CNRS PhD thesis proposal

Particle physics, medical imaging.

Development of the XEMIS2 liquid xenon Compton camera and its interface with 3-photon imaging

The XEMIS2 camera (XEnon Medical Imaging System 2) is a Compton camera, designed and assembled by the Subatech laboratory, for gamma metabolic imaging. Fruit of the developments initiated previously in the field of dark matter fundamental research, XEMIS2 holds a continuous detection medium made of liquid xenon. XEMIS 2 is currently in the advanced phase of installation at Nantes University Hospital (see Picture 1). Sized to image small animals, it opens up numerous sectors of metabolic imaging by offering a plurality of imaging modalities previously difficult to envisage without the technologies it houses. Furthermore, in collaboration and in order to improve the imaging capabilities of this camera, the LS2N laboratory is developing innovative methods to reconstruct images. In this context, our teams wish to propose a new joint research phase dedicated to the development of the XEMIS2 camera and its interface with 3-photon imaging.

Picture 1: Photography of the infrastructure hosting the XEMIS2 camera on the CIMA platform of the Nantes University Hospital.

The main task of the PhD student will be to set up a new processing algorithm of the raw data from the XEMIS2 camera taking into account the principles of the image reconstruction algorithm. The operation of the camera, as well as the use of the image reconstruction algorithm, will also be important tasks. They will make it possible to produce the images on which the optimization of the processing of raw data will be based. At the same time, the Monte Carlo simulation of the camera must be used to cross-check and consolidate the results obtained from real data. A continuous exchange between physicists and signal processing specialists will be fundamental for the co-design of data processing. This work will lead to the publication of a first image from the XEMIS2 camera, which will also be the first three-photon metabolic image published. This will generate new possibilities for collaboration between physicists, mathematicians, biologists, pharmacists, and doctors.

Location: Subatech laboratory, 4 rue Alfred Kastler - La Chantrerie 44307 Nantes, France.

Profile: student in the field of particle physics, nuclear physics, detector physics, signal processing.

Key words: medical imaging, liquid xenon, time projection chamber, experimental setup, Compton camera, 3-photon imaging, signal processing, health application, particle-matter interaction.

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Starting Date, duration: 1^{st} octobre 2024, grant for three years.

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