Squarks Searches Using Neural Network

R-parity Conservation

$$\tilde{q} \longrightarrow q\widetilde{\chi}_1^o$$

Non-degenerate mass case : $\Delta M \ > 10$

- MAD with the **C2 processing**.
- **Neural networks**.
- **Exclusion limits**.

C2 Processing

- Track Selection : cf. Chris Parkes selection criteria for hadronic analysis.

Same selection for the stop and sbottom analysis.

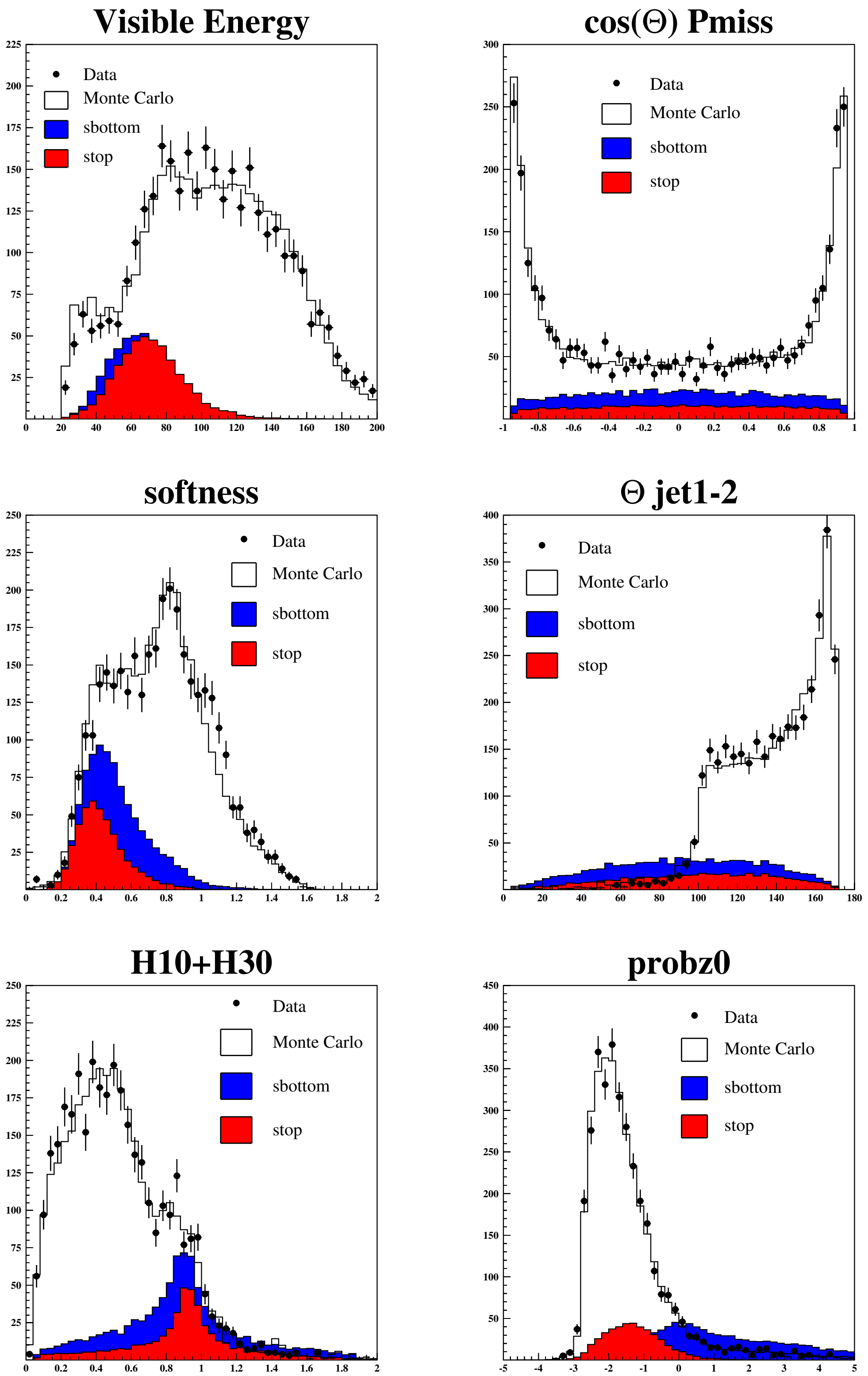
	$\Delta M > 30$	$\Delta M \leq 30$
Preselection	same preselection cuts	
STEP 1	$E_t > 20$ GeV	$E_t > 15$ GeV N ch. part. ≥ 7 N ch. part. $(\theta > 60) \geq 1$
STEP 2	θ jet1-jet2 $< 170.$	
STEP 3	Hermeticity Veto	

	$\Delta M > 30$			$\Delta M \leq 30$		
	Data	MC (unb.)	MC (b.)	Data	MC (unb.)	MC (b.)
Presel.	17750	35109.	19650.	17750	35109.	19650.
STEP 1	9197	9097.	9112.	8704	8587.	8597.
STEP 2	4229	3957.	3968.	4248	4002.	4003.
H. Veto	3435	3308.	3318.	3466	3352.	3355.

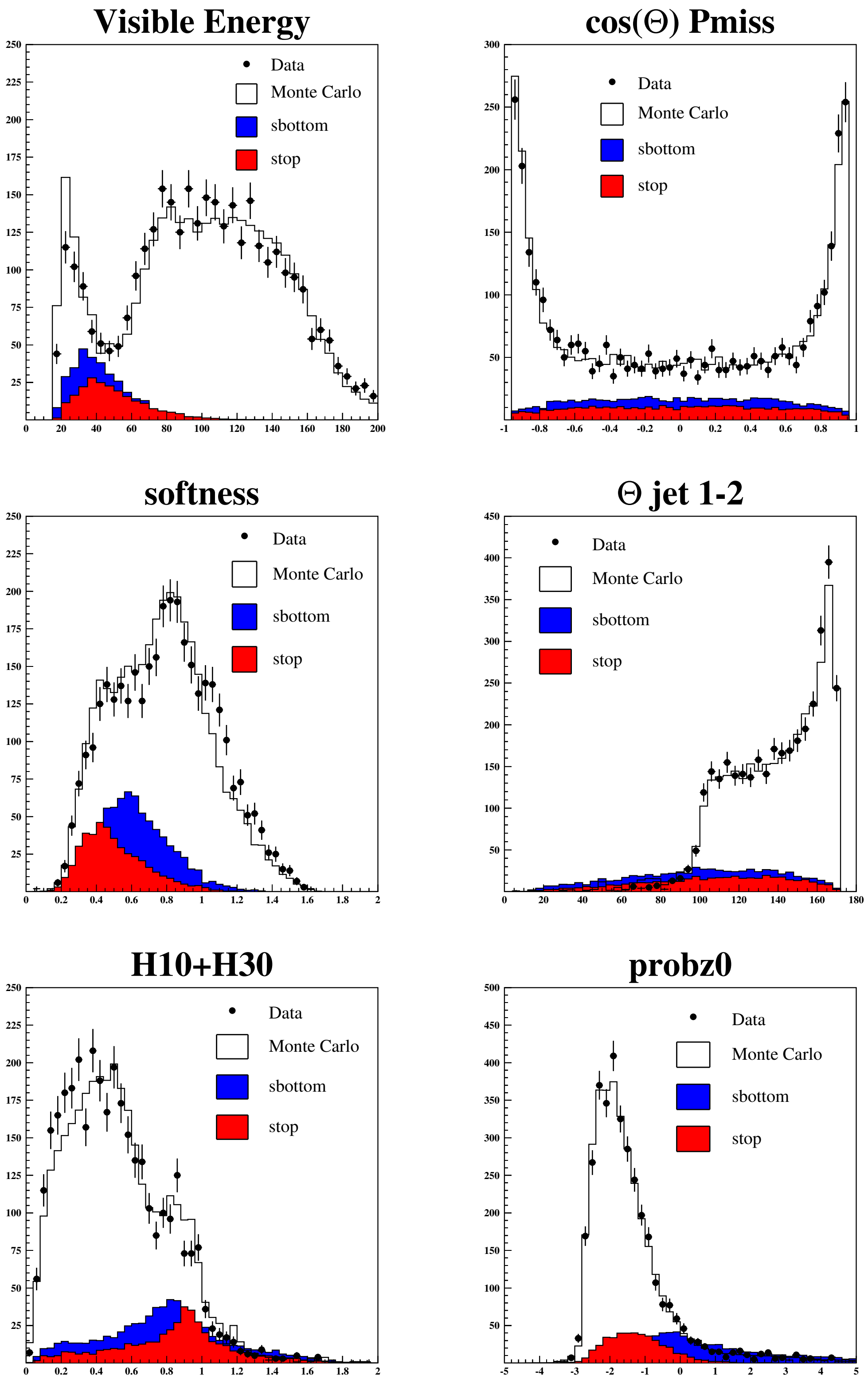
Hermeticity Veto : Loop over the taggers and find the most isolated tagger from jets and closest from P^{miss} :

$$40^o \text{ Taggers : } \theta^{jets} < 30^o \text{ OR } \theta^{Pmiss} > 50^o$$
$$90^o \text{ Taggers : } \theta^{jets} < 20^o \text{ OR } \theta^{Pmiss} > 80^o$$

MAD : high Δm



MAD : medium Δm



Same neural network structure and variables for the stop and sbottom analysis, AND for the mass analysis windows $\Delta m > 30$, $10 < \Delta M \leq 30$

- Number of inputs : 16
- Number of hidden nodes : 16
- Number of Outputs : 3

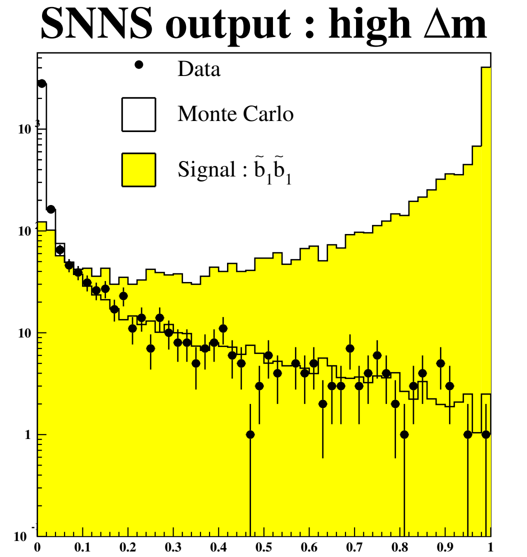
- Input variables : E_{vis}, E_t, M_{vis}, $\sqrt{s'}$, $\cos(\theta^{Pmiss})$, $E_t^{ch.}$(jet1), $E_t^{ch.}$(jet2), softness, $\theta_{jet1-jet2}$, $\theta_{jet1-jet2}^{trans.plane}$, acolin. and acoplan. wrt sphericity axe, acolin., H10+H30, probz0, $probz0_{2jets}^{durham}$.

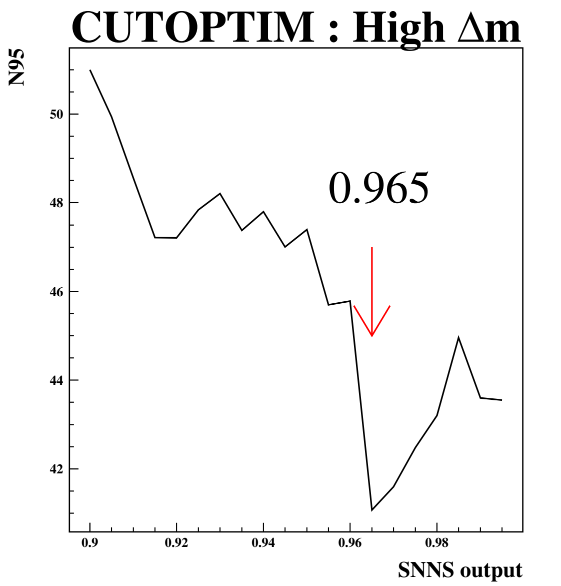
  softness=$\frac{M_1}{E_1} + \frac{M_2}{E_2}$

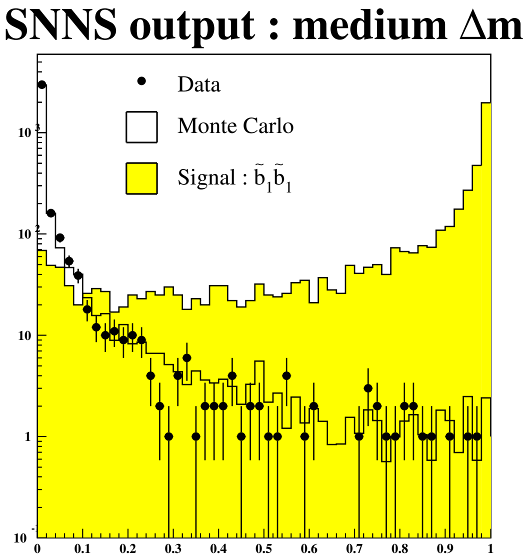
- Output :

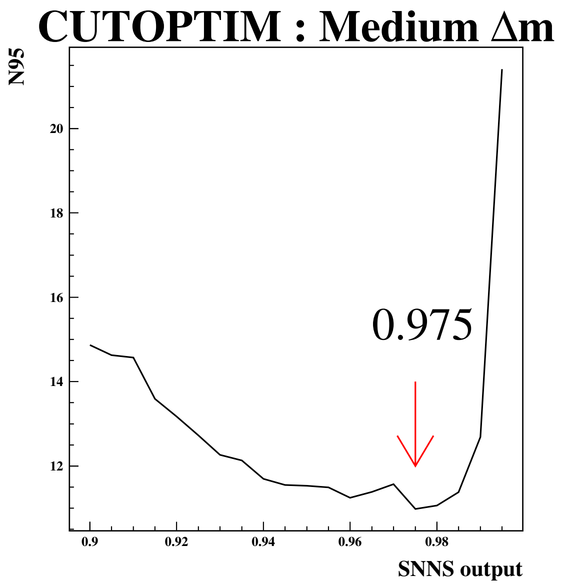
Output node	node 1	node 2	node 3
Signal	1	0	0
$q\bar{q}\gamma$ W^+W^- Z^oZ^o $W^{\pm}e\nu$ $\nu\nu qq$	0	1	0
$\gamma\gamma QCD$ $\gamma\gamma QPM$	0	0	1

$\tilde{b}_1$: Outputs

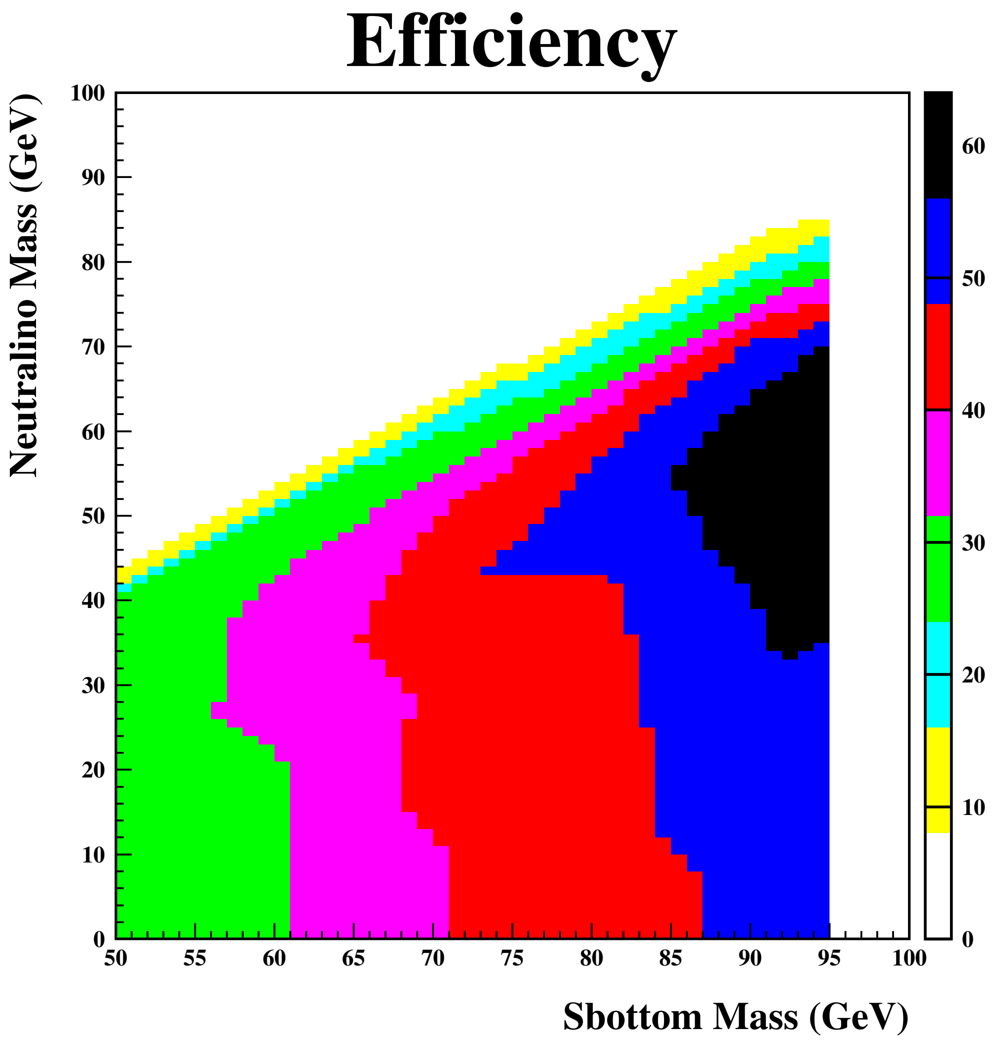




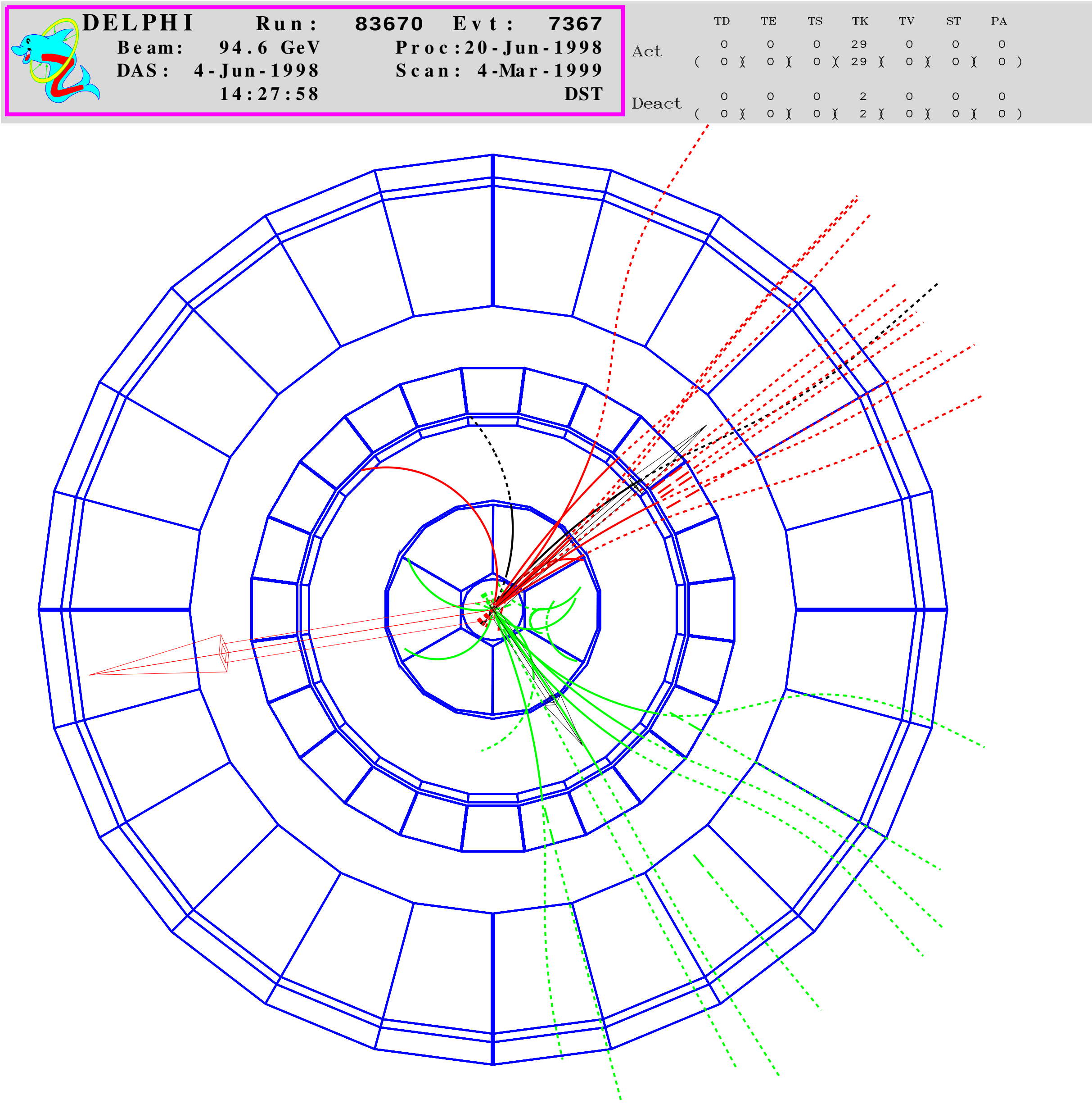


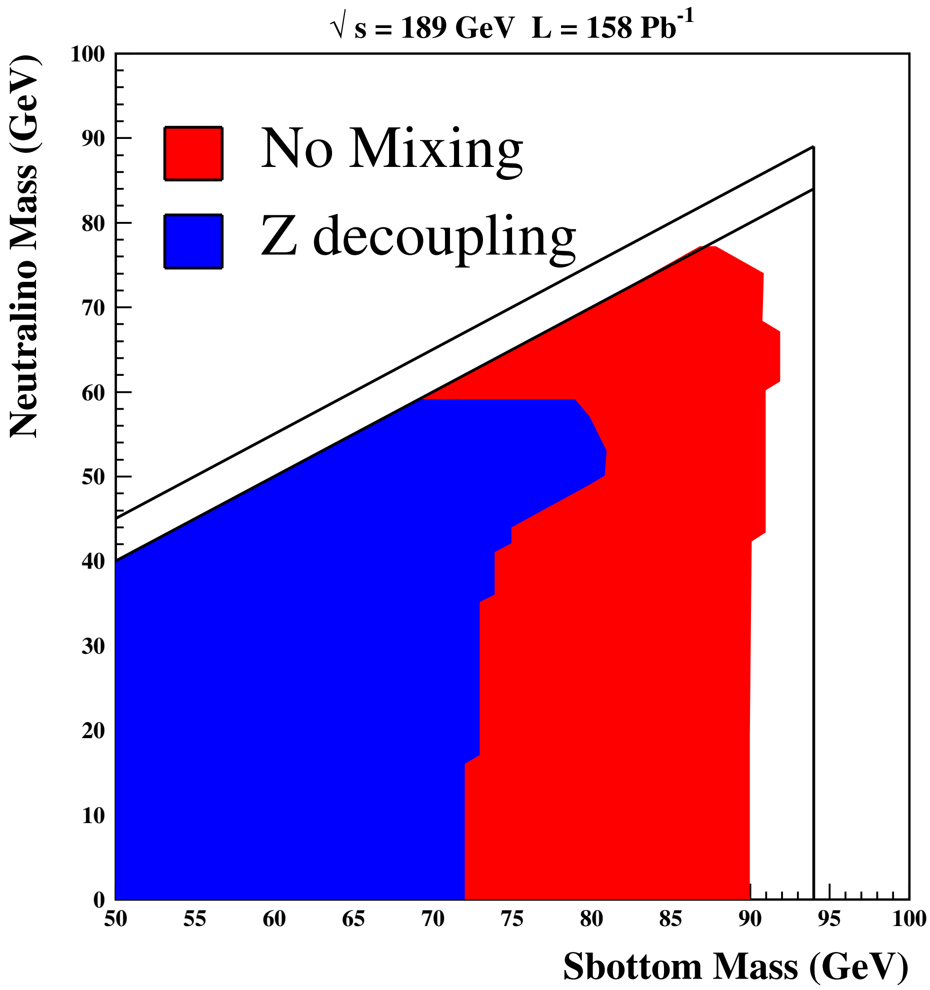


	$\Delta M > 30$	$10 < \Delta M \leq 30$
SNNS cut	0.965	0.975
Ndata	1	0
Nmc (unbiased)	3.45	2.57
Nmc (biased)	4.01	1.98
Nmc (substracting $\gamma\gamma$)	2.10	0.54



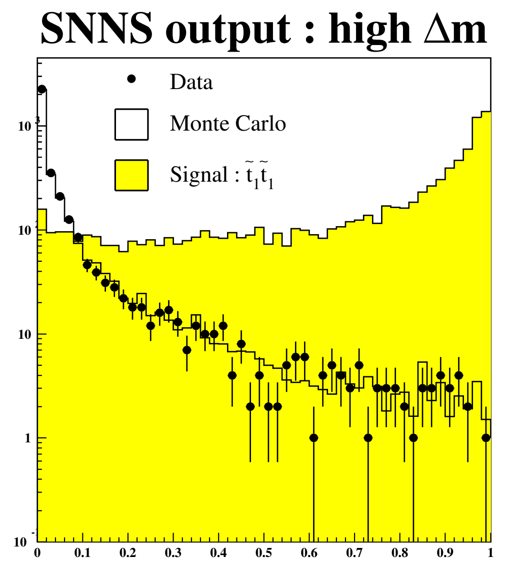
$\widetilde{b}_1$: Candidate

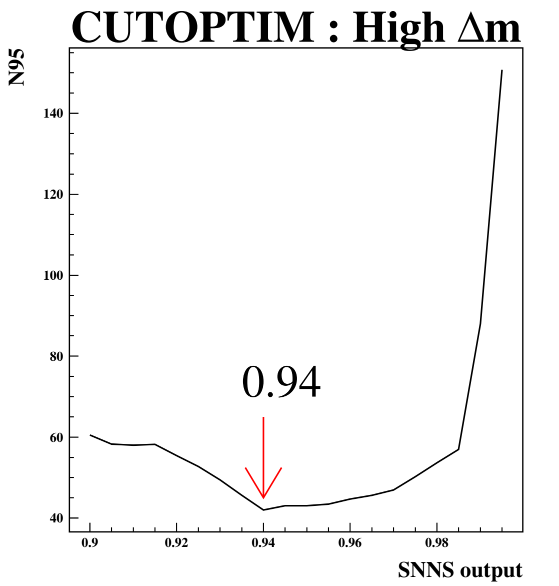


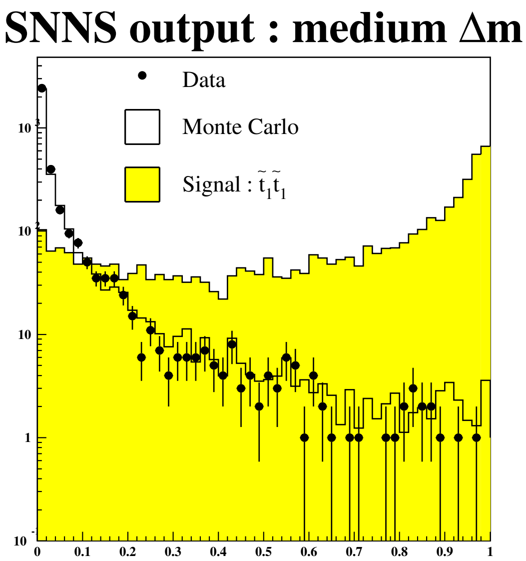


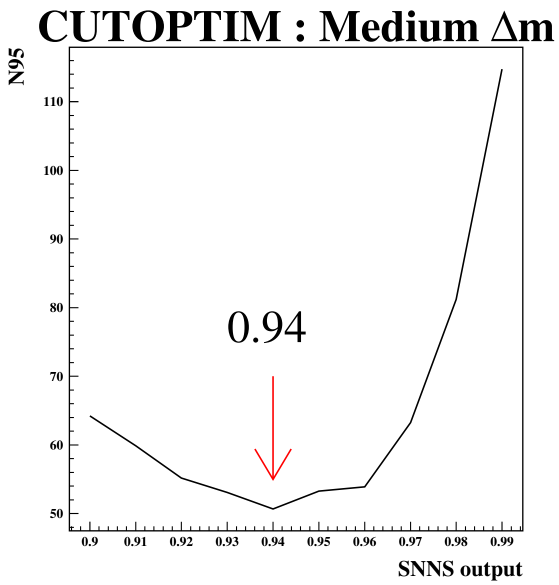
	$\Delta M \geq 15$
m($\tilde{b}_1$) (No mixing)	$\geq 90.$
m($\tilde{b}_1$) (Z decoupling)	$\geq 72.$

$\tilde{t}_1$: Outputs

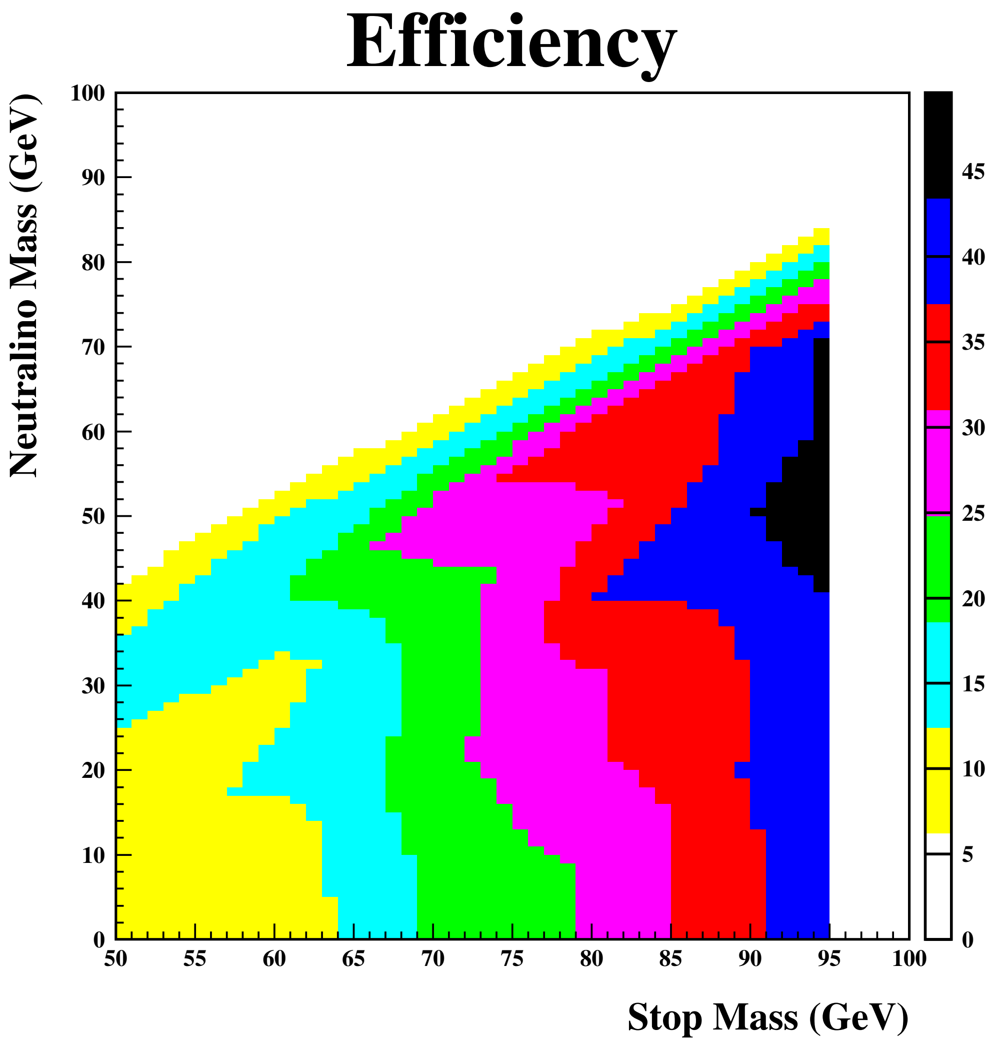


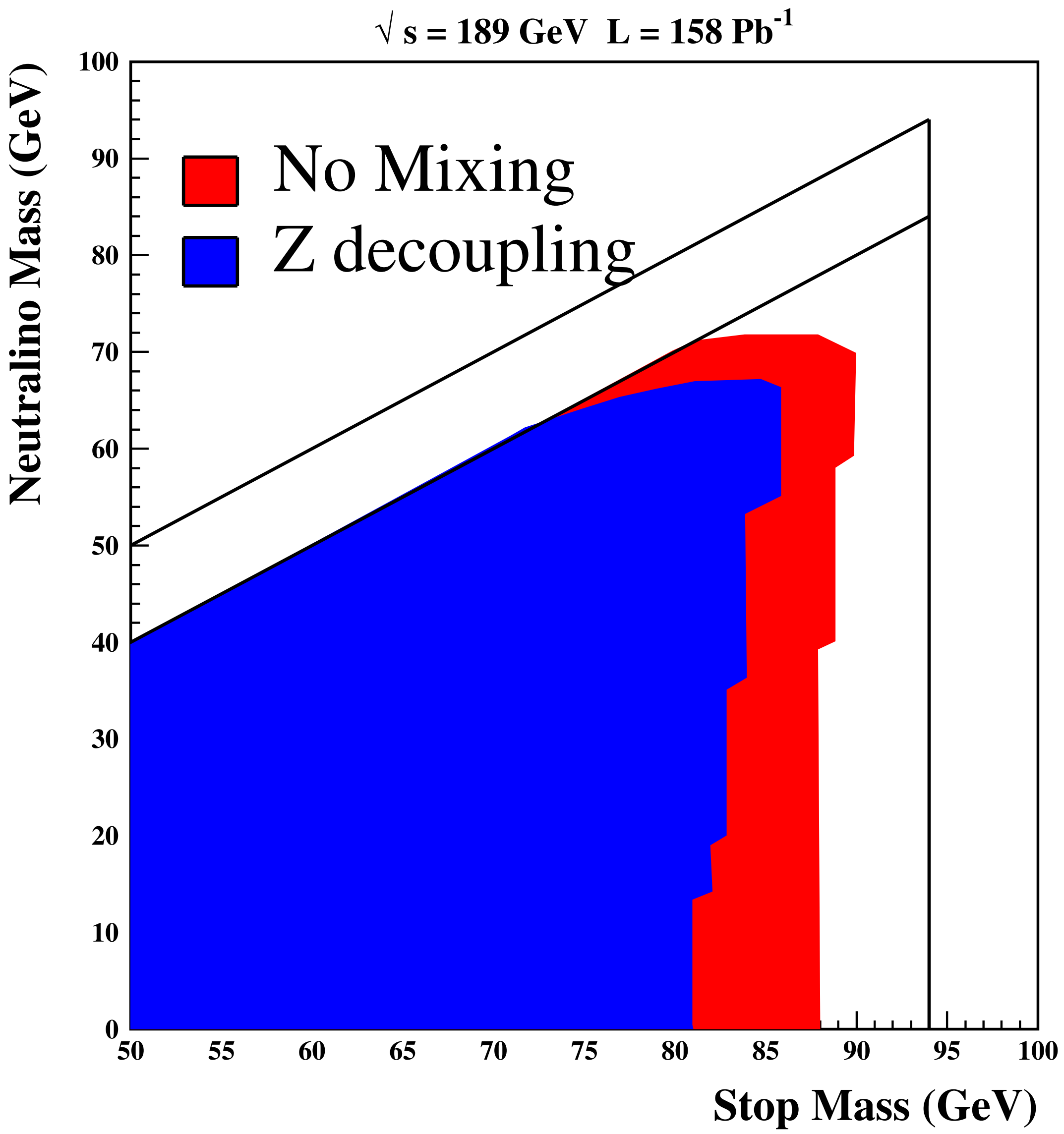






	$\Delta M > 30$	$10 < \Delta M \leq 30$
SNNS cut	0.94	0.94
Ndata	3	1
Nmc (unbiased)	6.89	5.95
Nmc (biased)	4.26	4.98
Nmc (substracting $\gamma\gamma$)	3.78	1.217





	$\Delta M \geq 15$
m($\tilde{t}_1$) (No mixing)	$\geq 88.$
m($\tilde{t}_1$) (Z decoupling)	$\geq 81.$

Conclusion

- Results : $\Delta M \geq 15$

	No mixing	Z decoupling
$\mathbf{m}(\tilde{b}_1)$	$\geq 90.$ ($\geq 87.$)	$\geq 72.$ ($\geq 62.$)
$\mathbf{m}(\tilde{t}_1)$	$\geq 88.$ ($\geq 84.$)	$\geq 81.$ ($\geq 79.$)

- Work to do :
  - Waiting for $\gamma\gamma$ samples at 189 GeV.
  - Run on the D2 processing.
  - Special treatment for the analysis $\Delta M \leq 10.$
  - Run the analysis on the 183 GeV data to add the 53 pb^{-1}.