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Backside channel for extended range of Spacepix-2 SoI MAPS detector

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Monolithic pixel detectors allow integration of sensing diode together with the pixel front-end electronics to fit in tens of micrometers pixel pitch. The high granularity of such detectors makes it difficult to measure the total energy deposition by high energy particles [1]. Especially heavy ion interactions are not detectable due to the saturation of charge sensing amplifier of individual pixels. A backside channel measurement is a novel technique that can measure energy deposition in the whole sensor, thus extending the detector range.

The backside channel collects total deposited amount of charge across the sensor and thus determines the amount of signal charge originating from heavy ion interactions. The backside channel consists of a front-end amplifier and a peak detector optimized for long hold time to operate at longer shutter times. Output of the backside channel is converted on chip by a 10-bit ADC. For calibration and debugging purposes, charge injection through injection capacitance into backside can be utilized in the same way as charge injection into pixels, as shown in Figure 1.

The PDH output is buffered and connected to analog pin for testing purposes. Charge sensitive amplifier is implemented as a folded cascode [2] with PMOS input transistor and a high compliance current cascode for improved voltage swing. The feedback capacitor has a value of 3pF allowing us to measure the total charge deposited on the detector up to 40 Me–with 10-bit resolution. Sensor diodes are biased with voltage of –150 V. In the backside configuration, bias voltage is AC coupled, to ensure the proper function. The backside channel is fabricated in 180 nm SoI process. The design and results of the backside channel will be presented in this work.

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