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## Design and performance of a direct charge-collecting pixel sensor for gaseous beam monitors

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The beam monitoring system, known as the eyes of the accelerators, is an essential part of the accelerator facilities. Its function is to monitor the beam parameters to improve the beam quality. The gaseous detector with direct charge collecting pixel readout shows excellent potential for non-destructive beam monitoring since it can provide high spatial resolution and handle high flux beam rates.

In this paper, a novel silicon pixel sensor that can directly collect charge in the gas media has been designed for future gaseous beam monitoring systems. This pixel sensor has a total size of 23 mm × 2.24 mm. The sensitive area contains 28 (row)×768 (col) of 29 $\mu$ m square pixels. Each pixel can collect the charge directly with the exposed topmost metal layer of the CMOS process as the charge sensing pad. Then, the in-pixel charge-sensitive amplifier converts the charges to an analogue signal, and the peak holding circuit captures the peak of the analogue signal for readout.

The pixel array is divided into 16 banks. The readout control adopts a rolling shutter scanning method, where each bank scans all its pixels simultaneously and sequentially to output the energy information off-chip. Performance evaluation shows that each pixel can measure charge up to ~20ke, and the conversion gain is ~35.2mV/ke-. The Equivalent Noise Charge (ENC) is relatively low, from 70e- to 100e-. The Integrity Nonlinearity is only ~1.08% in the measurement range.

## **Primary experiment**

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