Squark Searches for High ΔM

$\tilde{t}_1 \rightarrow$ c $\tilde{\chi}_1^o$, $\tilde{b}_1 \rightarrow$ b $\tilde{\chi}_1^o$

Simulation status :

- At 196 GeV
- At 200 GeV

Neural network method :

- Same structure as last year
- Reduction of the number of variables
- Last year analysis is applied at 192-196-200-202

Preliminary results :

- No excess has been seen
- Overview of the analysis :
  we have now more than 400 pb^{-1}
- What kind of exclusion can we expect

Simulation status :

At 196 GeV :

- The production started in july : processing 99A1
- DELSIM version 991 $\Longrightarrow$ Wrong HADANA version (4.05)

- Sbottom signal : SUSYGEN3
- Stop signal : MARC'S GENERATOR

52 points in the plane ($M_{\tilde{q}}$,$M_{\tilde{\chi}_1^0}$) :

- 1000 event per point
- $M_{\tilde{q}}$ = 50, 60, 70, 80, 90 and 96 GeV
- a step of 10 GeV in $M_{\tilde{\chi}_1^0}$ and the points ΔM =5

Already in FATMEN at CERN :

`XS_SBOT_E196_S99_1L_A1 and XS_STOP_E196_S99_1L_A1`

At 200 GeV :

- The production started last week : processing 99A1
- DELSIM version 993

- same grid except $M_{\tilde{q}}$ = 100 GeV

Neural network method :

Mass windows :

- $\Delta M \geq 30$
- $10 \leq \Delta M < 30$
- $5 \leq \Delta M < 10$: Marc's analysis
- stop : $2 \leq \Delta M \leq 5$: Orsay

Neural network structure :

- Neural networks trained at 189 GeV are used
- Waiting for the next processing to train at 192, 196, 200 and 202 GeV.

Output node	node 1	node 2	node 3
Signal	1	0	0
$q\bar{q}\gamma$ 4-fermions	0	1	0
$\gamma\gamma QCD$ $\gamma\gamma QPM$	0	0	1

Neural network method :

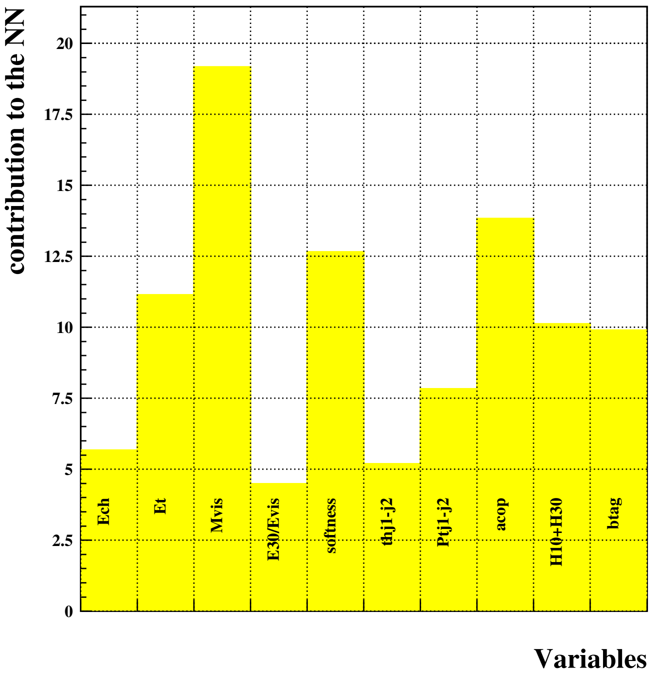
Reduction of the number of variables :

Last year : 16 variables $\Longrightarrow$ 10 variables

charged energy	(E_{ch})	transverse energy	(E_t)
visible mass	(M_{vis})	forward/visible energy	(E_{30}/E_{vis})
softness	$(E_{j1}/M_{j1} + E_{j2}/M_{j2})$	angle between the 2 jets	(θ_{j1-j2})
Pt jet1-jet2	$(\sqrt{Pt_{j1}^2 + Pt_{j2}^2})$	Acoplanarity	$(acop)$
Fox-Wolfram	$(H10 + H30)$	Jet b-tagging	$(Probz02)$

- Evaluating efficiency/purity for each set of variables used
- Calculating the contribution of each variable to the trained NN :

$$C_i = \frac{\Sigma_h |W_{i,h}|}{\Sigma_{i,h} |W_{i,h}|}$$



Monte-Carlo Samples :

$f\bar{f}(\gamma)$:

```
XS_ZGPY_E192_S99_1L_A1  (PYTHIA 5.722)
XS_ZGPY_E196_S99_1L_A1  (PYTHIA 5.722)
XS_ZGPY_E200_S99_1L_A1  (PYTHIA 6.125)

XS_BHFO_E196_F99_1L_A1  (192,196,200)

XS_KORA_E192_R99_1L_A1
XS_KORA_E196_R99_1L_A1  (196,200)

XS_MUMU_E196_R99_1L_A1  (192,196,200)
```

4-fermions :

```
XS_WWEX_E192_SA99_1L_A1
XS_WWEX_E196_SA99_1L_A1
XS_WWEX_E200_SA99_1L_A1

XS_EVQQ_E196_R99_1L_A1          (192,196,200)
XS_VVQQ_E196_R99_1L_A1           XS_LLLL_E196_R99_1L_A1
XS_EEQQ_E196_R99_1L_A1           XS_EEEE_E196_R99_1L_A1
XS_MMQQ_E196_R99_1L_A1           XS_EEMM_E196_R99_1L_A1
XS_TTQQ_E196_R99_1L_A1           XS_EETT_E196_R99_1L_A1
```

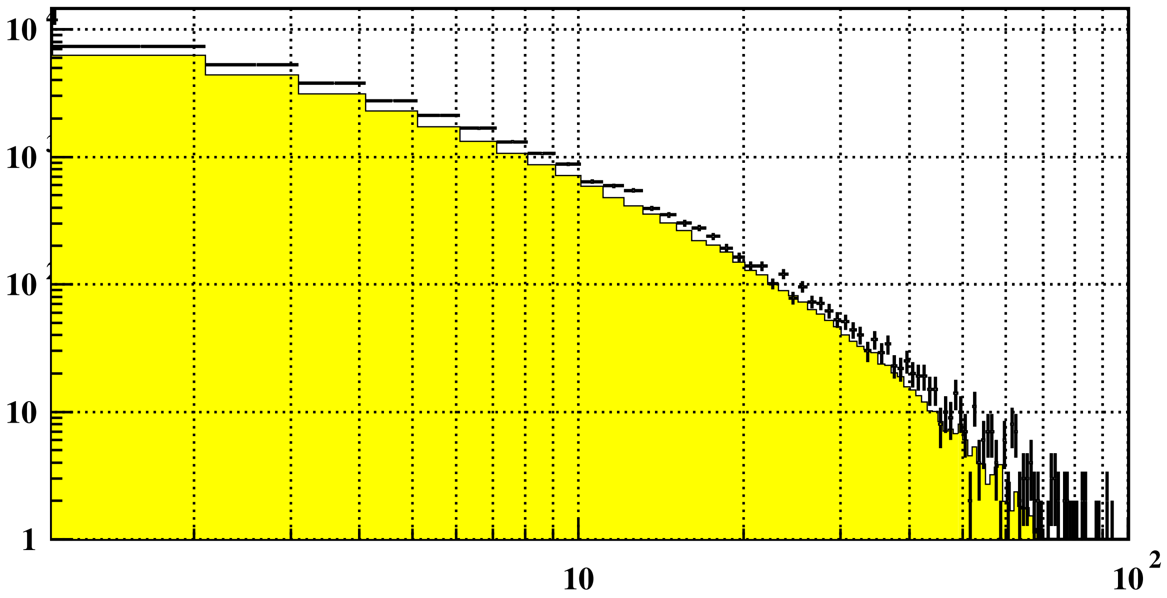
Two-Photons :

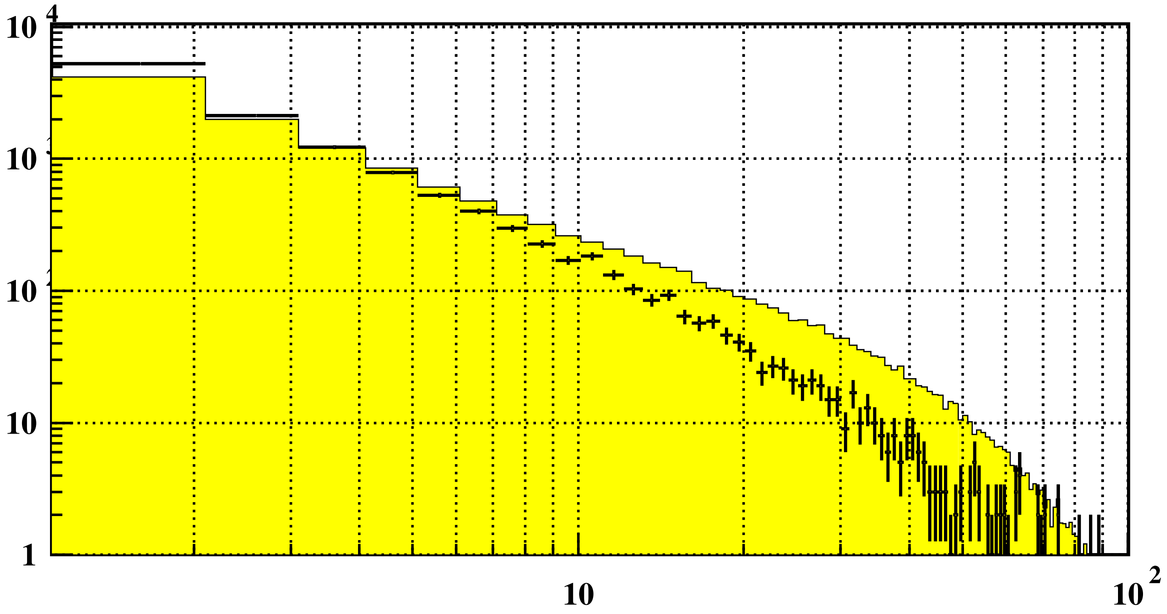
```
XS_GGM1_E189_K98_1L_D2

XS_GGTT_E196_S99_1L_A1 (unbiased)
XS_GGMU_E196_S99_1L_A1 (biased)
XS_GGEE_E196_S99_1L_A1 (biased)
```

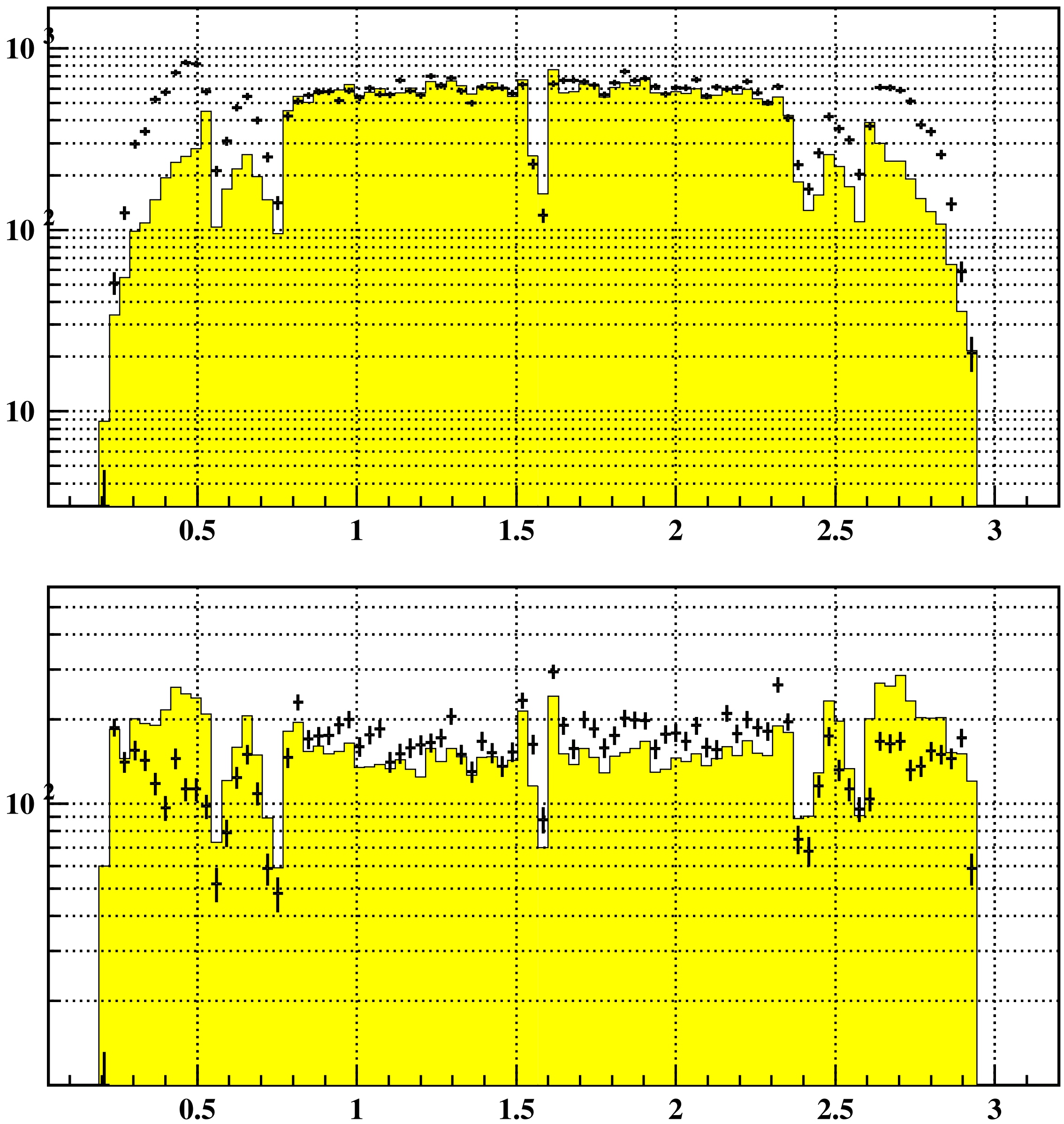
Data vs Monte-Carlo at 196 GeV :

HAC : charged and neutrals



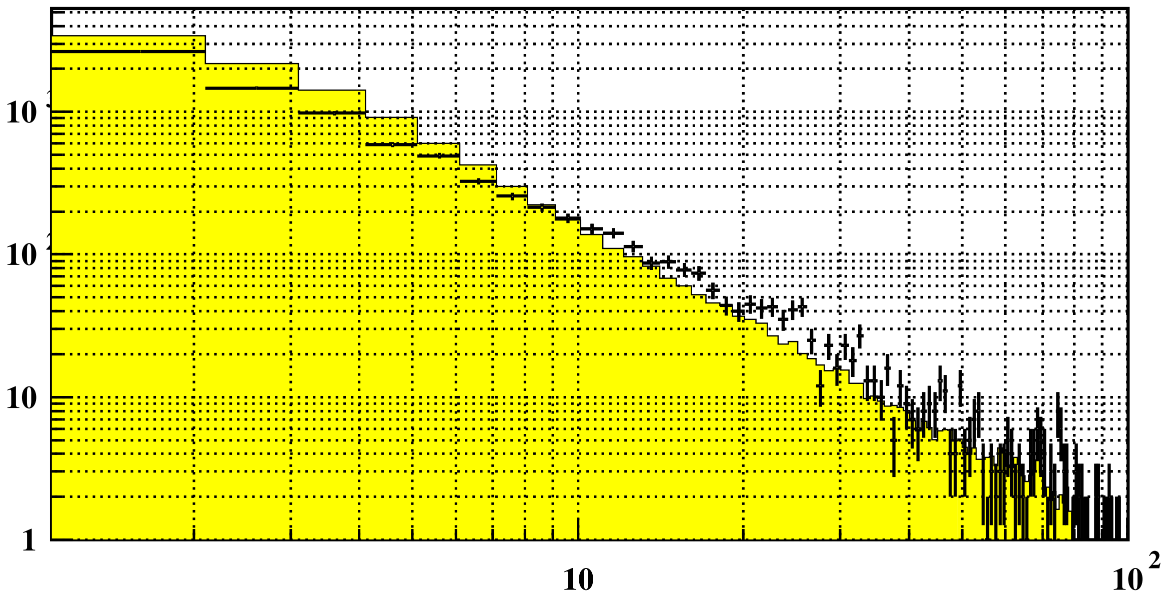


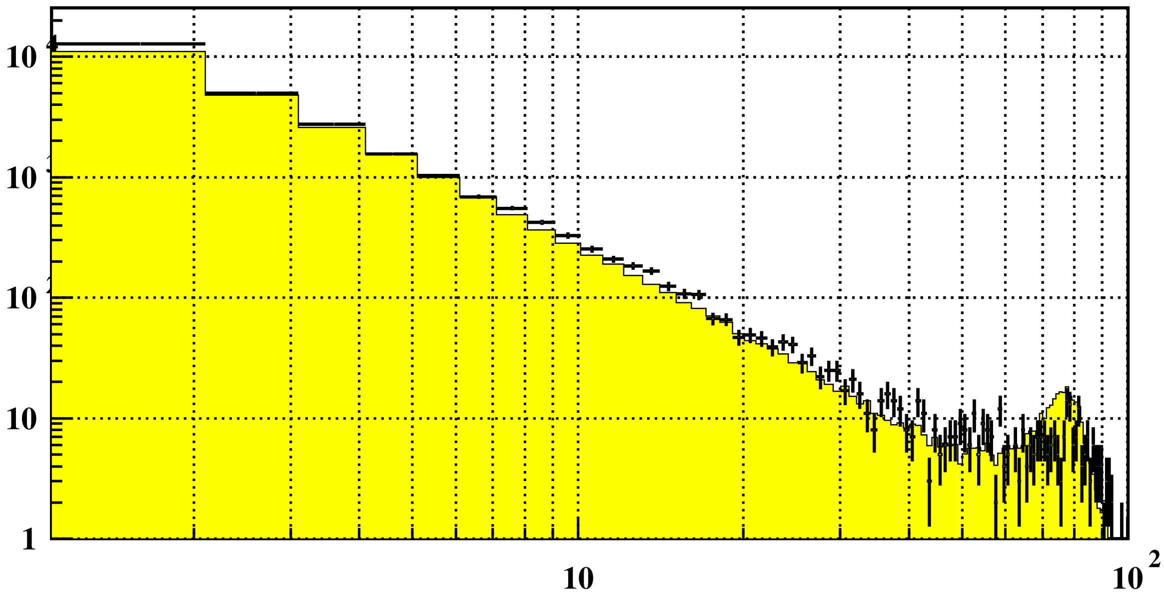
HAC : charged and neutrals



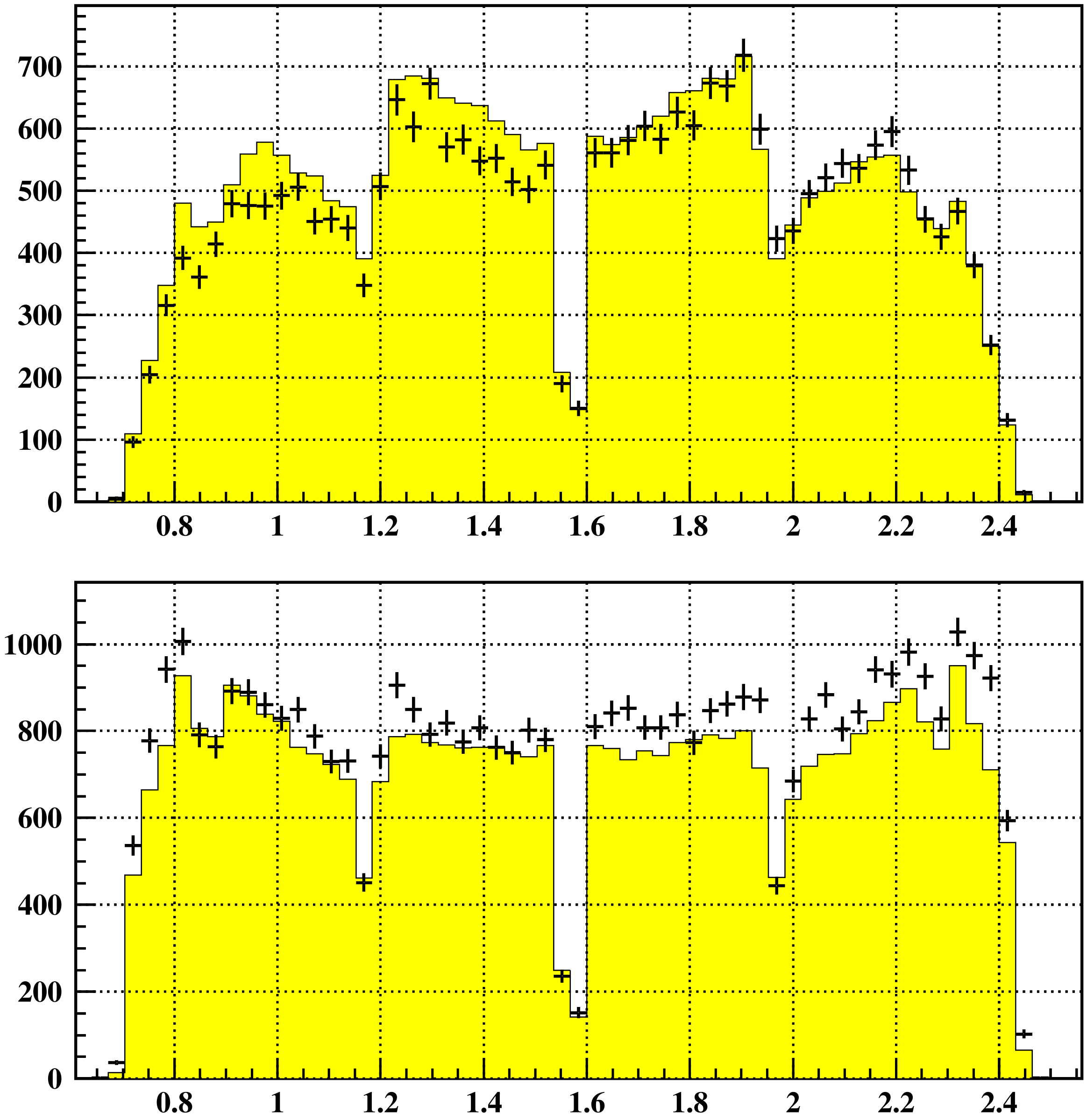
Data vs Monte-Carlo at 196 GeV :

HPC : charged and neutrals





HPC : charged and neutrals



The analysis :

Luminosities :

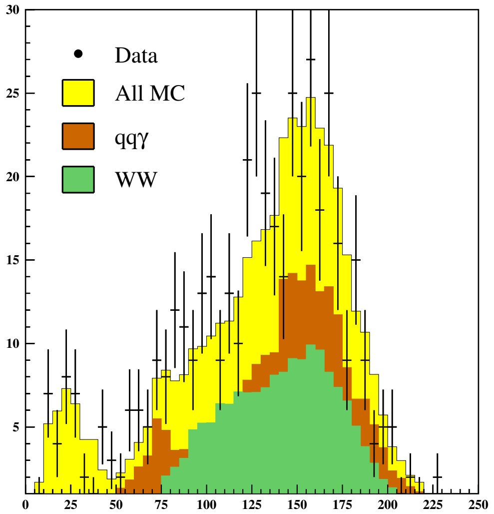
$$\mathcal{L}_{TOT} \;=\; 193.7\ pb^{-1}$$

$$\mathcal{L}_{192} = 25.9\ pb^{-1} \quad \mathcal{L}_{196} = 76.9\ pb^{-1}$$
$$\mathcal{L}_{200} = 74.5\ pb^{-1} \quad \mathcal{L}_{202} = 16.4\ pb^{-1}$$

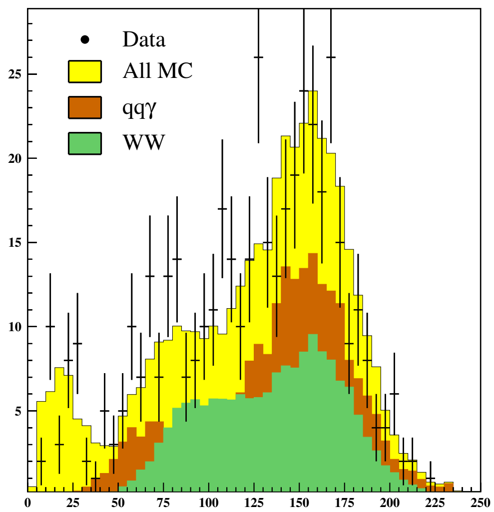
Selection criteria :

cuts	192		196		200		202	
	Ndata	Nmc	Ndata	Nmc	Ndata	Nmc	Ndata	Nmc
$N_{ch} \geq 6$ $E_t \geq 5$ $Pt^{ch}_{max} \geq 1.2$	9666	8661	28645	25571	27334	23783	6113	5370
$\mid c\theta_{Pm} \mid \leq 0.9$	2244	2027	6711	5882	6416	5245	1464	1204
$Pt \geq 4$	1173	1185	3391	3383	3109	2854	743	673
$\mid c\theta_{th} \mid \leq 0.9$	960	971	2778	2751	2543	2348	600	554
$E_{HPC} < 50$	647	674	1884	1869	1601	1633	352	383
$E_{EMF} < 20$	509	518	1432	1445	1197	1273	264	297
$E_{STIC} < 15$	491	493	1362	1378	1124	1219	256	284
40^o tagger veto	445	441	1231	1232	1008	1090	233	254

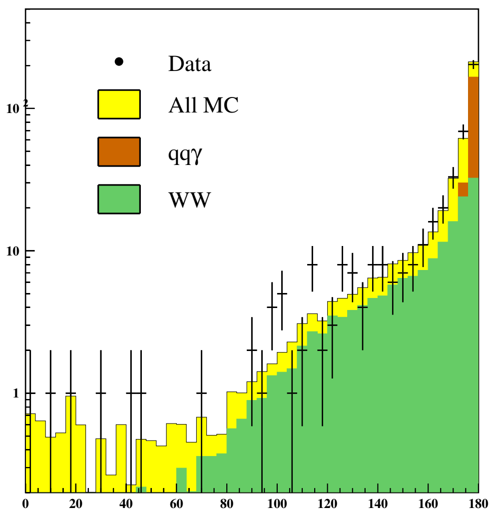
192 GeV :



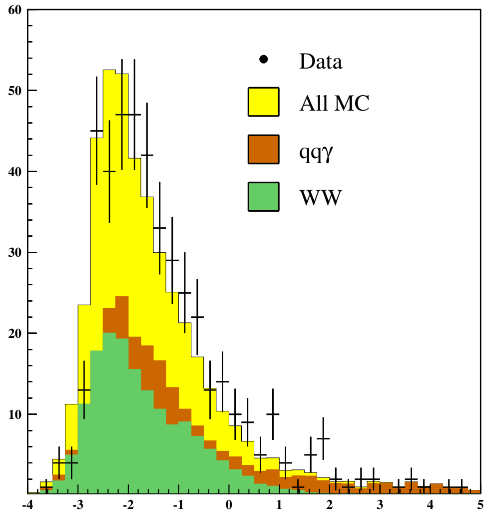
Visible Energy



Invariant visible mass

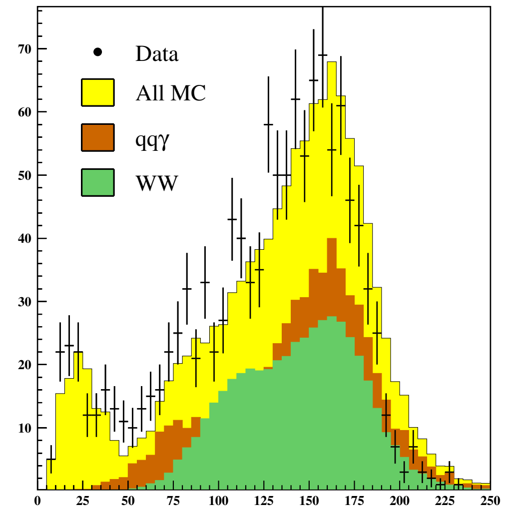


Coplanarity

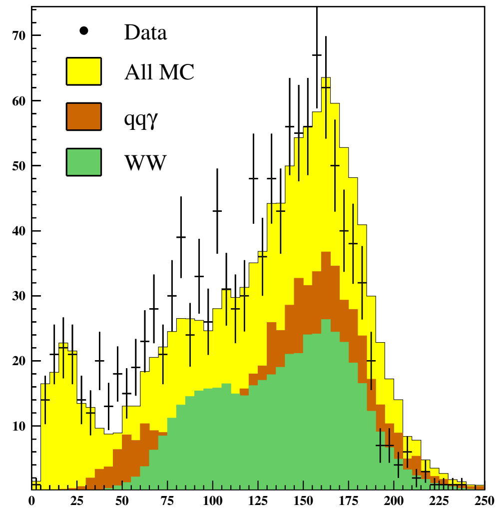


Probz0 2 jets

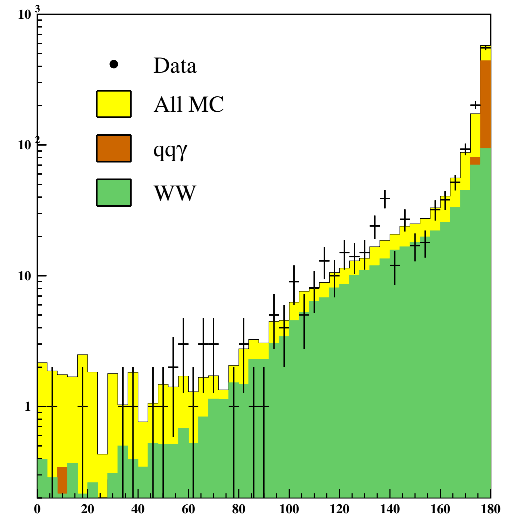
196 GeV :



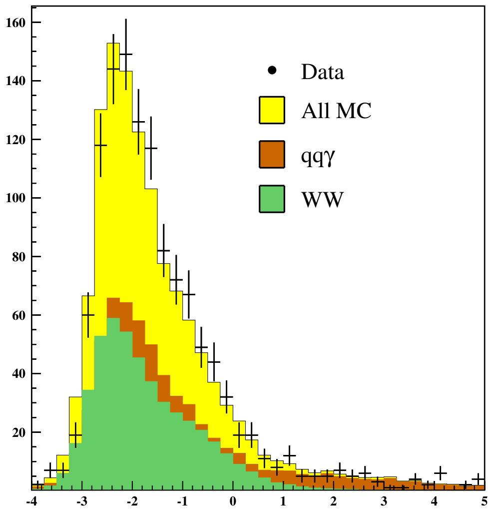
Visible Energy



Invariant visible mass

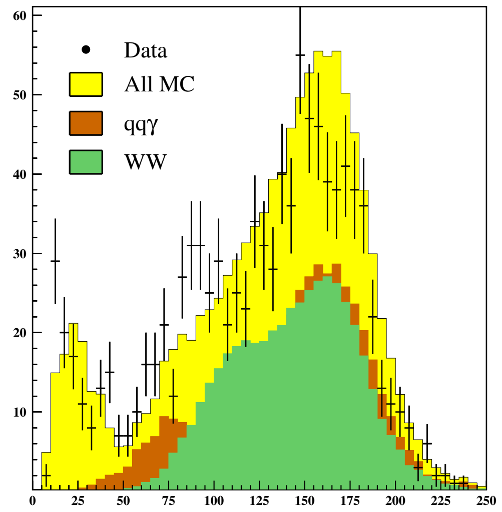


Coplanarity

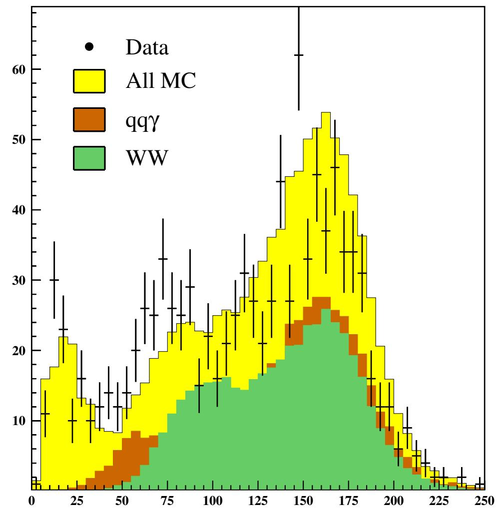


Probz0 2 jets

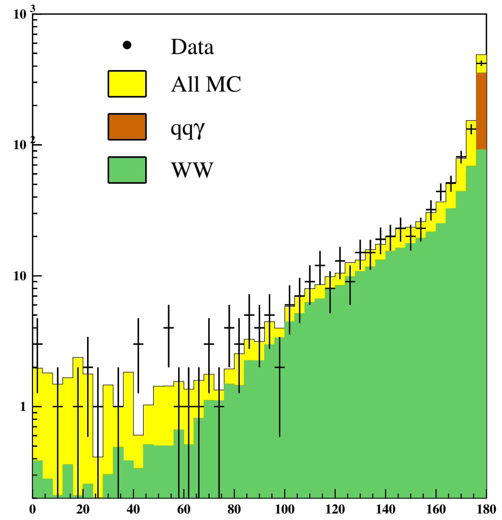
200 GeV :



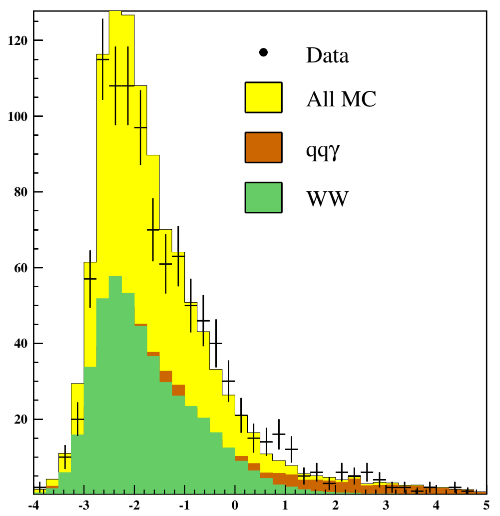
Visible Energy



Invariant visible mass

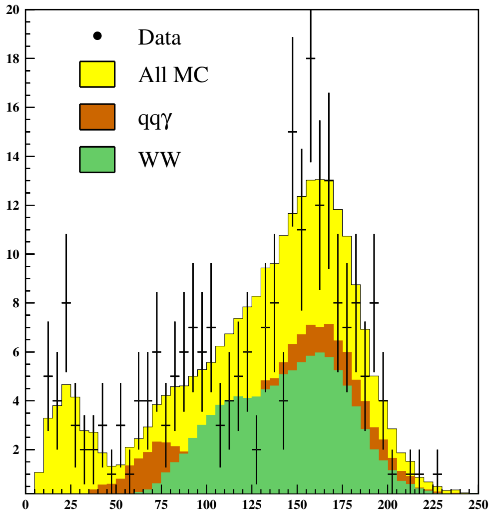


Coplanarity

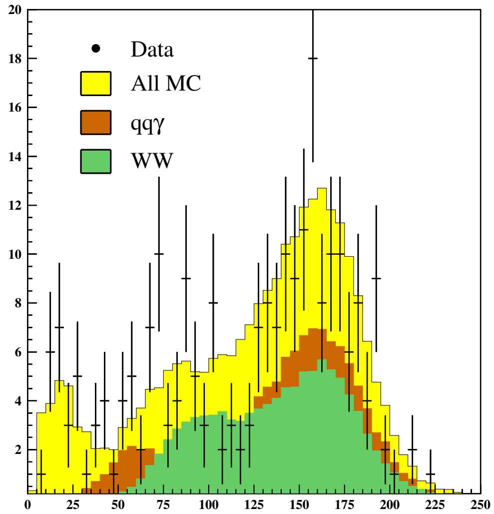


Probz0 2 jets

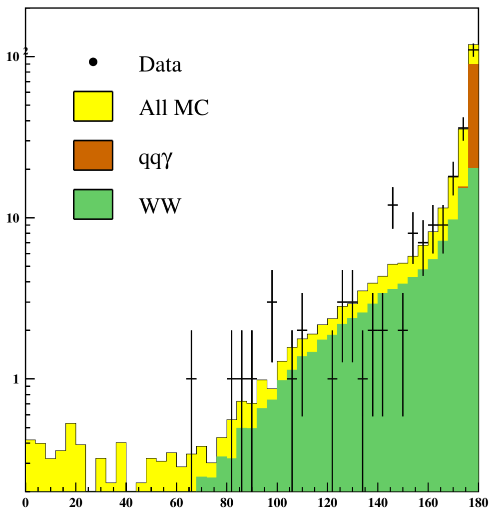
202 GeV :



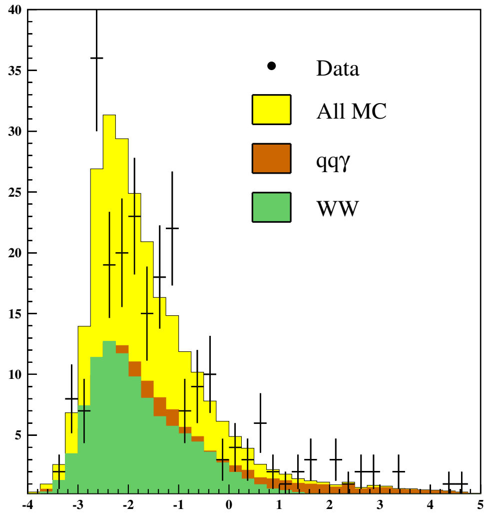
Visible Energy



Invariant visible mass

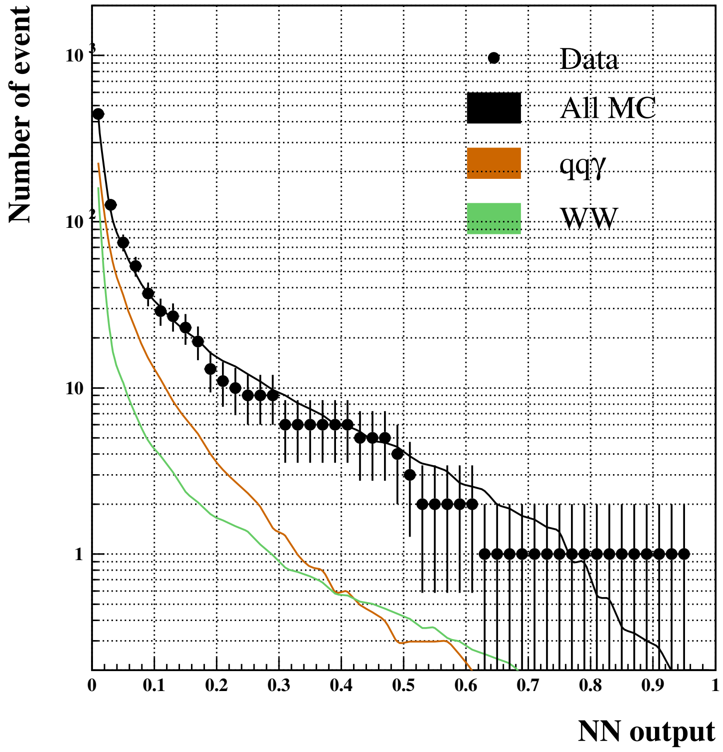


Coplanarity



Probz0 2 jets

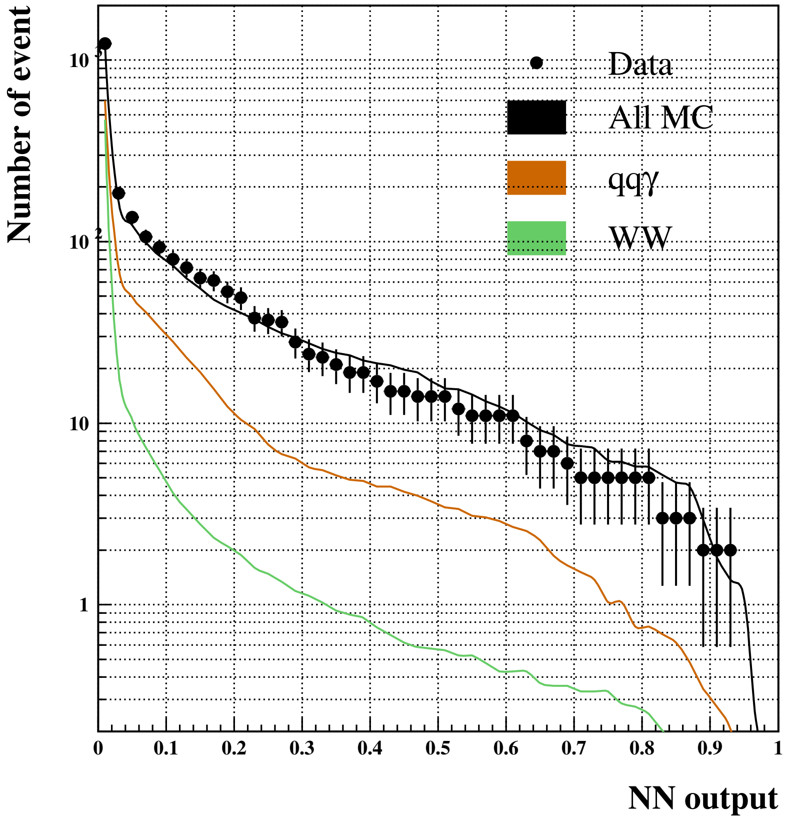
Stop $10 \leq \Delta M < 30$:



	sbottom		
	High	Low	Combined
Data	1	0	1
MC	0.69 ± 0.16	0.02 ± 0.008	0.70 ± 0.16

	stop		
	High	Low	Combined
Data	1	1	2
MC	0.80 ± 0.11	0.36 ± 0.13	1.05 ± 0.17

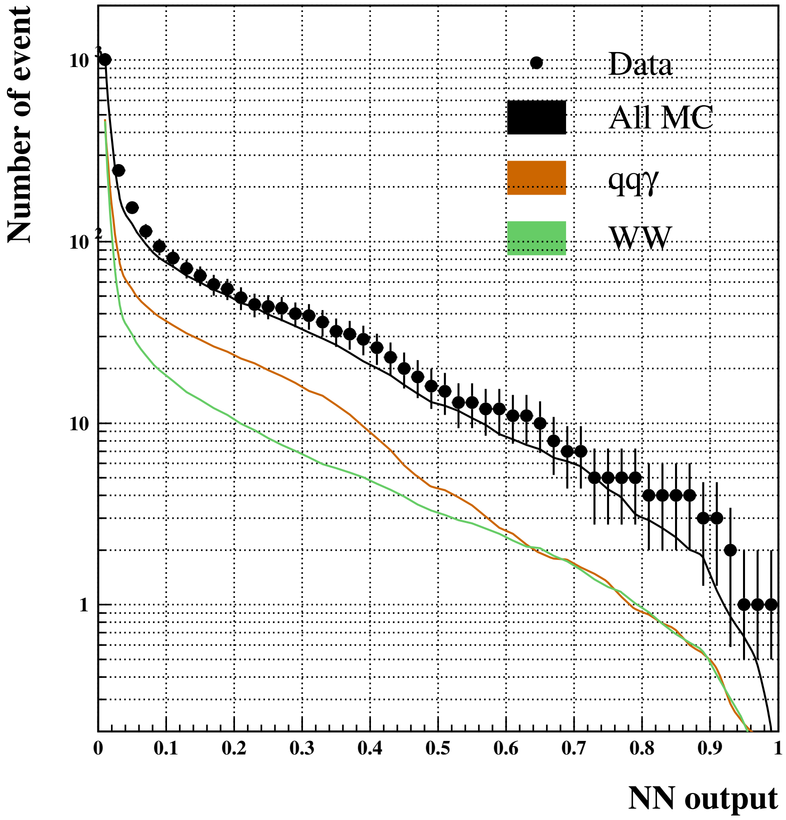
Sbottom $10 \leq \Delta M < 30$:



	sbottom		
	High	Low	Combined
Data	1	0	1
MC	1.12 ± 0.18	0.07 ± 0.03	1.15 ± 0.18

	stop		
	High	Low	Combined
Data	0	0	0
MC	2.00 ± 0.19	1.04 ± 0.35	2.78 ± 0.40

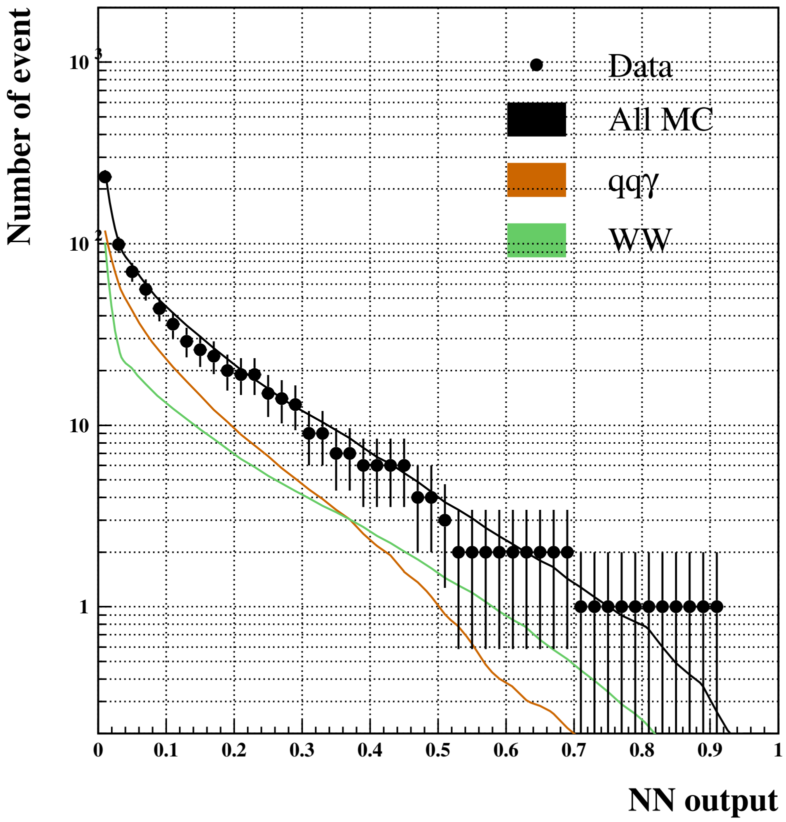
Sbottom $\Delta M \geq 30$:



	sbottom		
	High	Low	Combined
Data	1	1	2
MC	1.19 ± 0.15	0.13 ± 0.05	1.23 ± 0.15

	stop		
	High	Low	Combined
Data	1	0	1
MC	1.90 ± 0.15	0.97 ± 0.33	2.61 ± 0.36

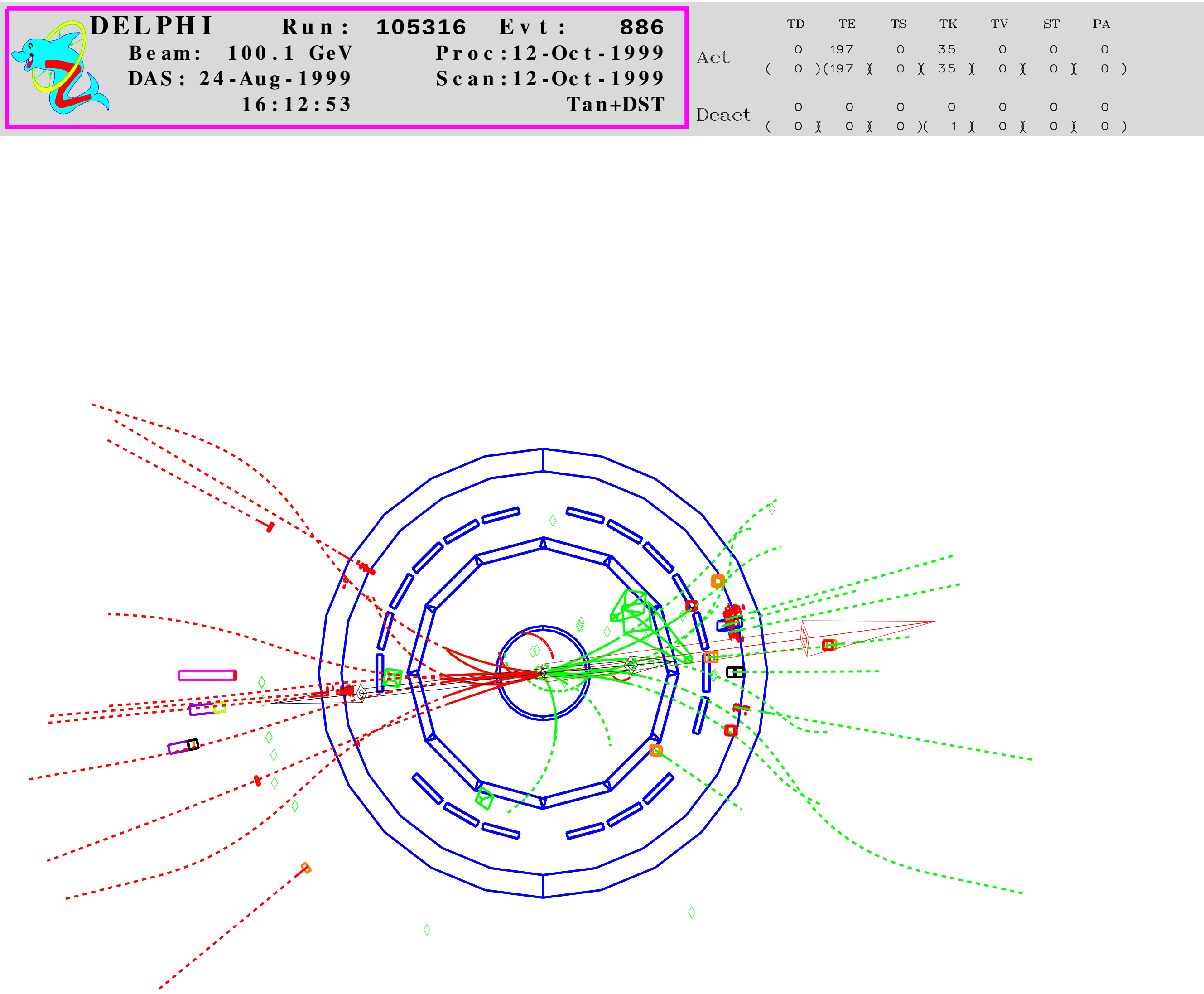
Stop $\Delta M \geq 30$:



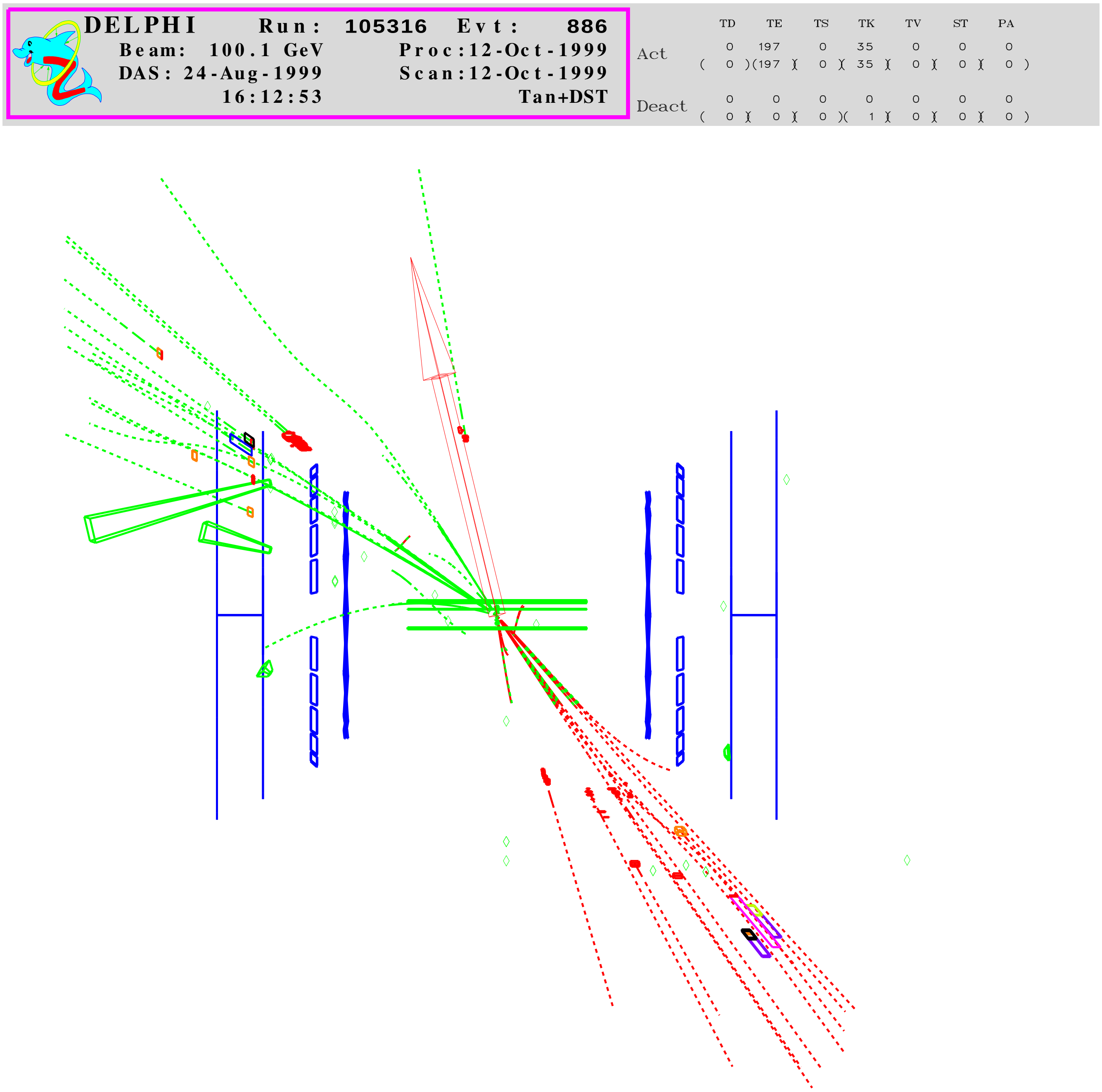
	sbottom		
	High	Low	Combined
Data	0	0	0
MC	0.28 ± 0.03	0.04 ± 0.01	0.29 ± 0.04

	stop		
	High	Low	Combined
Data	1	0	1
MC	0.45 ± 0.04	0.21 ± 0.07	0.60 ± 0.08

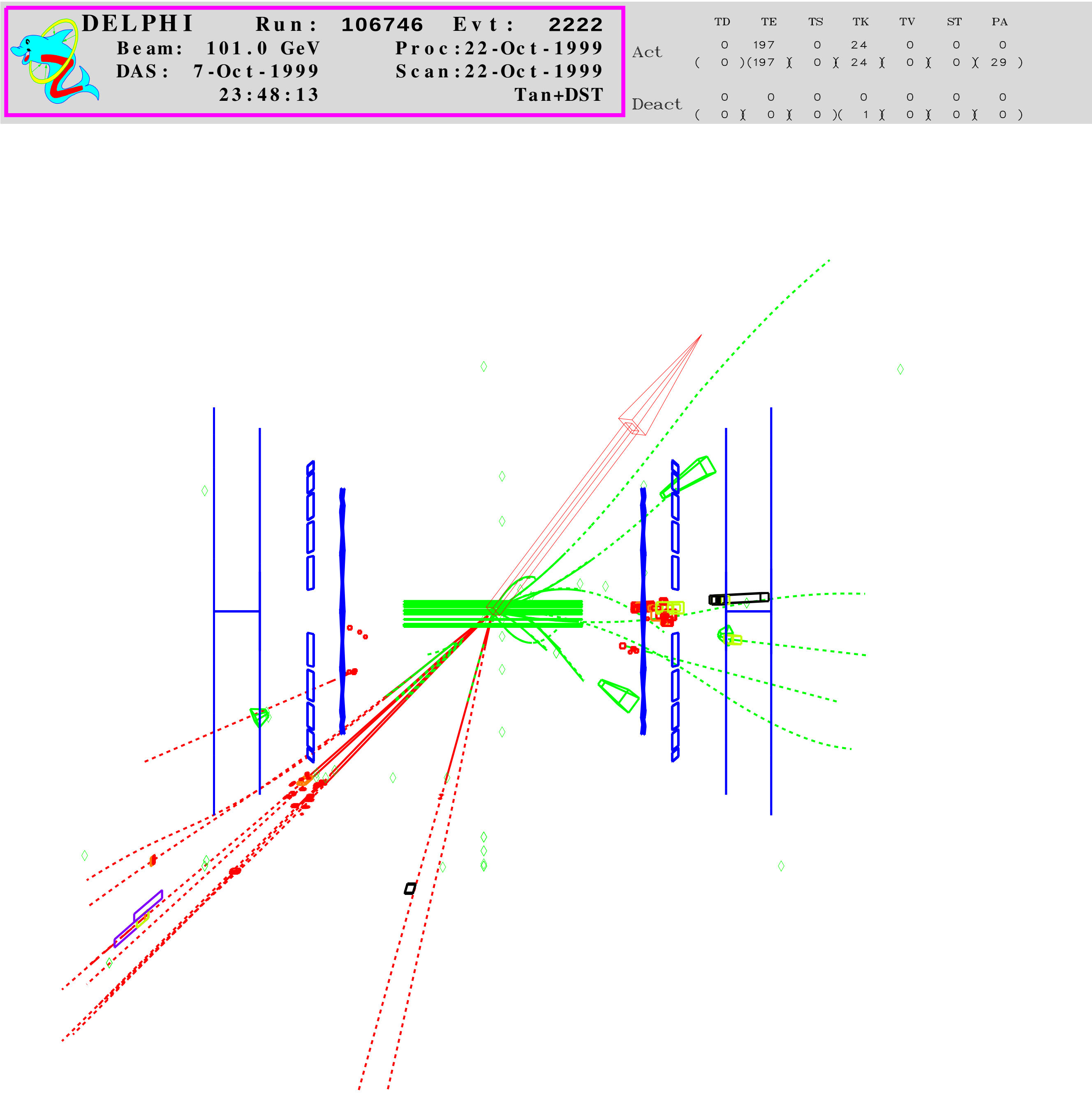
Sbottom candidate at 200 :



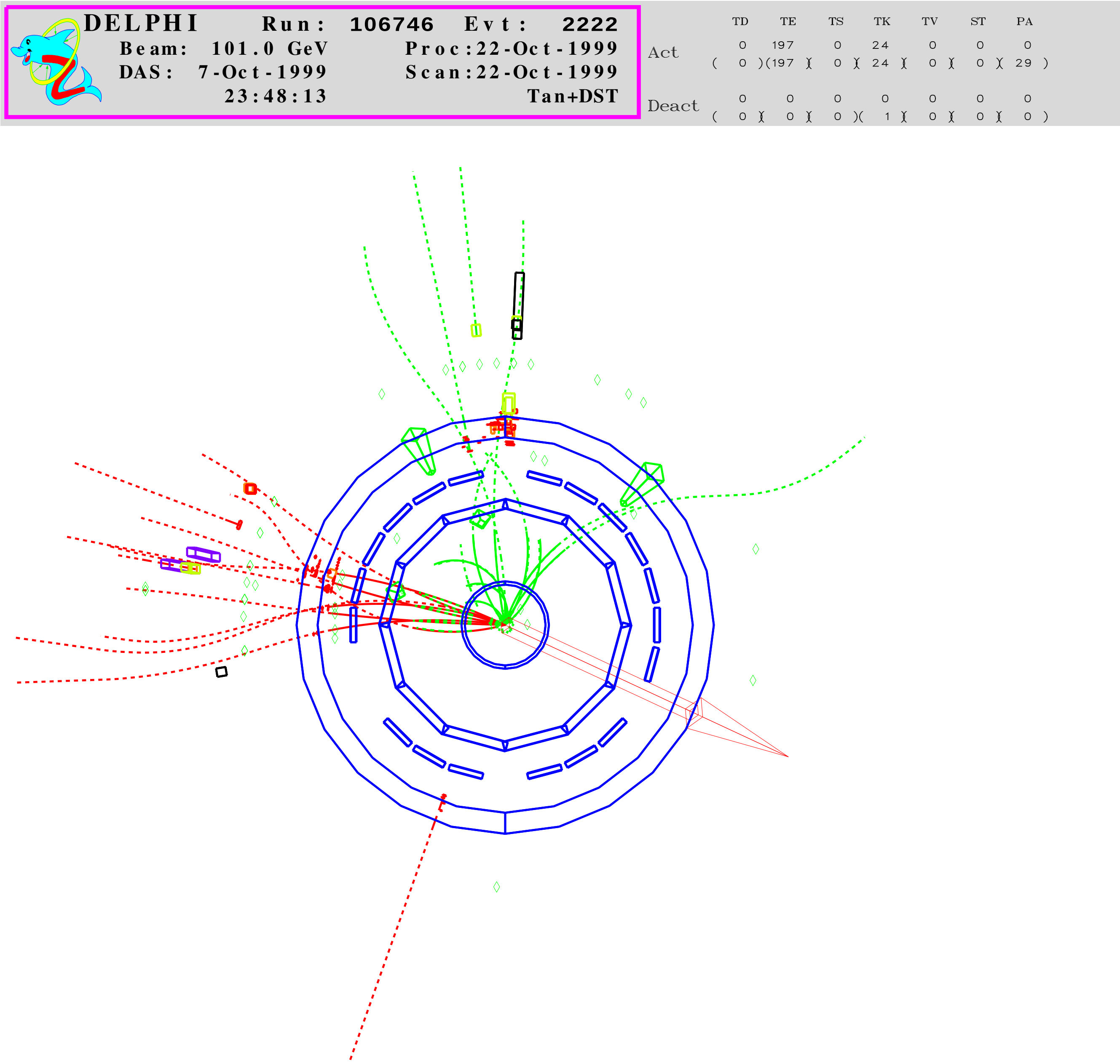
Sbottom candidate at 200 :



Stop candidate at 202 :



Stop candidate at 202 :



Final results:

Number of events:

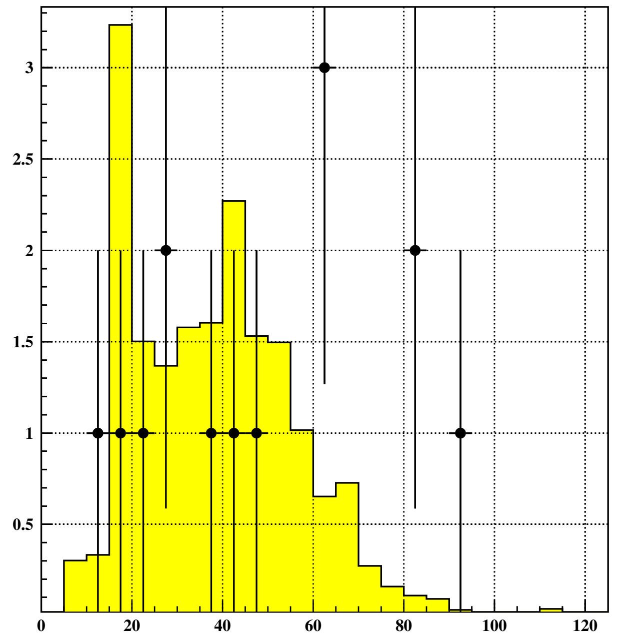
	sbottom		
	High	Low	Combined
Data	3	1	4
MC	3.27	0.26	3.37

	stop		
	High	Low	Combined
Data	3	1	4
MC	5.15	2.58	7.04

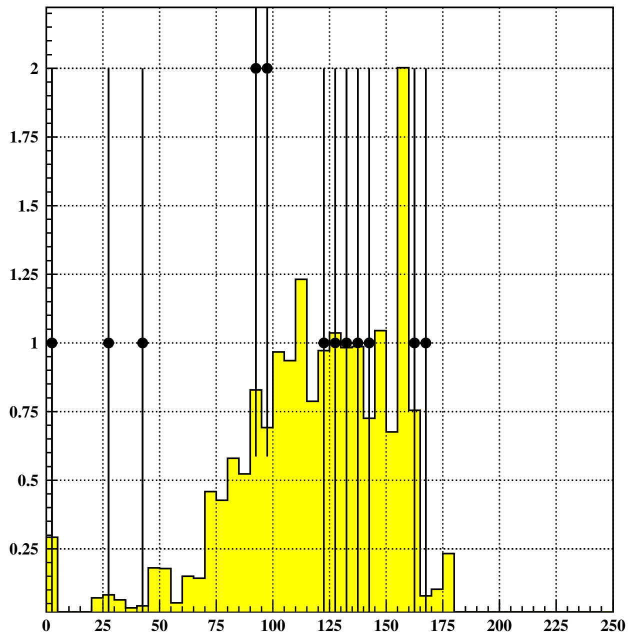
	squarks
Data	8
MC	9.15

No excess

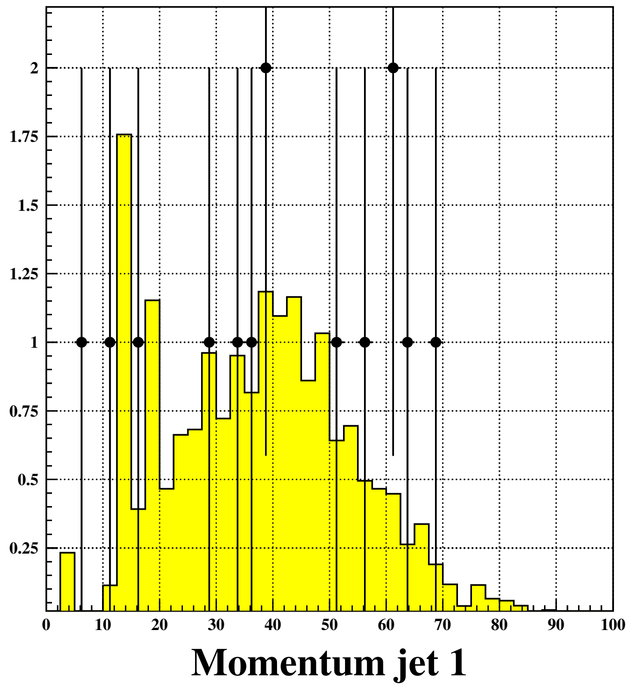
$\Longrightarrow$ PRELIMINARY EXCLUSION.

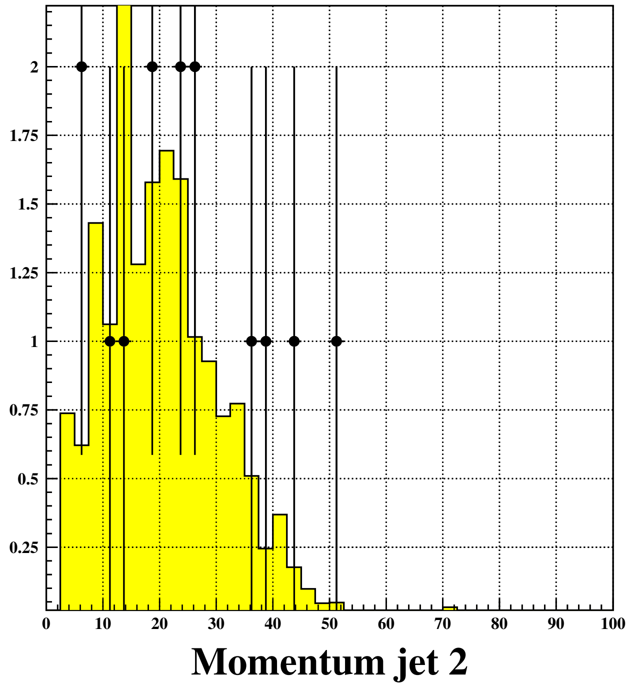


Invariant visible mass

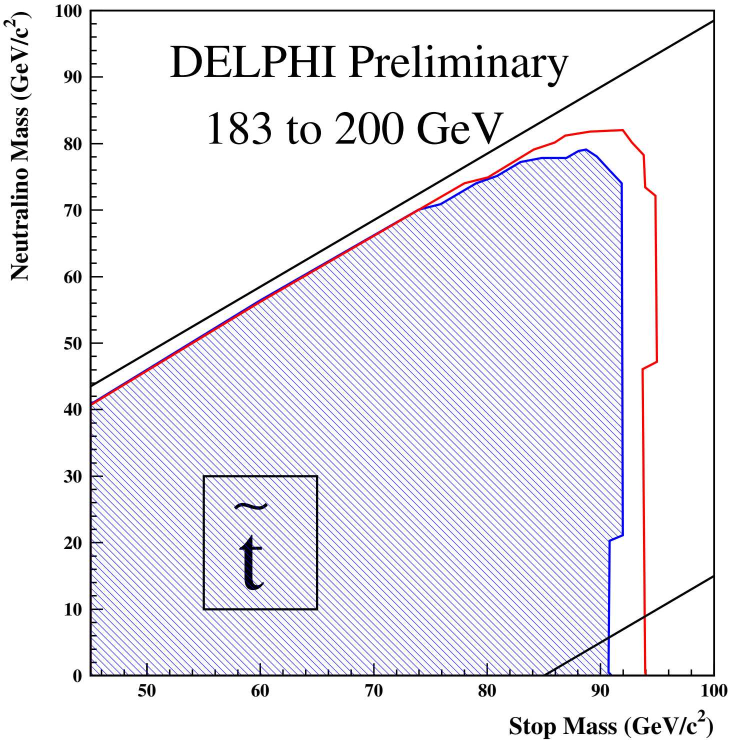


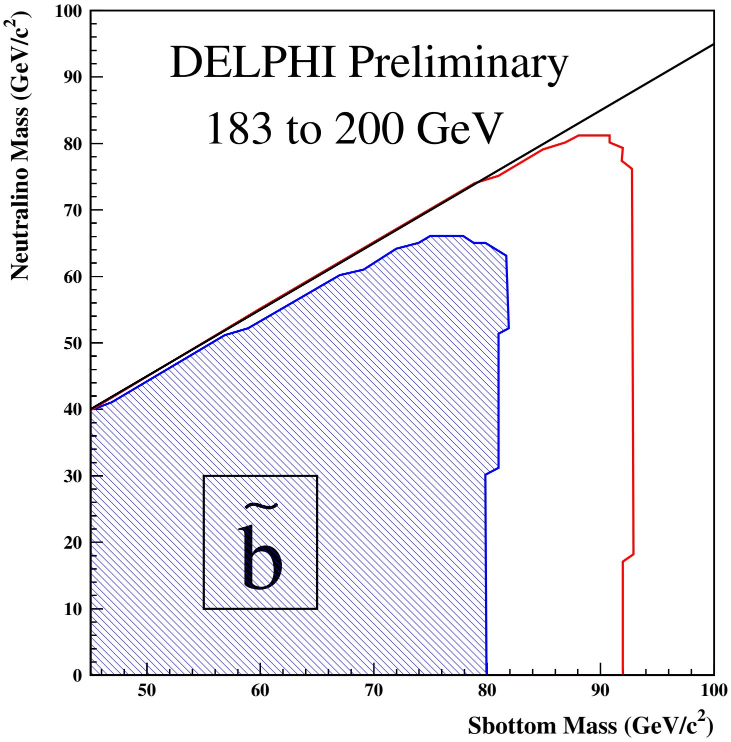
Invariant invisible mass


Momentum jet 1


Momentum jet 2

N run	N evnt	sbo1	sbo2	sto1	sto2	M_{vis}	M_{inv}
77116	8127	0	0	0	1	14.9	167.5
77883	12491	1	0	0	0	38.5	125.9
79958	4170	0	0	1	0	46.5	134.6
88410	17506	1	0	1	0	24.7	91.6
88625	7431	0	0	0	1	18.9	163.3
83670	7367	1	0	1	0	44.5	121.6
101882	15053	0	0	0	1	29.4	141.2
102367	22448	1	0	0	0	82.1	26.5
102665	4447	0	0	1	0	26.9	95.2
104075	18929	1	0	0	0	81.0	42.0
104807	19156	1	0	0	0	62.3	95.4
105114	8386	0	0	0	0	92.0	-
105316	886	1	0	1	0	60.8	137.3
105883	8546	1	0	0	0	60.2	93.4


DELPHI Preliminary
183 to 200 GeV
$\tilde{t}$
Neutralino Mass (GeV/c^2)
Stop Mass (GeV/c^2)
0
10
20
30
40
50
60
70
80
90
100
50
60
70
80
90
100


DELPHI Preliminary
183 to 200 GeV
$\tilde{b}$
Neutralino Mass (GeV/c^2)
Sbottom Mass (GeV/c^2)
0
10
20
30
40
50
60
70
80
90
100
50
60
70
80
90
100

Conclusion :

Number of events :

	Sbottom	Stop	Squark
Data	4	4	8
MC	3.37	7.04	9.15

Mass limits :

	$\Theta_{mix} = 0$	$Z^o decoupling$
Sbottom	≥ 92	≥ 80
Stop	≥ 94	≥ 91

- Combination of the results with Marc's analysis at low ΔM
- Exclusion using all DELPHI data

$\Longrightarrow$ **http://www.home.cern.ch/ verdier/**