Title: Implementation of an X-ray imaging system based on the KES technique at ELETTRA

The proposed PhD Thesis in Physics is part of the KISS project (K-edge Imaging at Synchrotron Sources) of INFN (group V) in which the INFN Section of Pisa, Cagliari and Trieste are involved together with Elettra-Sincrotrone Trieste.

The aim of this project is the development at the SYRMEP medical imaging beamline of the synchrotron ELETTRA a system based on the technique called *K-Edge Subtraction* (KES), an X-ray imaging technique that involves the use of one or more contrast agents containing high Z elements (for example I, Ba, Gd) and is based on the acquisition of two images, one with energy higher than that of the K-edge of the aforesaid element and the other with lower energy. These images are then elaborated with particular post-processing methods in order to optimize / increase the visibility of the parts containing the contrast agent with respect to the background.

Several applications are possible in particular by studying distinct biological functions in preclinical models. Of great biological interest are also applications based on the use of unconventional contrast media containing elements such as Ag, Au and Pt, also in the form of nanoparticles / nanomaterials.

The image acquisitions will be performed in planar mode and also in tomographic mode (Computed Tomography) where it is possible to measure the spatial distribution of the linear attenuation coefficient and the concentration of the contrast agent.

The KISS project involves the development of two different techniques that utilize synchrotron radiation:

1) technique based on the use of spectral detectors and polychromatic beam.

2) technique based on monochromatic beams.

The first approach involves the use of the polychromatic beam (white beam) produced by an ELETTRA bending magnet together with a high-resolution CdTe photon-counting detector capable of selecting two different energies thanks to its adjustable threshold of the discriminators.

The second approach involves the use of bend crystal monochromators in Laue

configuration which must be designed in order to simultaneously transmit two energies, above and below the K-edge of the contrast medium under examination.

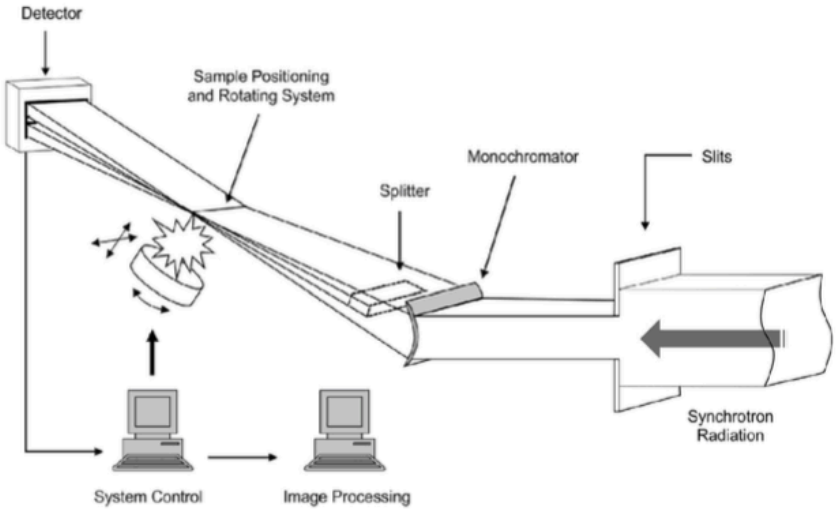

Figura 1: Sistema basato sull'uso della radiazione di sincrotrone e di un cristallo curvo che seleziona le energie E_{low} ed E_{high}.

The work of the Doctoral Thesis that is proposed here envisages in a first phase the design and implementation of the curved crystal system in order to obtain a complete device that can work on a wide energy range. Experimental tests of the device at the SYRMEP beamline on test objects designed ad hoc will then be carried out. Planar and tomographic experimental measurements will also be planned with polychromatic synchrotron radiation using spectral detectors and a quantitative comparison of images obtained with a monochromatic beam system will be performed.

A close collaboration is expected with the INFN Units participating in the project and the ELETTRA researchers.

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