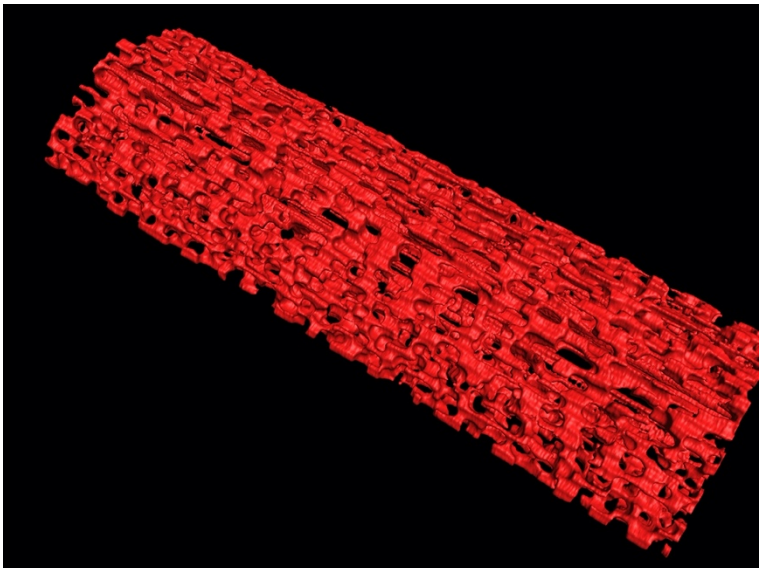
Sap flow and sugar transport in a pine needle

LadHyX, École Polytechnique, Paris
Thursday, June 10, 14:00

Tomas Bohr

Physics Department
Technical University of Denmark
Kgs. Lyngby
Denmark



Transfusion tissue connecting the mesophyll (outside)
with the phloem (inside), carrying water out and sugar in.

The survival of green plants depends on efficient use of photosynthesis in the leaves, where sunlight, water, and CO_2 are transformed to sugar – the raw material, which builds up even the largest trees. The sugar is transported dissolved in water through the sieve tubes of, the *phloem*, a vascular system, which runs through the veins of the leaves and on through the stem, all the way down into the roots. This vital sugar flow is driven by *osmosis*: water flow caused by differences in concentration of solutes. It is in the leaves – or in the needles of conifers – that this process is activated when the sugar is brought from the mesophyll (containing the photosynthetic chloroplasts) into the sieve tubes and thereby draws water into the phloem. The water comes from the other vascular system, the *xylem*, drawing water from the soil into the roots and all the way up into the leaves, where it moves in opposite direction to the sugar. How this is possible remains a major mystery.

The architecture of the vascular system of needles is simpler that that of broad leaves, since it consists or parallel tubes, so we have started our analysis there. I shall show that this architecture is actually challenging and makes it difficult for a long needle to export sugar from the region near the tip. This has forced us to look more carefully at the grouping of the phloem tubes and at the tissue transporting sugar from the mesophyll into the phloem. The latter has been done with X-ray tomography on intact needles, which has revealed an interesting and unexpected structure akin to swiss cheese (figure) carrying water out and sugar in.