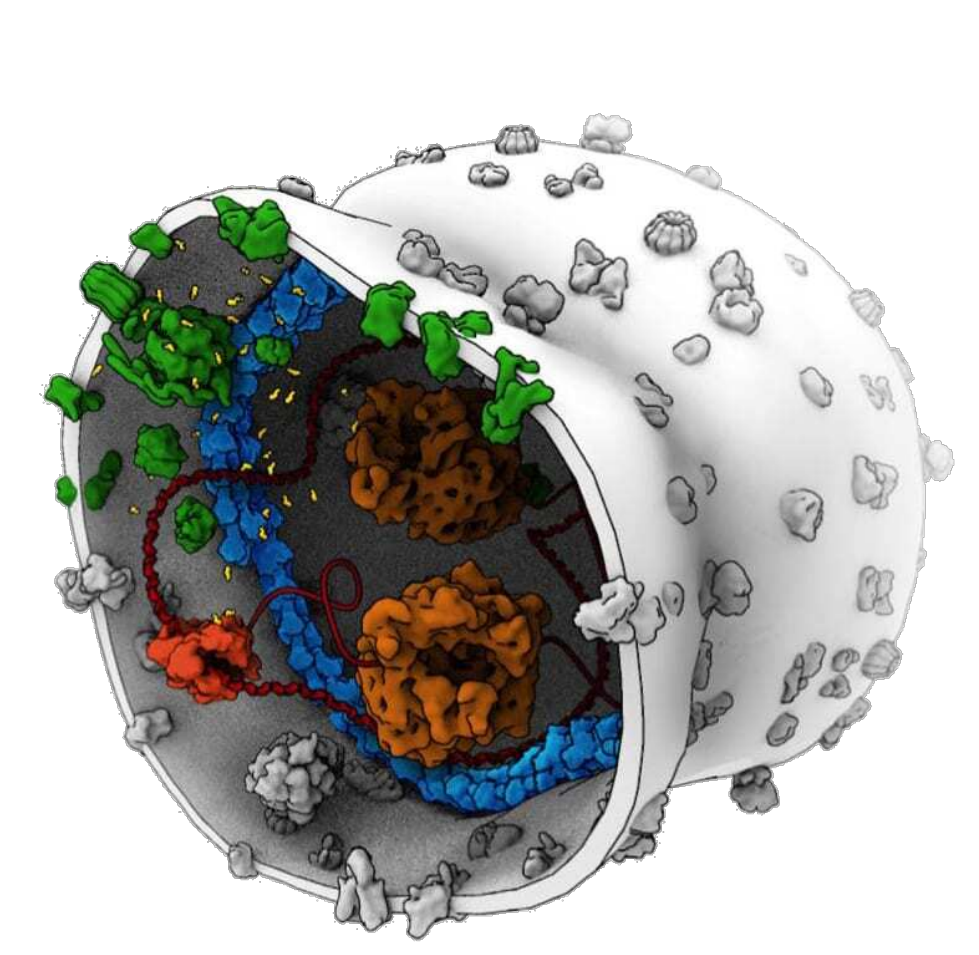


Biophysics of reconstituted cytoskeletal systems



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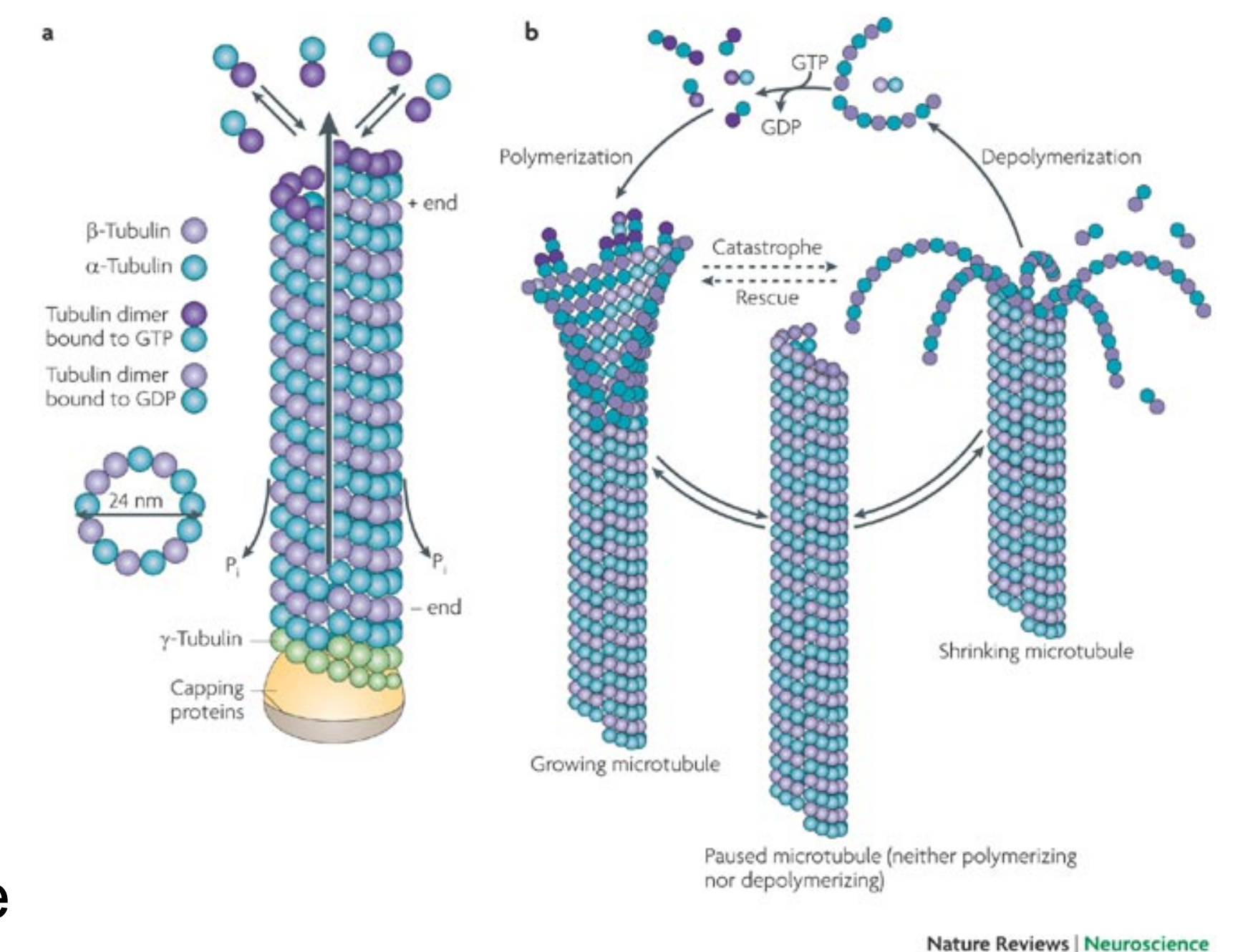
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Research in the group is aimed at a quantitative understanding of physical processes involved in organizing cytoskeletal systems in living cells. We are interested in,

- * molecular processes at the nanoscale that allow dynamic cytoskeletal filaments to generate picoNewton forces e.g. pulling or pushing forces that result from microtubule polymerization or depolymerisation
- * self-organizing properties of filament-motor systems such as kinesins and microtubules at the cellular scale
- * the influence that cytoskeletal organization has on the spatiotemporal organization of regulatory networks such as those involved in cell polarization processes and cell division.

We perform our experiments mostly in reconstituted minimal systems using quantitative techniques such as optical tweezers and various forms of (high-resolution) imaging, making use of microfabrication and microfluidic techniques to create well-controlled (confined) environments. In collaboration with others, we complement this in vitro approach with experiments in living cells as well as theoretical and computational modeling. The long term ambition of the group is to contribute to the achievement of building a complete functional synthetic cell (BaSyC).

Microtubule dynamics



Other bacterial filaments
bTub, ParM, TubZ, PhuZ

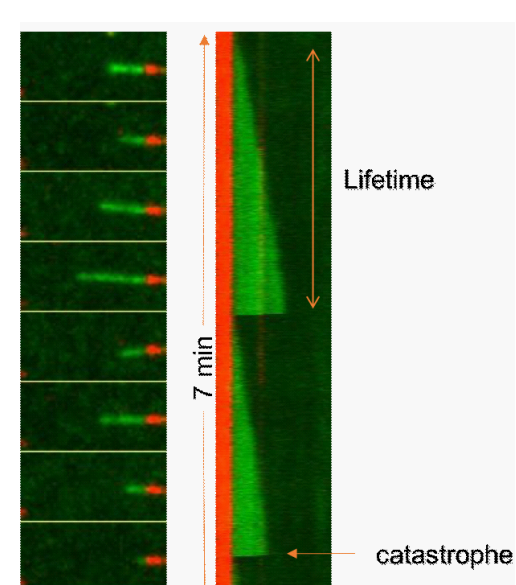
Projects

readily available

possible

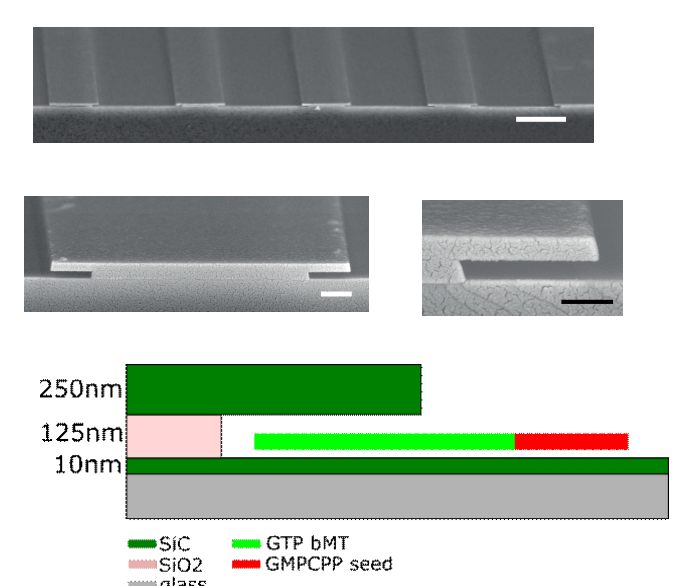
Free growth experiment

Characterization of dynamics of freely growing microtubules (MT) - measuring growth rate, shrinkage frequency



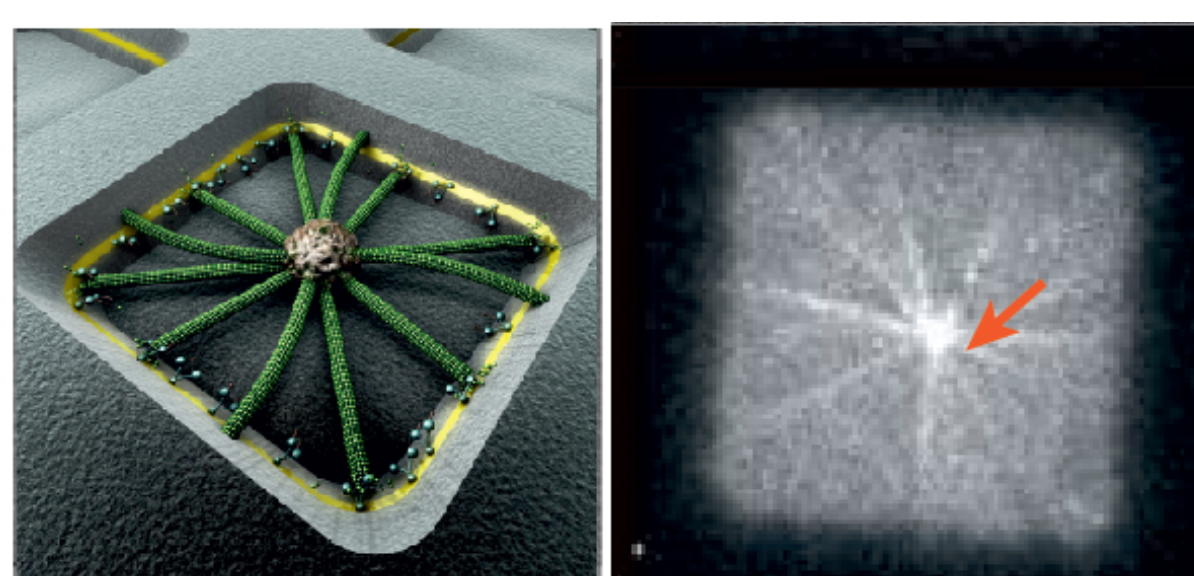
Barrier experiment

Effects of 1D confinement (i.e. barrier) on the MT growth dynamics

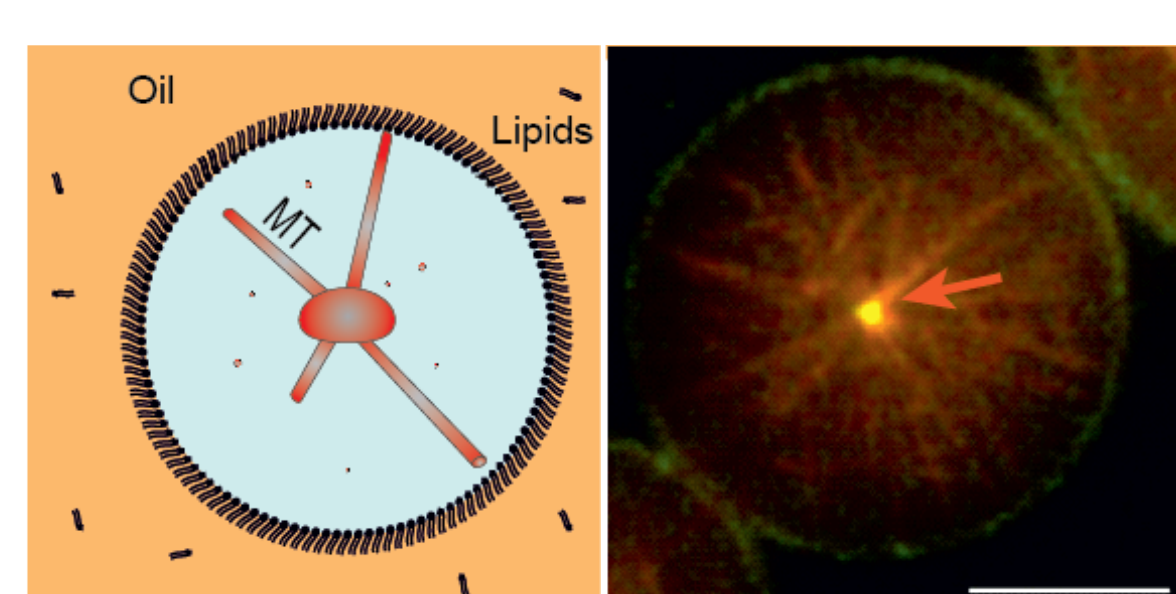


Chamber experiment

Organisation of MT aster in 2D space (i.e. micro fabricated chamber)

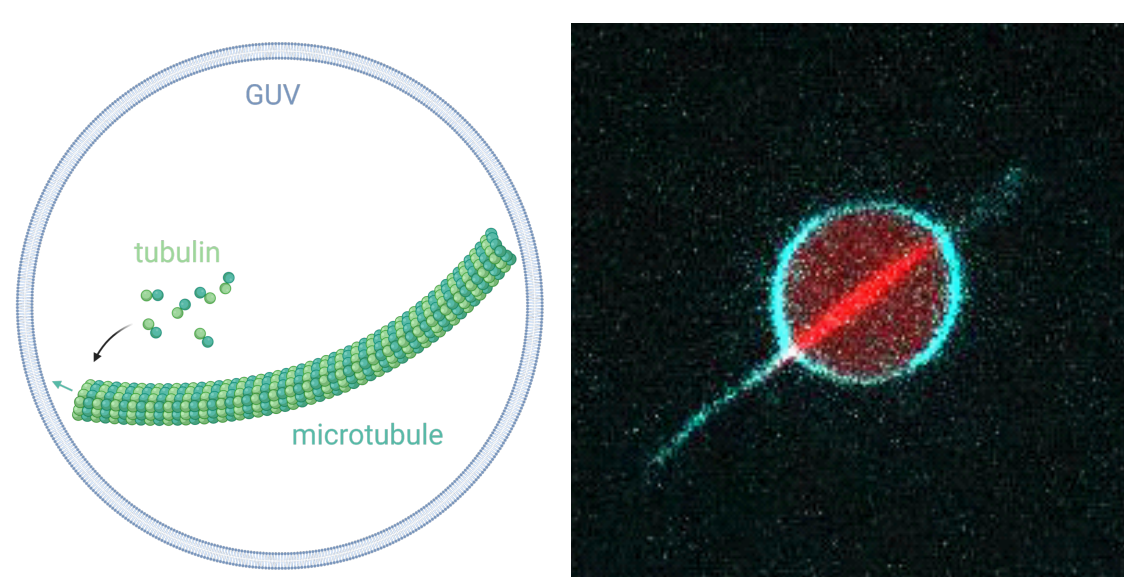


3D confinement experiment



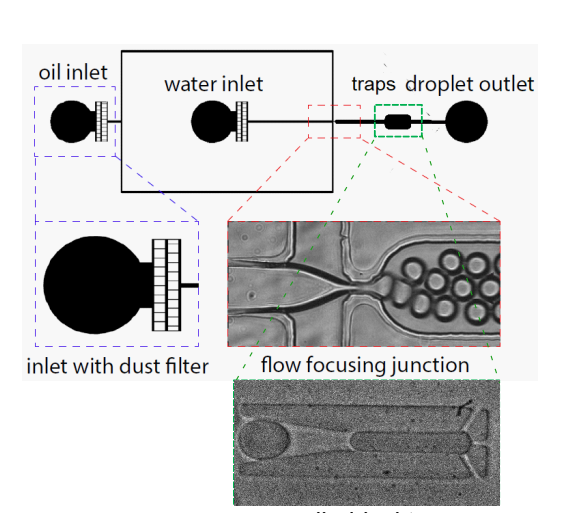
Organisation of MT aster in (3D) water-in-oil droplet

Encapsulation of MTs in liposomes - a 3D synthetic cell-like lipid membrane environment



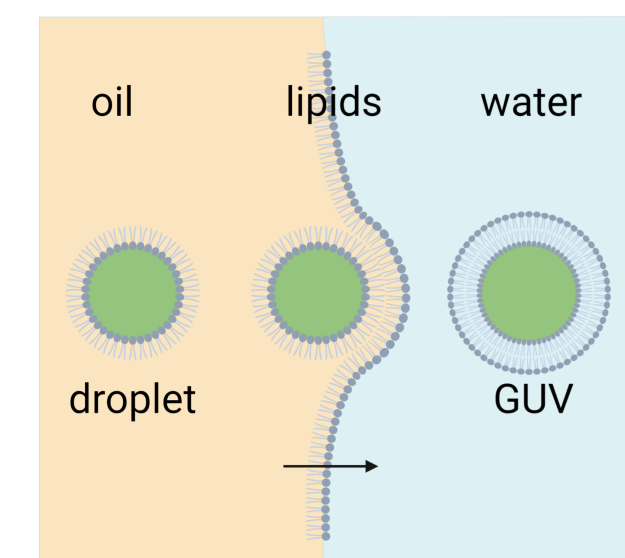
Droplet production

Water-in-Oil droplet production and trapping using microfluidics chips



Liposome production

Optimizing emulsion transfer methods for liposomes production - cDICE, emulsion transfer, OLA, dsGUV



Creating lipid domains on liposomes using lipid liquid-liquid phase separation

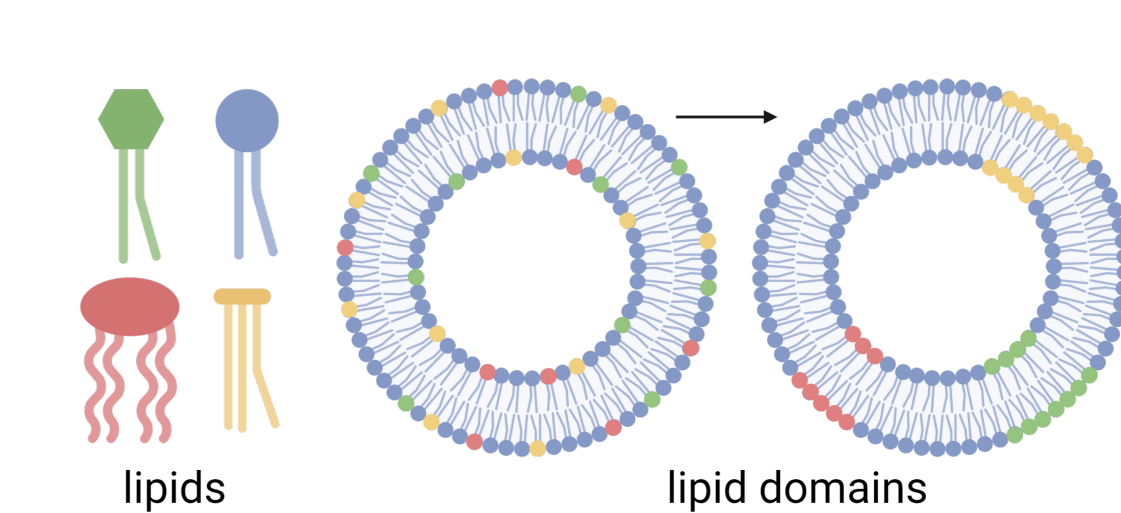
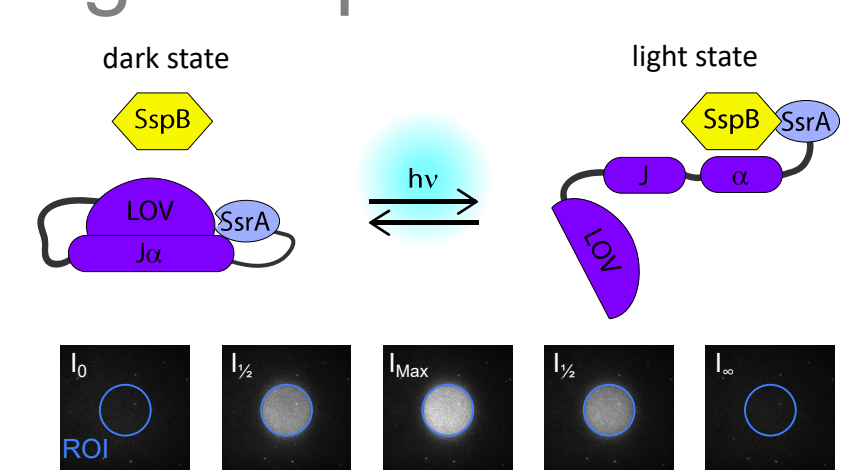


Photo-switchable proteins

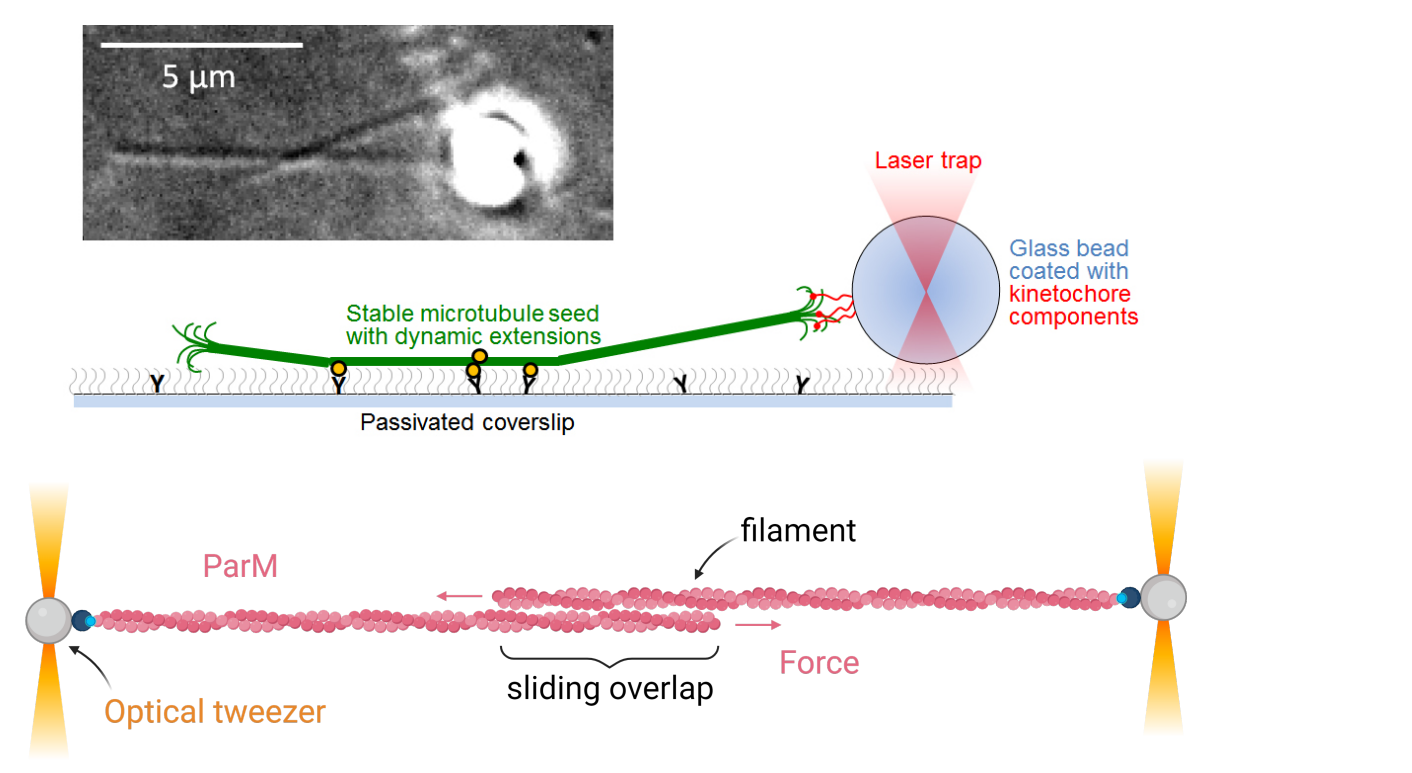
Characterization of light dependent association

Spatio-temporal control in minimal spindle

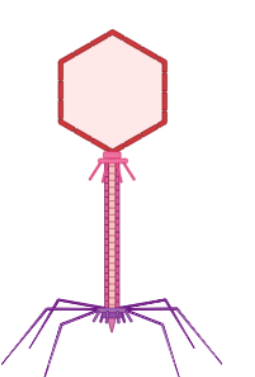


Optical tweezer measurement

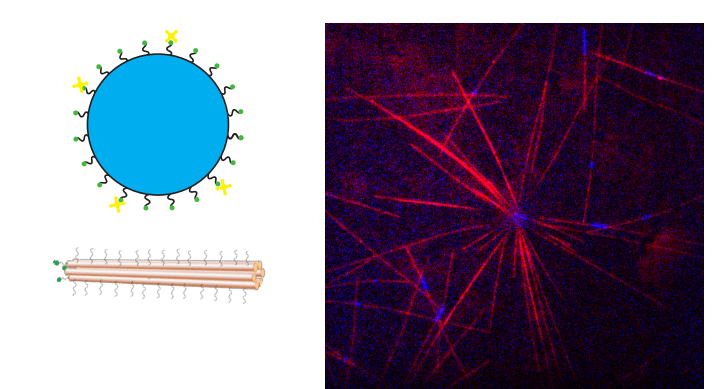
Quantifying force generated by MT associated proteins (MAP) Measuring ParM filament growth and anti-parallel spindle sliding forces



Search for PhuZ filament interaction partners from bacteriophage



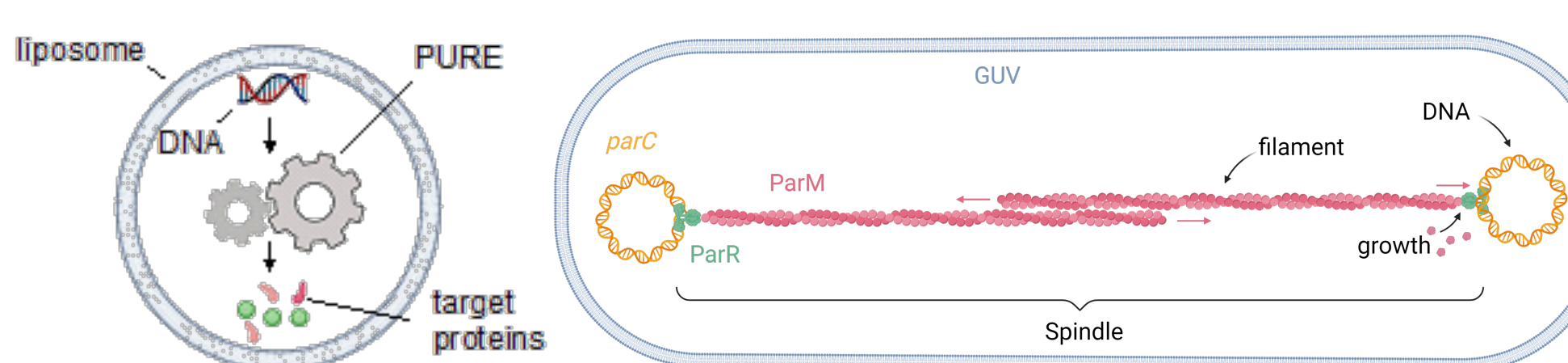
DNA origami based synthetic MT aster and complexes



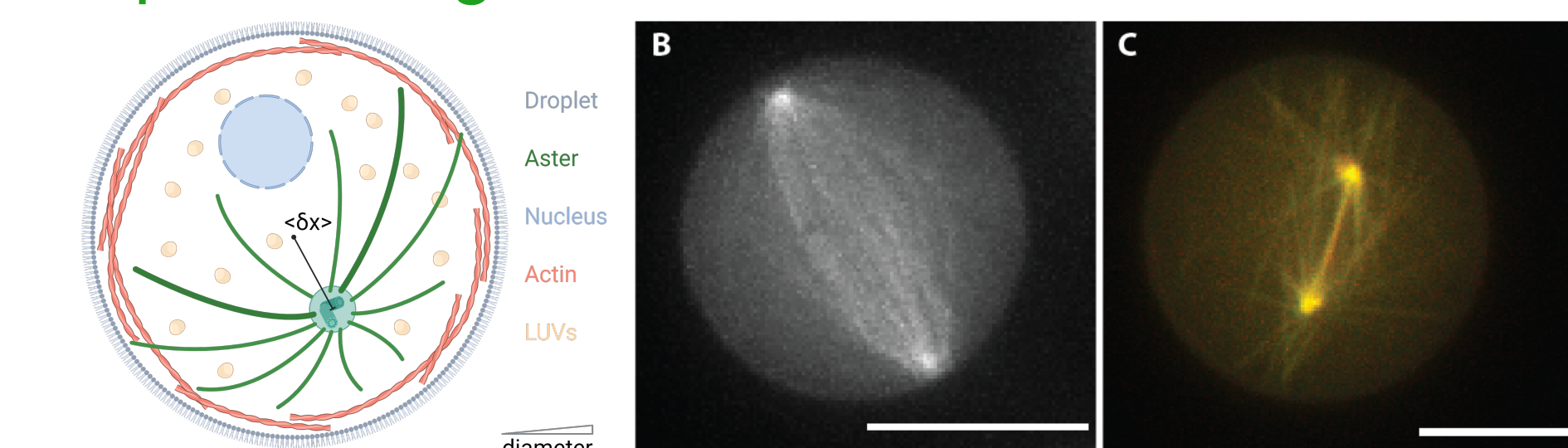
Quantifying Actin-MT crosslinker proteins e.g. Anillin

Minimal spindle assembly

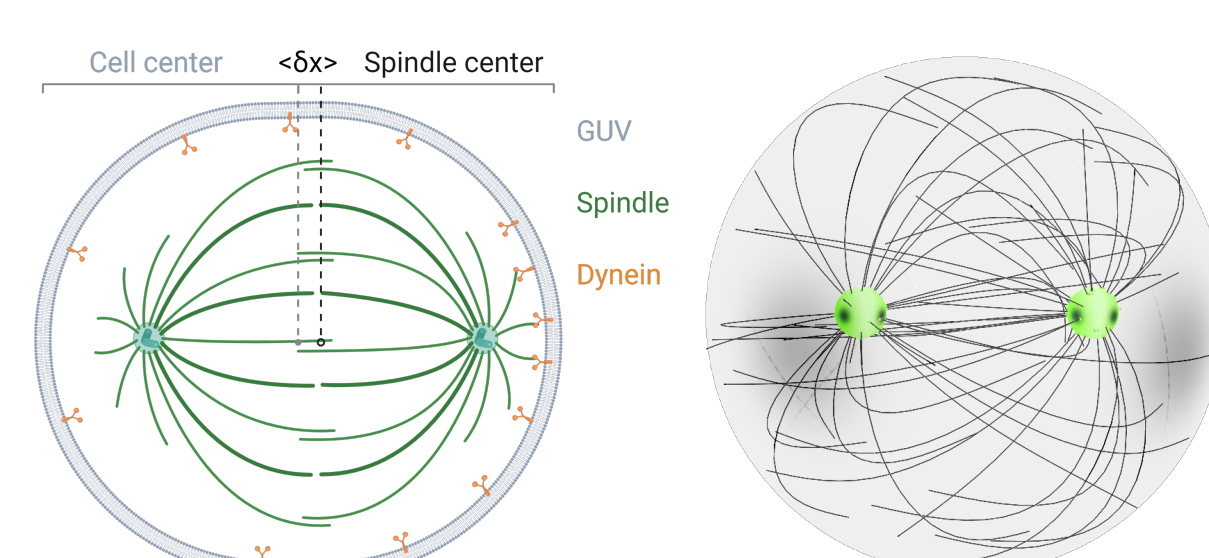
Building a minimal DNA segrosome for the synthetic cell using cell-free expressible (with PURE) bacterial filaments - bTub, ParM, TubZ, PhuZ in liposomes



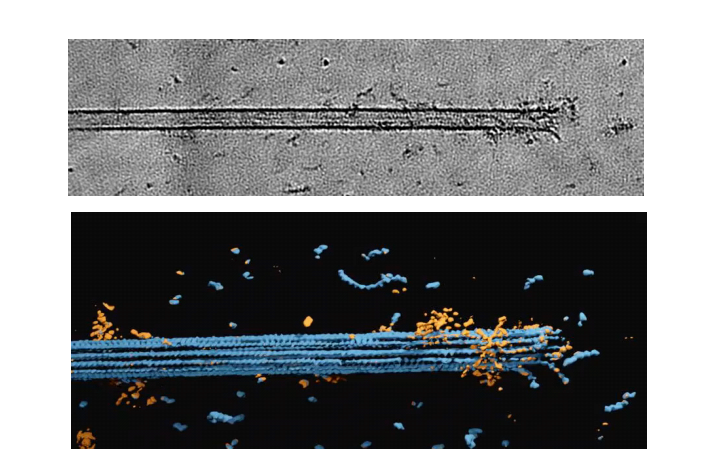
Reconstituting minimal eukaryotic MT aster and spindle in droplets, and studying the effect of organelles and other cytoskeletal components on positioning



Simulations to understand the force balance in asymmetric spindle positioning due to cortical force generators



Cryo & liquid phase EM of MT and MAPs



Funding

Members

