Introduction
The growth of a pollen tube, a protuberance of the germinating pollen grain, is vital for plant reproduction. This growth is extremely rapid and involves targeted intracellular cargo-transport, and the expansion of a pollen tube as a high-pressure vessel strongly depends on the mechanical properties of the cell wall.

Objectives:
• What is the effect of external mechanical stress on pollen tube growth?
• Does the geometry of the tube affect intracellular streaming?

Analytical Methods
We model the drag-generating actin filaments [4, 5] of the pollen tube as a distribution of Stokeslets, and analyse the resulting motion of the cytosol.

Experimental Methods
To probe the impact of mechanical stress distributed over the pollen tube surface on the growth of the cell, we have employed controlled perfusion in a microchannel. We have subjected germinating pollen grains to a uniform Hele-Shaw flow (Re ~ 10^3 – 10^4) in a rectangular channel, with wall shear stress $\tau \sim 10^5$ Pa.

Results

Conclusions
We have explored both internal and external mechanics of a growing pollen tube.

• We found some indication of orientation and growth attenuation responses in pollen tubes subjected to an external Hele-Shaw flow; further study is however required.
• High turgor pressure (~ 10^5 Pa) in the pollen tube [1], when compared to the applied external shear stress, makes a purely passive mechanics insufficient to account for the observed effects, and thus they likely involve intracellular regulation.
• Cytoskeletal geometry of the pollen tube is shown to be an important determinant of the mean velocity of cytosolic motion.

References