Two-dimensional encoded multiplexing readout with a 5x5cm$^2$ THGEM
1. INTRODUCTION

Micro-pattern Gas Detectors (MPGDs), an two-dimensional position sensitive detectors, are widely used in particle physics such as COMPASS, LHC, LHC and so on. Owing to the good spatial resolution, high rate capability, large active area and radiation hardnes, MPGDs also play an important role in high-energy, astrophysics and medical imaging. To obtain good spatial resolution, the strip size should be reduced and a large effective area requires a large number of channels. The conventional readout technique, strip strip readout, employ a large number of electronic channels. For example, in COMPASS, 3144 channels are needed for Micromegas and GMNT. In ATLAS, up to 320000 channels are needed for Micromegas.2 The large number of electronic channels result in a big challenge for the integration, power consumption, routing and cost. Encoded multiplexing readout has provided an attractive solution to reduce the number of readout channels. In this paper, we present a two-dimensional encoded multiplexing readout method, which can dramatically reduce the number of readout channels.

2. PRINCIPAL AND METHOD

In our previous work, a one-dimensional encoded multiplexing readsout is proposed3]. By using the redundancy that each strip usually activates multiple of several neighboring strips in MPDGs, a flexible and multi-channel readout concept has been developed. In COMPASS, a general formula of encoded readout is derived. As shown in figure 1, 2 strips read out by 5 readout channels. All kinds of combinations of 5 channels, corresponding to the 16 patterns, appear once in the encoding list [1,2,3,4,5;1,2,3,5,4;1,2,4,5;1,3,4,5]. The combination of two different channels can uniquely decode the two neighboring hit strips of the particle in the detector.

It's important that in some two-dimensional tracking situation, this method can be easily extended. We make a further step on one readout and a two-dimensional readout is proposed. As shown in figure 2, using two-dimensional orthogonal strip readout as charge collection electrode, encoding horizontal and vertical strips respectively reading out the signals and decoding to get the hit strips, thus synergetic relaxes we completed a two-dimensional readout.

3. VERIFICATION TEST

In order to verify this method, an X-ray imaging verification test was carried out on a 51x51cm 100% RECO, 4.8nA mesh strip Thin Gaseous Electron Multiplier (TGMEM) detector, using a X-ray source with 180Km eV full width, where 500 strips two-read-out by 50 coded readout channels. A manual movable platform was used for the position scanning test. The test platform setup is shown in figure 3 and the test platform structure is shown in figure 4. X-rays beam pass through Cu block engraved with letters in direction, then electrons based on the TGMEM chip read out the signals. Finally by decoding the channels' signals we get the hit position and rebuild the picture with known, thus the two-dimensional imaging is implemented.

4. CONCLUSION

The test results show the method has a good performance in two-dimensional imaging for GM, and has an attractive potential to help improve MPGDs with large number of readout. As this two-dimensional readout method can dramatically reduce the number of readout channel, it can also has a wide range of position imaging applications besides particle physics, such as medical imaging and industry.

REFERENCE