UNIVERSITÄT DUISBURG ESSEN

PHYSIK

Physikalisches Kolloquium

Mittwoch, 16.01.2019
13:00 Uhr
Hörsaal MC 122

X - ray imaging at the nanoscale: ptychography, holography and tomography

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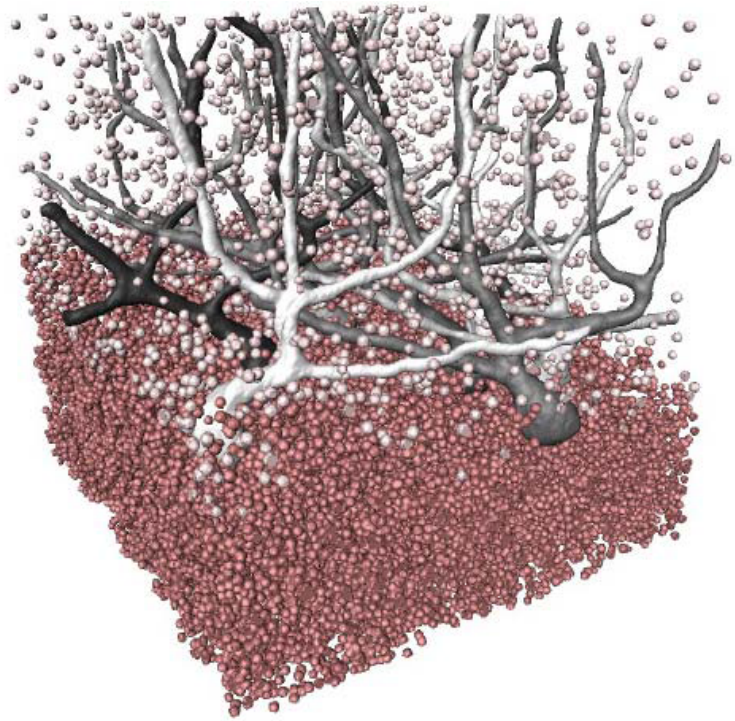

Figure. 3d reconstructions of human Purkinje cells by phase contrast x-ray tomography [4].

X - rays can deeply penetrate matter and thus provide information about the functional (interior) architecture of complex samples, from biological tissues and cells to nanoscale composite materials. Until recently, however, this potential of hard x - rays in view of penetration, spatial resolution, contrast, and compatibility with environmental conditions was significantly limited by the lack in suitable in x - ray optics. With the advent of highly brilliant radiation, and the development of lens - less diffractive imaging and coherent focusing, the situation has changed. We now have nano - focused coherent x - ray synchrotron beams at hand to probe nanoscale structures both in scanning and in full field imaging and tomography. We explain how the central challenge of inverting the coherent diffraction pattern can be mastered by different reconstruction algorithms in the optical far and nearfield. In particular, we present full field projection imaging at high magnification, recorded by illumination with advanced x - ray waveguide optics [1], and show how imaging and diffraction can be combined to investigate biomolecular structures within biological cells. We present different examples of biophysical and biomedical applications [2,3], including 3dvirtual histology of human brain tissue [4].

[1] M. Bartels, M. Krenkel, J. Habe, R.N. Wilke, T. Salditt, X - Ray Holographic Imaging of Hydrated Biological Cells in Solution, Phys. Rev. Lett. 114, 048103 (2015).
[2] M. Krenkel, A. Markus, M. Bartels, C. Dullin, F. Alves, T. Salditt, Phase - contrast zoom tomography reveals precise locations of macrophages in mouse lungs, Sci.Rep. 5, 09973 (2015).
[3] M. Bernhardt, J. - D. Nicolas, M. Osterhoff, H. Mittelstädt, M. Reuss, B. Harke, A. Wittmeier, M. Sprung, S. Köster, T. Salditt Correlative microscopy approach for biology using x - ray holography, x - ray scanning diffraction, and STED microscopy, Nat. Comm. 9: 3641 (2018)
[4] M. Töpperwien, F. Van der Meer, C. Stadelmann, and T. Salditt Three - dimensional virtual histology of human cerebellum by X - ray phase - contrast tomography, Proceedings of the National Academy of Sciences (2018), 201801678