# IMPRS on Multiscale Biosystems

**Project Title**: Control of membrane organization by septins

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**Project description**: Septins are an essential family of GTP-binding cytoskeletal proteins that are important for cell shape generation and recognition. They are believed to provide scaffolds for recruiting other proteins and because they form filaments, they are considered to be part of the cytoskeleton. As such, they associate with cytoskeletal elements and the plasma membrane and can modulate the morphology of the latter. First discovered as essential proteins in cell division, they are now known to play important roles in a variety of processes from cell division to neuronal degeneration.

The aim of this project is to understand the mechanism by which proteins from the septin family deform cellular membranes. We aim to engage a combination of purified components and establish in vitro reconstituted membrane systems mimicking the cellular environment. Live cell imaging, advanced and high-end microscopy techniques, including super-resolution microscopy and micro-manipulation approaches will be put to action to investigate how septins deform membranes, what forces are involved and which structural requirements of septins allow this to happen. Depending on the candidate background, the work will involve biochemical and cell-biology work in the Ewers laboratory at FU Berlin and biophysical in vitro work in the Dimova lab (www.dimova.de) at the MPI.

**Required background**: MSc. in biochemistry, biophysics or physics. A strong interest in Physics of biological systems, interest in interdisciplinary work; basic knowledge of membranes and microscopy experience will be advantageous.

**Papers to read before the interview**:


1. Bridges, A. A., Jentzsch, M. S., Oakes, P. W., Occhipinti, P. & Gladfelter, A. S. Micron-scale plasma membrane curvature is recognized by the septin cytoskeleton. *J Cell Biol* (2016). doi:10.1083/jcb.201512029
2. Tanaka-Takiguchi, Y., Kinoshita, M. & Takiguchi, K. Septin-mediated uniform bracing of phospholipid membranes. *Curr Biol* **19,** 140–145 (2009).
3. Tooley, A. J. *et al.* Amoeboid T lymphocytes require the septin cytoskeleton for cortical integrity and persistent motility. *Nat Cell Biol* **11,** 17–26 (2009).
4. Dasgupta, R., Miettinen, M. S., Fricke, N., Lipowsky, R. & Dimova, R. The glycolipid GM1 reshapes asymmetric biomembranes and giant vesicles by curvature generation. *Proc Natl Acad Sci USA* **115,** 5756–5761 (2018).

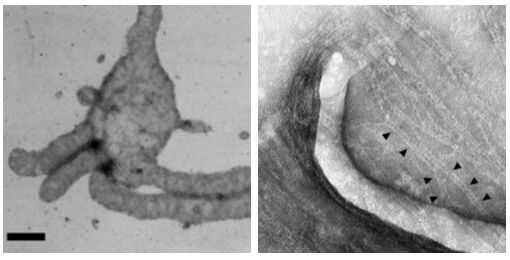
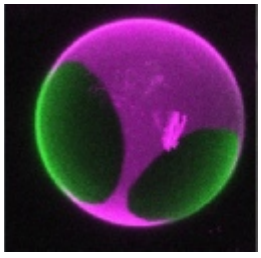
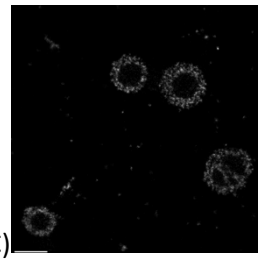

(A)  (B)  (C) 

**Figure:** (A) Left: Septin filaments polymerized on a vesicle deform it. Right: Closeup of polymerized filaments on vesicle. (B) Giant lipid vesicles exhibiting lipid phase separation as visualized by fluorophores partitioning in the domains (~25 microns in diameter). (C) Superresolution microscopy of septin filaments in genome-edited cells polymerized into a ring structure. Every dot represents one septin molecule. Scale bar = 500 nm.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