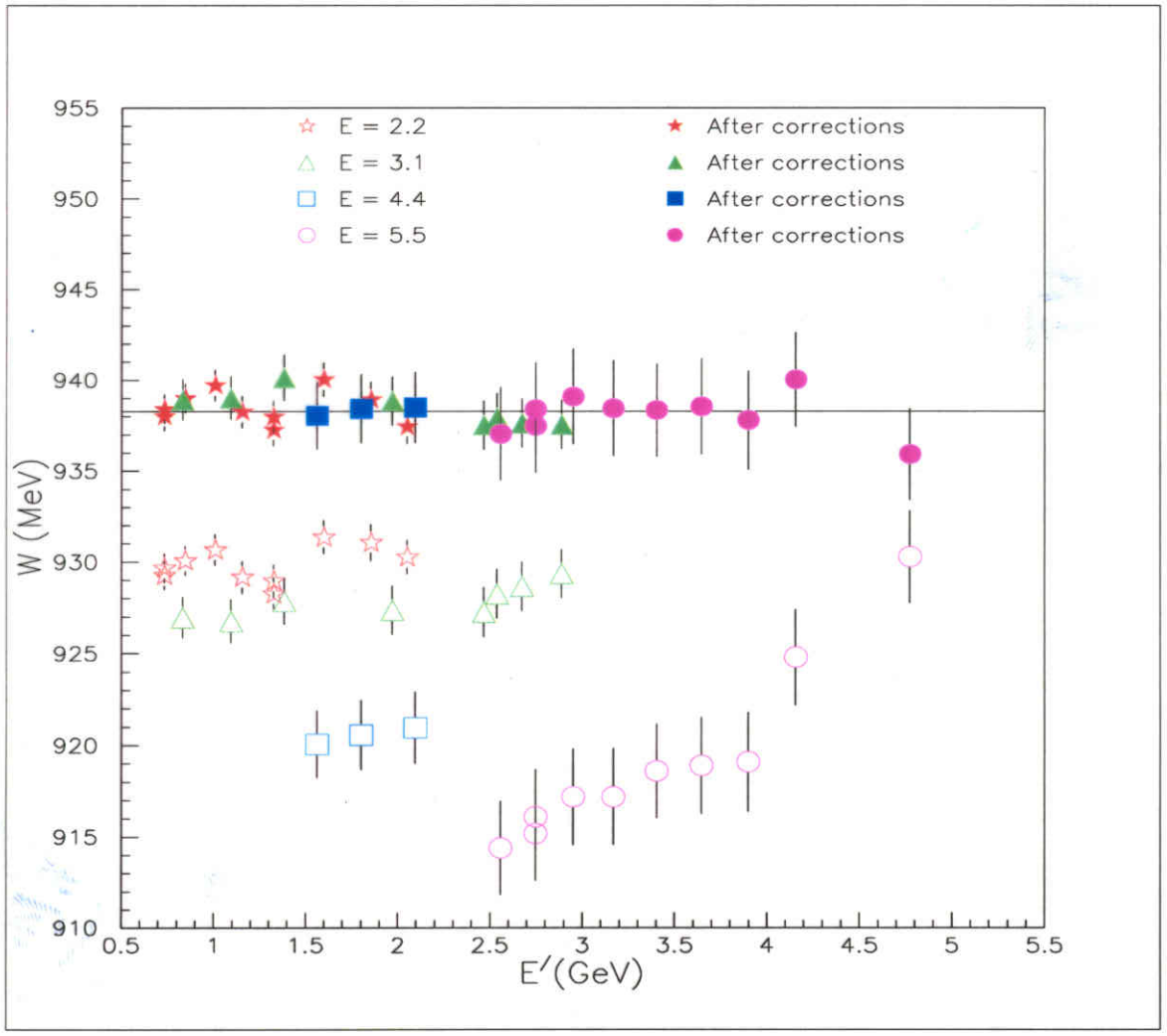
HMS Kinematic Corrections

$$\Delta P_{HMS} = -0.31\%$$

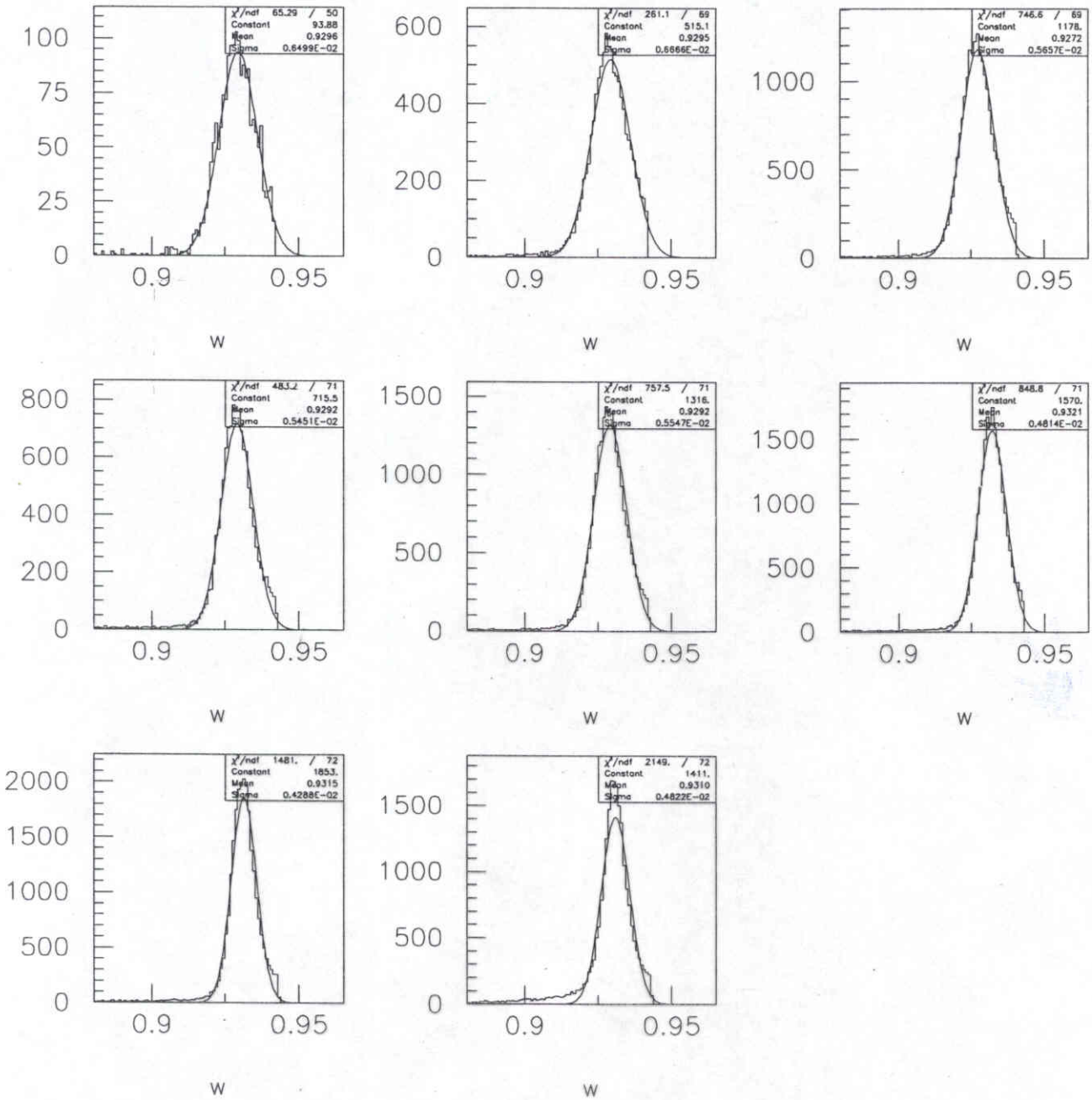
$$\Delta\theta_{HMS} = -1 \text{ mrad}$$



$$W - M_p = \frac{\partial W}{\partial E}\left(\frac{\partial E}{E}\right) + \frac{\partial W}{\partial E'}\left(\frac{\delta E'}{E'}\right) + \frac{\partial W}{\partial \theta}\,\delta\theta$$

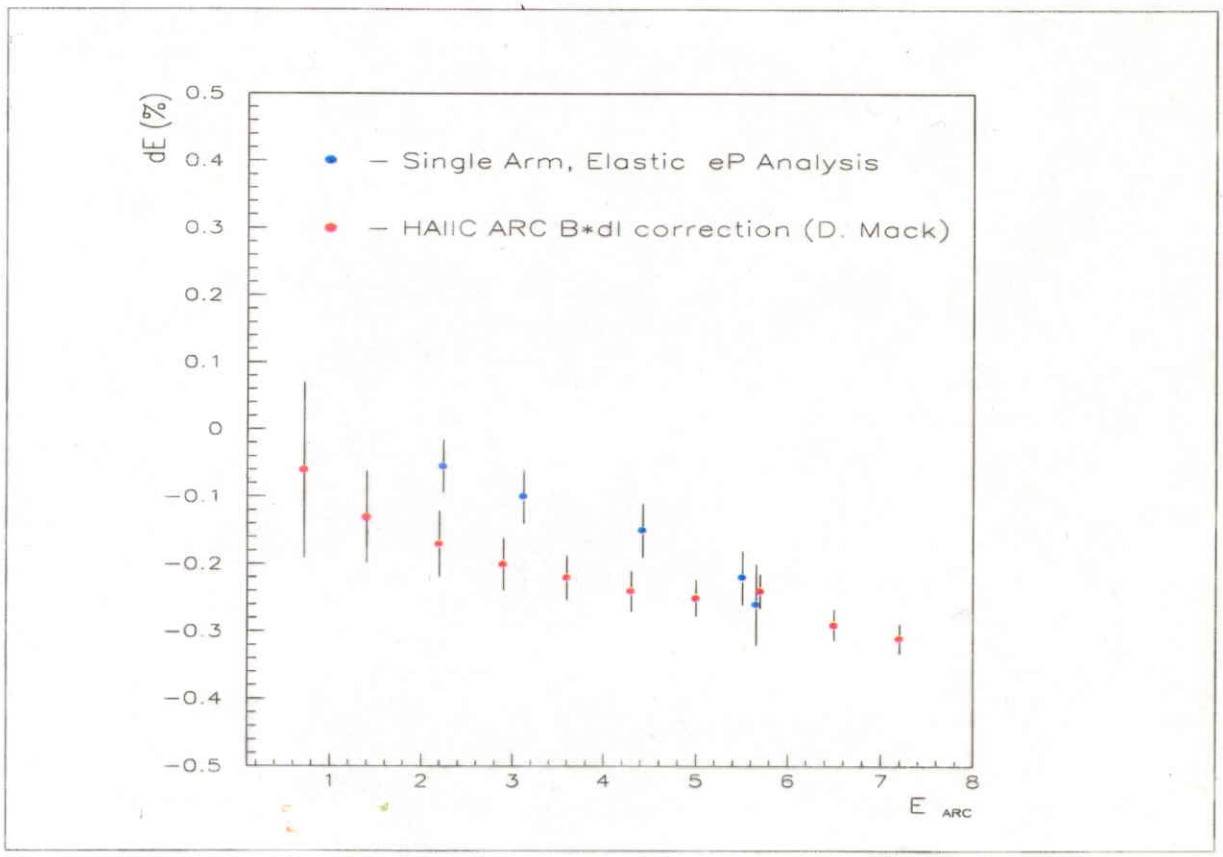
Assume $\frac{\delta E'}{E'}$ & $\Delta\theta$ are constants.

After Ionization Eloss + Radiative tail Correction.



- Recent field mappings of a 'golden' ARC Magnet indicate B*dl diffent from that used in ARC energy measurements. (D. Mack

- Error in the previous ARC measurements scales with energy.



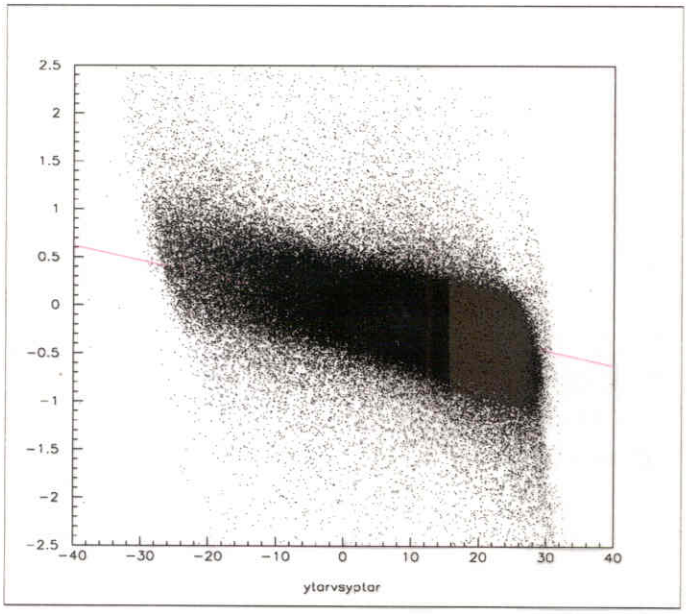
- Both studies indicate that the true beam energy is smaller than the HallC Arc measurement by an amount which scales with energy.

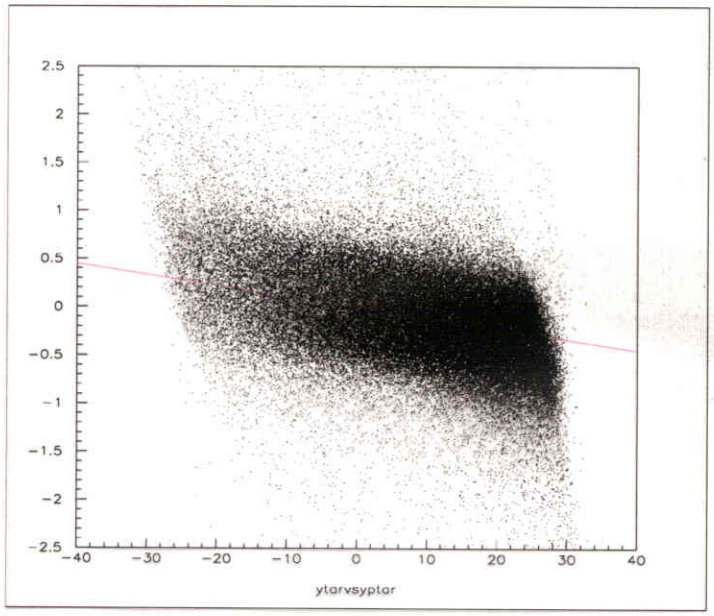
E (GeV)	E' (GeV)	θ (deg)	$\Delta W(MeV)$	dW/dE	dW/dE'	dW/dθ
2.238	0.731	80.0	-9.0	0.754	-2.246	-1.776
	0.731	80.0	-8.7			
	0.846	70.0	-9.0	0.871	-2.246	-1.961
	1.008	59.0	-8.1	1.087	-2.246	-2.125
	1.154	51.0	-10.0	1.188	-2.246	-2.213
	1.325	43.0	-10.3	1.365	-2.246	-2.231
	1.325	43.0	-10.4			
	1.596	32.0	-7.7	1.644	-2.246	-2.088
	1.853	22.0	-8.9	2.243	-2.246	-1.714
	2.050	13.0	-9.4	2.111	-2.246	-1.140
3.119	0.832	78.00	-11.4	0.858	-3.124	-2.797
	1.094	62.01	-11.7	1.128	-3.124	-3.319
	1.382	50.00	-10.8	1.425	-3.124	-3.639
	1.968	32.90	-11.6	2.032	-3.124	-3.683
	2.465	23.00	-11.9	2.464	-3.124	-3.213
	2.538	19.49	-10.8	2.617	-3.124	-2.916
	2.672	16.00	-10.4	2.759	-3.124	-2.539
	2.888	12.50	-9.6	2.886	-3.124	-2.087
4.420	1.562	51.02	-18.6	1.607	-4.429	-5.912
	1.802	45.00	-19.1	1.855	-4.429	-6.207
	2.093	38.99	-18.0	2.154	-4.429	-6.414
5.506	2.557	35.51	-22.8	2.628	-5.520	-9.018
	2.746	33.02	-22.5	2.822	-5.520	-9.085
	2.746	33.00	-21.4	2.824	-5.520	-9.085
	2.950	30.50	-20.7	3.007	-5.520	-9.096
	3.169	28.00	-20.9	3.257	-5.520	-9.038
	3.402	25.50	-19.5	3.496	-5.520	-8.291
	3.646	23.00	-19.0	3.746	-5.520	-8.653
	3.899	20.50	-18.5	4.005	-5.520	-8.896
	4.155	17.99	-12.9	4.267	-5.520	-7.793
	4.771	13.02	-8.3	4.771	-5.520	-6.355
5.661	3.868	22.60	-11.3	3.861	-5.678	-9.024
	4.304	18.60	-7.8	4.295	-5.678	-8.333
	4.737	14.60	1.1	4.726	-5.678	-7.247
	5.132	10.6	8.3	5.119	-5.678	-5.133

Table 1: Table of kinematics, measured ΔW, and derivatives.

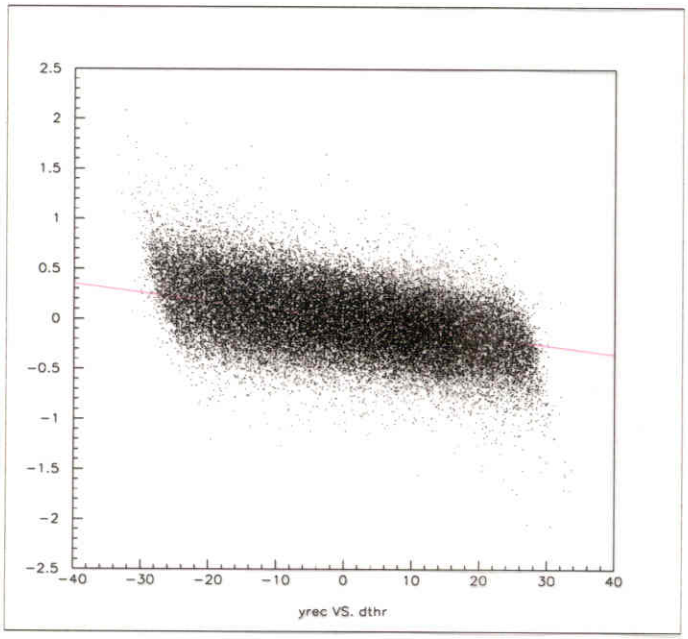
Large E' optics systematic

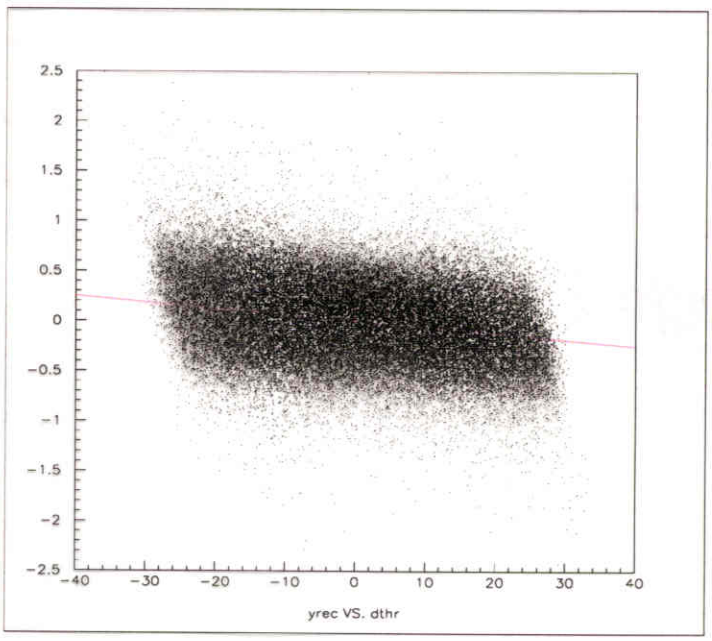
- Angle resolution is observed to be very poor for E' > 4 GeV
- Seen as a shift in the optical focal plane from the nominal position by an amount which scales with E'
- Results from a change in the field ratio of one or more magnets relative to the others





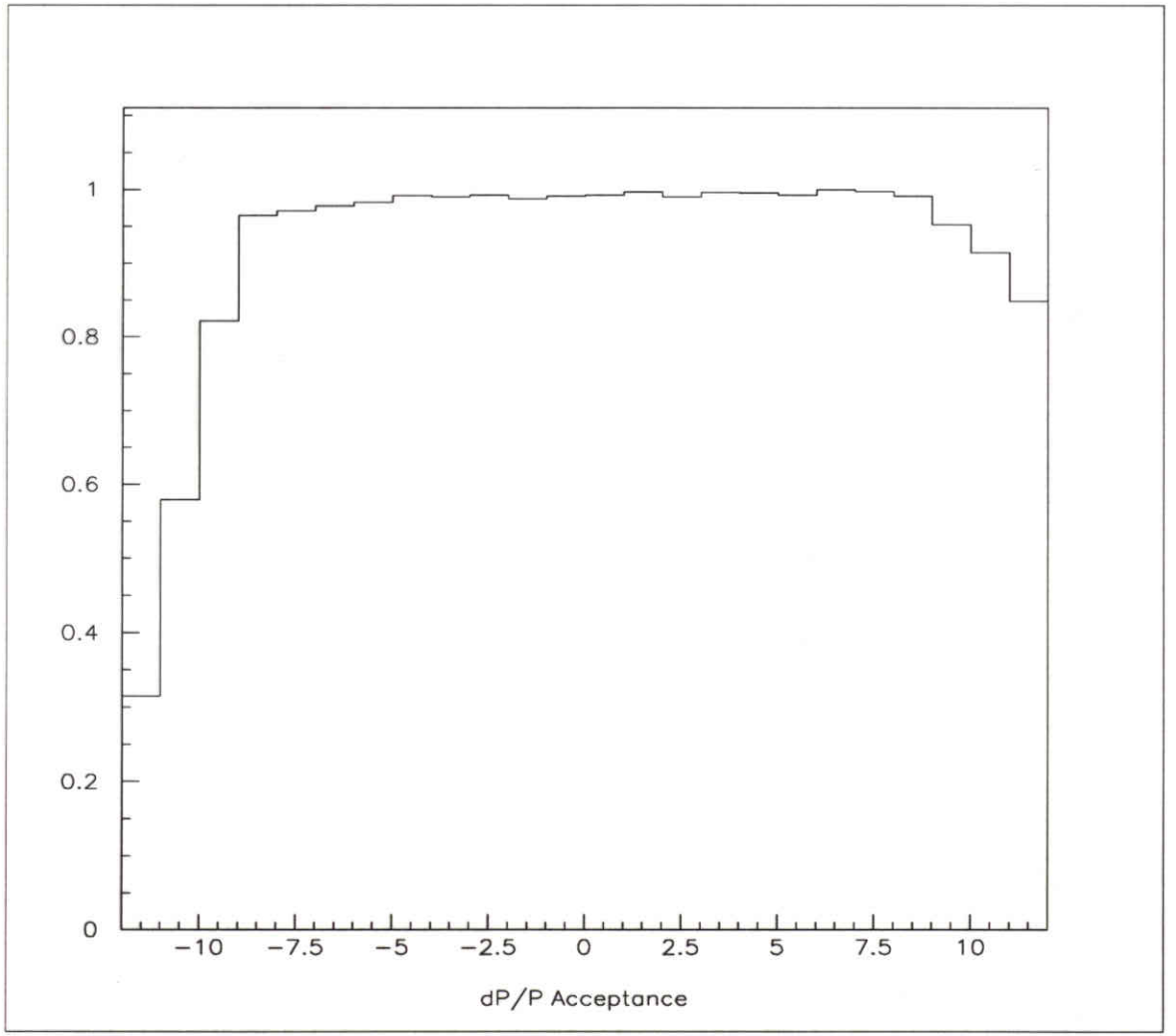
MC with Dipole saturation correction included





HMS Momentum Acceptance

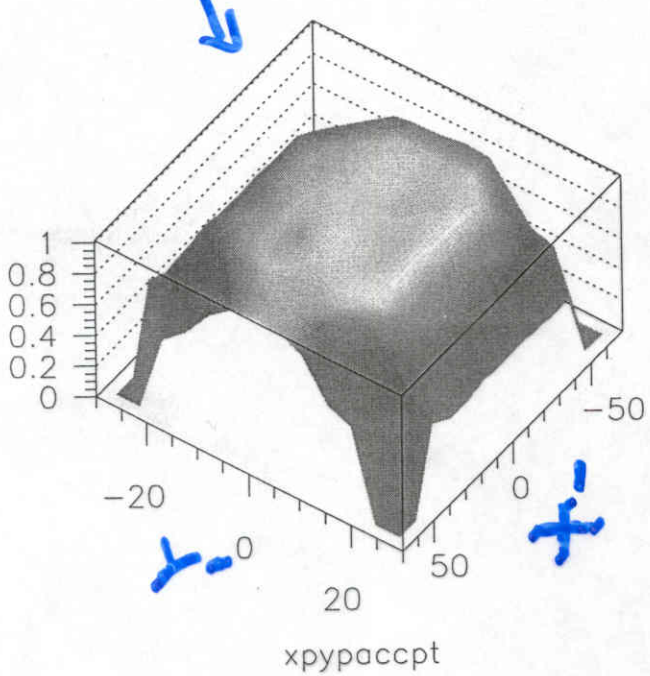
Drop at edges due to aperatures.

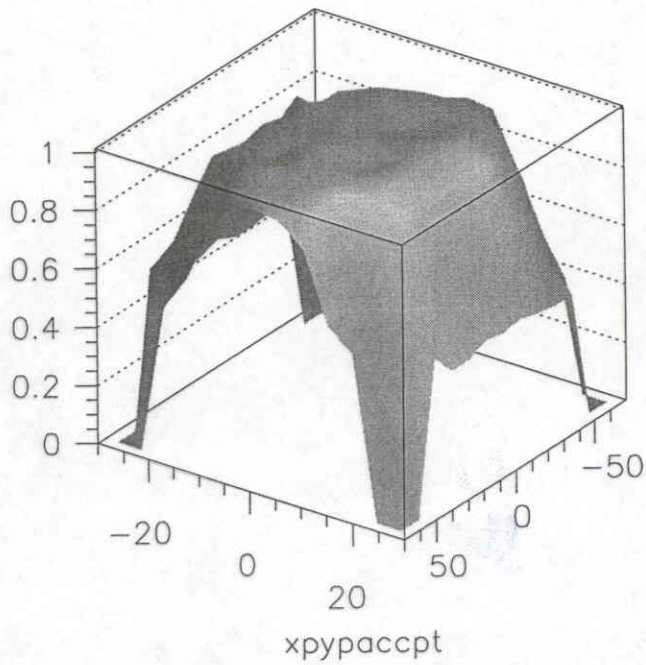


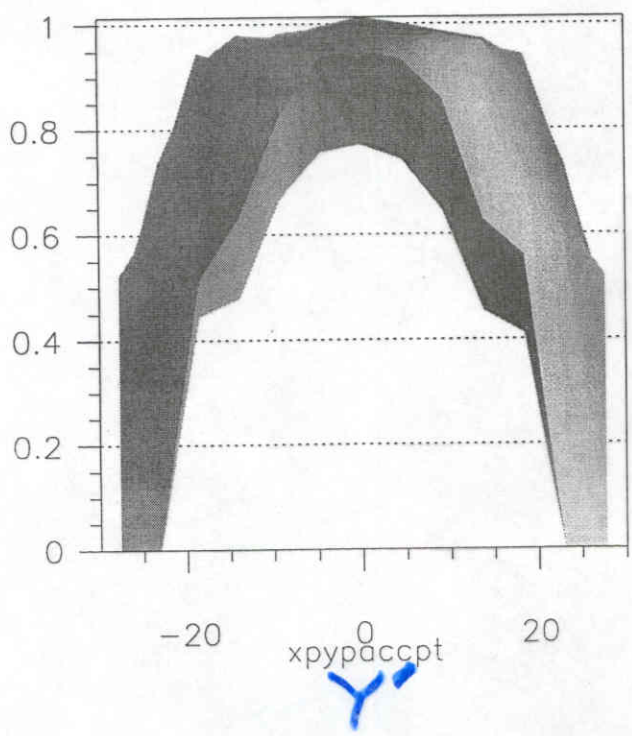
HMS Acceptance

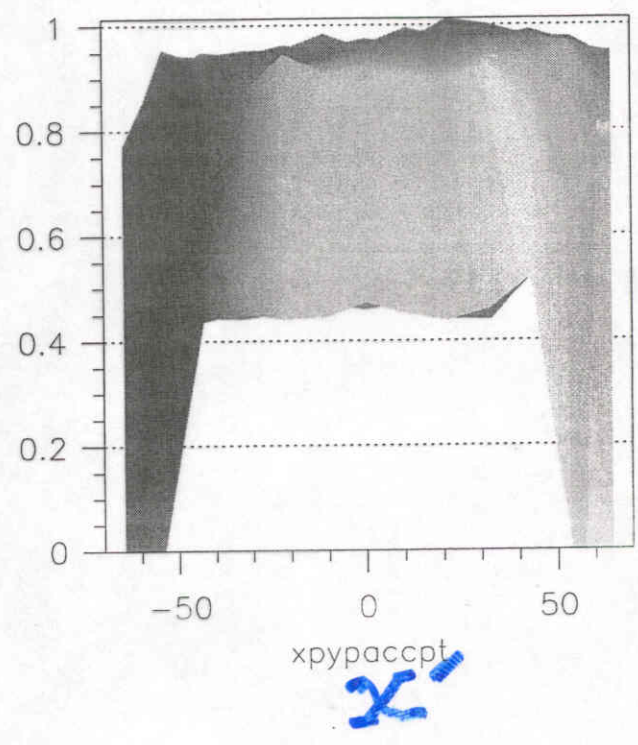
Defined primarilly by octagon shaped collimator.

55° 3 GeV

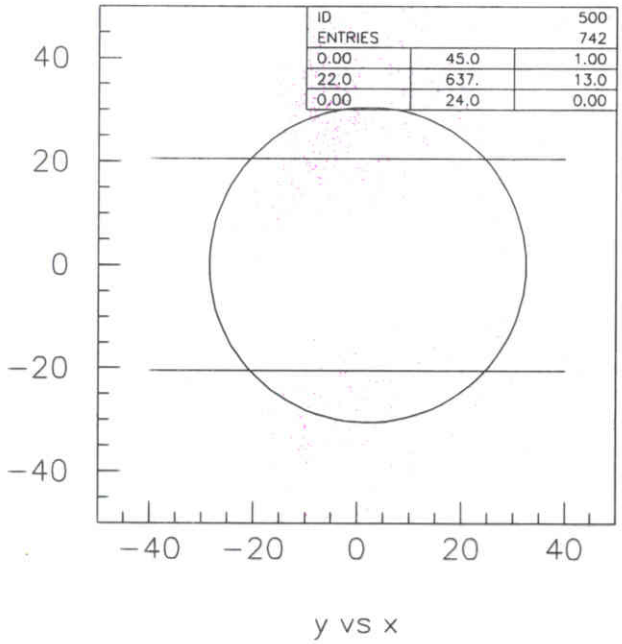


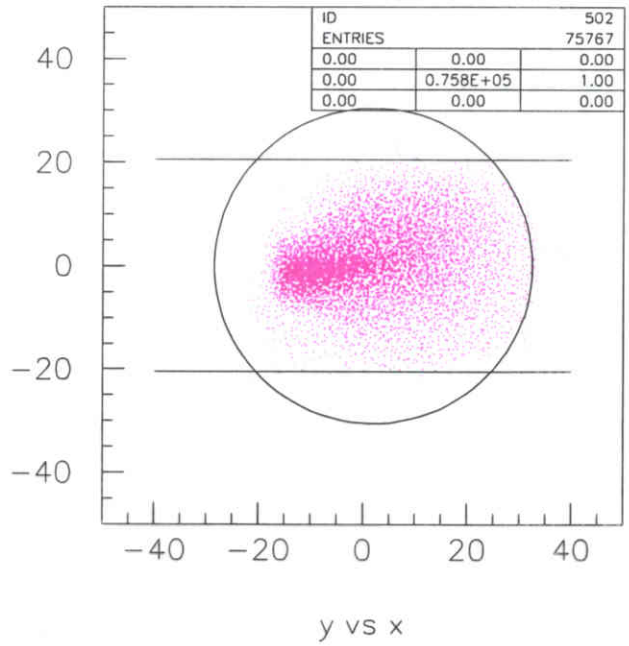


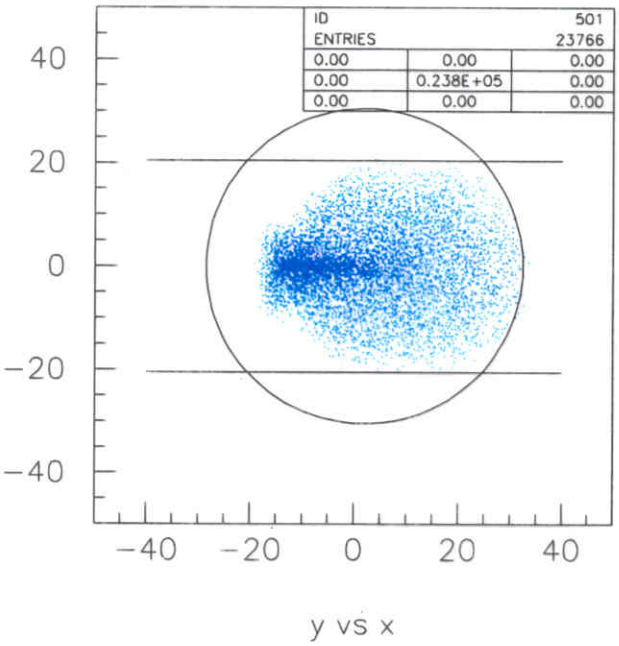


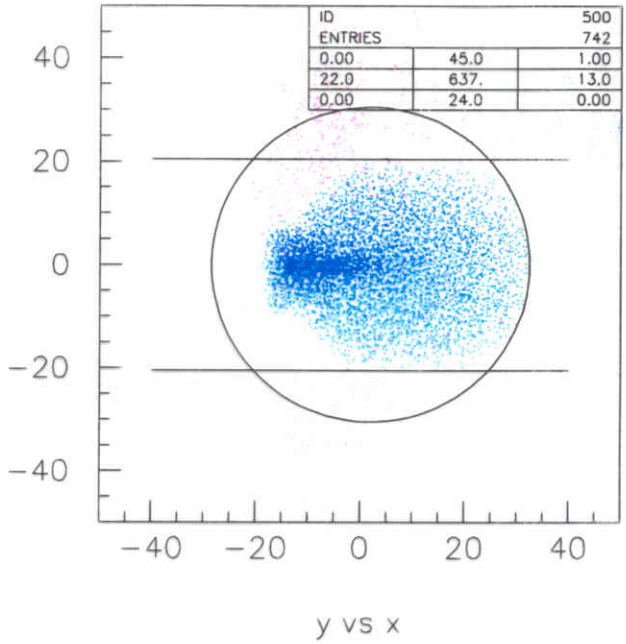


VCan Entrance



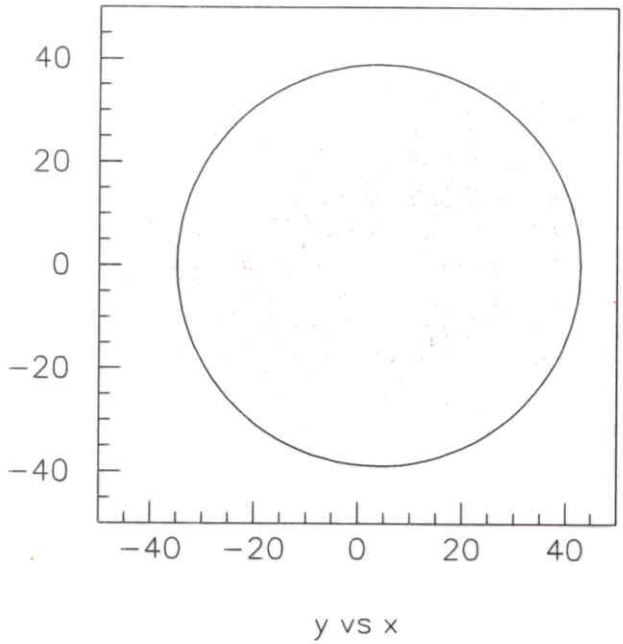


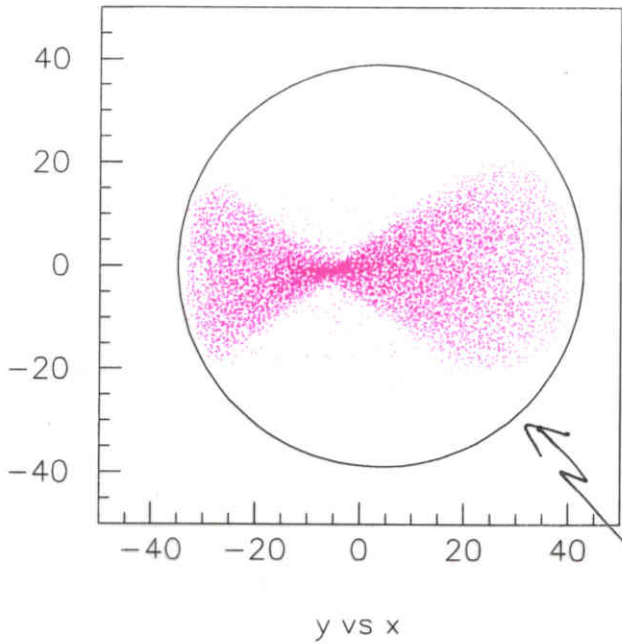




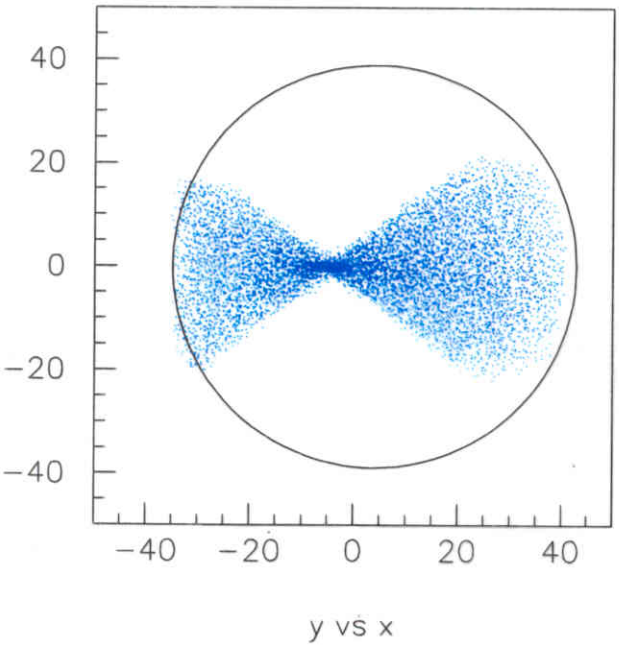
Last pipe entrance (Full Acceptance)

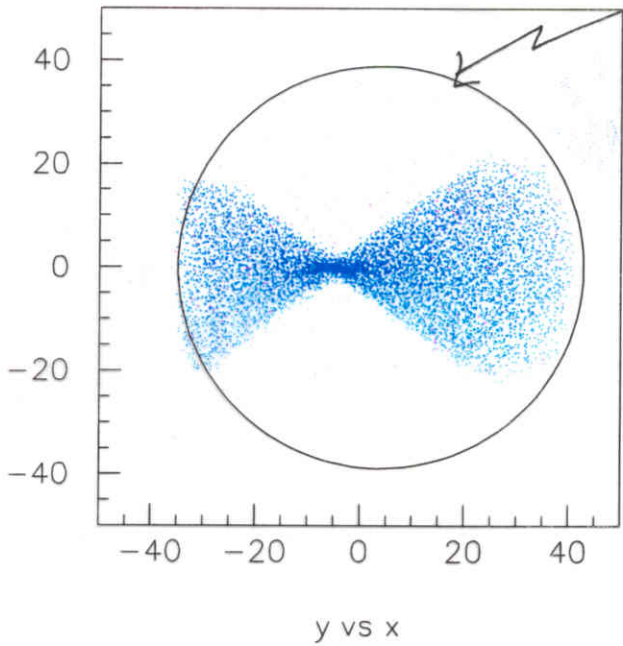
Old Pipe position





Pipe moved center data

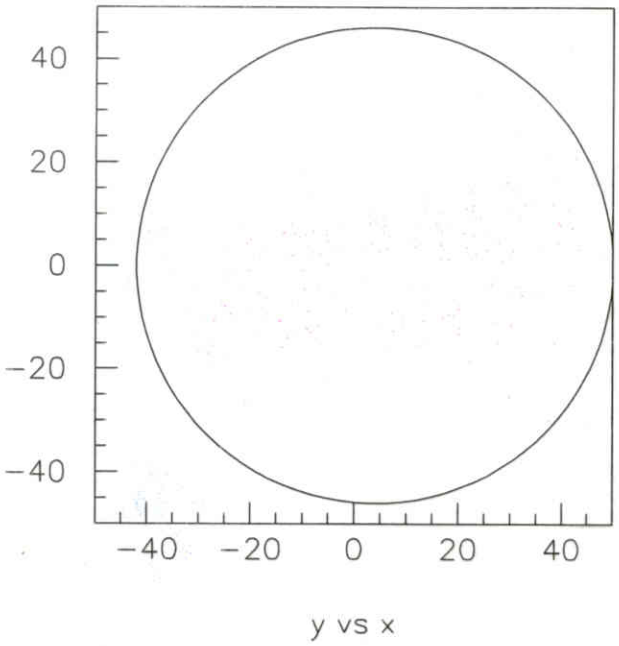


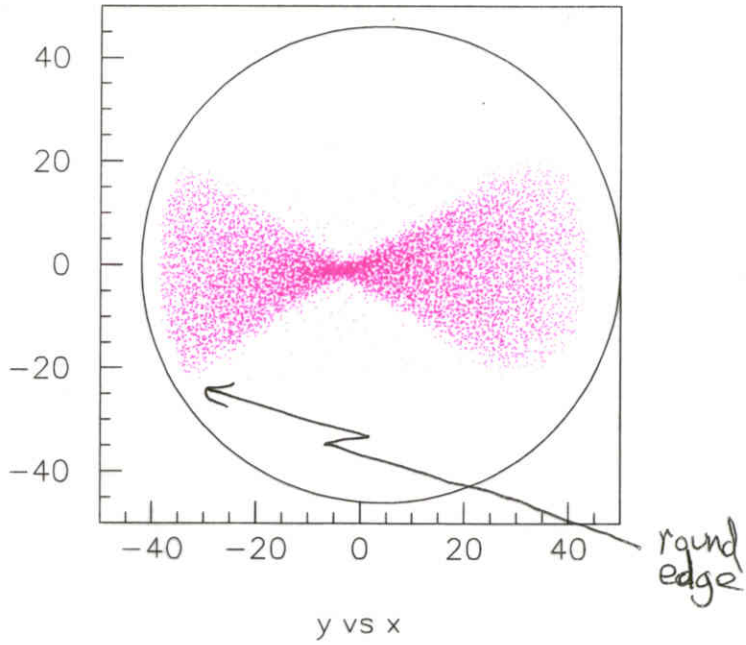


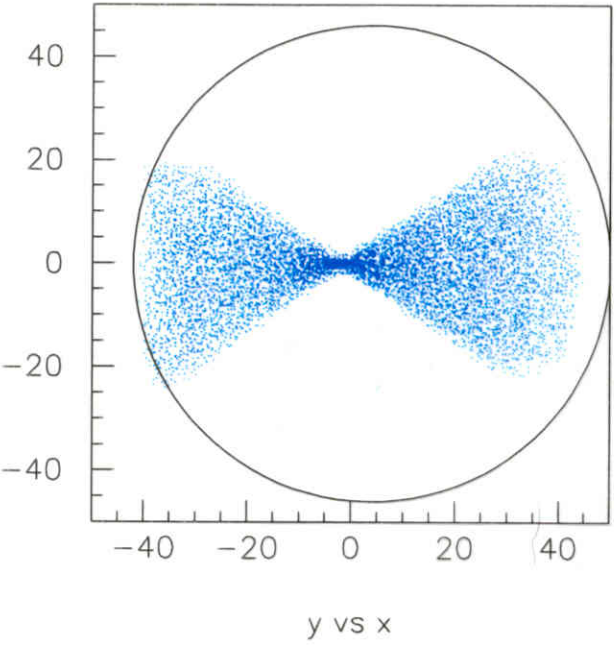
Hut Entrance

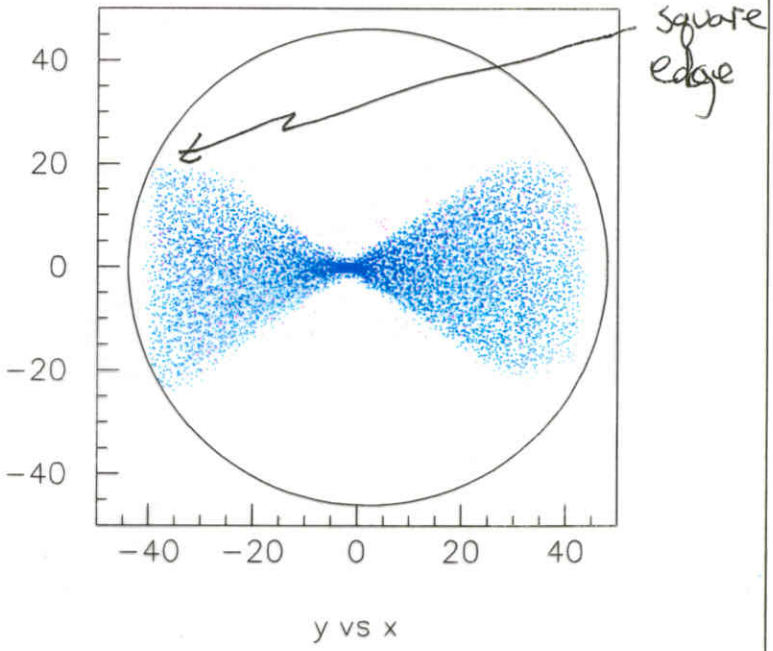
(Full Acceptance)

Old pipe position

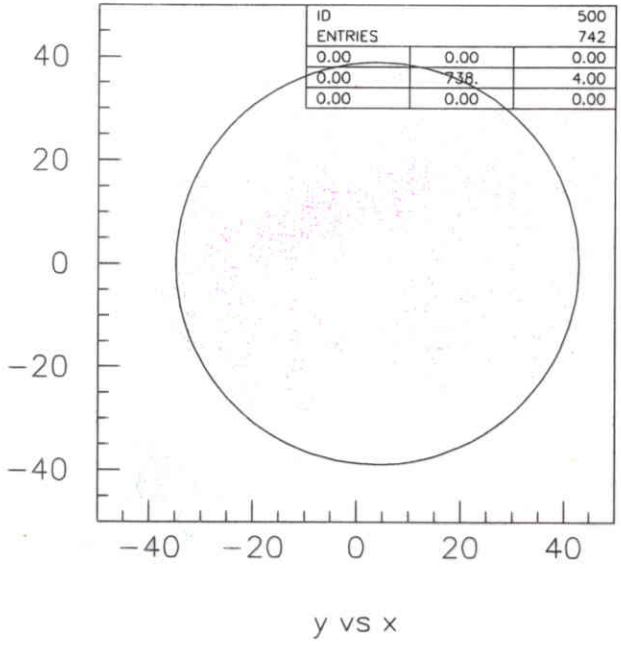


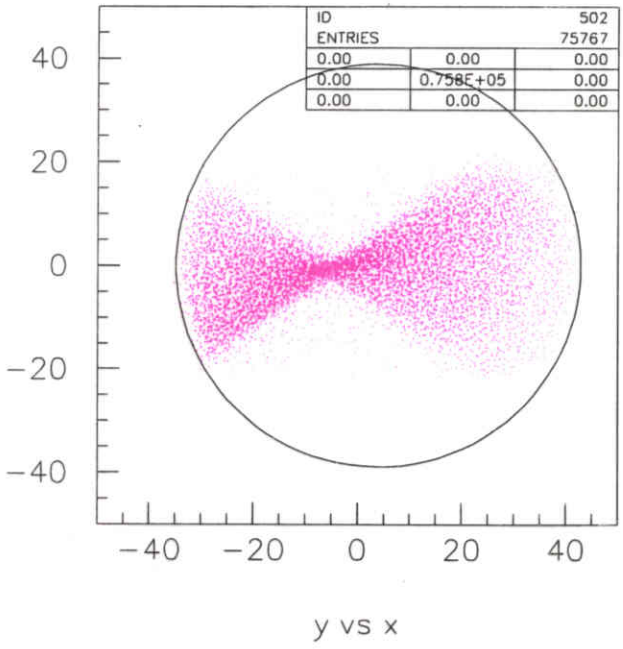


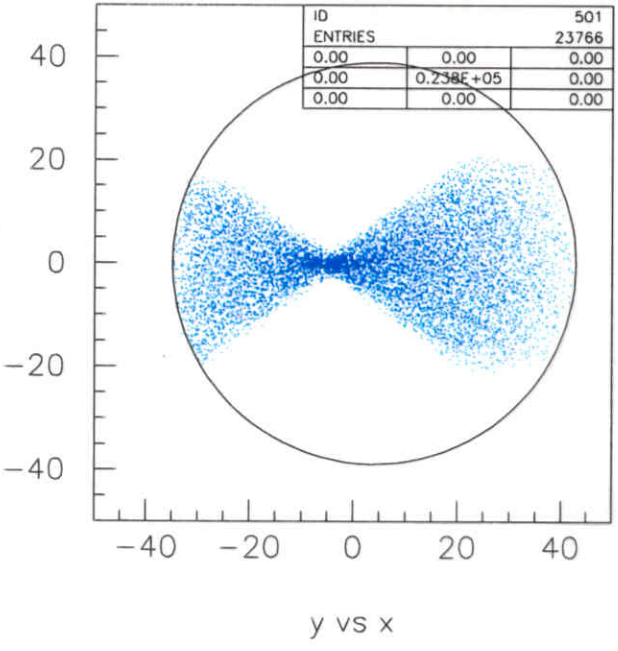


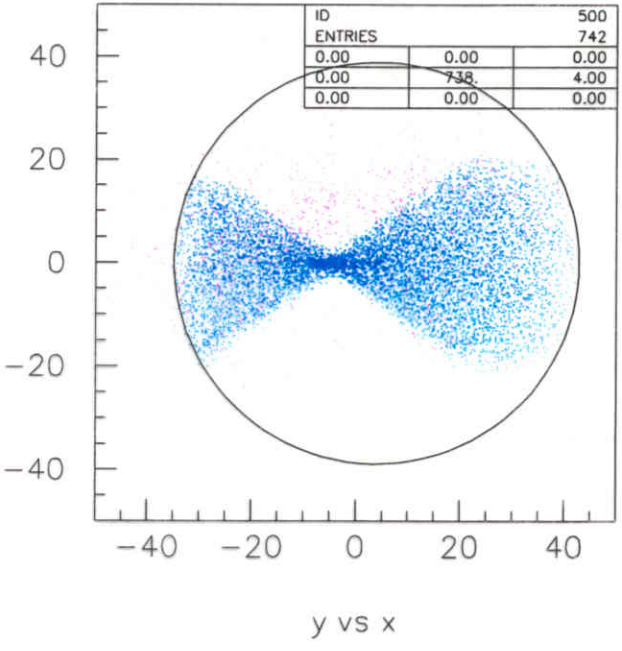


Last pipe Entrance

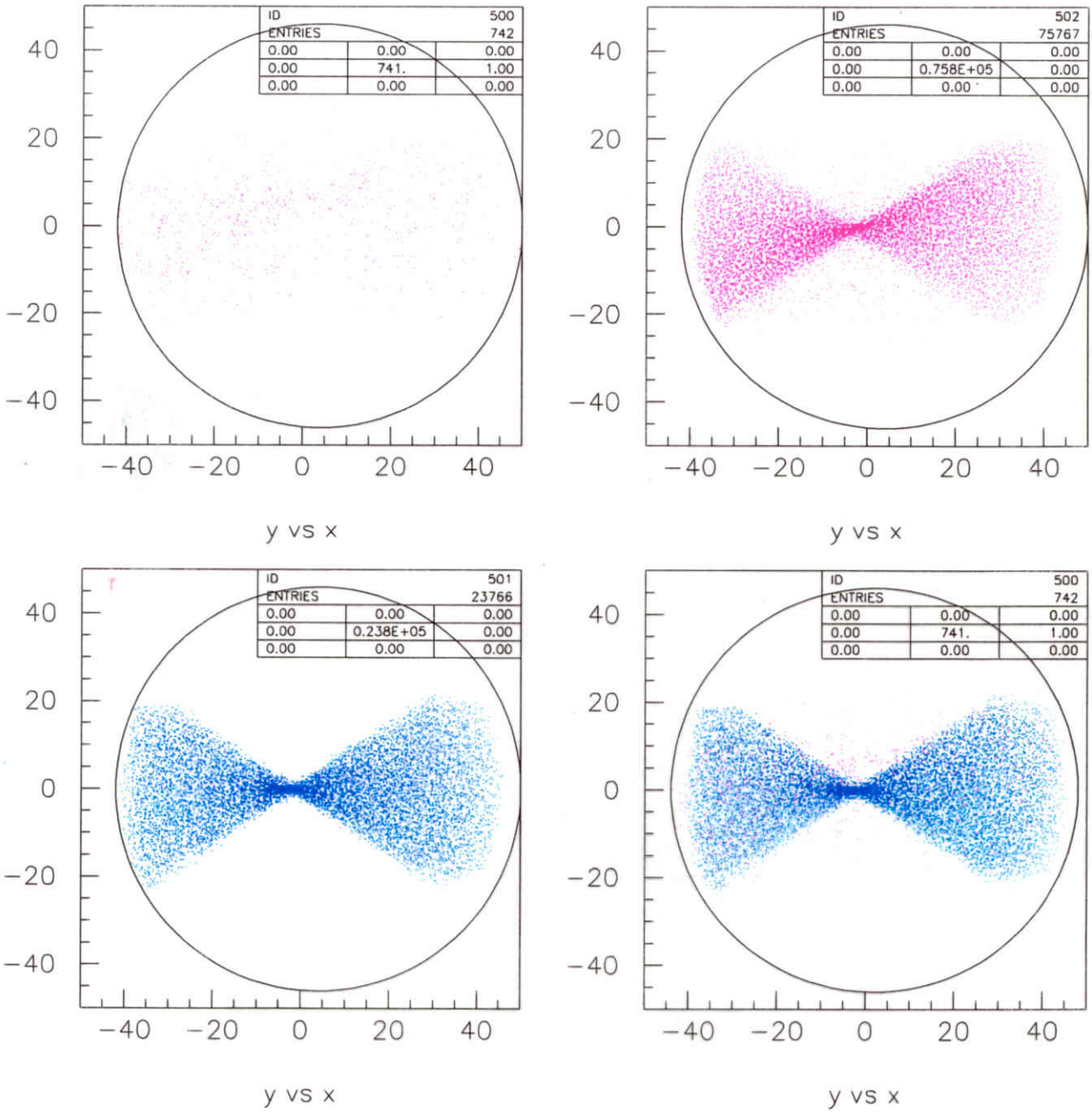






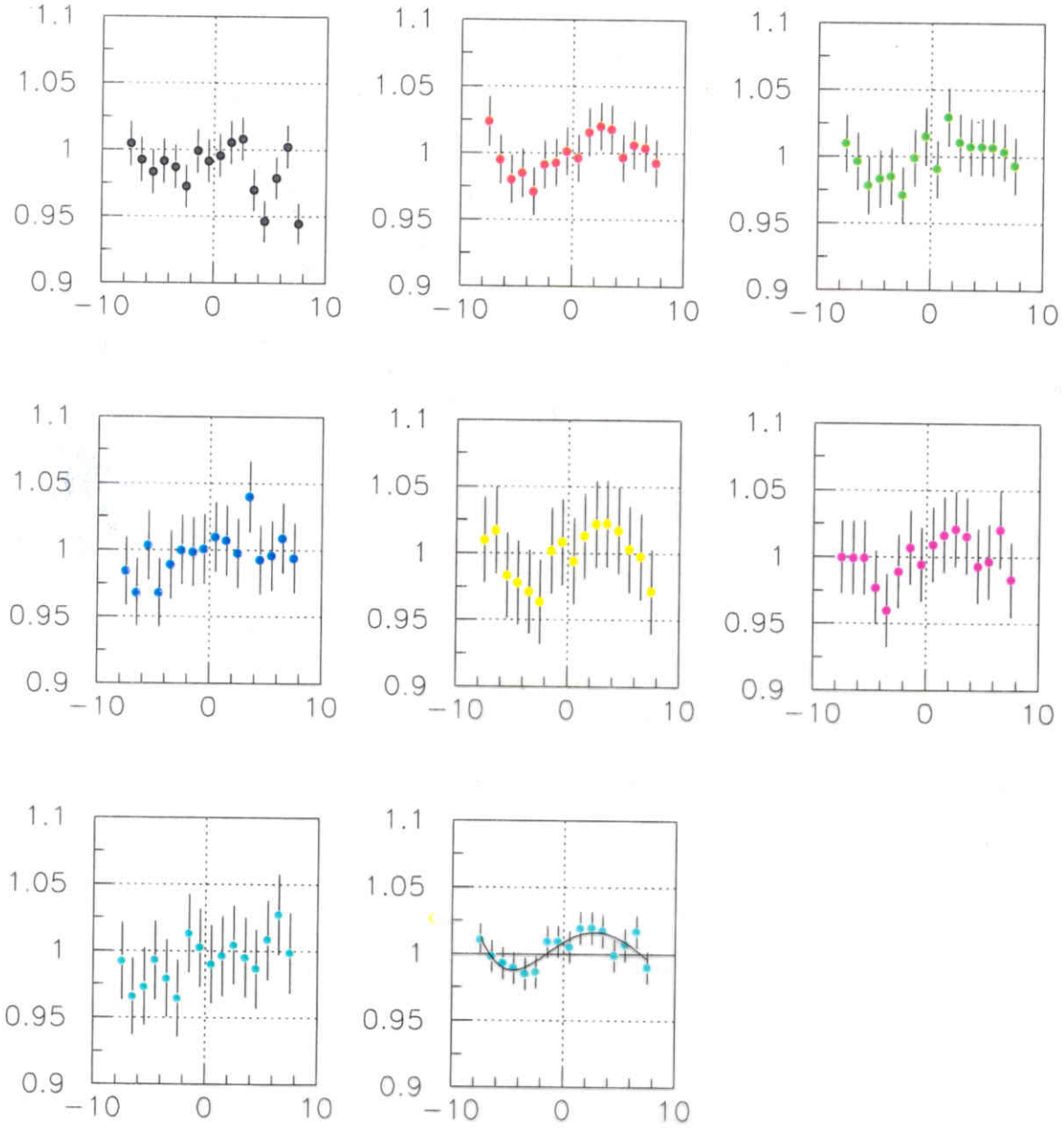


Last Pipe Exit / Hut Entrance



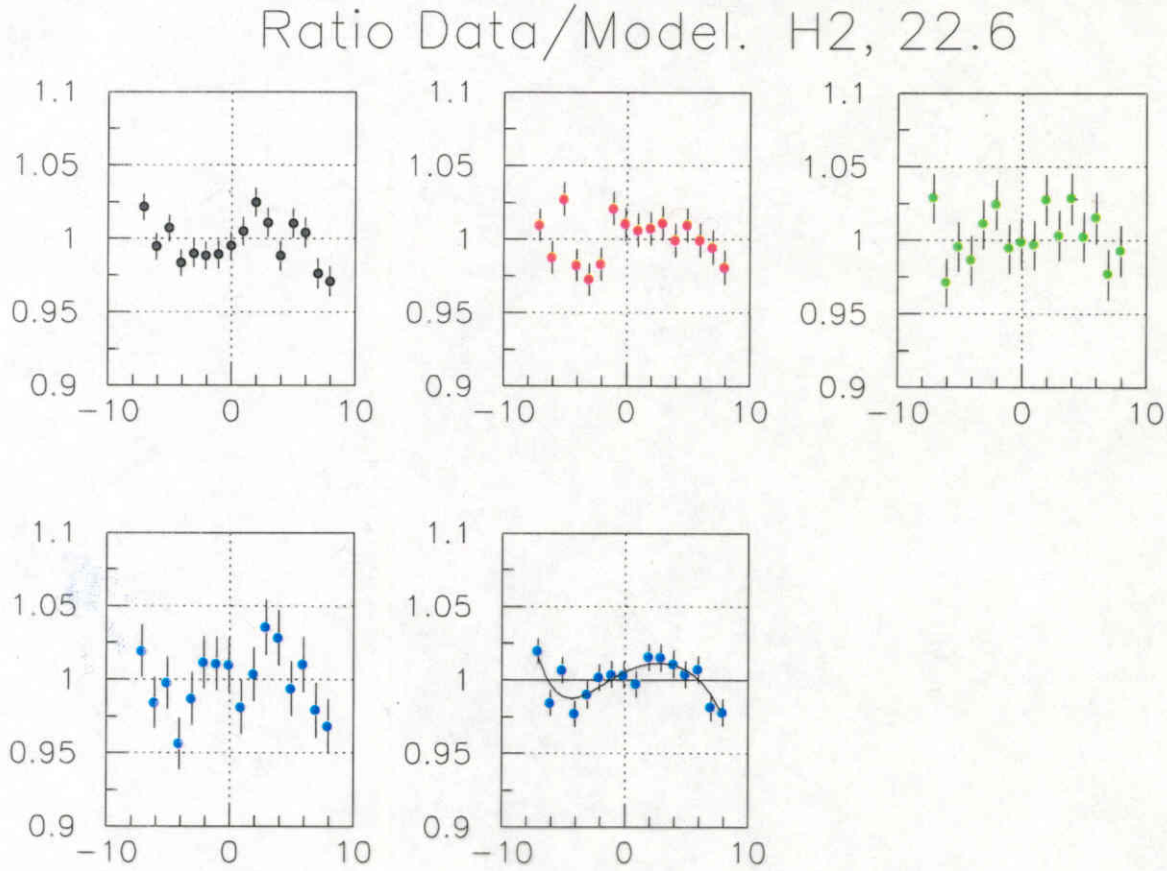
- These studies ⇒ Vaccume pipe at Hut is ~ 4cm Low.
- Just completed survey ⇒ " " " " ~ 3cm Low (±0.3)

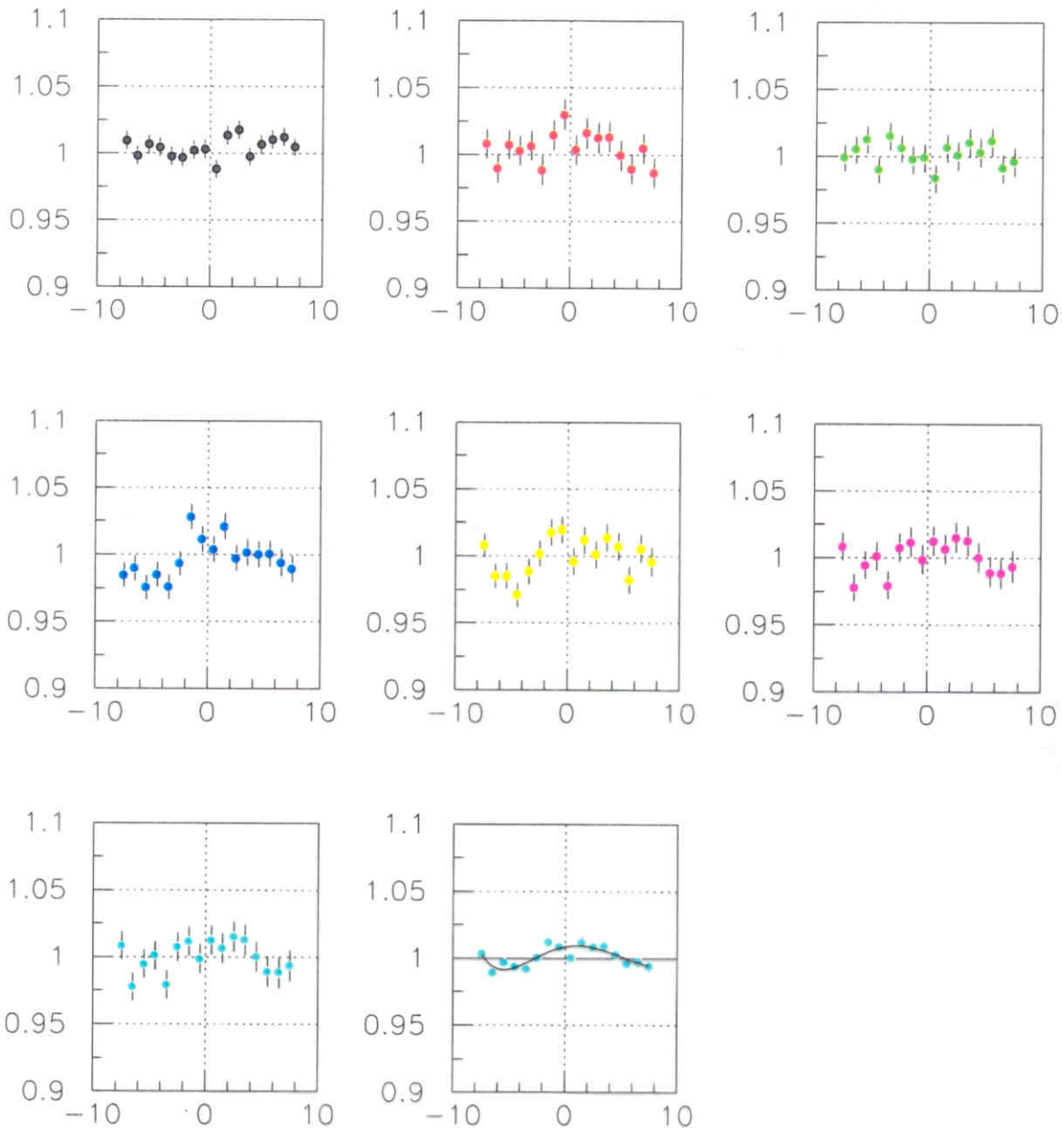
D2, E = 5.65, Θ = 10.6

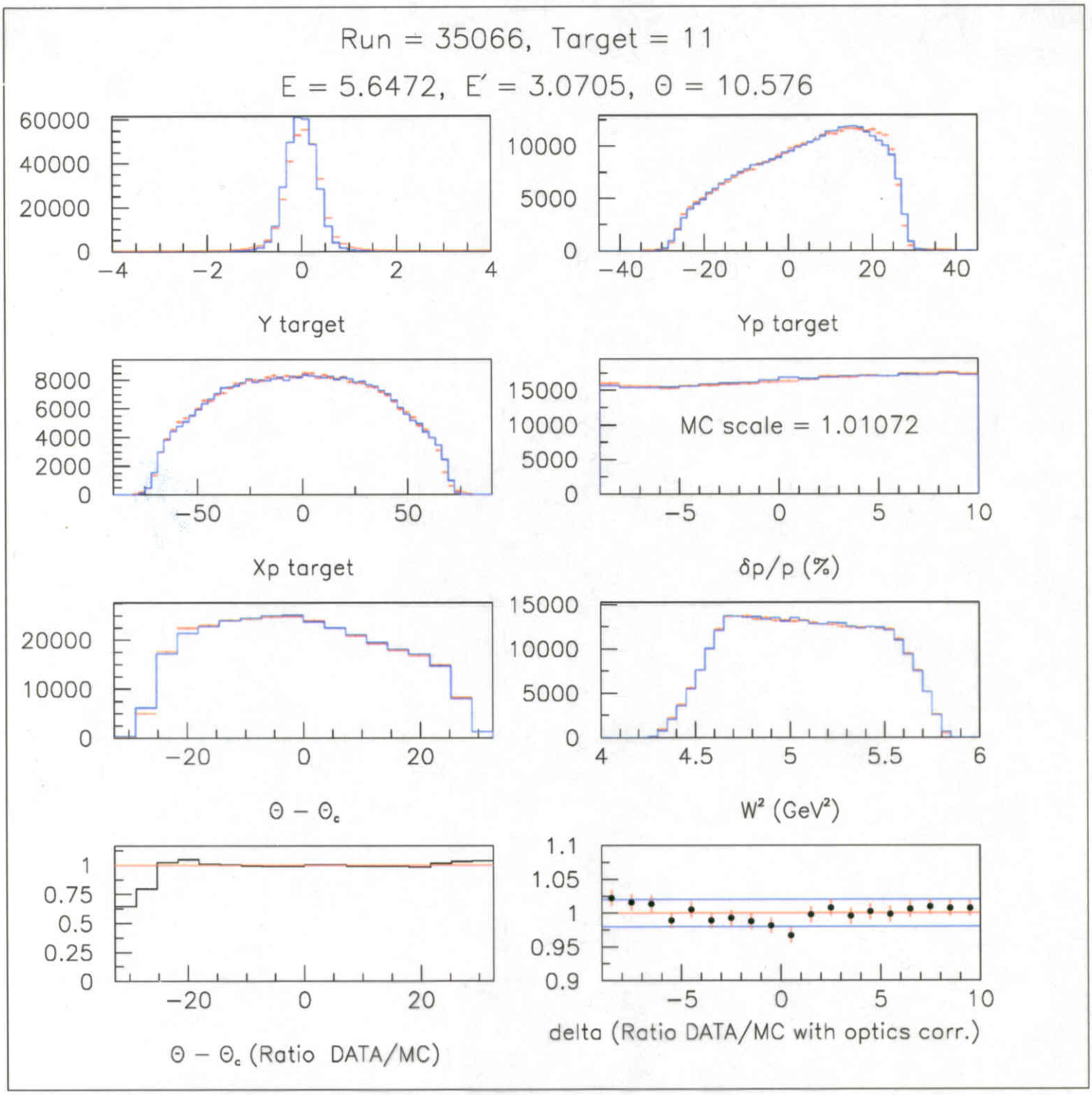


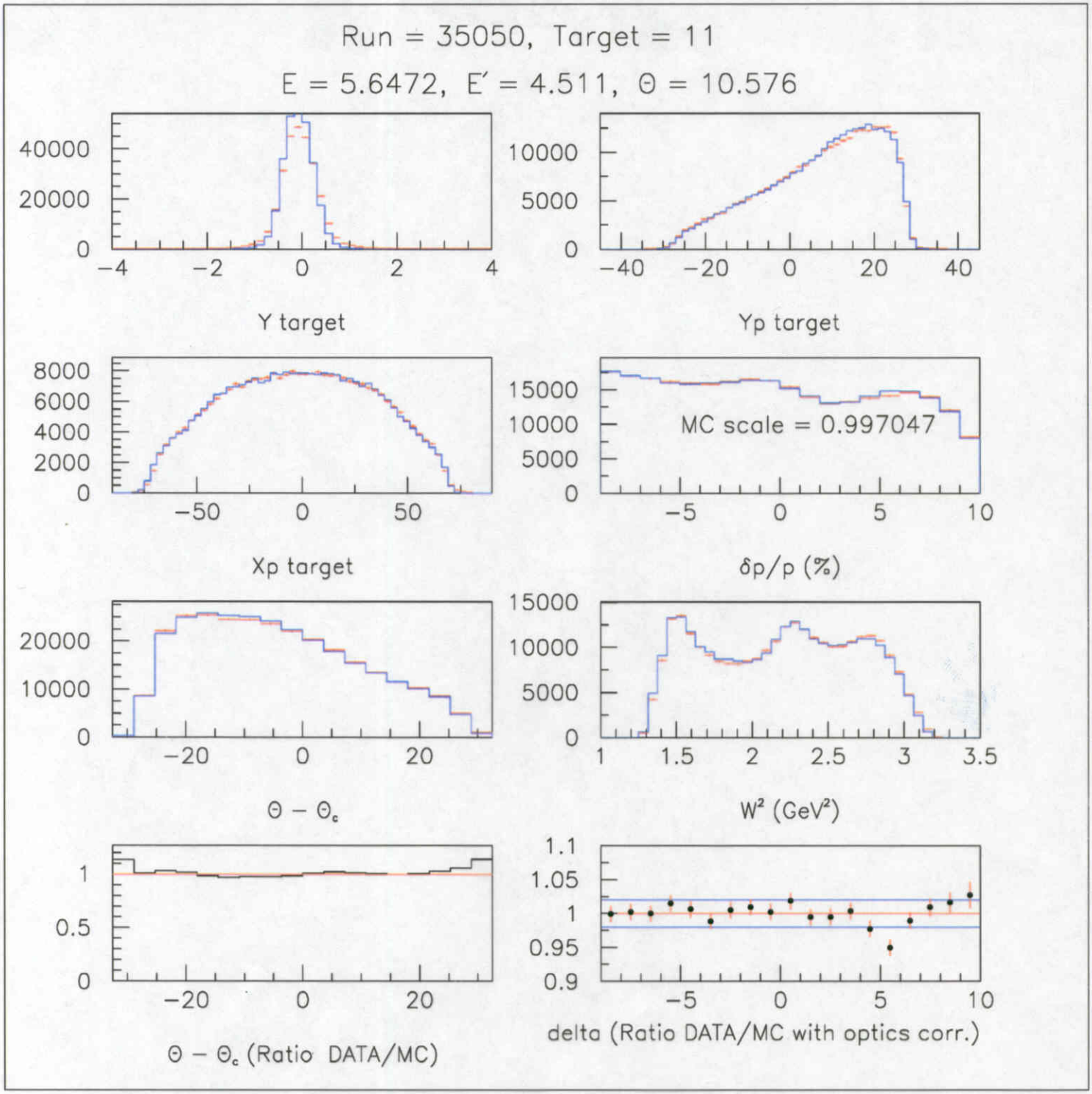
Optics / Acceptance Check

("Effective" white spectrum Method)



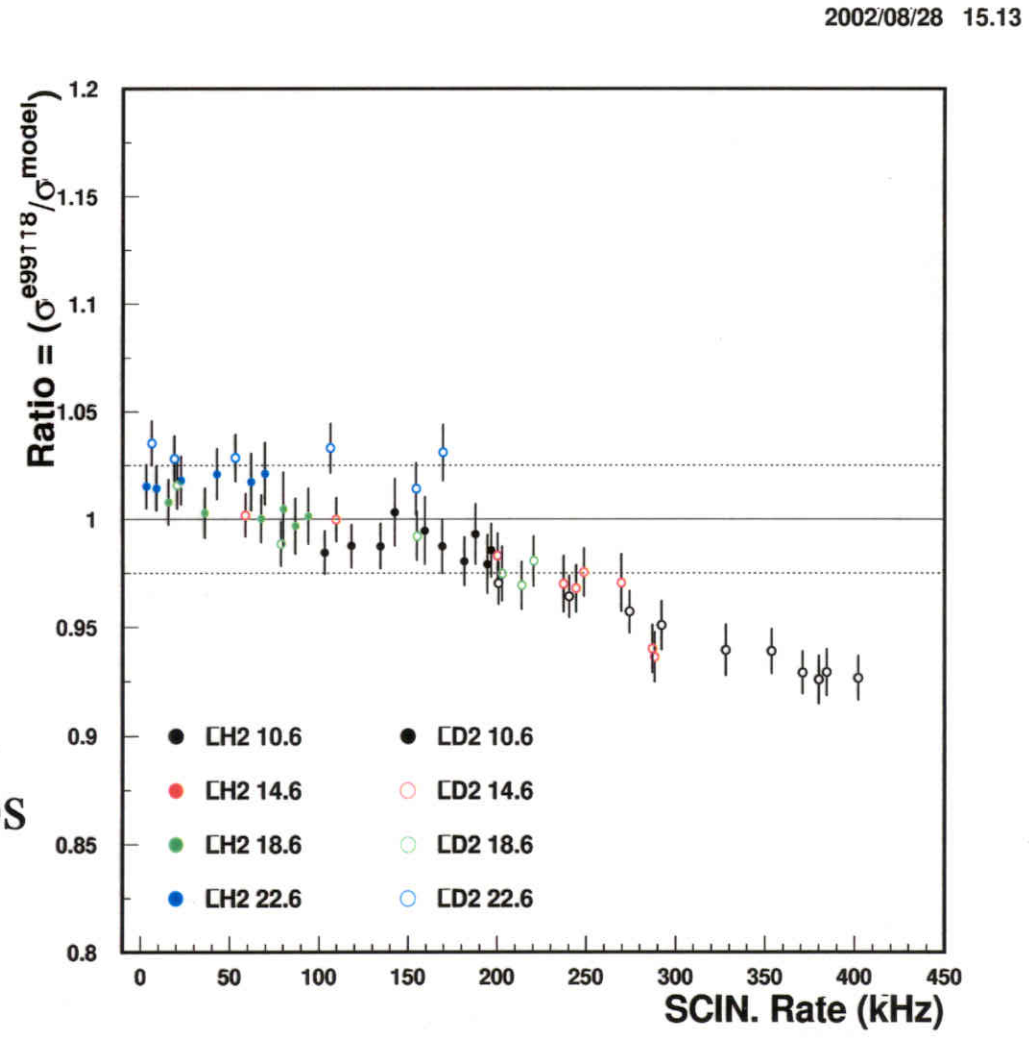

C1, E = 5.65, Θ = 10.6
1.1
1.05
1
0.95
0.9
−10
0
10


Run = 35066, Target = 11
E = 5.6472, E′ = 3.0705, Θ = 10.576
Y target
Yp target
MC scale = 1.01072
Xp target
δp/p (%)
Θ − Θc
W² (GeV²)
Θ − Θc (Ratio DATA/MC)
delta (Ratio DATA/MC with optics corr.)


Run = 35050, Target = 11
E = 5.6472, E′ = 4.511, Θ = 10.576
Y target
Yp target
MC scale = 0.997047
Xp target
δp/p (%)
Θ − Θc
W² (GeV²)
Θ − Θc (Ratio DATA/MC)
delta (Ratio DATA/MC with optics corr.)

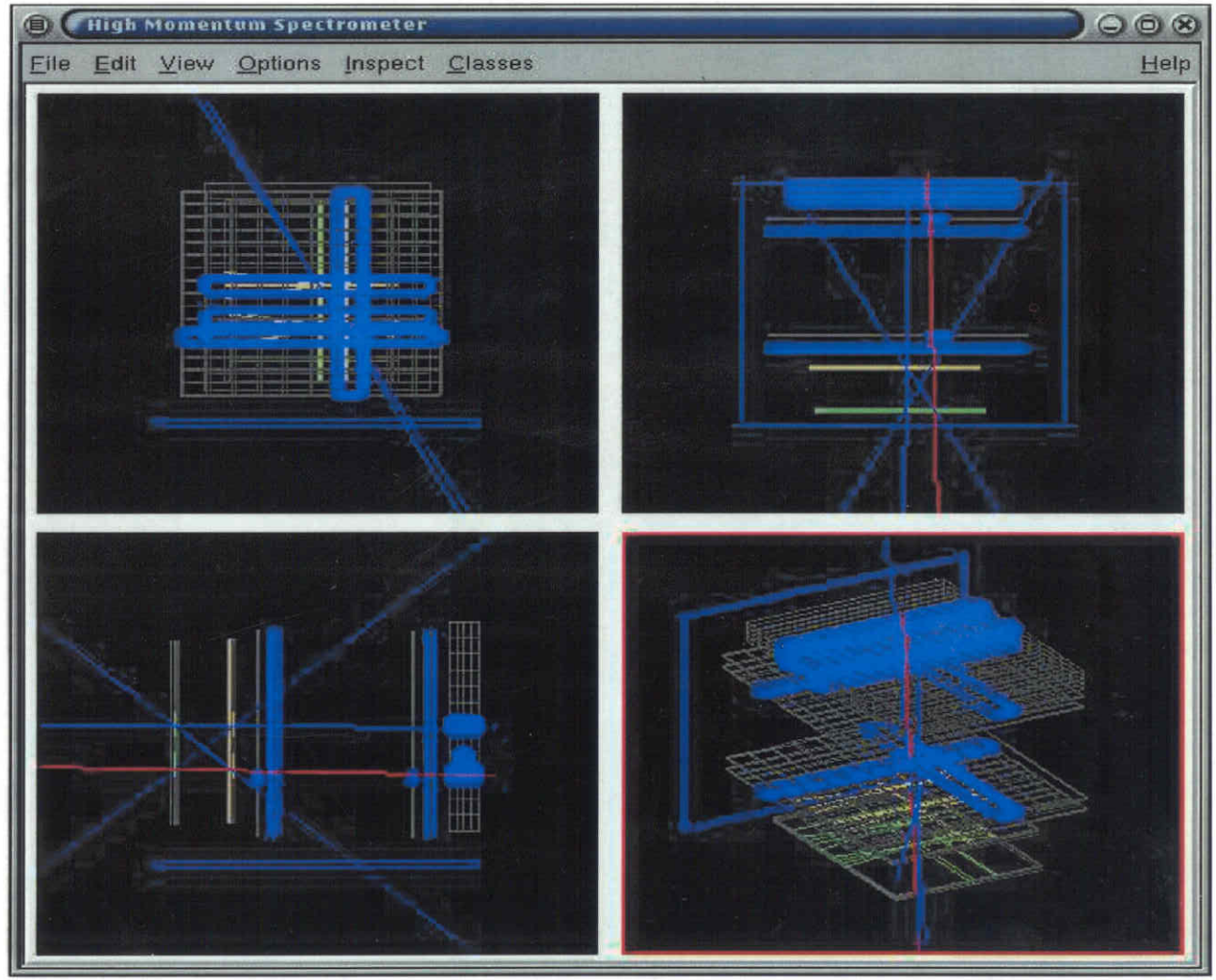
E99-118 Rate Systematic

- Observed strange shape in D2/H2 ratios.
- Observed E94-110 high rate elastics were VERY low (~ 600kHz)!
- Observed target boiling effects in aluminum.
- Observed rate dependence in measured cross sections ratios to model.



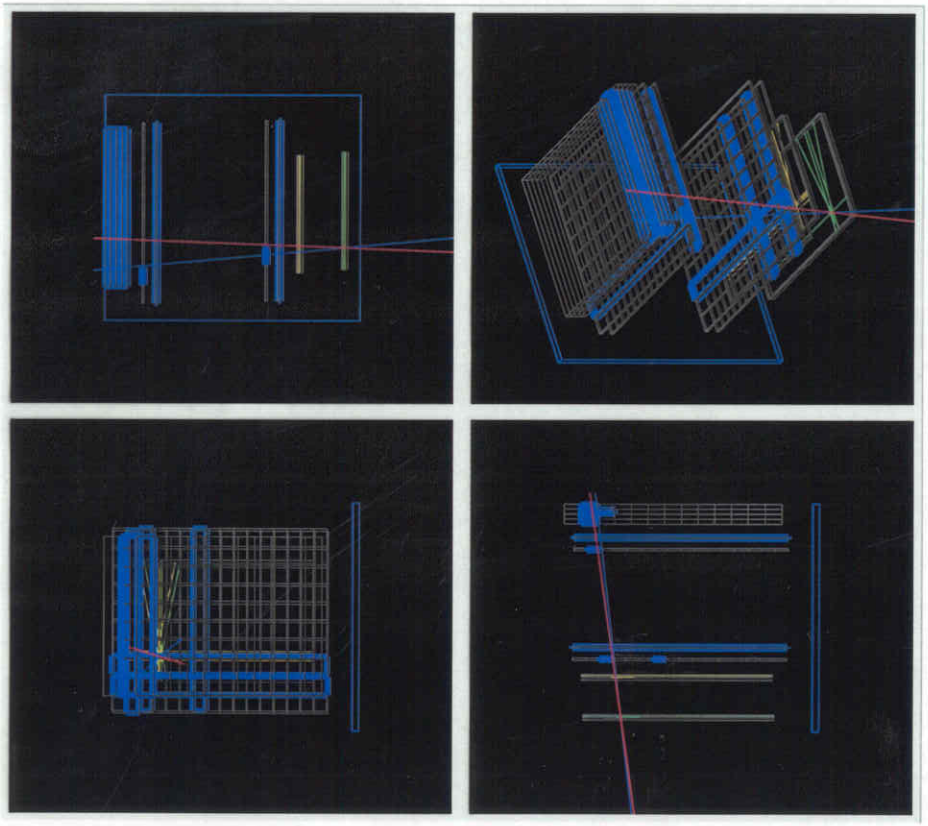
Multiple track events at high rates

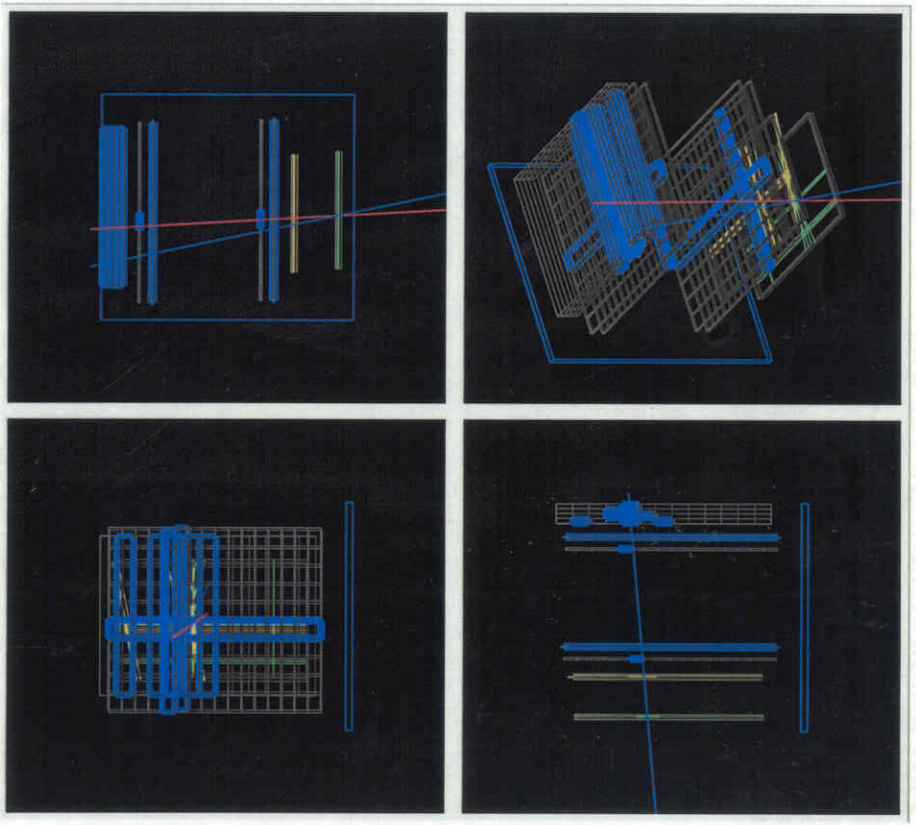
- 2 real electrons – 1 out of time in scintillators.
- Space Point : x-y position of a collection of wire hits (1 per plane only)
- Stub : Mini Track fit to hits in each SP. Every left/right possibility is fit and best fit determines left/right position.
- Stub requirements: position and angle comparisons for 1st stub projected to 2nd.



Multiple track selection with ghosts

- Wrong Track Selected
- Correct Track Selected

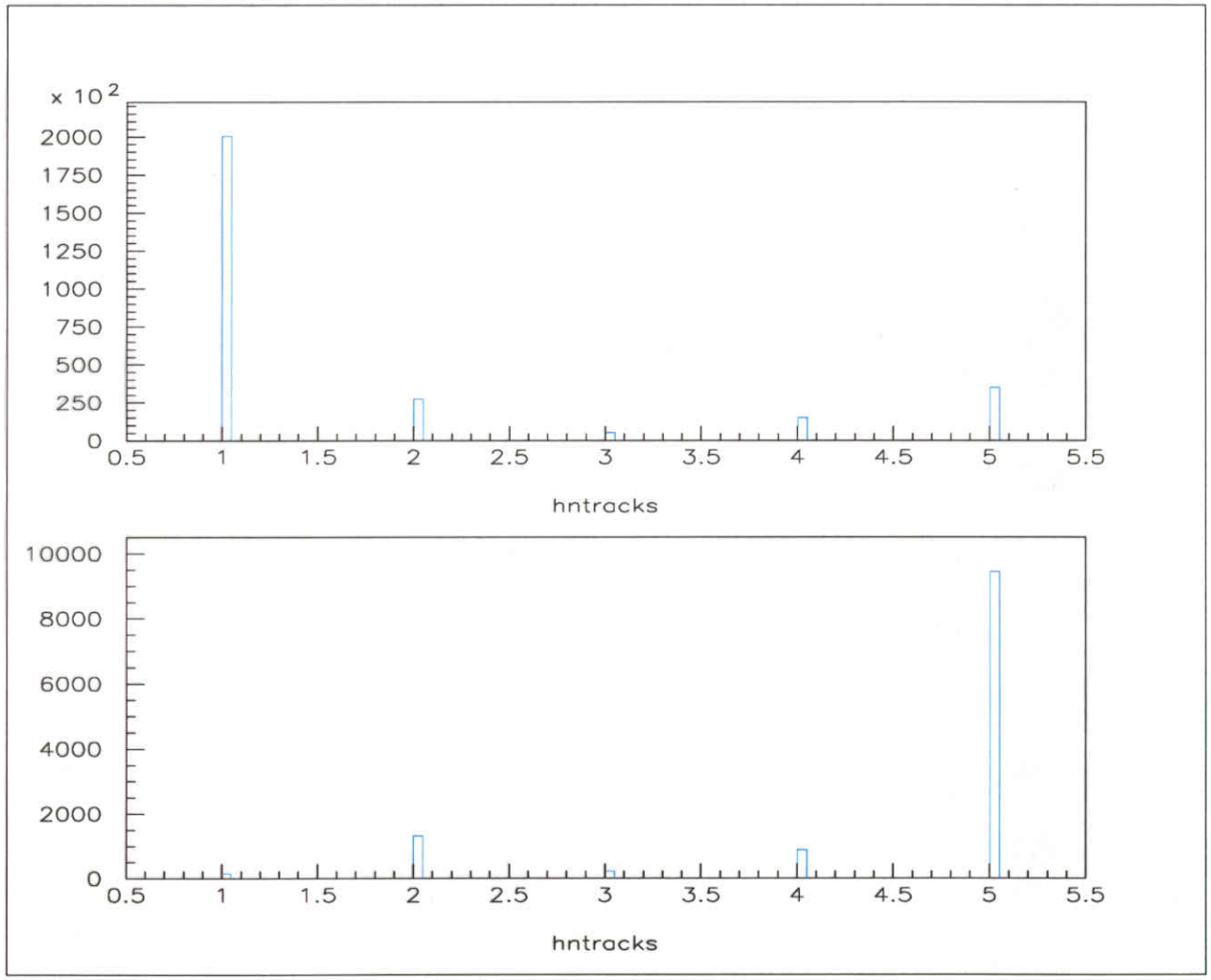




- Most mistracking is in Y!

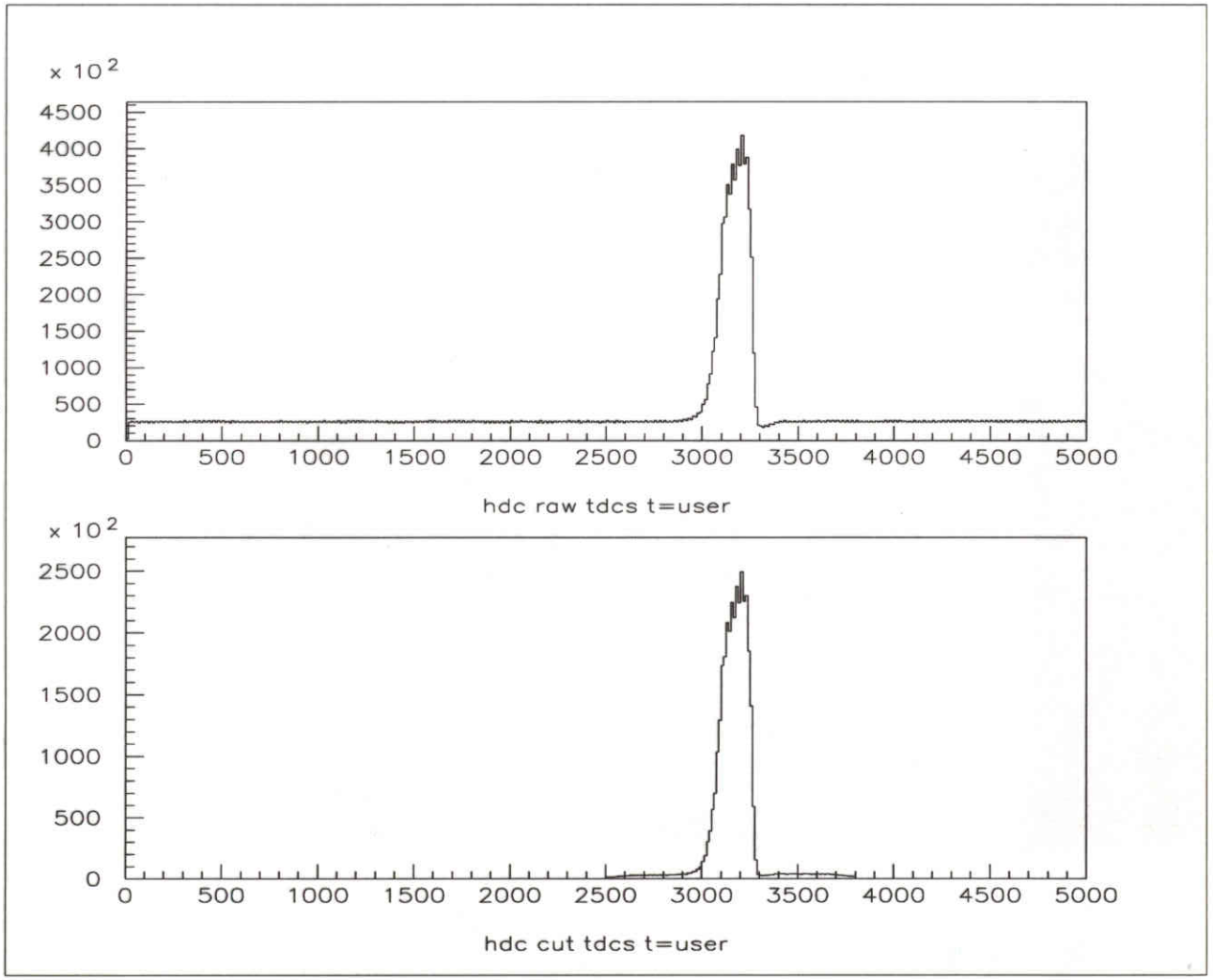
Track multiplicity for high rate Elastics

- Top: All events passing electron PID.
- Bottom: electron events reconstructing outside acceptance
- Rate = 600 kHz
- Most mistracked events had ghost tracks with best χ^2



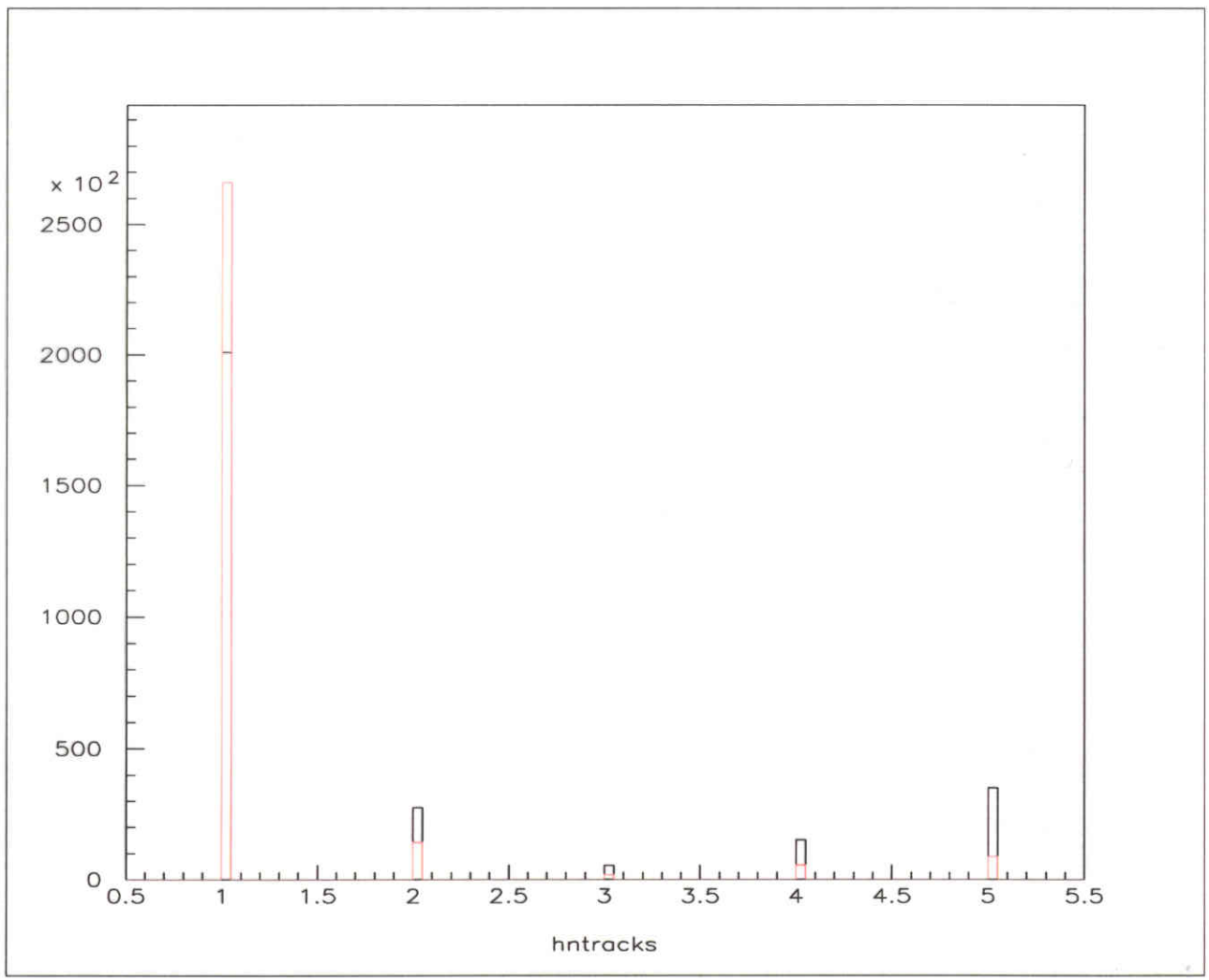
HDC TDC window for high rate Elastics

- Hits from out of time, pileup electrons where contaminating tracks.
- This can be a significant problem form elastics where the localized rate is VERY high!

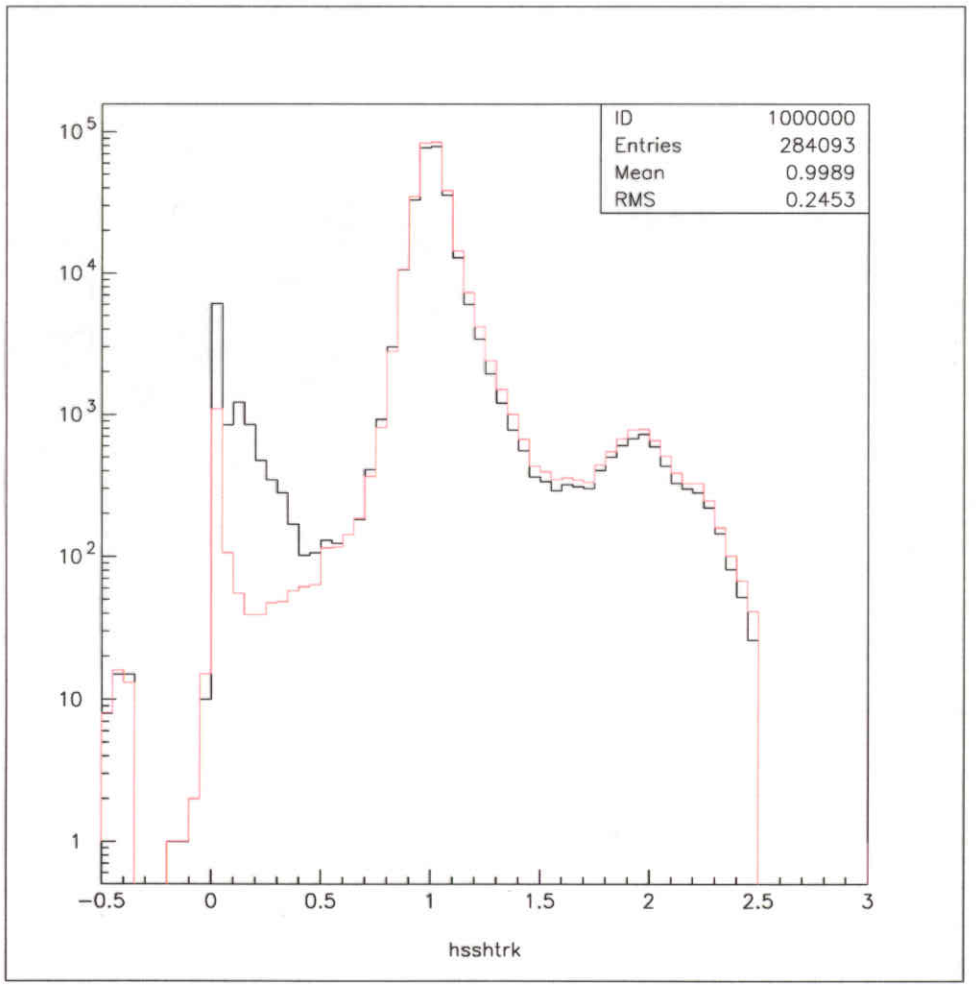


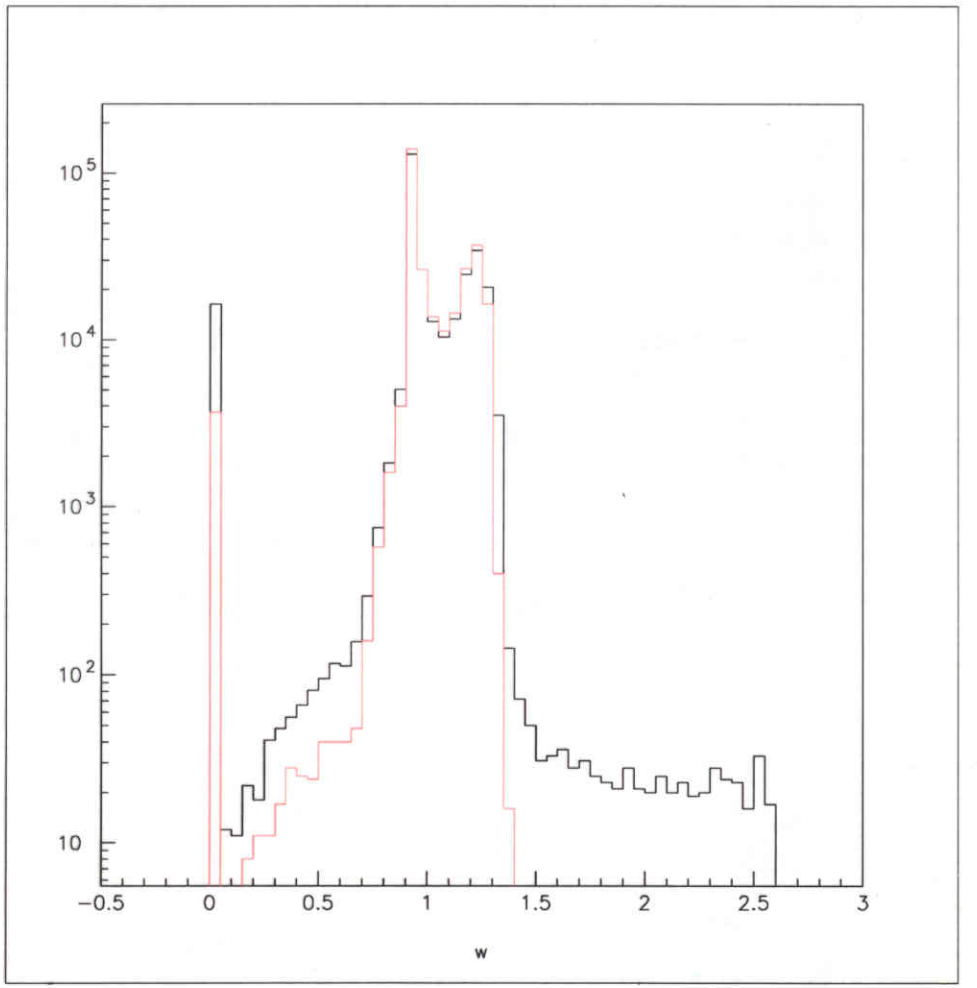
Effect of narrow HDC TDC on track multiplicity

- Effect of narrowing the DC TDC window on track multiplicity.

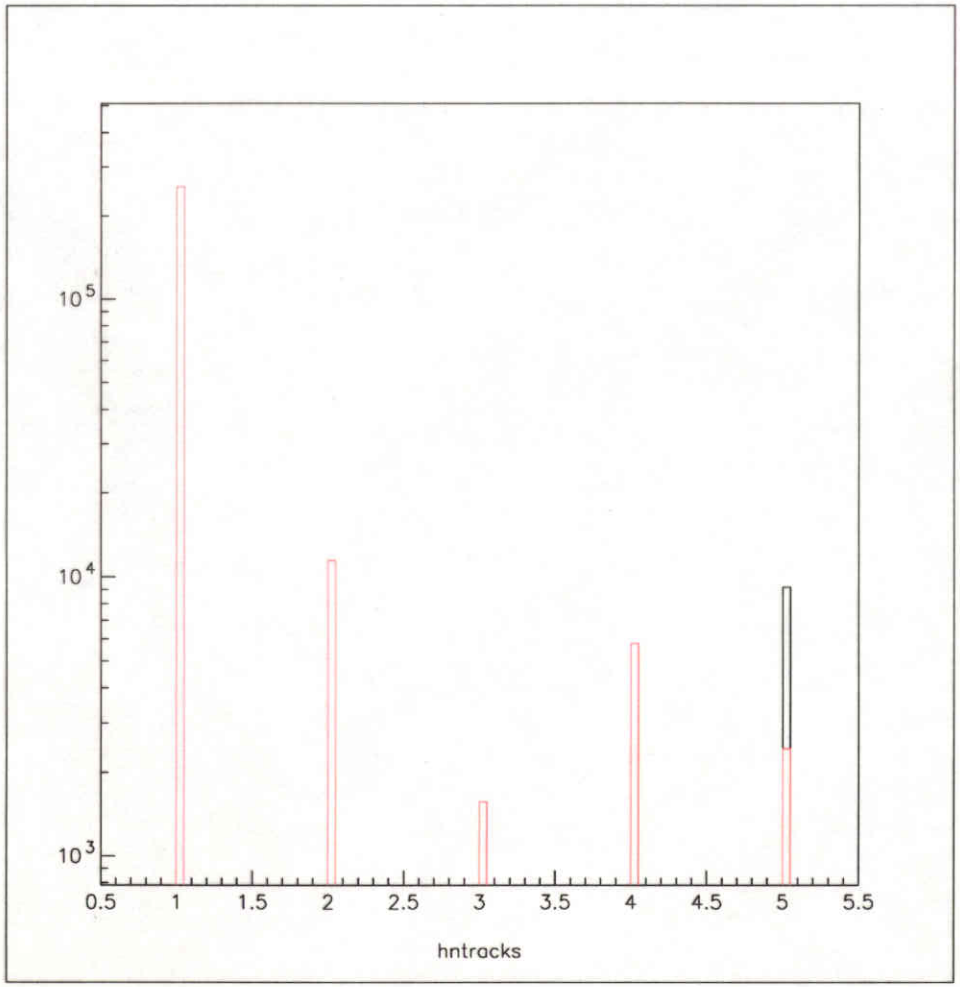


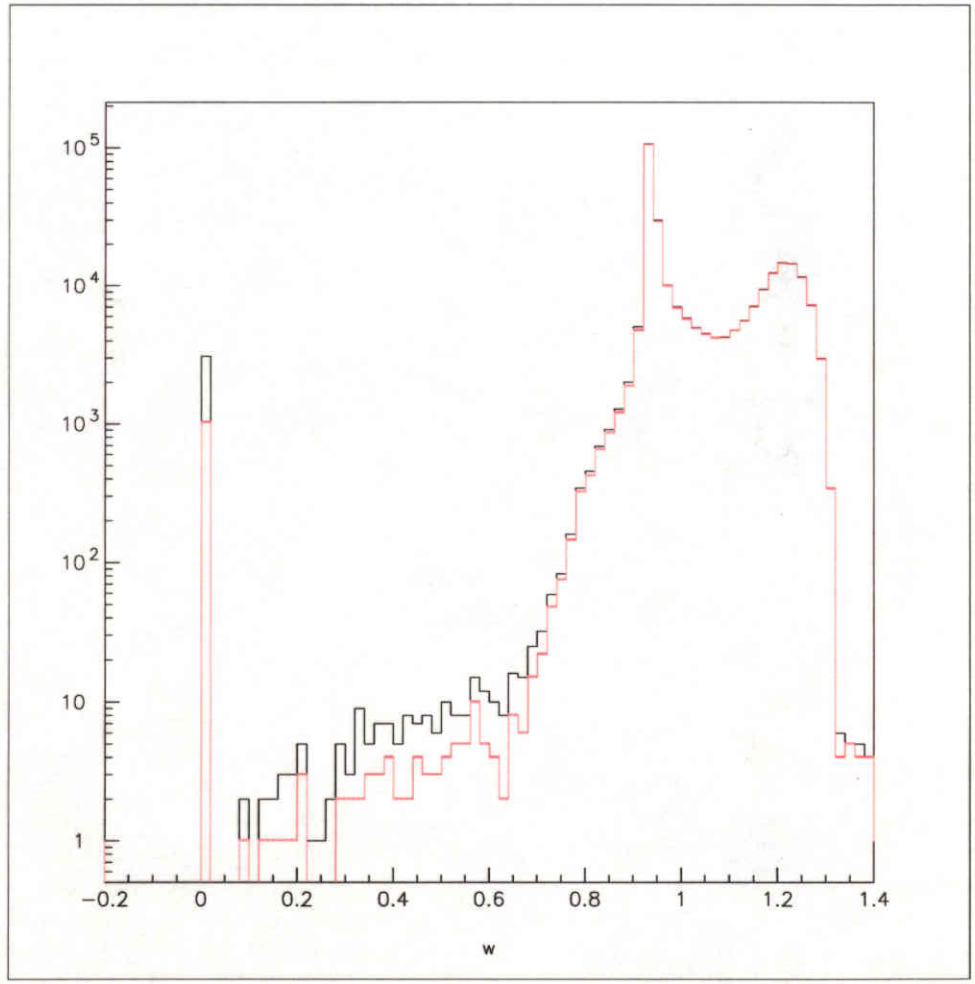
Effect of narrow HDC TDC on mistracked events



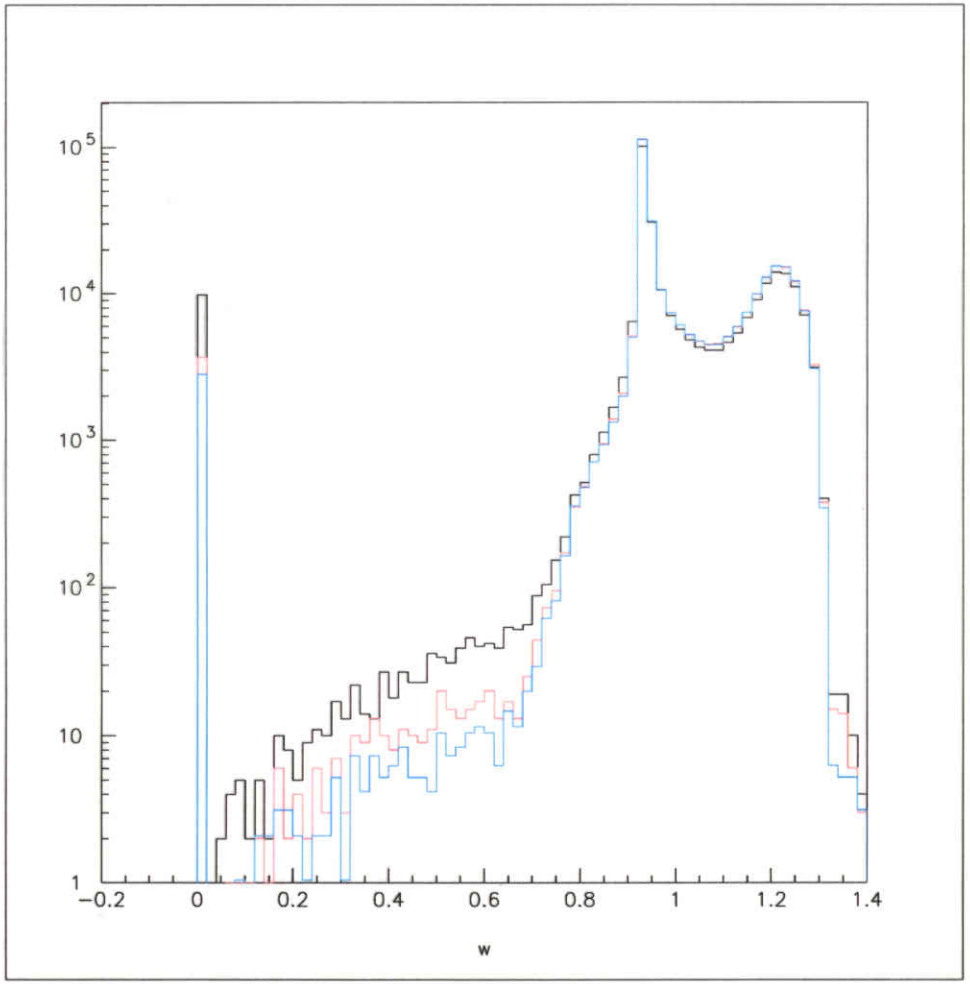


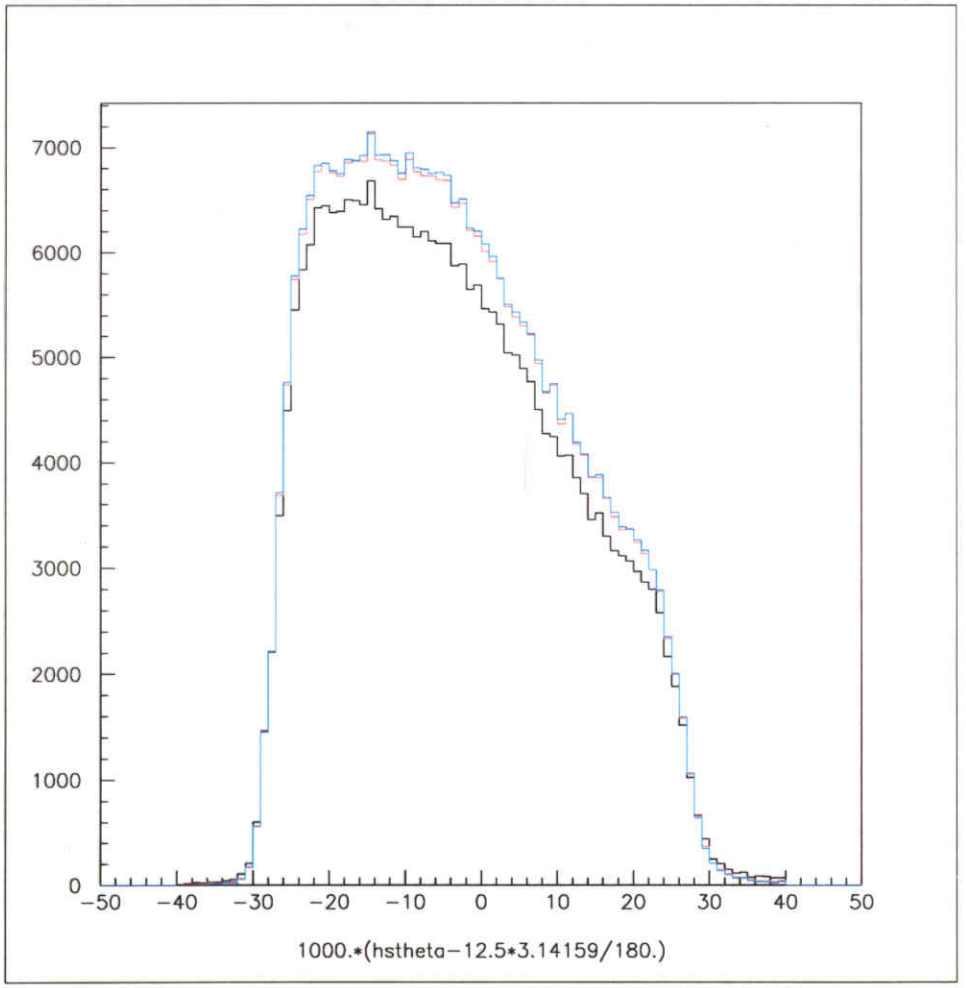
Maximum candidate tracks bug

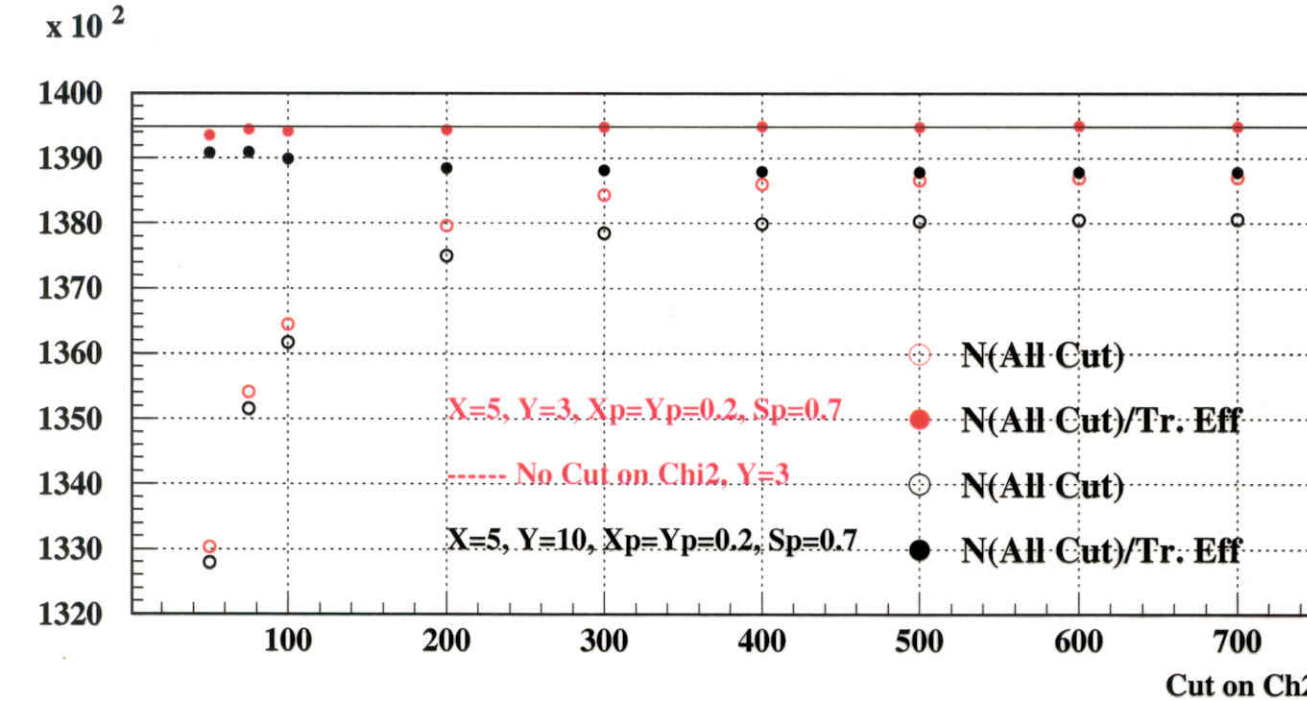


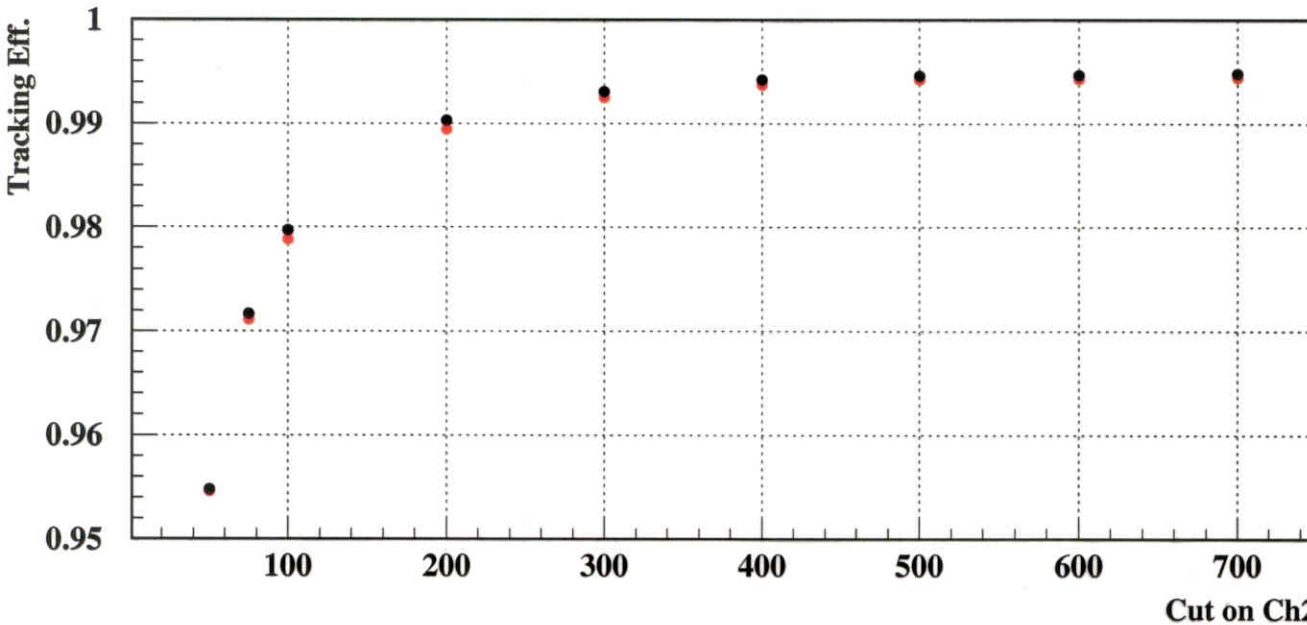


Narrow TDC + 2/2 Y tracking






x 10 2
1400
1390
1380
1370
1360
1350
1340
1330
1320
100
200
300
400
500
600
700
Cut on Ch2
X=5, Y=3, Xp=Yp=0.2, Sp=0.7
------ No Cut on Chi2, Y=3
X=5, Y=10, Xp=Yp=0.2, Sp=0.7
N(All Cut)
N(All Cut)/Tr. Eff
N(All Cut)
N(All Cut)/Tr. Eff


Tracking Eff.
1
0.99
0.98
0.97
0.96
0.95
100
200
300
400
500
600
700
Cut on Ch2