

GEM400: A Front-End Readout chip based on Capacitor Switch Array for Pixel-based GEM Detector

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The upgrade of Beijing Synchrotron Radiation Facility(BSRF) need two-dimensional position-sensitive detection equipment to improve the experimental performance. New structures and new technology GEM detector, in particular, pixel-based(Pad) GEM detector, has good prospects in the domain of synchrotron radiation and high energy physics experiments for its simple structure, superior performance and the flexible way of read-out. For the read-out of pixel-based GEM detector, we proposed a new read-out program, designed read-out ASICs based on capacitor switch array, and achieved the read-out of pixel-based GEM detector using System in Package technology.

Summary 500 words

The continuous development of high energy physics has promoted particle physics detection technology to progress. In recent years, new detectors such as Semiconductor detector, Gas Electron Multiplier are developing rapidly, and their position resolution can go to tens of microns or even micrometers, the signal rate can go to 1MHz/s or more, and its readout electronics has become very demanding requirements.

Firstly, the increase in channels per probe unit area and the corresponding number of electronics readout channels, leading to the difficulty of each channel's signal extraction. Secondly, the increase of the readout electronics density, make the crosstalk between channels become a very important issue. Again, the increase in the number of channels, will inevitably lead to a sharp increase in power consumption and cost. The traditional method of readout has been far from satisfying the needs of the new detectors' readout, only the development of high-density, high performance, lower power ASIC(Application Specific Integrated Circuit) chip, combined with advanced packaging technology, making detector and readout chip connected directly, can solve the difficulties encountered by the new intensive detectors' readout.

In order to achieve the read-out of larger scale pixel-based GEM detector, we proposed a circuit structure based on the capacitor switch array structure, and we did analyze and simulation of the circuit. Then, we designed the chip GEM400, a 400-channel ASIC based on capacitor switch array circuit, and gave a detailed simulation results. The simulation results show that the chip can allow the maximum amount of input charge 70pC on the condition of 100pF external integrator capacitor. At the same time, the chip has good channel consistency and better noise performance and lower power consumption. We proposed a readout scheme for pixel-based GEM detector, this scheme is based on GEM400 chip and System in Package technology.

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