LadHyX Seminar – November 20th, 10:45

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Mechanobiology of root hair growth

Plant growth is controlled by genetic circuits but also by mechanical cues as the plants need to adapt to their mechanical environment. The plant roots are good systems to study such an adaptation since they grow in soils which exhibit many mechanical heterogeneities. I studied the growth of the root hair, which is a cylindrical protrusion that grows from a root epidermal cell. This protrusion exhibits a highly polarized tip-focused growth, called tip-growth. It allows to explore and invade the soil. When penetrating the soil, which is a complex granular medium, the root hair is submitted to mechanical constraints resisting its elongation. My aim is to investigate the effect of mechanical cues on root hair growth. To this end, using custom-made glass cantilevers, I developed an experimental method allowing me to apply controlled forces on the tip of a growing root hair. I characterized the effect of a constant force on root hair growth. This enabled experimental measurements of root hair cell wall properties such as its effective viscosity and yield stress. Then, using a combination of microfluidics and optical microscopy, I characterized the growth speed of root hairs in different mechanical environments. In particular, the use of agar growth media of increasing young moduli leads to root hairs with lower growth speed and length. Finally, I determined the effect of external mechanical resistance on cell wall mechanics. I thus quantified the cell wall young modulus of living root hairs grown in medium of increasing stiffness using a bending experiment.