

Light sheet microscopy of cell sheet folding in Volvox

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Proposal Title	Light sheet microscopy of cell sheet folding in Volvox
The Idea	<p>We are applying for financial support by the OpenPlant Fund to help us improve our light sheet microscope. The amended setup will be used by the Cambridge group for laser ablation experiments on the freshwater alga Volvox. We are using the embryogenesis in Volvox as a model for epithelial development in metazoans.</p> <p>Stephanie Hoehn attended an EMBO course on modelling morphogenesis at the JIC in 2015, and is attempting to use computational modelling techniques developed by Prof. Enrico Coen's group at the JIC. She and her collaborators are combining imaging, experimental and theoretical approaches to study the so-called inversion process that bears similarity to gastrulation and neurulation. The Norwich group will use the light sheet microscope to study organs of the carnivorous plant Utricularia (Bladderwort).</p>
Who We Are	<p>Stephanie Hoehn, microscopy design and imaging, Goldstein group, DAMTP, Cambridge, UK, s.hoehn@damtp.cam.ac.uk</p> <p>Pierre Haas, mathematical modelling of biophysics, Goldstein group, DAMTP, Cambridge, UK, pah59@cam.ac.uk</p> <p>Karen Lee, OPT and future light sheet microscopy, Coen group, JIC, Norwich, UK, karen.lee@jic.ac.uk</p>
Implementation	<p>We have built an OpenSPIM light sheet microscope and successfully acquired the first 3D in vivo recordings of development in <i>Volvox</i>. We are planning to use laser ablation experiments to study the tensile forces acting on the cell sheet deformations in <i>Volvox</i>. However, our current setup has limitations in terms of frame rate and resolution. We would use the OpenPlant grant to complement internal funding to add an ablation laser, a faster stage, an additional detection objective for dual-view to our light sheet setup. This will enable us to visualize the dynamic response of the cell sheet after laser incisions. We will then integrate our findings on tensile forces into a mathematical model building on previous work of Pierre Haas and the Coen group at the JIC.</p> <p>Karen Lee will attempt to use our current and future light sheet setup to image plant organs that are too big to be fully imaged with confocal microscopy or optical projection tomography.</p>
Benefits and outcomes	<p>The amended light sheet microscopy and laser ablation setup will be available to researchers in Cambridge (including the Sainsbury Lab) and Norwich. The design will be openly available. We are starting new collaborations with Dr. Karen Lee at the JIC and with theorists of the Coen group.</p> <p>Advantages of using a green alga as a model organism for cell sheet folding is the non-invasive label free imaging of chlorophyll auto-fluorescence, the short generation time and the easily accessible embryonic cell sheet. Moreover, our approach brings together experimentalists and theorists.</p>

Studying the biomechanics of cell sheet folding is of major importance for the understanding of development and might foster tissue engineering.

**Sponsor for
the research
and cost
centre**

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Budget

Expenses

Ablation laser (Electro Scientific Industries): 8000£
Microscope stage (Picard Industries): 600£
40x objective (Olympus): 5000£

Sum: 13,600£

Funding

Internal funding: 9600£
OpenPlant grant: 4000£

Sum: 13,600£
