Combining imaging and modeling to understand how hormonal signals drive self- organization dynamics at the meristem

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Plant aerial organs are initiated sequentially at the shoot apex at precise spatial positions, generating spatio-temporal patterns of organogenesis that establish the primary architecture of the shoot, the phyllotaxis. Modeling and wet experiments have shown that auxin-based inhibitory fields are central to the dynamics of organogenesis at the shoot apex, making it a system of choice to address how spatio-temporal changes in signal distribution and signaling capacities regulate developmental patterning in space and time in this self-organizing system. We have recently discovered a second-type of field modulating cytokinin signaling activity. Cytokinin-based inhibitory fields control specifically the timing of organ initiation at the shoot apex and we have further shown that this timing is particularly prone to noise. I will show that a stochastic model of phyllotaxis allows understanding how the timing of organogenesis is influenced by biological noise in phyllotaxis. I will discuss the predictions and consequences of this new stochastic view of phyllotaxis, focusing notably on how it helps understanding the properties of hormone signaling at the shoot apex.