EUROPEAN **S**YNCHROTRON **R**ADIATION **F**ACILITY

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:** **Studies of lung function by synchrotron radiation bronchograph**	**Experiment number**: LS-1546
Beamline:	**Date of experiment**: from: 12.4. and 31.5.2000 to: 18.4. and 6.6.2000	**Date of report**: **24.1.2001**
Shifts: 18 + 18	**Local contact(s)**: W. Thomlinson	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists)

*A.R.A. Sovijärvi, Helsinki University Central Hospital

*S. Bayat, Faculte de Médicine, Université Joseph Fourier, Grenoble

*G. Le Duc, ESRF

*L. Porra, Department of Physics, University of Helsink

*P. Suortti, Department of Physics, University of Helsink

Report:

The purpose of the experiment was to develop methods for functional imaging of lungs using animal models. The beamtime allocated for the experiment was divided in two parts, where the first one was dedicated to instrumentation and methology, and the second one for actua imaging of rabbits.

The animals, New Zealand rabbits, are anesthetized and their respiration is regulated by the mechanical ventilation apparatus shown in Fig. 1. The gas mixture inhaled by the animal is computer-controlled by opening and closing the valves, and imaging is synchronized to take place during the apnea period to reduce the motion artifacts. Xenon gas mixed with oxygen is used as the contrast agent, and the K-edge subtraction (KES) method is used to determine the gas distribution in lungs. Projection images or radiographs are taken to provide a global view of the lungs, and a few horizontal sections are chosen for CT images. The number o respirations between the images was varied in order to find the optimum conditions for imaging the bronchi and lung tissue.

The experimental set-up is the same as the one used in coronary angiography. A bent Laue-type monochromator is used for focusing two fan beams at the animal. The energies of the beams bracket the K-absorption edge of Xe. During CT imaging the animal is rotated 360

degrees about an axis perpendicular to the incident beams, and the transmitted beams are recorded at 0.5 degree intervals using a position sensitive Ge detector with 2x432 elements. The CT image is reconstructed from the 720 projections using a filtered back-projection algorithm. A series of images is shown in Fig. 2. They show the increase of the contrast gas concentration in a cross section of the rabbit lungs. The absolute concentration of Xe can be calculated at different parts of the lungs, and this provides the values of local time constant and ventilation resistance, as shown in Fig. 3.

Ref. G. Le Duc et al., World Congress on Lung Health, Florence 2000, 30.8.-3.9.2000 (poster).
S. Bayat et al. "Quantitative lung imaging with synchrotron radiation using stable Xenon gas as contrast agent", submitted to "Radiology".

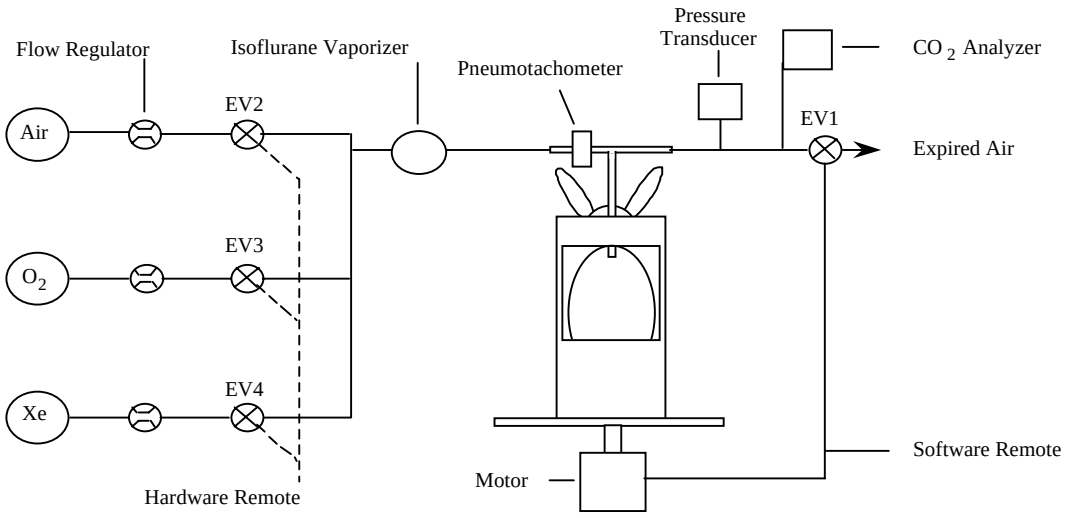

Figure 1

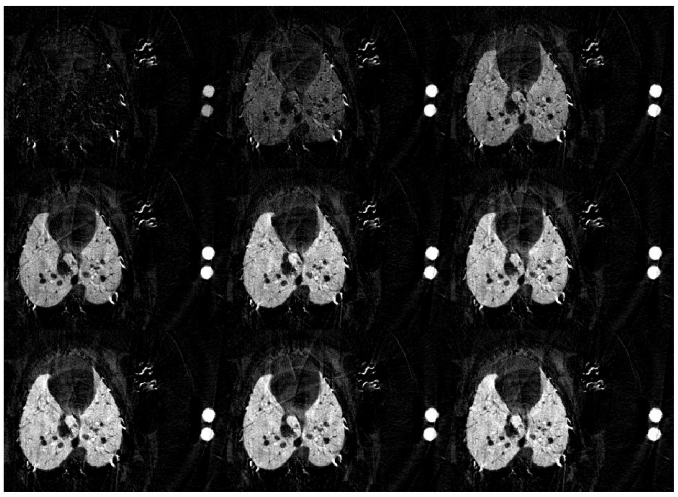

Figure 2

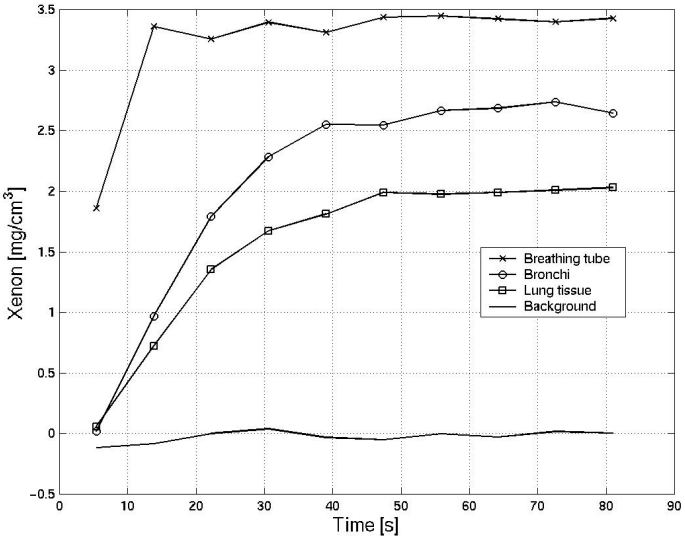

Figure 3