IL NUOVO CIMENTO **42 C** (2019) 206
DOI 10.1393/ncc/i2019-19206-7

Colloquia: IFAE 2018

Micro-TPC reconstruction performance for planar GEM detector with high-rate beam

I. Balossino([1])([2]) on behalf of CGEM-IT Group

([1]) *INFN, Sezione di Ferrara - Ferrara, Italy*
([2]) *Dipartimento di Fisica, Università di Ferrara - Ferrara, Italy*

received 31 January 2019

Summary. — A new reconstruction method for the Micro Pattern Gas Detectors (MPGD) has been implemented, called Micro-TPC, and implemented for Gas Electron Multiplier (GEM) detectors. The possible dependence of the drift velocity on the presence of residual charge in high-rate conditions motivated the test performed with planar GEM at MAMI Facility in Mainz. In this work the Micro-TPC technique, the setup and the results of the test beam that allowed to find the optimal working conditions will be presented.

1. – Introduction

Gas Electron Multiplier: GEM detectors were invented by Sauli [1] in 1997. GEMs are built as thin Kapton foil covered by copper and pierced with small bi-conical holes ($50\,\mu$m). The electron avalanche multiplication happens inside the holes, where a high field is provided by applying a voltage to the copper layers. In triple-GEM detectors, three GEM foils are placed between an anode and a cathode, as shown in fig. 1.

Micro-Time Projection Chamber: The goal is to calculate the position of the primary ionization points inside the drift gap minimizing the error. This is performed in the following steps (fig. 2) once a cluster is found: 1) extrapolation of the position by measuring the time of arrival of the signal on the anode assuming constant drift velocity; 2) linear fit of all the found positions; 3) position measurement from the fit that corresponds to half gap.

Test beam at MAMI: A check of the Micro-TPC performance in a challenging environment such as the MAinz MIcrotron Facility was performed thanks to the high-rate beam. Here four triple-GEM planar chambers ($10 \times 10\,\mathrm{cm}^2$) have been tested with two different gas mixtures, Ar:iC_4H_10 (90:10) and Ar:CO_2(70:30). The chambers could rotate to test the Micro-TPC at different incident angles.

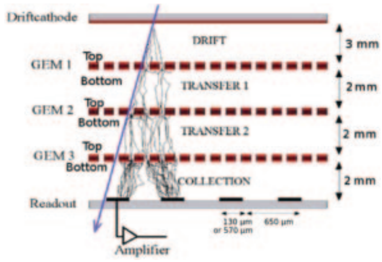

Fig. 1. – Avalanche scheme.

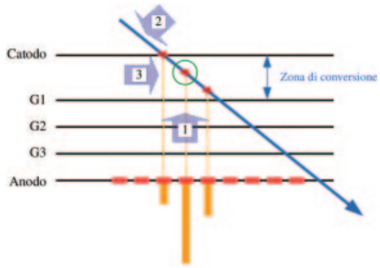

Fig. 2. – Micro-TPC reconstruction method.

2. – Results

A description of the results on the parameters that may affect the performance of Micro-TPC in high-rate environment is presented.

Gain: fig. 3 shows that the gain behaviour is compatible with the one of ref. [1]. The gain is stable up to more than 10^6 Hz/cm^2, then it increases up to 10^7 Hz/cm^2 to drop right afterwards. The possible explanation to this behaviour is correlated to the positive charge accumulation that modifies the electric field and increases the transparency of the GEMs.

Time resolution: It takes into account both the time resolution of the detector itself and the one of the electronics. In both gas mixtures fig. 4 shows the parameter stability with the rate up to 10^7 Hz/cm^2.

Drift velocity: The drift velocity has been calcualted by the time difference between the first and the last hit strips. The stability of this parameter up to 10^7 Hz/cm^2 validate the method with both gas mixtures, as shown in fig. 5.

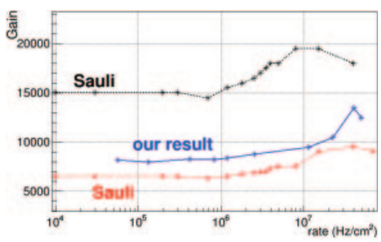

Fig. 3. – Gain *vs.* rate [2].

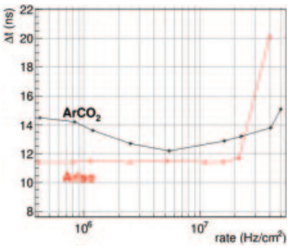

Fig. 4. – Time resolution *vs.* rate [2].

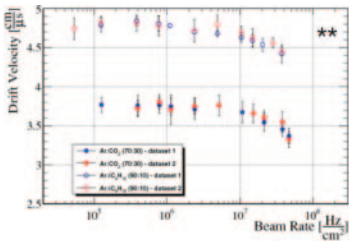

Fig. 5. – Drift velocity *vs.* rate [2].

3. – Conclusions

The use of the Micro-TPC reconstruction method has been validated at high rate up to 10^7 Hz/cm^2.

REFERENCES

[1] Sauli F., *Nucl. Instrum. Methods A*, **805** (2016) 2.
[2] Lavezzi L. *et al.*, *Performance of the Micro-TPC Reconstruction for GEM Detectors at High Rate*, arXiv:1803.07266 [physics.ins-det].