TTbar Background Study for Wprime Search

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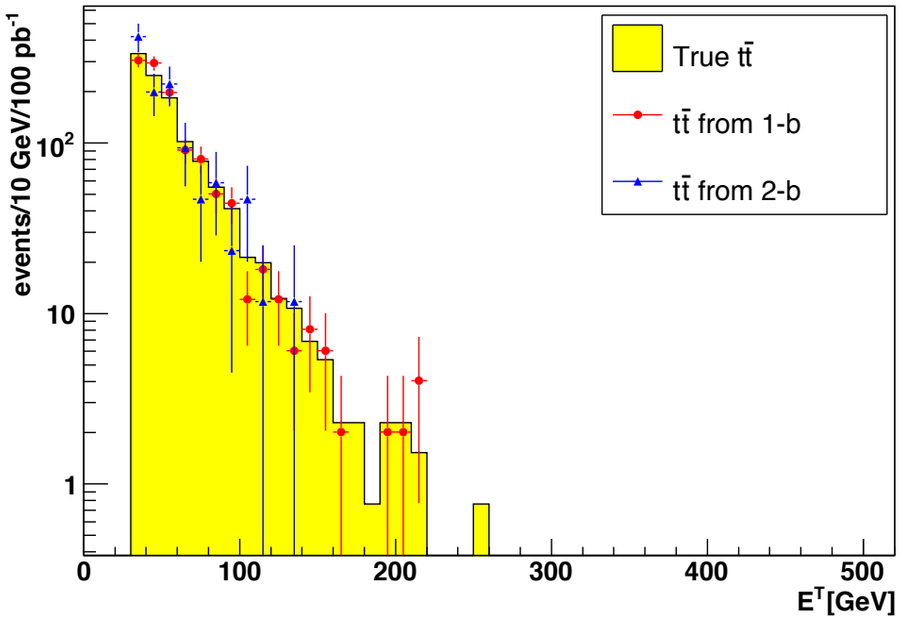
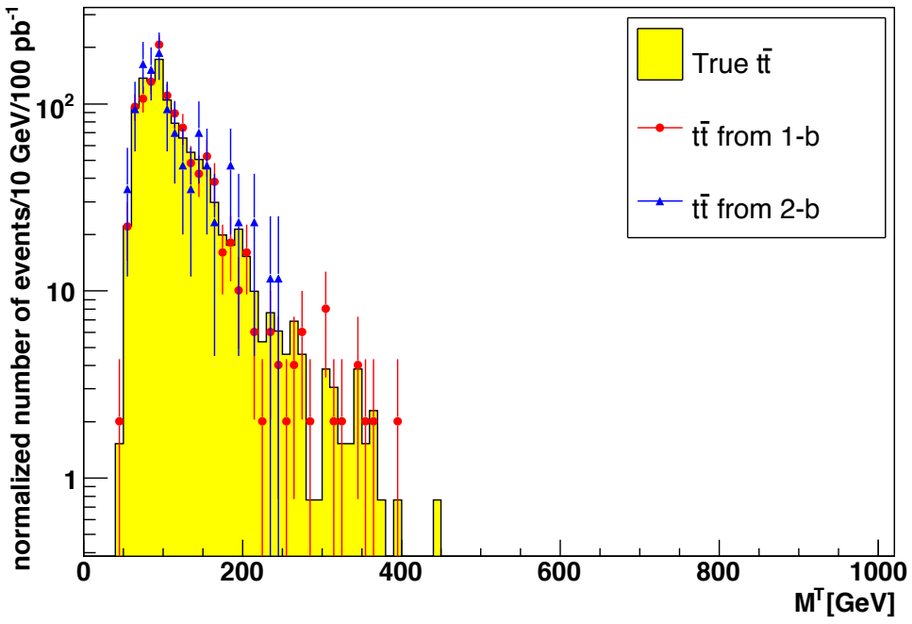
Data-driven Methods for TTbar background estimation

CMS AN 2008/046





$$n_1 = N_{t\bar{t}} A_1 \epsilon_b + 2N_{t\bar{t}} A_2 \epsilon_b (1 - \epsilon_b)$$

$$n_2 = N_{t\bar{t}} A_2 \epsilon_b^2$$

$A_{1/2} = n_{1/2} / N$

- n_1 : one b-tagged jet
- n_2 : two b-tagged jets
- A_1 : Geometrical acceptances for one b-quark(from Monte Carlo)
- A_2 : Geometrical acceptances for two b-quark (from Monte Carlo)
- N_{ttbar} : Total number of ttbar events
- ε_b : b-tagging efficiency

$$\varepsilon_b = \frac{(A_1/A_2 + 2)}{(n_1/n_2 + 2)}$$

	$t\bar{t}$ only	All events
n_1	431	519
n_2	74	74
ϵ_b	0.281 ± 0.041	0.243 ± 0.035
$N_{t\bar{t}}$ (1-b)	1136 ± 277	1509 ± 358
$N_{t\bar{t}}$ (2-b)	1136 ± 359	1509 ± 454
True $N_{t\bar{t}}$	1132	1132

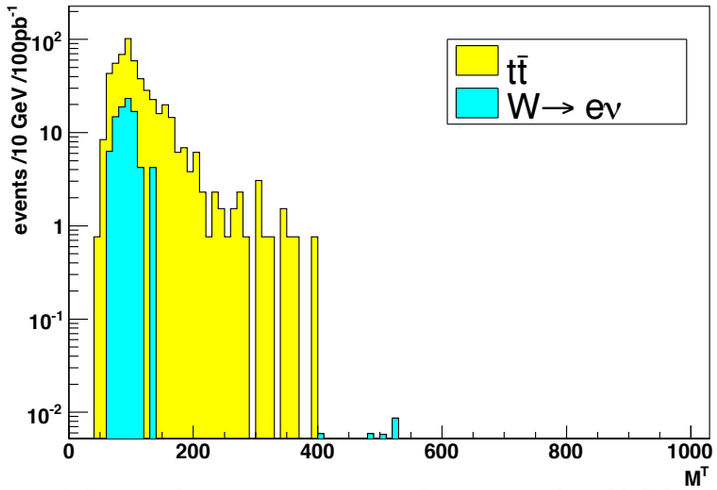
Data-driven Methods for TTbar background estimation

CMS AN 2008/046

- Electron
  - All the trigger, electron identification and isolation and kinematic selctions that are defining W'->enu sample
- b-jets
  - Parameters proposed by the HEEP group,
  - $|\eta| < 2.4$, $p^T_{jet} > 20$ GeV,
  - jetProbabilityBJetTags (B-jet Discriminator algorithm) > 0.7

Data-driven Methods for TTbar background estimation

CMS AN 2008/046



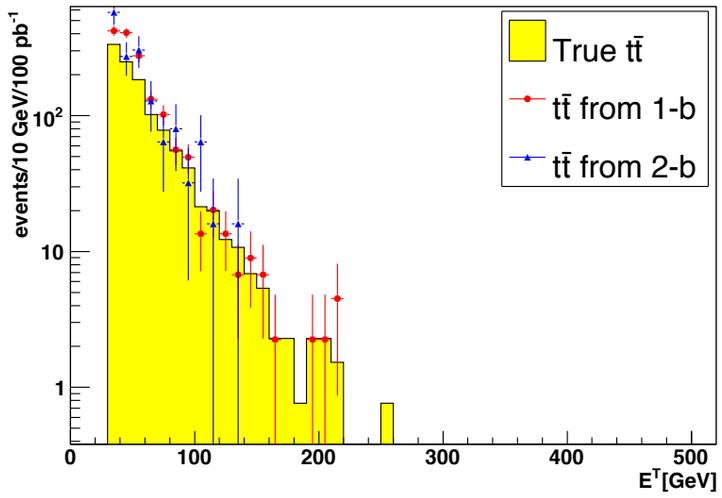
After the mass cut the residual W contamination is below 10%

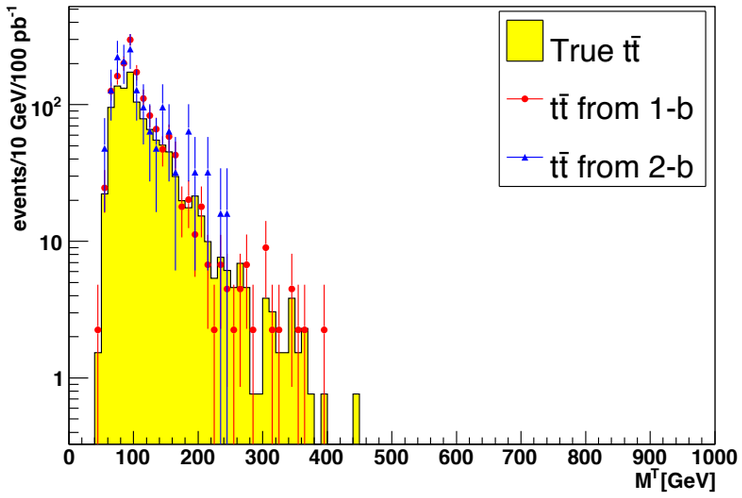
- Other possible sources of contamination by non-ttbar events are expected to be largely suppressed already by the events selections

EX)
Di-jet with one fake electron,
One fake b-tag,
Wbb, W'bb,
W+fake b-tag, W'+fake b-tag,
W'->tb, single top

$\varepsilon_b = 0.240 \pm 0.047$

TTbar + W->enu





	All events, full M^T range	All events, $M^T > 150$ GeV
$N_{t\bar{t}}$ (1-b)	1525 ± 474	229 ± 71
$N_{t\bar{t}}$ (2-b)	1554 ± 635	256 ± 104
True $N_{t\bar{t}}$	1132	216

CMSSW Environments

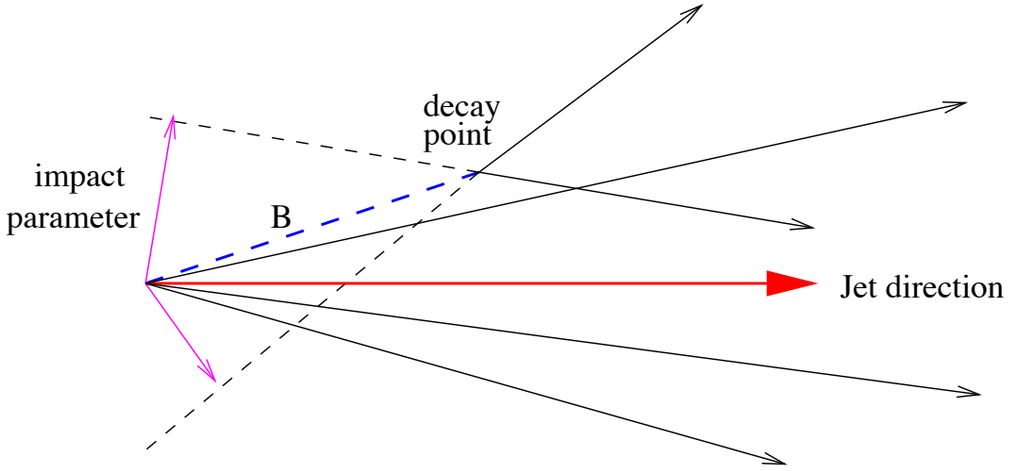
- CMSSW_2_2_6
- Physics Analysis Tools : PAT
- DATA :

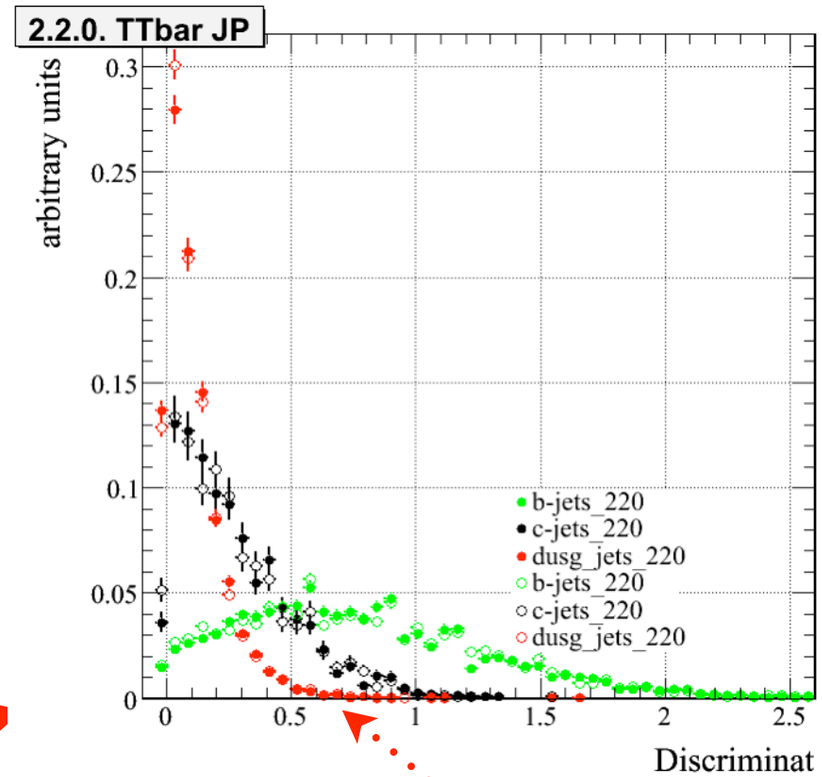
CMSSW_2_2_10-RelValTTbar-GEN-SIM-RECO-IDEAL_V12_v1
Total 9000Events. Cross section = 2.007E-7

```
process.myanalysis = cms.EDAnalyzer('WprimeAnalyzerPAT',

                                    electronTag = cms.InputTag("allLayer1Electrons"),
                                    jetTag      = cms.InputTag("allLayer1Jets"),
                                    metTag      = cms.InputTag("allLayer1METs"),
                                    TriggerResults = cms.InputTag("TriggerResults","","HLT"),

                                    ## for BJetTags
                                    jetPtCut = cms.untracked.double(20.),
                                    jetEtaCut = cms.untracked.double(2.4),

                                    barrelCuts = cms.PSet(heepBarrelCuts),
                                    endcapCuts = cms.PSet(heepEndcapCuts)

                                    )
```

B-Jet Tags selections

(B-Jet Tags algorithms)





- B- tag alorithms
  - Track Counting algorithm
  - Jet Probability algorithm
  - "Soft Muon" and "soft Electron" algorithm
  - "Combined Secondary Vertex" algorithm

$|\eta| < 2.4$

$p_{jet}^{T} > 20$ GeV

jetProbabilityBJetTags > 0.7

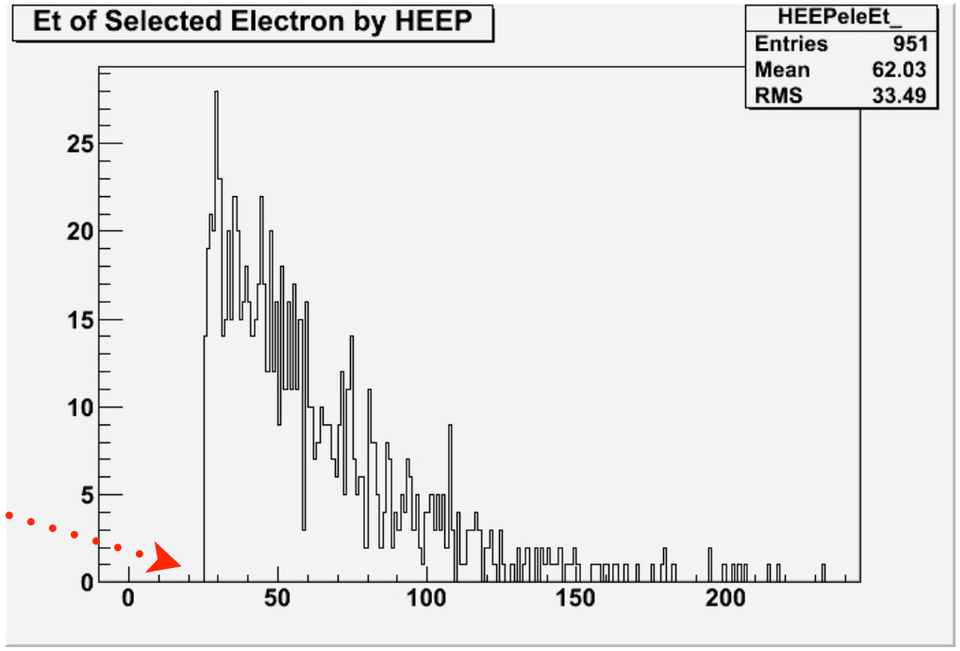
Reference Twiki Page
https://twiki.cern.ch/twiki/bin/view/CMS/SWGuideBTagging#Algorithms

http://cmsrocstor.fnal.gov/lpc1/cmsroc/yumiceva/validation/index_RecoB_CMSSW_2_2_0_TTbar.html

Electron selections using HEEP package

HEEP Selection cuts v2.0

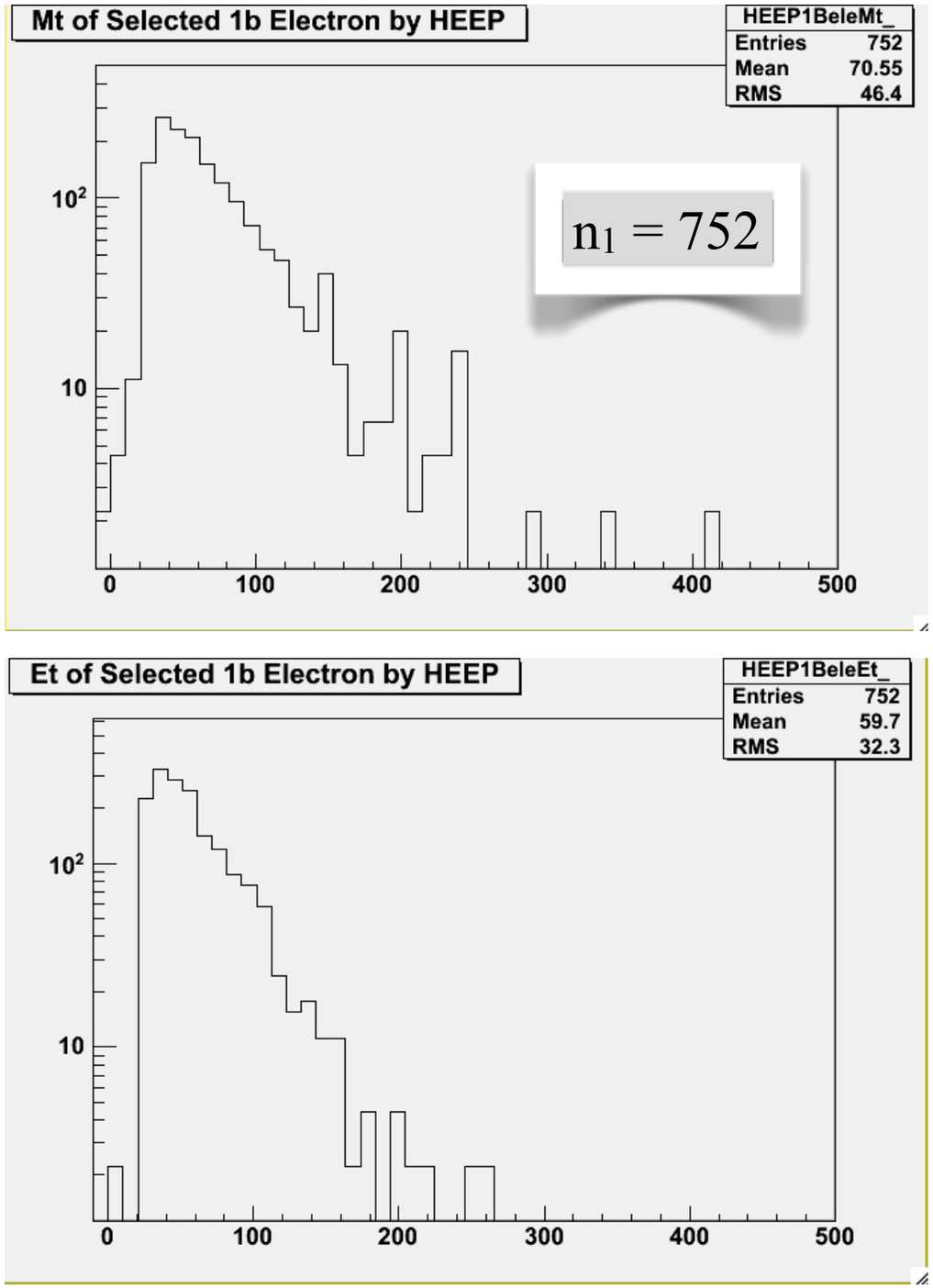
Official HEEP Selection v2.0 (Current Version)		
Variable	**Barrel**	**Endcap**
E_T	> 25 GeV	> 25 GeV
$\lvert\eta_{sc}\rvert$	< 1.442	1.560 < $\lvert\eta_{sc}\rvert$ < 2.5
classification	< 100	≥100
$\lvert\Delta\eta_{in}\rvert$	< 0.005	< 0.007
$\lvert\Delta\varphi_{in}\rvert$	< 0.09	< 0.09
H/E	<0.05	<0.05
$\sigma_{i\eta i\eta}$	n/a	<0.0275
E^{2x5}/E^{5x5}	>0.94 OR E^{1x5}/E^{5x5} > 0.83	n/a
EM + Had Depth 1 Isolation	<3+0.02*Et	<5.5 for Et<50 else
		<5.5+0.05*(Et-50)
Had Depth 2 Isolation	n/a	<0.5
Track Isol: Trk Pt	<7.5	<15



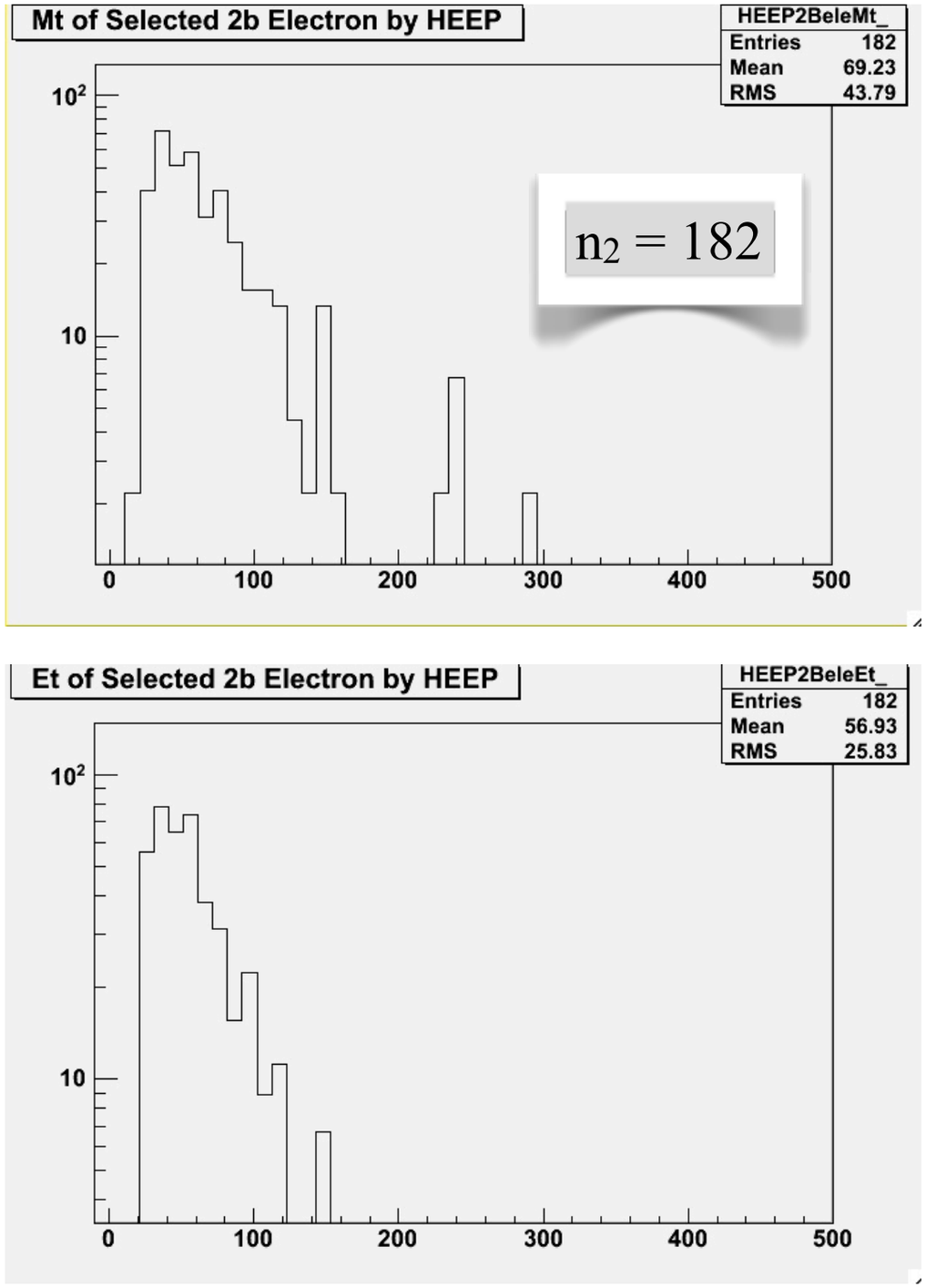

```
#include "SHarper/HEEPAnalyzer/interface/
HEEPEleSelector.h"


//for HEEP selections
heep::EleSelector cuts_;


int elecCutCode = cuts_.getCutCode(eles[i]);

 //HEEP selections
 if(elecCutCode==0x0 && eles[i].classification()<100){
```

E_T & M_T of selected electrons.

1 b-tag



2 b-tag



Summary & plan

- 1 b-jet and 2 b-jet tagging is done.
- 752, 182 electrons from 1 b-jet tags and 2 b-jet respectively
- Need more statistics and find variables, such as b-tagging efficiency, Acceptances, etc.
- Feedbacks from Wprime Group.
- Participation CMSSW 31X Background study (october excercise) for Wprime grooup

Backup

Variables

$n_1 = 752$

$n_1 = 182$

$$A_1 = n_1 / N$$

$$A_2 = n_2 / N$$

$$\varepsilon_b = \frac{(A_1/A_2 + 2)}{(n_1/n_2 + 2)}$$

$$n_2 = N_{t\bar{t}} A_2 \epsilon_b^2$$

$$n_1 = N_{t\bar{t}} A_1 \epsilon_b + 2 N_{t\bar{t}} A_2 \epsilon_b (1 - \epsilon_b)$$