Stop Production in Polarized Photon-Photon Collisions

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- Part1

  See PS files (5 pages) with the corresponding Feynman diagrams, formulae and plots used to calculate the cross-sections of $\gamma\gamma \to \tilde{t}_1\bar{\tilde{t}}_1$ process.

- Part2

  See below

In the $\gamma\gamma \to \tilde{t}_1\bar{\tilde{t}}_1$ and $\gamma\gamma \to t\bar{t}$ processes with the

e^+e^- CMS Energy = 1000 GeV

the subsequent decay channels are considered:

$$\tilde{t}_1\bar{\tilde{t}}_1 \to b\tilde{\chi}_1^+\,\bar{b}\tilde{\chi}_1^- \to b\bar{b}q\bar{q}'\mu^-\nu_\mu\tilde{\chi}_1^0\tilde{\chi}_1^0$$

$$t\,\bar{t} \to W^+W^-b\bar{b} \to b\bar{b}q\bar{q}'\mu^-\nu_\mu$$

In order to simulate the STOP pair production, we assumed the following scenario for the MSSM model parameters:

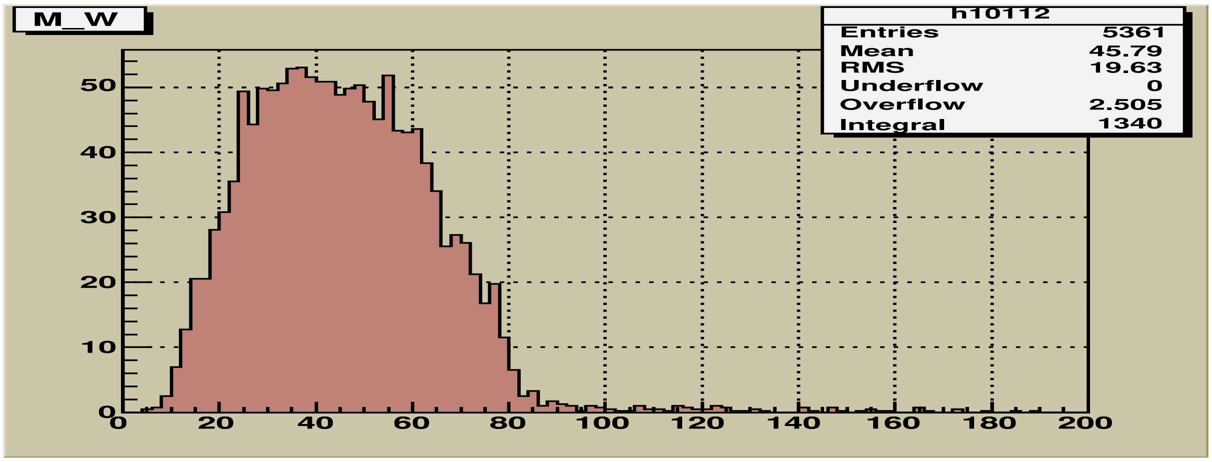
- $m_{\tilde{g}} = m_{\tilde{q}}$
- $m_{\tilde{q}} = 370GeV$ **(the mass of the light squarks is varied)**
- $m_{\tilde{t}_L} = m_{\tilde{t}_R} = m_{\tilde{b}_R} = m_{\tilde{q}} - 100GeV$ **(left and right squark masses)**
- $m_{\tilde{l}} = m_{\tilde{\nu}} = m_{\tilde{q}} + 10GeV$
- $A_t = A_b = -500GeV$ **(top and bottom trilinear coupling)**
- $m_{A^0} = 500GeV$ **(pseudoscalar higgs mass)**
- $\mu = -m_{\tilde{g}}$
- $tan\beta = 5$

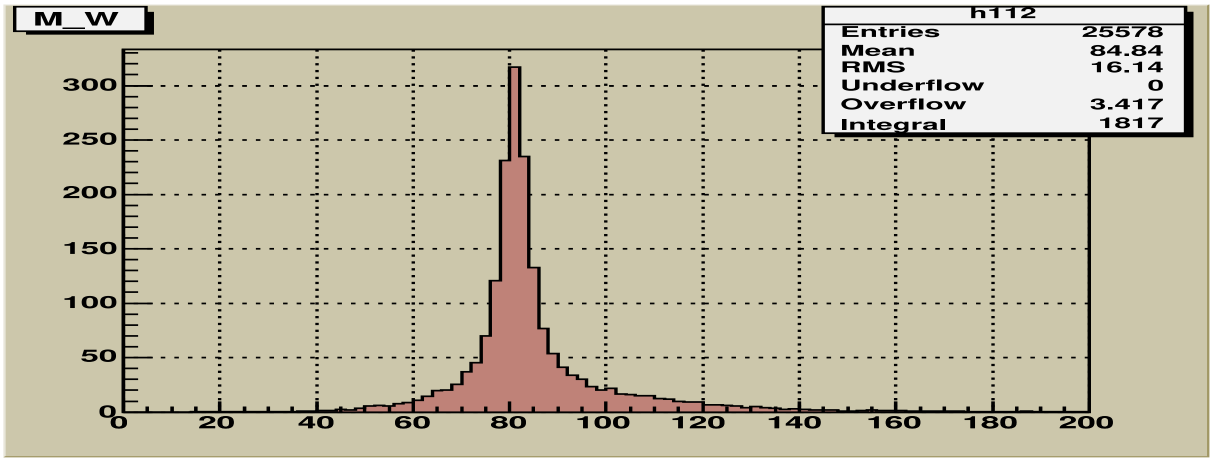
That corresponds to $M_{\tilde{t}_1}$ = 167 GeV

Our aim is:

- **To find out the physical variables (Energy, PT, angle and invariant mass distributions) most suitable for signal (stop)/ background (top) separation.**
- **To estimate the corresponding values of cuts on these variables**

$$M_{W_{inv}} = \sqrt{(P_{W_{jet1}} + P_{W_{jet2}})^2}$$



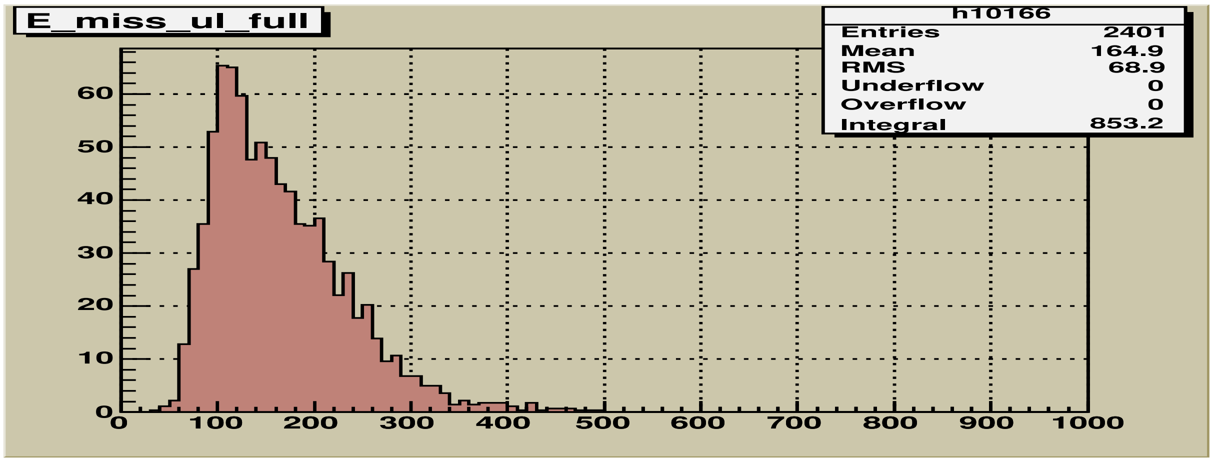


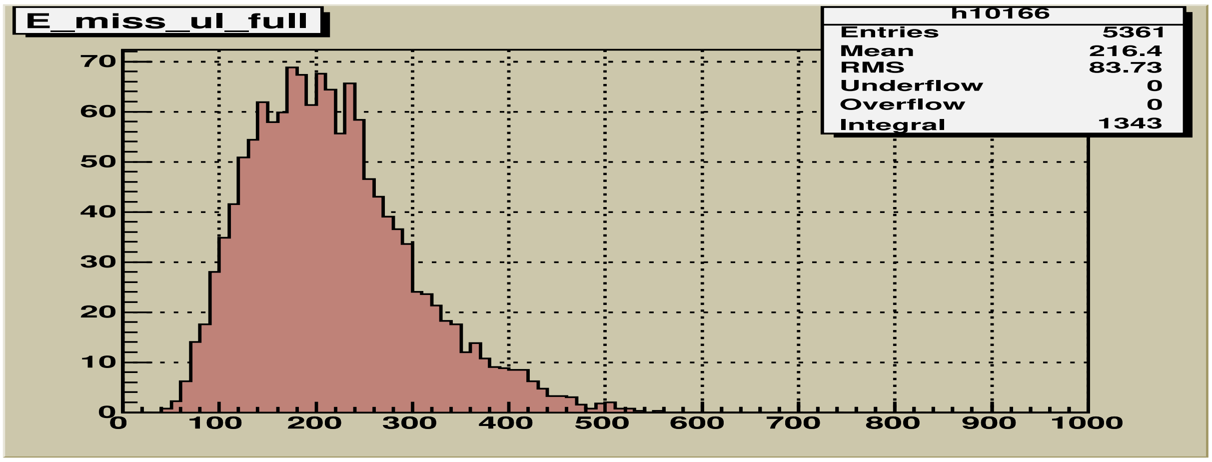
Top: STOP case

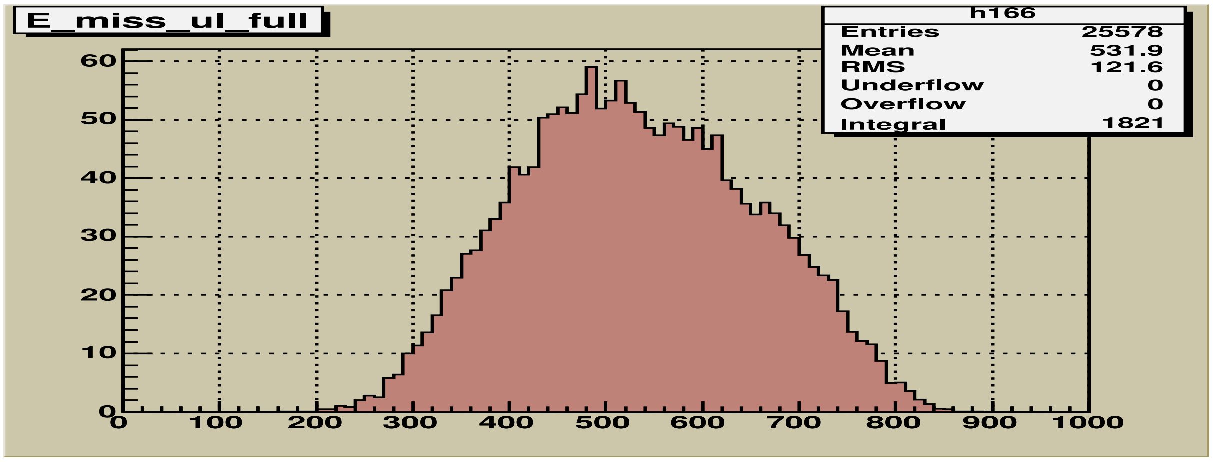
Bottom: TOP case

Conclusion: Good separation with M_W cut < 40 GeV

$$E_{miss} = E^{total}_{calorimeter}$$

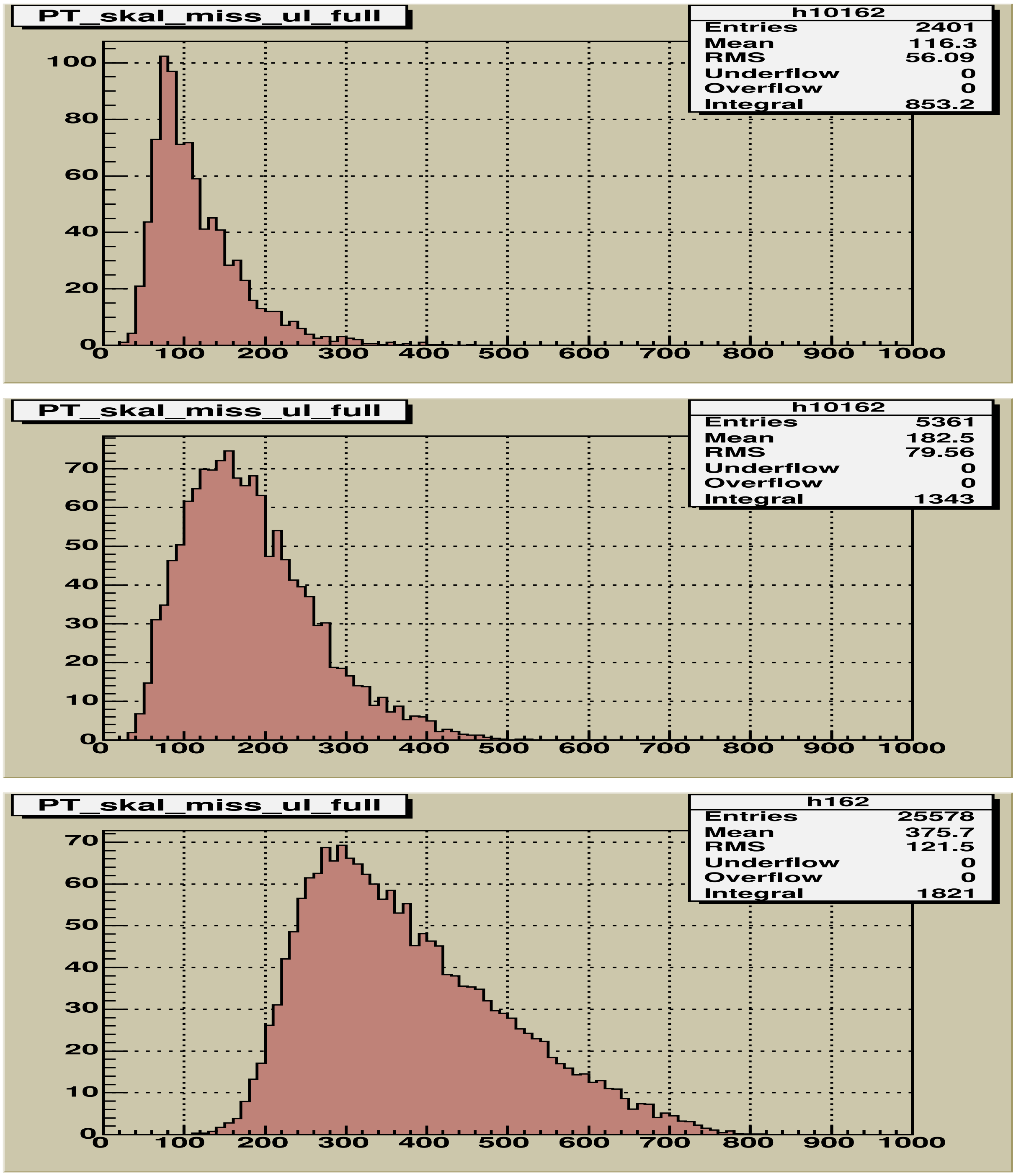






Top: STOP case Polarization ++/- -
Middle: STOP case Polarization +-/-+
Bottom: TOP case
Conclusion: Good separation with E_{miss} cut < 250 GeV

Total P_T *scalar Sum*



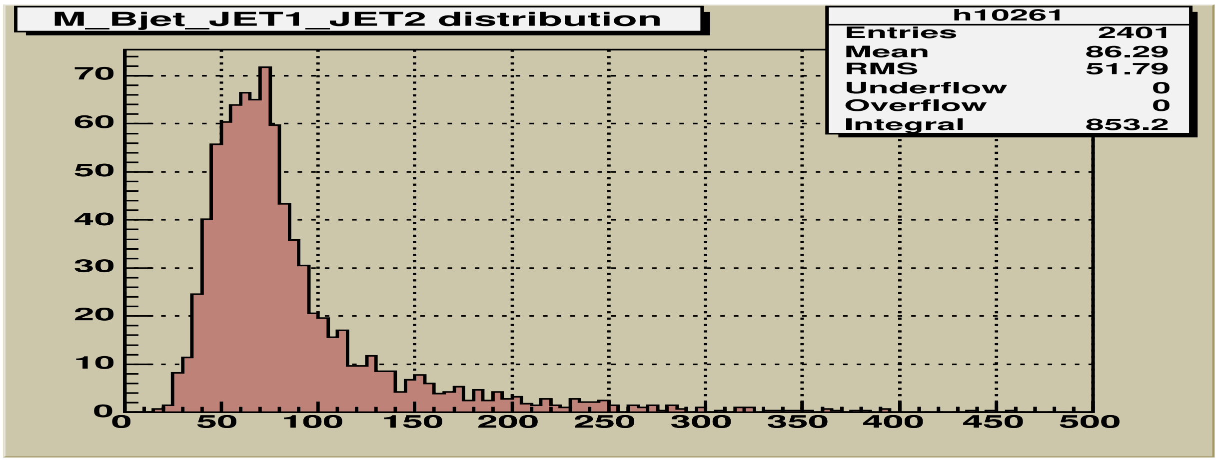
Top: STOP case Polarization ++/- -

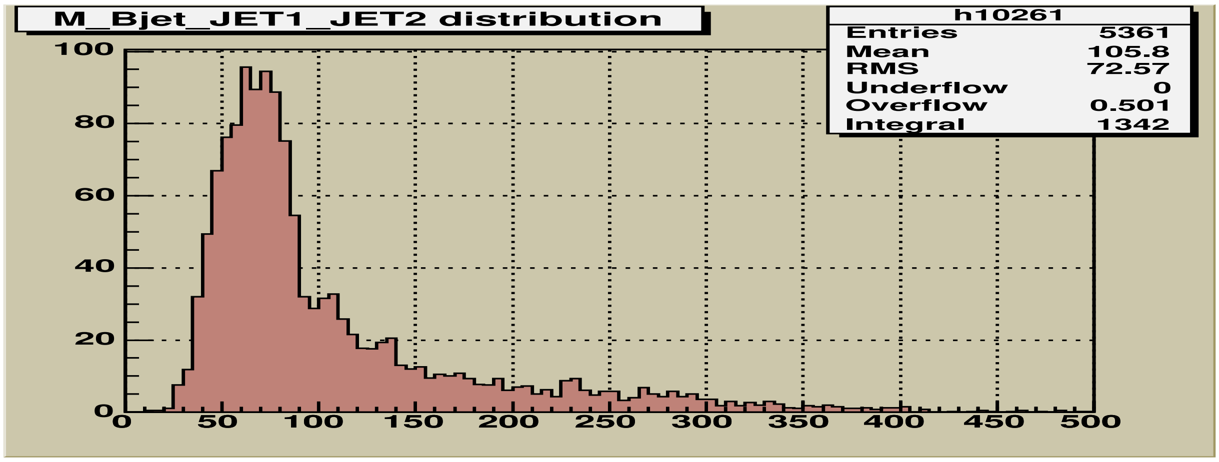
Middle: STOP case Polarization +-/-+

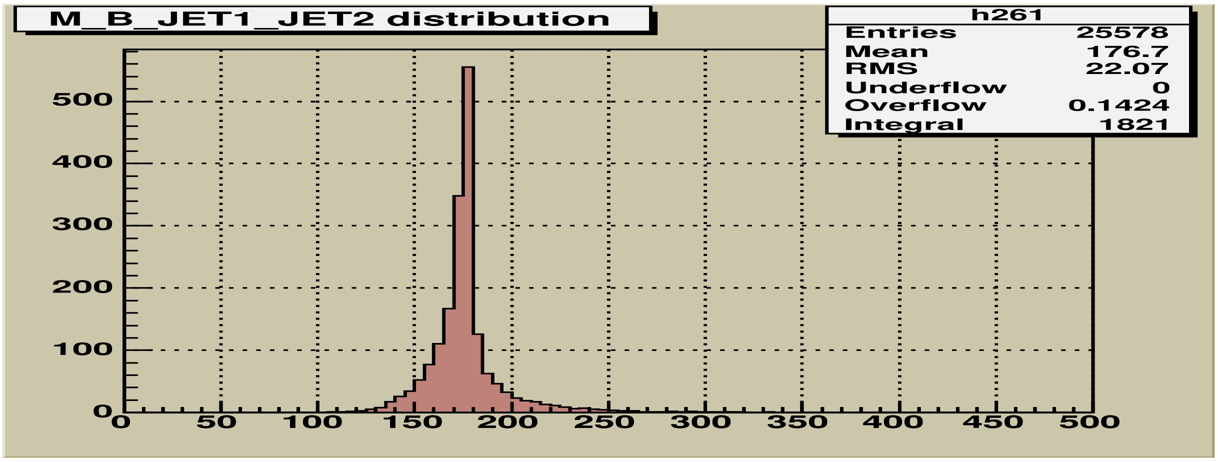
Bottom: TOP case

Conclusion: Good separation with $PT_{scalsum_{miss}}$ cut $<$ 150 GeV

$M_{inv_{(B_{jet}+(W_{jet_1}+W_{jet_2}))}}$







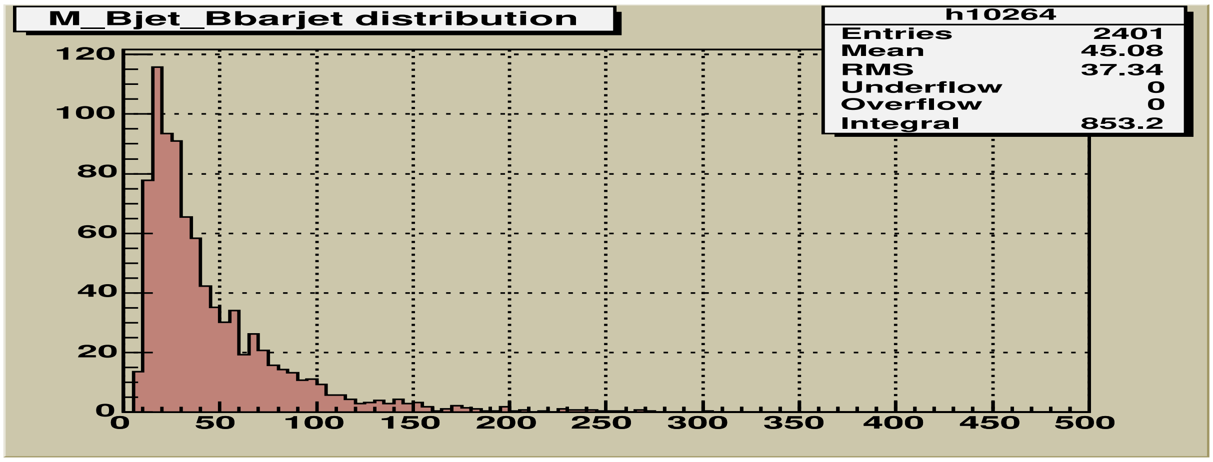
Top: STOP case Polarization ++/- -

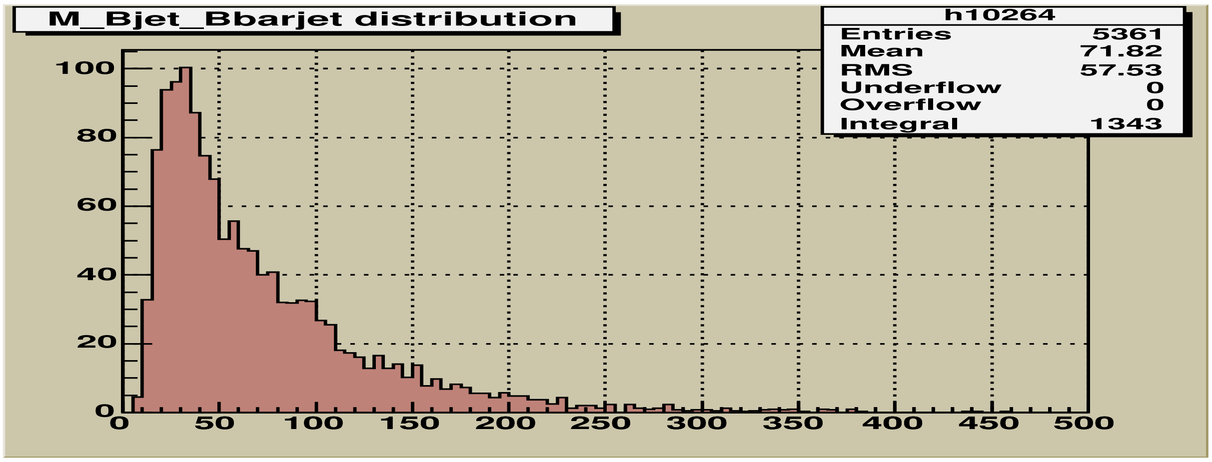
Middle: STOP case Polarization +-/-+

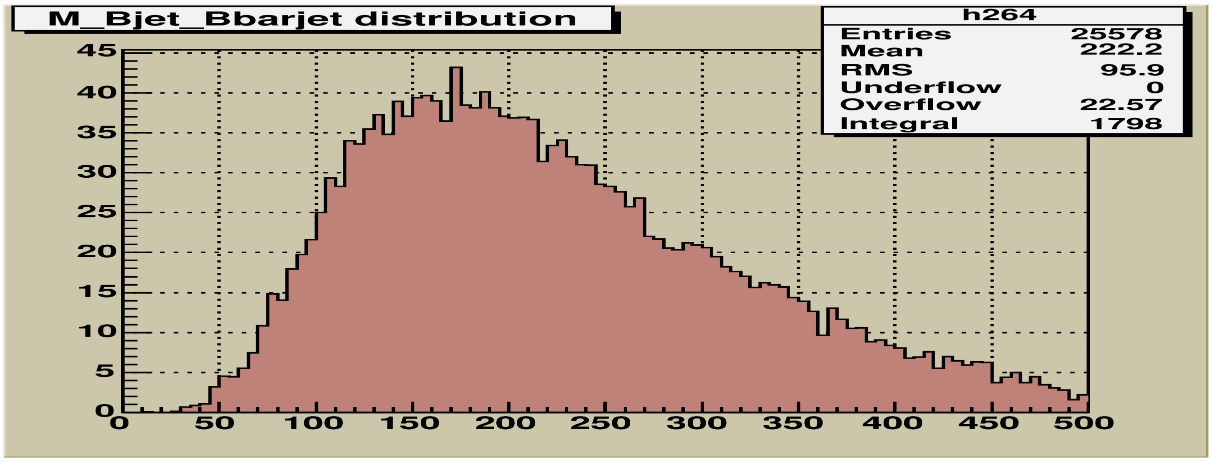
Bottom: TOP case

Conclusion: Good separation with M_{inv} cut $<$ 120 GeV

$$M_{inv_{B_{jet}+\bar{B}_{jet}}} = \sqrt{(P_{B_{jet}} + P_{\bar{B}_{jet}})^2}$$





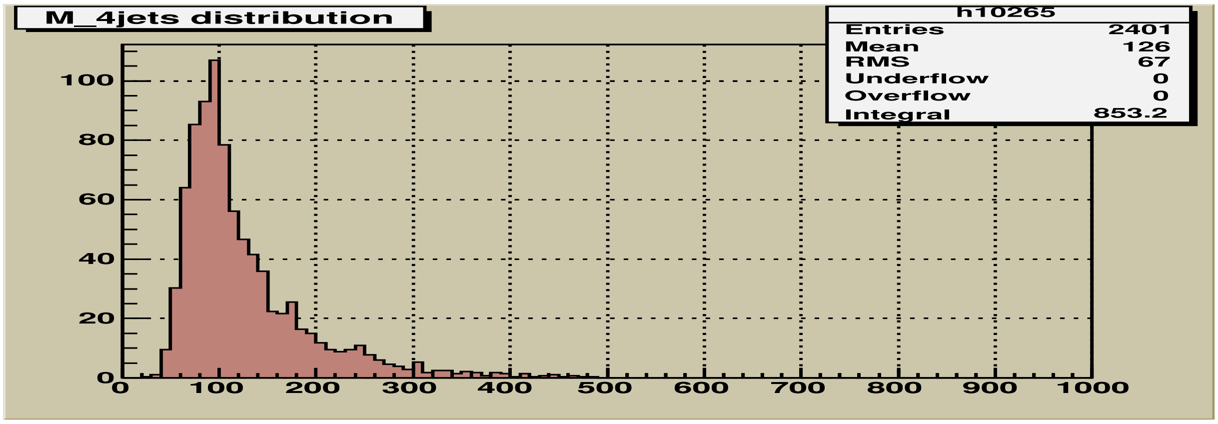


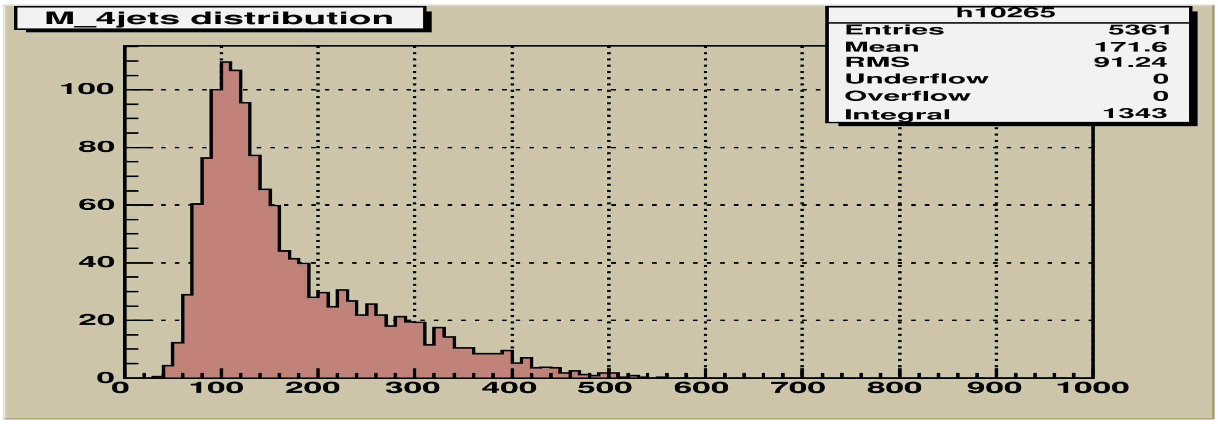
Top: STOP case Polarization ++/- -
Middle: STOP case Polarization +-/-+
Bottom: TOP case

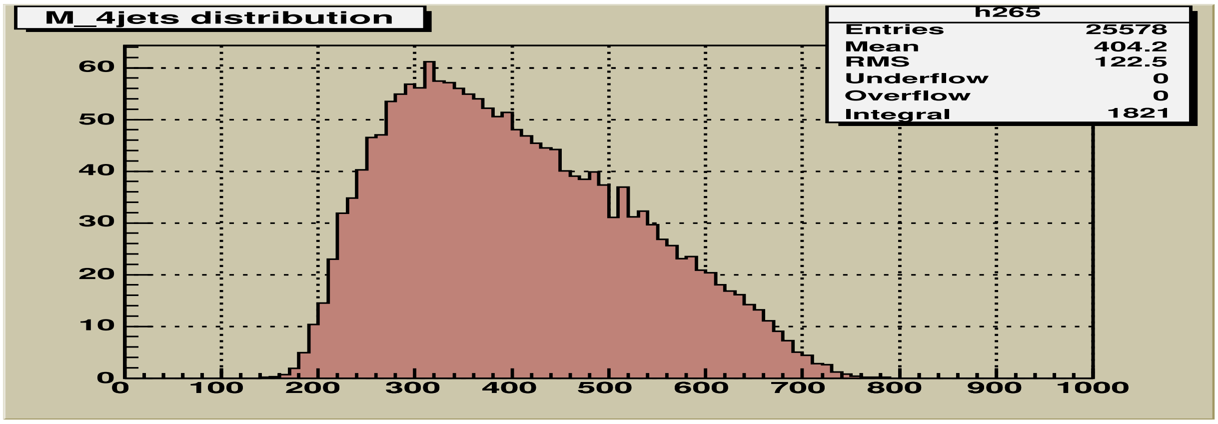
Conclusion: Good separation with $M_{inv_{B_{jet}+\bar{B}_{jet}}}$ cut < 50 GeV

$$M_{inv_{4jets}} = M_{inv_{B_{jet}+\bar{B}_{jet}+W_{jet1}+W_{jet2}}}$$

$$M_{inv_{4jets}} = \sqrt{(P_{B_{jet}} + P_{\bar{B}_{jet}} + P_{W_{jet1}} + P_{W_{jet2}})^2}$$





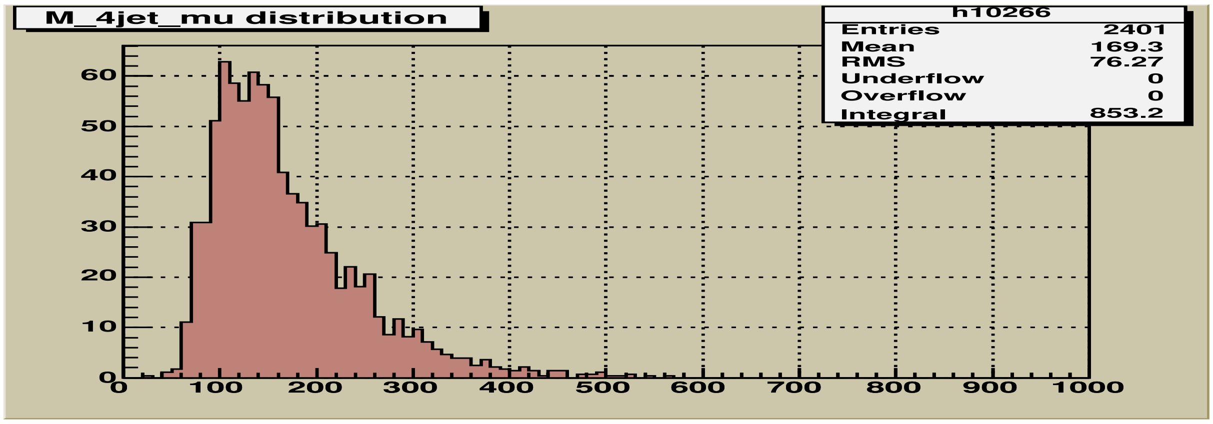


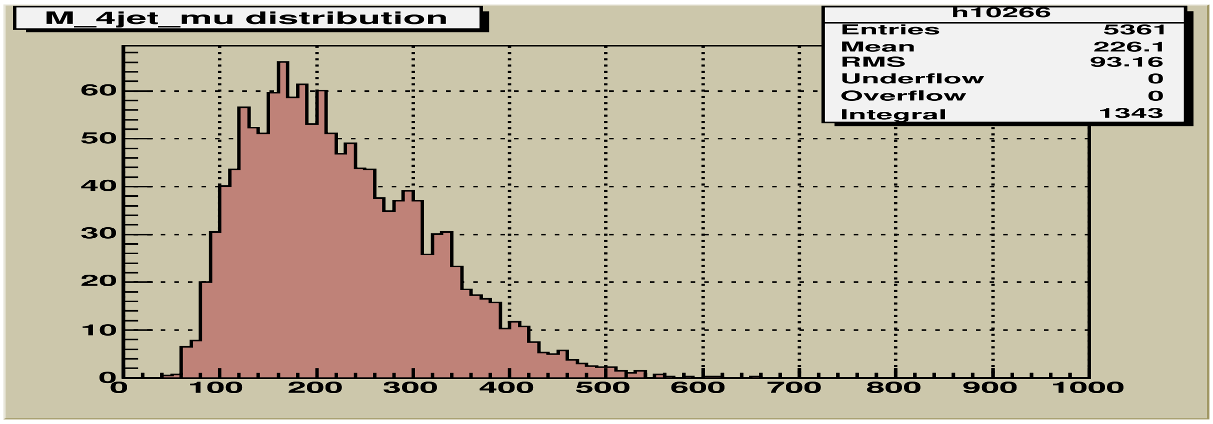
Top: STOP case Polarization ++/- -
Middle: STOP case Polarization +-/-+
Bottom: TOP case

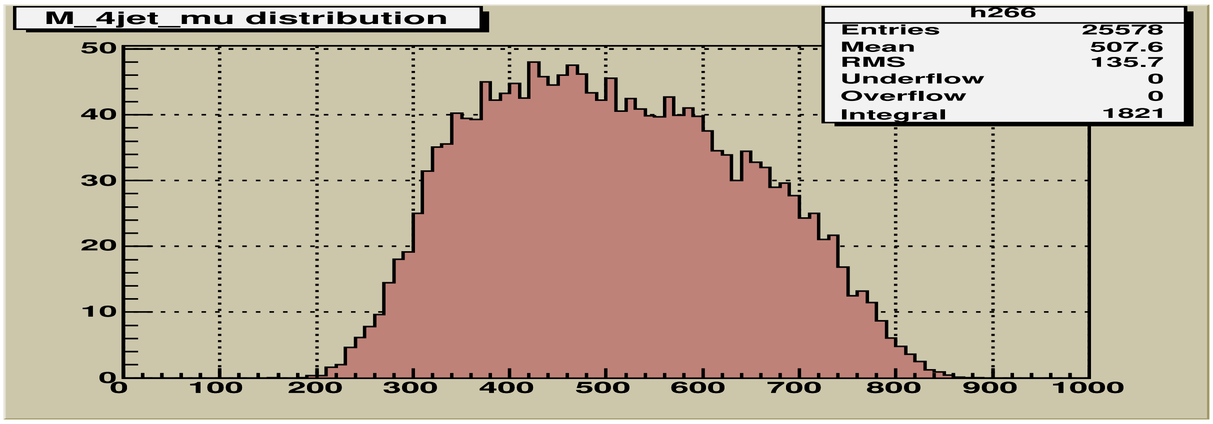
Conclusion: Good separation with $M_{inv_{4jets}}$ cut < 160 GeV

$$M_{inv_{4jets+\mu}} = M_{inv_{B_{jet}+\bar{B}_{jet}+W_{jet1}+W_{jet2}+\mu}}$$

$$M_{inv_{4jets+\mu}} = \sqrt{(P_{B_{jet}} + P_{\bar{B}_{jet}} + P_{W_{jet1}} + P_{W_{jet2}} + P_{\mu})^2}$$







Top: STOP case Polarization ++/- -
Middle: STOP case Polarization +-/-+
Bottom: TOP case

Conclusion: Good separation with $M_{inv_{4jets+\mu}}$ cut $<$ 200 GeV

Summary & plans

- **HERE**

we have considered one Stop mass point ($M_{\tilde{t}_1}$ = 167 GeV) for the illustration of usefullness of many different global ($E^{total}_{calorimeter}$, $P_T^{scalsum}$) and Inv. Mass variables

- **Our PLANS are :**

To account the detector effects (SIMDET):

- E_{jet} *resolution effects,*
- *Jet algorithms (jetfinders, ...)*

To consider other / also:

- $S_{e^+e^-}$ *points with* $\tilde{t}_1$ *and* $\tilde{t}_2$
- $M_{\tilde{t}_1}$ *values (and their reconstruction)*
- $\tilde{t}_1$ *decay channels*
- *MSSM sets of parameters (*$M_{\tilde{q}}, M_{\tilde{g}}$ *)*
- *SUGRA scenario*
- *WW, ZZ,* $b\bar{b}$ *and other backgrounds*
- *Comparison with simulation for LHC / TEVATRON energies*
- *NLO corrections (see the following talk of S.Berge)*