EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

# Experiment Report Form

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| | **Experiment title: Monoplanar microbeam and pencilbeam irradiation in the lung: decreasing the risk of pneumonitis and fibrosis in the lung behaviour and survival in an animal model of malignant brain tumour.** | **Experiment number**: MD 1049 |
| **Beamline**: ID 17 | **Date of experiment**: from: February 3 to: Febr. 06, 2018 | **Date of report**: February 23, 2018 |
| **Shifts:** 12 | **Local contact(s)**: Elke Bräuer-Krisch | *Received at ESRF:* |


**Names and affiliations of applicants** (* indicates experimentalists):

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## Report:

This was the first pilot experiment testing monoplanar microbeam irradiation (MBI) in the lungs of adult rats.

A fixed-space multislit collimator was used to generate microbeam arrays of quasi-parallel microbeams with an individual microbeam width of 50 µm and a center-to-center distance of 400 µm.

Of 46 mice, 36 underwent MBI of the right lung. Eighteen mice were irradiated with a peak dose of 40 Gy and the other 18 were irradiated with a peak dose of 400 Gy.

Animals were sacrificed and tissues were harvested at 24, 48 and 72 hours after irradiation. Four animals underwent apnea and ventilation but no irradiation. Six healthy male mice served as non-irradiated and non-ventilated controls.

At machine storage ring currents between 154.7 and 196.9 mA, dose rates between 69.3 Gy/sec/mA and 70.5 Gy/sec/mA were achieved in the irradiation hutch of the Biomedical Beamline ID 17.

## RESULTS:

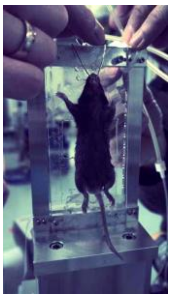

**Figure 1:** A positioning device was designed and build to optimize the position of theanaesthetized and intubated animal in the beam.
Irradiation was in ventral to dorsal direction in monoplanar microbeam technique.

Pre-irradiation imaging was used to assure that the heart was outside the irradiation field.
For every animal, one image was taken and the irradiation field was adjusted accordingly by a lateral and /or horizontal translation of the animal in order to avoid the heart, respecting a safety margin of ~1 mm (Fig. 2).
Using the imaging system for in-line imaging, an X-ray image was obtained with the animal positioned in the potential irradiation position. The position was then adjusted in such a way that the heart was reliably outside of the irradiation field. The image was obtained with the animal in apnea and the lung in inspiration position.

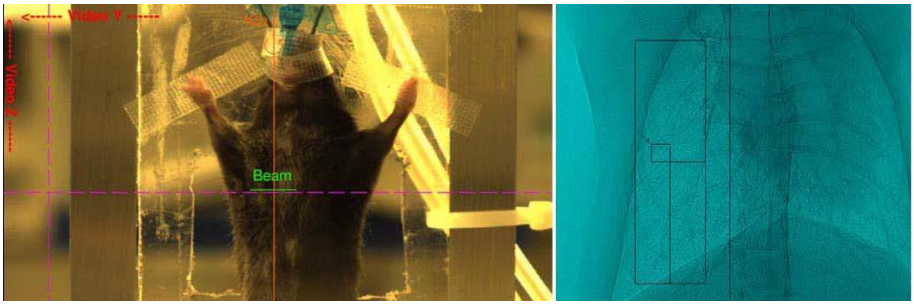


**Figure 2: Control monitor screenshot**

Since there was no experience regarding the effects of the heart to MRT, we choose an irraiation field in the right lung, sparing the heart (outlined in the right part of the screenshot. Monte Carlo calculations, were approx. 0.11 Gy for a peak dose of 40 Gy and 6 Gy for a peak dose of 400 Gy.

For dosimetry control and to record proper irradiation geometry, two different types of Gafchromic® film were used: EBT3 with an optimum dose range of 0.5 - 100 Gy and HD-V2 with an optimum dose range between 10 – 1000 Gy.

After the end of the observation period, the lungs were harvested and preapred for tissue processing / immunostaining.

A manuscript to be submitted to Scientific Reports is being prepard.

We wish to thank everybody at ID 17 for helping to make our experiments running as smoothly as they did.

We are especially grateful to have had this last experiment with Dr. Elke Bräuer-Krisch, without whom microbeam radiotherapy would not have advanced to the stage at which it is now.