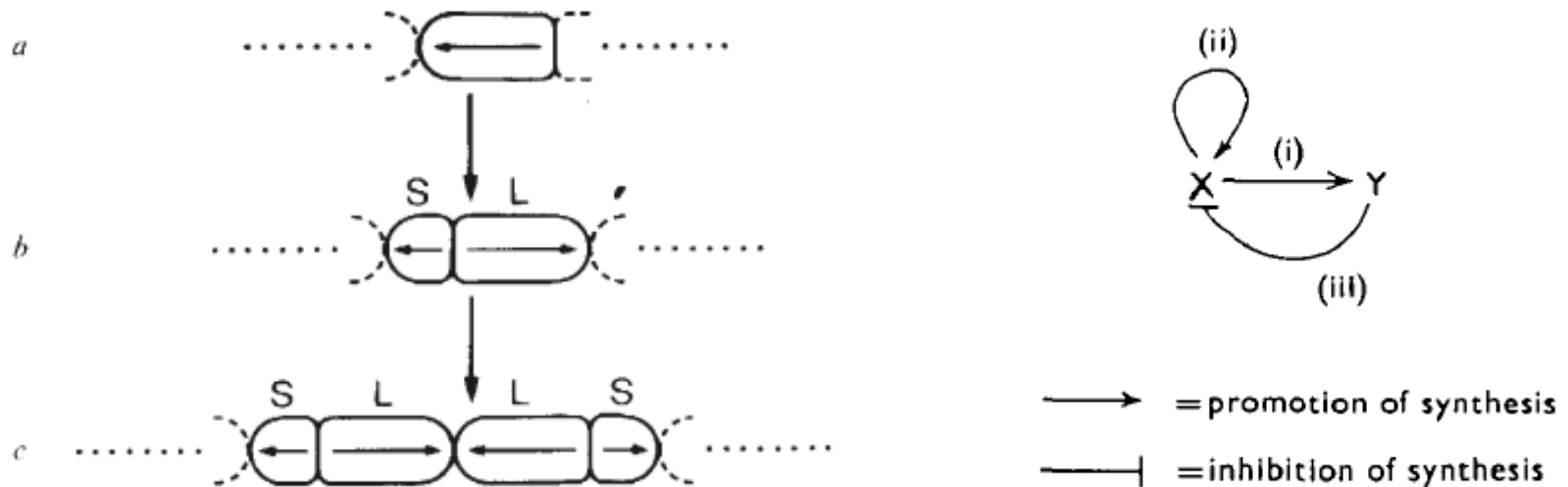
Noisy and dynamic patterns in plants

James Locke

Pattern formation in algae

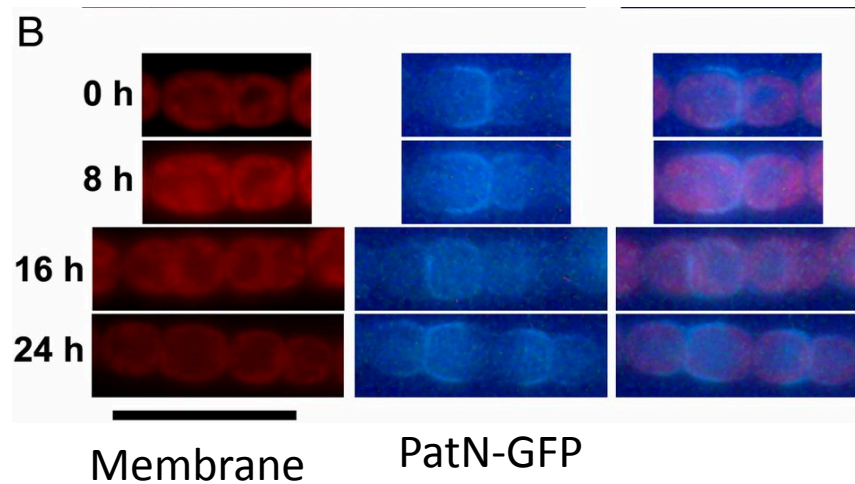
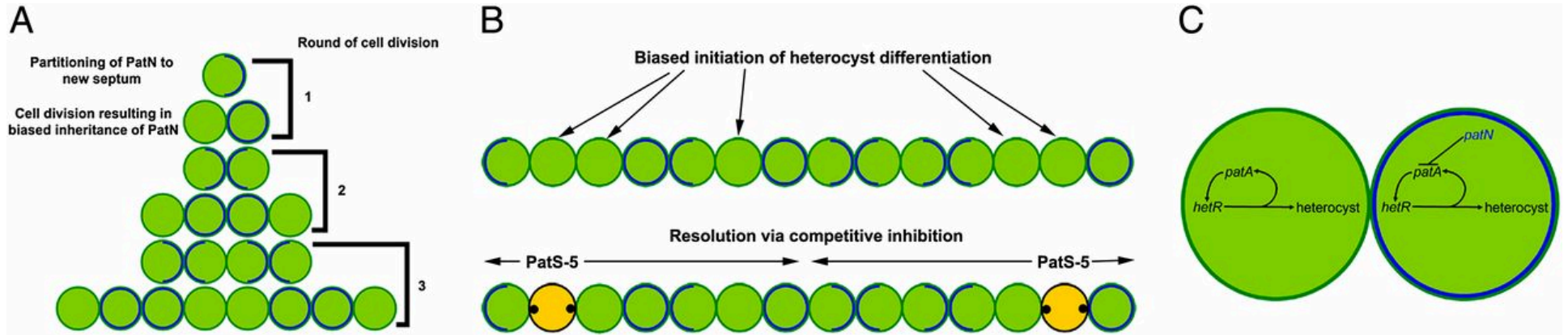


Division rule + zone of inhibition



Mitchison GJ et al., Science, 1976, Journal of cell science 1972, Nature 1972.

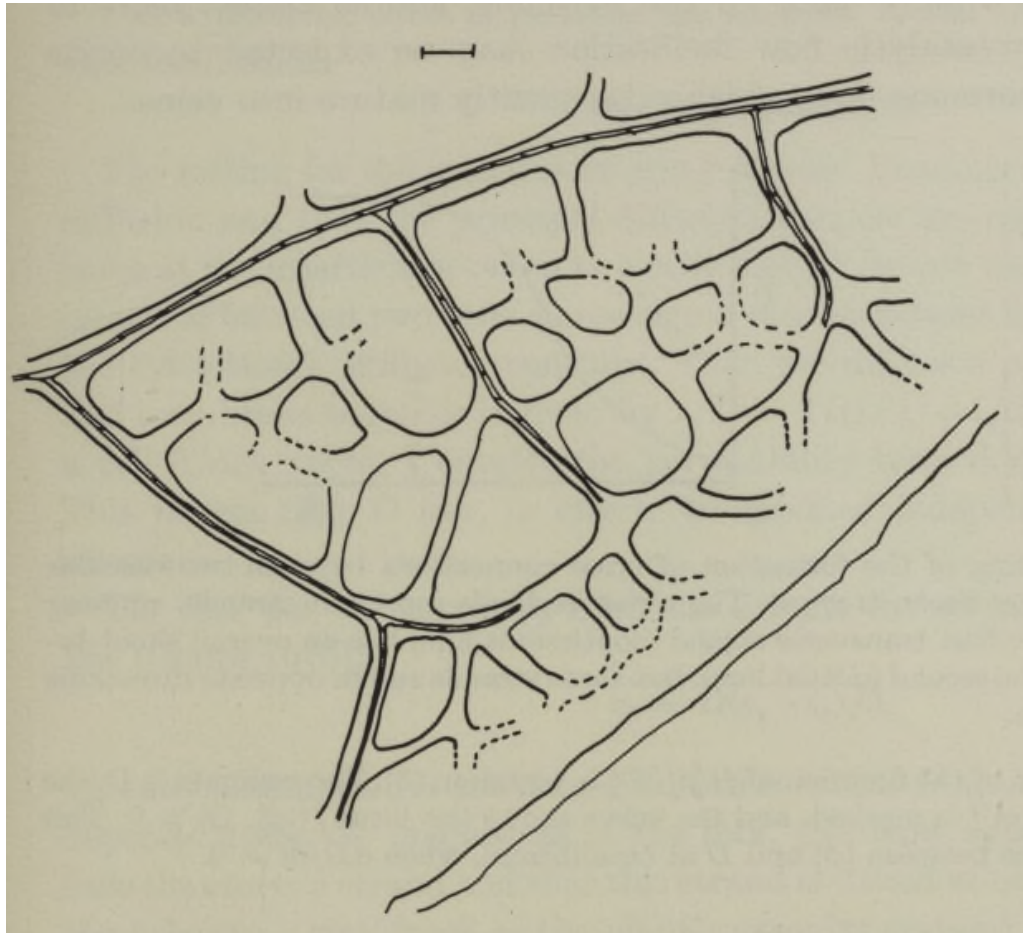
Biology catches up with the model.....



Fail




A model for vein formation in plants



G J Mitchison 1980 Proc R Soc Lond B

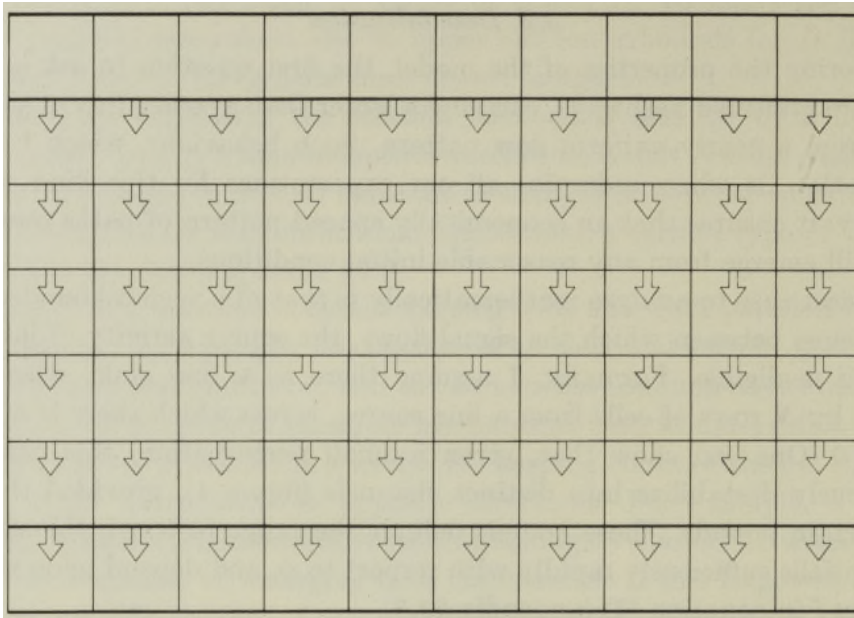
Canalisation hypothesis (Sachs and Mitchison)

Flux 

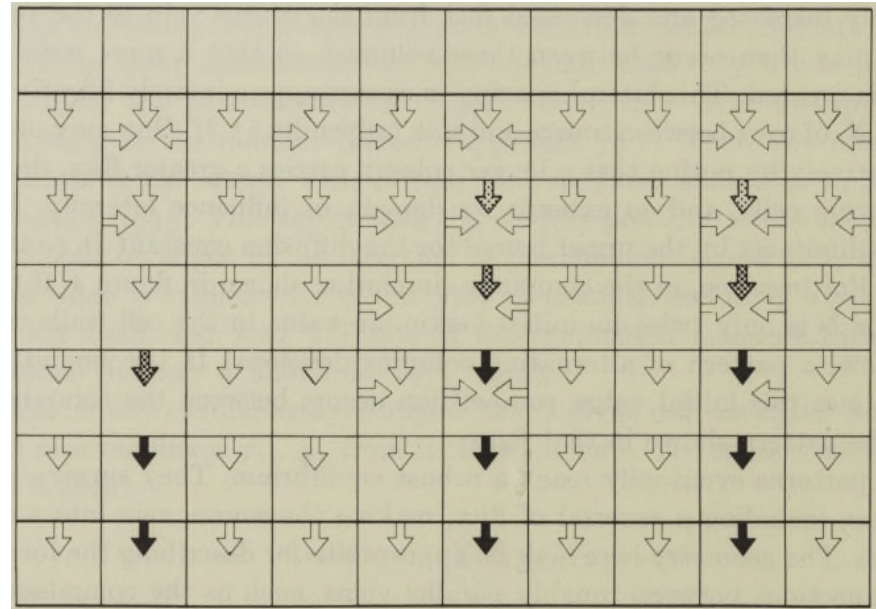


A model for vein formation in plants

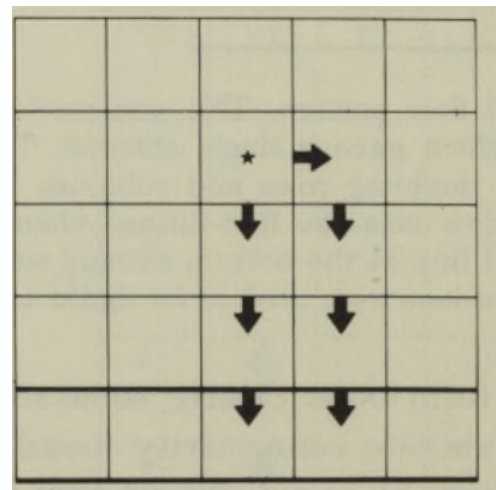
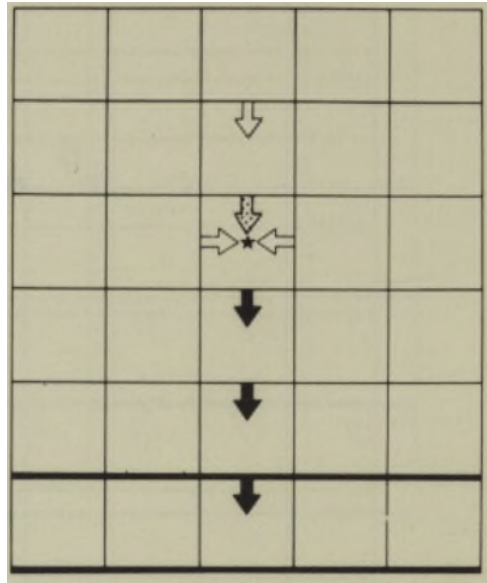
Initial state



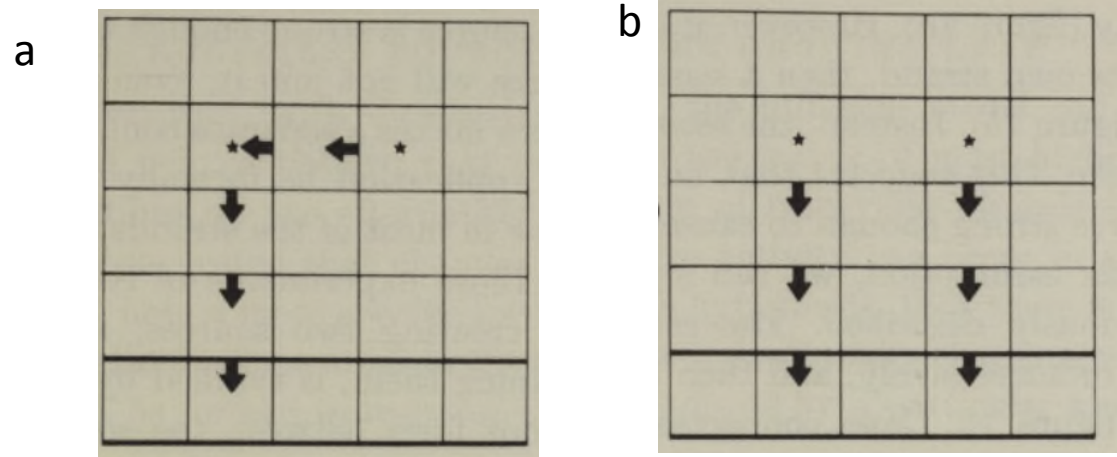
Final state



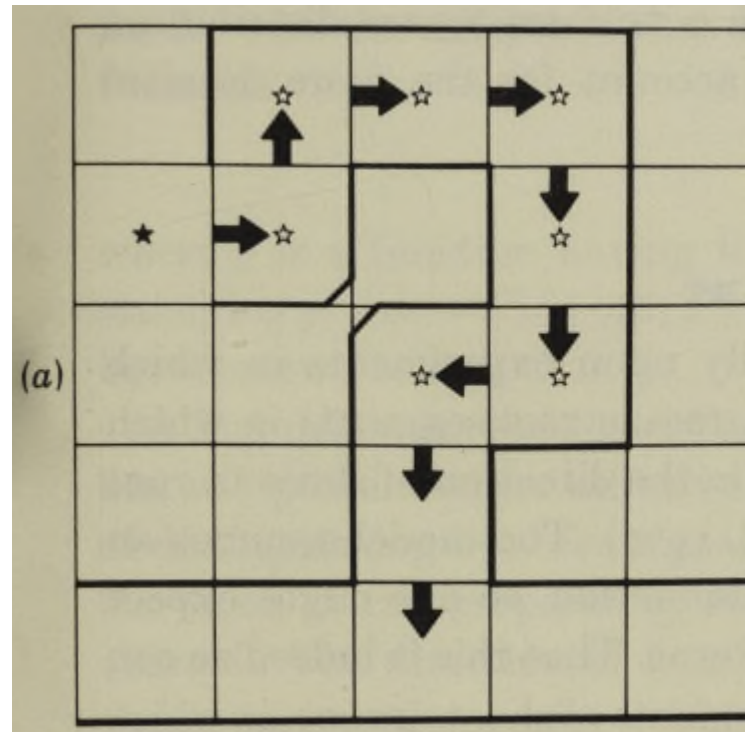
Strands created by localised sources (stars)



Two sources leading to different patterns

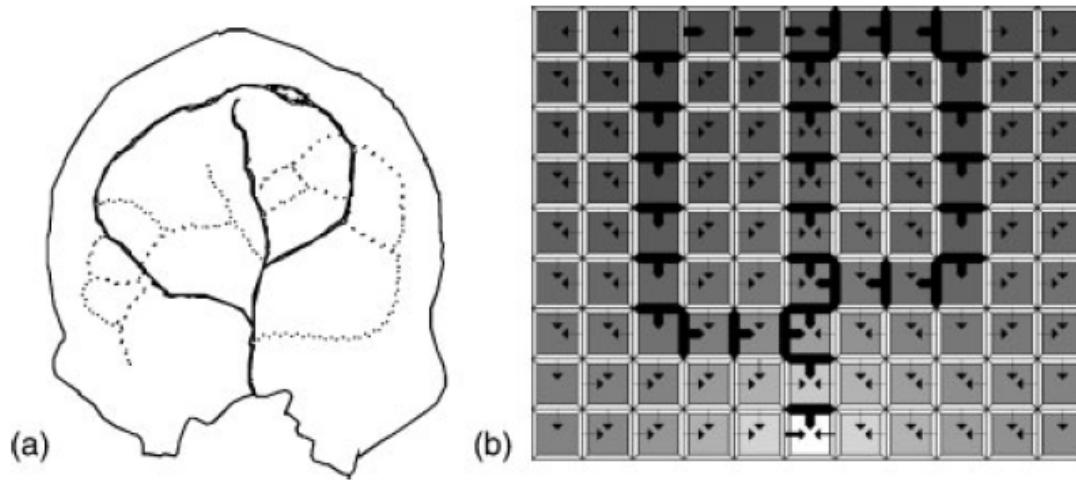


Vein formation in growing leaves



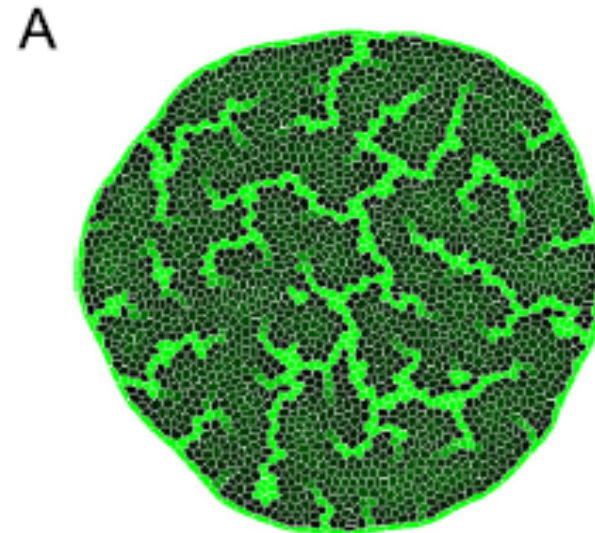
Model rediscovered 20 years later

Formation of secondary veins



Rolland Lagan and Prusinkiewicz 2005

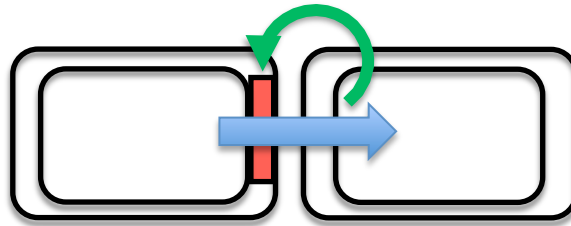
Interplay of vein formation and tissue growth




Lee et al 2014

Theoretical auxin-based hypotheses for PIN polarity

With-the-flux
(Sachs 1969, Mitchison 1980)

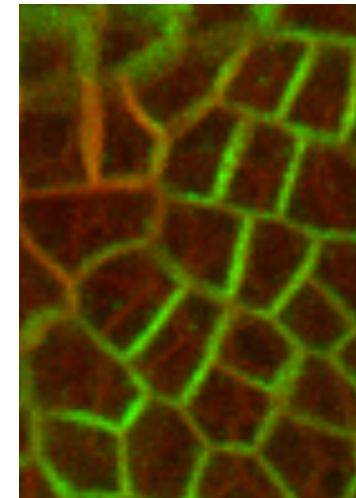
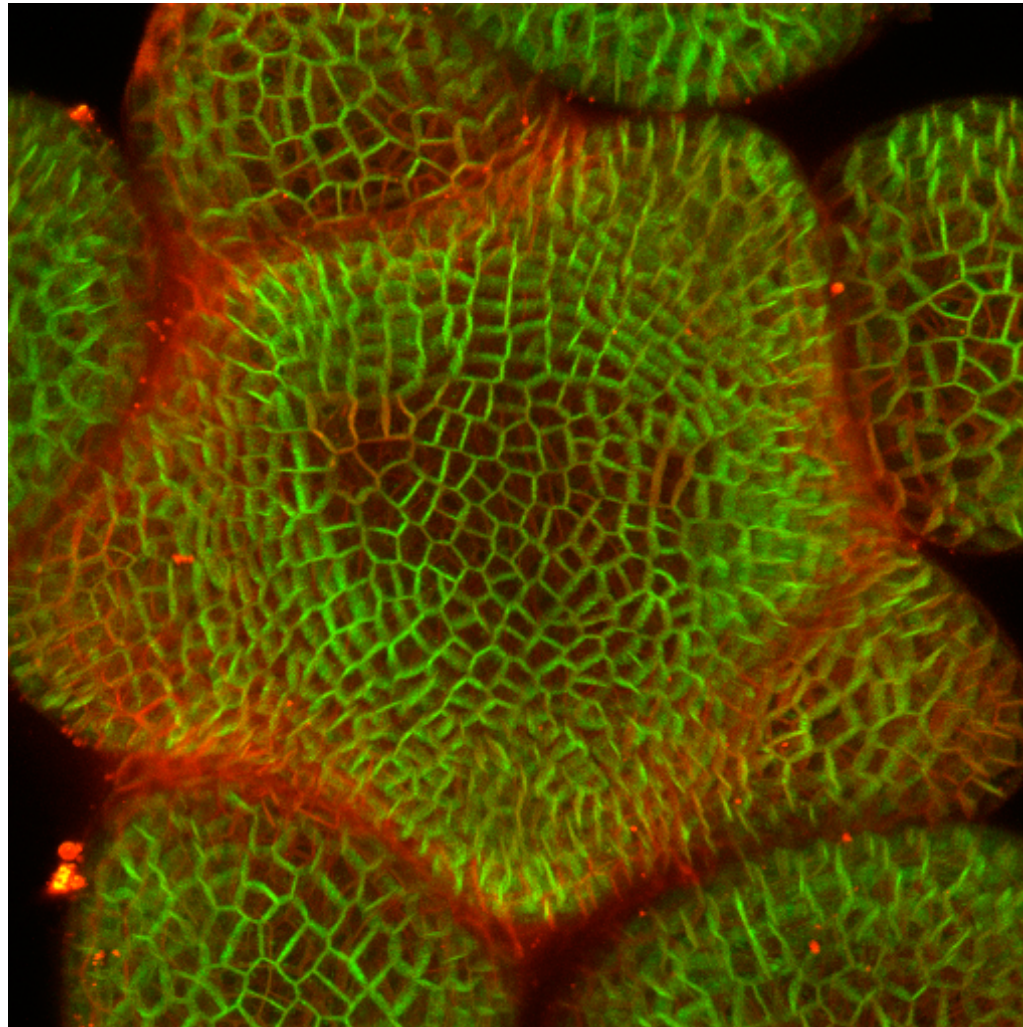


 PIN  auxin flux

Up-the-concentration
(Jönsson et al. 2006, Smith et al. 2006)

Intracellular partitioning
(Abley et al., 2013)

PIN polarization at the single cell level



Pau Formosa-
Jordan

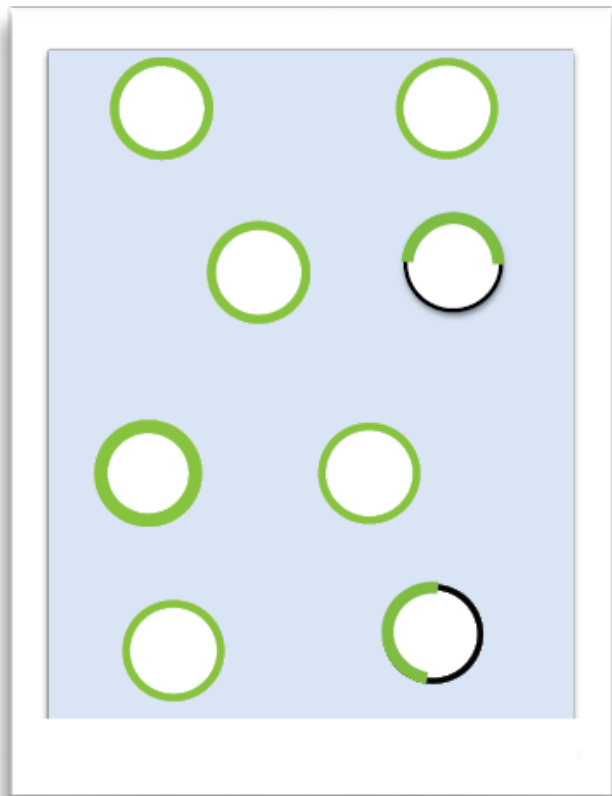
Green: PIN1-GFP
Red: PM-TdTomato

In collaboration with
Henrik Jonsson, Elliot
Meyerowitz

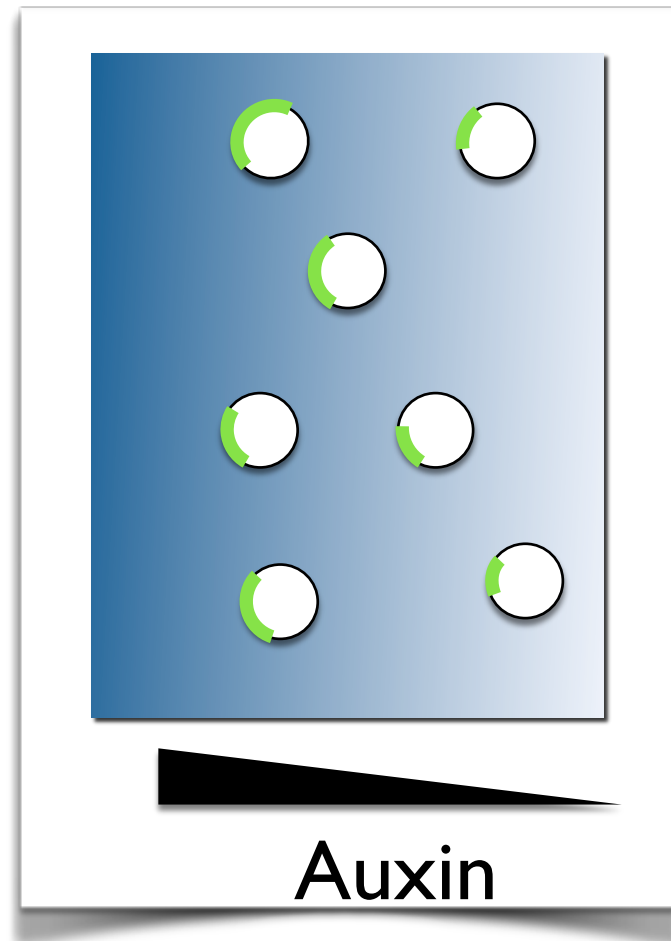
Studying PIN at the single cell level

How do PIN look under the microscope in single cells?

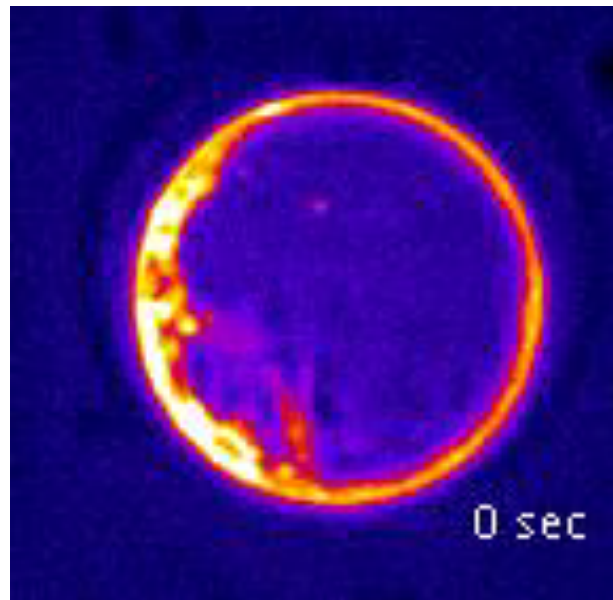
A quantitative approach



How do cells respond to auxin gradients?



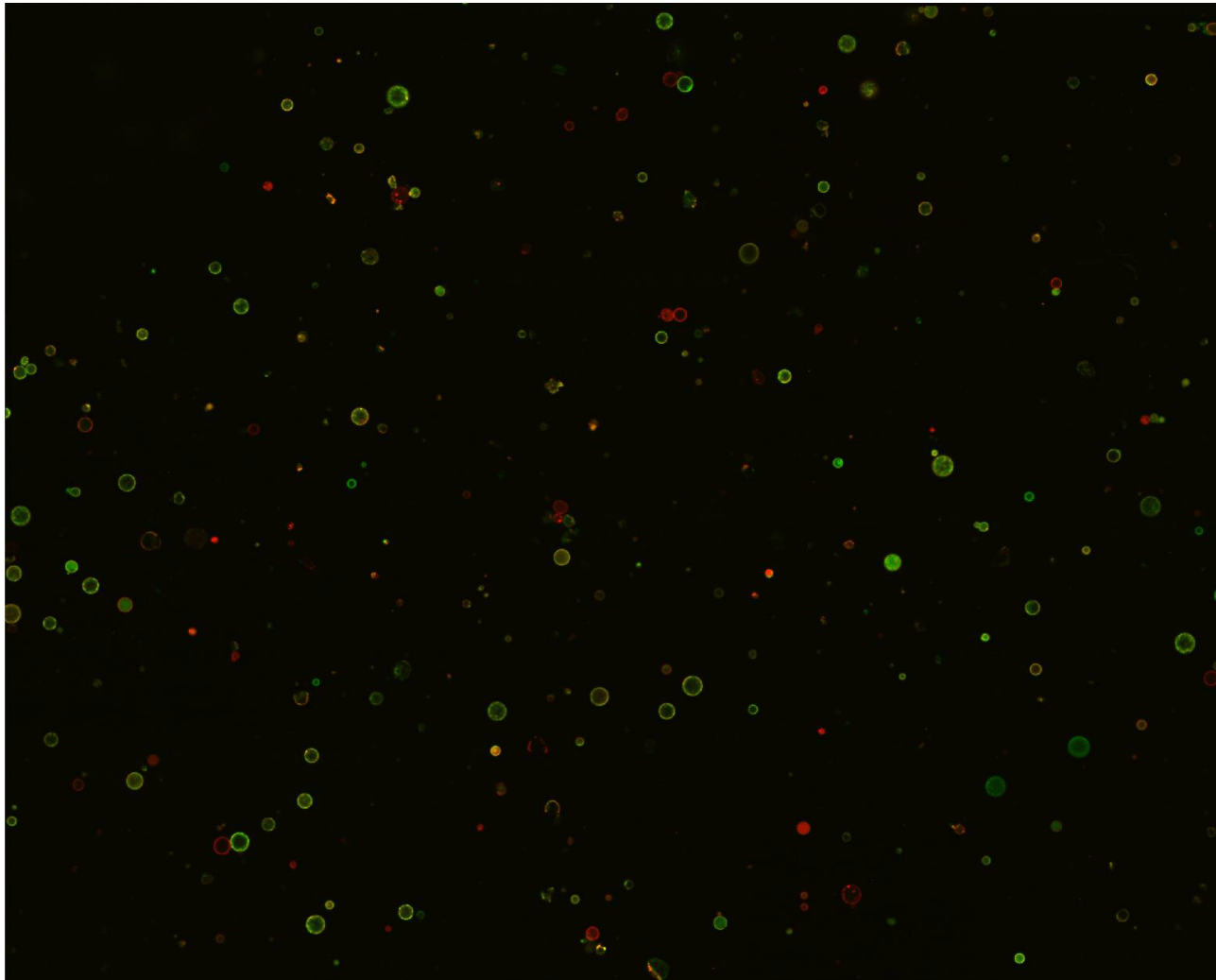
Arabidopsis protoplasts,
a possible model system to understand polarity



P35s:PIN1-GFP

 PIN1-GFP

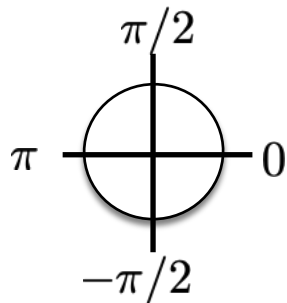
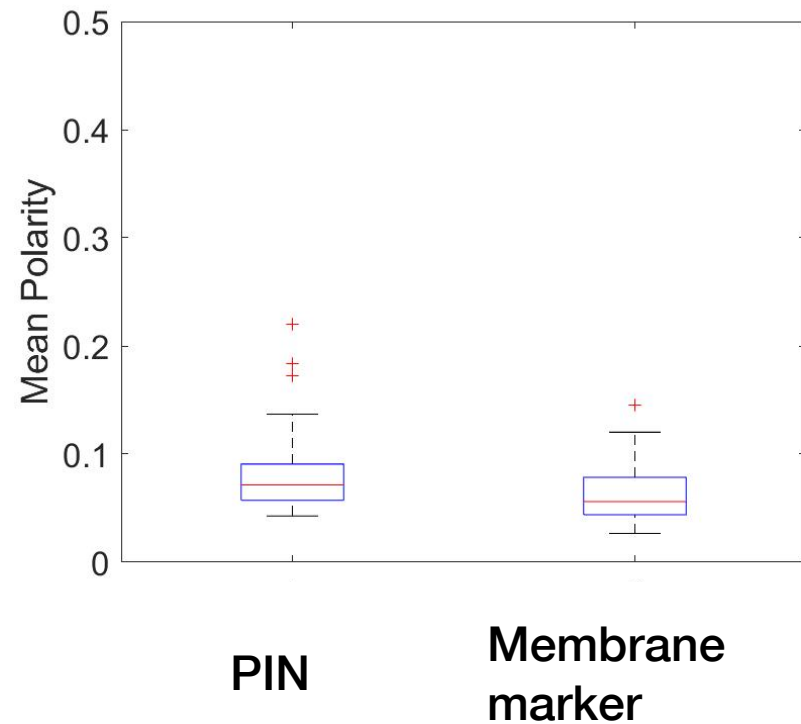
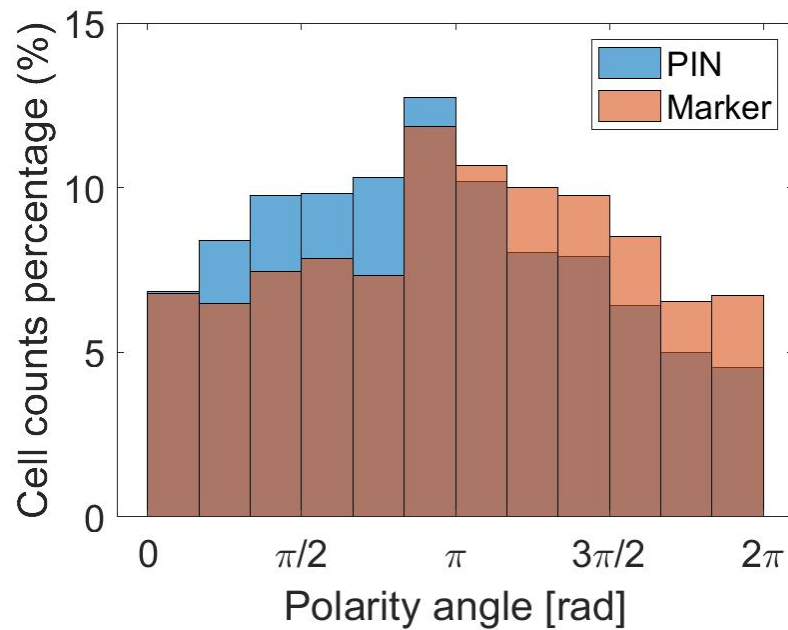
PIN1 shows rich spatio-temporal dynamics in fresh protoplasts without cell wall



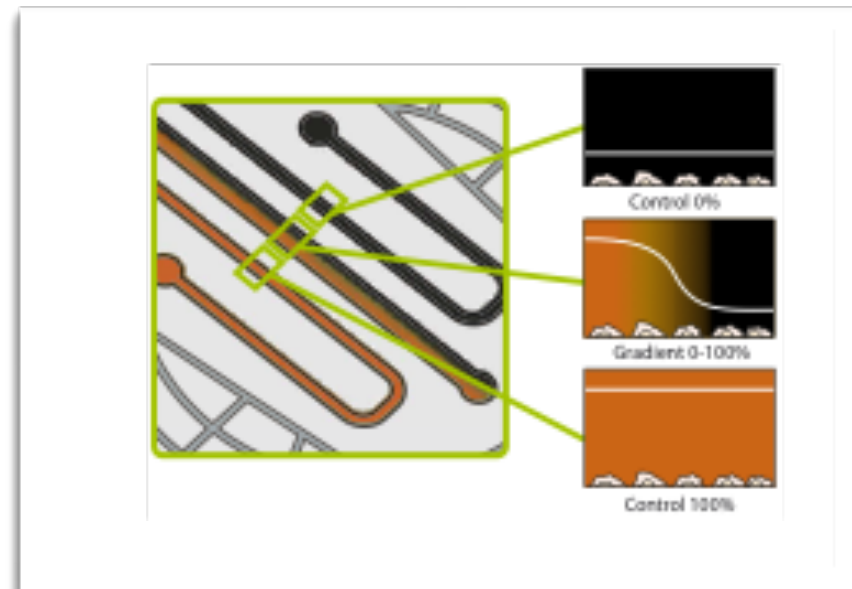
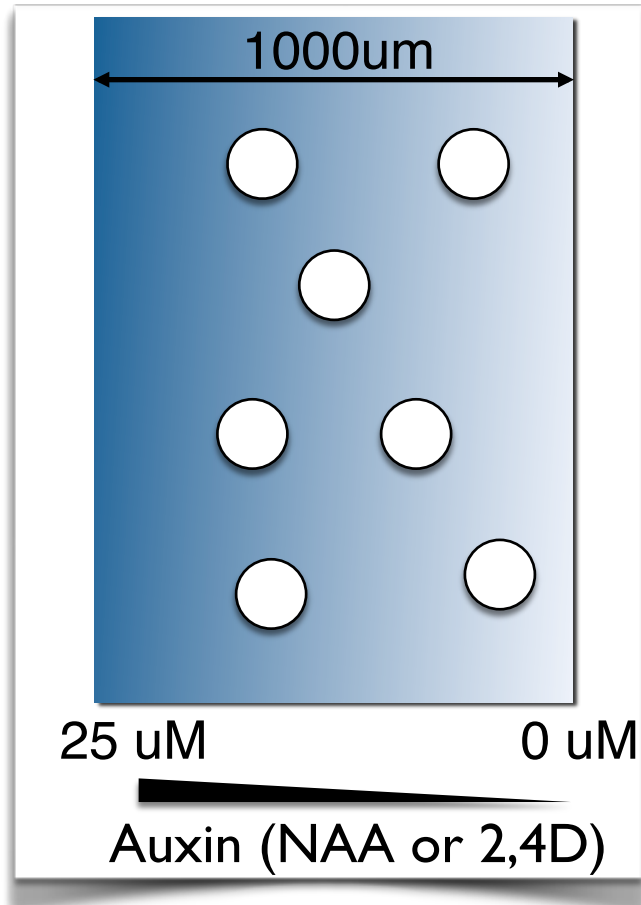
Green: PIN1-GFP Red: Membrane marker

Fresh protoplasts, dt=30min

In 'uniform conditions',
PIN and Membrane Marker are equally polar,
and its polarisation is quite random

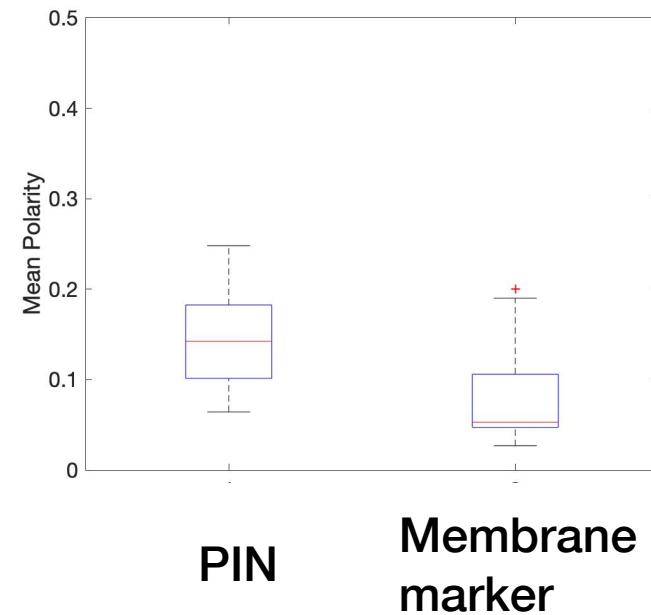
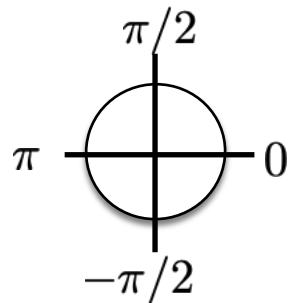
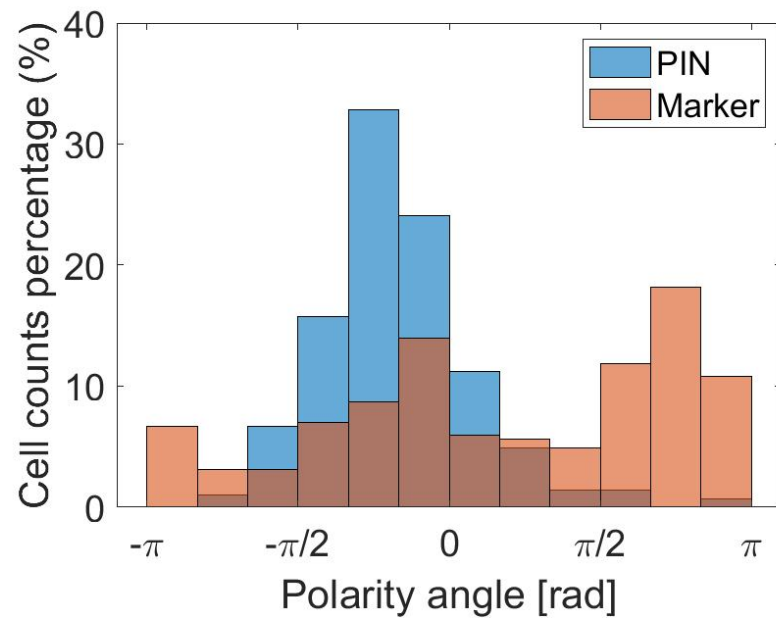


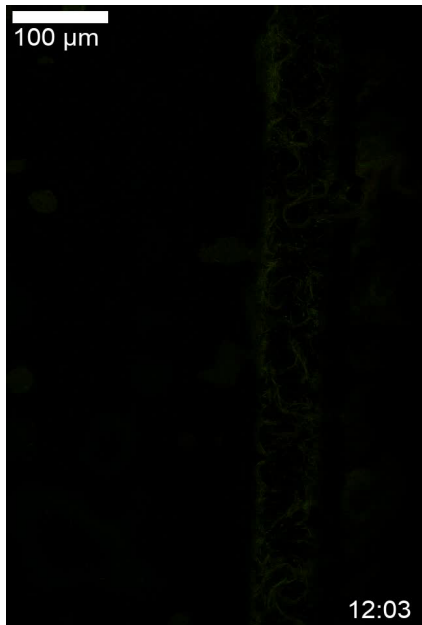
Can we drive persistent PIN-specific polarity through auxin gradients ?



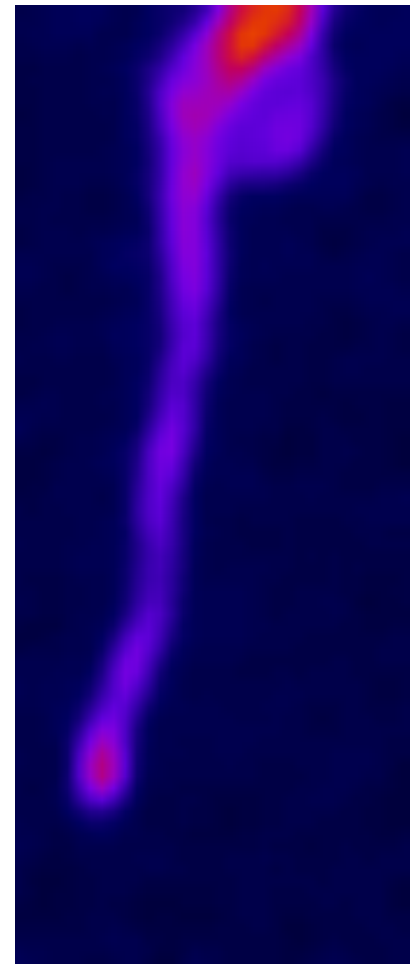
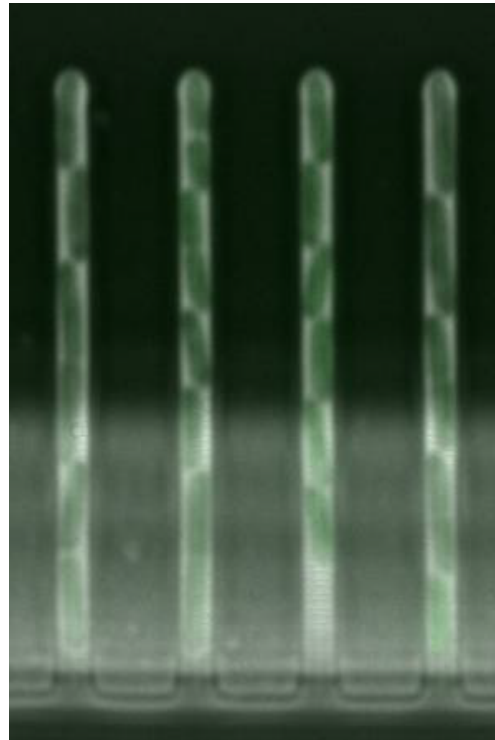
Cell director 2D: a framework to study how protoplasts respond to auxin gradients

Under an auxin gradient,
PIN tends to be oriented towards one direction,
and cells are more polar in PIN





Lab went a bit crazy



Graeme was also busy....

**The polar transport
of auxin and vein
patterns in plants**



**The Shape of an
Auxin Pulse**

G J Mitchison 1981 Proc R Soc Lond B

G J Mitchison 2015 Plos Comp Biol

**Conformal growth
of Arabidopsis
leaves**

G J Mitchison
2016 J Theo Biol

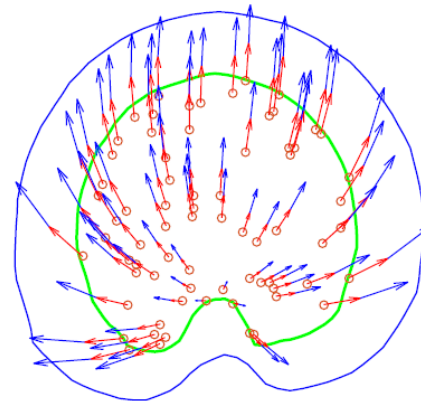


Fig. 9. Factorising the growth into two 12 h periods, using the Möbius transformation with matrix \sqrt{A} , where A represents the best fit for the 24 h between days 7 and 8 (leaf 4). The composition of the two maps, i.e. the result of following the red arrows and then the blue arrows, is equivalent to the 24 h best fit.



