

DELPHI week, November 2001

Presented by: S. Ask & T. Alderweireld

Search for charginos

○ The final selection

Year 2000 data, c1 processing.

Year 2000 data, s1 processing.

The II 1 Data-MC difference.

○ Detection efficiencies

Year 2000 data, c1 processing.

Year 2000 data, s1 processing.

○ Systematical errors

The “Verdier” approach.

Our results for the year 2000 data,
c1 & s1 processing.

EVENTS



for a given topology

Topological cuts
(the same for all ΔM)



Preselection cuts
(different for each ΔM)



Likelihood cut

$$(\mathcal{L}_{\mathcal{R}}(x_1, \dots, x_n) = \frac{\prod_{i=1}^n P_S^i(x_i)}{\prod_{i=1}^n P_B^i(x_i)})$$

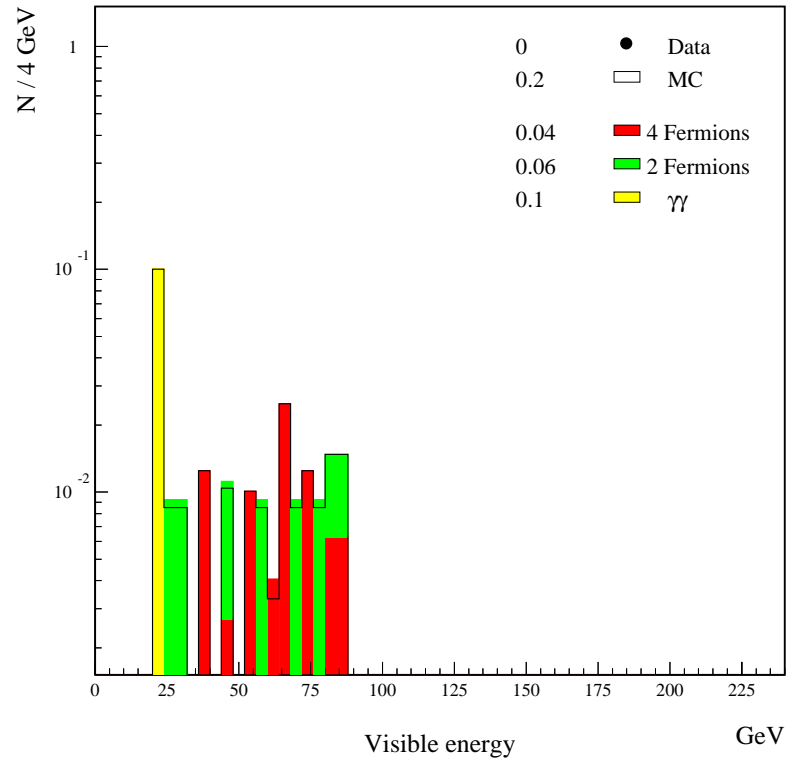
Optimised for $E_{cm} = 200, 206 \text{ \& } 207 \text{ S1}$

ΔM REGIONS

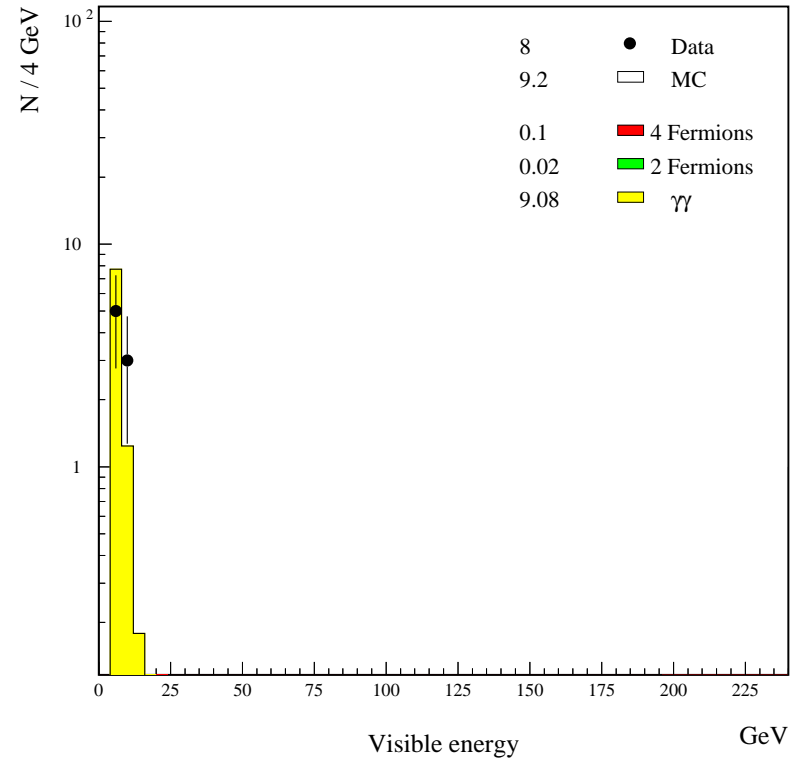
$3 \leq$	ΔM	< 5	GeV/c^2
$5 \leq$	ΔM	< 10	GeV/c^2
$10 \leq$	ΔM	< 25	GeV/c^2
$25 \leq$	ΔM	< 35	GeV/c^2
$35 \leq$	ΔM	< 50	GeV/c^2
$50 \leq$	ΔM		GeV/c^2

$E_{cm} = 205 \text{ GeV}, j_l 3 \text{ \& \# 1}$

DELPHI standard $\tilde{\chi}_1^+ \tilde{\chi}_1^-$ search

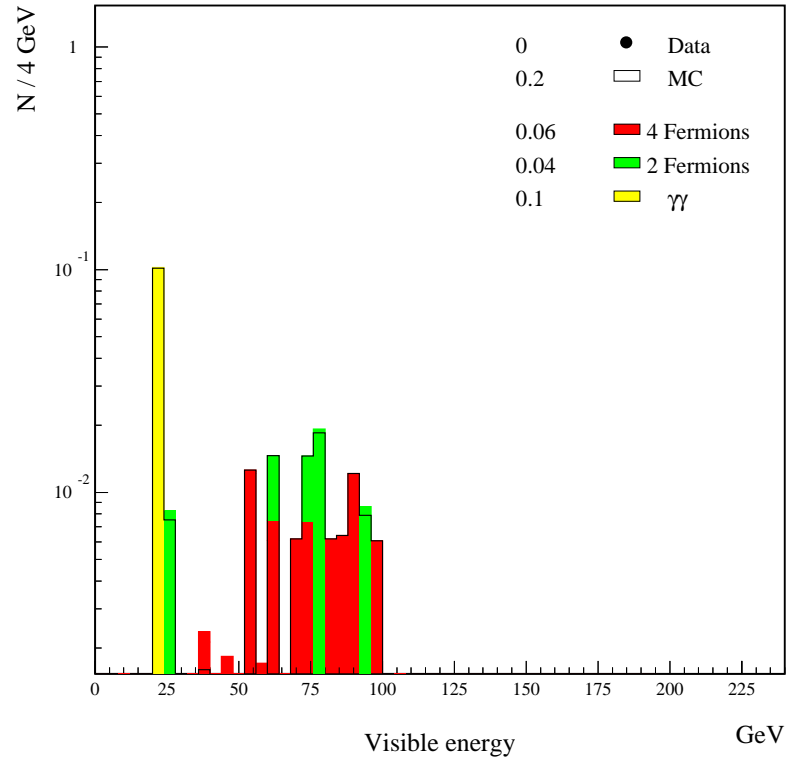


DELPHI standard $\tilde{\chi}_1^+ \tilde{\chi}_1^-$ search

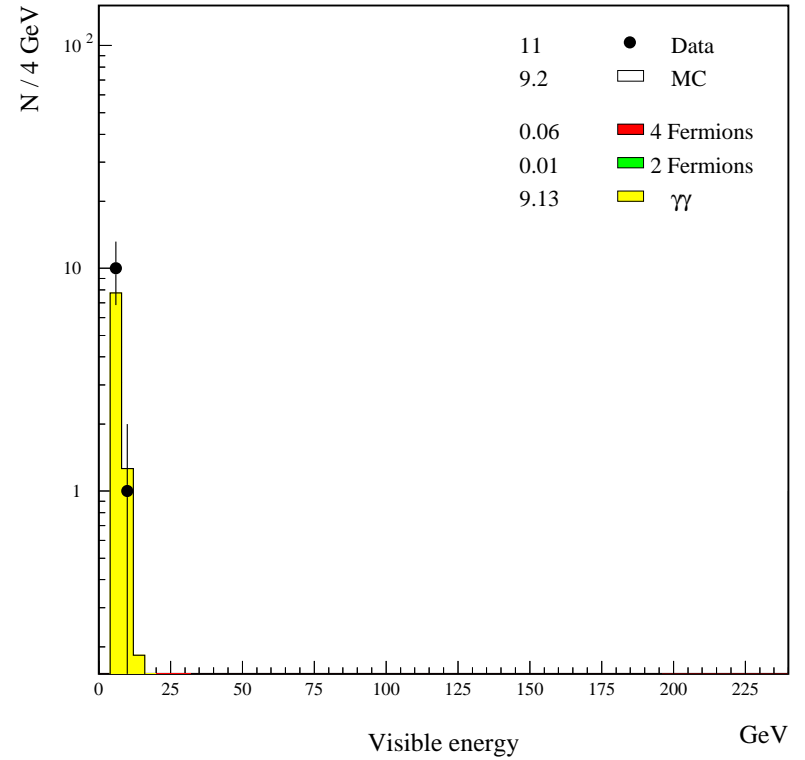


$E_{cm} = 207 \text{ GeV}, j \geq 3 \text{ \& \# 1}$

DELPHI standard $\tilde{\chi}_1^+ \tilde{\chi}_1^-$ search

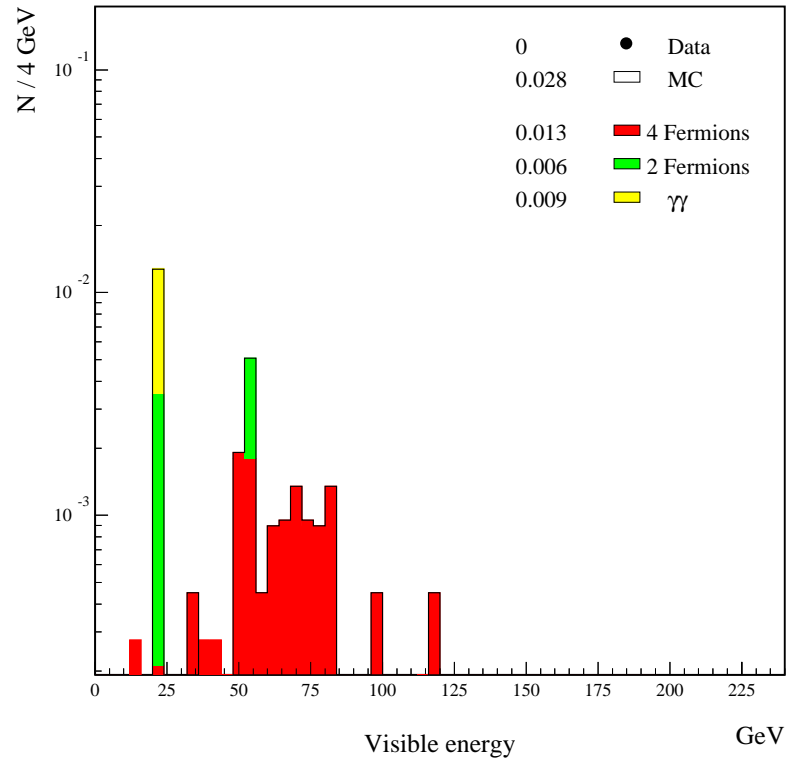


DELPHI standard $\tilde{\chi}_1^+ \tilde{\chi}_1^-$ search

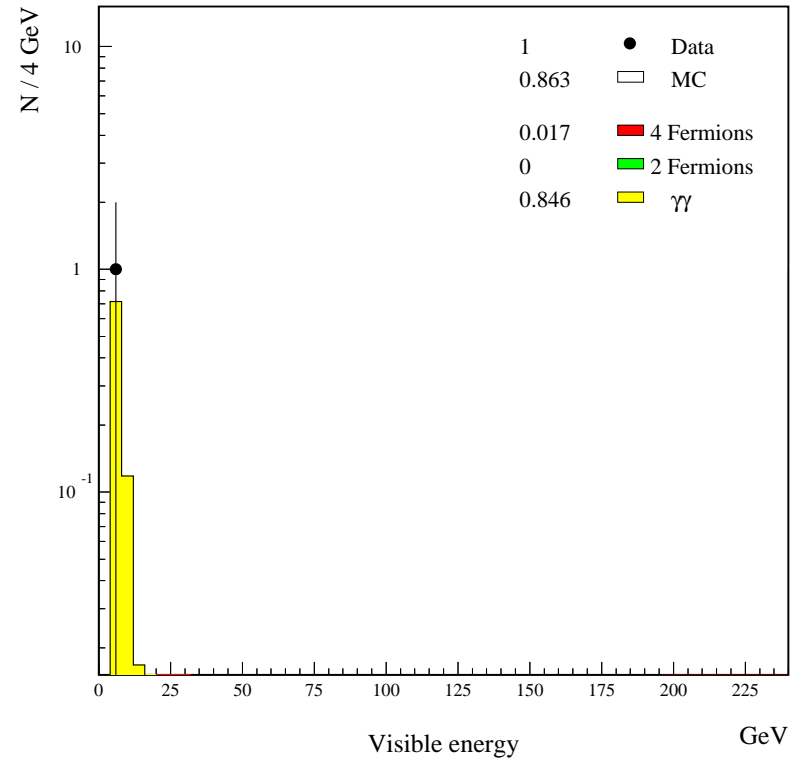


$E_{cm} = 208 \text{ GeV}, |j| \geq 3 \text{ \& \& } |l| \geq 1$

DELPHI standard $\tilde{\chi}_1^+ \tilde{\chi}_1^-$ search

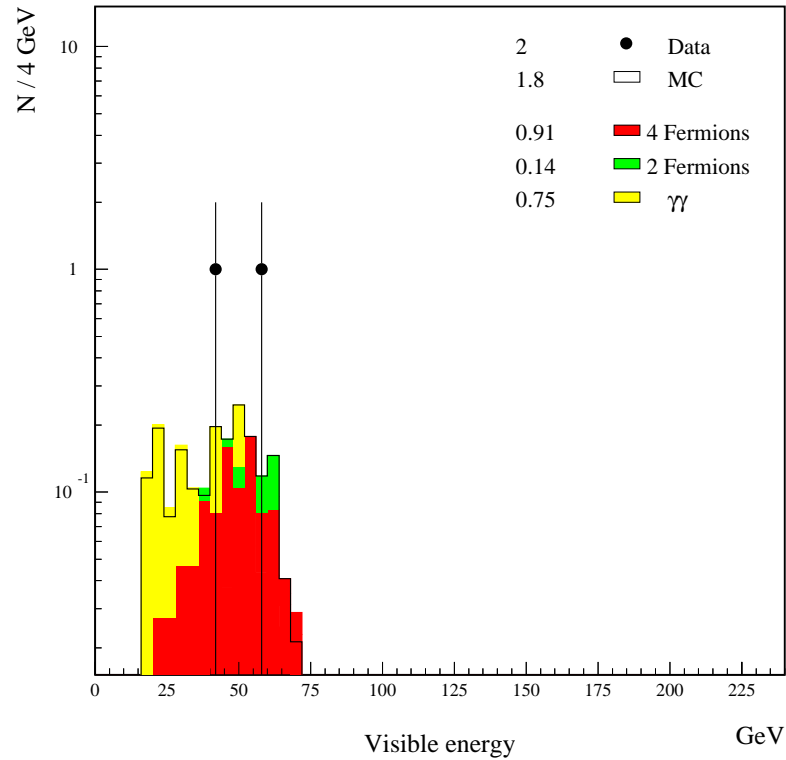


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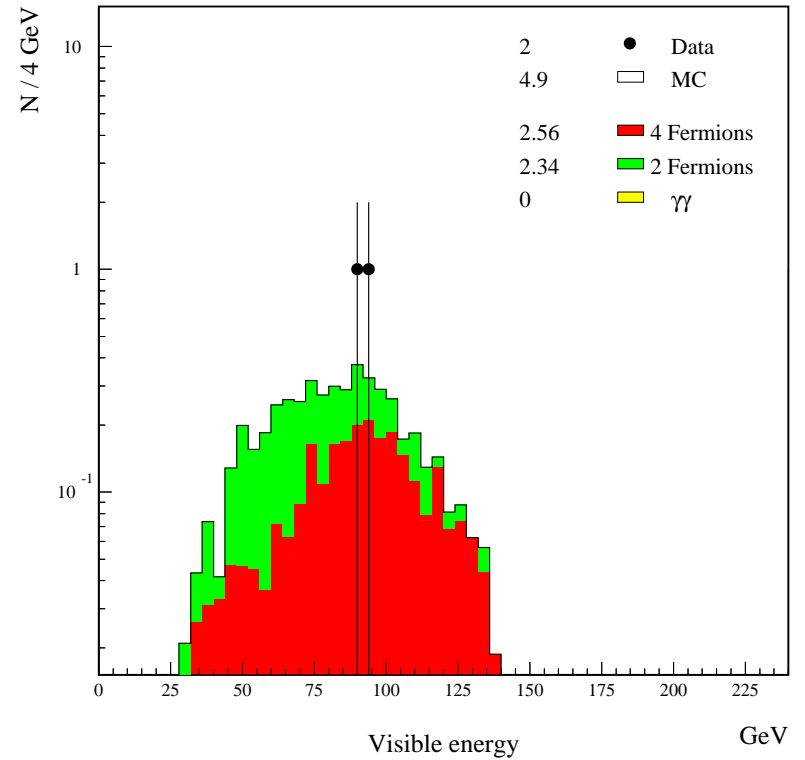


$E_{cm} = 205 \text{ GeV, jj 4 \& rad 5-6}$

DELPHI standard $\tilde{\chi}_1^+ \tilde{\chi}_1^-$ search

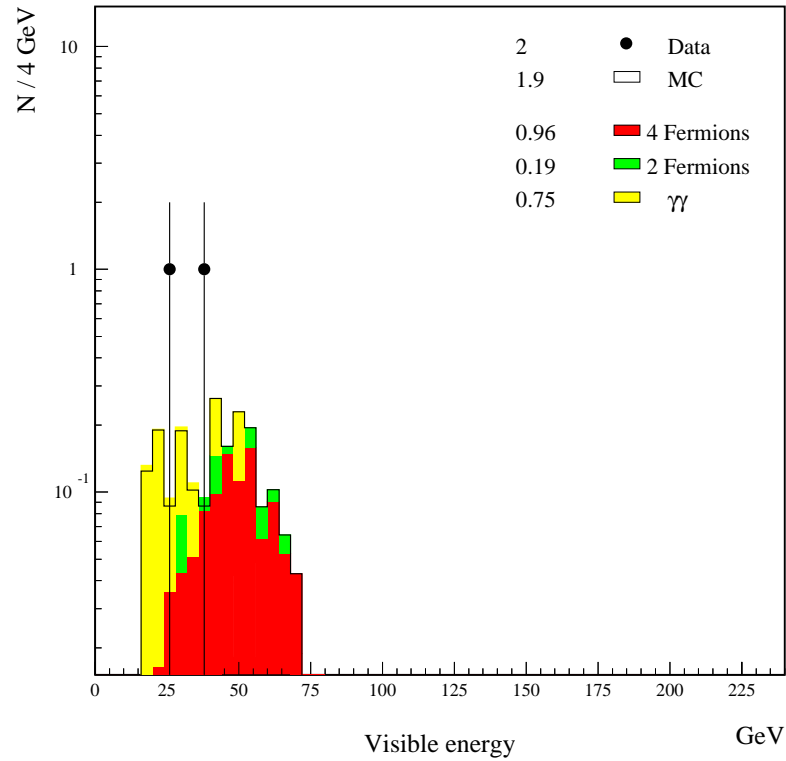


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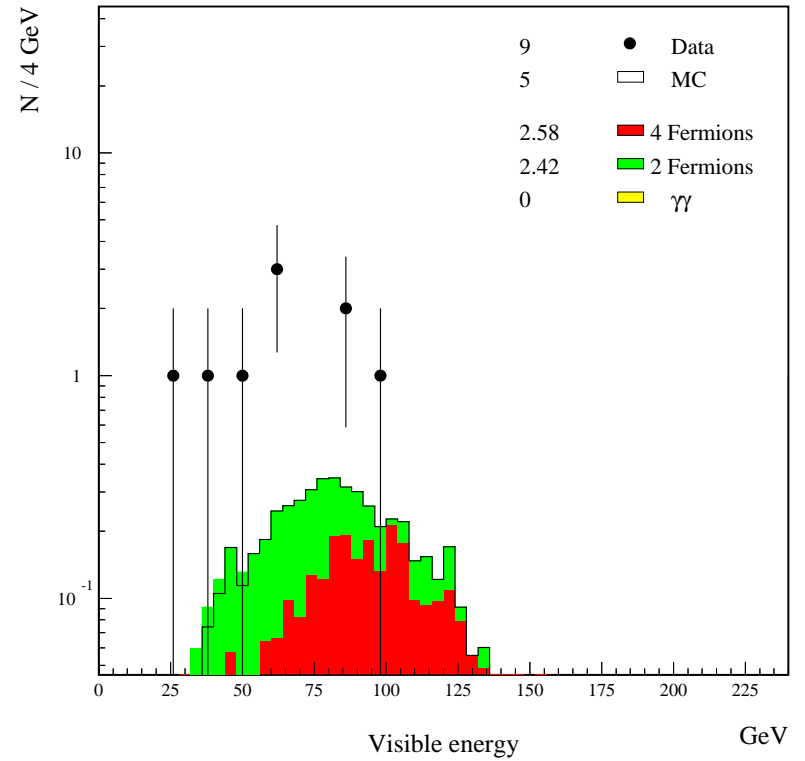


$E_{cm} = 207 \text{ GeV, jj 4 \& rad 5-6}$

DELPHI standard $\tilde{\chi}_1^+ \tilde{\chi}_1^-$ search

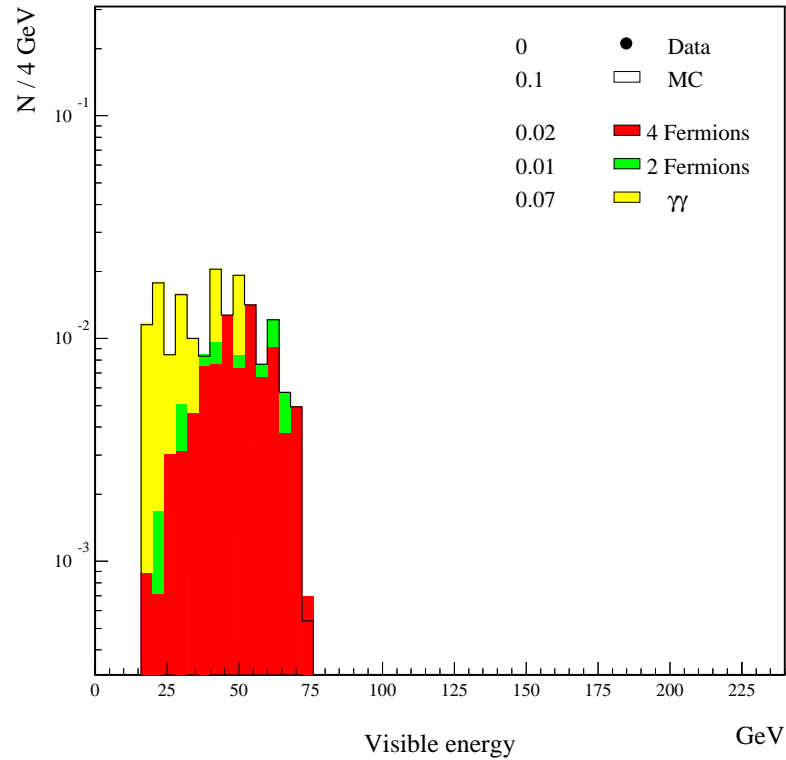


DELPHI standard $\tilde{\chi}_1^+ \tilde{\chi}_1^-$ search



$E_{cm} = 208 \text{ GeV, jj 4 \& rad 5-6}$

DELPHI standard $\tilde{\chi}_1^+ \tilde{\chi}_1^-$ search



DELPHI standard $\tilde{\chi}_1^+ \tilde{\chi}_1^-$ search

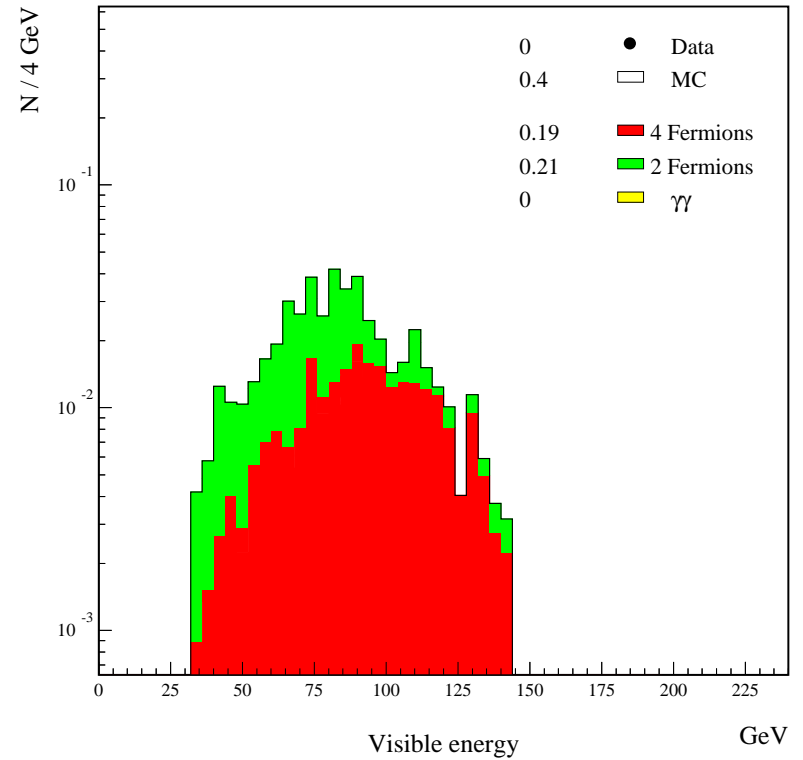


Table of candidates, $E_{cm} = 206 \text{ GeV C1}$

Topology:	$j\ell$	ll	jj	rad	TOTAL
	$3 \leq \Delta M < 5 \text{ GeV}/c^2$				
N data:	0	20	5	3	28
N backg:	0.44 $^{+1.2}_{-0.1}$	20.62 $^{+2.6}_{-1.6}$	7.49 $^{+1.6}_{-0.8}$	2.48 $^{+1.4}_{-0.2}$	31.03 $^{+3.6}_{-1.8}$
	$5 \leq \Delta M < 10 \text{ GeV}/c^2$				
N data:	0	0	2	3	5
N backg:	0.44 $^{+1.2}_{-0.1}$	2.02 $^{+1.4}_{-0.4}$	1.44 $^{+1.3}_{-0.2}$	2.48 $^{+1.4}_{-0.2}$	6.38 $^{+2.6}_{-0.5}$
	$10 \leq \Delta M < 25 \text{ GeV}/c^2$				
N data:	0	8	4	3	15
N backg:	0.44 $^{+1.2}_{-0.1}$	7.75 $^{+1.7}_{-0.6}$	5.61 $^{+1.4}_{-0.5}$	2.48 $^{+1.4}_{-0.2}$	16.28 $^{+2.9}_{-0.8}$
	$25 \leq \Delta M < 35 \text{ GeV}/c^2$				
N data:	1	13	3	3	20
N backg:	0.37 $^{+1.2}_{-0.0}$	11.64 $^{+1.6}_{-0.5}$	4.00 $^{+1.3}_{-0.4}$	2.48 $^{+1.4}_{-0.2}$	18.49 $^{+2.8}_{-0.7}$
	$35 \leq \Delta M < 50 \text{ GeV}/c^2$				
N data:	2	23	10	11	46
N backg:	2.37 $^{+1.3}_{-0.2}$	26.82 $^{+1.7}_{-0.7}$	8.03 $^{+1.4}_{-0.4}$	10.28 $^{+1.3}_{-0.5}$	47.48 $^{+2.9}_{-0.9}$
	$50 \text{ GeV}/c^2 \leq \Delta M$				
N data:	3	40	22	11	76
N backg:	3.79 $^{+1.3}_{-0.2}$	38.99 $^{+1.7}_{-0.7}$	18.67 $^{+1.4}_{-0.6}$	10.28 $^{+1.3}_{-0.5}$	71.72 $^{+2.9}_{-1.0}$
	TOTAL (logical .OR. between different ΔM windows)				
N data:	4	76	31	11	122
N backg:	5.04 $^{+1.4}_{-0.3}$	69.74 $^{+3.1}_{-2.1}$	29.00 $^{+1.9}_{-1.1}$	10.87 $^{+1.4}_{-0.5}$	114.65 $^{+4.1}_{-2.4}$

Table of candidates, $E_{cm} = 206.5 \text{ GeV S1}$

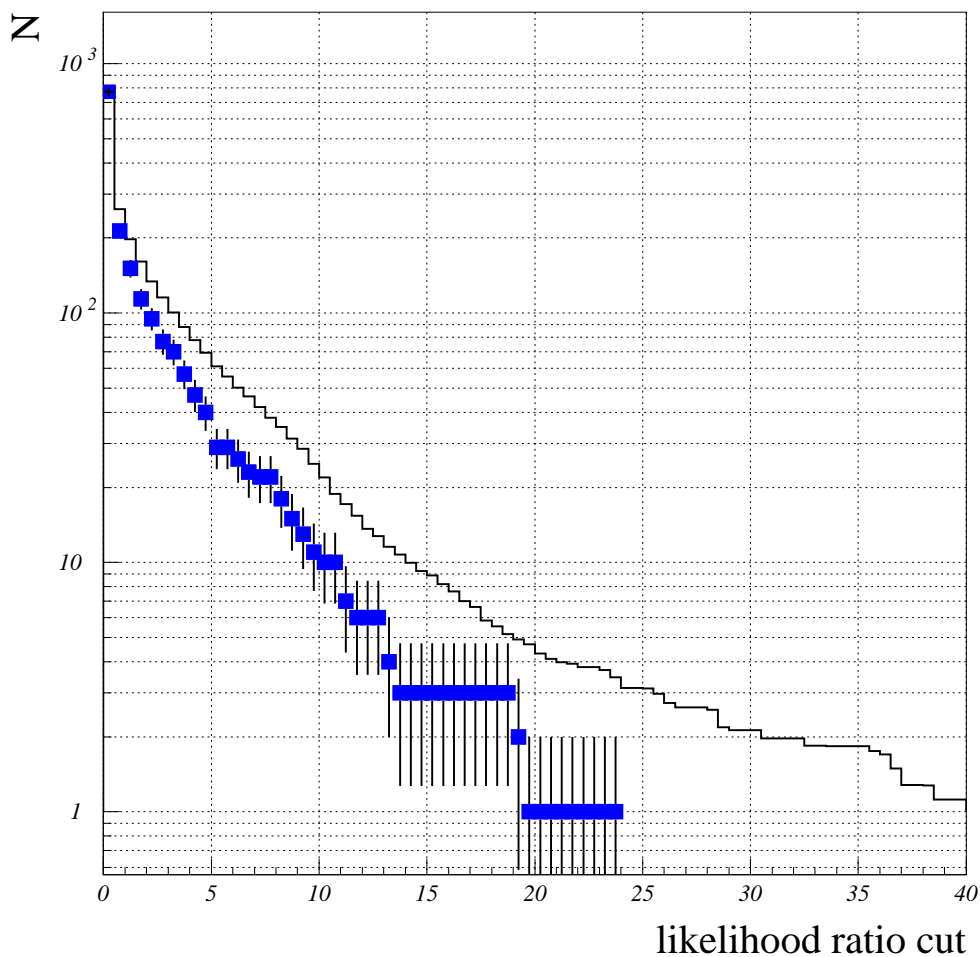
Topology:	j l	ll	jj	rad	TOTAL
	$3 \leq \Delta M < 5 \text{ GeV}/c^2$				
N data:	0	10	2	2	14
N backg:	0.20 $^{+0.5}_{-0.0}$	18.80 $^{+1.5}_{-1.1}$	2.13 $^{+0.8}_{-0.4}$	1.35 $^{+0.5}_{-0.1}$	22.47 $^{+1.8+1.3}_{-1.2-8.9}$
	$5 \leq \Delta M < 10 \text{ GeV}/c^2$				
N data:	0	4	4	2	10
N backg:	0.20 $^{+0.5}_{-0.0}$	3.64 $^{+0.8}_{-0.4}$	3.90 $^{+1.0}_{-0.6}$	1.35 $^{+0.5}_{-0.1}$	9.10 $^{+1.4}_{-0.7}$
	$10 \leq \Delta M < 25 \text{ GeV}/c^2$				
N data:	0	3	7	2	12
N backg:	0.20 $^{+0.5}_{-0.0}$	2.31 $^{+0.6}_{-0.2}$	5.43 $^{+1.0}_{-0.6}$	1.35 $^{+0.5}_{-0.1}$	9.29 $^{+1.3}_{-0.7}$
	$25 \leq \Delta M < 35 \text{ GeV}/c^2$				
N data:	0	3	4	2	9
N backg:	0.39 $^{+0.5}_{-0.0}$	5.31 $^{+0.6}_{-0.2}$	3.22 $^{+0.7}_{-0.3}$	1.35 $^{+0.5}_{-0.1}$	10.26 $^{+1.1}_{-0.4}$
	$35 \leq \Delta M < 50 \text{ GeV}/c^2$				
N data:	0	10	6	5	21
N backg:	0.67 $^{+0.4}_{-0.0}$	11.72 $^{+0.7}_{-0.3}$	4.96 $^{+0.6}_{-0.3}$	4.27 $^{+0.5}_{-0.2}$	21.62 $^{+1.1}_{-0.4}$
	$50 \text{ GeV}/c^2 \leq \Delta M$				
N data:	1	16	9	5	31
N backg:	2.04 $^{+0.5}_{-0.1}$	14.18 $^{+0.6}_{-0.3}$	6.35 $^{+0.6}_{-0.2}$	4.27 $^{+0.5}_{-0.2}$	26.84 $^{+1.1}_{-0.4}$
	TOTAL (logical .OR. between different ΔM windows)				
N data:	1	31	16	5	53
N backg:	2.34 $^{+0.5}_{-0.1}$	38.77 $^{+1.7}_{-1.2}$	13.08 $^{+1.2}_{-0.8}$	4.48 $^{+0.5}_{-0.2}$	58.67 $^{+2.2}_{-1.5}$

At the level of the preselection,
Data-MC comparison = **Ok**

At the level of the preselection,
Data-MC comparison = **NOT Ok**

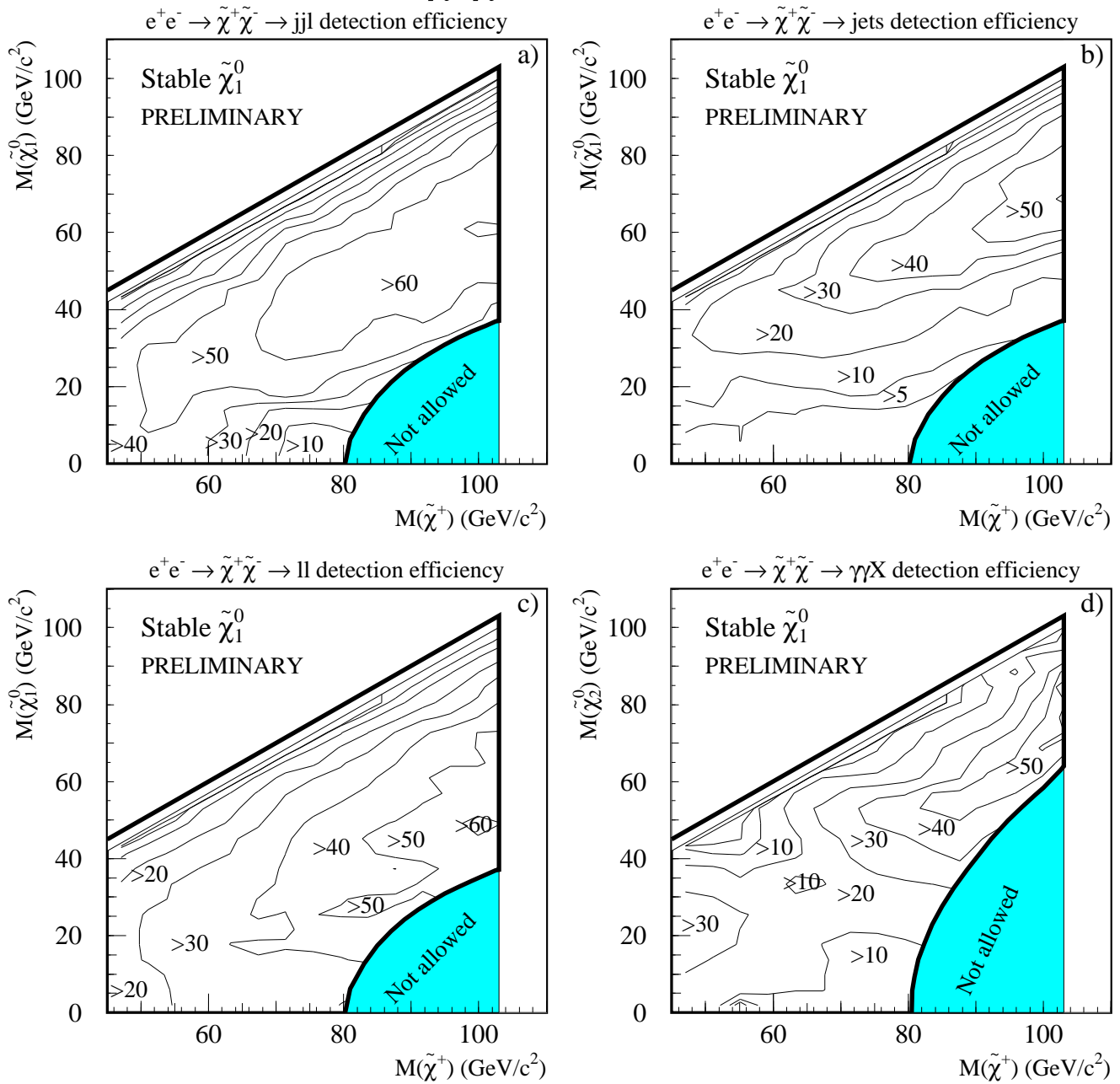
Problematic scenario for the method we
use for the systematics

ll topology - ΔM region 1 - $E_{cm} = 207$ GeV



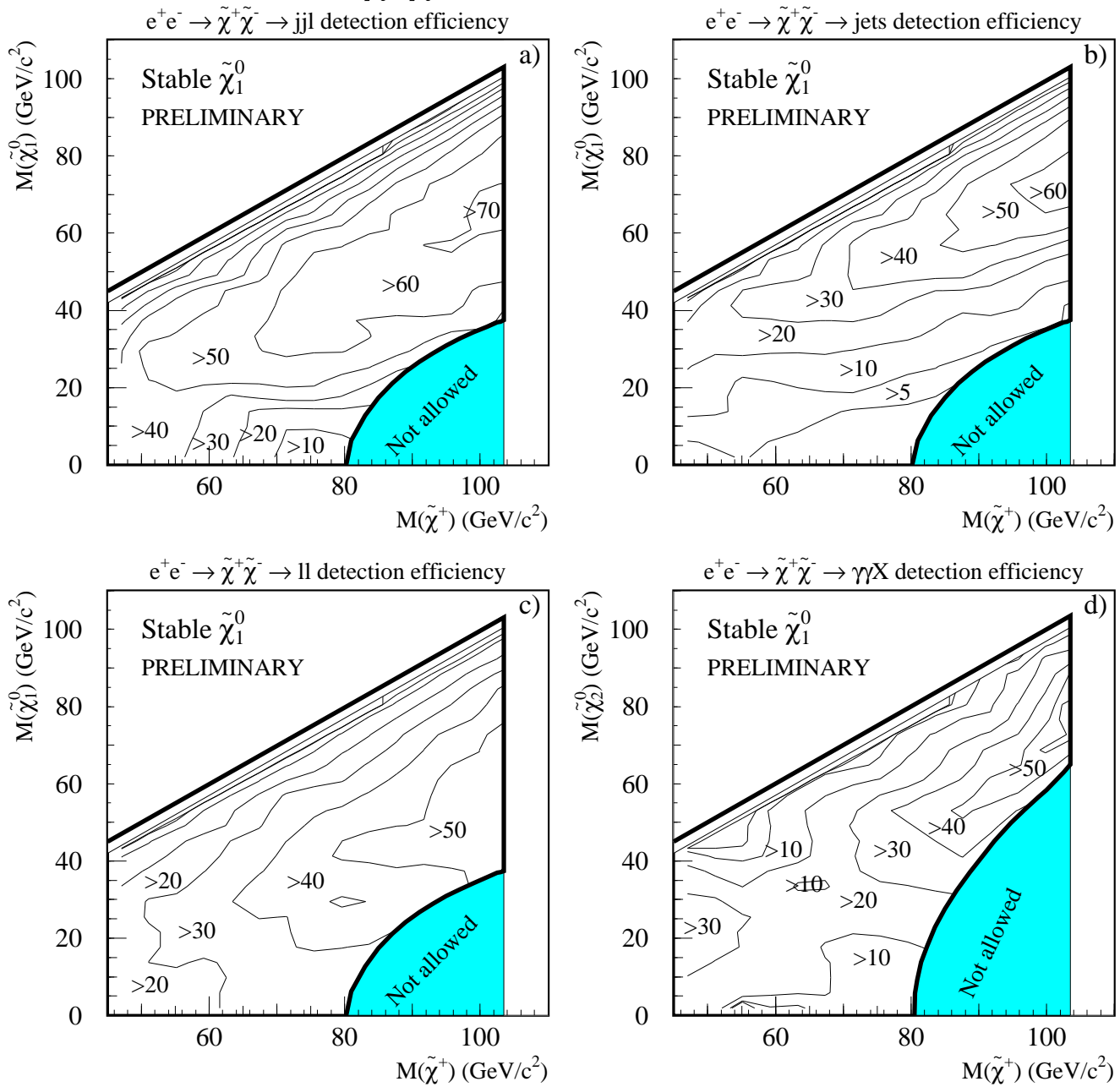
- Efficiency calculated at 132 simulated SUSY points
- Efficiency interpolated at an arbitrary point from the three closest simulated points

DELPHI $\tilde{\chi}_1^+ \tilde{\chi}_1^-$ efficiencies at 206 GeV



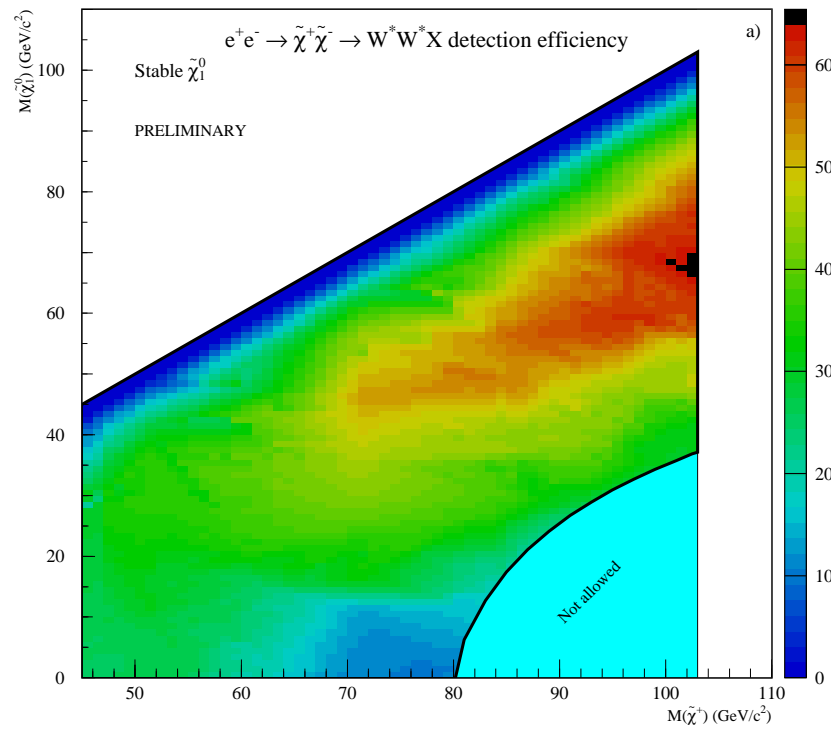
- Efficiency calculated at 132 simulated SUSY points
- Efficiency interpolated at an arbitrary point from the three closest simulated points

DELPHI $\tilde{\chi}_1^+ \tilde{\chi}_1^-$ efficiencies at 206.5 GeV (S1)

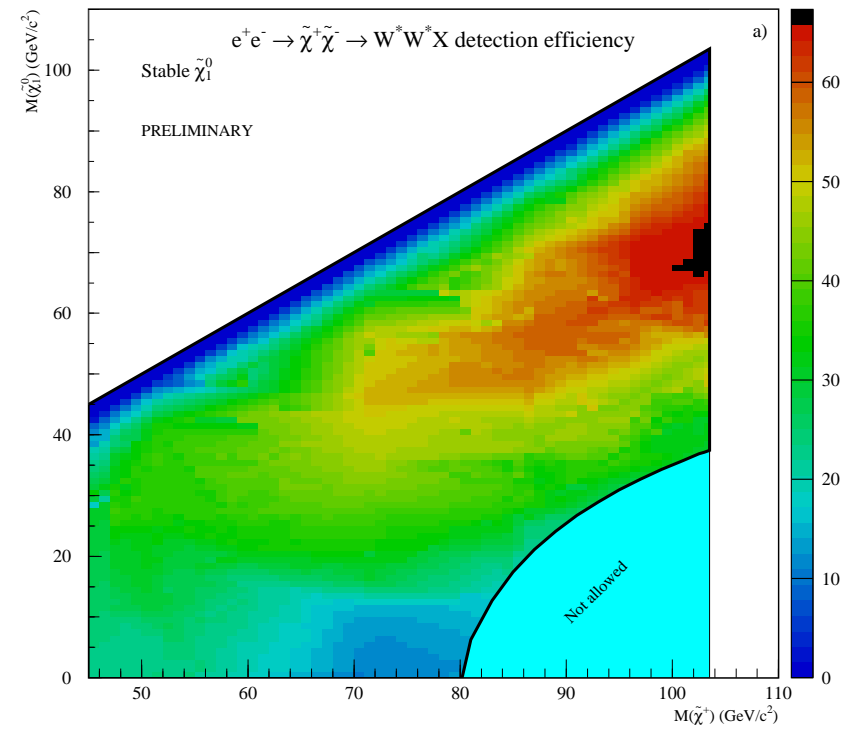


Tables for the SUSY working group ready

DELPHI $\tilde{\chi}_1^+ \tilde{\chi}_1^-$ efficiencies at 206 GeV



DELPHI $\tilde{\chi}_1^+ \tilde{\chi}_1^-$ efficiencies at 206.5 GeV (S1)



Systematical error of N_{Back}

Uncertainty from SM-process modelling:

2 & 4 fermion, $\approx 5\%$

Hadronic $\gamma\gamma$, $\approx 15\%$

(Comparison between TWOGAM and PYTHIA)

Very small effect on the limits

From detector response:

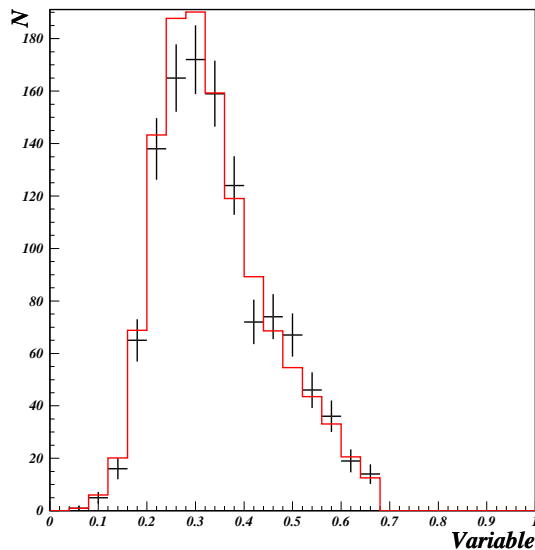
Used the code from P. Verdier

The “Verdier” approach

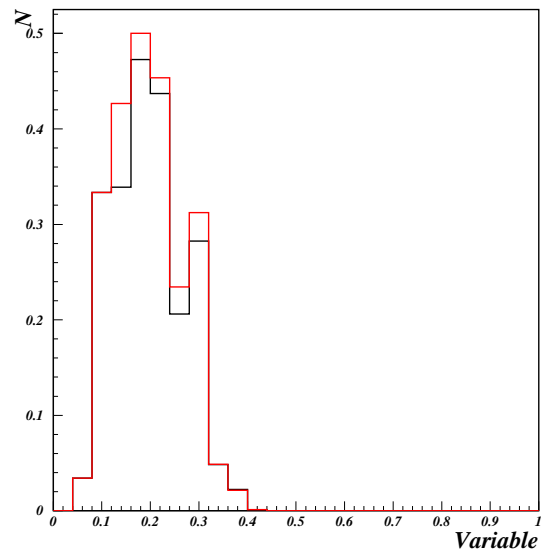
For each variable used in the analysis:

- The variable was separated into 25 bin data & background histograms.
- For each bin at **preselection** level the factor, N_{Data}/N_{Back} , was calculated.
(To get the background in perfect agreement with the data)
If the bin contained at least 1% of the total background and the number of data events was not equal to zero.
- The background events at the **final selection** was re-weighted with the relevant factor from the preselection histogram.

Preselection



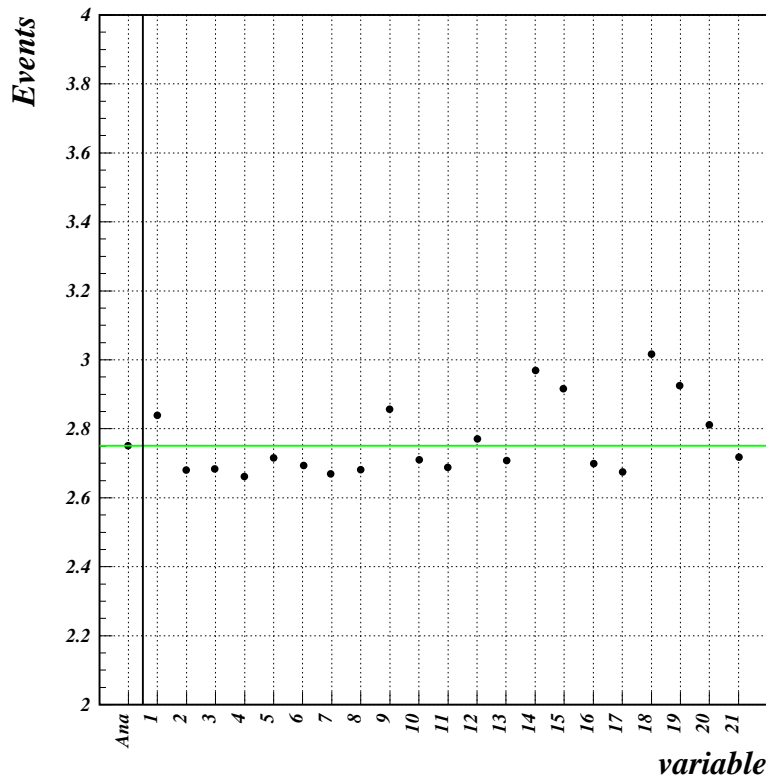
Final selection



- The error for a variable, i , was calculated,

$$\epsilon_i = N_{Back,i}^{rw} - N_{Back,i}$$

(Where N_{Back} is the total number of selected background events and N_{Back}^{rw} is the total number of re-weighted selected background events)



The total positive and negative systematical errors were then calculated as,

$$\epsilon^+ = \sqrt{\sum_{\epsilon_i > 0} \epsilon_i^2}$$

$$\epsilon^- = \sqrt{\sum_{\epsilon_i < 0} \epsilon_i^2}$$

The Kolmogorov test is a statistical test of the compatibility of two distributions.

- The test was made for the data and background histograms of the variables at preselection level.
- The test was made for the data and the re-weighted background histograms of the variables. Where the background histograms were re-weighted with respect to all the other variables.
- The output is the probability that the two histograms in the test comes from the same distribution.
- The Kolmogorov test showed that the systematical errors are conservative for all the different windows in our analysis. Since a lot of the errors are counted several times in the quadratic sum.

Kolmogorov test, jl 3 206

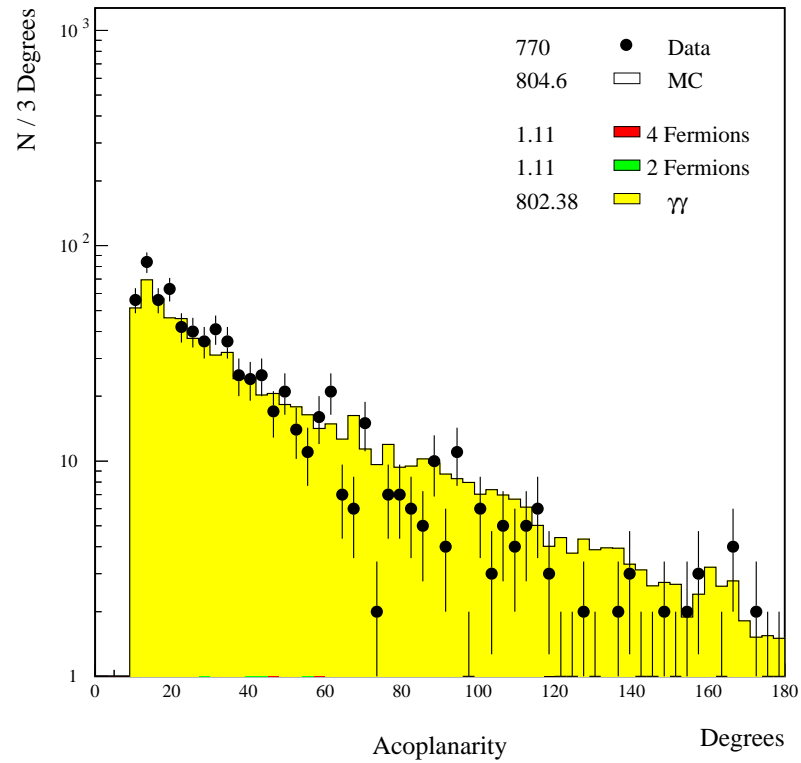
	1	2	3	4	5	6
Pre.	0.957	0.834	0.174	0.924	1.000	0.869
1	1.000	0.995	0.244	(0.878)	1.000	0.922
2	0.991	1.000	0.241	(0.913)	1.000	0.922
3	1.000	0.995	1.000	(0.911)	1.000	(0.834)
4	0.991	0.940	0.241	1.000	1.000	0.939
5	(0.928)	(0.789)	0.177	0.926	1.000	0.872
6	0.991	0.904	(0.145)	0.955	1.000	1.000

Systematical errors, $E_{cm} = 206 \text{ GeV C1}$

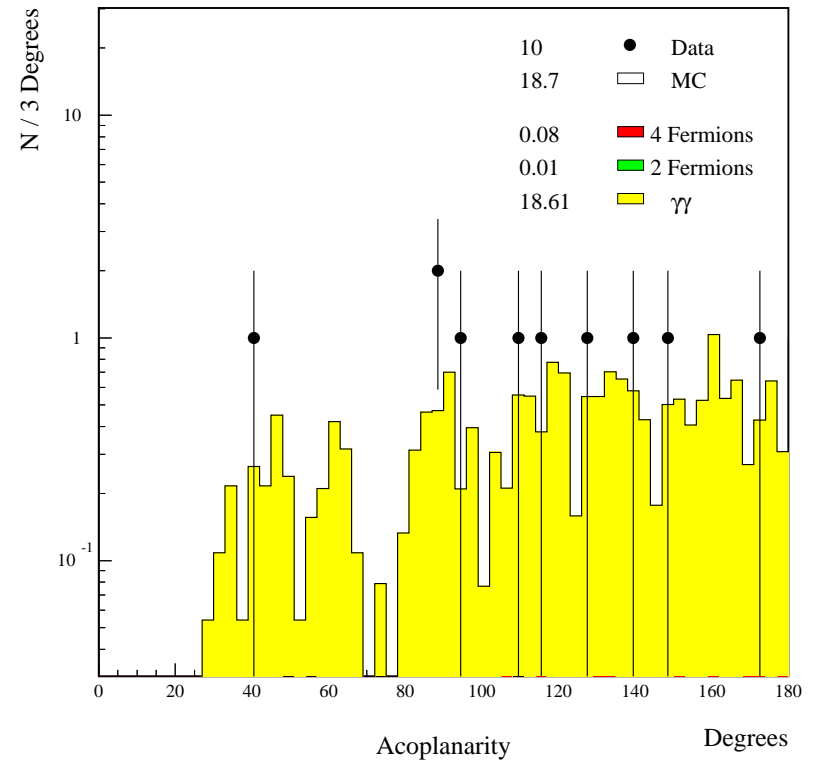
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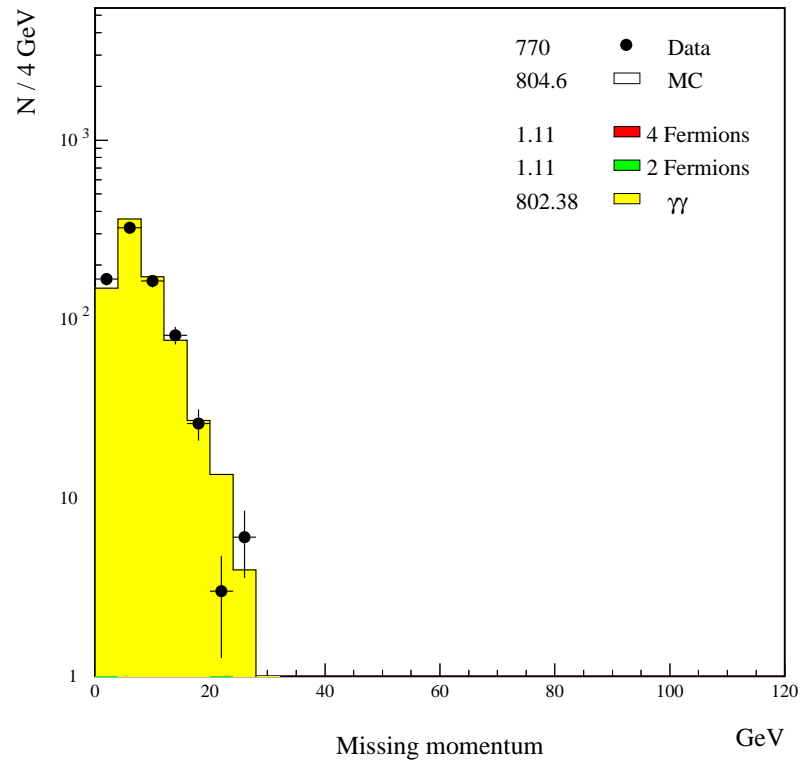


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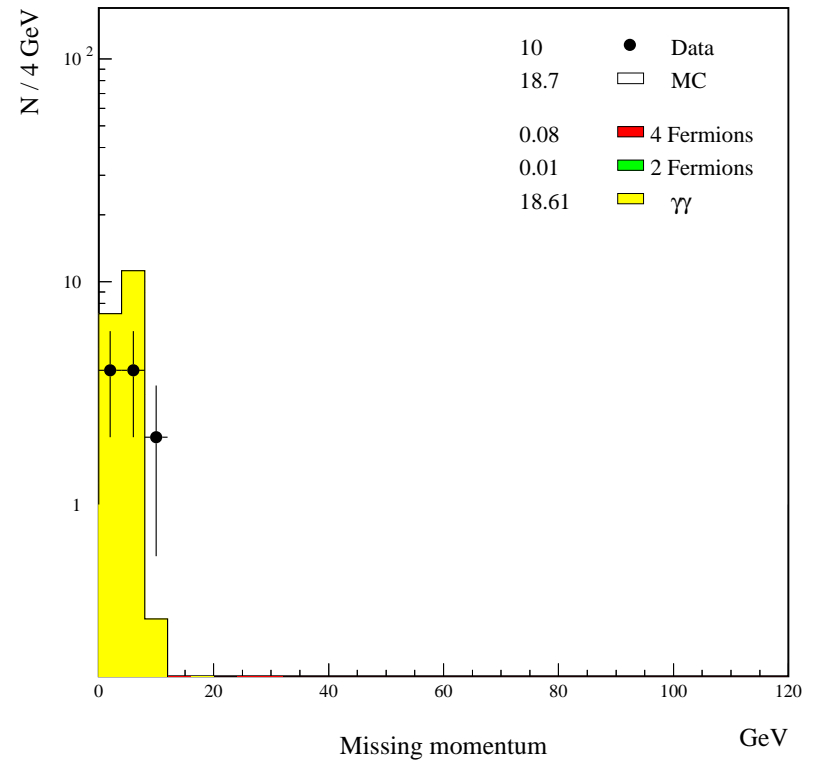


$E_{cm} = 207 \text{ GeV, S1, II 1}$

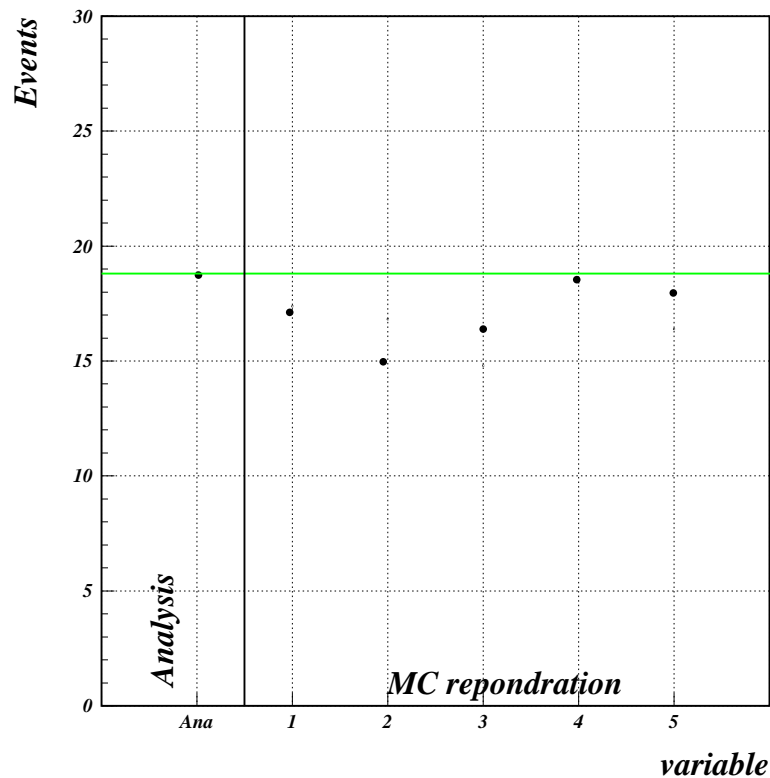
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DELPHI standard $\tilde{\chi}_1^+ \tilde{\chi}_1^-$ search



- The overestimation of the background at the final selection is seen in the systematical error for all the variables used in the analysis.
- But since the total number of events for Data and MC are in agreement at the preselection level it is for some variables not seen so well.



Systematical errors, $E_{cm} = 206.5 \text{ GeV S1}$

Topology:	$j \ell$	ll	jj	rad	TOTAL
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N data:	0	10	2	2	14
N backg:	0.20 $^{+0.1}_{-0.0}$	18.80 $^{+0.0}_{-4.0}$	2.13 $^{+0.9}_{-0.0}$	1.35 $^{+1.0}_{-0.0}$	22.47 $^{+1.3}_{-4.0}$
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