ESRF	Experiment title: X-ray microtomography of biological tissue using phase contrast	Experiment number: **MI 108**
Beamline: ID 11 (BL2)	Date of experiment: from: 26. March 1996 to: 30. March 1996	Date of report: 21. August 1996
Shifts: 15	Local contact(s): A. Kvick	*Received at ESRF:*

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Report: 3D imaging of soft tissue by x-ray phase contrast is advantageous by orders of magnitude in sensitivity compared to conventional absorption contrast [1]. The 3D distribution of a sample's refractive index is determined instead of the absorption coefficient. Quantitative measurement is performed by combining a standard microtomgraphy set-up with the specimen placed in one beam path of an x-ray interferometer (a skew-symmetric LLL type interferometer consisting of 4 Laue mirrors (Si 220): S, M_1, M_2, A). The interference patterns of sample- and reference-beam of at least 4 different settings of the phase shifter (PS) are recorded by a 2D x-ray detector (CCD) and numerically combined [2] to reveal a 2D phase-shift projection of the sample (S). This procedure is repeated at about 180 distinct angular positions of the sample to gain 3D sample composition by tomographic reconstruction. The specimen is placed in a liquid of adapted refractive index to prevent too large jumps of the phase (27T ambiguity [1]) at the sample's rims.

Fig. 1

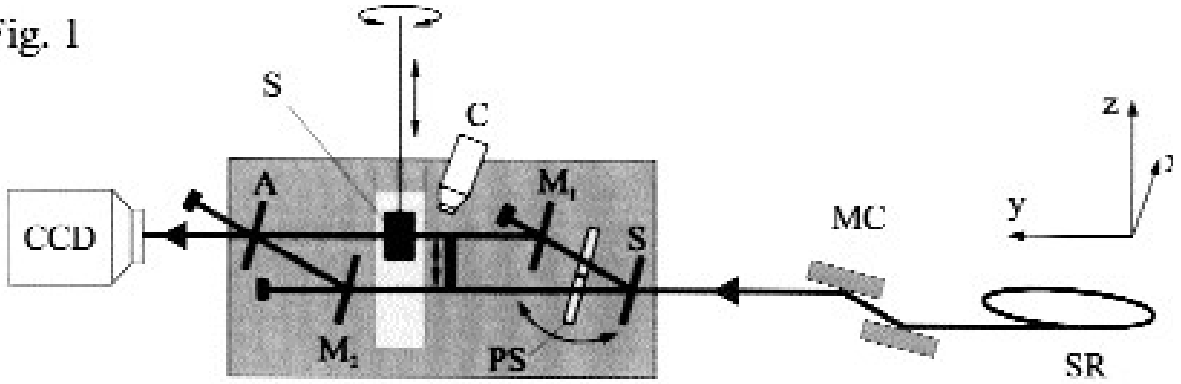
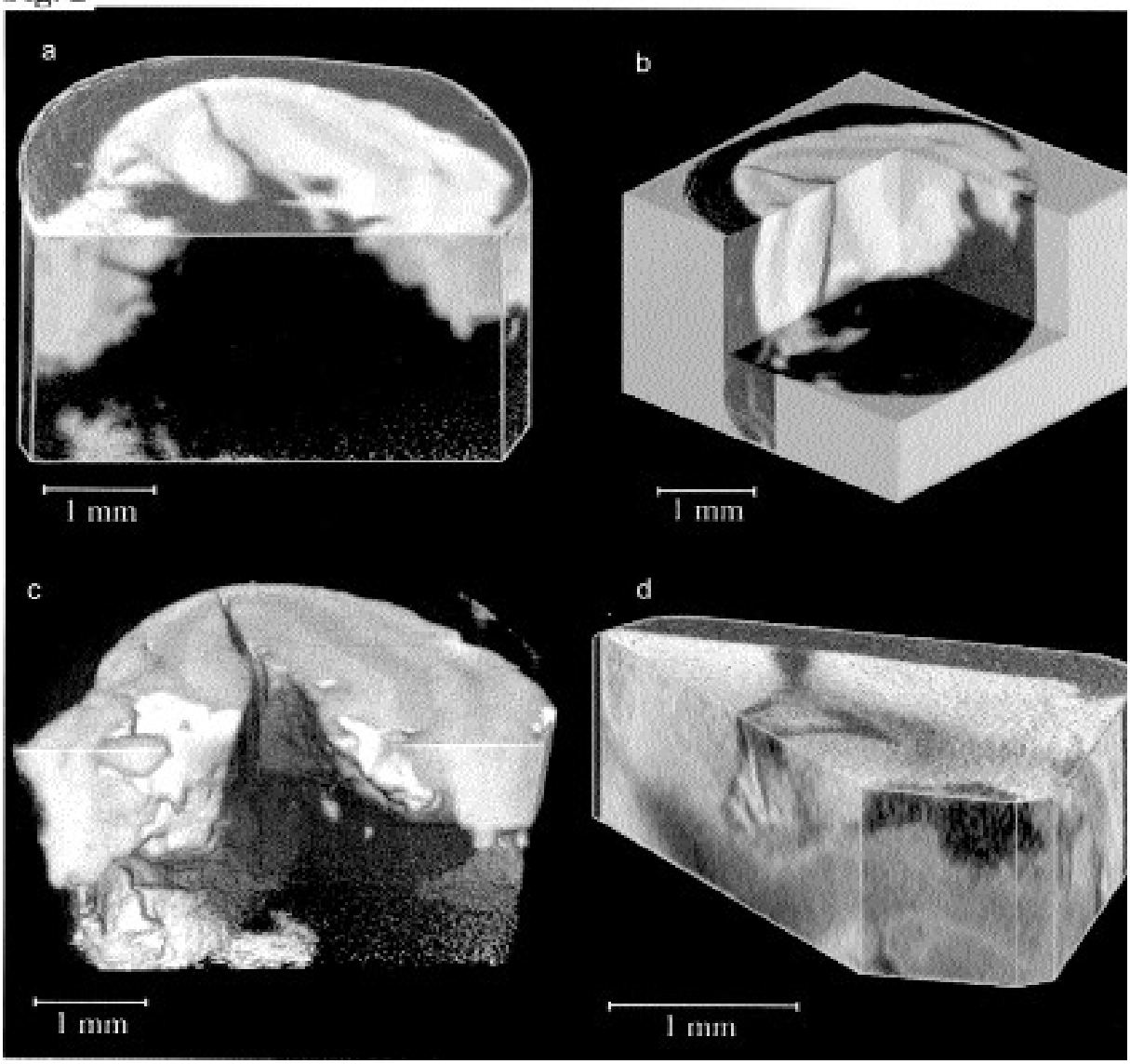


Fig. 2



First 3D investigations of rat cerebellum samples have been performed at ID11. Two examples are displayed in **Fig. 2.** In a and c different renderings of one sample are shown. Brain tissue (light grey) is easily distinguished from the surrounding PMMA (dark) embedding and even more grey and white matter can be identified. **Fig. 2a** displays a selected part of the sample volume by showing the surfaces of the 3D dataset. A semi-transparent rendering of the same sample volume is shown in c, displaying not only the surfaces but giving a view inside the sample by setting the embedding material transparent. In **b** a part of the whole 3D dataset is made visible by selecting 3 perpendicular cuts through the volume. **Fig 2d is** a small section of another cerebellum sample showing cuts through blood vessels in the sample region.

References

[1] F. Beckmann, U. Bonse, E. Busch and O. Giinnewig, *X-ray microtomography (μCT) using phase contrast for the investigation of organic matter,* J. Comput. Assist. Tomogr., to be published.

[2] F. Beckmann, U. Bonse, F. Busch, O. Giinnewig, *A Novel System for X-Ray Phase-Contrast Microtomography,* HASYLAB Annual Report II (1995) 691-692