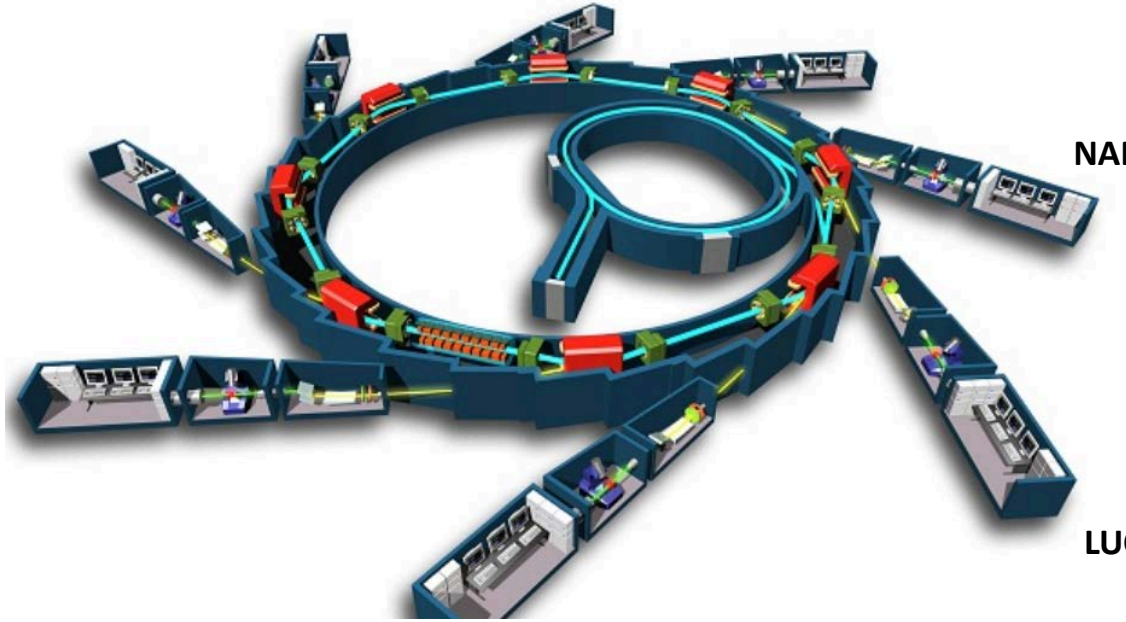
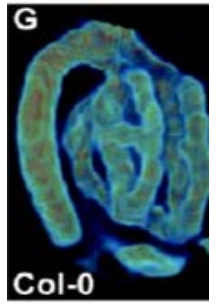
The advantages of analytical chemistry approaches to address plant nutrition issues

- elemental imaging
- speciation (chemical environment of atoms)

The use of synchrotron radiation to address our questions

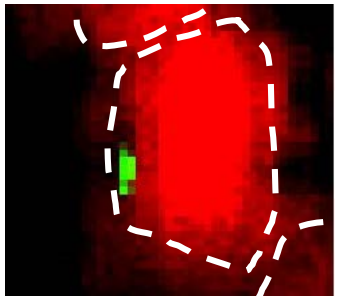


NANOSCOPIUM beamline: imaging + tomography (beam size 60x60nm)



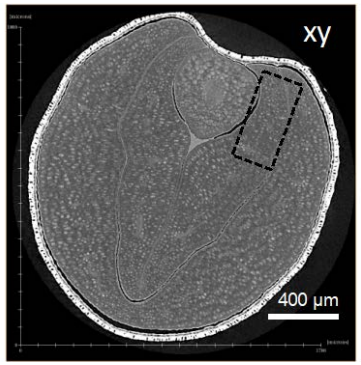
LUCIA beamline: imaging + speciation (beam size 3x3µm)

µXRF, synchrotron (Fe, K)



Local contacts from INRA: Thierry Chardot (INRA/IJPB), Camille Rivard (INRA/SOLEIL)

Fe XRF imaging in rapeseed cotyledons



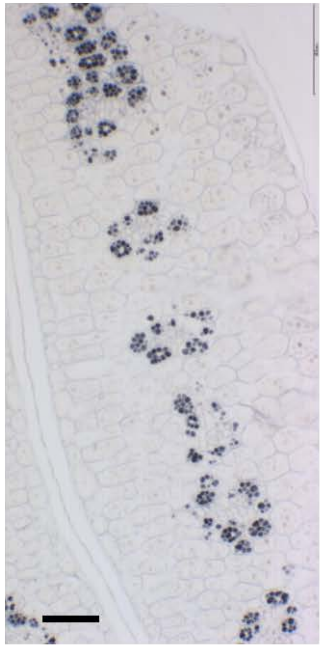
X-ray tomography

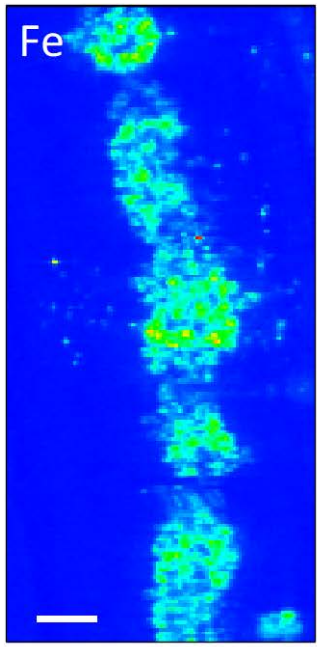
LUCIA beamline

M-P Isaure

Perls/DAB

XRF





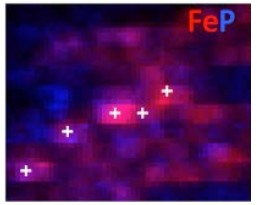
high

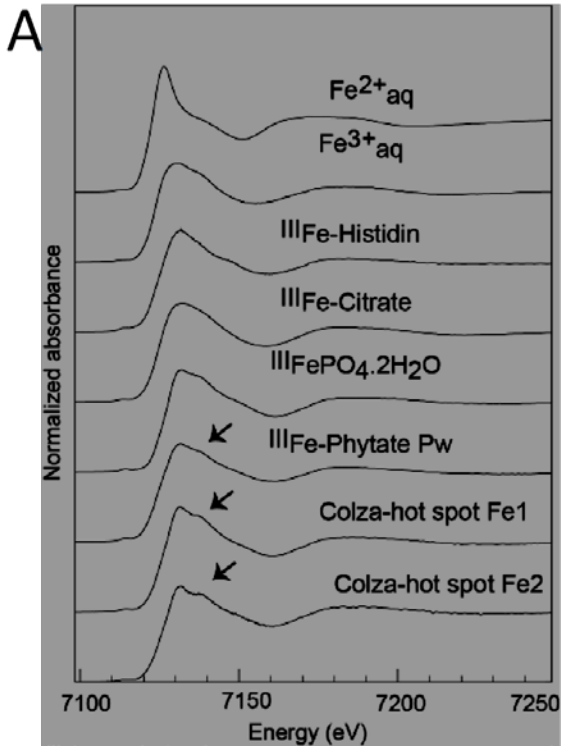
low

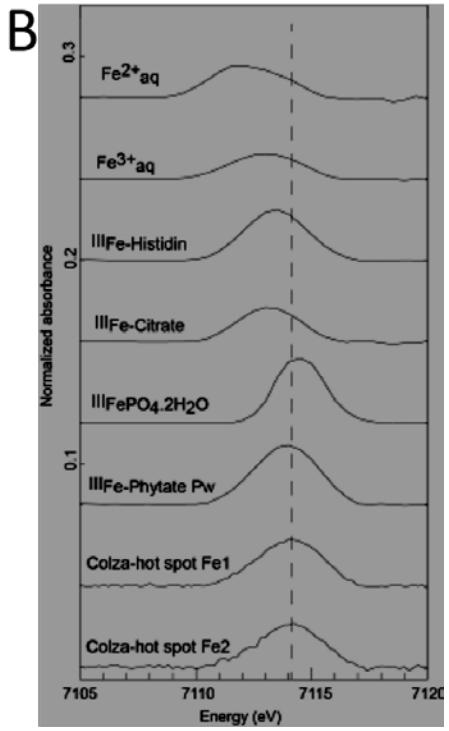
Co-localization of Fe and P in vacuoles

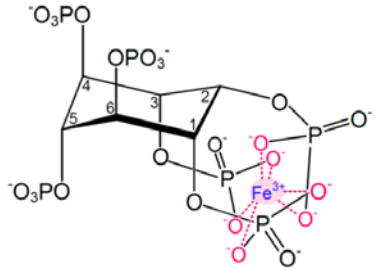
Fe speciation by XAS in rapeseed cotyledons

Ligne LUCIA









Fe^{3+}-phytate complex

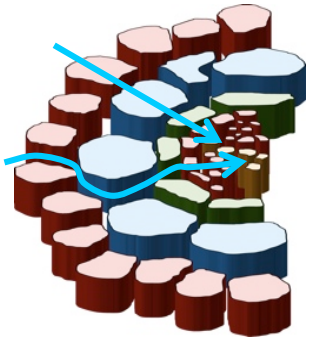
Fe is stored as ferric complexes with phytate in vacuoles

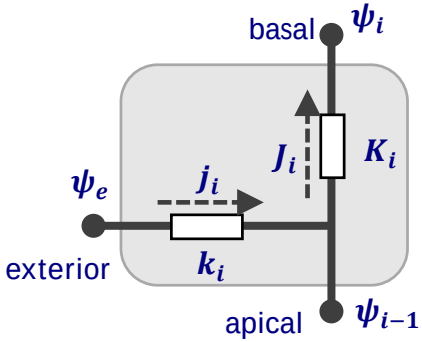
Water transport in roots

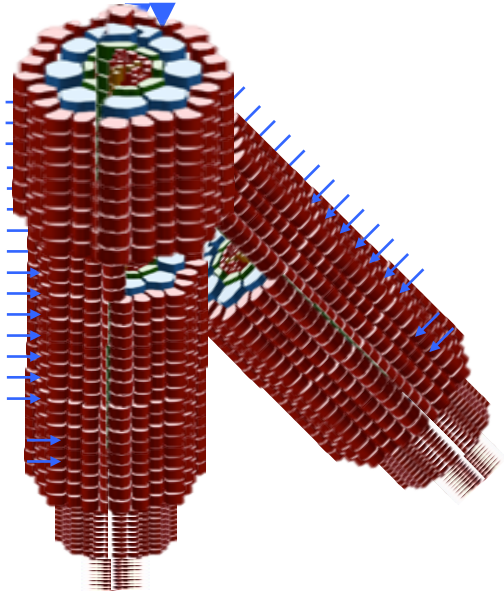
- Modeling the organ and tissues
- Single cell and root section water transport measurements

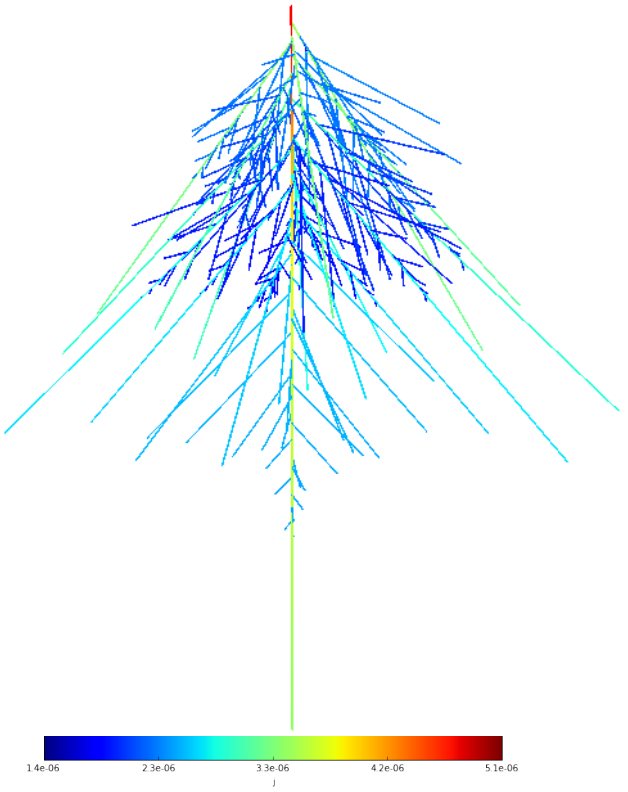
Yann Boursiac

Hydroroot : a model of hydraulic architecture









From a hydraulic unit to the whole root water transport




Christophe (Pradal + Godin + Maurel), Mikaël Lucas, Yann Boursiac

Eaudissect model of radial root water transport

Flow conservation

!! Stationary state !!

$$-\nabla \cdot (c\nabla\Psi) = 0$$

Biological inputs

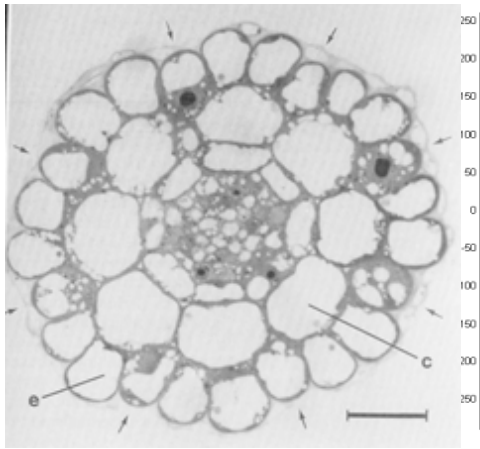
- c → Permeability coefficients
- Ψ_{in}, Ψ_{out} → Boundary conditions

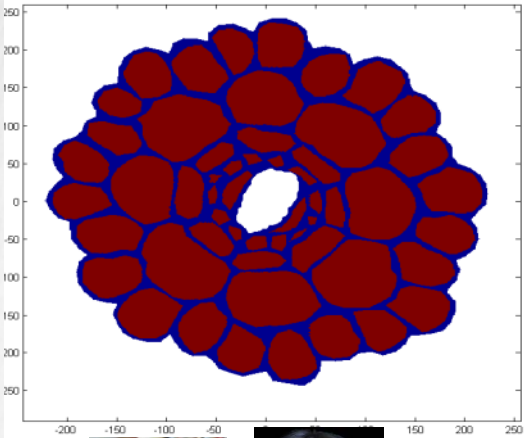
Water flow

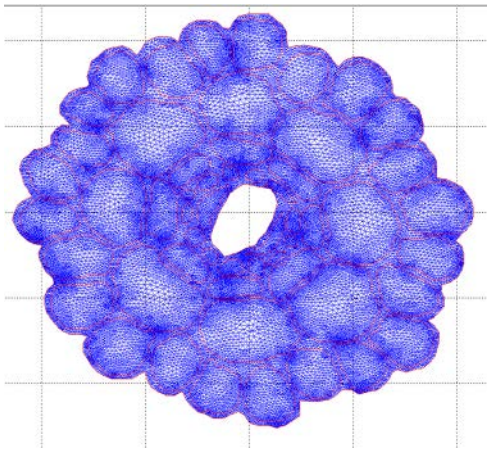
Wanted outputs

- Ψ → Water potential
- $c\nabla\Psi$ → Water flow

Finite elements

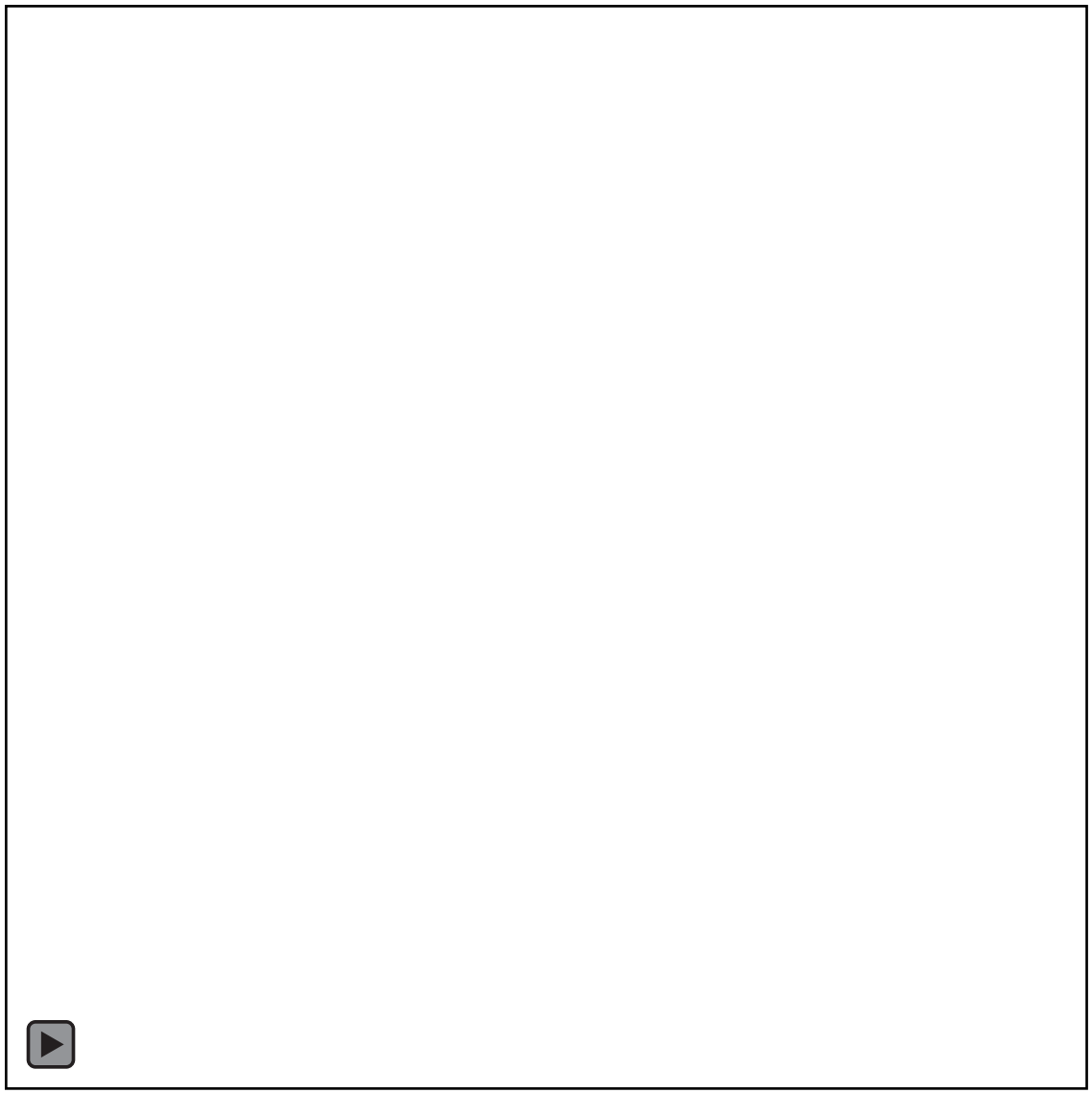






Didier Felbacq, Ana Maria Velez Cardona, Yann Boursiac

Water pathways through the root



There is no purely apoplastic pathway for water !

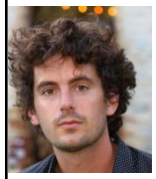
The « experimental model »

mpty cells

orous medium

o membrane

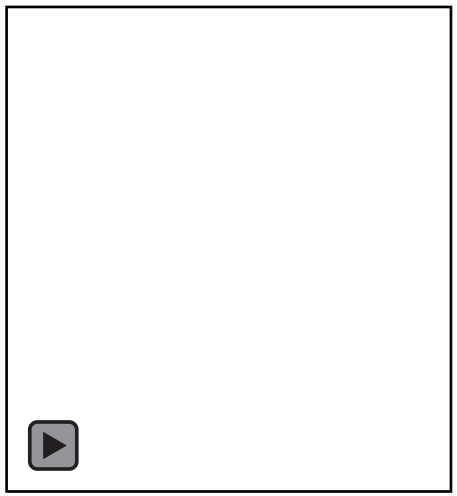
Flow of **pumped** dye

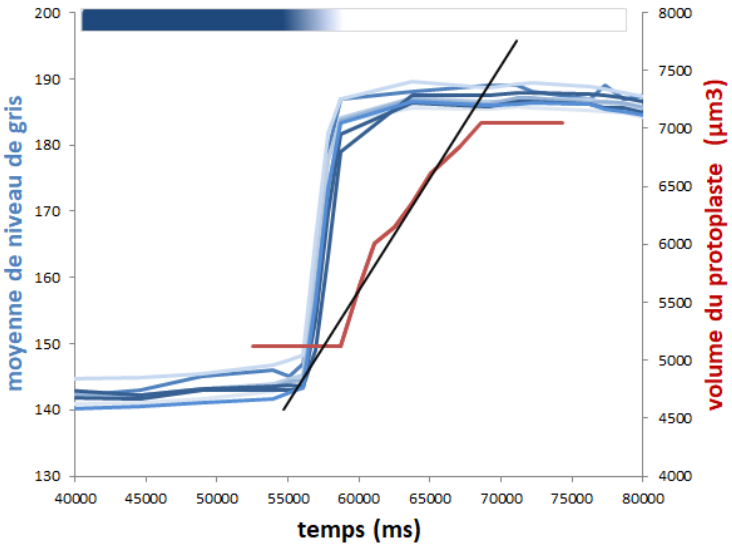


One step in between the mathematical model and reality

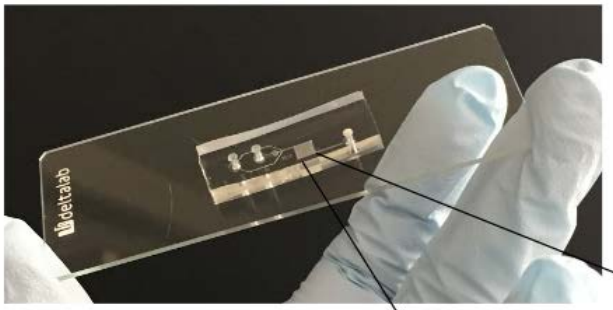
Bloen Metzger, Henri Lhuissier

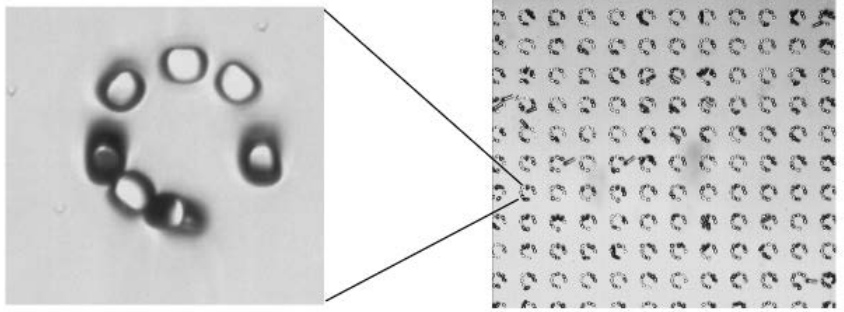
Improving the protoplasts swelling assays





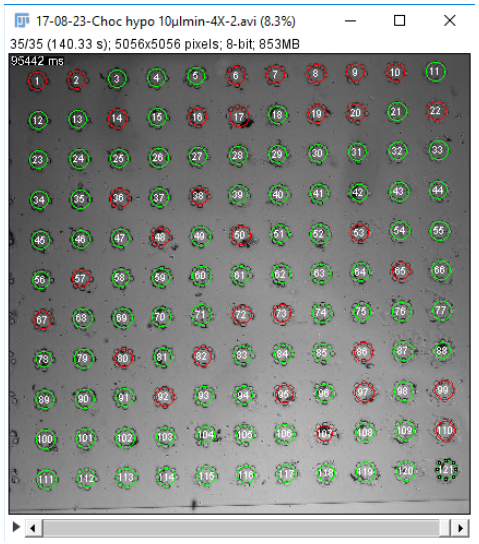
Development of a new technic based on microfluidics

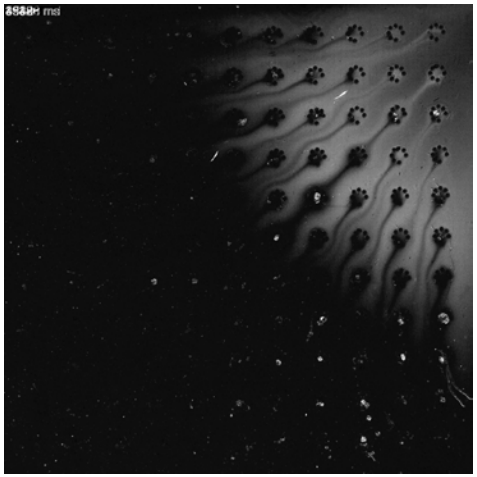




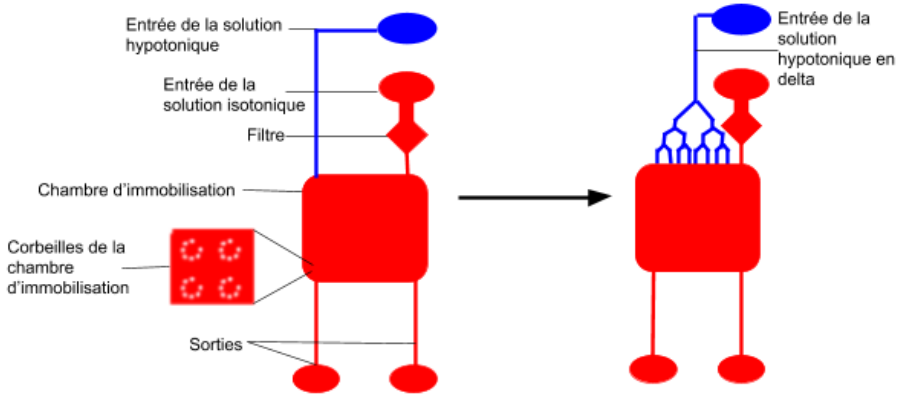
Soukaina Hajjaj, Benoît Charlot, Yann Boursiac

Improve the data analysis





Improve the microfluidic chip



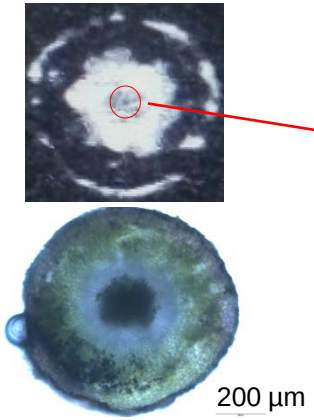
Soukkaina Hajjaj, Yann Boursiac, Benoît Charlot, Volker Baecker

Live measurements of sap flow: a new method

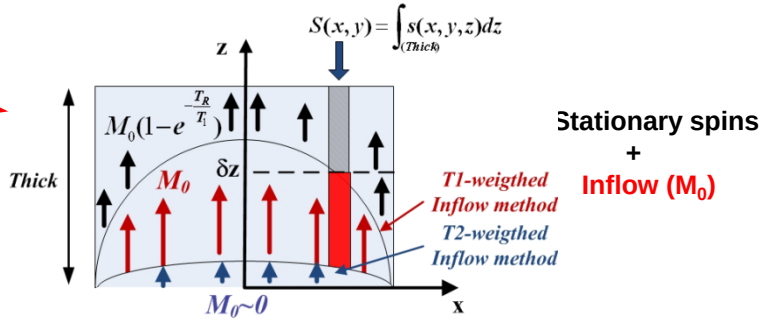
C. Coillot (BioNanoNMRI), N. Tang (BPMP)

New antennas

MRI of a plant hypocotyl

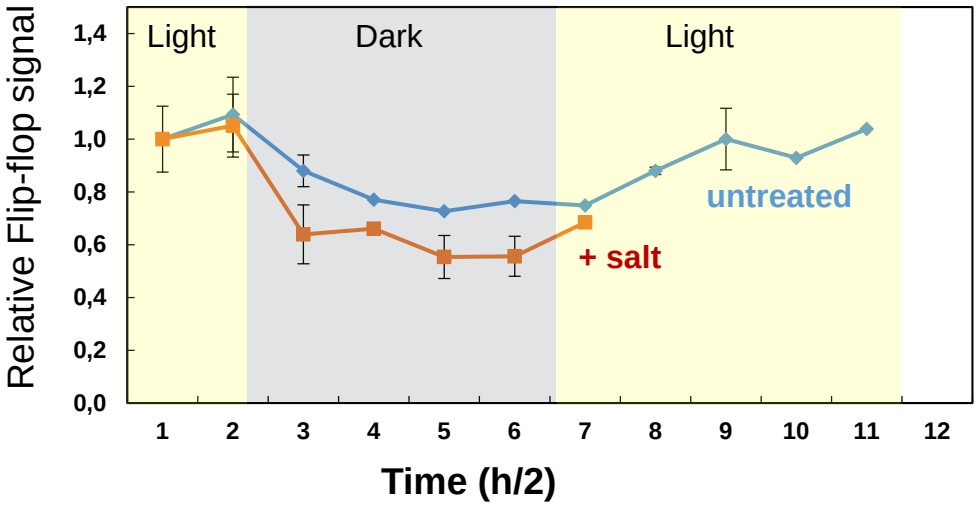


Flip-Flop Spin Echo Method



(C. Coillot *et al.*, unpublished)

Physiological validation



Ongoing work

→ Exploring new plant treatments or stresses (ABA)

→ Parallel measurements of stomatal conductance

→ Mutant genotypes with altered stomatal behavior (*ost2*)

PROS:

- Explicit the models and objects you have in mind
- Open up your mind
- Answer the questions you have with tools you don't
- Answer questions you did not expect
- Allow access to other types of calls

CONS:

- Depend on collegues availability
- Depend on fundings

FINANCIAL Support:

MITI, Labex Numev, SFR, MultiLabex calls, …

PERSPECTIVES:

Towards equilibrated collaborations

Spread the words (investment)

Collaborations about techniques (downsizing, higher throughput, new devices) and/or biological questions