

$$TZ \rightarrow 3\ell$$

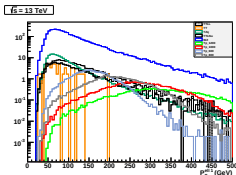
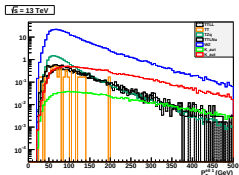
$\mathcal{L} = 100 \text{ fb}^{-1}$ with $K_{tZu} = 2 \cdot 10^{-4}$ (the best limit)
 $\mathcal{L} = 100 \text{ fb}^{-1}$ with $M_{T'} = 1 \text{ TeV}$, $g = 0.1$

Lorenzo Basso

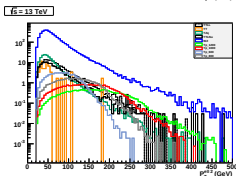
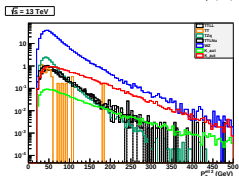
Preselection

- $p_{\ell}^T > 20 \text{ GeV}$, $p_j^T > 40 \text{ GeV}$, CVSM b-tagging
- isolation: CONE03 with threshold = 0.1 (kills $t\bar{t}$)
- $N_b \equiv 1$, $1 \leq N_J \leq 3$ (J = light and b jets)
- Z candidate as pair of $e^+e^- (\mu^+\mu^-)$ closest to M_Z
- W and top mass reconstructed with transverse mass (sharper)
- Cuts optimised with Kevin's macro
- Attempt to use TMVA (BDT)

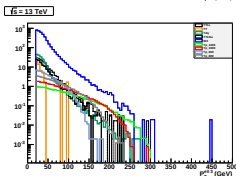
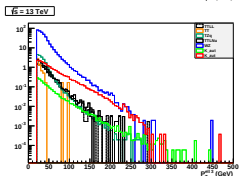
P_T of leptons for FCNC



PT of lepton 1

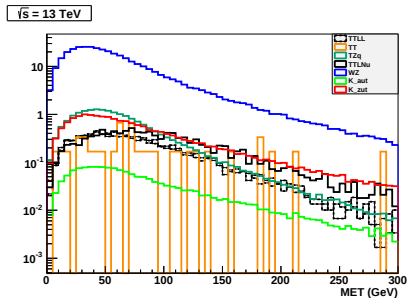


PT of lepton 2

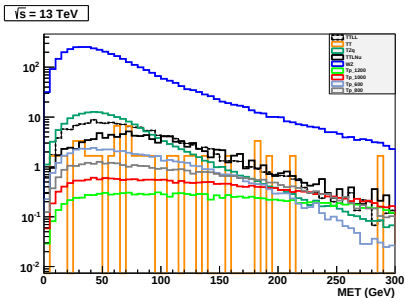


PT of lepton 3

MET - selection

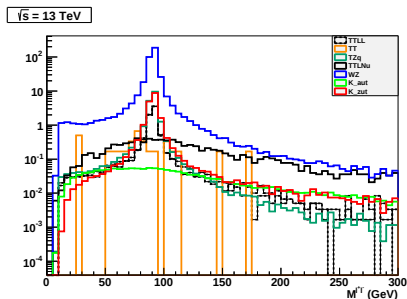


(Left) FCNC

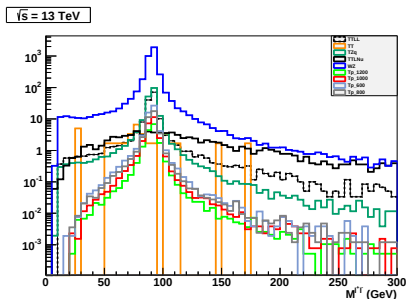


(Right) T'

MZ - selection



(Left) FCNC

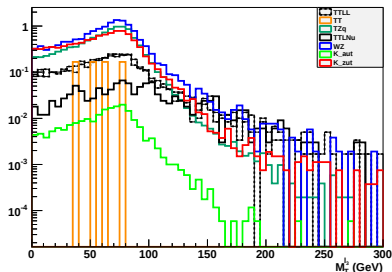


(Right) T'

Selection: $|M_{\ell+\ell^-} - 91| < 15 \text{ GeV}$

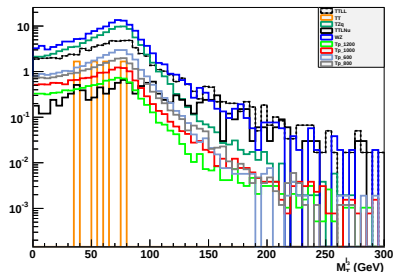
MW - selection (FCNC)

$\sqrt{s} = 13 \text{ TeV}$



(Left) M_T

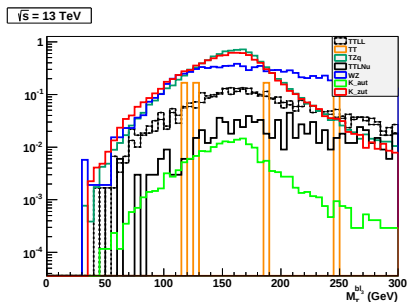
$\sqrt{s} = 13 \text{ TeV}$



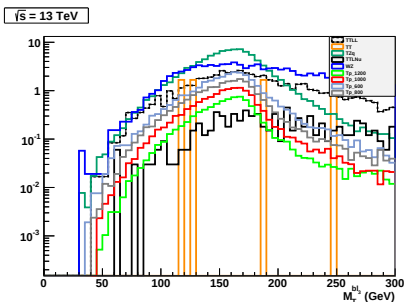
(Right) Invariant mass

Selection: $10 < M_{\ell_3}^T < 150$

Mtop - selection (FCNC)



(Left) FCNC

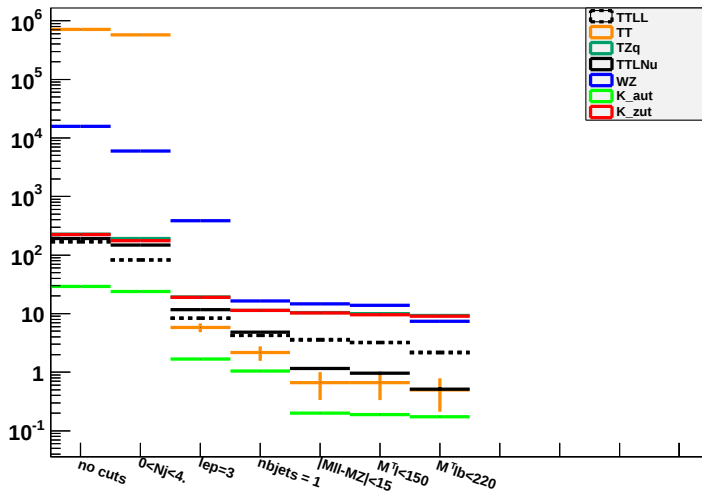


(Right) T'

Selection: $M_{bl_3}^T < 220$

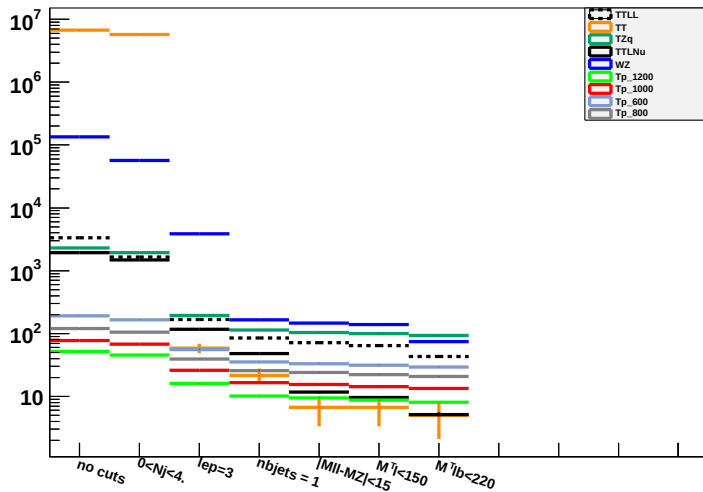
CutFlow - FCNC

$\sqrt{s} = 13 \text{ TeV}$

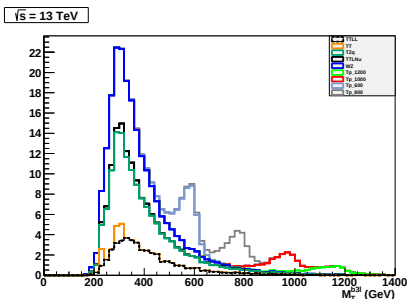
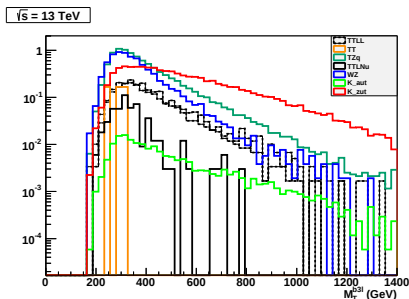


CutFlow - Tp

$\sqrt{s} = 13 \text{ TeV}$



Bonus level: M_{tZ}



$M_{b\ell\ell}^T$: transverse mass of top and Z (useful if tZ is resonant: T')

$\text{MAX } S/\sqrt{S+B} = 5.5$ (FCNC)

$= 3.7$ (600 GeV), 3.5 (800 GeV), 3.0 (1000 GeV), 2.4 (1200 GeV)

BDT

Variables

Variables for training:

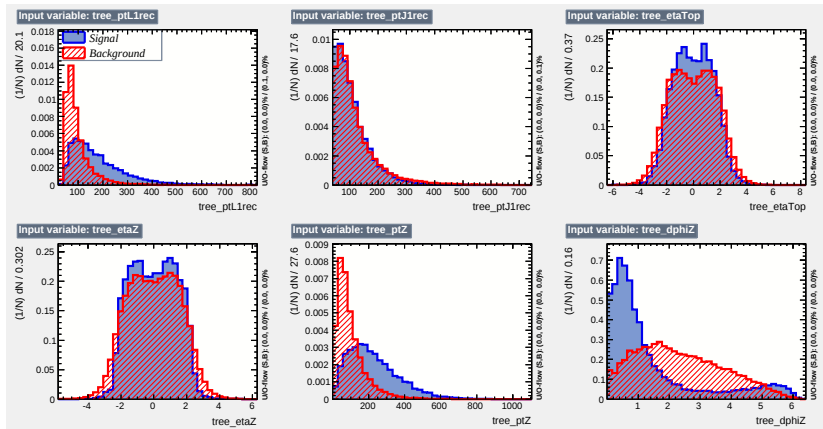
- $p^T(\ell_1), p^T(J_1)$
- $p^T(Z), \eta(Z)$
- $\eta(t)$
- $\Delta R(\ell_W, b), \Delta\phi(\ell_W, b)$
- $\Delta R(\ell_W, Z), \Delta\phi(\ell_W, Z)$
- $\Delta\phi(MET, Z)$
- $\Delta\phi(\ell^+\ell^-)_Z$
- $M_T(tZ)$

Useless:

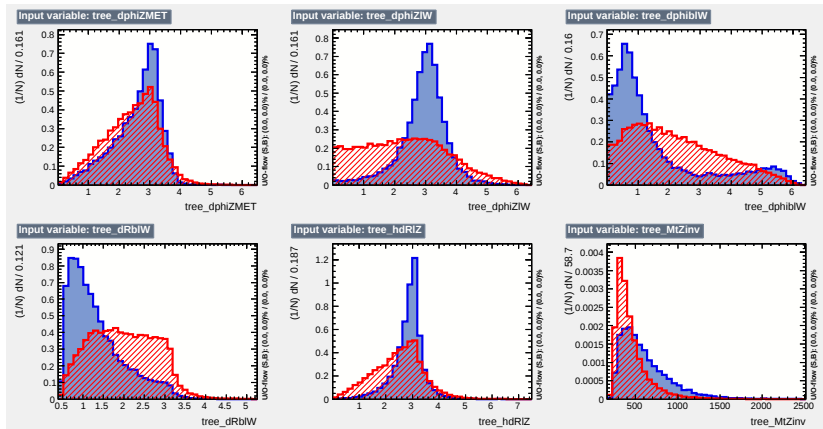
- N_b
- N_j
- $\eta(J_1), \eta(\ell_1)$
- M_{top}
- $\Delta R(tZ)$
- $\Delta R(\ell^+\ell^-)_Z$

Background: WZ and $tZj \times 1.5$

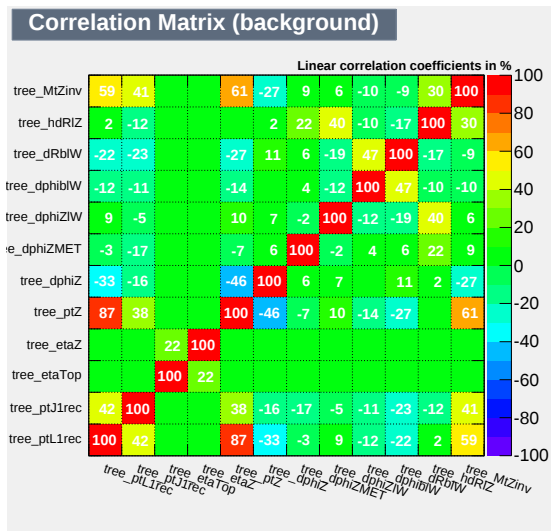
Variable training FCNC - 1



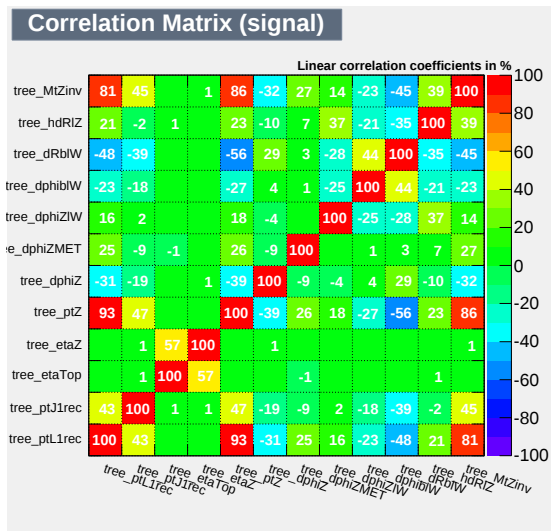
Variable training FCNC - 2



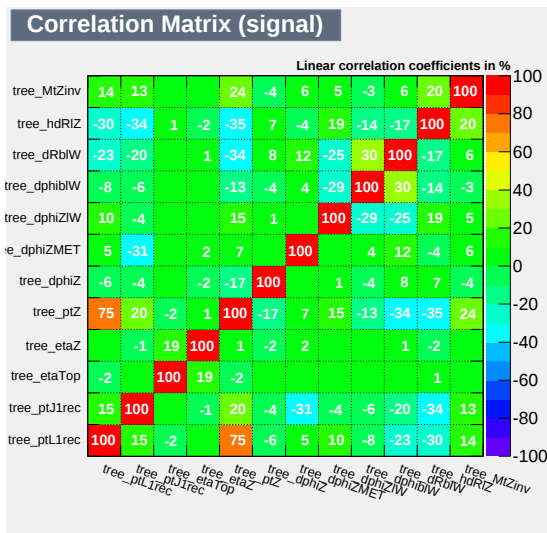
Correlations - background



Correlations - FCNC

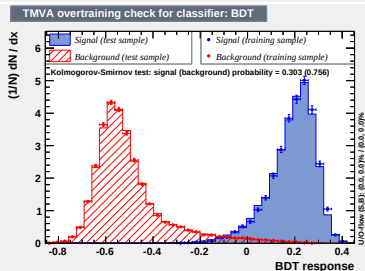
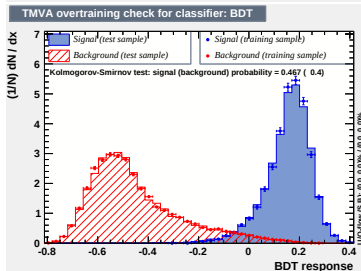
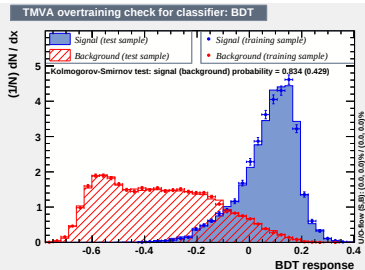
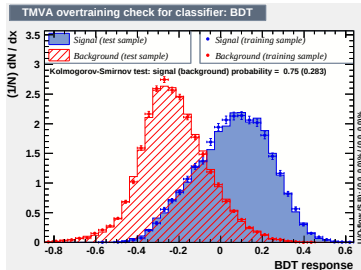


Correlations - T' (1000)



$P_T(\ell_1)$ highly correlated to $P_T(Z)$: maybe use $P_T(\ell_3)$ instead?

Overtraining



Results

signal	Training					
		FCNC	600	800	1000	1200
	FCNC	6.4	4.72	4.69	4.75	4.80
	600	2.36	3.58	2.5	2.32	2.18
	800	2.40	1.87	3.43	2.76	2.34
	1000	1.88	1.02	2.22	3.0	2.59
	1200	1.28	0.60	0.82	2.02	2.37

Cut&Count:

$$\text{MAX } S/\sqrt{S+B} = 5.5 \text{ (FCNC)}$$

= 3.7 (600 GeV), 3.5 (800 GeV), 3.0 (1000 GeV), 2.4 (1200 GeV)

(Notice, $tZq \times 1.5$ in MVA, but not in C&C yet)