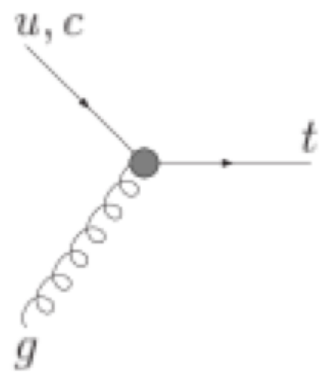
FCNC channel: pp → t

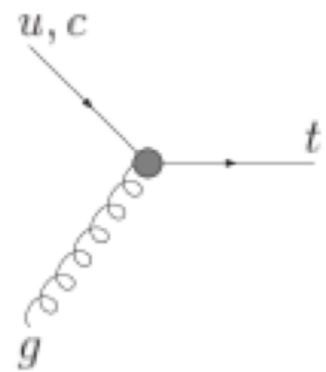


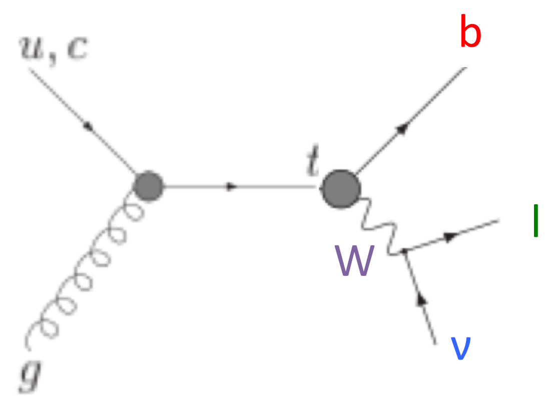
Caroline Collard (IPHC, Strasbourg)

02/07/2015

Signal

- 2 possible couplings : gut & gct
- Production with 0/1 jet (matched)
  - t-1j-Kappa-gut.txt
  - t-1j-Kappa-gct.txt
- Existing limits from ATLAS-CONF-2013-063:
  - BR_limit_gut = 0.0031 %
  - BR_limit_gct = 0.016 %
- NLO x-section arxiv:1409.6959
  ➔ use k=1.5
- Decay : t → b W with W→ lν

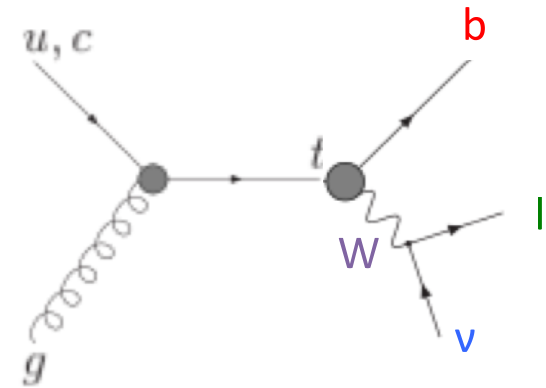




Backgrounds

- W+jets:
  - WToLNu-0Jet_sm-no_masses (including also -run2) to WToLNu-3Jets_sm-no_masses
- ttbar:
  - TTsemilep_madspin_1 &_2,
  - TTdilep_madspin
- Single top:
  - SingleTop_W_madspin,
  - SingleTop_s_madspin (old files),
  - SingleTop_t_4FS_madspin
- Z+jets:
  - ZToLL10-50-0Jet_sm-no_masses to ZToLL10-50-3Jets_sm-no_masses,
  - ZToLL50-0Jet_sm-no_masses to ZToLL50-4Jets_sm-no_masses_split
- Neglected in the study: multijets

Selection



- = 1 lepton pT=>30 GeV (no other lepton with pT=>20), |η|<2.5, Combined Iso (cone04)<=0.2
- 1 or 2 jets: pT(j1)=>30 GeV, pT(j2)=>20 GeV, (no other jet with pT=>20 GeV), |η|<=2.4, **H/E=1./EEoverHE()>0.15**, cleaning w/r to lepton in ΔR=0.1
- b-tagging: **Tight** criteria for j1.

  [Modification of the AnalysisHelper class to return the efficiency of b-tagging per jet -> used as a weight to avoid lack of statistics in my case for DY.]
- MET>=30 & M_T(W)>=50 GeV from ATLAS paper, used for multijet suppression.
- No photon with pT>=10 GeV, |η|<2.5, Combined Iso (cone04)<=0.2

Cut&Count

100 fb^{-1}

Cut	Sum Bg	Signal gct	Signal gut	T+jets	TT+jets	W+jets	ZToLL
nosel	3009515562 ± 965434	749982 ± 264	667187 ± 236	27237610 ± 16998	36605248 ± 7677	1613848064 ± 568471	1331824640 ± 780100
= 1*lep*	1365577560 ± 372593	243085 ± 150	173582 ± 121	3380814 ± 5455	13094378 ± 4557	1212020864 ± 252487	137081504 ± 273907
≥1 jet & $p_T(j_1) > 30$	301751034 ± 264519	193819 ± 134	125614 ± 103	3006797 ± 5071	12883153 ± 4529	222321536 ± 73444	63539548 ± 254028
$MET > 30$	154070967 ± 136078	138493 ± 113	90122 ± 87	2260305 ± 4376	10504655 ± 4062	131078720 ± 56288	10227287 ± 123747
$M_T > 50$	125850781 ± 103899	111539 ± 102	70745 ± 77	1739028 ± 3882	7571678 ± 3420	110892936 ± 52895	5647139 ± 89277
Tight b-tagging (j_1)	3698956 ± 8134	38623 ± 41	21694 ± 30	566115 ± 1660	2169427 ± 1266	870568 ± 1046	92846 ± 7792
1 or 2 jets	1856104 ± 5783	34790 ± 39	19606 ± 28	407140 ± 1459	594491 ± 587	790541 ± 997	63932 ± 5475
no photon	1792899 ± 5627	34486 ± 39	19429 ± 28	397749 ± 1448	552972 ± 570	782138 ± 992	60040 ± 5316

Sig = S/sqrt(S+B)
= 25.5 for gct
(BR_limit)

Sig = S/sqrt(S+B)
= 14.4 for gut
(BR_limit)

Comparison with ATLAS selection:
ATLAS@8TeV= exactly 1 jet

Sig = 25.0 for gct and 14.3 for gut if = 1jet

In our case we have a signal pp->t with up to 1 parton. So it make sense to keep also 1 extra jet (in addition to the b jet), even if the gain is small…

Contamination from other signals

100 fb^{-1}

	$= 1/2jbT, 0a$
Signal gct	34486 ± 39
Signal gut	19429 ± 28
Signal t+H K_{hct}	121 ± 0
Signal t+H K_{hut}	324 ± 1
Signal t+a K_{act}	471 ± 2
Signal t+a K_{aut}	178 ± 1
Signal t+a/inv K_{gct}	341 ± 1
Signal t+a/inv K_{gut}	241 ± 1
Signal t+inv K_{zct}	39 ± 0
Signal t+inv K_{zut}	389 ± 1
Signal t+inv Z_{zct}	21 ± 0
Signal t+inv Z_{zut}	128 ± 0

No contamination from other FCNC signals.
(the full names of the files considered are in back-up)

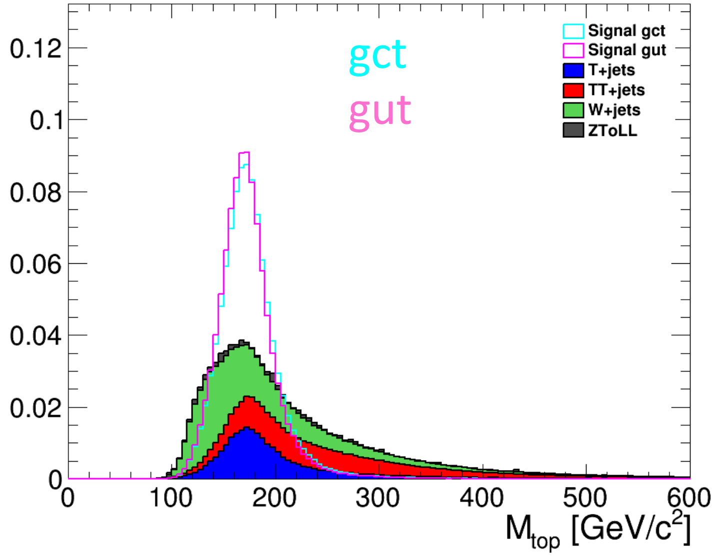
MVA analysis

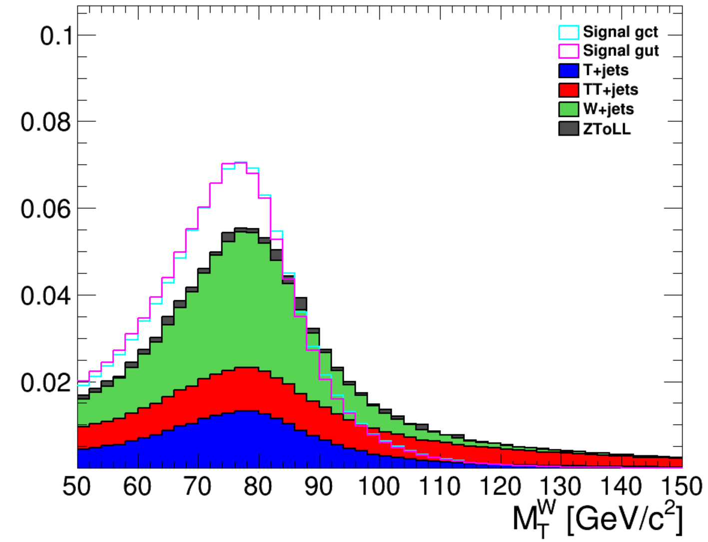
- Use BDT
- Start from 21 variables

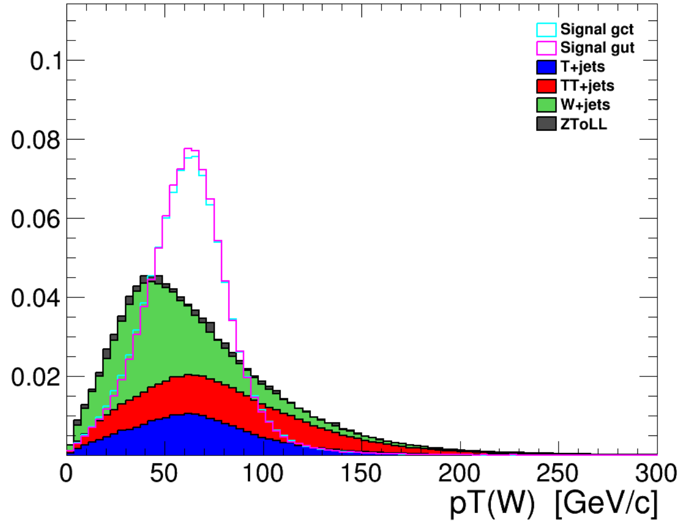
- Try to reduce the number of variables:
  - Keep the most discriminating ones and/or the variables which present very different correlations in signal and in background.
  - Remove the variables with too large correlations.

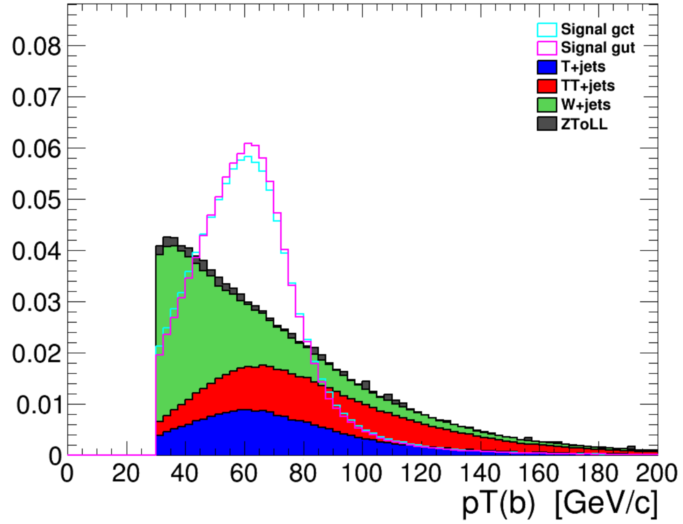
- Results: 9 variables in BDT:
  - M_{top}, $M_T(W)$,$p_T(W)$, $p_T(b{=}j1)$, $\Delta\phi(b,W)$, $\Delta\phi(l,b)$, $\Delta\phi(l,\nu = MET)$, $\eta(l)$, $Q(l)$

Input variables (1)

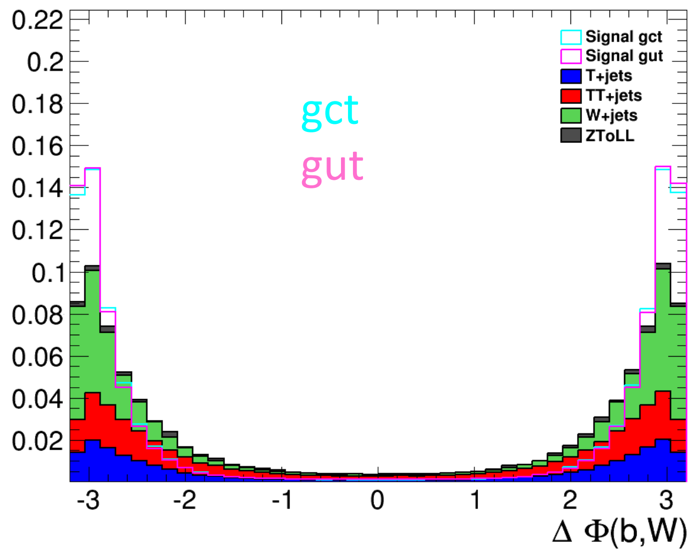


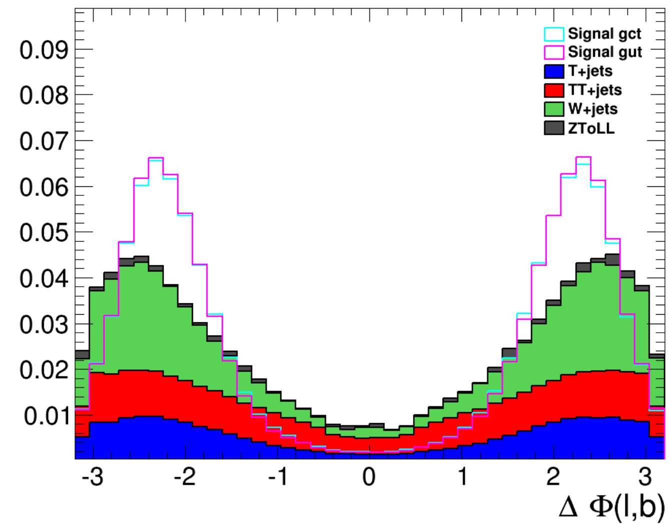


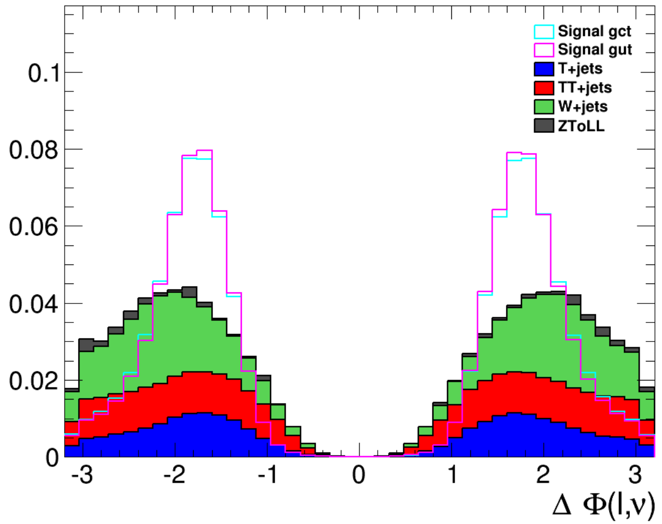




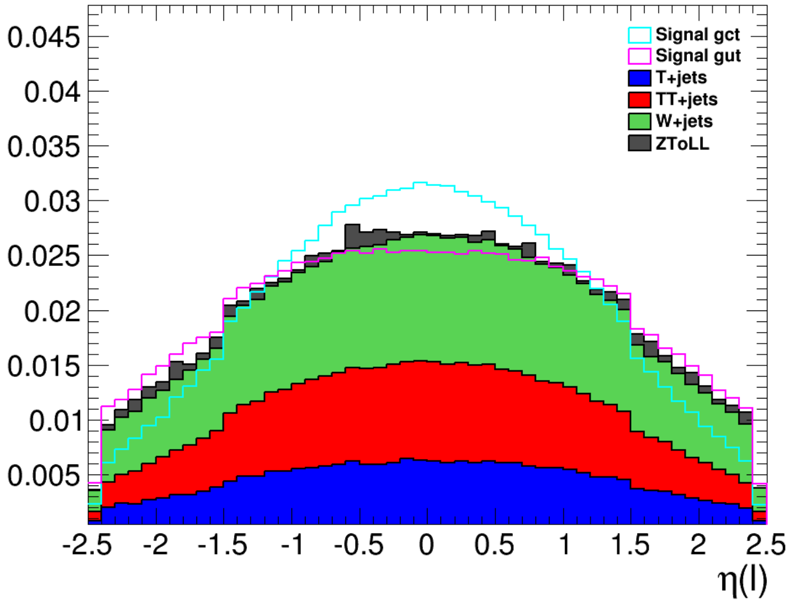
Input variables (2)

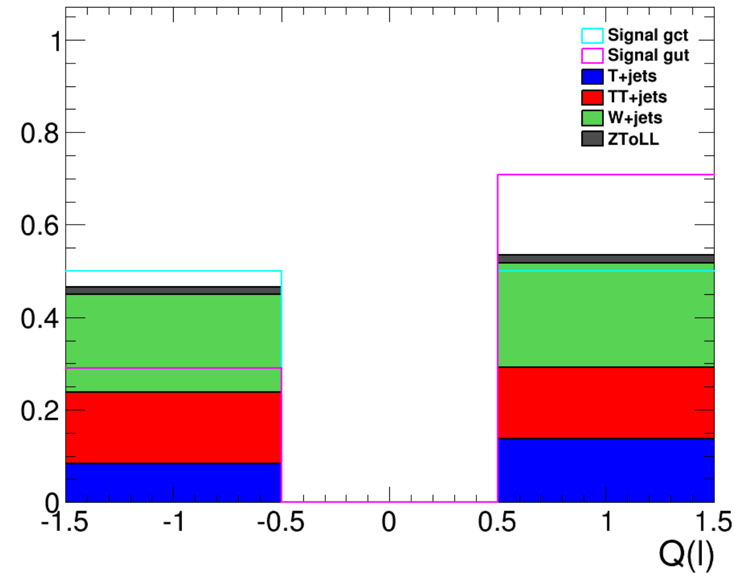






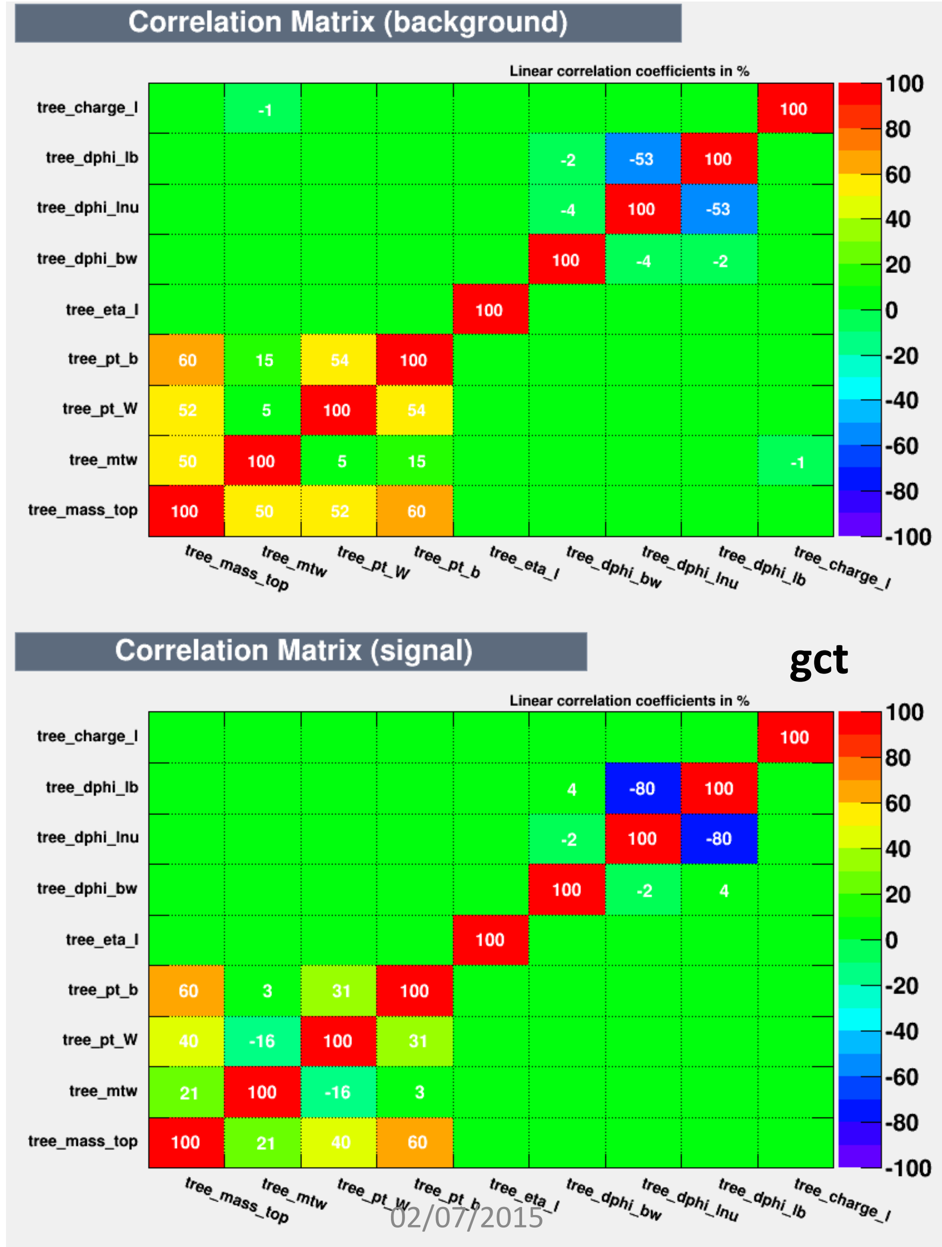
Input variables (3)



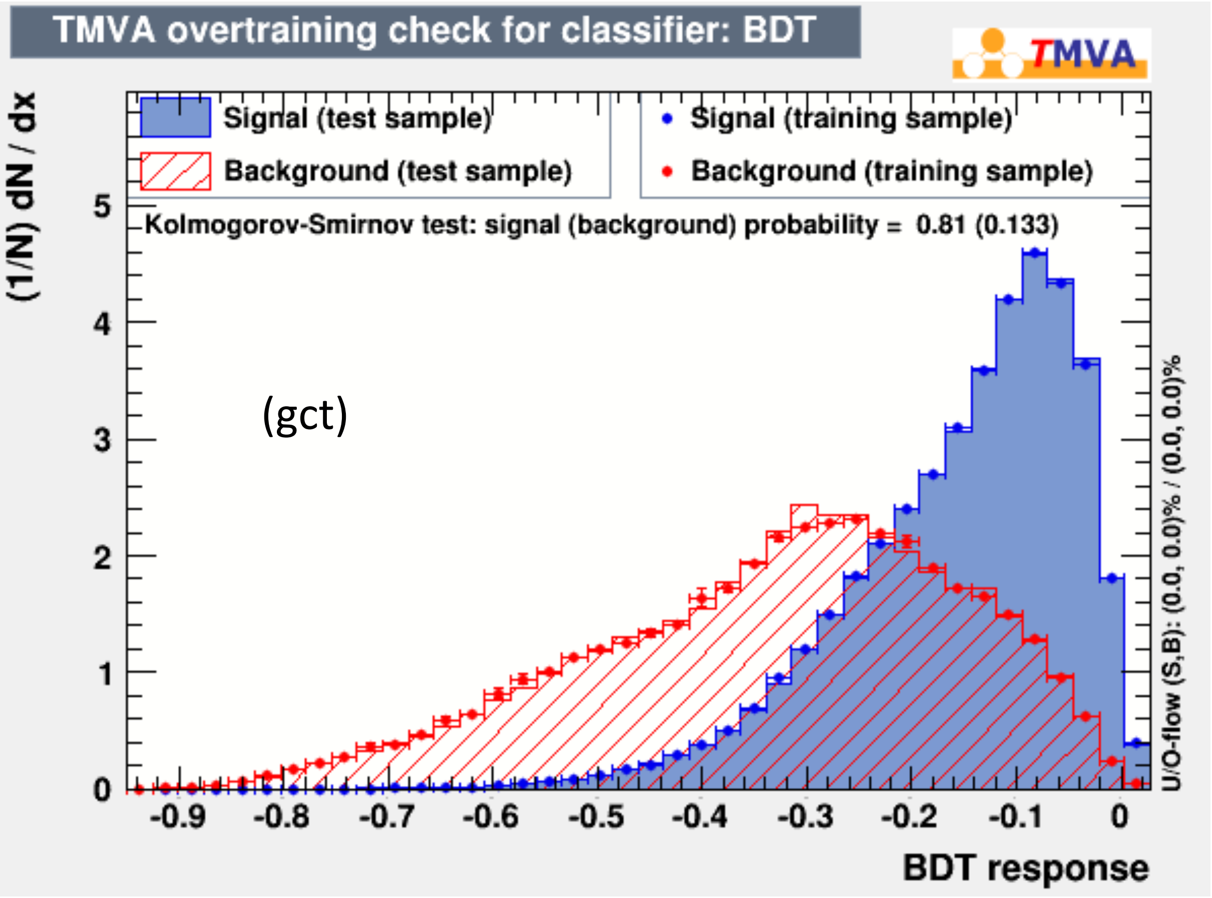


Those 2 variables (η and charge of the lepton) present a difference between the 2 signals. They will be used in both trainings (1 for gut and 1 for gct) even if they are not always very discriminating (ex: η(l) for gcut), in order to use the same set of variables for the 2 signals.

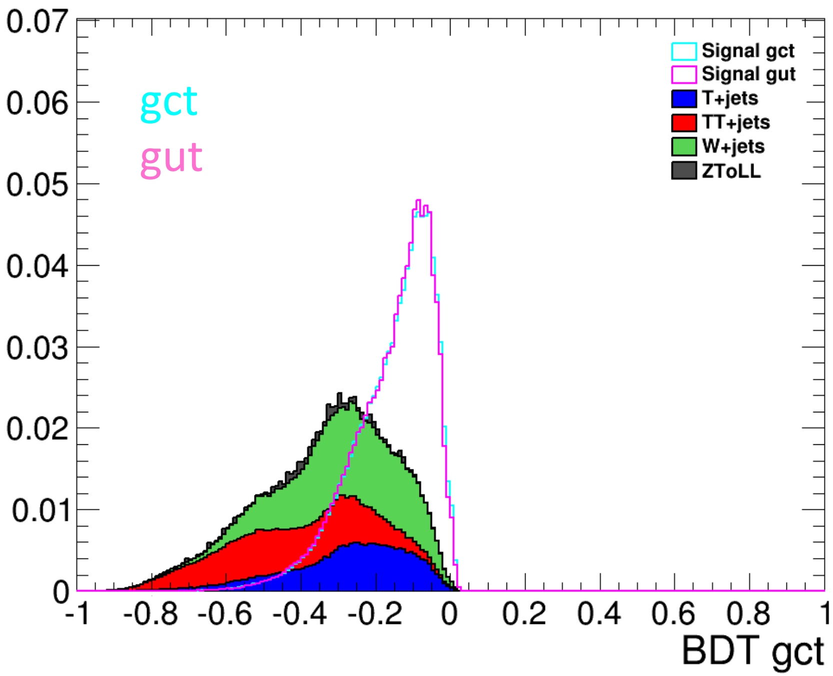
Correlation between input variables

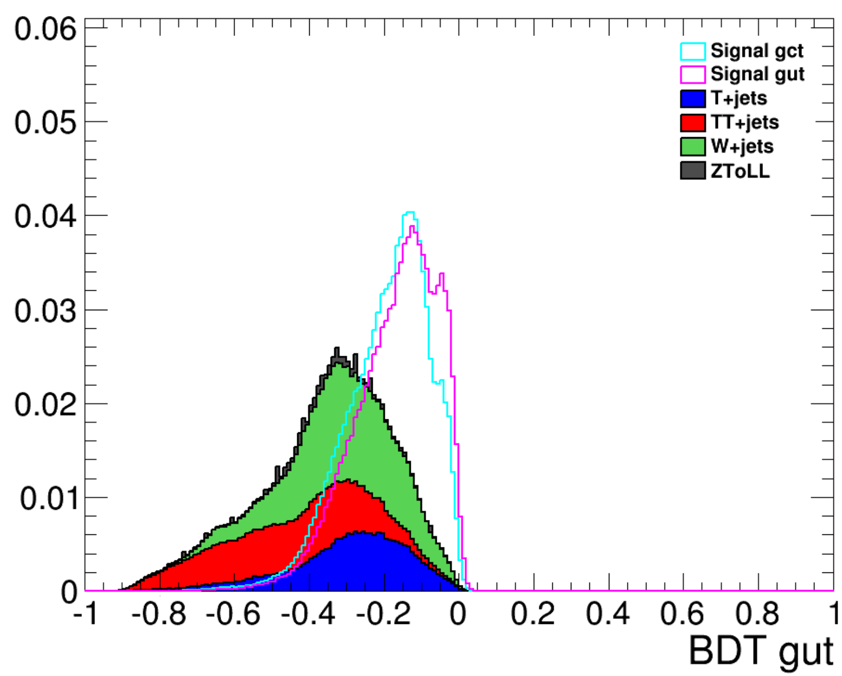


No overtraining



BDT output

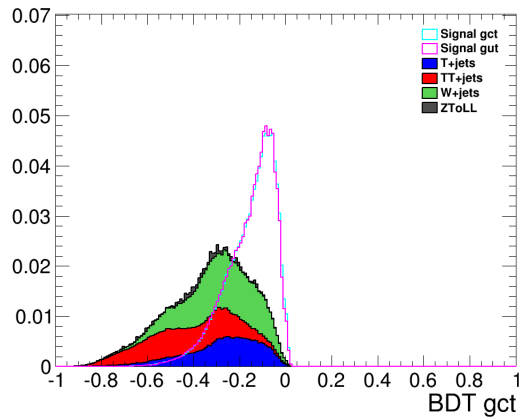


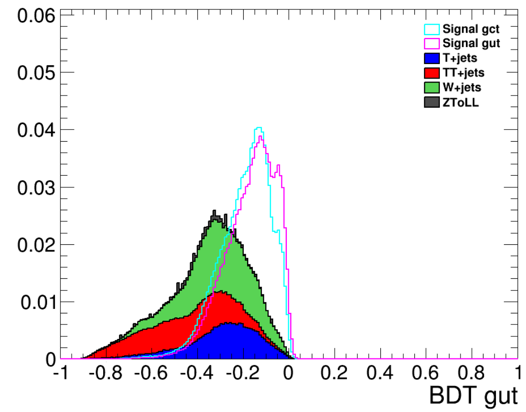


Very similar output BDT for gut and gct signals when using the gct training.

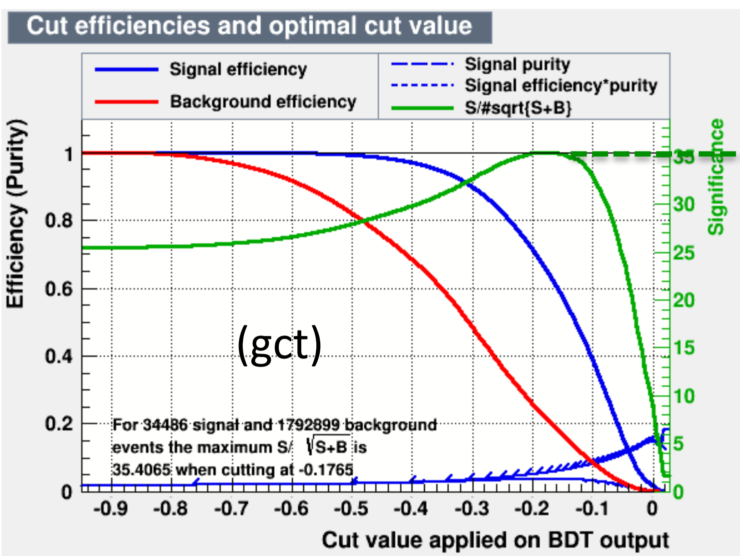
Slightly different output BDT for gut and gct signals when using the gut training. This is due to Q(l) which has a large discriminating power for gut (and not for gct).

Significance for BDT analysis





Compute the significance for a given BDT cut



Sig = S/sqrt(S+B)	gct	gut
Cut&Count	25.5	14.4
BDT	35.4	21.5

Keep the best significance.
This is for a fixed BR (BR_limit), assuming the other signal is 0.

Comparison w/ ATLAS

Different choice of variables for MVA:

ATLAS= pT(b), pT(W), Δϕ(W, MET) in the top rest frame, Q(l), η(l), Δϕ(l, b), η(top), Δϕ(l, W), Δϕ(b, top), Δϕ(l, top), Δϕ(W, top), MET, η(nu).

Here=M_{top}, $M_T(W)$,$p_T(W)$, $p_T(b=j1)$, Δϕ(b,W), Δϕ(l,b), Δϕ(l,ν =MET), η(l), Q(l).

[red are the common ones]

Using ATLAS's set of variables on top of my selection leads to significance of 33.6 for gct and 20.2 for gut, which is a bit lower than the values obtained with a BDT trained over the my 9 preferred variables (in which the mass(top) has the best ranking in both gct and gut scenarios).

Sig = S/sqrt(S+B)	gct	gut
BDT	35.4	21.5
ATLAS set	33.6	20.2

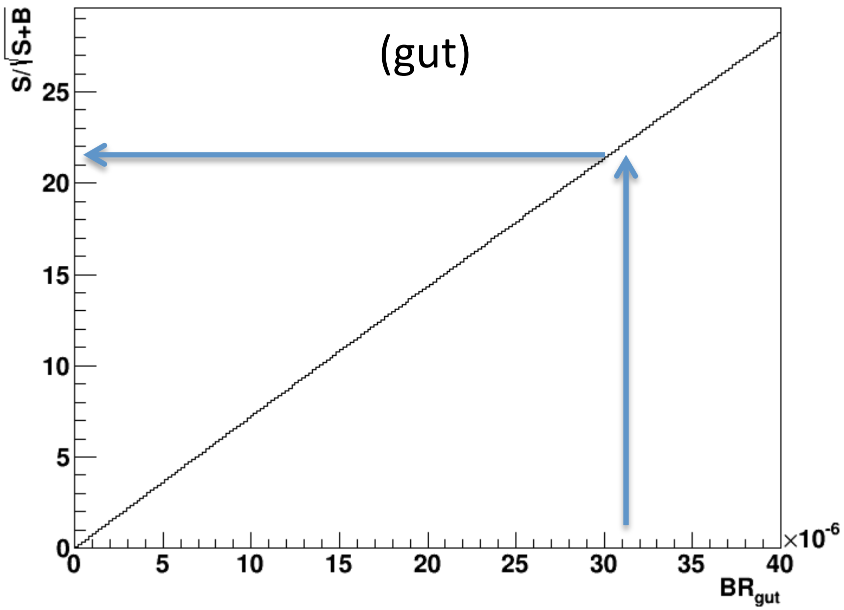
Scan over BR or Coupling

We can repeat the same procedure for different BR or Coupling K.

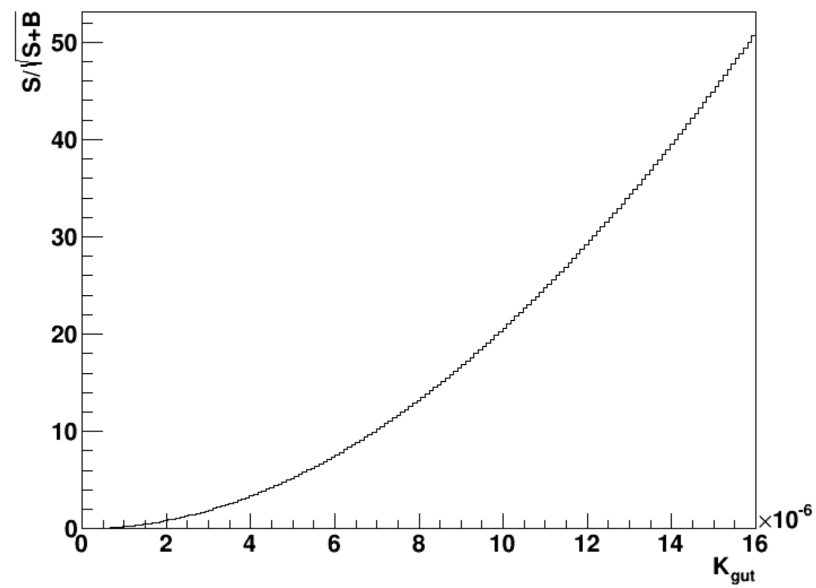
K = sqrt[(BR * Gamma_top) / partial width (K=1)]

Signal scales as BR/BR_limit.

Sig (gut) = 21.5 @ BR_Limit



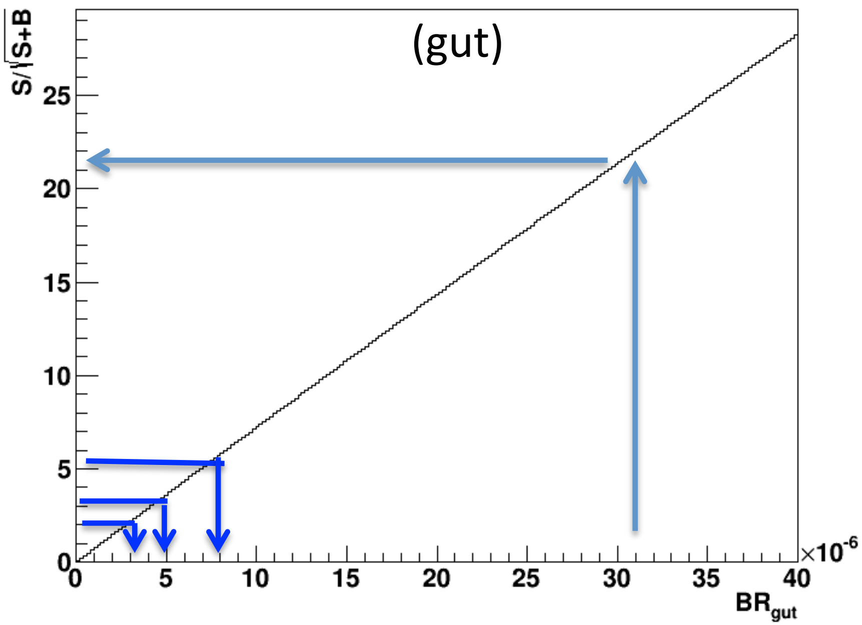
Signal scales as K^2/K_limit^2.



Scan over BR or Coupling

K = sqrt[(BR * Gamma_top) / partial width (K=1)]

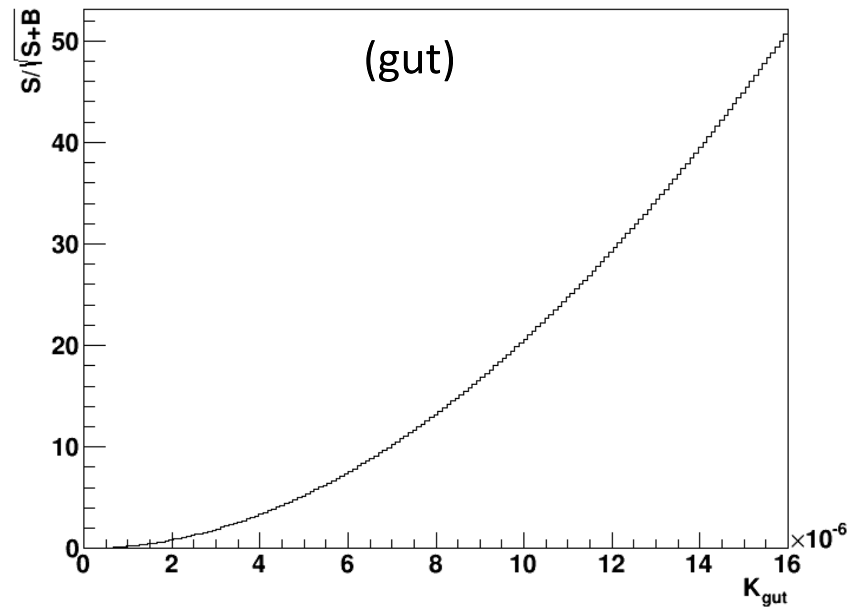
Signal scales as BR/BR_limit.



→1D limit values (based on BDT results):

Sig = S/sqrt(S+B)	2sigma,	3 sigma,	5 sigma
BR(gut)	2.9e-06	4.3e-06	7.1e-06
BR(gct)	9.25e-06	1.325e-05	2.225e-05

Signal scales as K^2/K_limit^2.

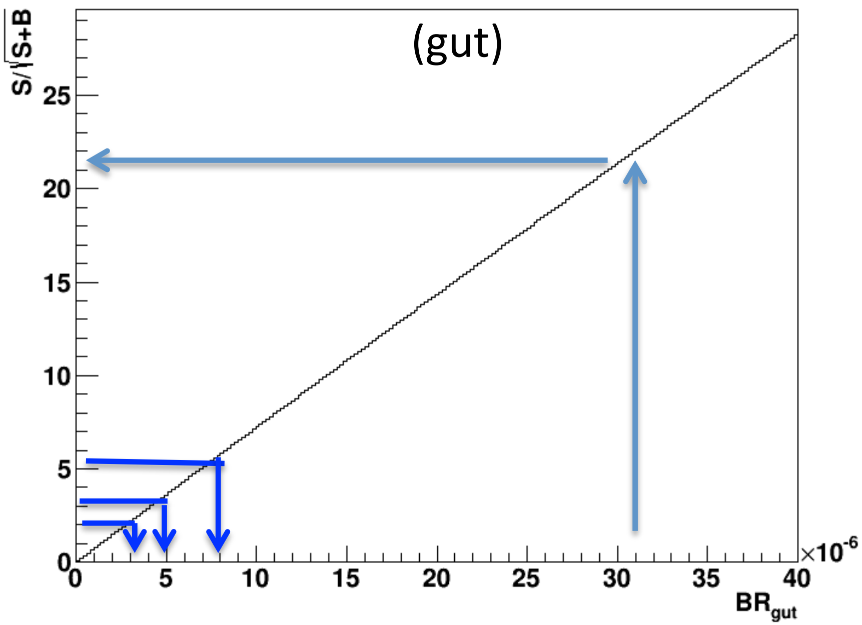


→1D limit values (based on BDT results):

Sig = S/sqrt(S+B)	2sigma,	3 sigma,	5 sigma
K(gut)	3.25e-06	3.95e-06	5.15e-06
K(gct)	5.65e-06	6.95e-06	8.95e-06

Scan over BR or Coupling

Signal scales as BR/BR_limit.



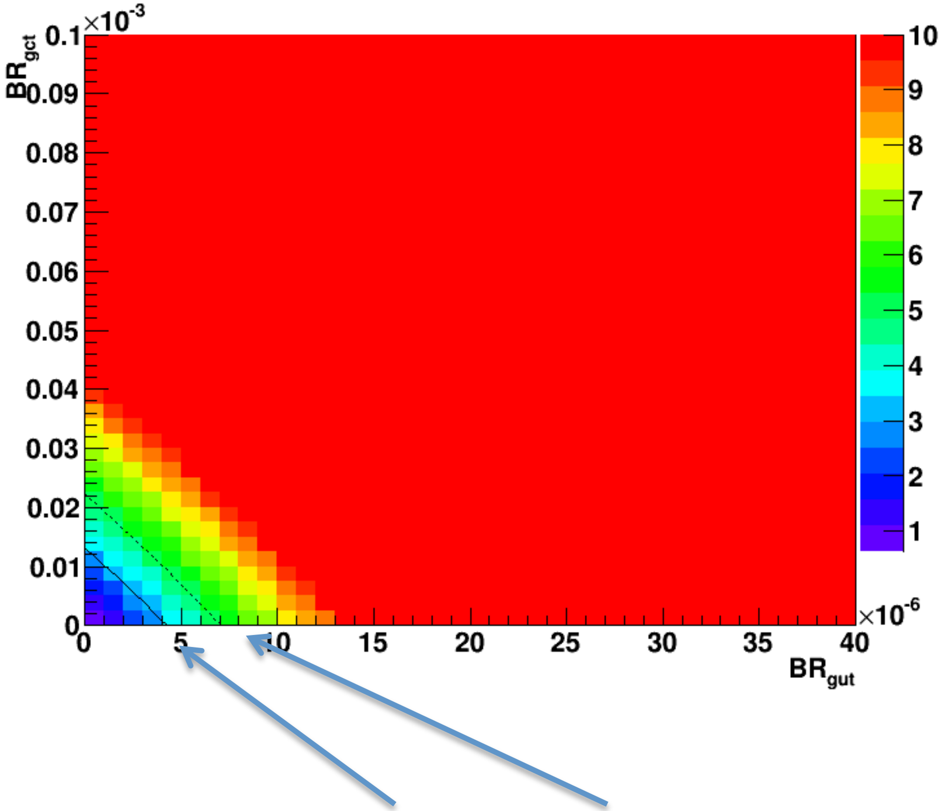
→1D limit values (based on BDT results):

Sig = S/sqrt(S+B)	2sigma,	3 sigma,	5 sigma
BR(gut)	2.9e-06	4.3e-06	7.1e-06
BR(gct)	9.25e-06	1.325e-05	2.225e-05

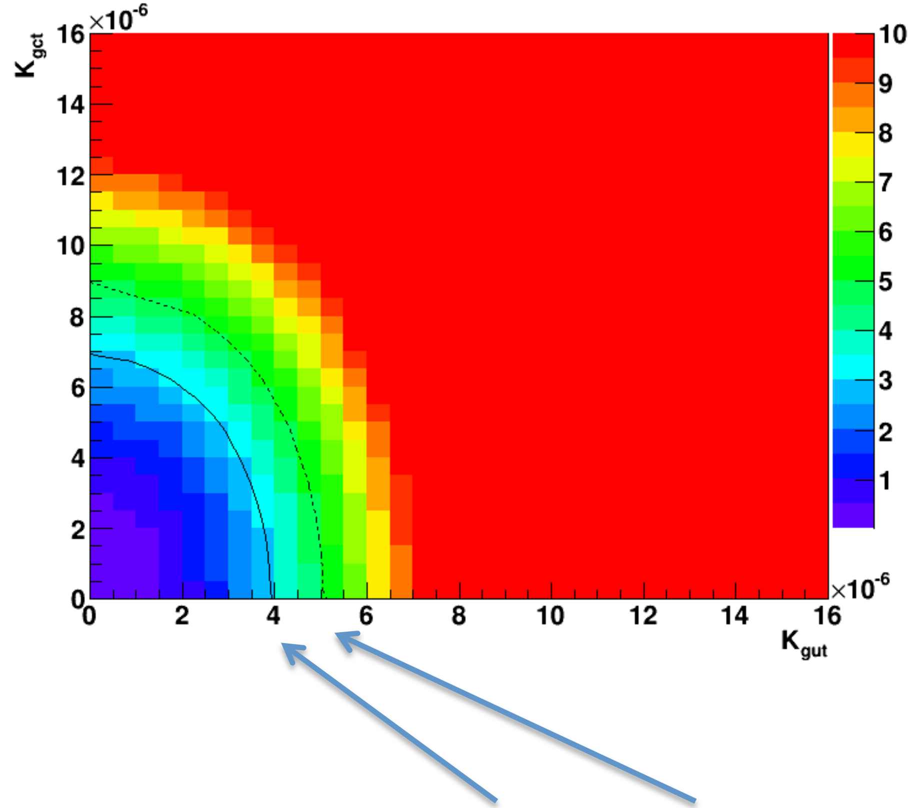
Acutal limit @8TeV from ATLAS:
BR(gut) < 3.1e-05 (excluded @95%)
BR(gct) < 1.6e-04 (excluded @95%)

2D Limits

Limits can also be extracted in 2D, assuming both signals may exist at the same time.
Plots gct vs gut with color axis = max (significance for gct training, significance for gut training)



Contours @ 3sigma and 5 sigma



Contours @ 3sigma and 5 sigma

Multijets: Impact on the 1D Limits

→1D limit values (based on BDT results):

Sig = S/sqrt(S+B)	2sigma,	3 sigma,	5 sigma
K(gut)	3.25e-06	3.95e-06	5.15e-06
K(gct)	5.65e-06	6.95e-06	8.95e-06
BR(gut)	2.9e-06	4.3e-06	7.1e-06
BR(gct)	9.25e-06	1.325e-05	2.225e-05

→ Multijet :15% → Sig' = S/sqrt(S + 1.15*B) [using the same BDT cut as in the previous case]

Sig'	2sigma	3 sigma	5 sigma
K(gut)	3.35e-06	4.15e-06	5.25e-06
K(gct)	5.85e-06	7.15e-06	9.25e-06
BR(gut)	3.1e-06	4.7e-06	7.7e-06
BR(gct)	9.75e-06	1.425e-05	2.375e-05

Small effect!

Acutal limit @8TeV from ATLAS:
BR(gut) < 3.1e-05 (excl @95%)
BR(gct) < 1.6e-04 (excl @95%)

Systematics: Impact on the 1D Limits

→1D limit values (based on BDT results):

Sig = S/sqrt(S+B)	2sigma,	3 sigma,	5 sigma
K(gut)	3.25e-06	3.95e-06	5.15e-06
K(gct)	5.65e-06	6.95e-06	8.95e-06
BR(gut)	2.9e-06	4.3e-06	7.1e-06
BR(gct)	9.25e-06	1.325e-05	2.225e-05

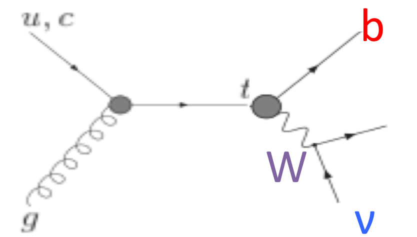
→ uncertainty→ Sig'' = S/sqrt(S+ B + (x*B)**2) [with new BDT cut optimization]

Sig''	2sigma	3 sigma	5 sigma
with x=0.10			
BR(gut)	3.75e-05	5.75e-05	9.25e-05
BR(gct)	0.000225	0.000325	0.000525
with x=0.05			
BR(gut)	2.125e-05	3.125e-05	5.125e-05
BR(gct)	0.0001025	0.0001525	0.0002575
with x=0.025			
BR(gut)	1.375e-05	1.875e-05	3.125e-05
BR(gct)	5.75e-05	8.75e-05	0.0001475

Same order than actual limit!

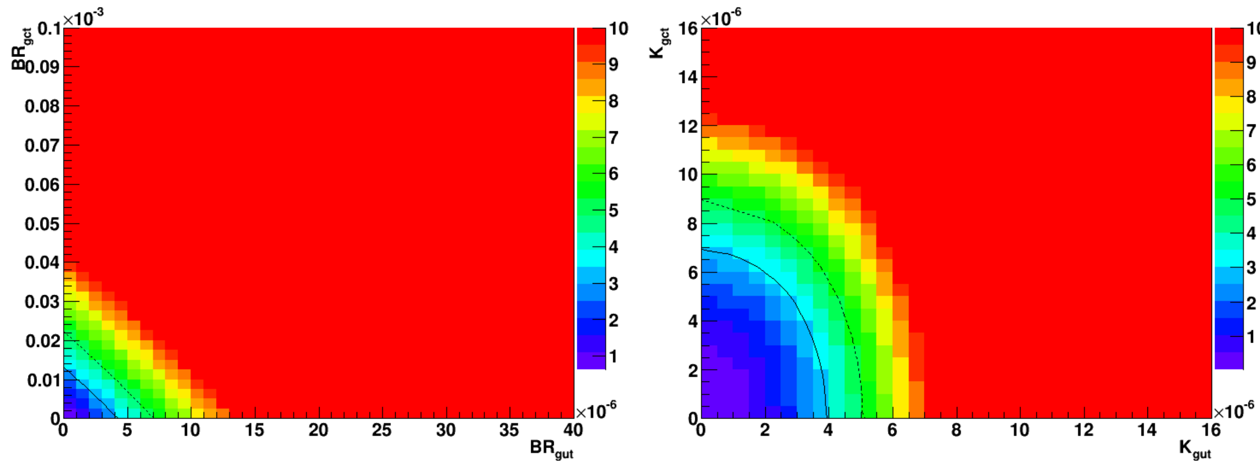
Acutal limit @8TeV from ATLAS:
BR(gut) < 3.1e-05 (excl @95%)
BR(gct) < 1.6e-04 (excl @95%)

Conclusions



The full study of pp→t in the lνb channel has been presented here.

Prospects of what can be reached with 100 fb^{-1} at 13TeV in the pp→t→lνb channel:



Expect improved results by comparison to Run1 limits.

Remarks:

- The multijet background has been neglected in the study. Adding a 15% background contribution has a small effect on the limits.
- In opposite, including systematics has a huge effect, because background is large. → Shape analysis could help.

Translation for the signal names

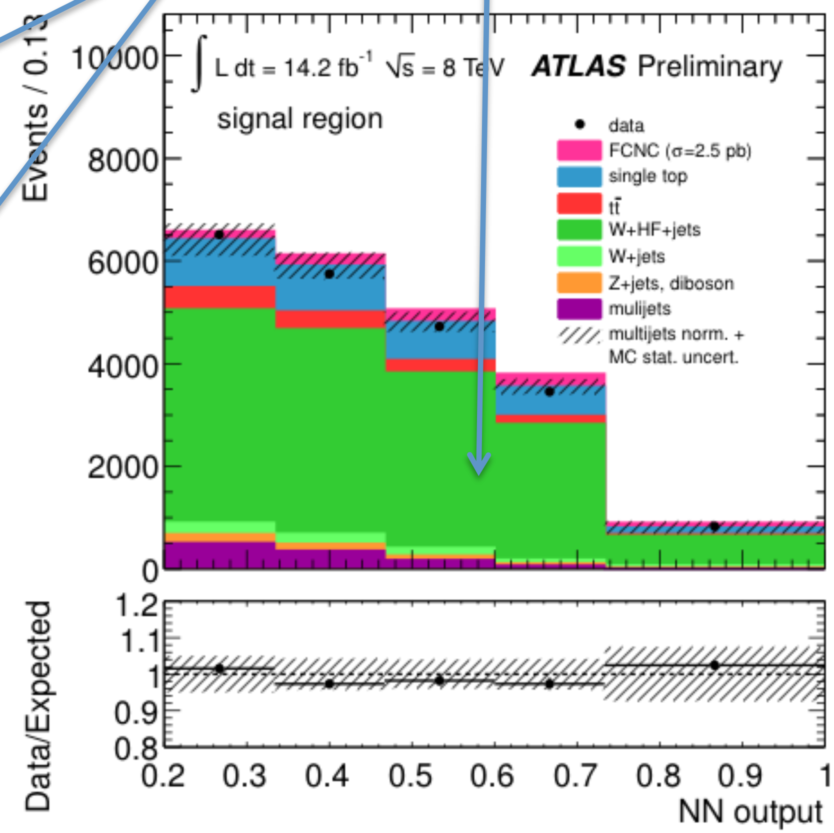
```
Insert("tGamma-Kappa-act", "Signal t+a $K_{act}$");
Insert("TTtoLGamma-Kappa-act", "Signal t+a $K_{act}$");

Insert("tGamma-Kappa-aut", "Signal t+a $K_{aut}$");
Insert("TTtoLGamma-Kappa-aut", "Signal t+a $K_{aut}$");

Insert("tGamma-Kappa-gct", "Signal t+a/inv $K_{gct}$");
Insert("tZ-monolep-met-Kappa-gct", "Signal t+a/inv $K_{gct}$");
Insert("tHToZZ-Kappa-gct", "Signal t+a/inv $K_{gut}$");
Insert("tGamma-Kappa-gut", "Signal t+a/inv $K_{gut}$");
Insert("tZ-monolep-met-Kappa-gut", "Signal t+a/inv $K_{gut}$");
Insert("tHToZZ-Kappa-gut", "Signal t+a/inv $K_{gut}$");

Insert("tZ-monolep-met-Kappa-zct", "Signal t+inv $K_{zct}$");
Insert("tZ-monolep-met-Kappa-zut", "Signal t+inv $K_{zut}$");

Insert("tZ-monolep-met-Zeta-zct", "Signal t+inv $Z_{zct}$");
Insert("tZ-monolep-met-Zeta-zut", "Signal t+inv $Z_{zut}$");

Insert("tHToZZ-Kappa-hct", "Signal t+H $K_{hct}$");
Insert("TTtoLHtoZZ-Kappa-hct", "Signal t+H $K_{hct}$");
Insert("tHToZZ-Kappa-hut", "Signal t+H $K_{hut}$");
Insert("TTtoLHtoZZ-Kappa-hut", "Signal t+H $K_{hut}$");
```

Comparison w/ ATLAS

Table 4: Uncertainties on the number of expected candidate events on each signal and background source for the systematic variations explained in Section 5.

Systematic	Signal	W+jets	W+HF+jets
Jet energy scale	$< \pm1\%$	$\pm13\%$	$\pm3\%$
Jet energy resolution	$\pm4\%$	$\pm20\%$	$\pm3\%$
b-tagging efficiency	$\pm5\%$	$\pm1\%$	$\pm1\%$
c-tagging efficiency	$< \pm1\%$	$\pm3\%$	$\pm20\%$
Mistag rate	$< \pm1\%$	$\pm26\%$	$< \pm1\%$
Muon momentum scale	$< \pm1\%$	$< \pm1\%$	$< \pm1\%$
Muon identification	$\pm1\%$	$\pm1\%$	$\pm1\%$
Electron energy scale	$< \pm1\%$	$< \pm1\%$	$< \pm1\%$
Electron identification	$\pm1\%$	$\pm1\%$	$\pm1\%$
Missing transverse momentum	$< \pm1\%$	$< \pm1\%$	$< \pm1\%$
PDF	$\pm3\%$	$\pm4\%$	$\pm8\%$
W+jets modelling	—	$< \pm1\%$	$< \pm1\%$
Cross section	—	24%	55%
Systematic	**$t\bar{t}$**	**single-top**	**Z + jets**
Jet energy scale	$\pm13\%$	$\pm4\%$	$\pm4\%$
Jet energy resolution	$\pm1\%$	$\pm2\%$	$\pm6\%$
b-tagging efficiency	$\pm5\%$	$\pm5\%$	$\pm4\%$
c-tagging efficiency	$< \pm1\%$	$< \pm1\%$	$\pm5\%$
Mistag rate	$< \pm1\%$	$< \pm1\%$	$\pm3\%$
Muon momentum scale	$< \pm1\%$	$< \pm1\%$	$< \pm1\%$
Muon identification	$\pm1\%$	$\pm1\%$	$\pm1\%$
Electron energy scale	$< \pm1\%$	$< \pm1\%$	$< \pm1\%$
Electron identification	$\pm1\%$	$\pm1\%$	$< \pm1\%$
Missing transverse momentum	$< \pm1\%$	$< \pm1\%$	$\pm3\%$
PDF	$\pm4\%$	$\pm2\%$	$\pm5\%$
ISR/FSR	$\pm3\%$	$\pm5\%$	—
Cross section	8%	10%	24%

Larger background is W+HF



(hatched = stat error + multijet norm uncert)

Test BDT 21 variables, signal gct

```
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varList.push_back("tree_pt_l");            nbinsVar.push_back(80); xminVar.push_back(0.);   xmaxVar.push_back(200.);
varList.push_back("tree_eta_l");           nbinsVar.push_back(50); xminVar.push_back(-2.5); xmaxVar.push_back(2.5);
varList.push_back("tree_pt_b");            nbinsVar.push_back(80); xminVar.push_back(0.);   xmaxVar.push_back(200.);
varList.push_back("tree_eta_b");           nbinsVar.push_back(50); xminVar.push_back(-2.5); xmaxVar.push_back(2.5);
varList.push_back("tree_mtw");             nbinsVar.push_back(50); xminVar.push_back(50.);  xmaxVar.push_back(150);
varList.push_back("tree_pt_W");            nbinsVar.push_back(80); xminVar.push_back(0.);   xmaxVar.push_back(300.);
varList.push_back("tree_mass_top");        nbinsVar.push_back(120); xminVar.push_back(0.);   xmaxVar.push_back(600.);
varList.push_back("tree_eta_top");         nbinsVar.push_back(40); xminVar.push_back(-10.);  xmaxVar.push_back(10.);
varList.push_back("tree_met");             nbinsVar.push_back(100);xminVar.push_back(0.);   xmaxVar.push_back(200);
varList.push_back("tree_dphi_lnu");        nbinsVar.push_back(40); xminVar.push_back(-3.2); xmaxVar.push_back(3.2);
varList.push_back("tree_dphi_lb");         nbinsVar.push_back(40); xminVar.push_back(-3.2); xmaxVar.push_back(3.2);
varList.push_back("tree_dphi_lw");         nbinsVar.push_back(40); xminVar.push_back(-3.2); xmaxVar.push_back(3.2);
varList.push_back("tree_dphi_lt");         nbinsVar.push_back(40); xminVar.push_back(-3.2); xmaxVar.push_back(3.2);
varList.push_back("tree_dphi_bt");         nbinsVar.push_back(40); xminVar.push_back(-3.2); xmaxVar.push_back(3.2);
varList.push_back("tree_dphi_wt");         nbinsVar.push_back(40); xminVar.push_back(-3.2); xmaxVar.push_back(3.2);
varList.push_back("tree_dphi_wnu");        nbinsVar.push_back(40); xminVar.push_back(-3.2); xmaxVar.push_back(3.2);
varList.push_back("tree_dphi_boost");      nbinsVar.push_back(40); xminVar.push_back(-3.2); xmaxVar.push_back(3.2);
varList.push_back("tree_dphi_bw");         nbinsVar.push_back(40); xminVar.push_back(-3.2); xmaxVar.push_back(3.2);
varList.push_back("tree_eta_nu");          nbinsVar.push_back(50); xminVar.push_back(-5.); xmaxVar.push_back(5.);
varList.push_back("tree_dr_lt");           nbinsVar.push_back(80); xminVar.push_back(-8.); xmaxVar.push_back(8.);
```

15:07

```
--- TFHandler_Factory       : Ranking input variables (method unspecific)...
--- IdTransformation        : Ranking result (top variable is best ranked)
--- IdTransformation        : --------------------------------------
--- IdTransformation        : Rank : Variable       : Separation
--- IdTransformation        : --------------------------------------
--- IdTransformation        :    1 : tree_mass_top   : 1.811e-01
--- IdTransformation        :    2 : tree_pt_W       : 1.058e-01
--- IdTransformation        :    3 : tree_pt_b       : 9.945e-02
--- IdTransformation        :    4 : tree_dphi_lnu   : 9.145e-02
--- IdTransformation        :    5 : tree_mtw        : 7.622e-02
--- IdTransformation        :    6 : tree_dphi_bw    : 6.115e-02
--- IdTransformation        :    7 : tree_met        : 5.822e-02
--- IdTransformation        :    8 : tree_dphi_boost : 5.772e-02
--- IdTransformation        :    9 : tree_pt_l       : 5.673e-02
--- IdTransformation        :   10 : tree_dphi_lb    : 5.501e-02
--- IdTransformation        :   11 : tree_dphi_lw    : 5.301e-02
--- IdTransformation        :   12 : tree_dphi_wnu   : 4.985e-02
--- IdTransformation        :   13 : tree_eta_top    : 2.212e-02
--- IdTransformation        :   14 : tree_dr_lt      : 2.174e-02
--- IdTransformation        :   15 : tree_dphi_bt    : 2.079e-02
--- IdTransformation        :   16 : tree_eta_l      : 6.668e-03
--- IdTransformation        :   17 : tree_eta_nu     : 5.230e-03
--- IdTransformation        :   18 : tree_eta_b      : 1.751e-03
--- IdTransformation        :   19 : tree_charge_l   : 1.095e-03
--- IdTransformation        :   20 : tree_dphi_wt    : 1.020e-03
--- IdTransformation        :   21 : tree_dphi_lt    : 2.524e-04
--- IdTransformation        : --------------------------------------
```

```
--- Factory              : Ranking input variables (method specific)...
--- BDT                  : Ranking result (top variable is best ranked)
--- BDT                  : ---------------------------------------------
--- BDT                  : Rank : Variable       : Variable Importance
--- BDT                  : ---------------------------------------------
--- BDT                  :    1 : tree_mass_top   : 1.736e-01
--- BDT                  :    2 : tree_pt_W       : 1.160e-01
--- BDT                  :    3 : tree_mtw        : 9.651e-02
--- BDT                  :    4 : tree_dphi_bw    : 7.589e-02
--- BDT                  :    5 : tree_dr_lt      : 6.764e-02
--- BDT                  :    6 : tree_pt_b       : 6.110e-02
--- BDT                  :    7 : tree_dphi_boost : 4.242e-02
--- BDT                  :    8 : tree_met        : 4.218e-02
--- BDT                  :    9 : tree_eta_l      : 3.849e-02
--- BDT                  :   10 : tree_dphi_wt    : 3.323e-02
--- BDT                  :   11 : tree_dphi_bt    : 3.209e-02
--- BDT                  :   12 : tree_dphi_lw    : 3.178e-02
--- BDT                  :   13 : tree_dphi_lb    : 2.976e-02
--- BDT                  :   14 : tree_pt_l       : 2.876e-02
--- BDT                  :   15 : tree_eta_b      : 2.820e-02
--- BDT                  :   16 : tree_dphi_lnu   : 2.703e-02
--- BDT                  :   17 : tree_charge_l   : 2.175e-02
--- BDT                  :   18 : tree_eta_nu     : 1.708e-02
--- BDT                  :   19 : tree_dphi_wnu   : 1.691e-02
--- BDT                  :   20 : tree_dphi_lt    : 1.654e-02
--- BDT                  :   21 : tree_eta_top    : 3.011e-03
--- BDT                  : ---------------------------------------------

--- =============================================================================
--- Classifier  ( #signal, #backgr.)  Optimal-cut  S/sqrt(S+B)   NSig    NBkg   EffSig  EffBkg
--- ---------------------------------------------------------------------------------------
---       BDT:  (   34486,  1792899)    -0.1800     35.4951  22582.62  382191.7  0.6548  0.2132
--- ---------------------------------------------------------------------------------------
```

Results from differents tests

full 21 var gct

```
--- ==========================================================================
--- Classifier   ( #signal, #backgr.)  Optimal-cut  S/sqrt(S+B)     NSig     NBkg   EffSig   EffBkg
--- --------------------------------------------------------------------------
---       BDT:  (    34486,  1792899)     -0.1800     35.4951  22582.62  382191.7   0.6548   0.2132
--- --------------------------------------------------------------------------
```

9 var gct

```
--- ==========================================================================
--- Classifier   ( #signal, #backgr.)  Optimal-cut  S/sqrt(S+B)     NSig     NBkg   EffSig   EffBkg
--- --------------------------------------------------------------------------
---       BDT:  (    34486,  1792899)     -0.1765     35.4065  22466.64    380168   0.6515    0.212
--- --------------------------------------------------------------------------
```

9 var gut

```
--- ==========================================================================
--- Classifier   ( #signal, #backgr.)  Optimal-cut  S/sqrt(S+B)     NSig     NBkg   EffSig   EffBkg
--- --------------------------------------------------------------------------
---       BDT:  (    19429,  1792899)     -0.1709     21.5089   11133.2    256786    0.573   0.1432
--- --------------------------------------------------------------------------
```

atlas gct

```
--- ==========================================================================
--- --------------------------------------------------------------------------
---       BDT:  (    34486,  1792899)     -0.1759     33.6112  22209.73  414424.9    0.644   0.2311
--- --------------------------------------------------------------------------
```

atlas gut

```
--- ==========================================================================
--- Classifier   ( #signal, #backgr.)  Optimal-cut  S/sqrt(S+B)     NSig     NBkg   EffSig   EffBkg
--- --------------------------------------------------------------------------
---       BDT:  (    19429,  1792899)     -0.1990      20.181  11653.17    321775   0.5998   0.1795
--- --------------------------------------------------------------------------
```

Check when varying the multijet cut, for gct only (using the same 9 variables)

	Cut&Count	MVA
#jets=1 or 2	Sig=25.5	Sig=35.4
#jets=1	Sig=25.0	Sig=33.4
#jets=2	Sig=11.0	Sig=15.2

#jets=1 or 2

```
--- ===============================================================================
--- Classifier   (  #signal, #backgr.)  Optimal-cut  S/sqrt(S+B)     NSig     NBkg   EffSig   EffBkg
--- ---------------------------------------------------------------------------------------
---       BDT:  (    34486,  1792899)     -0.1765      35.4065     22466.64    380168   0.6515    0.212
--- ---------------------------------------------------------------------------------------------------------------------
```

#jets=1 (large reduction on ttbar (factor ~4) DY background and single top (factor ~2), but less efficient on W+jets)

```
--- ===============================================================================
--- Classifier   (  #signal, #backgr.)  Optimal-cut  S/sqrt(S+B)     NSig     NBkg   EffSig   EffBkg
--- ---------------------------------------------------------------------------------------
---       BDT:  (    24007,   901697)     -0.1631      33.4359      15323.53  194711.1   0.6383   0.2159
--- ---------------------------------------------------------------------------------------------------------------------
```

#jets=2 (this mainly reduces the W+jets background)

```
--- ===============================================================================
--- Classifier   (  #signal, #backgr.)  Optimal-cut  S/sqrt(S+B)     NSig     NBkg   EffSig   EffBkg
--- ---------------------------------------------------------------------------------------
---       BDT:  (    10479,   891202)     -0.2439      15.2455      7471.508  232706.7    0.713   0.2611
--- ---------------------------------------------------------------------------------------------------------------------
```