Lorentz angle measurements with ALICE TRD prototypes

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The study of rare probes via their (semi-)leptonic decays in the ALICE experiment requires dedicated triggers. The TRD provides the necessary capabilities to trigger on high p_t (>3 GeV) electrons by means of track reconstruction in a magnetic field and TR signature.

TRD prototype tests were carried out in August 2001 at the GSI secondary pion beam with a momentum of 1 GeV/c. A drift chamber (DC), operated with $Xe,CO_2(15\%)$ mixture was placed in magnetic fields of up to 0.3 T, produced by two coils in a Helmholtz configuration. We used a prototype equipped with chevron pad plane with FADC readout. The detector provides information on the position of ionization electrons in the gas volume, which can be used to reconstruct the trajectory of an incident particle. Exploiting this feature, we performed a first direct measurement of the Lorentz angle (the angle of drifting electrons with respect to the electric field lines) for a Xe,CO_2 mixture (see [1] for other mixtures). This quantity is very important for the final detector, as it has implications on track reconstruction at the trigger level.

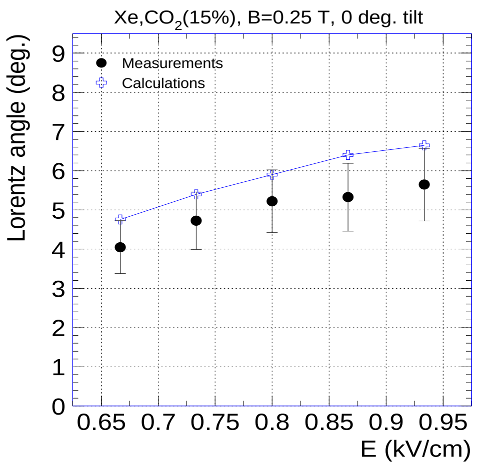

Figure 1: Lorentz angle in $Xe,CO_2(15\%)$ mixture as a function of the applied drift field for B=0.25 T.

Fig. 1 shows the measured Lorentz angle as a function of the drift field for B=0.25 T. Two correction were taken into account: i) the chamber tilt (due to positioning imprecision), which is determined in B=0 runs; ii) the deflection of the beam in the magnetic field, which is measured by two silicon sicrostrip detectors, placed before and after the DC. The errors on our results have two sources: i) the inaccuracy to distinguish between the drift region and the amplification region of the detector; ii) the angular spread of the beam. We compare our results to GARFIELD/MAGBOLTZ [2, 3] calculations. We find overall agreement with the calculations, but the measured Lorentz angles are systematically lower than the calculated ones. In Fig. 2 we present the Lorentz angle as function of the magnetic field for a drift field of 0.66 kV/cm. In this case too, there is a similar agreement with the calculations.

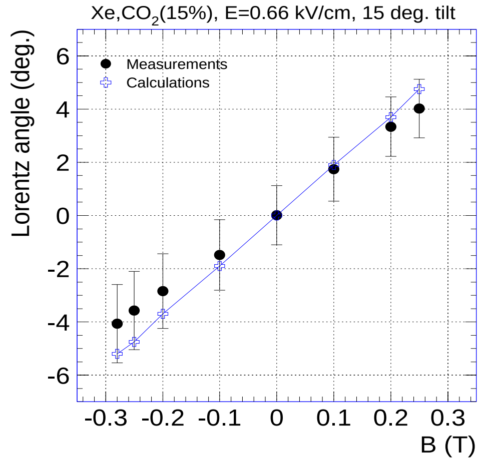

Figure 2: Lorentz angle in $Xe,CO_2(15\%)$ mixture as a function of the external magnetic field B.

In November 2001 we performed similar measurements using a 4 GeV/c pion beam at the CERN PS. This time we operated two chambers with rectangular pads in a dipole magnet. As drift gas we used a neon-based mixture, $Ne,CO_2(13\%)$. The results are presented in Fig. 3 in comparison to GARFIELD calculations. Taking into account the errors of the method, our results are in a similar agreement with the calculations for the Ne,CO_2 mixture as in the case of Xe,CO_2 mixture.

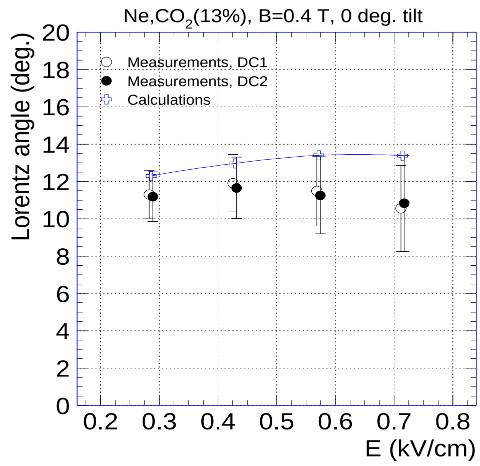

Figure 3: Lorentz angle in $Ne,CO_2(13\%)$ mixture as a function of the drift field for B=0.4 T.

References

[1] U. Becker et al., Nucl. Instr. Meth. A421 (1999) 54.
[2] R. Veenhof, Nucl. Instr. Meth. A419 (1998) 726.
[3] S. Biaggi, Nucl. Instr. Meth. A421 (1999) 234.