

Flows in Starfish Oocyte Cytoplasm Driven by Surface Contraction Wave

Nils Klughammer¹, Johanna Bischof², Péter Lénárt² and Ulrich S. Schwarz¹

¹*Institute for Theoretical Physics, University of Heidelberg, Heidelberg, Germany and*

²*Cell Biology and Biophysics Unit, European Molecular Biology Laboratory (EMBL), Heidelberg, Germany*

Meiotic divisions of starfish oocytes are closely related to surface contraction waves (SCWs) of which the exact function is unclear. Apart from generating large-scale deformations of the cell envelope, they also lead to hydrodynamic flows inside the cell. Both cell deformations and hydrodynamic flow can be measured with optical microscopy and quantified using image analysis.

We have developed an analytical continuum theory to predict the hydrodynamic flow from the experimentally measured cell deformations. This now can be compared with the experimental data giving us the possibility to study flow generation and to estimate properties of the cytoplasm, including its viscosity. It also allows us to predict the pressure field, that cannot be measured directly. Finally our results might be used to elucidate if the hydrodynamic flow is simply a physical consequence of the SCWs or also has a biological function, e.g. to distribute certain factors inside the large cell.