<table>
<tr><td rowspan="1">ESRF</td><td>Experiment title: EFFECTIVE ATOMIC NUMBER IMAGING BY MEASUREMENT OF THE COHERENT-COMPTON RATIO</td><td>Experiment number:
MI-239</td></tr>
<tr><td>Beamline:
ID15 / BL25</td><td>Date of experiment:
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Report:

Coherent-Compton ratio measurement allows to characterize materials by their effective atomic number (Z_{eff}). Our project is to apply this technique to human brain imaging in order to establish a relation between presence of specific neurological elements and tumors appearance. The principle of this technique consists in counting photons which are scattered in a little volume of matter, in the direction θ from the incident beam. This volume, called measurement volume, is defined by the intersection of the incident and the scattered beams, obtained with two collimators. The photons are counted by a cooled germanium detector resolved in energy in order to separate the Compton photons from the Rayleigh ones. The Coherent-Compton ratio is a value only depending on the Z_{eff} . To perform this measurement, we need a high monochromatic photons flux. Imaging is possible if we move the measurement volume, point by point, throughout the sample. The experiment, detailled in the next paragraph, was realized on beamline ID15 / BL 25.

The experiment

The experimental conditions have been defined in the precedent experiment which was realized in june 1996 (MI113). The incident beam energy has been set at 60 keV. The scattered angle θ is set at 35° and the counting time at 5 seconds per point. The spatial resolution is defined by the collimators, specifically machined to reach a resolution of 1 mm^2 in the tomographic slice. The choice of all these parameters are the result of a compromise. During the MI 184 experiment, we tested this technique on samples made up with polyethylene (PE) and containing different concentrations of eight specific elements (K, I, Ca, Zn, Al, Cu, Gd, Fe). The aim of the present experiment is to evaluate, in vivo, the capabilities of the Rayleigh to Compton ratio method. To do that, a rabbit head has been imaged, thus allowing simultaneously the study of biological tissues, of skull and of three solutions containing respectively 10, 8 and 6 $g.l^{-1}$ of potassium, iron and iodine. The little bottles containing these solutions are installed into the rabbit head as shown figure 1. As the acquisition technique is the same as the first generation tomograph, it is possible to realize simultaneously a transmission computed tomography (TCT) (figure 2).

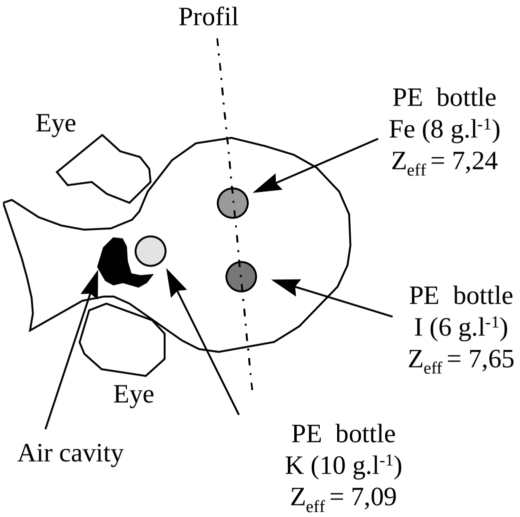

Fig 1. Schema of the rabbit head

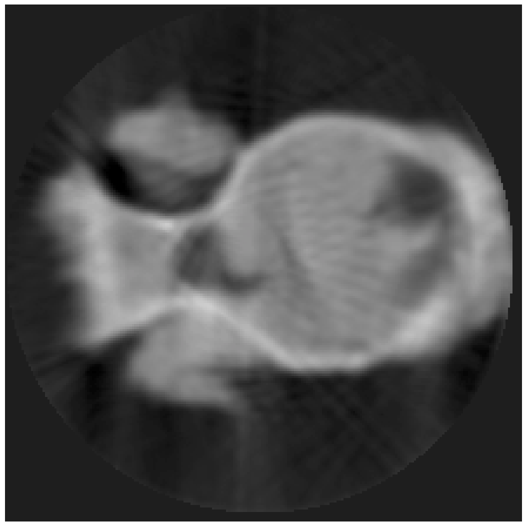

Fig 2. Transmission Computed Tomography of the rabbit head.

Contrary to TCT image, the Rayleigh to Compton image (figure 3) easily shows significant differences between cerebral tissues, the added solutions and even the PE bottles.

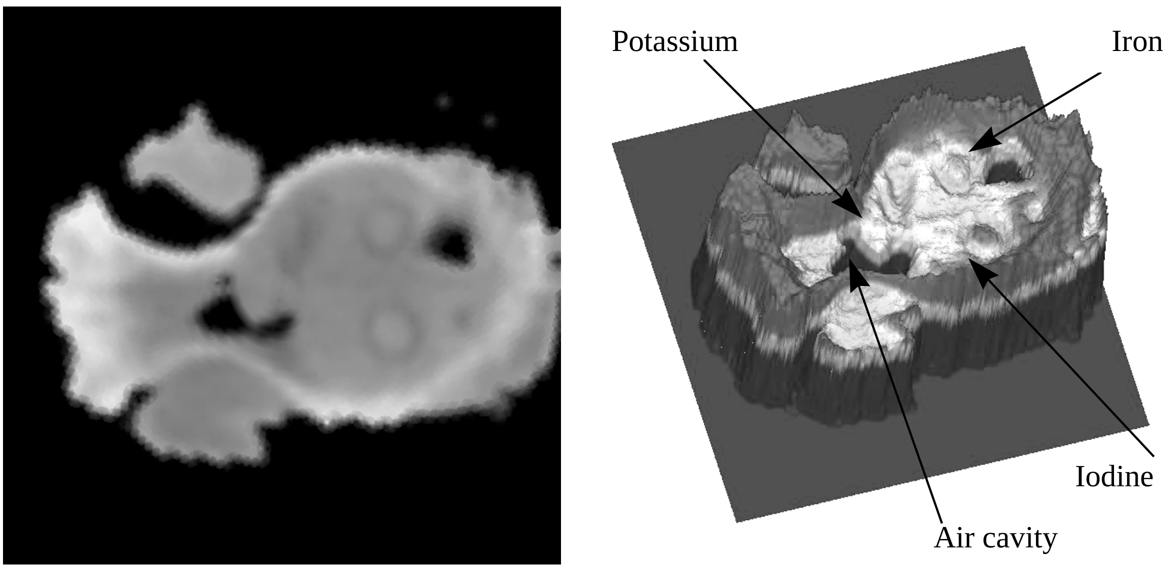

Fig 3. Rayleigh to Compton image of the rabbit head.

The figure 4 shows the Rayleigh to Compton ratio profil along the line plotted on figure 1.

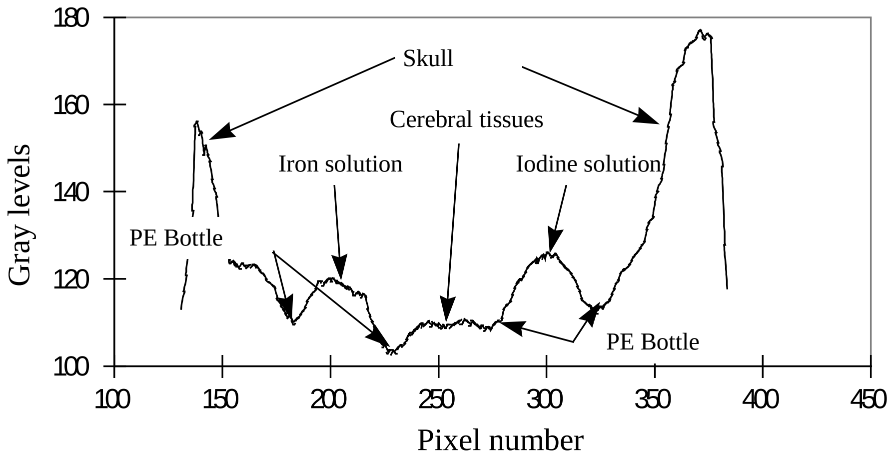

Fig 4. Rayleigh to Compton ratio profil