EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

ESRF

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office using the **Electronic Report Submission Application:**

http://193.49.43.2:8080/smis/servlet/UserUtils?start

Reports supporting requests for additional beam time

Reports can now be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title:** Cerebral angiography using K-edge subtraction method	**Experiment number**: MD-75
Beamline:	**Date of experiment**: from: March 5 to: March 9, 2004	**Date of report**: March 31, 2004
Shifts:	**Local contact(s)**: Dr. Stefan Fiedler	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Dr. Elisabeth Schultke, Liverpool University, U.K. and University of Saskatchewan *

Dr. Kotoo Meguro, University of Saskatchewan, Canada *
Dr. Michael Kelly, University of Saskatchewan, Canada *
Dr. Robert Griebel, University of Saskatchewan, Canada
Dr. Bernhard Juurlink, University of Saskatchewan, Canada
Dr. Stefan Fiedler, ESRF, France *
Ms. Rina Meguro, Tokyo International Medical Centre, Japan *
Dr. Geraldine LeDuc, ESRF, France
Dr. Jean-Francois Le Bas, CHU, France

Report:

The beamtime allocated for MD-75 was the first time our neurovascular research group conducted any synchrotron-supported experiments. We had made first contact with the team of ID 17 in April 2003. Judging by the harmonic atmosphere in which our experiments were conducted and by the results of our first experiments, the time leading up to the experimental time had been well used. This applies to the general planning of the experiments as well as to the preparations of the animal experiments. Special thanks for the latter goes to Dr. Geraldine LeDuc and Mr. Dominique Dallery. We also wish to thank everybody who made a special effort to make possible the use of the fluoroscopy unit, the availability of which on site at ID 17 proved to be a vital component of our experiments.

Experiments:

All experiments were conducted using adult male New Zeeland rabbits (ca. 2.5 kg).

Experimental techniques used were subtraction angiography, both conventional X-ray imaging technique (Philips BV 212 C-arch) and synchroton-supported K-edge subtraction angiography (KEDSA).

The first 4 shifts were dedicated to familiarize ourselfes with the animal modela and finding an optimal approach that satisfied the need for continous anesthesia of the experimental animals as well as a clutter-free environment for the tomographic imaging mode. Digital subtraction angiography images using conventional X-ray imaging (fluoroscopy unit) were acquired. The initial plan was to use the FreLoN detector for image acquisition, in order to take advantage of its higher resolution. However, we found that not-anticipated software problems occuring with the use of the FreLoN detector would require a longer time to be solved, before it could be used for our experiments. In order to make optimal use of the remaining experimental time, we decided to switch to the Germanium detector. This proved to be a good decision.

Within the remaining experimental time, we were able to demonstrate that:

1) Good visualization of the cerebral circulation is possible after intravenous injection of iodinated contrast agent (Iomeron 350). The lowest dose, at which the vascular tree was still (weakly) visible was determined as 0.5 ml (single shot).
2) Good visualization of the vertebral arteries is possible after intravenous injection of contrast agent with doses of 1 – to 1.5 ml / sec and total doses of 5 – 7.5 ml. Considering the smallness of the animals and respectively the small diameter of their blood vessels, compared to human patients, we would expect to be able to visualize a major portion of the vessels contributing to blood perfusion of the spinal cord. The higher X-ray absorption rate caused by larger bone mass and adipose tissue would, hopefully, be offset by higher total doses of contrast agent.
3) Good visualization of the major blood vessels of a hind limb was possible after intravenous administration of contrast agent.

All three applications of i. v. angiography successfully tested during our beamtime could have implications for clinical pratice. We therefore whish to further develop the techniques (models and acquisition procedures) in future collaboration with the ID 17 team. The next step should

be to test our hypotheses that a) visualization of cerebral and spinal vasculature is also possible in larger experimenetal subjects (i.e.pigs) and b) that the diameter of the smallest detectable blodd vessel is equal regardless of the size of the animal. If evidence could be found for the latter, synchrotron-supported K-edge subtraction angiography might emerge as a more patient-friendly angiographic diagnostic method for difficult neurovascular cases.

We plan to report on the results of our experiments in three scientific papers:

M. Kelly, S. Fiedler et al.: Synchrotron-supported peripheral angiography; a feasibility study in an animal model. For submission to *Canadian Journal of Surgery*.

M. Kelly, E. Schultke et al.: Synchrotron-supported intravenous cerebral angiography in a rabbit model. For submission to *Journal of Neurosurgery*.

E. Schultke, M. Kelly et al.: Synchrotron-supported angiography of the spinal cord after intravenous contrast administration: an experimental study. For submission to *Academic Radiology*.

Abstracts and references for publications will be submitted once they have been accepted and go into print. Abstracts of posters or oral presentations that will be reprinted in scientific journals will also be forwarded to the ESRF User Office.