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Design and characterisation of a Highly Miniaturised Radiation Monitor

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Reliable data on the ionising radiation environment are regarded as very important to ensure an efficient design and operation of spacecraft. Engineering such sensors, and their cost, anyway, still represents a limitation to their widespread adoption. Here we present a Highly Miniaturised Radiation Monitor (HMRM), developed by the Science and Technology Facilities Council and Imperial College London within the framework of a European Space Agency technology development contract. Its aim is to greatly reducing costs and complexity of radiation detectors.
At the core of the current design is a CMOS Image Sensor. Size and mass are considerably reduced thanks to this approach and there is also scope for a reduction in power consumption. This makes the HMRM much easier to integrate on a spacecraft.
The image sensor is based on a 50 by 51 pixel array. The selected pixel is a 4T, to reduce the noise. The array is readout in snapshot mode at a frame-rate of 10,000 fps.
Biasing currents and voltages are generated on-chip to reduce the number of signals required to control the sensor. The sensor is designed to work on a large range of temperatures, from -40.C to +80?C, hence a temperature sensor has been integrated.
The digital output data are obtained with a three bits column parallel ADC with programmable thresholds. An analogue readout has been also designed to characterise and debug the ASIC.
In this following paper we want to present also the results obtained from the measurements on the prototype. Preliminary PTC plots show a gain of 60uV/e- with CDS and a noise of 16e- rms, which include the noise from the external board.
The sensor was manufactured on standard (low) and high resistivity epitaxial substrates, the former being the baseline for the technology and the latter the one which will be used in the instrument. The high-resistivity allows the charge to be collected by drift and not diffusion, thus reducing the overall cross-talk. In both substrates, the epitaxial layer is 12 um thick.

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