Universität Basel

Research Project

Micro- and nanoanatomy of human brain tissues

Third-party funded project

Project title Micro- and nanoanatomy of human brain tissues
Principal Investigator(s) Müller, Bert ;
Co-Investigator(s) Bieri, Oliver ; Bunk, Oliver ; Müller-Gerbl, Magdalena ; Pfeiffer, Franz ; Weitkamp, Timm ;
Organisation / **Research unit**
Departement Biomedical Engineering / Biomaterials Science Center (Müller)
Department
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The human body contains 10ˆ14 cells, which are categorized into 200 to 400 cell types. The human brain accounts for about 2% of the weight of an average person. This is a much larger percentage than in other primates. Despite of its size and complexity one can reasonably assume that it is possible to reveal the individual cells within the human brain and describe its three-dimensional structure on the cellular level. To achieve this goal, we will perform grating-based hard X-ray phase tomography using synchrotron radiation facilities. In addition we will expand the available laboratory system phoenix nanotomő m from GE Healthcare by a grating interferometer. An average human cell contains 10ˆ14 atoms, which are categorized in the 118 elements of the periodic table. Thanks to this clarity, one can reasonably expect that it is possible to reveal the nanostructure of selected pieces of brain tissues. To achieve this, we will perform spatially resolved X-ray scattering experiments at the cSAXS-beamline, Swiss Light Source at the Paul Scherrer Institut. The myelinated axons, for example, which stretch for over 10ˆ8 m if aligned end-to-end, exhibit a quasi-periodical arrangement of the lamellar structure of the myelin sheaths repeating less than every 20 nm. This characteristic periodicity will be used to determine the abundance and the orientation of the myelin fiber bundles in projection images similar to histology and in three-dimensional space applying tomographic reconstruction techniques, which are to be further developed. The interdisciplinary project aims to bridge the gap concerning spatial resolution between the tomography data from clinical modalities (CT and MRI) and histological approaches employed by anatomists and pathologists taking advantage of recent developments in physics: X-ray scattering and phase tomography.

Keywords synchrotron radiation-based micro CT, micro-anatomy, grating interferometer, phase tomography, magnetic resonance imaging (MRI), spatially resolved X-ray scattering, X-ray tomography, stereotactic brain atlas
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