TEST MEASUREMENTS FOR THE MEG DRIFT CHAMBERS

R–99-05, MEG Collaboration: BINP Novosibirsk – INFN & Univs. Genova, Lecce, Pavia, and Pisa – KEK – Osaka Univ. – PSI – ICEPP Tokyo – Waseda

In parallel to the development of the technology necessary to construct the drift chambers [1] , a series of measurements was performed using two specially constructed detectors. The goal was to test the intrinsic performance of the methods selected, to obtain the positron hit position on the wire planes, with the desired precision, using:

- drift time measurement for the coordinate perpendicular to the wires (x), the Monte Carlo simulation (MC) shows that a precision of σ = 200 μm is required.

- combination of charge division on the anode (MC, σ = 1 cm required) and the analysis of the induced signals on the 4 cathode vernier strips (MC,σ = 300 μm required) for the direction along the wire (y) c.f. Figure 1 .

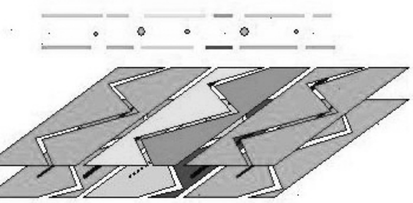

Figure 1: Structure of the cathode vernier strips.

In the MEG experiment, 6 signals per wire (anode right and left, 4 cathode strips)will be read out using a "slow" version (500 MHz, 1000 points) of the sampling chip developed for the timing scintillators and the Xe calorimeter. Since this was not available it was replaced by 8 channels of LRS digital oscilloscopes with equivalent characteristics (500 MHz, 500 points). That was sufficient to equip the anodes for the charge division test, using a Sr^{90} source. It also allowed 8 anodes of the 4 small chambers tested with pions and positrons in the πM1 beam, to be equipped.

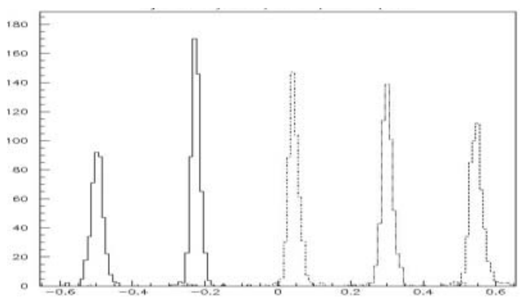

Figure 2: Right-left pulse-height asymmetry measured at 5 equidistant points along the 1-meter steel anode.

In the case of the cathodes, 2 ADCs were used, the second one for a base-line measurement. This solution however, cannot fully correct for cross talk, saturated pulses and oscillating noise. The test nevertheless confirmed that the PSI 3-channel preamplifier chip matches the sampling readout system.

Figure 2 shows the pulse-height asymmetry of the left versus right channels of the 25 μm steel anode of the 1-meter long chamber when exposed to a collimated Sr^{90} source, placed equidistantly at 5 positions along the wire. The width of the distribution corresponds to a σ = 1.5 cm and was measured 200 V below the nominal value. In the beam test, trajectories of the πM1 particles were fitted using the 4 chambers. The spatial resolution for the drift coordinate (x) and that along the wire (y) were obtained from the differences dx, dy, between the fitted and measured values, as shown in figure 3. This shows the differences dx as a function of drift time for the 4 planes. The width of the dx distribution is $\sigma \leq$ 2 ns corresponding to a $\sigma \leq$ 100 μm spatially. Similarly, in

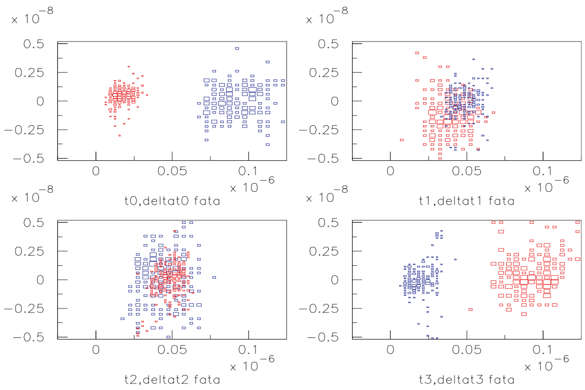

Figure 3: Trajectory fit using the drift times of 4 planes. Shown are differences between fit and measured times as a function of the drift time.

Figure 4, dy is shown, here 3 planes equipped with cathode readout were used. In this case a better resolution than the required 300 μm was obtained.

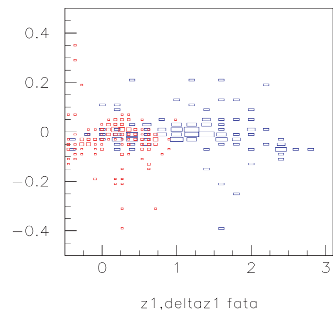

Figure 4: Trajectory fit using the cathodes of 3 planes. Shown are differences between the fit and measured values as a function of position.

For the chosen gas mixture (50 % He, 50 % ethane), the measurements made in a 1 Tesla magnetic field, in the πM1 beam, confirmed the expected few % variation of the drift behaviour.

REFERENCES

[1] PSI Proposal R-99.05.1, May 1999.