



Experiment title:
SOME FEASIBILITY STUDIES FOR A
MONOCHROMATIC CEREBRAL CT SCANNER

Experiment
number:
MI -102

Beamline:
ID15

Date of experiment:
February 1996

Date of report:
August 1996

Shifts:
18

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Received at ESRF:
0 2 SEP 1996

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Report:

Feasibility studies for a monochromatic cerebral CT scanner have continued. Tomographic subtraction images of phantoms have been taken at the iodine K-edge with a single pixel germanium detector (translation and rotation of the object). A few monochromatic images of a rabbit head have been obtained with the germanium multipixel detector of the medical beamline and an 18-channel prototype electronics. Sensitivity measurements on projections for potassium solutions have also been performed, as a first step towards evaluating dual-photon absorptiometry as a technique for measuring potassium concentration in cerebral tissue.

Subtraction images of a 10 cm diameter plexiglass phantom with iodine-filled holes were obtained at the iodine K-edge. Integrated skin-dose during the measurement was equivalent to 1/6th of a "nominal" medical dose of 50 mGy per image pair. Iodine concentrations ranged from 50 $\mu\text{g}/\text{cm}^3$ to 3 mg/cm^3 . The images are not included as contrast is lost from the printing and reproduction. Conclusions from these first measurements as well as the statistical measurements performed earlier on projections lead us to believe that, on a full scale medical cerebral CT scanner under usual dosimetry conditions for such an imaging procedure we should be able to quantify

concentrations of 2 mg/cm^3 in a voxel $5 \text{ mm} \times 5 \text{ mm} \times 5 \text{ mm}$ with a 10% precision, on a difference-image taken at the iodine K-edge. Detectability limit, under the same conditions, should be around $100 \text{ } \mu\text{g/cm}^3$. Iodine concentration in blood under usual conditions is on the order of 4 mg/cm^3 . Iodine concentration in healthy cerebral tissue is 0.2 mg/cm^3 . In pathological tissue, in particular when there is breakdown of the brain-blood barrier, it can be up to the iodine concentration in blood.

Monochromatic images (E on the order of 33 keV) of a rabbit head were taken at different heights with the multi-element solid-state Germanium detector built for the angiography project on the medical beamline. It is a current-integrated detector. Eighteen channels of electronics were available in a prototype form for this test. The figure below shows two of the nine slices obtained.

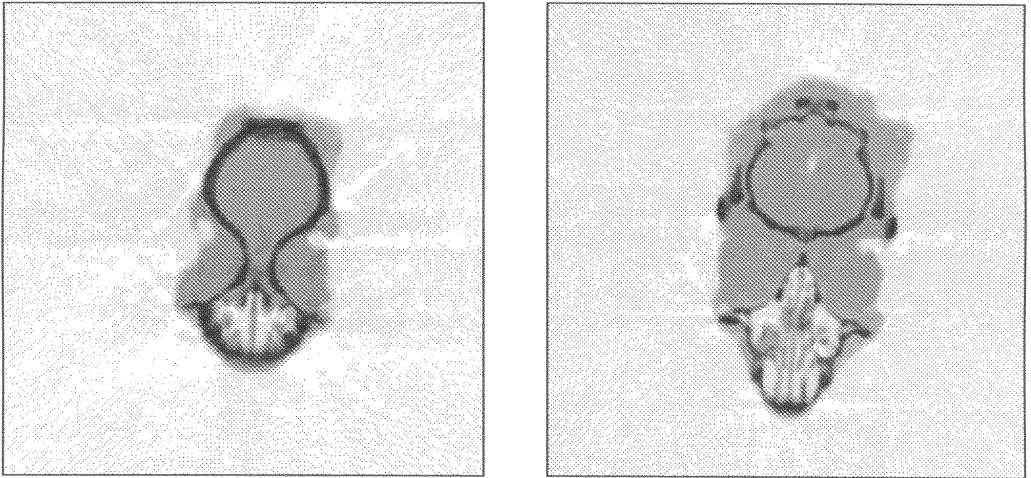


Figure 1: Two slices of a rabbit head taken at different heights - $E = 33 \text{ keV}$