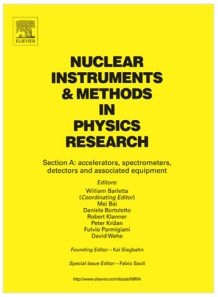
Accepted Manuscript



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PII: S0168-9002(18)31270-1
DOI: https://doi.org/10.1016/j.nima.2018.09.117
Reference: NIMA 61282

To appear in: *Nuclear Inst. and Methods in Physics Research, A*

Received date : 29 June 2018
Accepted date : 25 September 2018

Please cite this article as: J. Heymes, et al., Implantable CMOS pixel sensor for positron imaging in rat brain, *Nuclear Inst. and Methods in Physics Research, A* (2018), https://doi.org/10.1016/j.nima.2018.09.117

Implantable CMOS Pixel Sensor for Positron Imaging in Rat Brain

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Abstract

IMIC is a Monolithic Active Pixel Sensor prototype designed for the MAPSSIC project, which aims at developing wireless intracerebral probes dedicated to image positron-emitting source activity in the brain of awake and freely moving rats. Former experiments with the PIXSIC positron probe based on a passive sensor have validated the proof of concept, but have also shown limitations with regards to the probe robustness and to its transparency to annihilation photons. The IMIC circuit features a matrix of 16 × 128 active pixels of 30 × 50 µm^2 size and targets to overcome the PIXSIC probe drawbacks by exploiting a thin sensitive layer of 18 µm, still featuring an overall thickness close to 300 µm. Additionally, by using a low power (55 nW/pixel) in-pixel front-end architecture providing binary output, IMIC solves the challenge of implanting an active sensor in tissues where overheating is forbidden.

The needle-shaped sensor 610 µm × 12000 µm was fabricated and tested in laboratory. The whole sensor dissipates 160 µW and its imaging capabilities were asserted with various sources : ^{55}Fe, ^{90}Sr and ^{18}F. These tests also demonstrated robust count-rate measurement with IMIC in the range 10–1000 counts/matrix/s. Finally, a dedicated setup qualitatively confirmed excellent

Preprint submitted to Elsevier *29 juin 2018*

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