

M. Martinez

# Squark/Gluino Search (Part II)

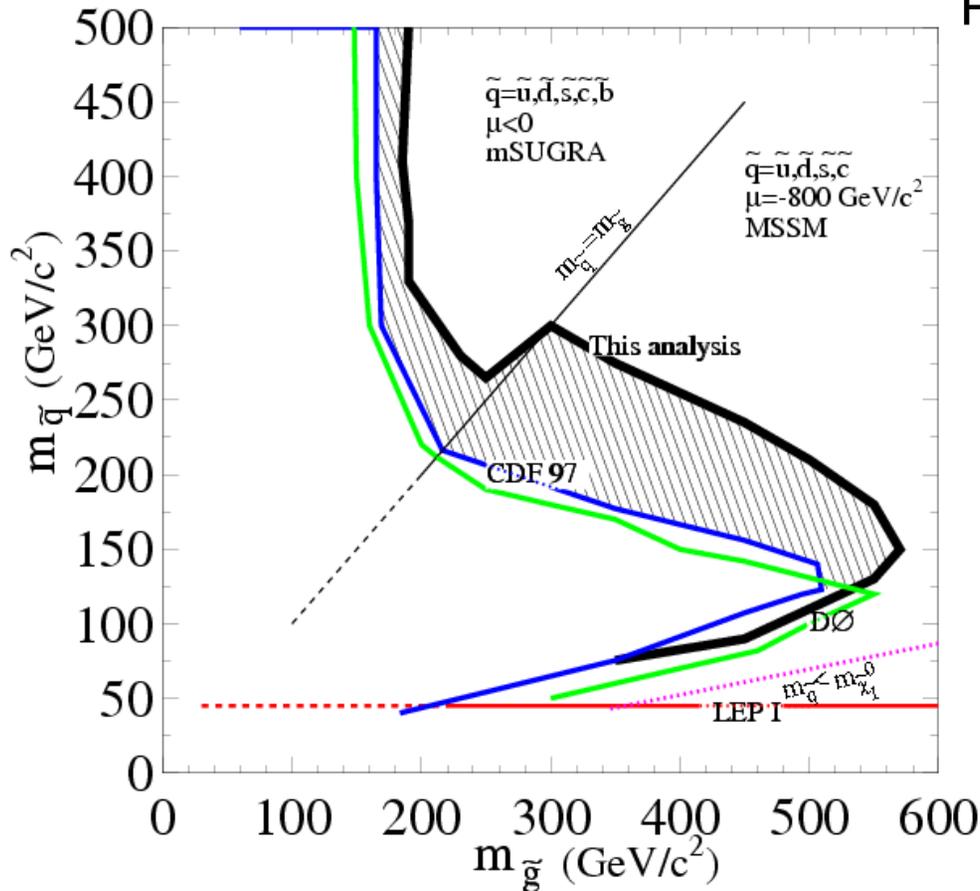


Towards blind box and sensitivity  
determination

SUSY Meeting (7<sup>th</sup> December 2004)

# SUSY Samples

Points used in Run I and not excluded



Samples generated in mSUGRA  
 ( $A_0 = 0$  ,  $\text{sign}(\mu) = -1$ ,  $\tan\beta = 3$ )  
 Third generation removed from  
 $2 \rightarrow 2$  process (no stop, sbottom)

ID	Squark mass (GeV)	Gluino mass (GeV)
A16	404.577	174.077
A17	469.923	176.120
A2	460.926	212.489
A3	415.601	213.521
A6	371.077	211.224
A7	317.937	183.679
A8	302.745	206.626
A9	286.523	202.587
B1	277.424	270.326
B2	267.941	287.926

In addition we are mapping the whole mSUGRA region in the plot

# Selection Cuts All uncorrected

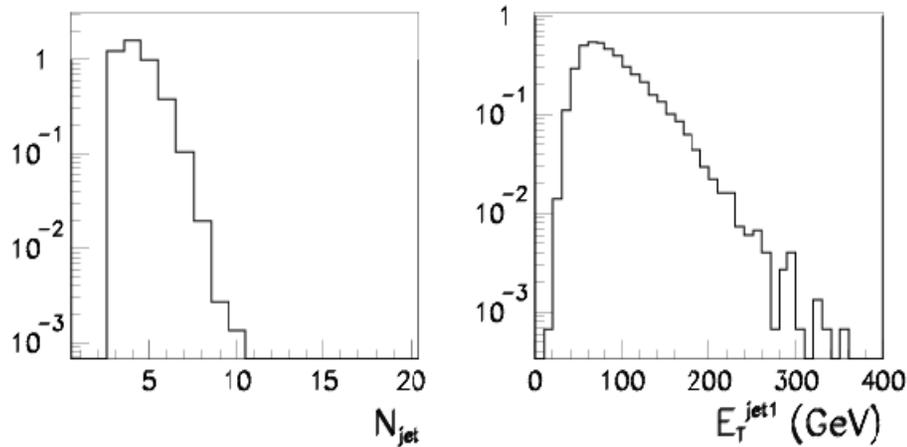
SELECTION CUTS	
	Vertex: $ V_z  < 60$ cm
	At least 3 jets with $E_t > 15$ GeV and $ \eta  < 2.3$
	At least one of them central ( $ \eta  < 1.1$ )
	MET $> 40$ GeV
Not applied yet	Jet EM Fraction $< 0.9$ (all three jets)
	Delta phi (MET-jet) $> 0.5$ (all three jets)
	$E_t(\text{jet 1}) > 70$ GeV & $E_t(\text{jet 2}) > 35$ GeV
	EEMF $> 0.175$
	ECHF $> 0.1$
	N isolated tracks = 0***

\*\*\* sum pt of tracks around each track with pt  $> 8$  GeV/c should be less than 2 GeV/c

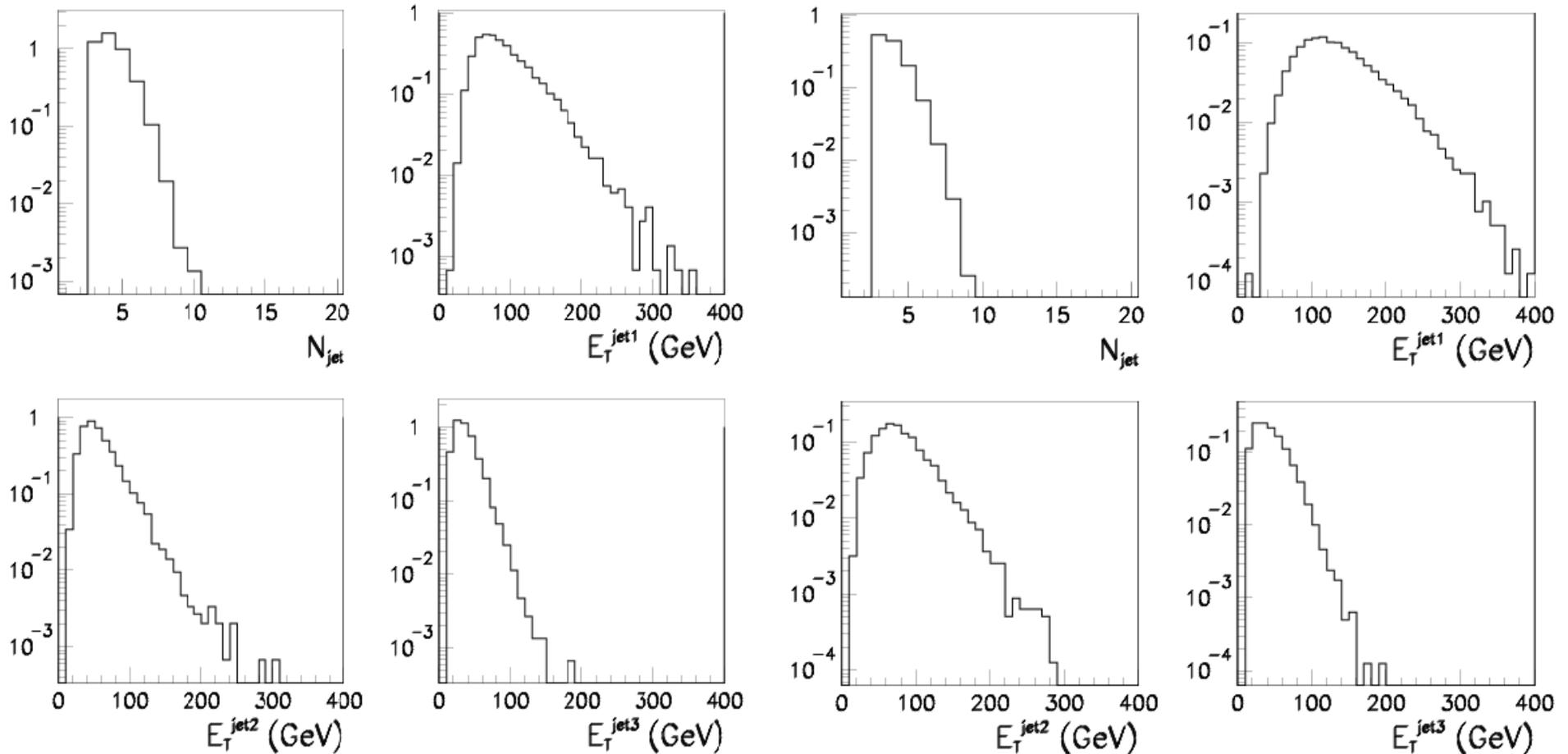
Normalized to LO x-section

# SUSY Distributions (I)

mSUGRA point a16



mSUGRA point b1

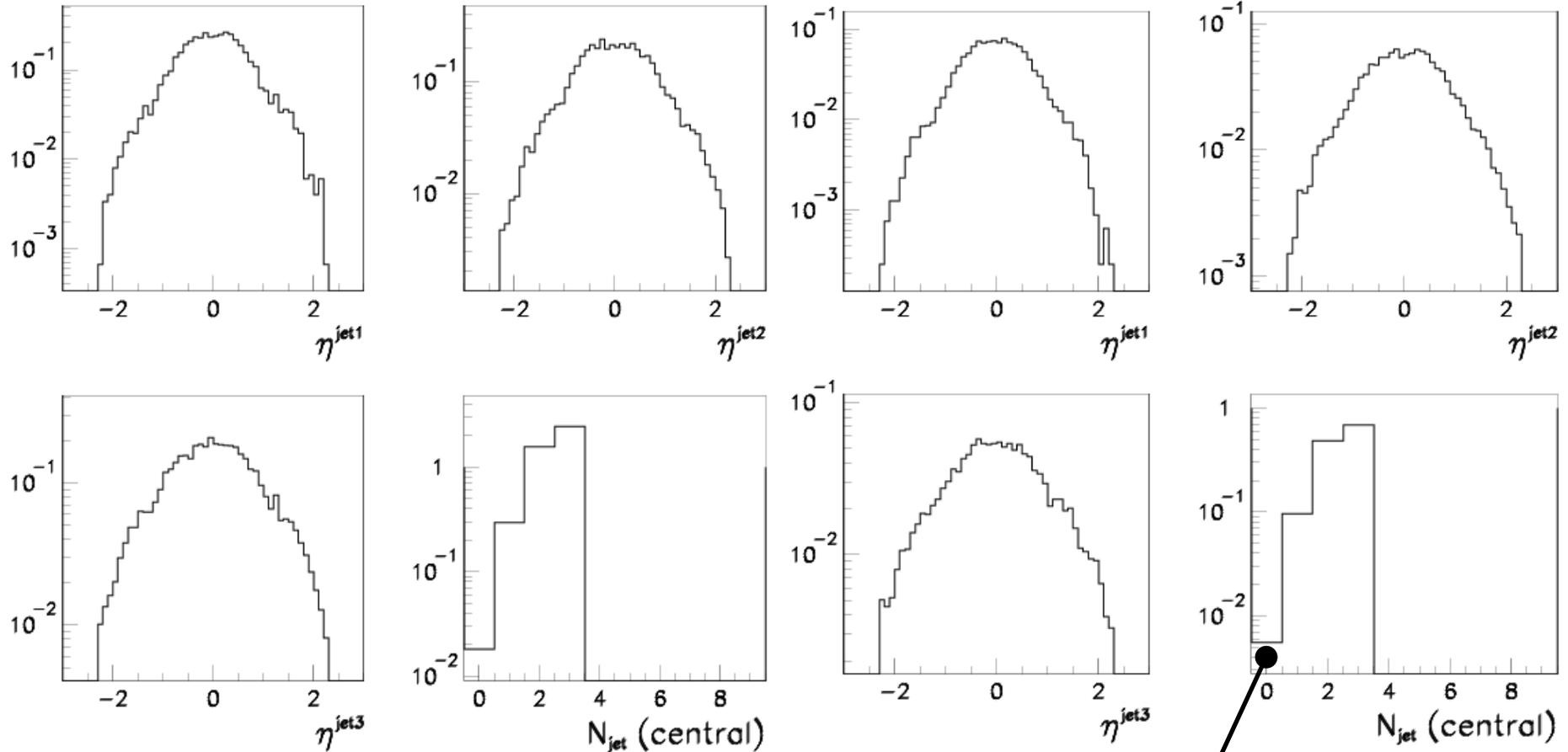


Very high jet multiplicity....very energetic leading jets...

# SUSY Distributions (II)

mSUGRA point a16

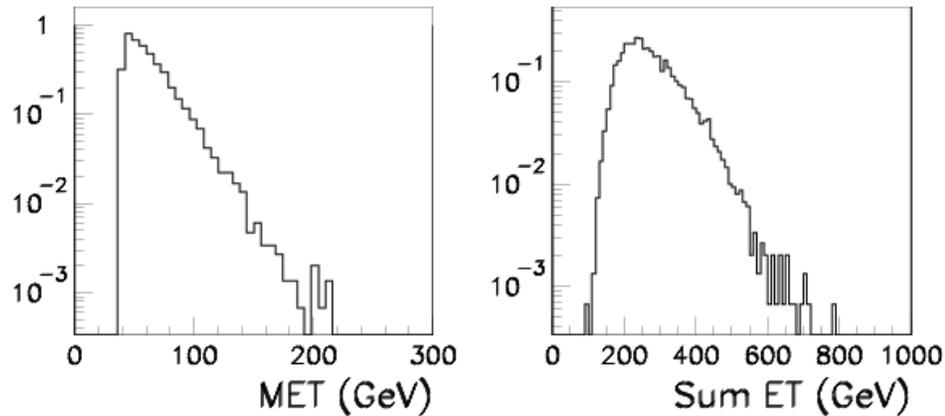
mSUGRA point b1



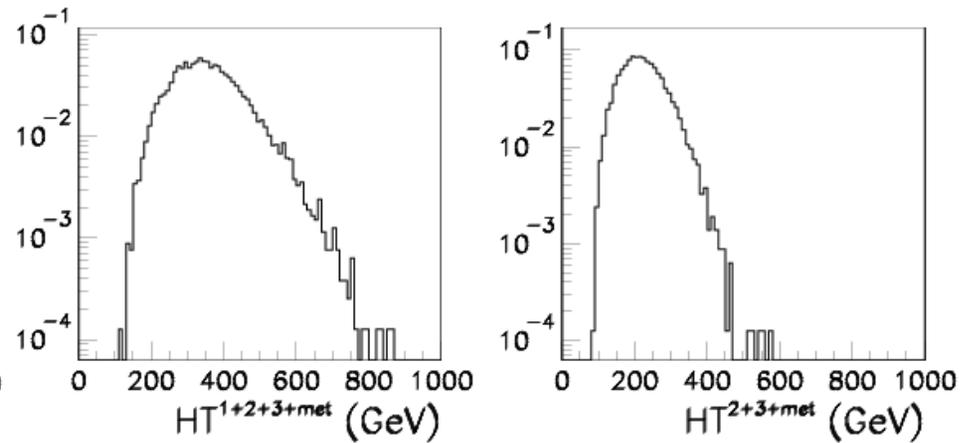
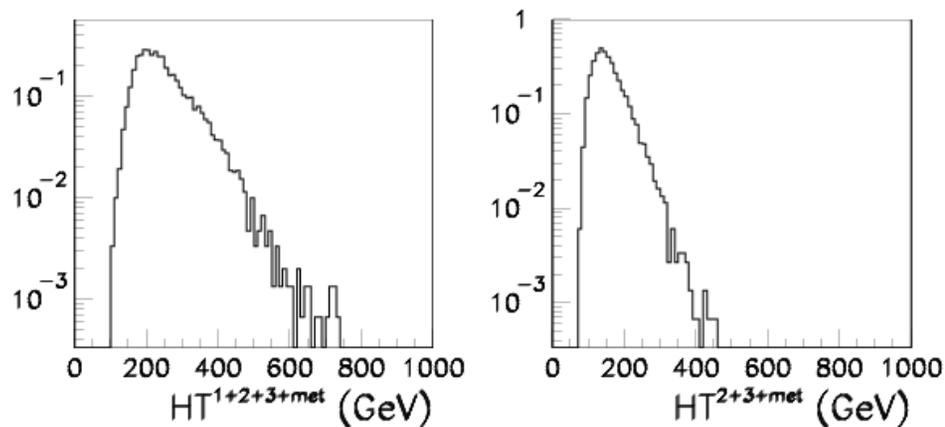
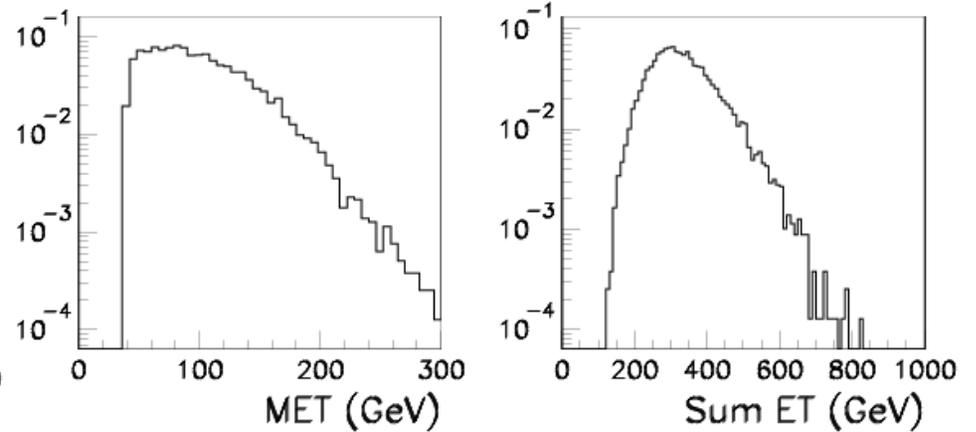
Event is central (asking for a leading central jets is very efficient..)

# SUSY Distributions (III)

mSUGRA point a16



mSUGRA point b1

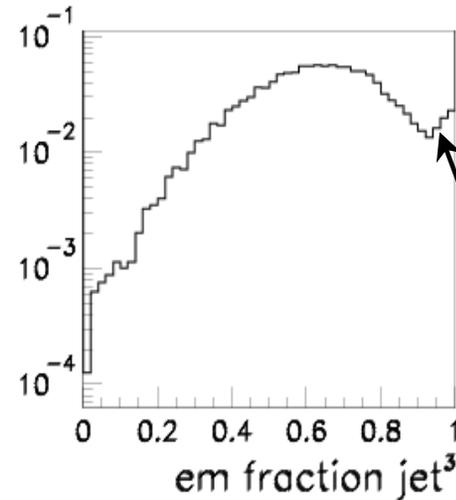
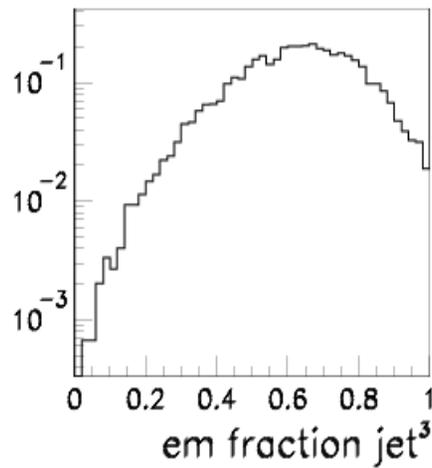
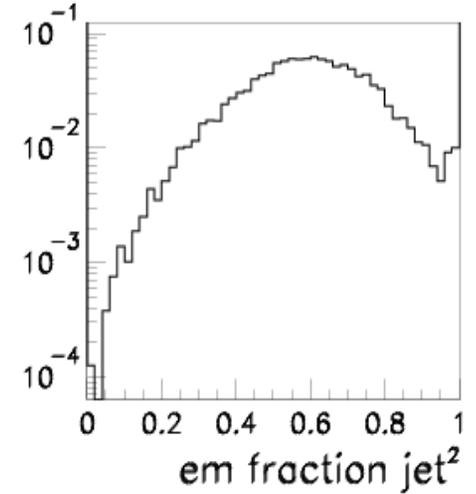
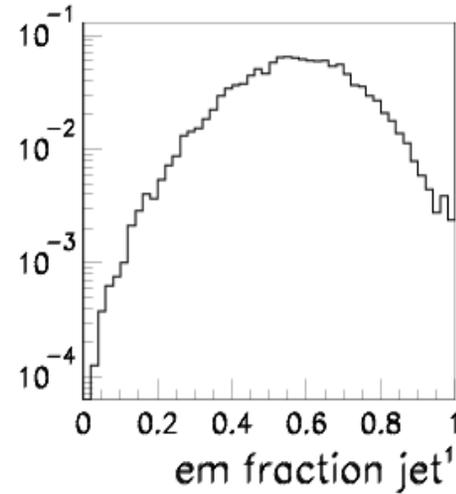
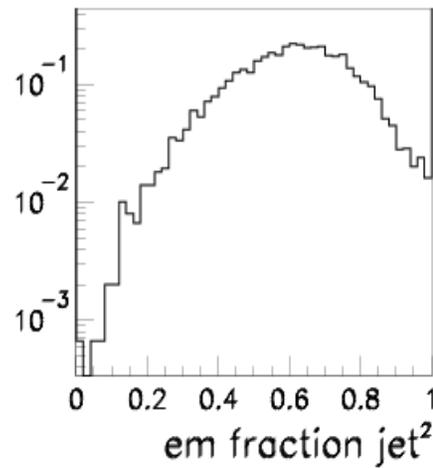
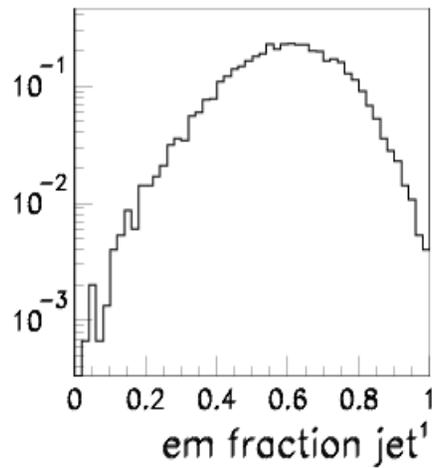


Exploring different HT definitions...

# SUSY Distributions (IV)

mSUGRA point a16

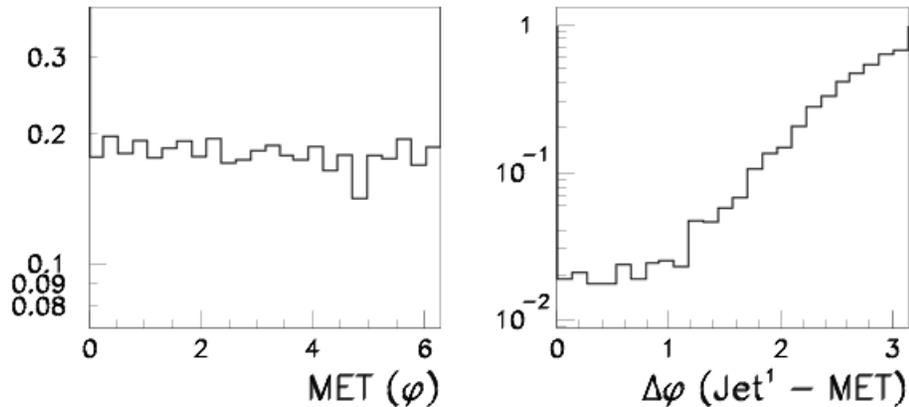
mSUGRA point b1



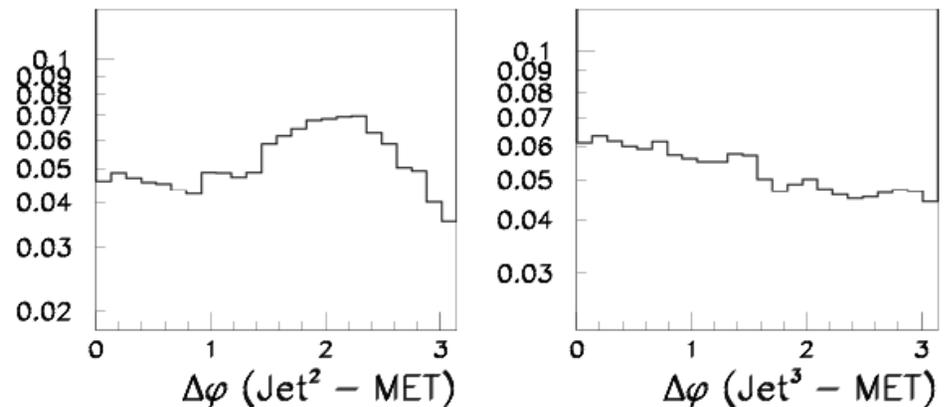
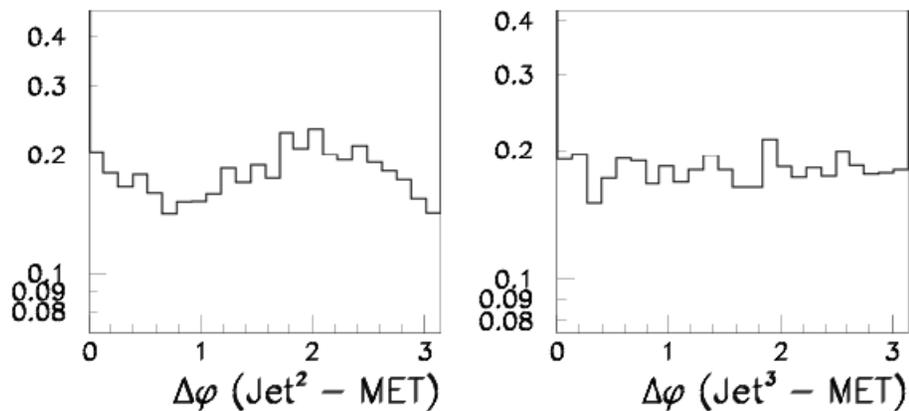
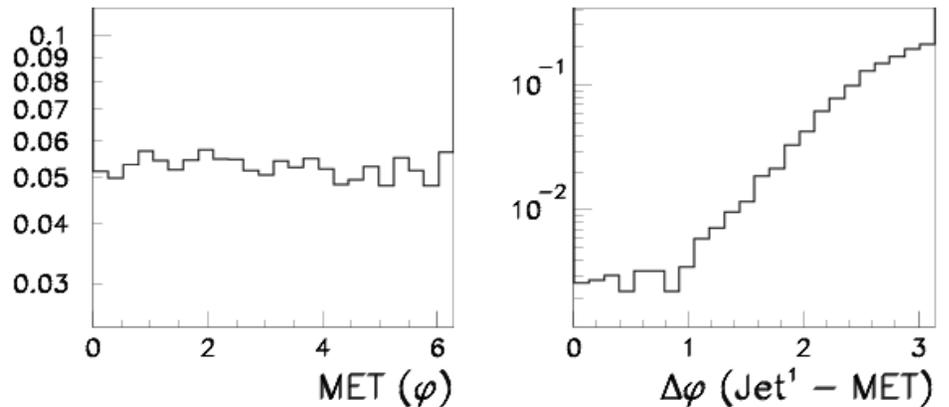
No major 100% EM jet contributions but some semi-leptonic decays

# SUSY Distributions (V)

mSUGRA point a16



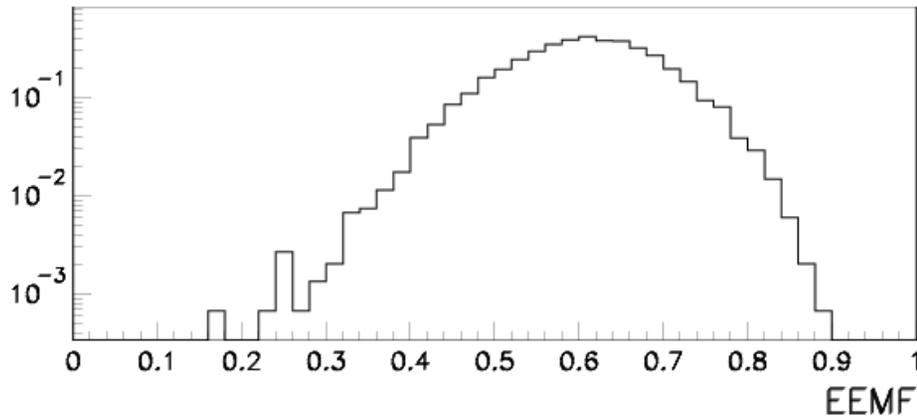
mSUGRA point b1



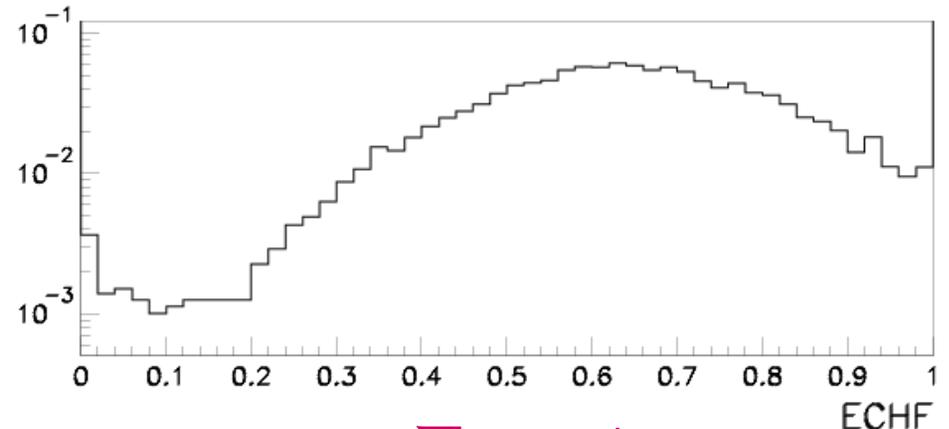
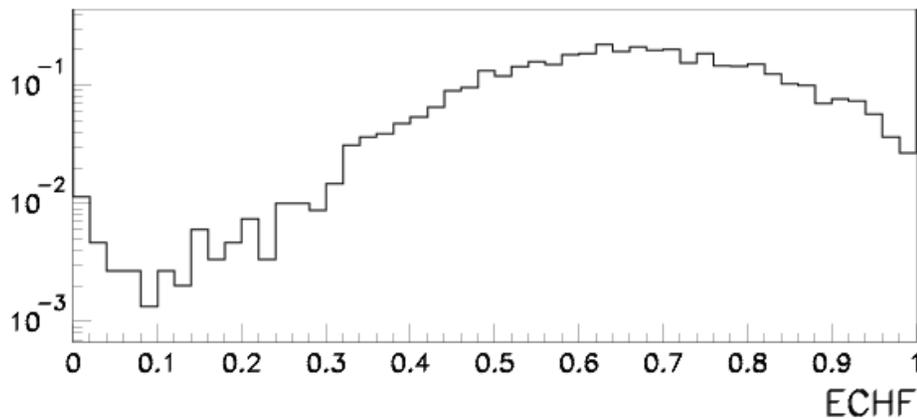
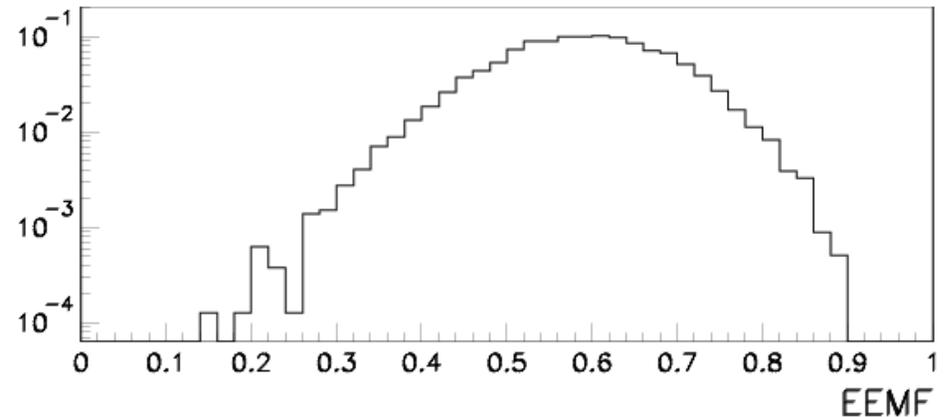
No strong correlation between jets and MET azimuthal direction  
(there are other jets in the event from squark/ gluino cascades..)

# SUSY Distribution (VI)

mSUGRA point a16



mSUGRA point b1

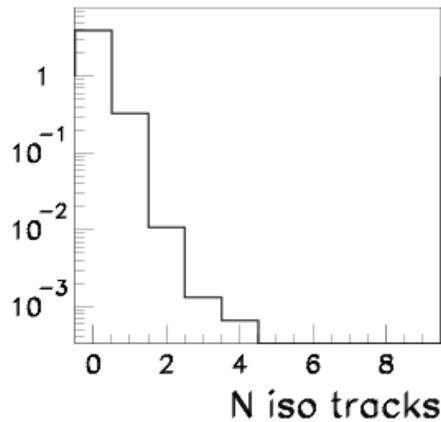
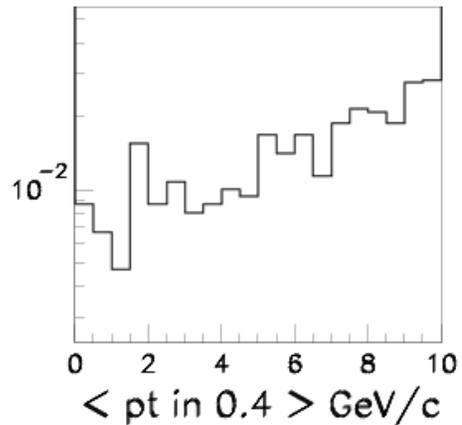
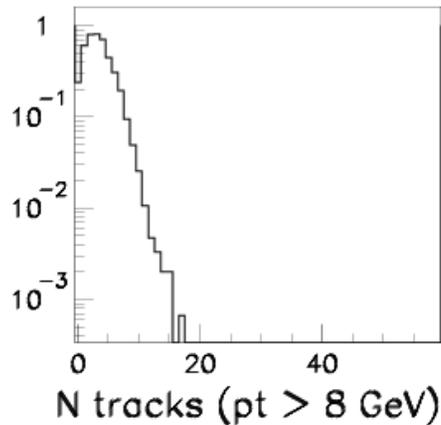


$$ECHF = \frac{1}{N_{\text{cjets}}} \sum_{\text{cjets}} \frac{\sum_{\text{inside jet}} P_T^{\text{tracks}}}{E_T^{\text{jet}}}$$

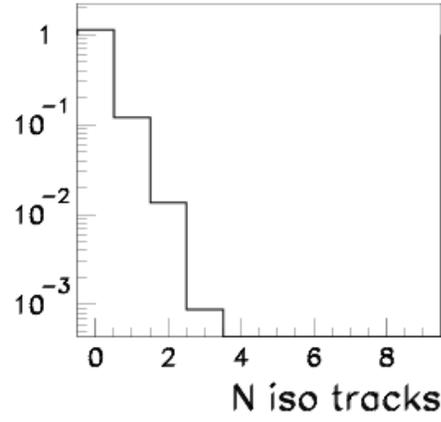
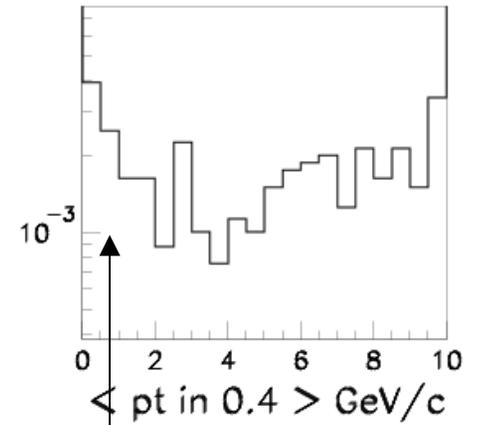
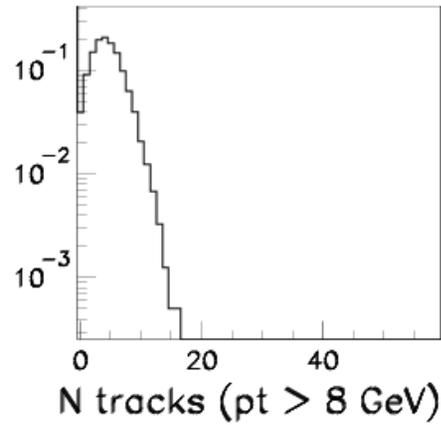
$$EMMF = \frac{\sum_{\text{all jets}} E_T^{\text{jet}} f^{\text{emc}}}{\sum_{\text{all jets}} E_T^{\text{jet}}}$$

# SUSY Distribution (VII)

mSUGRA point a16



mSUGRA point b1



sum pt of tracks around each track with  $pt > 8 \text{ GeV}/c$  less than  $2 \text{ GeV}/c$   
(using a cone of radius 0.4)

# Background Samples

SAMPLE	LUMINOSITY
$Z \rightarrow \nu\nu + 3p$ *	1637 pb-1
$W \rightarrow e\nu + 3p$	1339 pb-1
$W \rightarrow \mu\nu + 3p$	1646 pb-1
$W \rightarrow \tau\nu + 2p$ *	445 pb-1
Top (175 GeV) *	9971 pb-1
WW (all decays)	529 pb-1
QCD **	only 7.8 pb-1 shown now

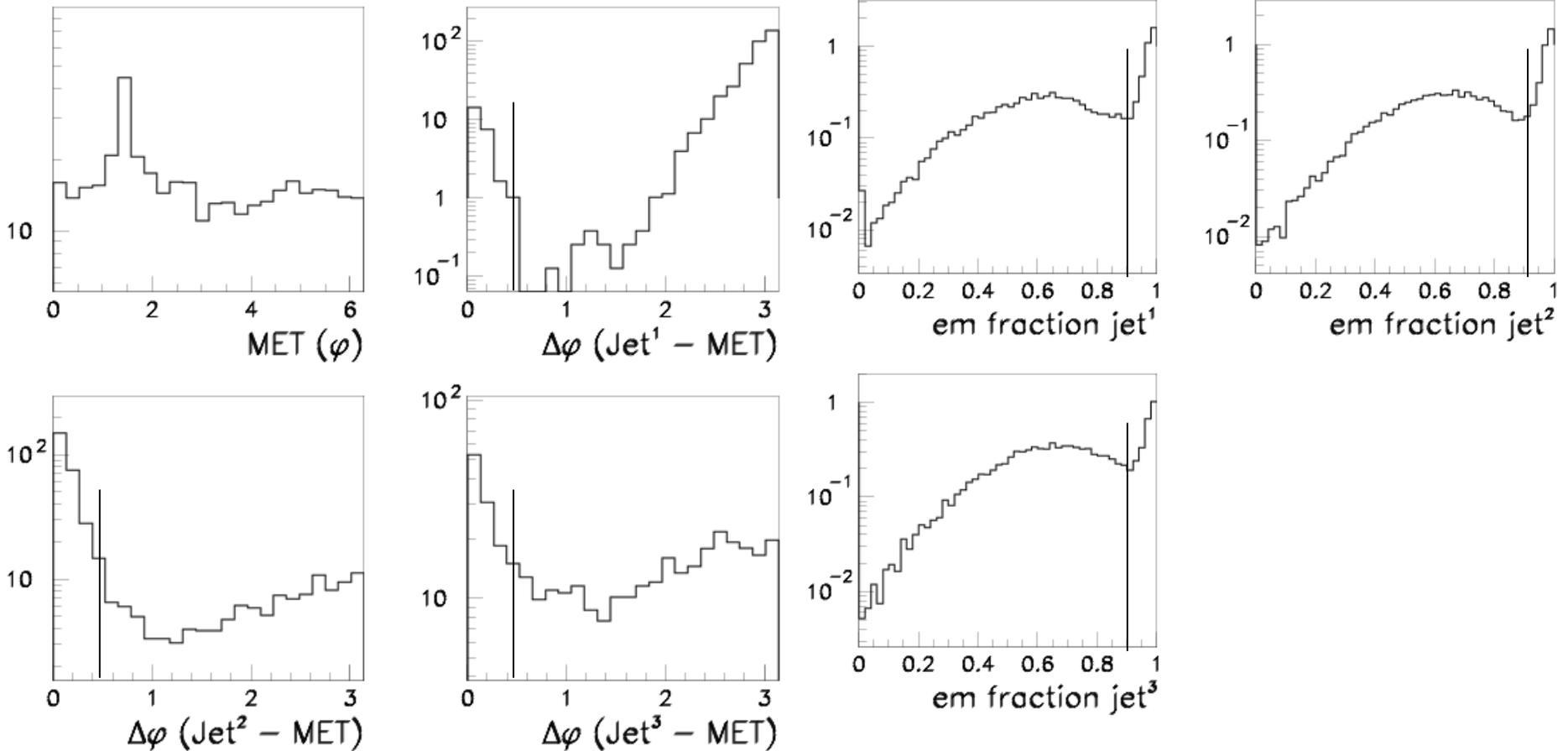
\* Almost identical to SUSY signal in some regions...

\*\* Most important background...we are generating huge samples at the Tier 1 center in Barcelona....

# Background Distributions

QCD  $P_t$  60 GeV

$W - e \nu + 3$  partons



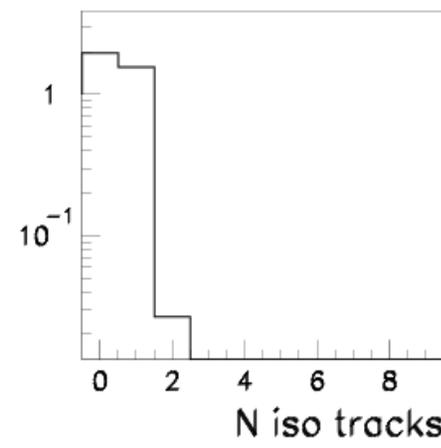
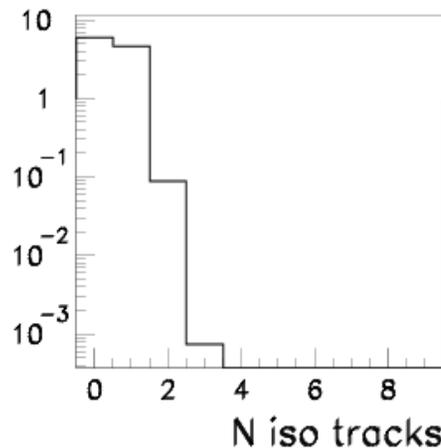
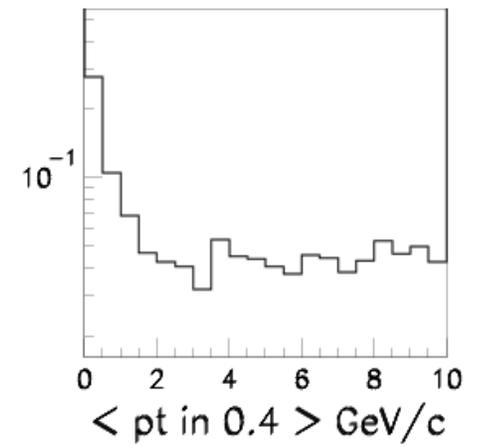
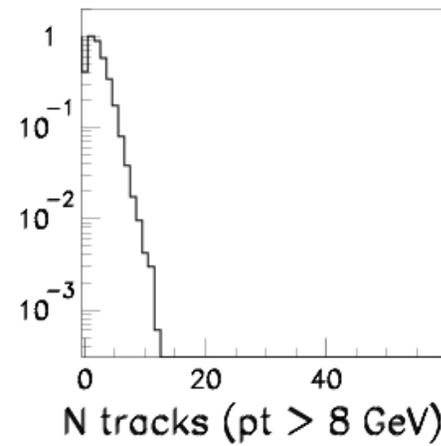
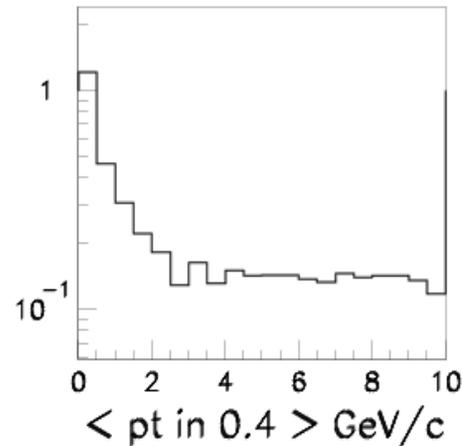
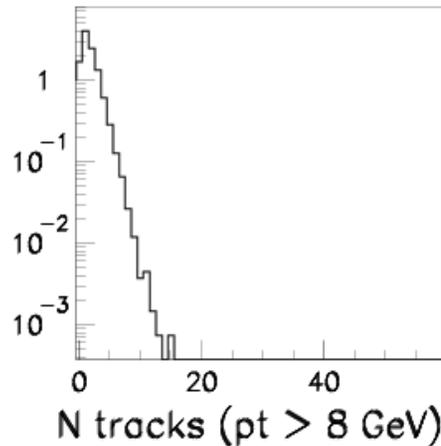
Strong  $\Delta\phi$  (jet-MET) Correlation

Electrons are identify as jets

# Background Distributions

$W - e \nu + 3 \text{ partons}$

$W - \mu \nu + 3 \text{ partons}$

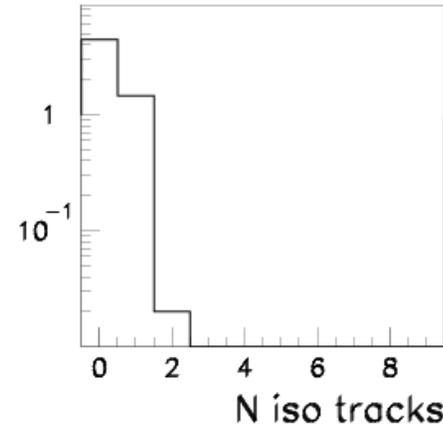
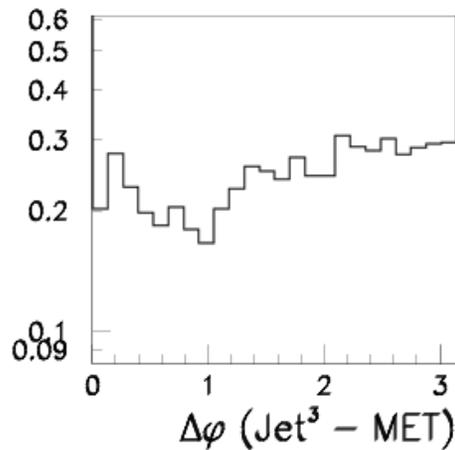
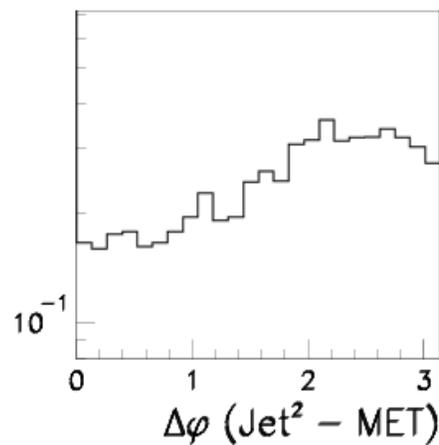
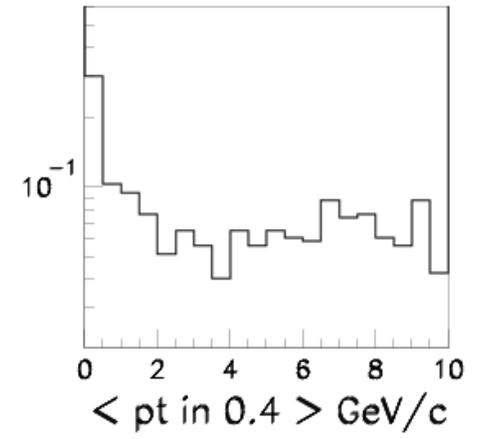
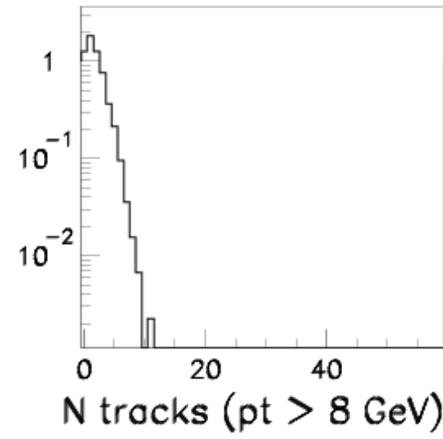
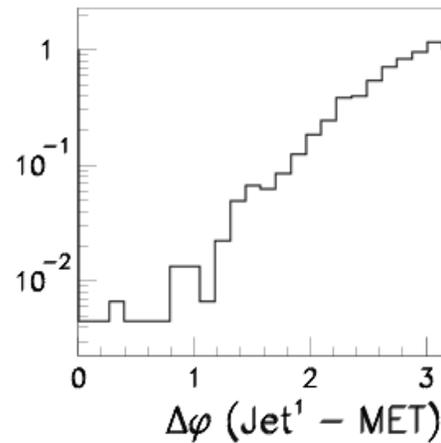
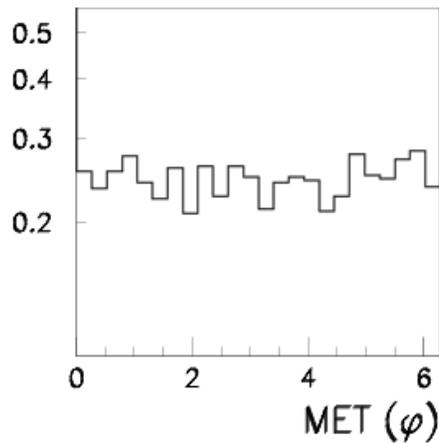


sum  $pt$  of tracks around each track with  $pt > 8 \text{ GeV/c}$  less than  $2 \text{ GeV/c}$  (using a cone of radius 0.4) ....we observe isolated tracks from  $e$  and  $\mu$

# Background Distributions

W -  $\tau\nu$  + 2 partons

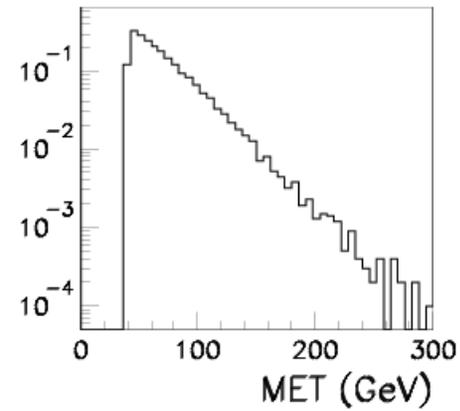
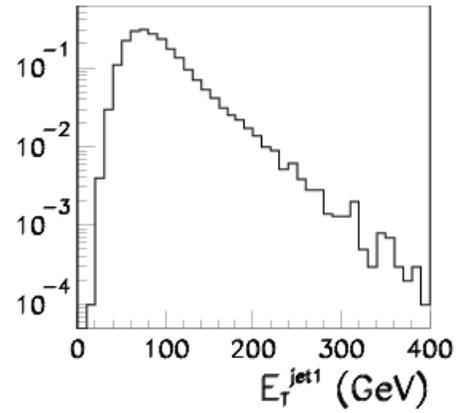
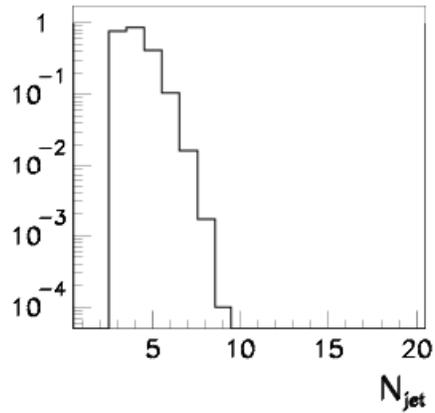
W -  $\tau\nu$  + 2 partons



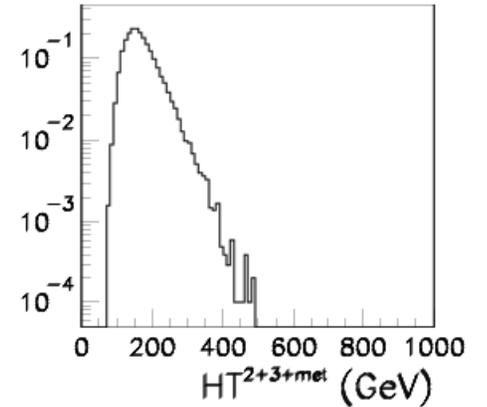
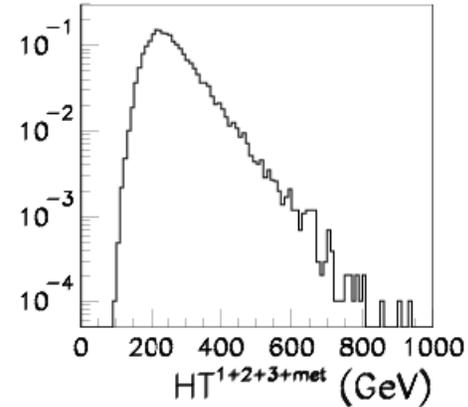
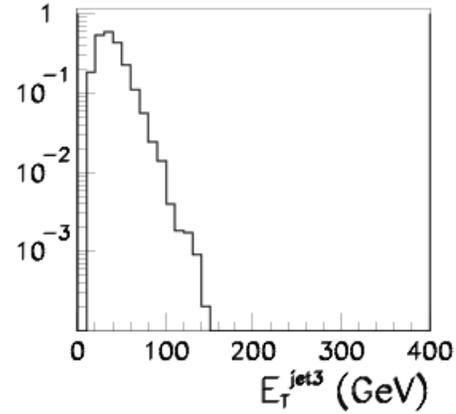
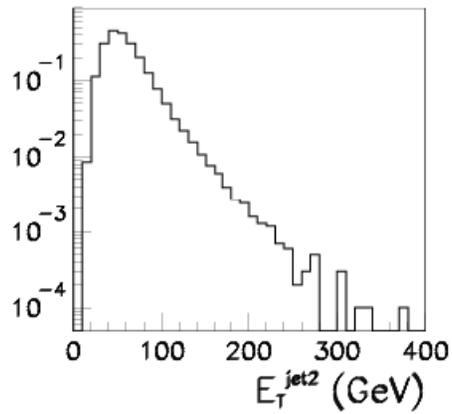
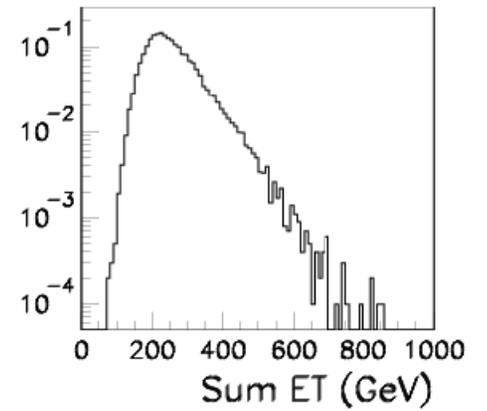
Similar to SUSY samples...we are exploring a TAU ID cut...

# Background Distributions

top (M=175 GeV)



top (M=175 GeV)

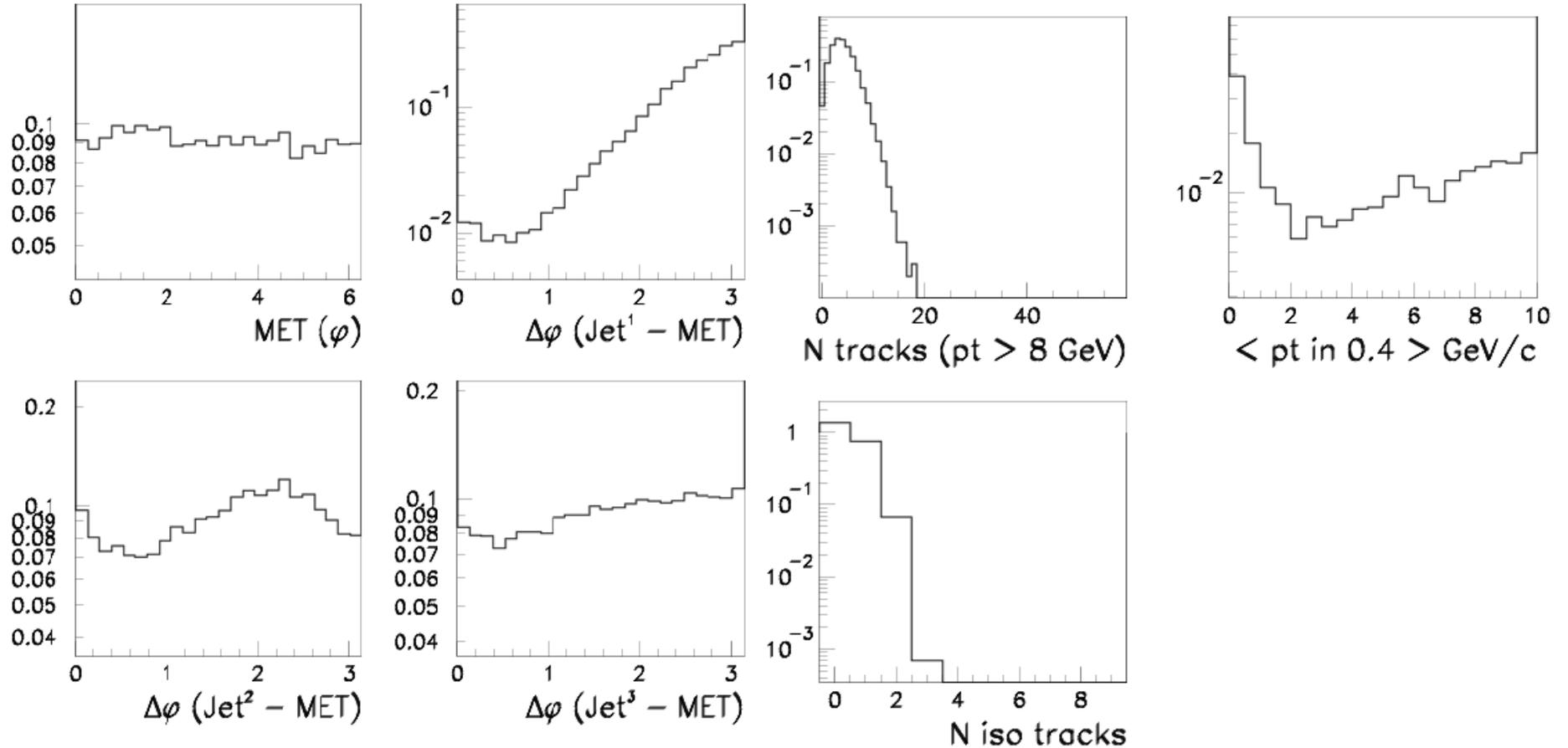


Very Similar to SUSY samples.....

# Background Distributions

top (M=175 GeV)

top (M=175 GeV)



Very Similar to SUSY samples.....

# Selection Cuts

## SELECTION CUTS

Vertex:  $|V_z| < 60$  cm

At least 3 jets with  $E_t > 15$  GeV and  $|\eta| < 2.3$

At least one of them central ( $|\eta| < 1.1$ )

$MET > 40$  GeV

Jet EM Fraction  $< 0.9$  (all three jets)

Delta phi (MET-jet)  $> 0.5$  (all three jets)

$E_t(\text{jet } 1) > 70$  GeV &  $E_t(\text{jet } 2) > 35$  GeV

$EEMF > 0.175$

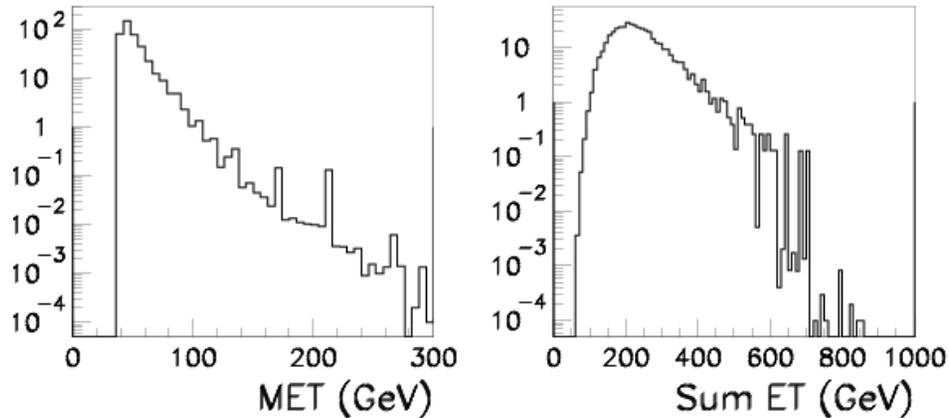
$ECHF > 0.1$

N isolated tracks = 0\*\*\*

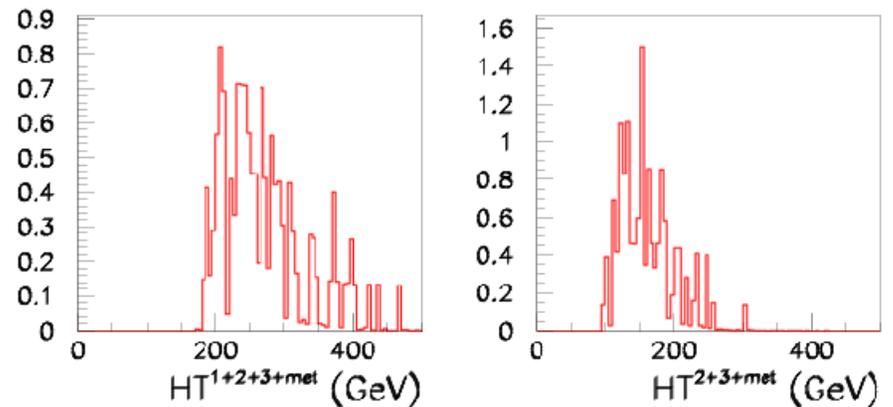
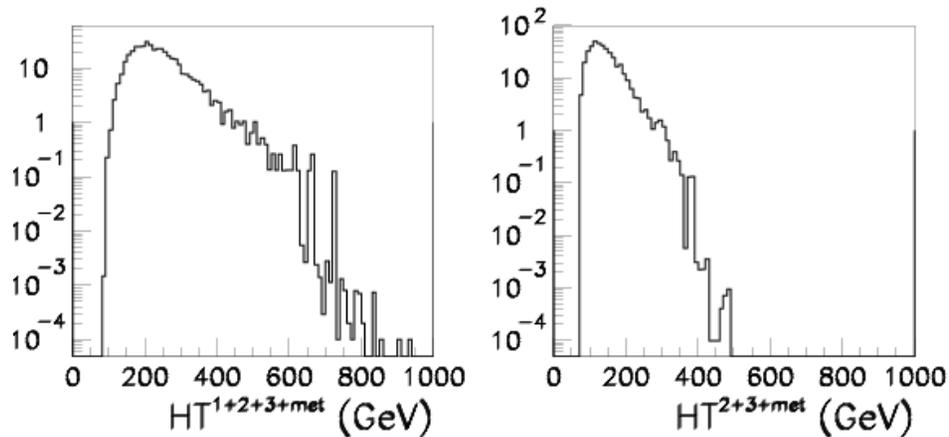
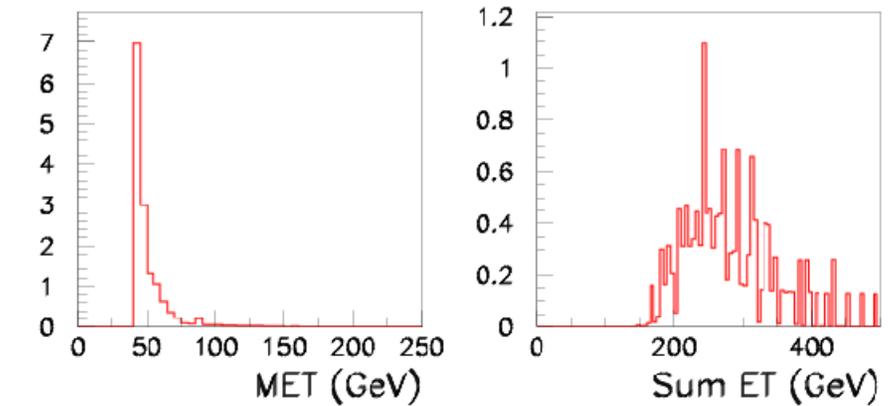
Applied now

# Background Reduction

All Backgrounds



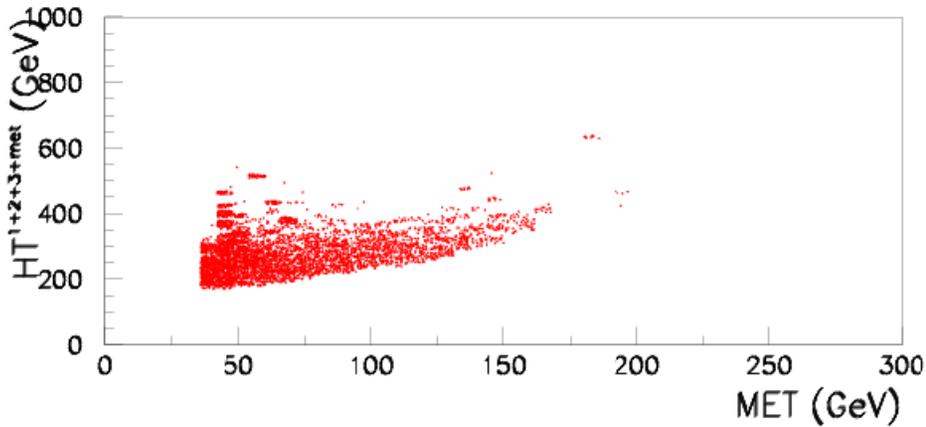
All Backgrounds



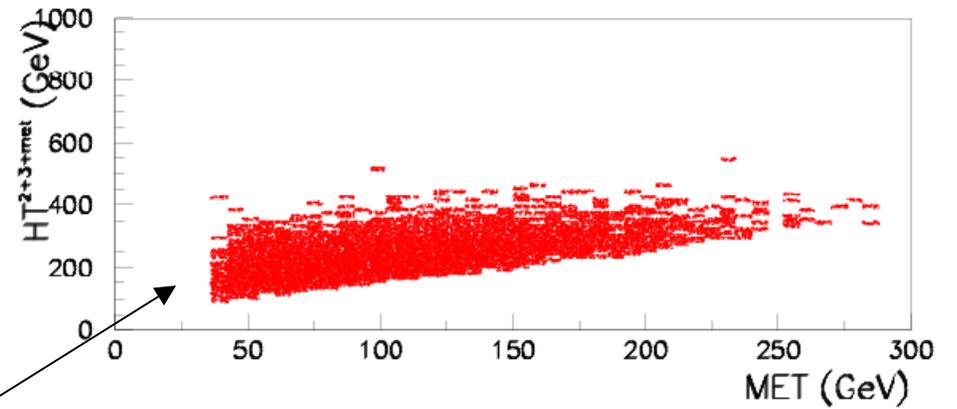
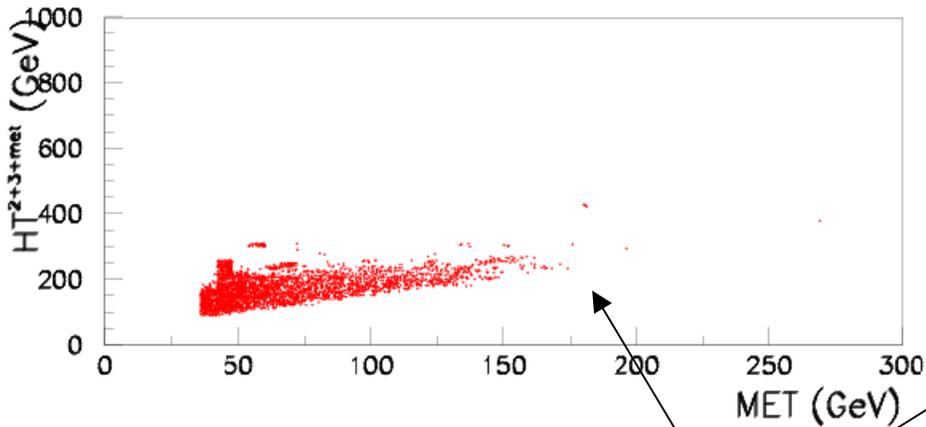
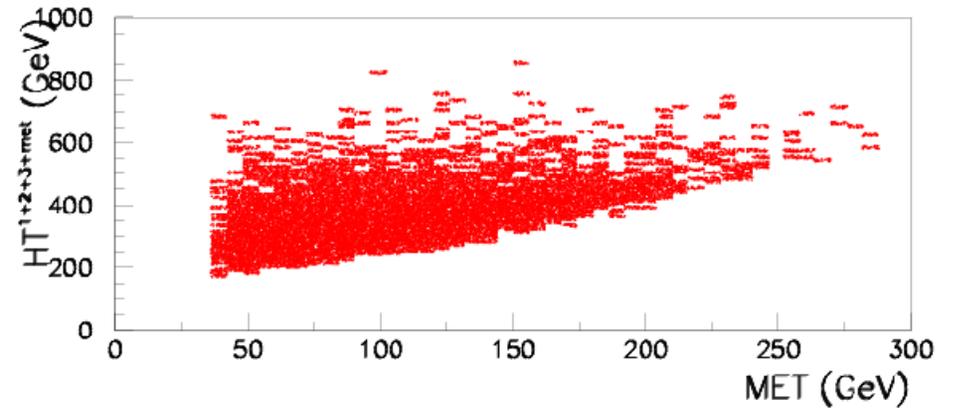
Background reduction of more than 100 after cuts..

# Sensitivity

All Backgrounds



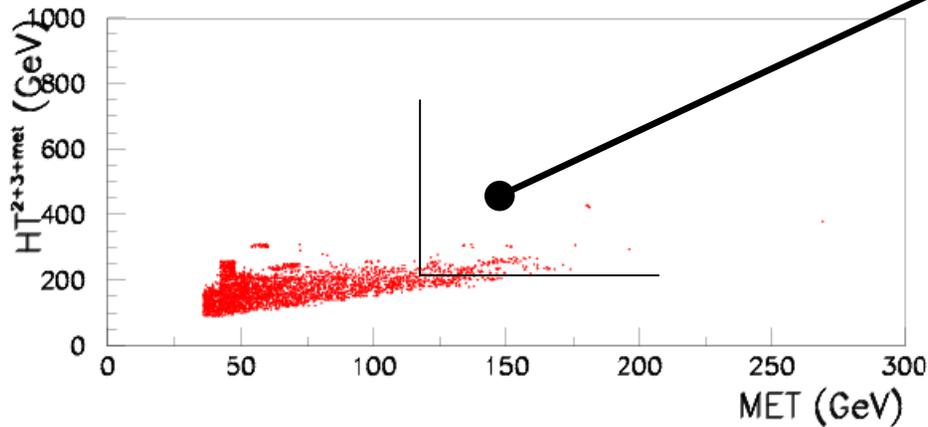
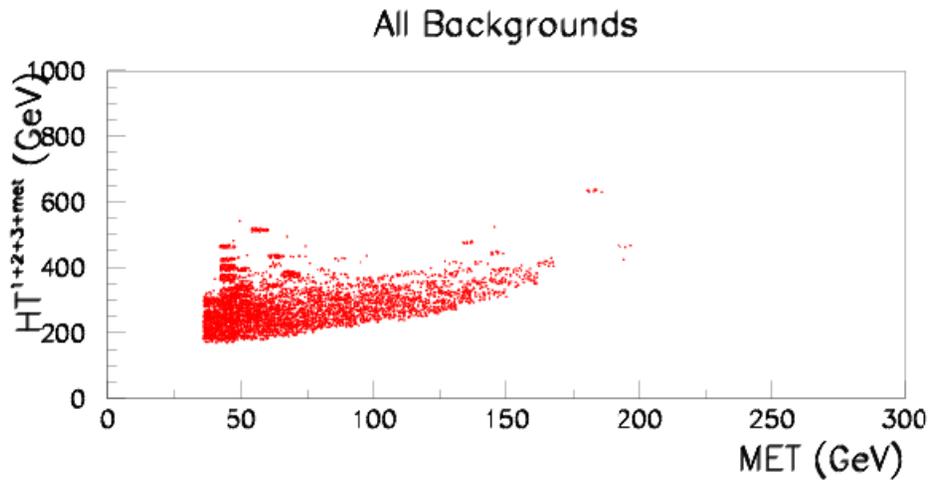
mSUGRA point b1



We will plot  $(S+B)/B$  in different MET vs HT quadrants

Still using LO x-sections....

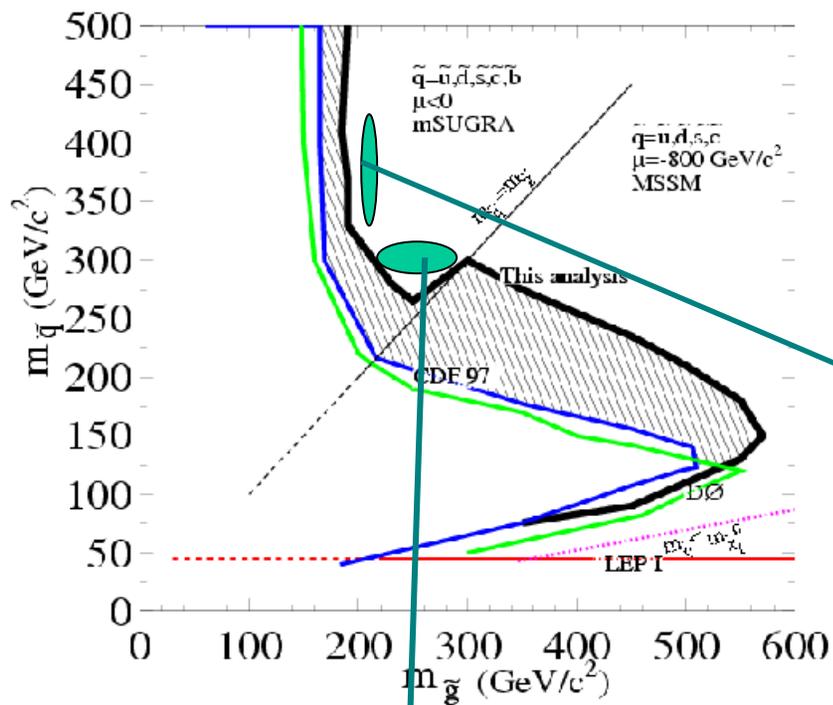
# Sensitivity



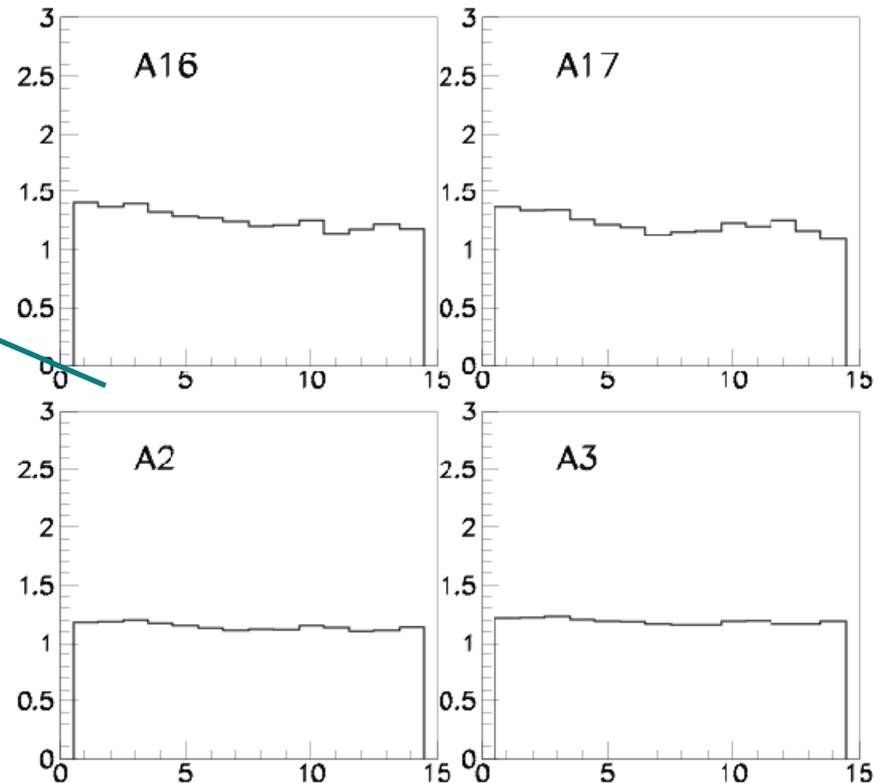
	MET > (GeV)	HT(2,3,met)> (GeV)
1	70	150
2	80	160
3	90	170
4	100	180
5	110	190
6	120	200
7	130	210
8	140	220
9	150	230
10	160	240
11	170	250
12	180	260
13	190	270
14	200	280

We compute  $\sigma(S+B)/\sigma(B)$

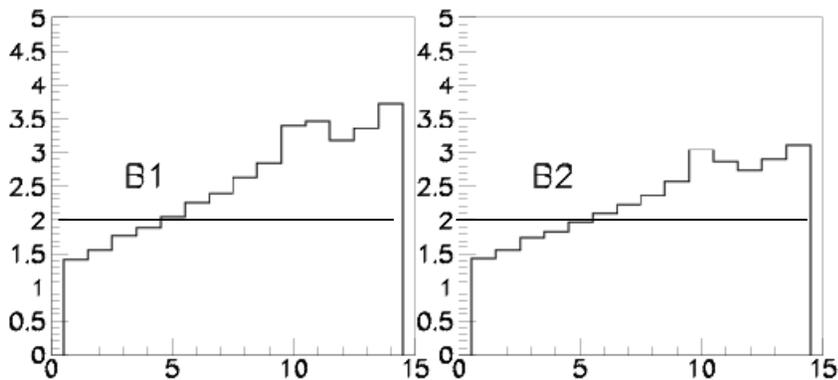
# Still using LO x-sections.... Sensitivity



(SUSY+Backg.)/Backg. (MET, HT QUAD.)



(SUSY+Backg.)/Backg. (MET, HT QUAD.)



No conclusion until more QCD MC is included....but this shows the idea

id= 6 → MET > 120 GeV & HT > 200 GeV

# Final Notes

- This is work in progress but we are now putting all pieces together (lots of things yet to be done!)
- Additional Clean-up cuts and TAU ID still under study to further reduce background....  
(+ more careful study of trigger efficiencies..etc..)
- Burning now Tier 1 in BCN to generate QCD  
(that will cost IFAE-CDF PI some “bottles of wine”)
- For Moriond’05 we expect to identify a high-MET/HT region for exclusion (discovery...?) at some new gluino/ squark mass range(s)

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