T486

The influence of positive ions on the performance of a jet-cell-type chamber filled with a cool gas

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We have studied particle identification performance of a mini-jet-cell type drift chamber filled with a CO_2(90%)/Isobutane(10%) gas mixture. This gas mixture choice is due to its small diffusion coefficient and small Lorentz angle. The chamber, having only 10 sampling layers but with the same cell structure as with the central tracking detector we proposed for a future linear e+ e^- collider JLC, has been exposed to e, π, and p beams with momenta of 0.5–1.5 GeV/c at the T1-beam line of 12-GeV KEK proton synchrotron (KEK-PS) in 2000. The results of dE/dx measurements show good separation capability under practical operating conditions of the chamber. On the other hand, when the beam background was severe and positive ions were accumulated in the sense volume of the chamber, we observed the charged tracks deviated from those which would result under circumstances free from positive ions. The drift velocity in a CO_2 -based gas is sensitive to local electric field strength. In order to study this global space charge effect, we made an experiment using the same chamber and an UV laser beam at KEK-PS once again. The layout of our experimental apparatuses on the T1 beam line is shown in Fig.1. In the experiment the movement of the laser beacon tracks were observed under the controlled intensity of defocused particle beam. In Fig. 2, we plot the difference between the measured charged tracks on the beam spill ($\Delta X_{beam\ ON}$) and between the beam spill ($\Delta X_{beam\ OFF}$) as a function of total sense wire currents. The results are found clearly the difference between ΔX ($\Delta X_{beam\ ON} - \Delta X_{beam\ OFF}$) is in proportion to total sense wire currents, that is, positive ion densities. Fig. 3 is the difference between ΔX plotted as a function of drift distance in the sense volume of the chamber. This result is shown a distortion of local electric field strength due to positive ions.

Fig.1. Layout of the experimental apparatuses on the T1 beam line at the 12GeV KEK proton synchrotron

Fig.2. $\Delta X_{beam\ ON} - \Delta X_{beam\ OFF}$ as a function of total sense wire currents

Fig.3. $\Delta X_{beam\ ON} - \Delta X_{beam\ OFF}$ as a function of drift distance

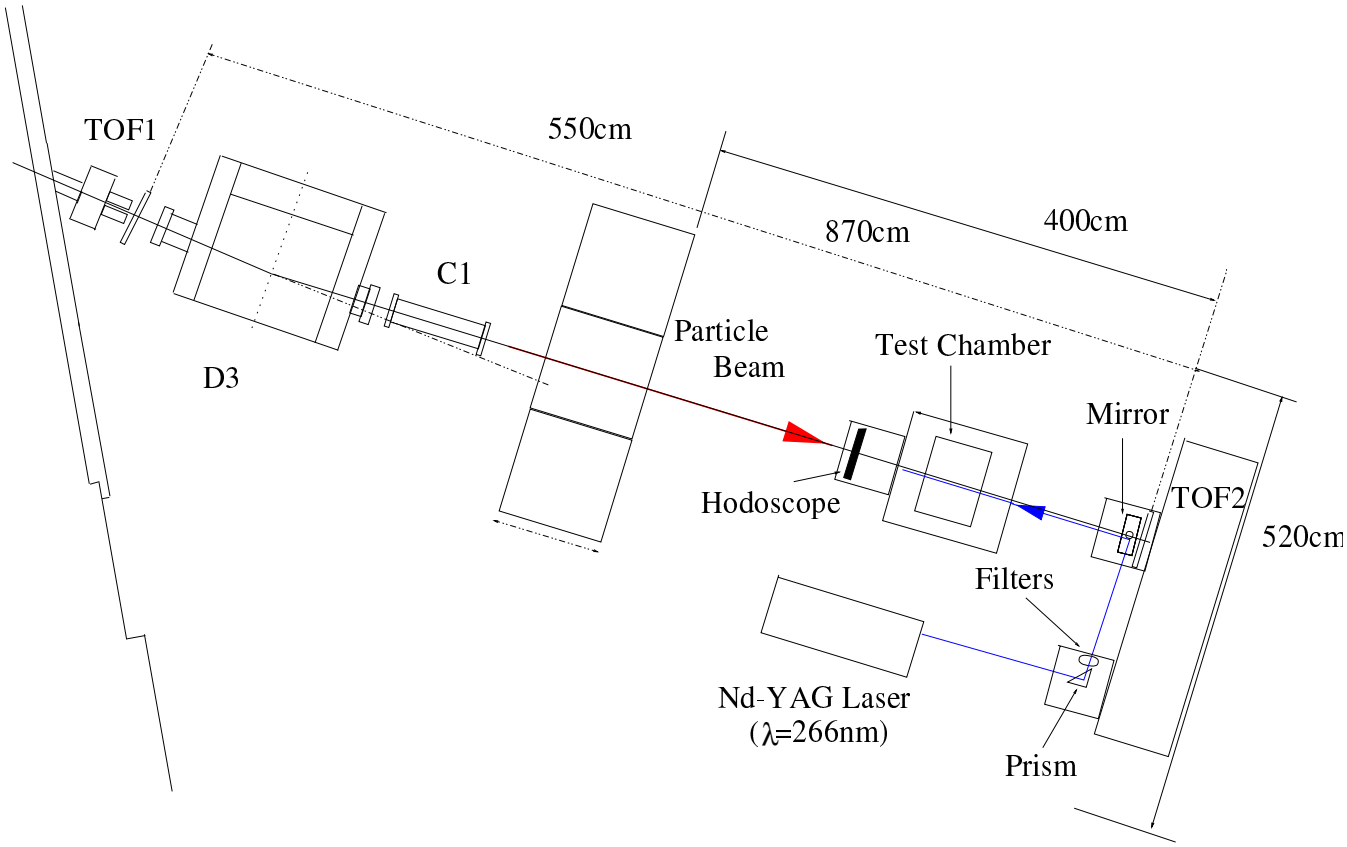

Fig.1. Experimental Setup.

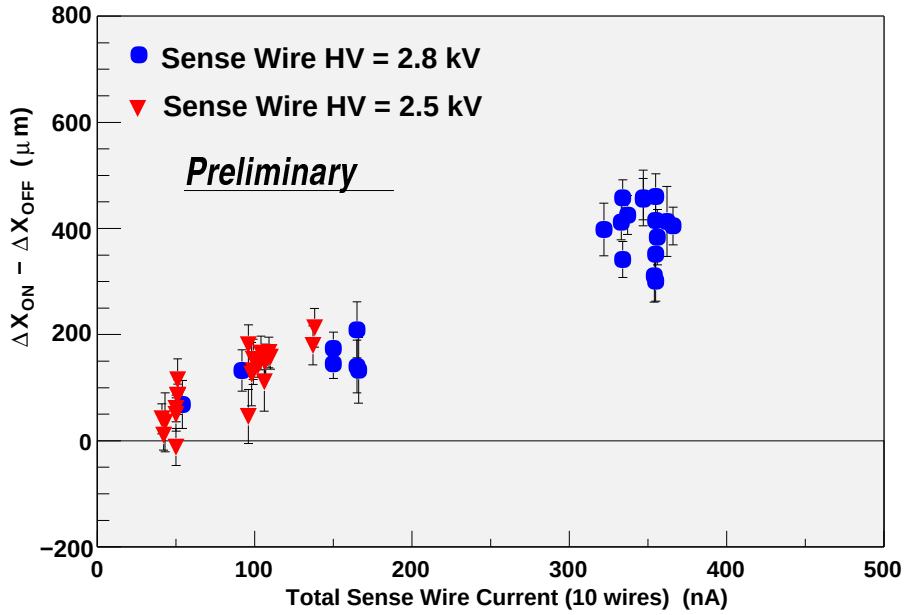

Fig.2. $\Delta X_{beam-ON}$ - $\Delta X_{beam-OFF}$ as a function of total sense-wire current.

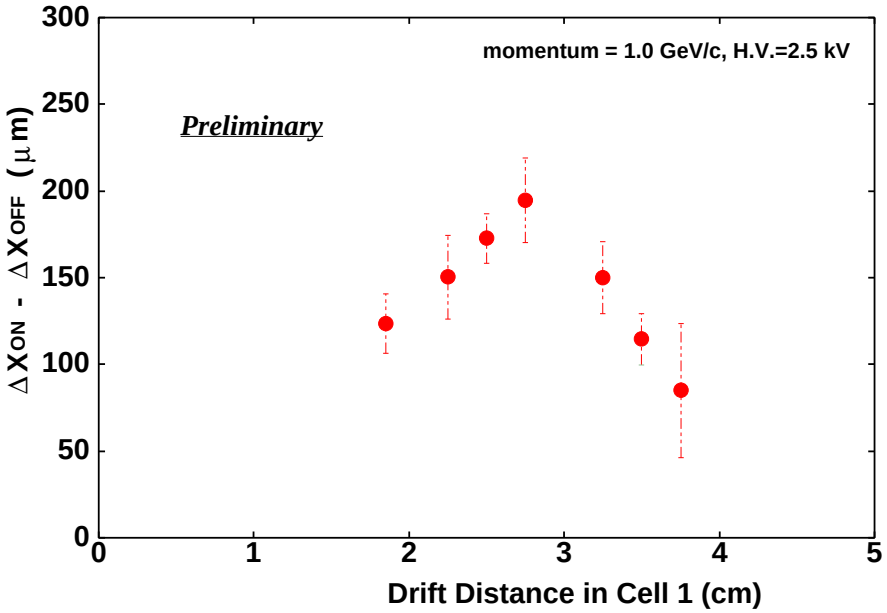

Fig.3. $\Delta X_{beam-ON}$ - $\Delta X_{beam-OFF}$ as a function of drift distance.