Intra-cellular microfluidics to probe the role of physical transport in morphogenesis

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Whereas modern genetics have provided great insights into the regulatory basis of embryogenesis, the role of physical transport in developing systems remains largely enigmatic due to the lack of suitable perturbation methods.

A particularly important morphogenetic event is cell polarization prior to asymmetric cell division. For the nematode worm C. elegans cell polarization was suggested to result from the interplay of PAR proteins and cortically induced flows.

However, it remains a challenge to show the causal role of flows at the onset of embryogenesis by direct flow perturbation experiments.

Towards this end, we exploit thermo-viscous pumping (Weinert & Braun, J. Appl. Phys. 2008) to control directed flows in living embryos without affecting their biological integrity. By perturbation of wild type-flow patterns, we are able to alter cell polarization dynamically and highly localized. To our knowledge our experiments represent the first non-invasive *transport-only* perturbation of developing organisms.