

PHYSICAL MATHEMATICS SEMINAR

Design Principles of Sugar Transport Systems in Plants

KAARE HARTVIG JENSEN
Harvard University

ABSTRACT:

Plants require effective vascular systems for the transport of water and dissolved molecules between distal regions. Their survival depends on the ability to transport sugars from the leaves where they are produced to sites of active growth; a flow driven, according to the Münch hypothesis, by osmotic gradients generated by differences in sugar concentration. The length scales over which sugars are produced and over which they are transported, as well as the radius of the network of porous cylindrical phloem cells through which the transport takes place, vary among species over several orders of magnitude. A major unsettled question is whether the Münch transport mechanism is effective over this wide range of sizes. A model is presented which provides a relationship between the sugar flux and the geometric and material parameters of the plant. The model is evaluated on “artificial” and real plants, with good agreement between experiments and theory. Predictions of the model are explored and are shown to lead to several surprising geometric design constraints on the relative size of the plants organs.

TUESDAY, MAY 15, 2012

2:30 PM

Building 2, Room 105

*Reception at 3:30 PM in Building 2, Room 290
(Math Dept. Common Room)*

<http://math.mit.edu/pms>



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