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#9-124 MACACO III+ characterization and tests with I-131

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The IRIS group of IFIC has developed a Compton camera for medical applications made of LaBr3 crystals coupled to SiPM arrays. The prototype MACACO III consists of three detector planes, each one composed of a LaBr3 monolithic crystal coupled to a 64-channel SiPM array. The readout is carried out with the ASIC VATA64HDR16 operated with the AliVATA readout board. Besides the tests conducted with this system for protontherapy treatment monitoring, it has been tested also for radionuclide therapy with very promising results. Test were carried out in La Fe Hospital (Valencia, Spain) filling 3D printed Derenzo-like phantoms with 18F-FDG and I-131. Rods of 6, 5 and 4 mm diameter were visible in the images. Tests were also carried out with patients undergoing treatment with 131I-NaI. Metastatic lesions imaged with MACACO III could be correlated with the images obtained by the gamma camera Bright View XCT from Philips. The system was also employed for imaging Ac-255. Alpha emitters are promising in radionuclide treatmens due to the high LET and short range of alpha particles, sparing healthy tissue. However, the activities are much lower than those employed with beta emitters and they usually emit high energy photons, thus making imaging with gamma cameras very challenging. The system was able to image the 6 mm diameter rods of the phantom filled with Ac-225, in collaboration with the hospital Léon Bérard of Lyon, but with a long acquisition time. The measurements with MACACO III evinced the need of enhancing the system efficiency. Thus, a new system has been assembled, MACACO III+ with four detectors in the second detection plane, with a total amount of 256 channels. The system has been characterized in the laboratory to equalize the response of the data acquired in the four different possible combination of detectors, with photons interacting in the detector that composes the first plane and in any of the four detectors of the second plane. The image reconstruction software has been modified accordingly. The system was able to image arrays of Na-22 souces separated 8, 6 and 4 mm. The prototype MACACO III+ has also been tested in La Fe hospital with a 3D printed thyroid-shaped phantom filled with I-131. Tests were done filling the phantom uniformly and also with hot spots in a warm background in a 10:1 activity ratio. In addition, at CICbiomaGUNE, tests with a mouse phantom and living mice have been carried out. The resulting images have been compared with those obtained with a gamma-cube SPECT system from Molecubes. In the mouse phantom, four organs were filled: brain, heart, kidneys and bladder. Two living mice were tested, showing uptake in the thyroid and bladder. Data were taken for 120 minutes with the SPECT system and for 30 minutes with MACACO III+, yielding similar images. The system efficiency is being further enhanced by assembling another detector plane composed of four individual detectors. Detector characterization as well as simulations to estimate the response of a system composed of two four-detector planes (MACACO IV) are ongoing. The data analysis is also being improved through the use of neural networks for event selection.

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