ESRF	**Experiment title:** Insight into human brain with resolution down to the cellular level by grating-based phase contrast micro-computed tomography	**Experiment number:** MD 539
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Report:

Grating-based phase-contrast tomography served for (*i*) the visualization of the microstructure of the human thalamus, (*ii*) high-resolution measurements of a piece of thalamus and (*iii*) human brain (cerebellum) in fomblin in order to compare phase-contrast tomography with MR-microscopy where fomblin is an appropriate storage liquid during the measurements.

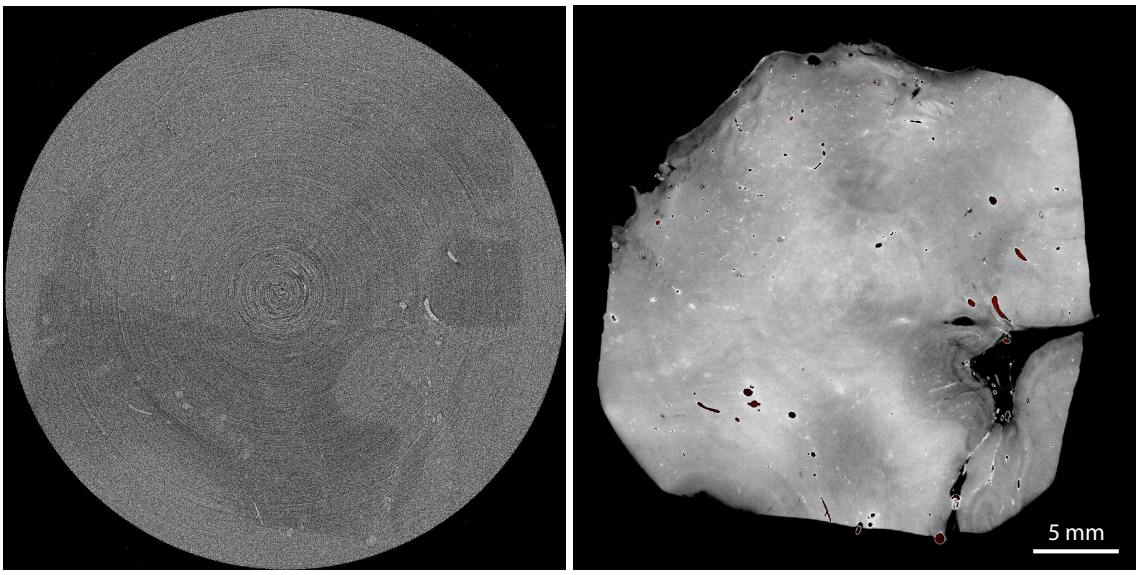

Fig. 1: *Virtual slice through the absorption and phase contrast data.*

Fig. 2: *Phase-contrast three-dimensional rendering of the of the human thalamus. The segmentation of the vessel tree in the lower part can be achieved by simple intensity-based segmentation. The arrowhead indicates a blood vessel of around 600 μm diameter.*

The experiments were carried out at the 9^{th} Talbot order distance at a selected photon energy of 23 keV using a beam-splitter gratimg fabrcated at the Paul Scherrer Institute and an analyzer grating from Karlsruhe Institute of Technology [1]. Projection radiographs were taken in 1499 steps (whole thalamus) and 999 steps (other specimens) over a range of 360°. The detector was a lens-coupled device system using a FReLoN 2K CCD with 2048 × 2048 pixels. In order to fit the whole thalamus, which has a diameter of around 35 mm, in the field of view, a detector with a pixel size of 20 μm and one of 30 μm were used. For the small brain blocks, a detector pixel size of 7.5 μm was chosen. At each projection angle, four phase-stepping images (with an exposure time of 1 s for each image) were taken over one period of the interferometer fringe pattern. Fig. 1 shows an exemplary reconstructed slice in absorption (left) and phase contrast (right) of the whole thalamus. Once the serial sections of histology will be available (Sept. 2011), the data will be non-rigidly registered to finally correct the preparation artifacts and to build a more precise atlas of the thalamus. It is planned to publish the results in a peer-reviewed journal. Besides the correction of the histological slices, grating interferometry is outstandingly suited for the visualization of blood vessels as illustrated in Fig. 2. There, a simple intensity-based segmentation of the lower part of the 3D rendering allowed to visualize the internal vessel tree of the thalamus. Exploiting this strong point, additionally, three calcified human arteries embedded in paraffin were scanned using a detector of 5 μm pixel size in order to determine the lumen size available for blood flow. We are currently preparing the results of these data sets for publication in a peer-reviewed journal.

[1] Weitkamp, T., Zanette, I., David, C., Baruchel, J., Bech, M., Bernard, P., Deyhle, H., Donath, T., Kenntner, J., Lang, S., Mohr, J., Müller, B., Pfeiffer, F., Reznikova, E., Rutishauser, S., Schulz, G., Tapfer, A., Valade, J., Recent developments in X-ray Talbot interferometry at ESRF-ID19. Proceedings of SPIE **7804** (2010) 780406 (10 p.).