ESRF	**Experiment title:** Micro computed tomography of human brain tissue using grating-based phase contrast	**Experiment number:** MD 328
Beamline: ID19	**Date of experiment:** from: Jul 14, 2008 to: Jul 20, 2008	**Date of report:** May 6, 2011
Shifts: 15	**Local contact(s):** Timm Weitkamp	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):
Bert Müller[1,*], Anne Morel[2], Daniel Jeanmonod[2], Franz Pfeiffer[3,*], Christian David[4,*], Timm Weitkamp[5,*]
[1]*Biomaterials Science Center, University of Basel, Basel, Switzerland*
[2]*Department of Functional Neurosurgery, University Hospital Zurich, Zurich, Switzerland*
[3]*Physik-Department E17, Technische Universität München, Garching, Germany*
[4]*Laboratory for Micro- and Nanotechnology, PSI, Villigen, Switzerland*
[5]*ID19, ESRF, Grenoble, France*

Report:

Tomography with micrometer resolution is important to non-destructively obtain the morphology of the human brain without deformations induced by conventional histology. In order to visualize the human thalamus, especially uncovering the thalamic nuclei, which is one of the most ambitious challenges in X-ray tomography, we used grating-based phase contrast.

Two specimens (A: $\emptyset = 15\ mm$, B: $\emptyset = 42\ mm$) were examined. For Specimen A a FReLoN 2K detector with a pixel size of 7.5 μm, for Specimen B a pixel size of 30 μm were chosen. The experiments were carried out at the 9^{th} Talbot order distance at a selected energy of 26 keV using gratings from Paul Scherrer Institute.

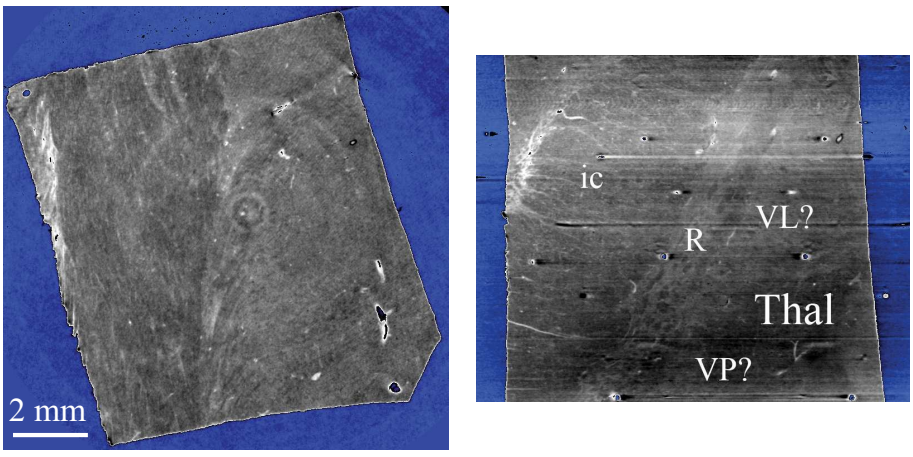

Fig. 1: *Two orthogonal virtual slices through the tomogram of a thalamus block indicate the visualization of different structures inside Specimen A.*

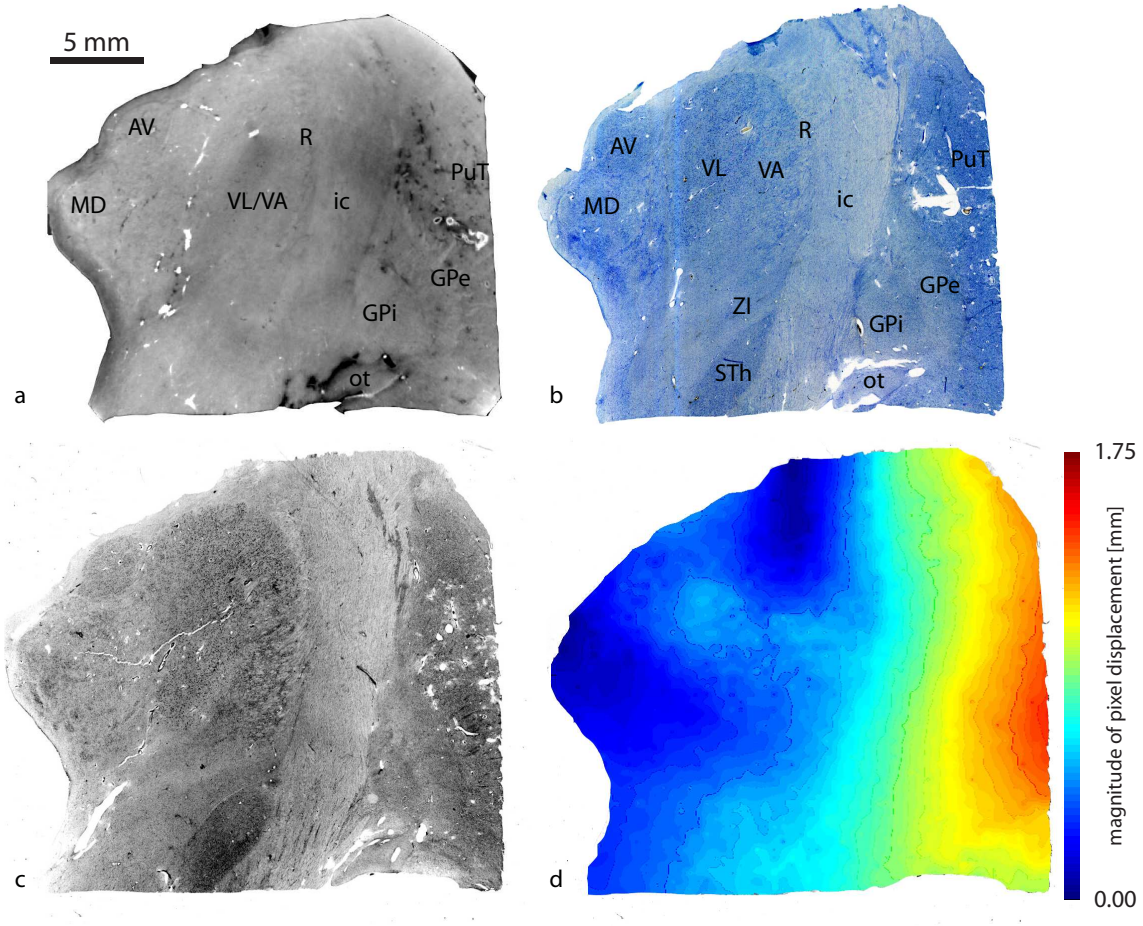

Fig. 2: *The reconstructed phase-contrast slice (a) and the related Nissl-stained histological slice (b) illustrate microstructures of the human thalamus.Nissl-stained histological slice (c) with the related strain field (d) [1]. This strain field was used to correct the conventional histological slice.*

Fig. 1 illustrates the anatomical features of Specimen A including nucleus ventralis lateralis (VL), nucleus ventralis posterior (VP), reticular thalamic nucleus (R) and inferior colliculus (ic). The results were presented at the DPG Frühjahrstagung (Dresden 2009).

As the diameter of the whole thalamus was larger than the beam width, the experiment was performed using an asymmetric axis position shifted 9 *mm* from the center of the detection unit. Fig. 2 (a) shows one reconstructed slice where different structures can be identified and verified by the related Nissl-stained histological slice (Fig. 2 (b)). Furthermore, the phase-contrast data set was used for the determination of the strain field of the histological data induced by sectioning and staining procedures (Fig. 2 (c-d)) The results were presented at the SPIE conference (Optics and Photonics, San Diego 2010)[1].

[1] Schulz, G., Morel, A., Imholz, M. S., Deyhle, H., Weitkamp, T., Zanette, I., Pfeiffer, F., David, C., Müller-Gerbl, M., Müller, B., Evaluating the microstructure of human brain tissues using synchrotron radiation-based micro computed tomography. Proceedings of SPIE **7804** (2010); 78040F (8 p.).