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Scintillation signal in XEMIS2, a liquid xenon Compton camera using a 3γ imaging technique

The XEMIS project (Xenon Medical Imaging System) which makes use of 3γ imaging technique, aims at making a precise 3D localization of radioactive emitter and reducing drastically (100 times less) the injected activity to the patient. The 3γ imaging is characterized by the simultaneous detection of 3 γ-rays emitted by ^{44}Sc within a liquid xenon Compton camera.

This project consists of 3 main steps: XEMIS1, which is a prototype of a single-phase liquid xenon Compton camera, has provided the experimental feasibility of 3γ imaging technique. The second prototype of a larger scale liquid xenon cylindrical camera for small animal imaging, XEMIS2, has been designed for preclinical application, and is now under qualification. The final objective, XEMIS3, which is a larger liquid xenon Compton camera, will be oriented to whole human body imaging application.

The principle of XEMIS2 is based on the measurement of both scintillation and ionization signals, generated after the interaction of an ionizing particle within the liquid xenon. To detect those signals, the active volume of XEMIS2 is surrounded by a set of UV-sensitive Hamamatsu photomultipliers and two end segmented anodes. Our poster will focus on the scintillation signal detection of XEMIS2. In the preliminary stage, the scintillation light is detected by 64 PMTs, providing the interaction time of the γ-rays interaction. Besides, by combining PMT signals with the additional information provided by the ionization signal, it is possible to reconstruct the axial position of each interaction inside the detector. Furthermore, in order to reduce the occupancy of the TPC, the scintillation signals will be used for spatial pre-localization of each γ-ray interactions. It will allow to handle a 10-fold higher activity by increasing the numbers of PMTs from 64 to 380. The XEMIS2 is being commissioned and the first image of a small animal is foreseen at the CIMA center of the Nantes Hospital by the end of the 2017 year.

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