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Track distortion in a micromegas based large prototype of a Time Projection Chamber for the International Linear Collider

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The principal particle tracker at the International Linear Collider (ILC) is planned [1] to be a large Time Projection Chamber (TPC) where different Micro Pattern Gaseous Detector (MPGDs) candidate as the gaseous amplifier. A Micromegas (MM) based TPC can meet the ILC requirement of continuous and precise pattern recognition.
Seven MM modules, working as the end-plate of a Large Prototype TPC (LPTPC) installed at DESY, have been tested with a 5 GeV electron beam. Due to the grounded peripheral frame of the MM modules, at low drift, the electric field lines near the detector edge remain no longer parallel to the TPC axis. This causes signal loss along the boundaries of the MM modules as well as distortion in the reconstructed track. In presence of magnetic field, the distorted electric field introduces E×B effect [2].

A detailed numerical study has been accomplished to understand the features of this distortion. Three Micromegas modules are simulated resembling the experimental setup. Tracks are allowed to point in different directions. Taking the primary track as reference, residuals are calculated. The field lines, drift lines of the electrons, diffusion of electrons in gas, nature of track distortion, expectations of the residuals are numerically calculated in presence and in absence of magnetic field. The E×B effect has been simulated as well. Simulated results follow the experimental observations. Effect of very small variation in geometrical positions of the modules is being carried out.

References

1. T.Behnke(ed.) et al., International Linear Collider Technical Design Report: Executive Summary 1 (2013).
2. Thesis of Wenxin Wang: 'A Large Area Micromegas TPC for Tracking at the ILC', University of Paris-Sud, 2013.

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