Biophysical techniques for the study of phase transitions in cells

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Recently, phase transitions of protein-RNA droplets in cells, and of the cytoplasm of entire cells [1], have been shown to play important roles in physiological and pathological processes in biology. Their molecular control is still unclear at this point. We have applying a range of biophysical techniques for the specific study and quantitative characterization of such phase transitions. We use a dual-beam laser trap, real-time deformability cytometry and atomic force microscopy for the viscoelastic characterization of cells and protein-RNA granules *in vitro*. We combine opto-fluidic object rotation with quantitative phase microscopy to obtain phase images from multiple angles, which in turn are tomographically reconstructed by a back-propagation algorithm [2] to obtain 3D distributions of refractive index and mass density inside trapped objects [3]. Finally, we have also established Brillouin microscopy for the 3D mapping of mechanical properties inside cells with diffraction-limited resolution. I will present and discuss our findings obtained with this unique toolset.

[1] M. C. Munder et al. eLife 5:e09347 (2016).

[2] P. Müller et al., BMC Bioinformatics 16(1):367 (2015).

[3] M. Schürmann et al., arXiv:1706.00715 (2017).