

Development and evolution of multilayer Medical Applications CompAct COMPTON camera (MACACO)

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Compton cameras (CCs) have gained renewed interest in different areas, including medical applications, such as hadron therapy treatment monitoring [1] or molecular imaging in nuclear medicine [2]. Over the years, CCs have improved in diverse domains [3] and offer advantages due to their high sensitivity, large field of view, compatibility with high-energy radiotracers, lower attenuation, and better isotope separation in imaging. CCs have demonstrated suitability in prompt-gamma (PG) imaging, dosimetry imaging in neutron capture therapy, and imaging with poly-energetic photons. While CC prototypes with solid state crystals exhibit better energy resolution, the scintillator-based systems achieve better timing resolution and can cover larger areas at affordable cost and are better suited for operation in clinical environments. Recently, state-of-the-art innovations are being proposed for Compton cameras for their utilization in targeted radionuclide therapy (TRT) and targeted alpha therapy (TAT) [4].

At the Instituto de Física Corpuscular (IFIC), the IRIS group (Image Reconstruction, Instrumentation and Simulations for medical imaging applications) has developed MACACO (Medical Applications CompAct Compton camera), a Compton camera based on monolithic LaBr₃ crystals coupled to SiPM arrays [5]. Several prototypes have been developed with the VATA64HDR16 ASIC as readout electronics, increasing system performance from one prototype to the following one. Such systems, initially developed for proton therapy monitoring [6], have been tested for this application, and the last two versions, MACACO III [7] and MACACO III+ [8], also tested for treatment verification in TRT. In addition, in order to improve the timing resolution and readout speed in proton therapy monitoring, a prototype with the TOFPET2 ASIC from PETSys was also employed in MACACOp [9] and FALCON [10].

I'll present the developments of MACACO prototypes and their performance evaluation with emphasis on their recent results.

References:

- [1]. G. D. Flux, Br. J. Radiol., 90, 20160748, (2017).
- [2]. M. Fontana et. al., Phys. Med. Biol., 62, 8794 (2017).
- [3]. G. Llosa, M. Rafecas, Eur. Phys. J. Plus, 138, 214 (2023).
- [4]. Advanced Imaging DEtector for targeted Radionuclide therapy, Euratom Project, Grant agreement, ID: 101165088. <https://cordis.europa.eu/project/id/101165088>
- [5]. E. Muñoz et. al., Phys. Med. Biol. 62 (2017) 7321–7341.
- [6]. E. Muñoz, et. al., Sci Rep 11, 9325 (2021).
- [7]. L. Barrientos, et. al., Nuclear Inst. and Methods in Physics Research, A 1014 (2021) 165702.
- [8]. L. Barrientos, et. al., Radiation Physics and Chemistry 208 (2023) 110922.
- [9]. R.Viegas, et. al., Radiation Physics and Chemistry 202 (2023) 110507.
- [10]. R. Viegas, et. al., IEEE NSS MIC (2023) DOI: 10.1109/NSSMICRTSD49126.2023.10338253.

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