ANKE Drift Chamber Test*

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During the ANKE ABS test runs in November 2005, there was a posibility to test the performance of the forward Drift Chamber (DC) using: the two different gas mixtures - ($C_2H_6(20\%)+Ar$) and ($CO_2(50\%)+Ar$), and different high voltage (V) and threshold (Thr) settings. The chamber was produced and installed in the ANKE Forward Detector system early 2005. It contains three wire planes and was used in operation in Jan/Feb '05 ANKE beam times together with the two MultiWire Proportional Chambers (MWPC 2, 3) produced by B. Zalikhanov. The DC information is used to correct the momentum value of the forward particles calculated using two MWPC and consequently to increase the momentum resolution. The measurement for the different setting parameteres of DC was done using ANKE at 0 degree, with the zero magnetic field and with the proton beam of energy $T_p = 0.6$ GeV on CH_2 strip target. Our aim was to determine the conditions for the highest resolution and efficiencies.

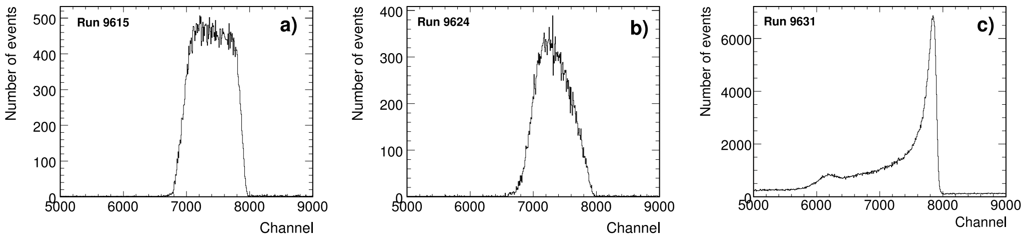

Figure 1: The Raw drift time distribution – **a)** Gas: $C_2H_6(20\%)+Ar$, $V_0 = 850$, $V_1 = 1350$, $Thr = 160$; **b)** Gas: $C_2H_6(20\%)+Ar$, $V_0 = 850$, $V_1 = 1350$, $Thr = 210$; **c)** Gas: $CO_2(50\%)+Ar$, $V_0 = 1450$, $V_1 = 1950$, $Thr = 160$.

The drift time distributions for different codnitions are shown in the figure 1. Here one channel corresponds to 120 ps. For these distributions we used only tracks which fired in the forward hodoscope and were

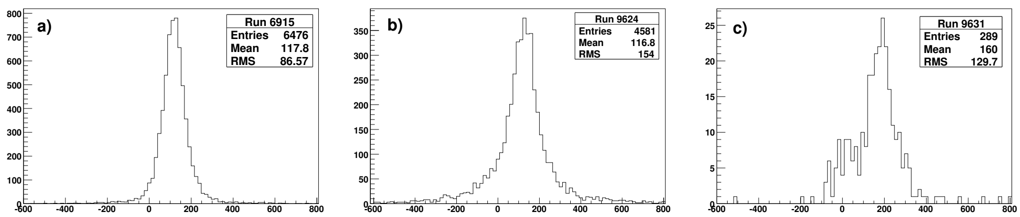

Figure 2: Resolution: **a)** Gas: $C_2H_6(20\%)+Ar$, $V_0 = 850$, $V_1 = 1350$, $Thr = 160$; **b)** Gas: $C_2H_6(20\%)+Ar$, $V_0 = 850$, $V_1 = 1350$, $Thr = 210$; **c)** Gas: $CO_2(50\%)+Ar$, $V_0 = 1450$, $V_1 = 1950$, $Thr = 160$.

reconstructed from 2nd and 3rd MWPC. In the figure 2 there is shown drift time difference between 3rd and 1st plane ($DT_3 - DT_1$). By the width precision of these distributions we can determine the time resolutions. We see from the pictures that for the a) case the resolution is better then for the others.

Gas $C_2H_6(20\%)+Ar$									
Run	V_1	Thr	ε_1	ε_2	ε_3	DT1(ch)	DT2(ch)	DT3(ch)	Shape
9614	1300	160	0.988	0.978	0.980	72	78	79	"OK"
9615	1350	160	0.989	0.988	0.980	71	71	73	"OK"
9616	1400	160	0.977	0.973	0.979	73	74	71	"OK"
9618	1450	160	0.982	0.965	0.978				"BAD"
9617	1500	160	0.927	0.880	0.910				"BAD"
9623	1300	210	0.989	0.951	0.987				"BAD"
9624	1350	210	0.844	0.808	0.754				"BAD"
9625	1400	210	0.978	0.969	0.959				"BAD"
9626	1450	210	0.984	0.984	0.986				
Gas $CO_2(50\%)+Ar$									
Run	V_1	Thr	ε_1	ε_2	ε_3	DT1(ch)	DT2(ch)	DT3(ch)	Shape
9644	1900	160	0.952	0.953	0.951				"BAD"
9631	1950	160	0.945	0.952	0.957				"BAD"
9635	2050	160	0.961	0.955	0.964				"BAD"

Table 1: High voltage and efficiencies for different gas mixture

From the drift time and space relation obtained by the integration method we can calculate the drift velocity in the linear approximation: $v_{dr} \cong 47.8\,\mu m/ns$. A rough estimate of the DC space resolution can be derived from the Gausian fit of the ($\mathrm{DT}_3 - \mathrm{DT}_1$) distribution: $\sigma_{DT_3-DT_1} = 64$ TDC channels, $(1\mathrm{ch} = 0.12$ ns$)$, $\sigma_{DC} = \dfrac{64 \times 0.12 \times 47.8}{\sqrt{2}} \approx 260\,\mu m$. The mixture $(C_2H^6(20\%)+Ar)$ is simpler in calibration since it has quite linear drift function, but close to the anode wire and the field wire there are nonlinearities which must be taken into account in a more precise calibration procedure [1, 2]. The mixture $(CO_2(50\%)+Ar$ has strongly nonlinear drift function (shape "BAD"), but it is characterized by lower diffusion of electrons and smaller Lorentz angle and with a proper calibration can be considered for future application, espesially for high magnetic field. The values of the different setting parameters are presented in the table 1. For our calibration method for the drift time distributons it's better to have the flat region and sharp edges to have a good calibration, like it is on the figure 1.a. The efficieny is calculated in this way: $\varepsilon = \dfrac{N_{out}}{N_{in}}$, where N_{in} are the tracks which were reconstructed from MWPC2 and MWPC3 (one cluster event), passed throgh the D2 exit window, selected by Y_2 vs Y_3 correletion and hit the the forward hodoscope. N_{out} is the number of those tracks which accepted by the condition $\Delta d < 10$ mm, where $\Delta d = WP(DC1) - WP(MWPC2,3)$ the difference between calculated wire position in Drift Chamber (from MWPC 2,3) and measured position (using DC geometry). The corresponding results ar listed in the table 1.
So, from this table it is seen that the best working parameters of DC in this beam time conditions were: Gas mixture - $C_2H_6(20\%)+Ar$ and other settings - $V_0 = 850, V_1 = 1350, Thr = 160$.

References

[1] ATLAS Internal Note. MUON-NO-040, 4 May 1994. S. Baranov, A. Glazov, V. Dodonov "Autocalibration method for determination of drift time - space relation for HPDT"

[2] ATLAS Muon Note, 16 April 1999. M.Deile, N.P. Hessy "Obtaining the Space-Time Relationship of Drift Tales from the Drift-Time Spectra"

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