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Two-dimensional encoded multiplexing readout with a 5x5cm2 THGEM

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Owing to the good spatial resolution, high rate capability, large active areas, and radiation hardness, Micro-pattern Gas Detectors (MPGDs), such as GEM, are widely used in high-energy physics, and have expanded to astrophysics, nuclear physics and medical imaging. As two-dimensional position sensitive detectors, MPGDs usually employ strips readout or pixels readout. To obtain good spatial resolution, the strip size should be reduced and a large effective area requires a large number of channels. The conventional two-dimensional tracking for MPGDs requires a large number of electronics channels, and in consequence poses a big challenge for the integration, power consumption, cooling and cost. It has become an issue to the further applications of MPGDs, and how to reduce the electronic channels has been an urgent problem to be solved.
In our work, a new tracking method for MPGDs based on two-dimensional encoded multiplexing readout is present, which can significantly reduce the number of readout channels. An easily-extensible encoded multiplexing readout method was developed in our previous work, and a general formula of encoding & decoding for n channels is derived. We make a further step on our research and a two-dimensional readout is presented. Using two-dimensional orthogonal strip readout as charge collection electrode, encoding horizontal strips and vertical strips respectively, and then synthesizing the result we implement two-dimensional readout. In order to verify this method, an X-ray imaging verification test was carried out on a 5×5 cm2 Thick Gas Electron Multiplier (THGEM) detector, using an 8 keV Cu X-ray source with 100μm slit, where 200 strips were read out by 30 encoded readout channels. The electronics is based on the VATA160 chip. In the test, X-ray beam pass through Cu board engraved with letters to detector. Then electronics read out the signals. Finally by decoding the channels'signals we get the hit position and rebuild the images with letters, thus two-dimensional imaging is implemented.
The images rebuilt indicate this method is feasible for two-dimensional readout of MPGDs. For it can dramatically reduce the number of readout channels, this method has potential to play an important role in building large area detectors, and is worth for further research. Moreover, it can also be used for other detectors, like Drift Chambers or scintillators.
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