NEW METHOD FOR MEASUREMENT OF ELECTRON DRIFT VELOCITY IN DRIFT CHAMBERS

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Drift chambers are widely used in high energy experiments, They provide high space resolution ($\approx 50\,\mu m$) with relatively small amount of the read out electronics. One practical problem that should be solved while using the drift chambers is a high precision control of the electron drift velocity on a level of 10^{-3}. Very small changes in the ratio of the components in the gas mixture, in the gas purity, in the gas pressure, temperature, in the magnitude of the electric or magnetic fields lead to significant changes in the electron drift velocity. And it is not always possible to keep all these parameters stable during the long run experiments.

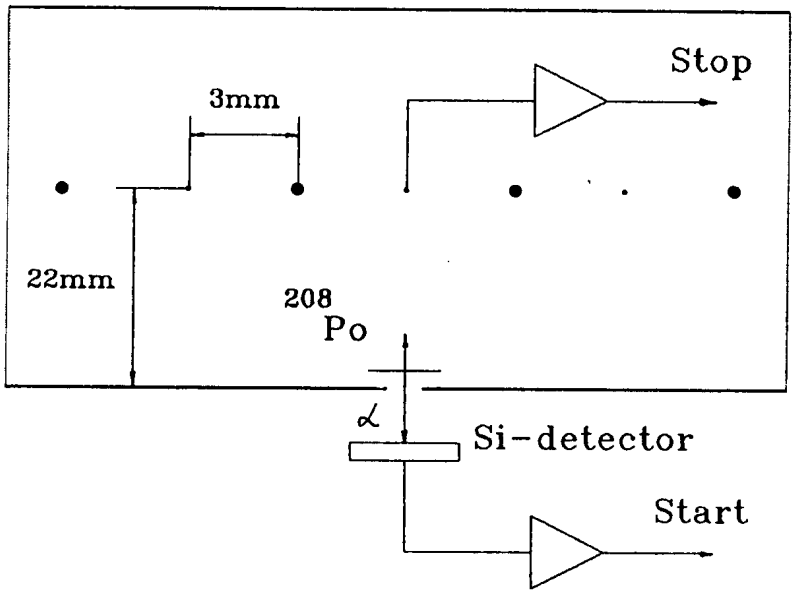

Fig.1. Schematical view of one of FTC cells with α-source

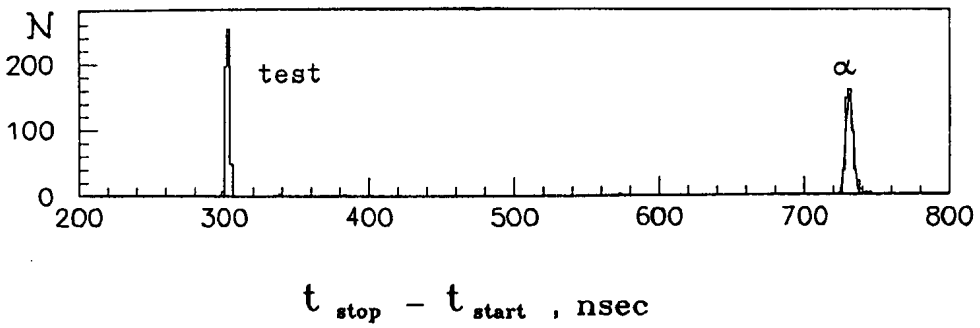

Fig.2. Time distribution of test signals from α-souce

We have proposed [1]a method of absolute measurements of the electron drift time by detection of pulses produced by the α-decay recoils. The idea of the method is to create some ionization well defined both in space and in time. The ionization produced by the recoiled nucleous is localized well enough due to short range of the recoil ($\leq 50\,\mu m$), while the time of emission of the recoil is precisely fixed by the α-particle detected with a Si-detector. The advantage of the method is relatively simple technique that does not occupy much space

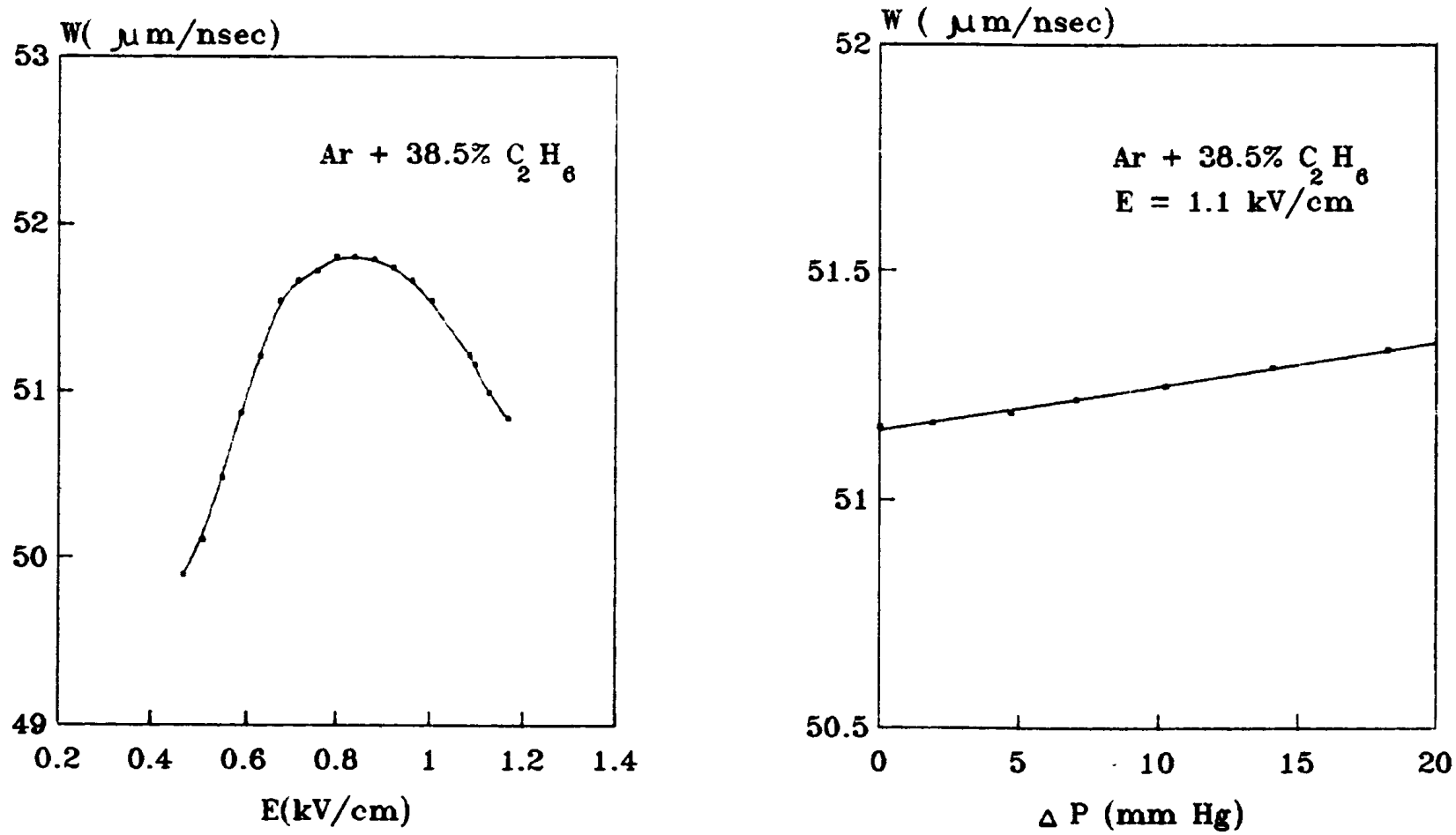

Fig.3. Mustration of measurements of electron drift velocity with α-recoil method

around the drift chamber. It is essential also that the measurements are possible even in the case when the drift chamber is placed in the magnetic field.

We have employed this method to measure the electron drift velocity in the Forward Tracking Chamber (FTC) of the L3 detector at CERN. The FTC is a multicell drift chamber. The drift velocity was controlled in 8 of 256 cells. One of these sells is shown schematically in fig.1. A hole of 1 mm in diameter drilled opposite to a signal anode wire was scaled with a $3\,\mu m$ copper foil. A source of 208-Po was deposited at the foil surface facing the chamber. The life time of the α-source is 2.9 years. The α-particles penetrated through the foil and they were detected with a Si-detector. The recoils were emitted into the chamber volume, and the ionization ($\sim 10^3$ electrons) was produced in the close proximity to the cathode surface. Therefore the drift distance was defined by the chamber geometry. In the time measurements, the signals from the Si-detector served as the "starts", pulses from the sense wire are used as the "stops". The drift time was determined as the difference in appearances of the signals from the Si-detector (t_{start}) and the anode wire (t_{stop}). The zero time position was controlled by test signals sent simultaneously to the Si-detector and to the anode wire preamplifiers. Fig.2 demonstrates a time distribution of the pulses measured in one of the cells of the FTC installed in the L3 detector. The measurements were perfomed in the presence of the magnetic field. The measured drift time was 425 *ns*. The time spread of the test signals was $\sigma = 1.4\ ns$ and that of the recoil signals was $\sigma = 2.5\ ns$. It follows from these measurements that the drift time can be controlled with a precision of 10^{-3}. As an illustration, fig.3 shows the electron drift velocity measured by our method in function the electric field and on the gas pressure.

Reference

1. Vorobylov A.A. et al. //Nucl.Instr.Meth., A301. 1991. 167.