Focusing on mitochondria with super-resolution microscopy

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Mitochondria, the 'powerhouses of the cell', are double membrane organelles that are essential for eukaryotic life. Their shapes range from small oval fragments to interconnected networks of tubules that are constantly moving, fusing, and dividing. The innermost mitochondrial aqueous compartment, the matrix, is bounded by the highly convoluted inner membrane, which in turn is surrounded by the smooth outer membrane. The inner membrane projects cristae into the matrix. Depending on the cell type and physiological conditions, the cristae can adopt a wide variety of shapes, ranging from simple tubular to lamellar.
Several proteins, including the MICOS (mitochondrial contact site and cristae organizing system) proteins have been described to influence the architecture of mitochondria. However, little is known on the distributions of such proteins within these organelles. A major challenge in obtaining a comprehensive view on the sub-mitochondrial localization of proteins in mitochondria is their small diameter (~ 200-400 nm), thus largely precluding the use of conventional diffraction-limited microscopy to study sub-mitochondrial protein localizations. We employ STED nanoscopy and other microscopies to investigate the inner mitochondrial architecture. This talk will summarize our recent progress.

References

Stoldt, S., Wenzel, D., Kehrein, K., Riedel, D., Ott, M., and Jakobs, S.: Spatial orchestration of mitochondrial translation and OXPHOS complex assembly.
Nature Cell Biology 20, 528–534 (2018)

Sahl, S.J., Hell, S.W. and Jakobs, S.: Fluorescence nanoscopy in cell biology.
Nature Reviews Molecular Cell Biology 18, 685-701 (2017)

Große, L., Wurm, C.A., Brüser, C., Neumann, D., Jans, D.C., and Jakobs, S.: Bax assembles into large ring-like structures remodeling the mitochondrial outer membrane in apoptosis.
EMBO J 35, 402-413 (2016)