ALEPH 89-22
TPCGEN 89-3
W. Tejessy
9.2.1989

ℵ *TPC MEETINGS*

Minutes of the meeting held on February 3, 1989

Addendum

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As mentioned in the minutes to the meeting, which were distributed a week ago, abstracts of the following contributions have been collected from the speakers and are appended to this memo:

- Ed Blucher, appendix A
- Stephan Haywood, appendix B
- Michael Smelling, appendix C

wt/EF
14 February 1989

Secretary: W. Tejessy

E. Blucher
TPC Meeting
3-Feb-1989

Symptoms of First Pad Row Problems in TPC

1. $r - \phi$ coordinates measured with the first pad row of the TPC show large systematic shifts which are a function of azimuthal position along the pad row (ϕ).

2. All cosmic ray data (sectors 2, 5, 20, 23) show the effect within $\pm.15$ radians of the y axis; the magnitude of the shift is near zero close to the center of the sector (the y axis for these sectors) and about 1mm at $\pm$ 0.15 rads. Where the effect is visible, the first pad row coordinates are always shifted away from $y = 0$.

3. Except in sector 20, the residual shift in cosmic ray data does not show a significant z dependence (*i.e.*, no strong dependence on the drift distance to the TPC endplate.) In sector 20, the azimuthal position where the residual shift is zero appears to be a function of z.

4. YAG laser data from side B show residual shifts of the same sign and magnitude as those present in cosmic ray data.

5. YAG laser data from side A do not show any effect; there are no data available for the first pad row in sector 2, so it is impossible to compare cosmic ray data and YAG data for the same sector on side A.

6. MOPA laser data do not show any problem with pad row 1. The azimuth of the periscopes for the Mopa laser, however, do not allow a direct comparison with cosmic ray or YAG data.

$r - \phi$ Alignment of Sectors with Cosmic Rays and MOPA Laser

To check the consistency of alignment measurments made with the MOPA laser, the relative rotation in the $r - \phi$ plane ($\Delta r\phi$) was measured with at least two diferent beams for each W and K sector pair. The differences between these redundant measurements imply large systematic errors. Results for four pairs of sectors are given in the table below; the statistical errors on each measurement are also given. Analysis of cosmic ray data seems to give a more reliable measurement of the relative alignment of sectors. The relative alignments measured with cosmic ray data for the same four pairs of sectors are also given in the table.

	$\Delta r\phi$ (mrad)	
Sectors	MOPA Laser	Cosmic Rays
2-10	-0.117 ± 0.056	-0.21 ± 0.08
	0.284 ± 0.055	
5-16	0.036 ± 0.016	-0.05 ± 0.09
	0.442 ± 0.019	
20-28	-0.21 ± 0.08	-0.31 ± 0.04
	-0.18 ± 0.09	
	-0.34 ± 0.02	
23-34	0.17 ± 0.03	-0.29 ± 0.04
	-0.32 ± 0.03	
	-0.40 ± 0.03	

Track Curvature from Potential Mismatch (Stephen Haywood)

We have considered several beams, including the wire and pad tracks and using three pairs of sectors. Our results are not perfectly consistent within the errors, and this leads to an uncertainty on our determination of the optimal voltage settings (which can be determined from this analysis). One such estimate yields a value of -68 Volts, and I would conclude that the optimal voltage is

$\pm$ 5 Volts of the nominal setting.

Estimating the corresponding sagitta is very tricky, and I can do little more than make a reasonable guess. This sagitta will depend on many factors (eg. dip angle, drift-distance), but for the 30° and 39° beams

the r-z sagittas seem to be within about $\pm 400\mu$m of zero

(one estimate yields $250 \pm 350\mu$m). If this effect really is attributable to radial electric fields, then with a 15kG field, it would lead to an r-phi sagitta of the order of $\pm 60\mu$m, which in turn corresponds to $1/p_t$ of about $(1600\ \text{GeV})^{-1}$.

Wire Gain Systematics (Stephen Haywood)

d(gain)/dr in $\%m^{-1}$

Sector Munich#	TPC#	Gain Fe^{55} (A) ± 0.6	'Gain' DAC (B) ± 2	Cosmic Data (C) ± 1.5
average	K	−4.4	−0.6	−
K07	2	−4.2	6.7	−10.5
K03	5	−3.9	−3.7	−8.2
K11	20	+2.0	−1.3	−0.8
K13	23	−6.3	−5.8	−13.6
average	M	−12.0	+1.3	−
M02	33	−9.4	+5.1	−5.7
average	W	−6.1	+6.5	−
W11	10	−6.7	+17.3	−5.2
W07	16	−3.5	+20.7	+2.4
W03	28	−9.9	+10.7	−10.8
W08	34	−8.2	+1.5	+0.1

The slopes of the gains measured by the Fe^{55} and the DACs are not significant alone - for example, the capacitive 'teeth' contribute to a net slope. There is some unknown scale factor, f, on the slopes from the DAC measurements.

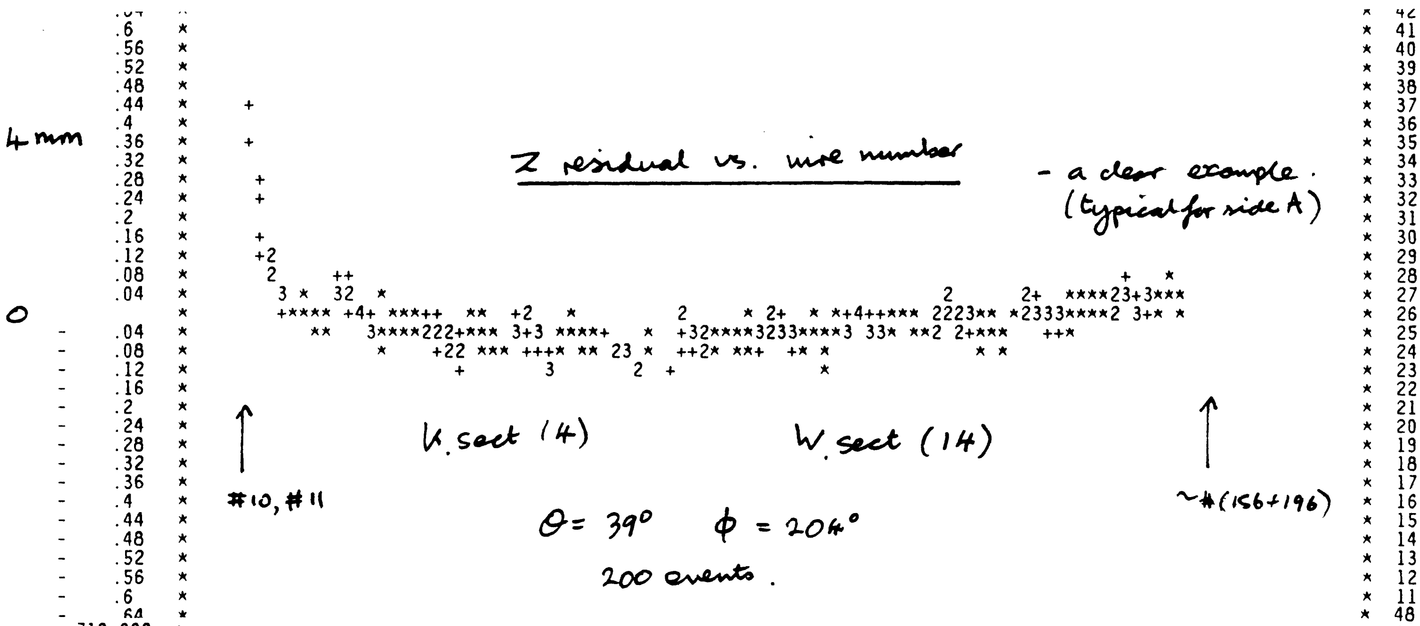
One would hope to find the relation that $C = A - fB$. Given that we want the sector gains to be uniform across a sector, we would hope that $C \approx 0$, implying $A \sim B$. There is no obvious correlation. Therefore, at present, the sectors have systematic non-uniformities at the level of $10\%m^{-1}$.

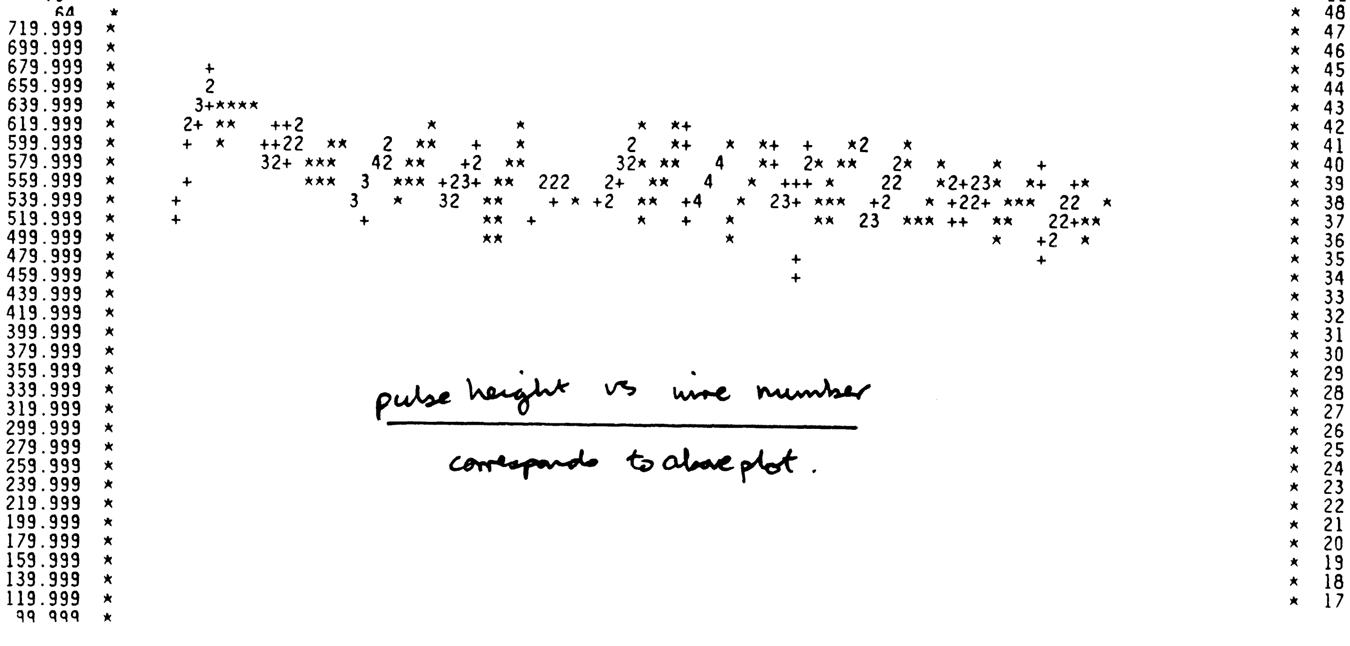
Hooks at Low Wire Numbers seen in YAG Data (Stephen Haywood)

Large hooks have been seen in the wires at low wire number: wires 10 to 19 (wires 1 to 7 are not readout; 8 and 9 suffer from severe edge effects). These were removed for the purposes of looking at the curvature over the bulk of the TPC (see above). These hooks are additional to the effects caused by the reflection of the 90° YAG beams off the central membrane, and in the following these beams will be ignored.

On side A, no effect is seen in the $\theta = 19°$ beams; while for the other beams, it is seen with a consistent sign - compatible with a pull towards the inner field cage. In the latter case, there is generally a loss in pulse height on the wires - up to 50% in some cases. The maximum displacements in z for the 67°, 39° and 30° beams are of the order of 2, 4 and 3 mm. These phenomena seem reasonably compatible with some attractive force situated around the mirrors resulting from a charge accumulation. The 19° beam does not pass any mirrors and so may not see a significant effect. Although the radial distortions should transform into longitudinal distortions like $\tan\theta$, the beams with higher θ see more mirrors, and thus see a multiple effect. It is puzzling that no obvious effects are seen in the pad data, since the relevant wires overlap half of the first padrow.

On side B, the picture is far less clear. While effects are seen, the sign of the hooks is not consistent, and there are hooks in the 19° beams. We have looked at cosmic data for both sides, and it showed no effect. Presumably, it would not be very sensitive to the effect because of the wide range of the trigger. Clearly, cuts could be made to investigate cosmics near the mirrors. This has not yet been done.





Measuring the Drift-Velocity with TPC Wire Data

Analyzed: Run 715 , 100 Laser events on side B

Method: Use wire hits that have been associated to reconstructed tracks which can be identified with one of the laser beams. For each coordinate take the average drift time over all 100 events and the error of the average. To subtract systematics of the wire electronics only consider drift time differences to the 90deg beam. After applying fiducial cuts by a straight line fit determine separately for sectors 20, 22, 24, 28, 32 and 36 the slopes S = d(drift-time-difference)/d(wire-number) for the beams seen there.

fiducial cuts:
- inner sectors : 30 < wire number < nmax - 5
- outer sectors : 5 < wire number < nmax - 10

straight line fits : <chi2/df> = 1.43

Then extract vz for each sector from a fit of

$$\cos(d)\,\frac{S}{u} = \frac{-1}{vz} * (F1(th)-F1(90deg)) + p2 * (F2(th)-F2(90deg))$$

- d : difference between azimuth of the laser beams and the transver direction normal to the wire direction (d = 6 deg)
- u : wire pitch (u = 4mm)
- vz: 1st fit parameter : z-component of the drift velocity
- p2: 2nd fit parameter (depends on transverse components of the drift velocity and the tilt angle of the incoming beam)
- th: deflection angle of the laser beam
- ph: azimuthal angle of the laser beam
- F1: (1+tan(d)*(ph(observed)-ph(nominal)) / tan(th)
- F2: 1./sin(th)**2

Results:

Sector	vz [cm/usec]	chi2/df
20	5.054 +- 0.007	31/2
22	5.068 +- 0.003	8/2
24	5.057 +- 0.003	12/2
28	5.074 +- 0.012	5/1
32	5.060 +- 0.004	18/1
36	5.056 +- 0.004	5/1

weighted average 5.0607 +- 0.0016

Errors are dominated by the errors of the deflection angles, assumed to be 0.01 deg for this analysis.