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Particam: A fully digital sensor for sub micron resolution

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While silicon industry advances to smaller and smaller feature sizes, silicon particle detectors struggle to follow that miniaturisation. One of the main bottlenecks are the relatively large transistors required for the optimal performance of the analogue frontend. Particam instead uses a digital only approach which is focused on digital storage cells switching due to transient radiation (Single Event Upset (SEU)). Normally, great effort is expended to prevent SEUs from affecting the registers of any ASIC, designs can also be optimised in the opposite way. With a pixel being little more than a memory cell it can be designed with close to minimum feature size with very few transistors allowing pixel pitches of a few microns.

A proof of principle demonstrator with different pixel flavours with pitches ranging from 6.5um to 2um has been produced in the UMC 65nm process. Test pulse measurements show the circuits work as intended, the charge collection was found to be insufficient for most types of ionising radiation besides alpha particles. Samples coated with a neutron converter are under investigation as demonstrator for precision measurements. Results of this prototype are to be presented.

A second prototype fabricated in the LFoundry 110nm node exploring if the charge collection in a thin epi-layer process is sufficient for this concept. First measurements of this prototype will be shown.

In addition, plans for further developments and possible applications will be discussed.

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