

# Effects of Increase of Magnetic Field

3 T  $\rightarrow$  4 T

Peter Steffen (20.3.99)

**pro:** jet particles more separate  
 $\Rightarrow$  easier reconstruction of  $E$  (single part.)  
• charged particles  $\leftrightarrow$  jet core (photons)  
less back ground at beam line

**con:** more spiralling particles  
 $\Rightarrow$  more difficult reconstruction in tracker

• spiralling particles accumulate in endcap calorimeter  
 $\Rightarrow$  more overlays with endcap jets

**analysis:**  $e^+e^- \rightarrow HZ (\rightarrow 8 \text{ jets})$   
 $\rightarrow$  high part. mult.

$$\sqrt{s} = 500 \text{ GeV}, M_H = 380 \text{ GeV}$$

$$H \rightarrow t\bar{t}$$

$$t \rightarrow bW$$

$$W, Z \rightarrow q\bar{q}$$

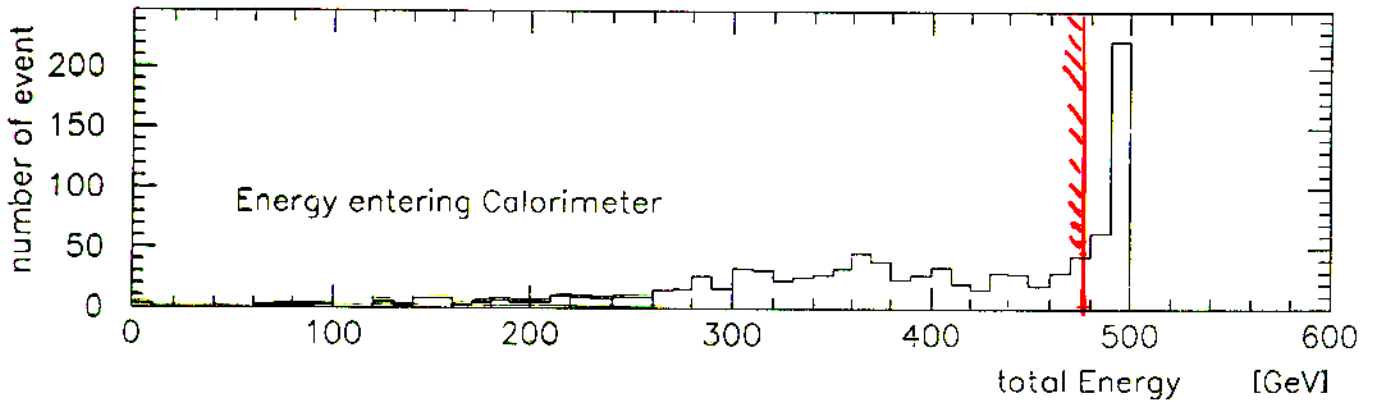
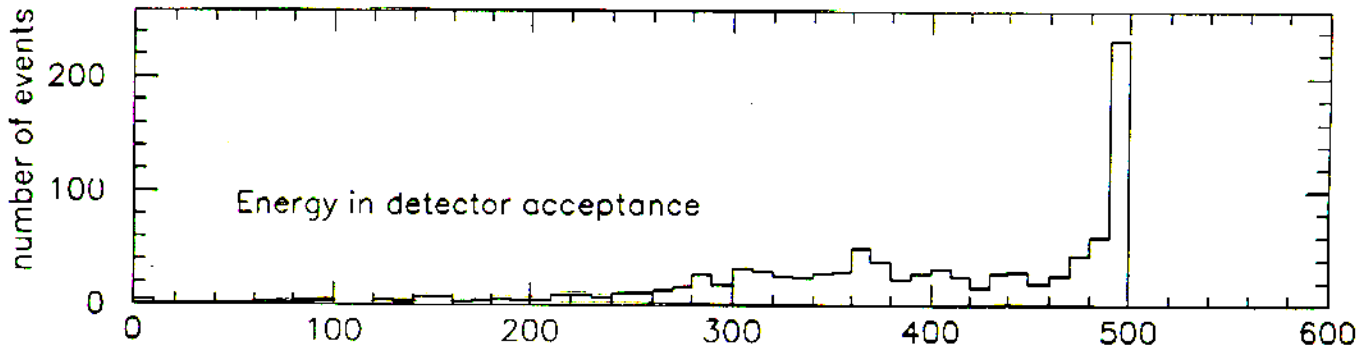
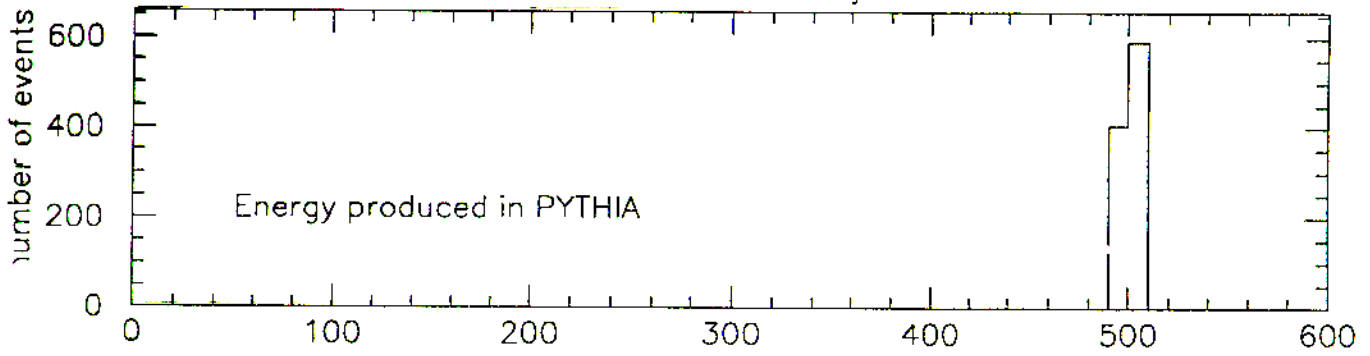
$\rightarrow E_{tot}$

1000 Events generated (PYTHIA, SIMDET)

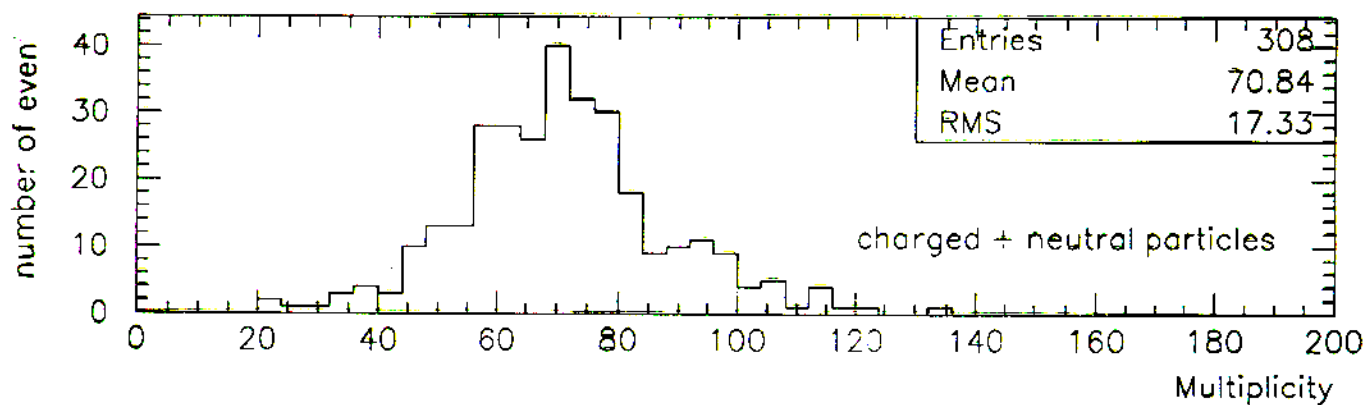
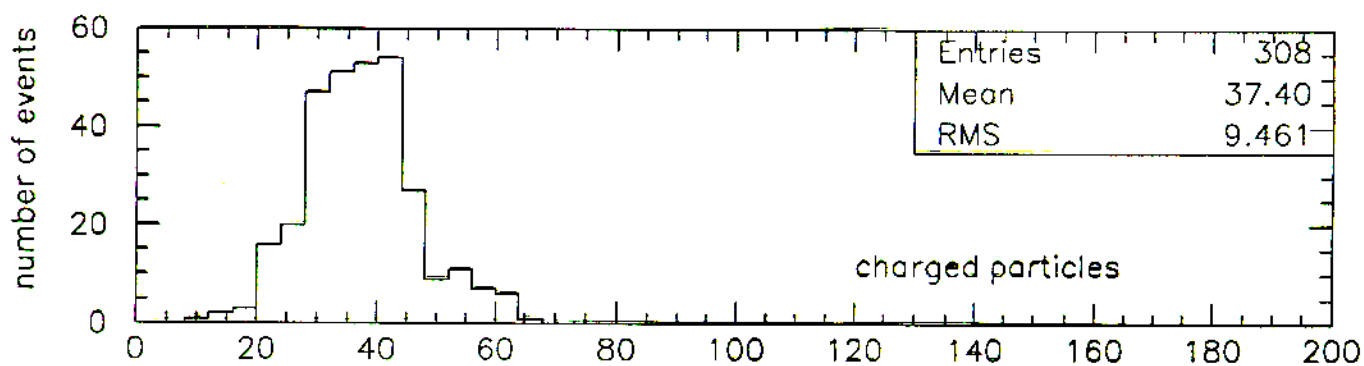
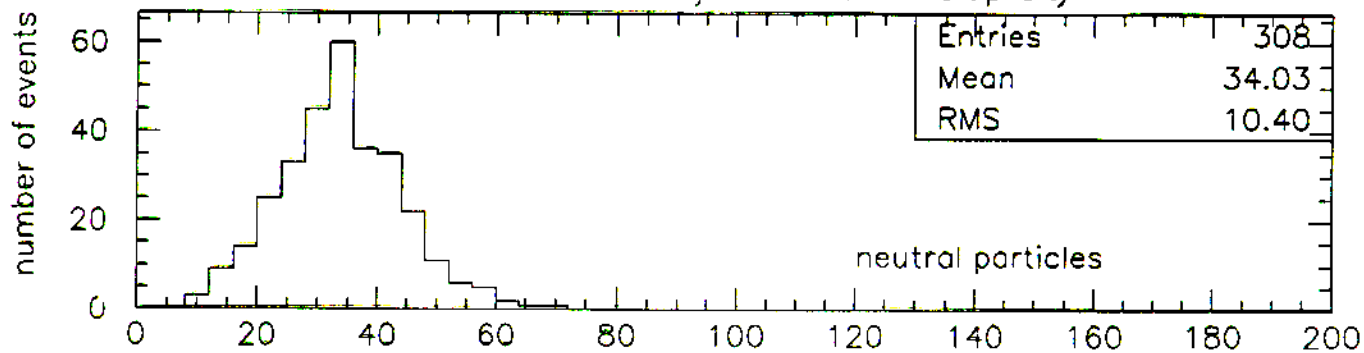
308 events: with  $E_{tot}$  (measurable)  $\gg 475 \text{ GeV}$   
in most cases  $\gg 8$  jet events

692 events: with missing  $E_V$  ( $Z, W, b$ -decays)  
: missing  $E$  in fwd/bwd direction

$e^+e^- \rightarrow HZ \rightarrow 8 \text{ jets}$



$e^+e^- \rightarrow HZ \rightarrow 8 \text{ jets} : \text{Particle Multiplicity}$



## Effects in Calorimeter

- Extrapolate charged + neutral particles

$$R = 1.7\text{m}, \quad \pm Z = 2.8\text{m}$$

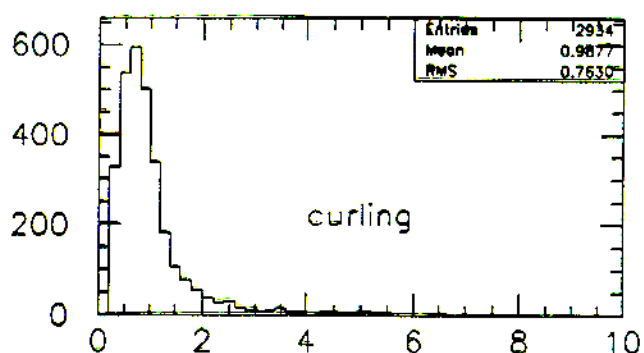
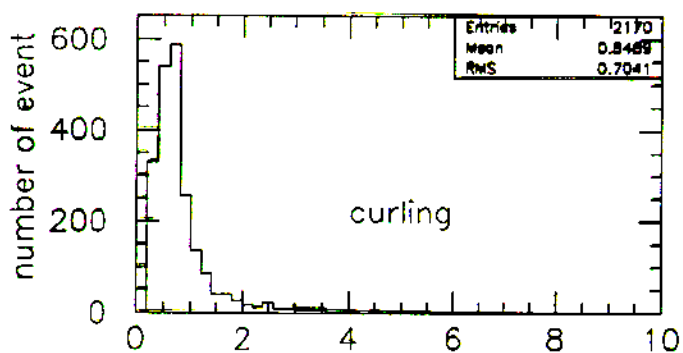
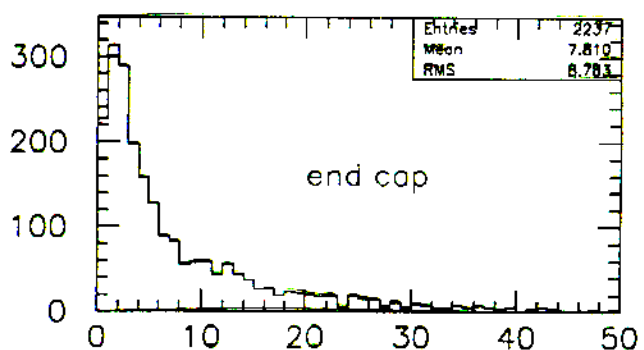
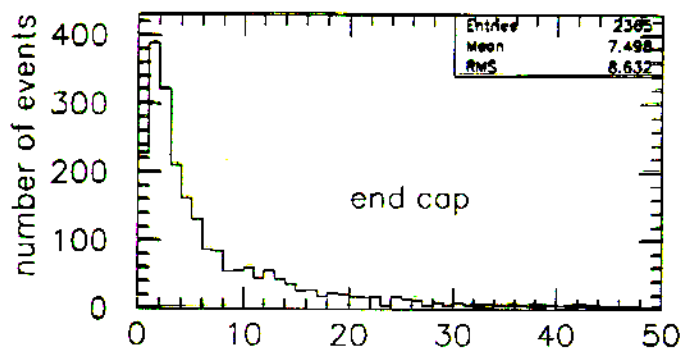
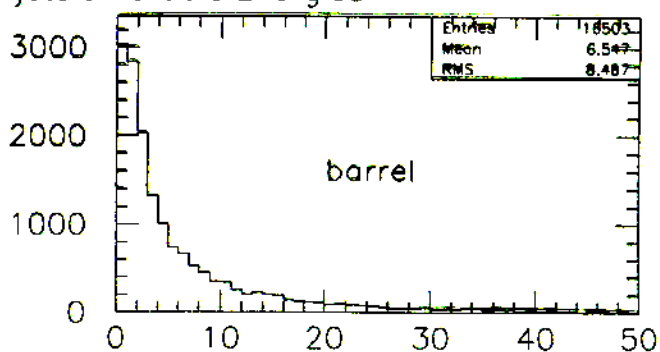
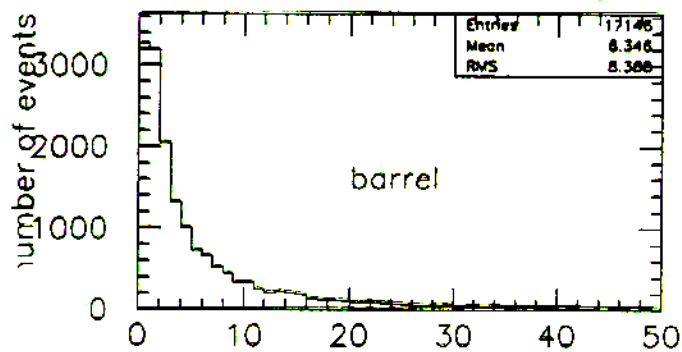
- classes: barrel  
end cap  
spiralling ( $> 1\text{tau}$ )  
→  $E_{\text{part}}$

	3T		4T	
	part.	$\langle E_{\text{part}} \rangle$ [GeV]	part.	$\langle E_{\text{part}} \rangle$ [GeV]
barrel	17'146	6.3	16'503	6.5
endcap	2'365	7.5	2'237	7.8
spiralling	2'170	.85	2'934	.99

+35% spiralling tracks to endcap

+57% energy in endcaps from spiralling tracks

$e^+e^- \rightarrow HZ \rightarrow 8 \text{ jets} : \text{Particle Energies}$



B = 3T

B = 4T

Particle Energy [GeV]

# Overlap of Particles in Calorimeter

charged with neutrals  $\Rightarrow$  Energy flow

charged with charged  $\Rightarrow$  ghost neutrals

+ reduced in barrel

= increased in endcap by spiralling tracks

Overlap:  $\Delta < 5(3) \cdot \Delta_0$  (calo cell size)  
 $\uparrow \approx \sigma_T$  of elm. shower  
 $\Delta =$  distance (charged p. to closest)  
 $\Delta_0 =$  EMC cell size = 2.8 cm

$\rightarrow \Delta$ -plots

$\rightarrow$  table: overlaps

$\rightarrow$  inclination of charged is ignored!

## Result:

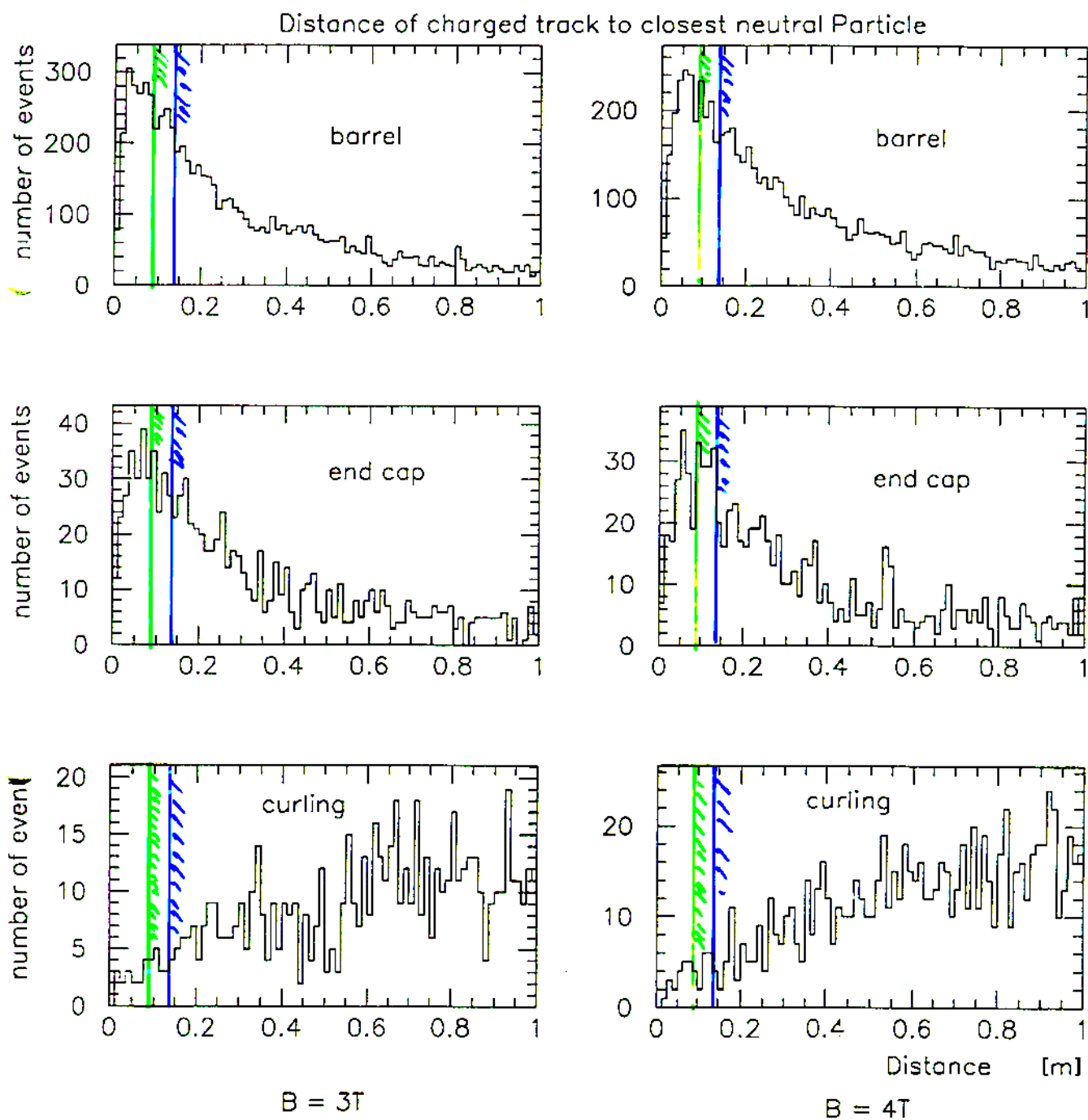
plots of  $E_{part}$  vs  $E_{part}/E$

for charged tracks in overlap with neutrals

$E_{part}/E_{neutral}$  measure of problem

of E-determination

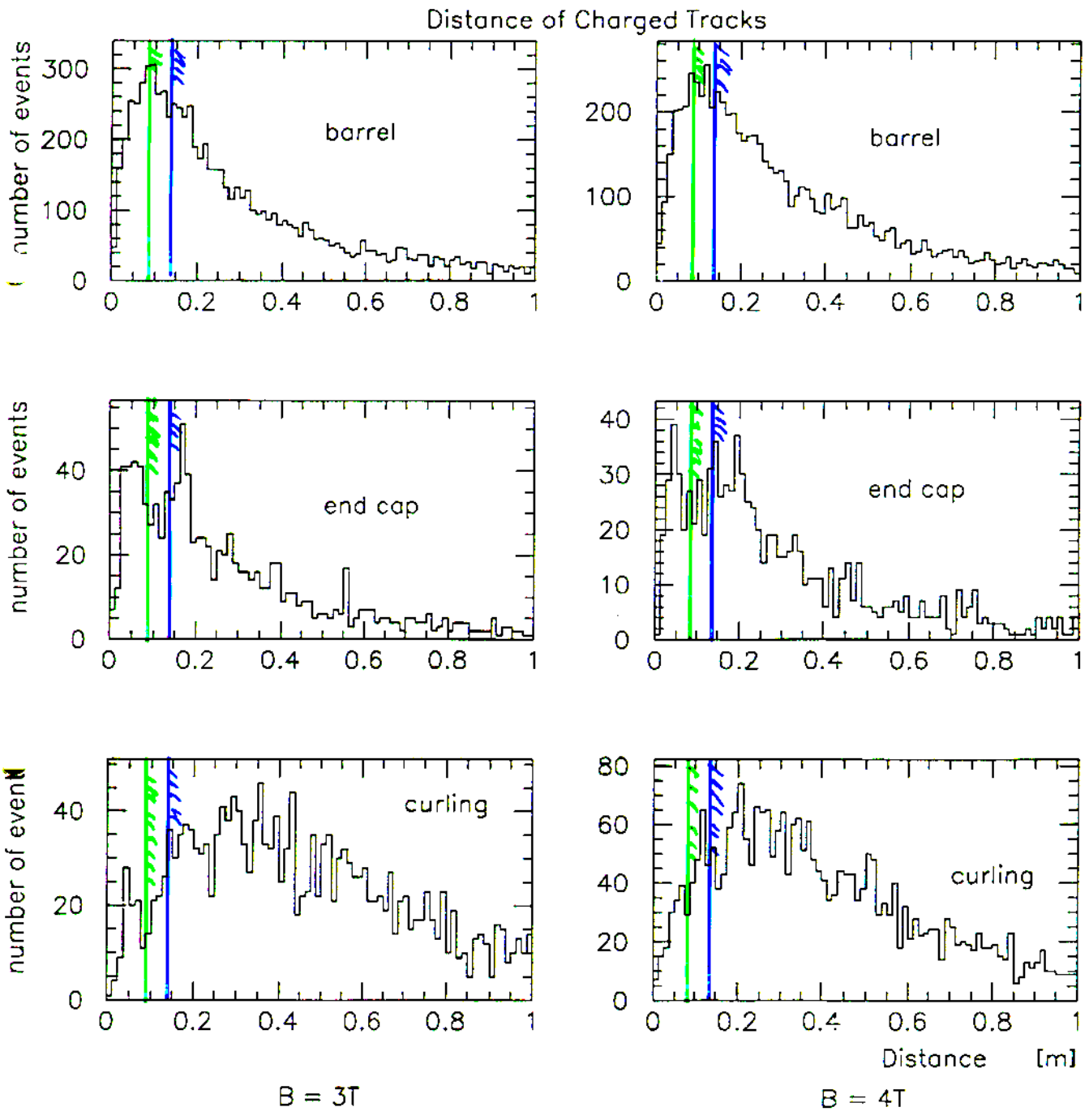
$\rightarrow$  plots E vs  $E/E_{neutral}$



Overlap of Charged Tracks with Neutrals

$$\Delta < 5 \Delta_0 (= 2.8 \text{ cm})$$

$$\Delta < 3 \Delta_0$$



Overlap of Charged Tracks with Charged  
 $\Delta < 5 \Delta_0 (=2.8\text{cm})$   
 $< 3 \Delta_0$

# Overlap of Charged Tracks with Neutrals

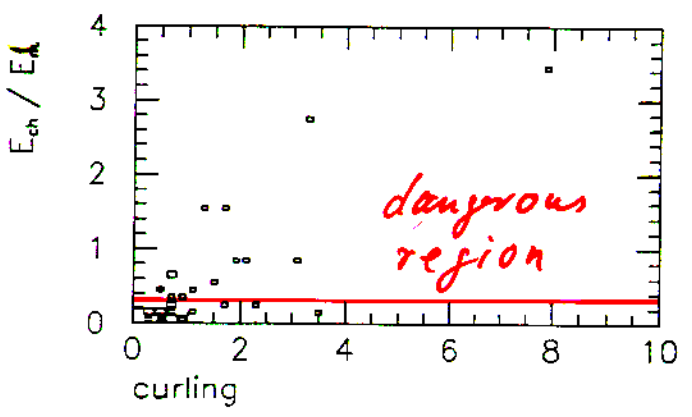
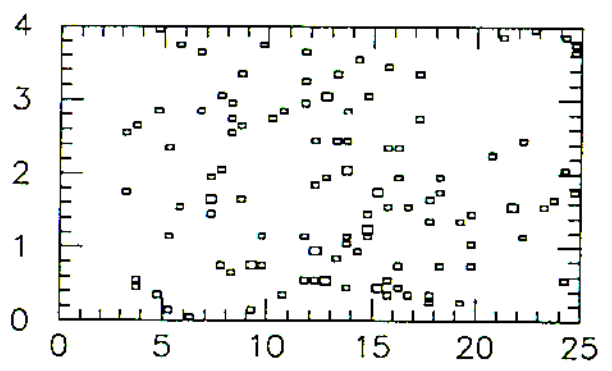
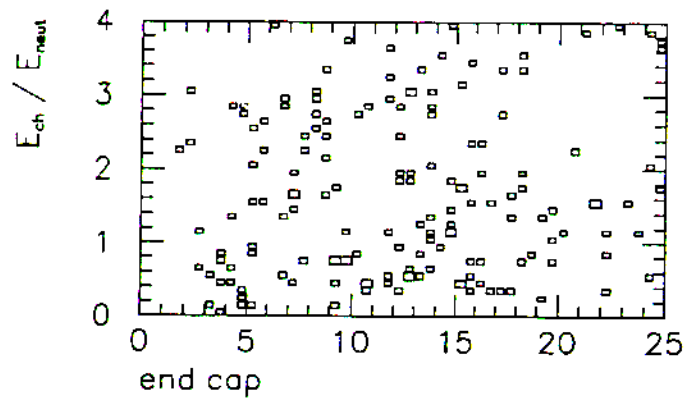
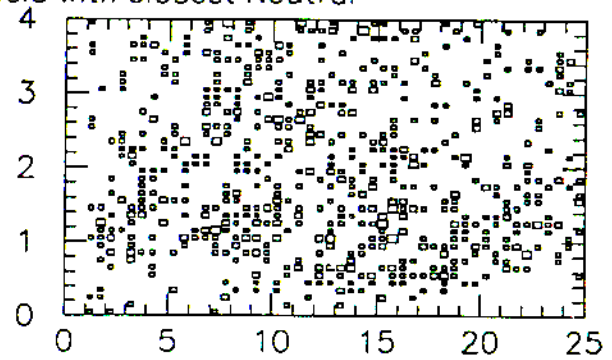
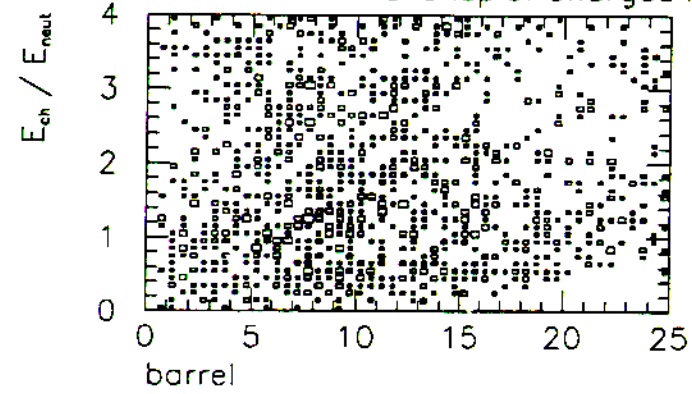
class		3T	increase (%)	4T
barrel	$\Delta < 5\Delta_0$	2'676	-20	2'137
	$< 3\Delta_0$	1'623		1'257
endcap	$\Delta < 5\Delta_0$	319	+15	276
	$< 3\Delta_0$	188		146
spiralling	$\Delta < 5\Delta_0$	31	+26	39
	$< 3\Delta_0$	15		20

# Overlap of Charged Tracks

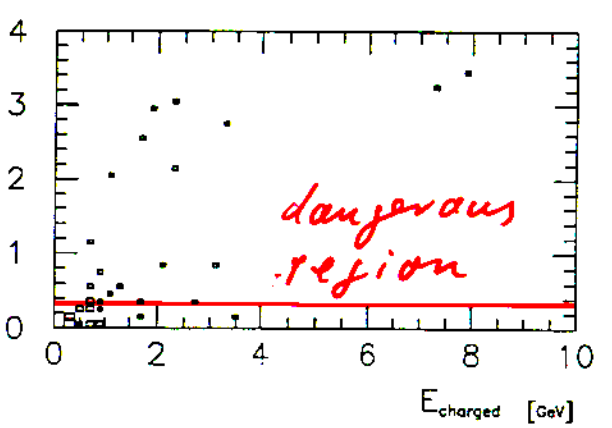
class		3T	increase	4T
barrel	$\Delta < 5\Delta_0$	2'614	-20	2'106
	$< 3$	1'415		1'075
endcap	$< 5$	340	-20	273
	$< 3$	211		159
spiralling	$< 5$	182	+100	383
	$< 3$	90		162

summary: barrel: overlap decreased by ~20%  
 BUT still high  
 $\langle \text{overlaps} \rangle / \text{event} = 8.7 \rightarrow 6.9$   
 endcap: overlaps increase (+26% for neutrals)  
 BUT still small contribution from spiralling tracks

Overlap of Charged Particle with closest Neutral



$B = 3T$



$B = 4T$

$E_{charged}$  [GeV]

## Summary

tracker: spiralling particles have to be traced up to end cap face:  
increased number increases the reconstruction problem

probably manageable

calorimeter: jet core opened (~20%)  
increased overlaps in the endcap  
by spiralling particle  
BUT still small in number

## Conclusion

No big performance change expected from higher Field

**BUT** effects on background have not been considered.