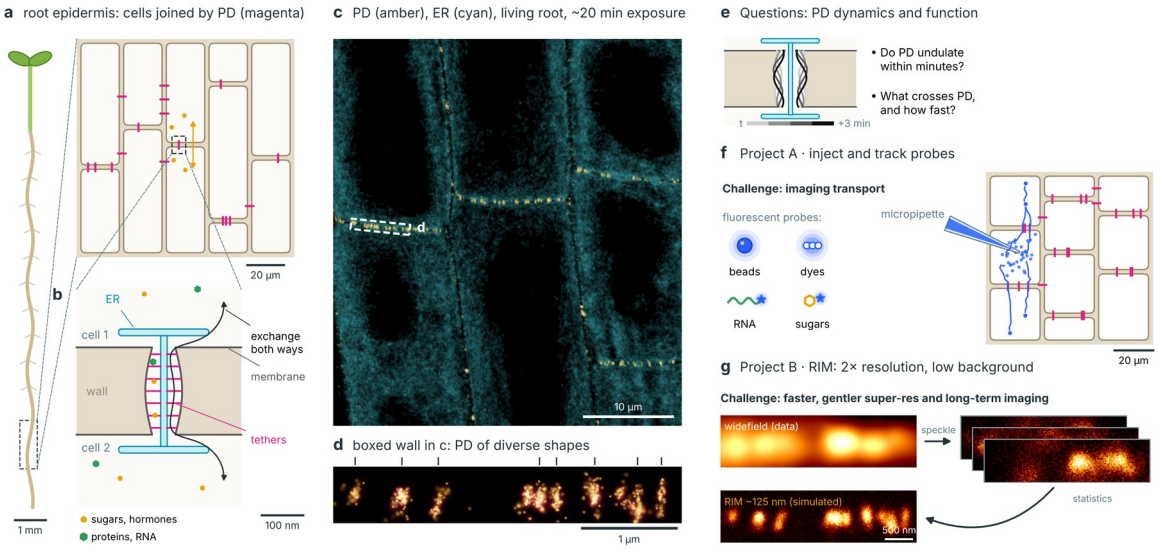
Internship offer · Spring–Summer 2027 · two projects

Super-resolution microscopy of plasmodesmata in living plants

The Nanobiomicroscopy group at LP2N (Laboratoire Photonique, Numérique et Nanosciences, Institut d'Optique d'Aquitaine; head: **Prof. Laurent Cognet**) offers **two internship projects for Spring–Summer 2027** (2–6 months, flexible). Both are supervised by **Dr. Nathan Ronceray** within the Plant Wiretap project, in close collaboration with the plant biology group of **Prof. Emmanuelle Bayer** (Laboratoire de Biogenèse Membranaire, Université de Bordeaux).

Project context

Plant cells are connected by **plasmodesmata (PD)**, nanoscale membrane-lined channels that bridge neighbouring cells (Fig. a, b). Sugars, hormones, proteins and RNAs travel through PD: they are how plant cells communicate and coordinate. PD are dynamic and tightly regulated (Li et al., Science 2024; Pérez-Sancho et al., Cell 2025), yet they remain poorly understood, for lack of tools to observe them in living tissue. We recently developed the **first single-molecule super-resolution approach that works in living plants** (Ronceray et al., in preparation), producing the first super-resolved images of PD in a living root (Fig. c, d). These images reveal a striking diversity of PD shapes (Fig. d), suggesting that PD fluctuate (Fig. e). **We want to understand transport through PD by imaging both probes moving through them (Fig. f) and their fluctuations (Fig. g).** We offer two project tracks, below.



(a) Seedling to root epidermis; PD in magenta. **(b)** One PD (after Pérez-Sancho et al., Cell 2025). **(c)** Living root, ~20 min exposure; PD imaged via the labelled MCTP tethers sketched in (b). **(d)** Boxed wall in (c). **(e)** Open questions: do PD undulate, and what crosses them? **(f)** Injected probes (blue) spread along the cell file. **(g)** Widefield (data, mean of raw frames) → speckle frames → RIM (simulated). Images c, d: Ronceray et al., in prep.

Project A · Microinjection to image PD function

Genetically encoded labels (Fig. c, d) reveal where PD are and how they are built, but not what passes through them. To interrogate cell-to-cell movement directly, we will gently inject bright, mobile probes into root cells and track them as they cross PD (Fig. f; Howell et al., PNAS), building on promising trials in the lab.

1. Design and build a compact microscope with a microinjection setup at LP2N (micropipettes, pressure control, micromanipulation).
2. Establish a protocol to inject fluorescent probes into *Arabidopsis* root cells.
3. Track single probes from cell to cell on our single-molecule microscope.
4. Extend tracking to 3D using PSF engineering.

Project B · Gentle super-resolution to follow PD over time

PD may fluctuate on the minute timescale, possibly driving active transport, but our single-molecule approach integrates for longer and cannot resolve this. **Random illumination microscopy (RIM)** doubles the resolution and rejects background at low light doses (Fig. g; Mangeat et al., Cell Rep. Methods 2021), allowing super-resolved images every minute.

1. Implement RIM on our custom microscope and adapt it to live roots.
2. Search for minute-scale PD fluctuations, and test how they change under stress conditions.
3. Image PD over hours in growing *Arabidopsis* roots to follow their development, with smart acquisition that keeps PD in view.

Training & target profile

Hands-on training in custom microscopy, Python instrument control, image analysis and live plant imaging. The projects suit M1 or M2 students in (bio)physics, optics or engineering who are curious about plant biology; no prior plant biology background is needed. Each project is scaled to the internship length.

PhD opportunity & application

The internship can lead to a **funded PhD** at Institut d'Optique / LP2N. To apply, send a CV and a short motivation paragraph stating your preferred project to nathan.ronceray@u-bordeaux.fr. Prior experience in optics is a plus but not required.

More information: The Plant Wiretap · host groups: Cognet group · Bayer group