Full Status Report on

$t\bar{t}$ CROSS-SECTION WITH JET PROBABILITY

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Introduction

- Setup of this analysis: `v.5.3` offline, `top_533_nt5` (Data sample $\sim$318.5 pb^{-1})

- Samples used

  ◇ Data: `bhel0d` and `bhmu0d`
  ◇ Signal: PYTHIA ttbar MC (`ttopel`, top mass = 178 GeV)
  ◇ W+HF: ALPGEN+HERWIG
  ◇ MC derived backgrounds: `wtop1w`, `wtop1z`, `ztopcz`, `mtopta`, `mtopya` and `ztop1i`

- In this analysis, we define as tagged jets those with positive JP$<$0.01 and JP$<$0.05.

- In this talk, we will show the procedure for single tags with JP$<$0.01 and final numbers for both cuts and single and double tags

Introduction

- JetProb efficiencies and scale factors are described in CDF note 7444

	ϵ^{data}	ϵ^{MC}	Scale Factor
JP $<$ 1%	0.258 $\pm$ 0.018	0.316 $\pm$ 0.021	0.817 $\pm$ 0.070
JP $<$ 5%	0.334 $\pm$ 0.026	0.392 $\pm$ 0.026	0.852 $\pm$ 0.072

- Mistag Matrix is described in CDF note 7442

	JP $<$ 1%	JP $<$ 5%
Overall - tag rate (%)	1.22 $\pm$ 0.08	5.30 $\pm$ 0.25
Overall + tag rate (%)	3.54 $\pm$ 0.18	9.20 $\pm$ 0.26

- All the results are (or will be soon) in www-cdf.fnal.gov/internal/physics/top/RunIIWjets/webpages/jetprob/cdfonly.html

- CDF Note 7697

Optimization cuts: H_T cut

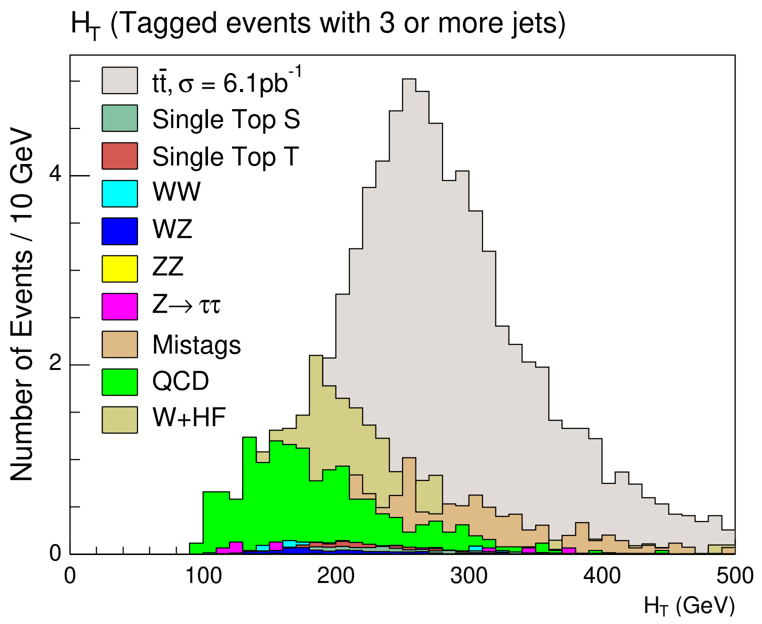
- H_T = scalar sum of $\not\!\!E_T$, electron E_T, muon P_T and jet E_T

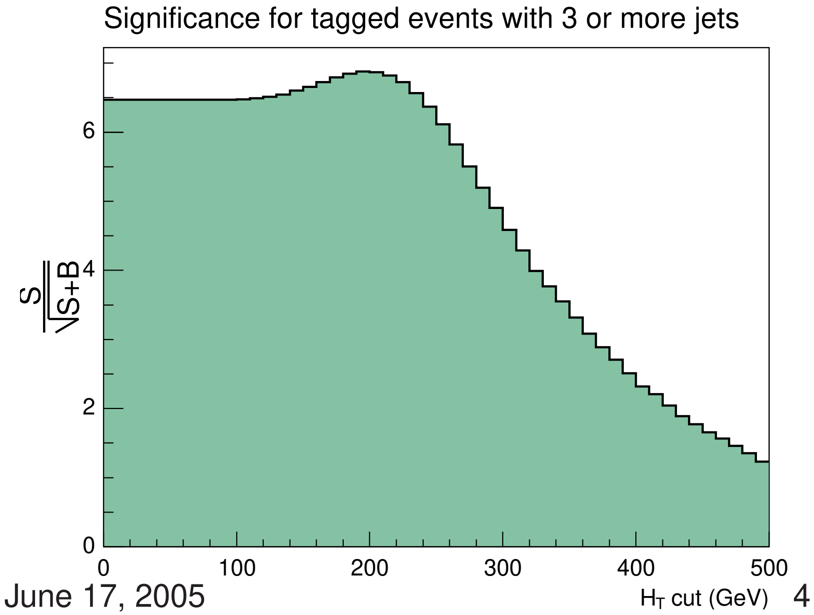
- Seek to maximize the significance

- The significance peaks at 200 GeV, we thus choose this number as our H_T cut

- Acceptances w/wo H_T cut

	$H_T > 0$	$H_T > 200$
CEM	4.75 ± 0.05	4.30 ± 0.04
CMUP	2.97 ± 0.04	2.68 ± 0.04
CMX	1.01 ± 0.02	0.90 ± 0.02



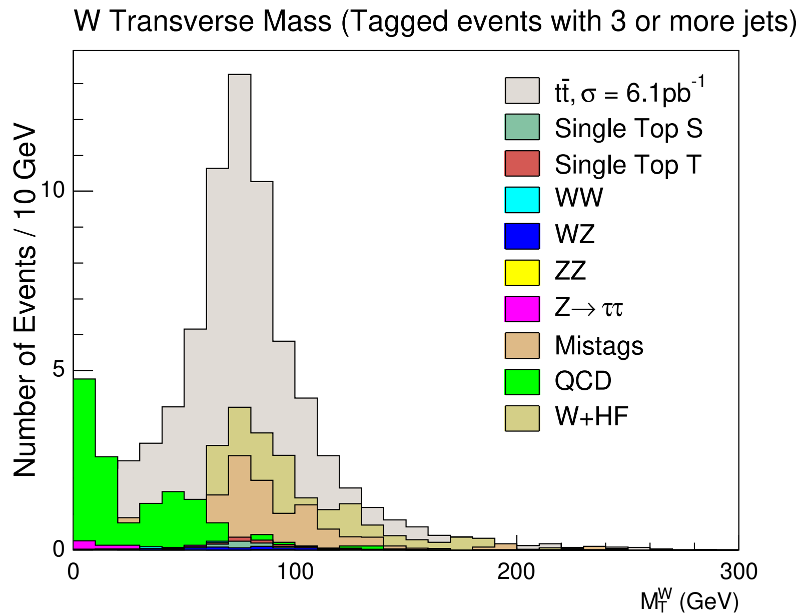


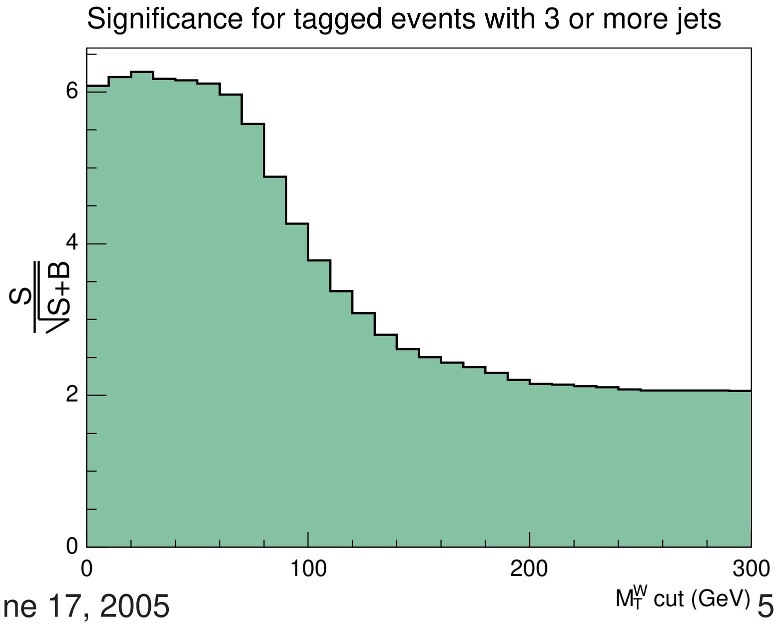
Optimization cuts: W transverse mass

- The Non-W background has the largest uncertainty. In order to reduce this uncertainty we will try to remove it

- The Non-W shape of the transverse mass of the W boson, M_T^W, distribution is very different from the other backgrounds

- Again, seek to maximize the significance but, now, S is the number of events from real W boson and B the number of events from Non-W background





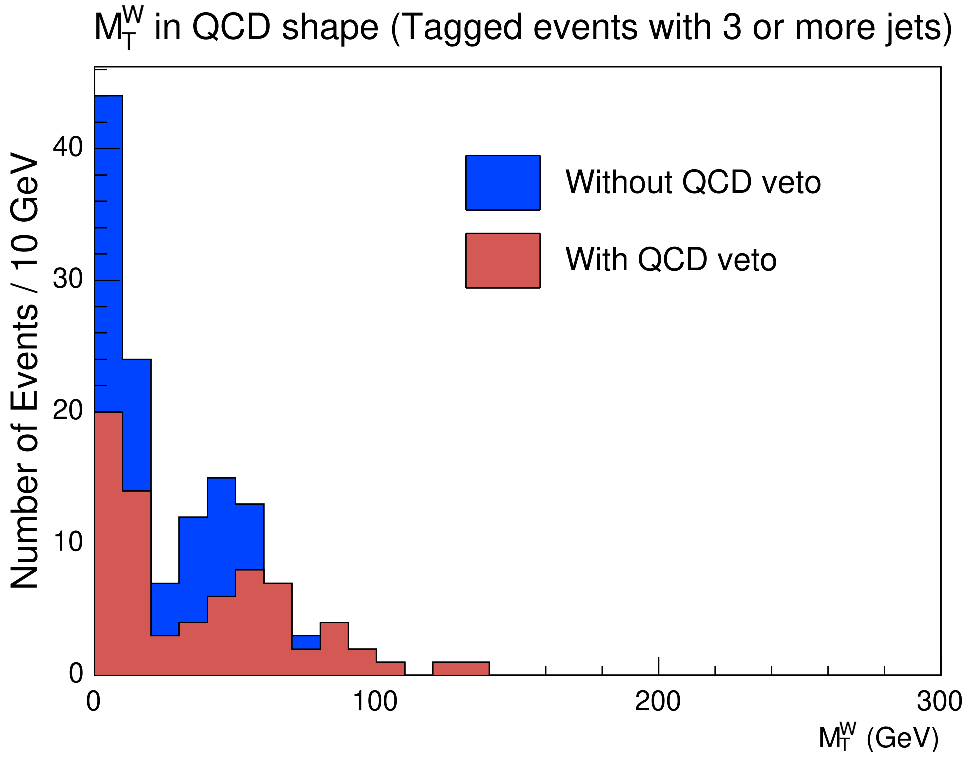
Optimization cuts: W transverse mass

- QCD veto or $M_T^W > 20$ GeV???

- W transv. mass distributions w/wo QCD veto for the QCD background

- Sig(QCD veto) $<$ Sig(M_T^W >20)

	S/$\sqrt{S+B}$
QCD veto, $M_T^W > 0$	6.12
No QCD veto, $M_T^W > 20$	6.27



- Acceptances with QCD veto or $M_T^W > 20$ GeV do not change much

	CEM	CMUP	CMX
$H_T > 200$ and QCD veto	4.08 ± 0.04	2.54 ± 0.03	0.85 ± 0.02
$H_T > 200$ and $M_T^W > 20$	4.05 ± 0.04	2.52 ± 0.03	0.84 ± 0.02

- From now on, we will apply the M_T^W cut instead of the QCD veto

Data sample (CDF note 7372)

- The data sample is based on all data taken untill August'04 shutdown (run range 141544 - 186598)
- We use DQM goodrun list version 7.0 (runs taken between February and May 04 are excluded)
- Run excluded: 164844 (luminosity not well determined)
- Include runs with good SVX information
- Luminosity (pb^{-1})

CEM	CMUP	CMX
318.5	318.5	305.2

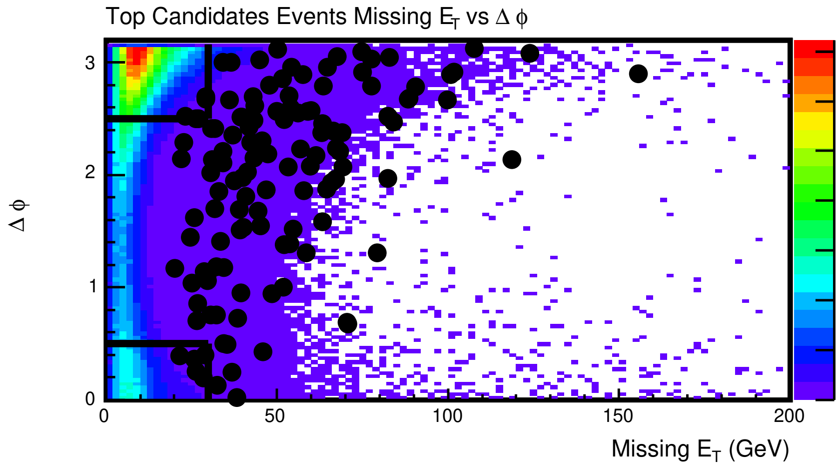
Event selection (Single tag, JP$<$1%)

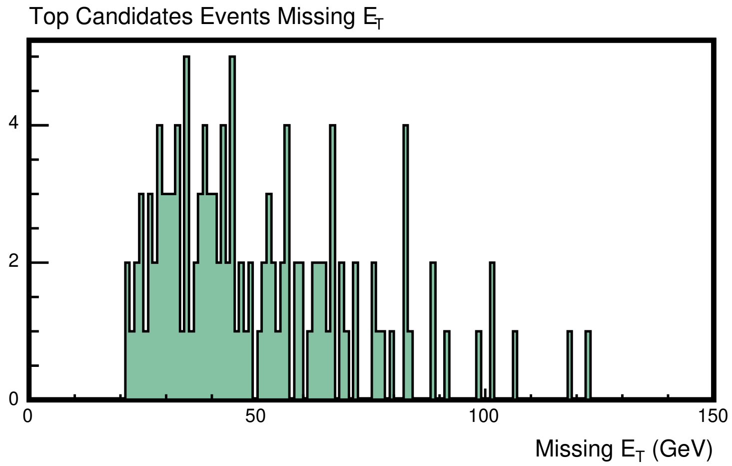
- Our selection is based on the standard Lepton+jets selection (CDF note 7372) + optimized cuts: $H_T >$200 GeV ($\geq$ 3 jets) and $M_T^W >$20 GeV
- There is an inconsistency between TopEventModule and JetProbMod concerning the primary z-vertex for the event, so we decided to apply a cut in z-vertex (for more details see Luca's talk at High p_T b tag Meeting this morning). We scale the MC acceptance by 0.98 $\pm$ 0.02
- Number of selected pretag and tagged events vs jet multiplicity

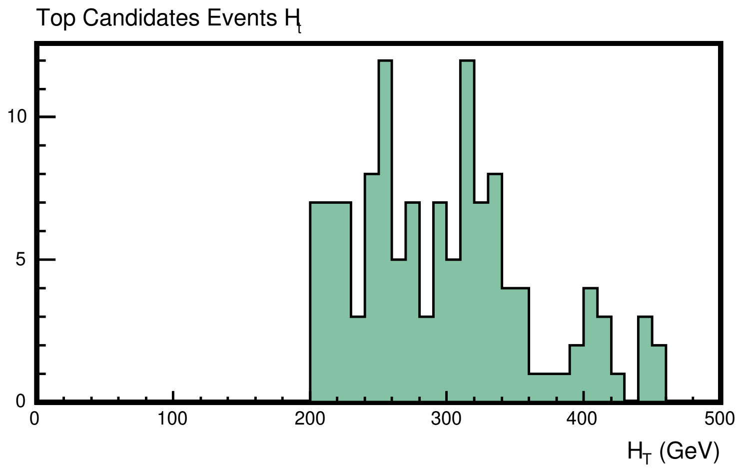
Jet Multiplicity	1 jet	2 jet	3 jet	$\geq$ 4 jets
Pretag events				
CEM	16897	2657	182	105
CMUP	8169	1175	83	44
CMX	4273	610	35	17
Total	29339	4442	300	166
Single tag events (JP$<$1%)				
CEM	207	106	33	36
CMUP	92	58	13	24
CMX	51	27	6	8
Total	350	191	52	68

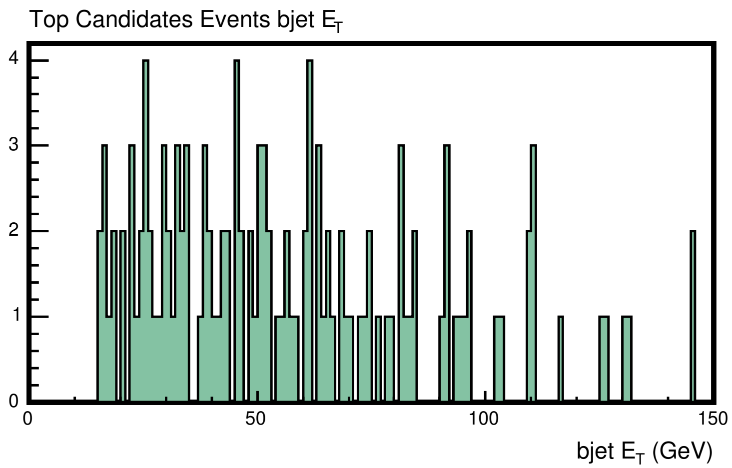
Event selection (Single tag, JP<1%)

- Some top candidates plots:









Event selection (Single tag, JP$<$1%)

- Candidates events and % overlap between JP (1%) and SecVtx

◇ Single tag:

	JP (1%)	SecVtx	Both	Only JP	Only SecVtx	Overlap (%)
CEM	33+36	37+41	56	13	22	81.16
CMUP	13+24	13+24	30	7	7	81.08
CMX	6+8	8+8	13	1	3	92.86
Total	52+68	58+73	99	21	32	82.5

◇ Double tag:

	JP (1%)	SecVtx	Both	Only JP	Only SecVtx	Overlap (%)
CEM	7+9	9+7	9	7	7	56.25
CMUP	4+8	5+8	9	3	4	75.0
CMX	1+1	1+2	2	0	1	100
Total	12+18	15+17	20	10	12	66.67

⋆ JP selects 30 events (25% of the single tag), SECVTX 32 (24.4%)

$t\bar{t}$ Acceptance (Single tag, JP$<$1% and JP$<$5%)

- JP tagging efficiencies for $t\bar{t}$ events (sample of $\sim$1M PYTHIA Monte Carlo events with top mass 178 GeV/c^2)

Quantity	CEM	CMUP	CMX
Acc. No Tag	$3.67 \pm 0.02 \pm 0.28$	$1.92 \pm 0.01 \pm 0.15$	$0.75 \pm 0.01 \pm 0.06$
Single tag (JP$<$1%, SF = 0.817 ± 0.070)			
Tag Eff.	$54.46 \pm 0.21 \pm 3.60$	$53.87 \pm 0.27 \pm 3.56$	$54.94 \pm 0.47 \pm 3.58$
Average Tag Eff.	$54.31 \pm 0.16 \pm 3.58$		
Acc. with Tag	$2.00 \pm 0.01 \pm 0.20$	$1.03 \pm 0.01 \pm 0.11$	$0.41 \pm 0.01 \pm 0.04$
Lum (pb^{-1})	318.5 ± 18.8	318.5 ± 18.8	305.2 ± 18
$\epsilon_{t\bar{t}} \int$L dt	$6.36 \pm 0.04 \pm 0.74$	$3.29 \pm 0.03 \pm 0.39$	$1.31 \pm 0.02 \pm 0.15$
Single tag (JP$<$5%, SF = 0.852 ± 0.072)			
Tag Eff.	$68.5 \pm 0.2 \pm 3.8$	$68.3 \pm 0.3 \pm 3.8$	$69.2 \pm 0.4 \pm 3.8$
Average Tag Eff.	$68.5 \pm 0.1 \pm 3.8$		
Acc. with Tag	$2.51 \pm 0.01 \pm 0.24$	$1.31 \pm 0.01 \pm 0.12$	$0.519 \pm 0.006 \pm 0.049$
$\epsilon_{t\bar{t}} \int$L dt	$7.99 \pm 0.04 \pm 0.89$	$4.18 \pm 0.03 \pm 0.47$	$1.65 \pm 0.02 \pm 0.18$

$t\bar{t}$ Acceptance uncertainties

- Summary of the uncertainties on the signal acceptance. Uncertainties are given in percentage

Quantity	CEM	CMUP	CMX
$\delta\epsilon_{trigger}$	0.06	0.5	0.4
$\delta\ SF_{leptonIDandreconstruction}$	0.7	1	0.6
δ conversion veto	1.4	-	-
δ cosmic veto	-	1	1
$\delta\ E_T\ (P_T)$ cut	0.3	1.2	1.2
$\delta\epsilon_{z\ vertex}$		0.3	
δ jet energy scale		4.2	
δ PDF		2	
δ ISR/FSR		1.3	
δ MC modeling		1.6	
δ Lepton Isolation		5	
δ z cut		2	

Mistags (Single tag, JP$<$1%)

- We obtain the mistag rate from the mistag matrix prediction applying the mistag estimation for each jet in the pretag data sample and summing the mistag weights for all the jets in the event

- Mistag has to be scaled down by the fraction of pretag events which are due to Non-W

- Mistag rate for positively tagged jets is slighty higher than the negative negative tag rate $\Rightarrow$ we scale our prediction with a factor 1.57 $\pm$ 0.10 (CDF note 7696)

Jet Multiplicity	1 jet	2 jets	3 jets	$\geq$ 4 jets
Prediction x (1 - $F_{non\ W}$) x LR Asymmetry				
Mistag electrons	85.9 $\pm$ 6.2	29.1 $\pm$ 1.8	5.1 $\pm$ 0.3	3.9 $\pm$ 0.2
Mistag muons	62.5 $\pm$ 4.0	20.6 $\pm$ 1.6	3.0 $\pm$ 0.1	2.6 $\pm$ 0.1
Total	148.4 $\pm$ 8.2	49.8 $\pm$ 2.8	8.1 $\pm$ 0.4	6.6 $\pm$ 0.3

QCD Background (Single tag, JP$<$1%)

- Extracted from the standard "MET vs ISO" method. We define 4 regions in the $\not{E}_T$ vs.isolation plane:

  - Region A: Iso $>$ 0.2 and $\not{E}_T < 15$ GeV
  - Region B: Iso $<$ 0.1 and $\not{E}_T < 15$ GeV
  - Region C: Iso $>$ 0.2 and $\not{E}_T > 20$ GeV
  - Region D: Iso $<$ 0.1 and $\not{E}_T > 20$ GeV

- In the non-isolated region, jets containing the lepton are not counted.

- We correct the number of events in the side band region for the signal contribution

QCD Background (Single tag, JP$<$1%)

- Pretag event counts in the $\not\!\!E_T$ and isolation sidebands and fraction of non-W background in the pre-tagged sample

Jet Multiplicity	1 jet	2 jets	3 jets	$\geq$ 4 jets
Pretag Electrons				
Region A	100600	12756	1745	216
Region B	61818	5228	593	98
Region C	1651	428	27	15
Region D	16897	2657	182	105
F_{non-W}	0.060 ± 0.002	0.066 ± 0.004	0.05 ± 0.01	0.06 ± 0.02
$F^{corr.}_{non-W}$	0.060 ± 0.002	0.070 ± 0.004	0.05 ± 0.01	0.05 ± 0.02
Pretag Muons				
Region A	36599	5248	657	97
Region B	11718	968	114	21
Region C	737	181	12	11
Region D	12442	1785	118	61
F_{non-W}	0.0190 ± 0.0007	0.019 ± 0.002	0.018 ± 0.006	0.04 ± 0.02
$F^{corr.}_{non-W}$	0.0190 ± 0.0007	0.019 ± 0.002	0.014 ± 0.005	0.03 ± 0.01

$$F_{non-W} = (B \times C) / (A \times D)$$

QCD Background (Single tag, JP$<$1%)

- We estimate this background with 3 different methods (errors are only statistical in all of them):

  ◇ 1. Extrapolating from region B the tagging efficiency, we predict the expected number of tags from non-W events as

$$N^{tag}_{non-W} = F_{non-W} \times \epsilon_B \times N^{D}_{events}$$

  ◇ 2. Calculating the tagged event rates in each sideband and dividing by the number of jets in the bin, the predicted tag rate per jet in the signal region

  D Pred = (Tag Rate B $\times$ Tag Rate C) / Tag Rate A (tag rate / jet)

  and doing the average over all the bins...

QCD Background (Single tag, JP$<$1%)

◇ 3. Using tagged events in all regions...

$$\mathrm{N}^{tag}_{non-W} = (B/A)_{tagged} \times \mathrm{C}_{tagged}$$

Jet Multiplicity	1 jet	2 jets	3 jets	$\geq$ 4 jets
Electrons				
$(B/A)_{tagged}$	0.36 $\pm$ 0.01	0.26$\pm$ 0.02	0.26 $\pm$ 0.05	0.4 $\pm$ 0.2
C_{tagged}	75	25	2	1
N^{tag}_{non-W}	26.7 $\pm$ 3.3	6.6 $\pm$ 1.4	0.5 $\pm$ 0.4	0.4 $\pm$ 0.4
Muons				
$(B/A)_{tagged}$	0.102 $\pm$ 0.008	0.10 $\pm$ 0.02	0.11 $\pm$ 0.04	0.2 $\pm$ 0.1
C_{tagged}	37	204	4	1
N^{tag}_{non-W}	3.8 $\pm$ 0.7	2.0 $\pm$ 0.6	0.5 $\pm$ 0.3	0.2 $\pm$ 0.1
Final result	30.5 $\pm$ 3.3	8.6 $\pm$ 1.5	0.9 $\pm$ 0.5	0.5 $\pm$ 0.4

◇ We will use the numbers corresponding to the last method and we will assign a systematic uncertainty of 50% which takes into account the difference between the 3 methods

W + Heavy flavor (method 2) (Single tag, JP$<$1%)

- We use the heavy flavor fractions in W + jets events from the CDF note 7007 which includes a scale up factor of 1.5 $\pm$ 0.4 to correct the gluon splitting discrepancy between Jet Data and MC

- We extract the HF tagging efficiencies applying JP to the W$b\bar{b}$, W$c\bar{c}$ and Wc MC sample (includind the SF tagging efficiency)
  - ◇ We assume the same scale factor for b's and c's
  - ◇ We scale up the error for c-SF by 50%

Jet Multiplicity	1 jet	2 jet	3 jet	$\geq$ 4 jets
1B($\geq$1 tag)	29.5 $\pm$ 0.3 $\pm$ 2.5	29.4 $\pm$ 0.6 $\pm$ 2.5	35.4 $\pm$ 1.5 $\pm$ 3.0	31.2 $\pm$ 3.2 $\pm$ 2.7
2B($\geq$1 tag)	0 $\pm$ 0 $\pm$ 0	50.5 $\pm$ 0.7 $\pm$ 4.3	54.6 $\pm$ 1.6 $\pm$ 4.7	52.8 $\pm$ 2.2 $\pm$ 4.5
2B($\geq$2 tags)	0 $\pm$ 0 $\pm$ 0	10.3 $\pm$ 0.4 $\pm$ 1.8	12.3 $\pm$ 1.1 $\pm$ 2.1	10.7 $\pm$ 1.4 $\pm$ 1.8
1C($\geq$1 tag)	6.8 $\pm$ 0.2 $\pm$ 0.9	7.5 $\pm$ 0.4 $\pm$ 1.0	8.9 $\pm$ 1.0 $\pm$ 1.1	6.8 $\pm$ 1.8 $\pm$ 0.8
2C($\geq$1 tag)	0 $\pm$ 0 $\pm$ 0	13.5 $\pm$ 0.6 $\pm$ 1.7	16.9 $\pm$ 1.5 $\pm$ 2.2	13.9 $\pm$ 1.7 $\pm$ 1.8
2C($\geq$2 tags)	0 $\pm$ 0 $\pm$ 0	0.43 $\pm$ 0.12 $\pm$ 0.11	1.2 $\pm$ 0.4 $\pm$ 0.3	0.5 $\pm$ 0.3 $\pm$ 0.1
WC($\geq$1 tag)	7.2 $\pm$ 0.2 $\pm$ 0.9	7.5 $\pm$ 0.3 $\pm$ 1.0	8.2 $\pm$ 0.9 $\pm$ 1.1	6.3 $\pm$ 1.1 $\pm$ 0.8

MC derived Backgrounds (WW, WZ, ZZ, Z$\tau\tau$, Single Top)

- Theoretical Cross Section and sample used for each process

Process	σ_{th}	MC Sample	Events
WW	13.25 ± 0.25	wtop1w	403681
WZ	3.96 ± 0.06	wtop1z	393986
ZZ	1.58 ± 0.02	ztopcz	396973
Single top $W^\star$	0.88 ± 0.05	mtopya	193181
Single top W-g	1.98 ± 0.08	mtopua	187559
Z$\tau\tau$	254.3 ± 5.4	ztop1i	890892

- We calculate the number of events for each background by

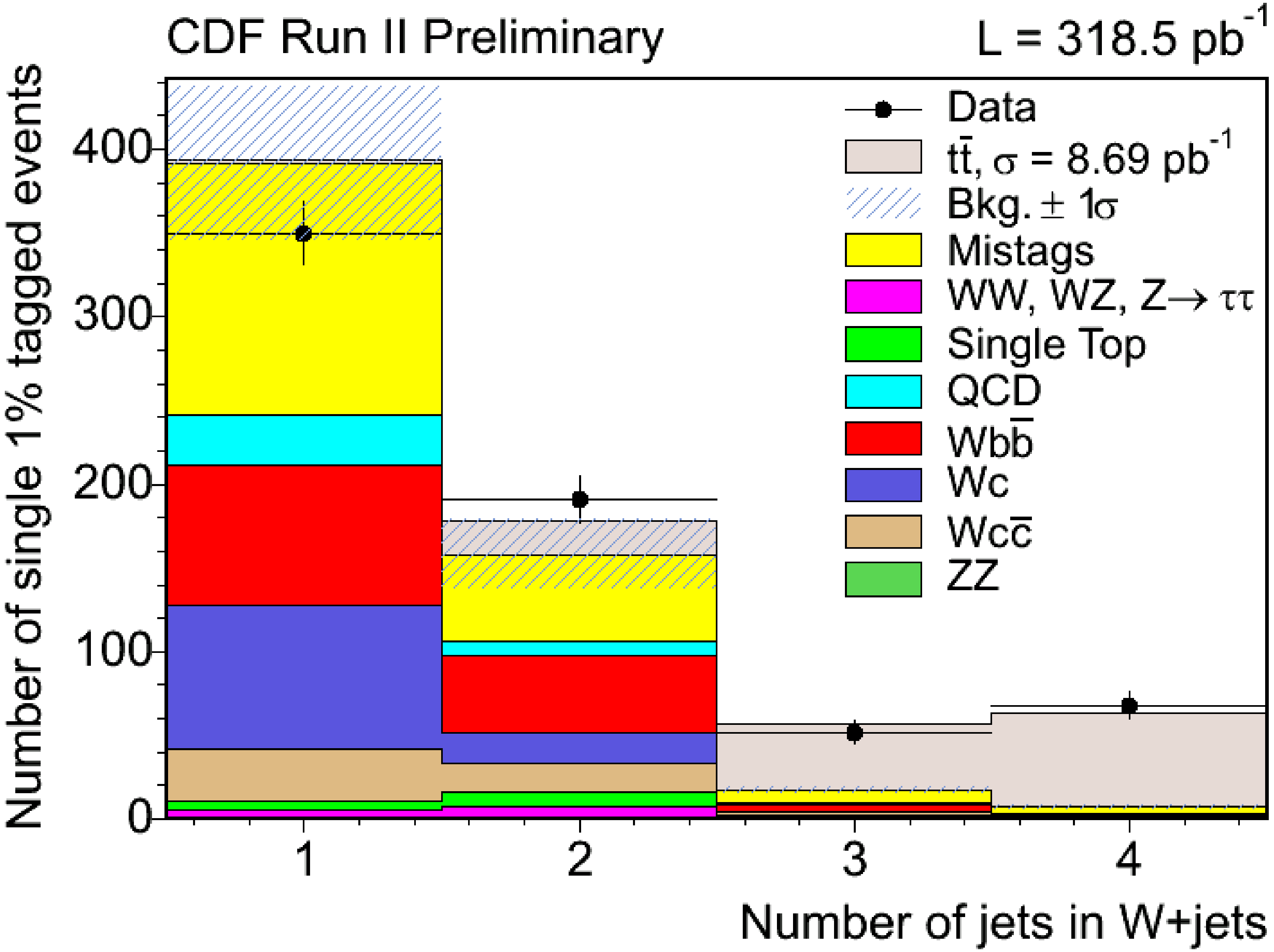
$$N_{events} = \sigma_{th} \times \text{Acc} \times \epsilon_{tag} \times \int \text{L dt}$$

- The results for these backgrounds are shown in next slide

Summary Backgrounds (Single tag, JP$<$1%)

Jet Multiplicity	1 jet	2 jet	3 jet	$\geq$ 4 jets
MC Derived Backgrounds				
WW	2.30 $\pm$ 0.30	4.79 $\pm$ 0.59	0.59 $\pm$ 0.09	0.30 $\pm$ 0.06
WZ	0.96 $\pm$ 0.12	1.95 $\pm$ 0.22	0.23 $\pm$ 0.04	0.07 $\pm$ 0.02
ZZ	0.027 $\pm$ 0.006	0.093 $\pm$ 0.014	0.013 $\pm$ 0.004	0.006 $\pm$ 0.003
Single top $W-g$	4.09 $\pm$ 0.50	4.93 $\pm$ 0.60	0.72 $\pm$ 0.09	0.20 $\pm$ 0.03
Single top W^*	1.32 $\pm$ 0.17	4.18 $\pm$ 0.49	0.60 $\pm$ 0.07	0.13 $\pm$ 0.02
$Z \rightarrow \tau^- \tau^+$	1.95 $\pm$ 0.42	0.59 $\pm$ 0.22	0.12 $\pm$ 0.09	0 $\pm$ 0
Total	10.64 $\pm$ 1.30	16.53 $\pm$ 1.88	2.27 $\pm$ 0.28	0.71 $\pm$ 0.09
W + Heavy Flavour				
W$b\bar{b}$	83.0 $\pm$ 23.4	46.5 $\pm$ 13.0	5.8 $\pm$ 1.6	3.2 $\pm$ 0.9
W$c\bar{c}$	31.2 $\pm$ 9.3	17.2 $\pm$ 5.1	2.3 $\pm$ 0.7	1.16 $\pm$ 0.38
Wc	86.4 $\pm$ 21.4	18.3 $\pm$ 4.7	1.35 $\pm$ 0.37	0.57 $\pm$ 0.17
Total	200.6 $\pm$ 42.2	81.9 $\pm$ 19.5	9.4 $\pm$ 2.3	4.9 $\pm$ 1.3
Others				
Mistag	149.7 $\pm$ 8.2	52.1 $\pm$ 2.8	8.6 $\pm$ 0.4	6.8 $\pm$ 0.3
non W	30.5 $\pm$ 15.6	8.6 $\pm$ 4.6	0.91 $\pm$ 0.64	0.49 $\pm$ 0.49
Total Background	391.5 $\pm$ 46.5	159.2 $\pm$ 20.9	21.9 $\pm$ 2.6	12.9 $\pm$ 1.5
$t\bar{t}$ (6.1 pb)	1.7 $\pm$ 0.4	14.0 $\pm$ 1.8	27.5 $\pm$ 3.3	39.4 $\pm$ 4.6
Total Background	391.4 $\pm$ 46.5	158.0 $\pm$ 20.9	17.4 $\pm$ 2.6	7.2 $\pm$ 1.5
$t\bar{t}$ (8.69 pb)	2.4 $\pm$ 0.5	20.0 $\pm$ 2.5	39.2 $\pm$ 4.7	56.2 $\pm$ 6.6
Data	350	191	52	68

Summary Backgrounds (Single tag, JP$<$1%)



Cross section estimation (Single tag, JP$<$1%)

- We calculate the $t\bar{t}$ cross section by $\sigma = \frac{N-B}{\epsilon \times \int L dt}$ and the value we get is

$$\sigma_{t\bar{t}} = 8.7\ ^{+1.1}_{-1.0}\ \text{(stat)} \pm 1.1\ \text{(syst)}\ \text{pb}$$

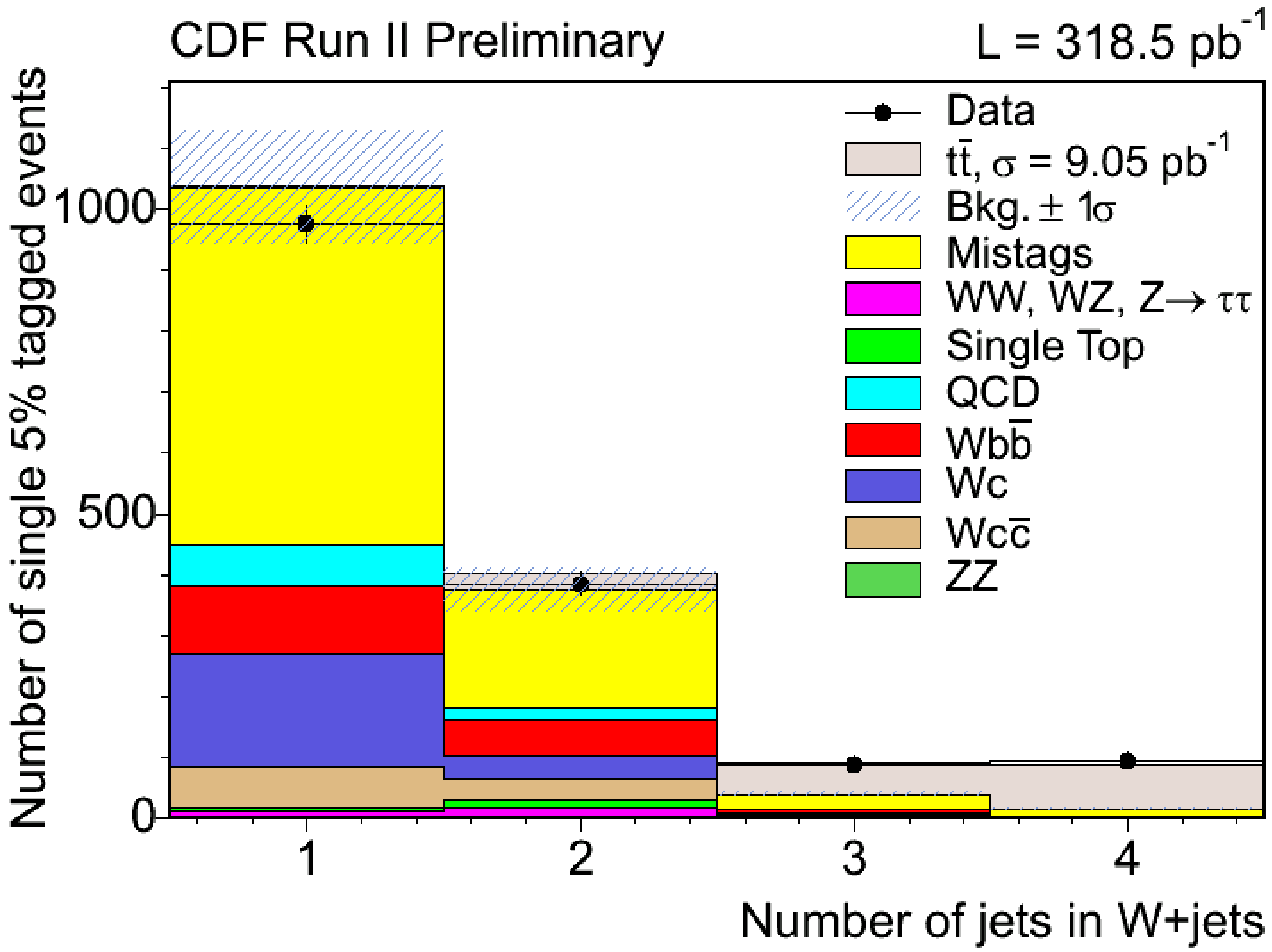
Source	Fractional Syst. Uncert.	Contribution to $\sigma_{t\bar{t}}$
MC Acceptance	7.6%	7.30%
Tagging Scale Factor (b's/c's)	8.6/12.9%	7.21%
Left-Right Mistag Asymmetry	6.37%	0.582%
Non-W Fraction	50%	0.340%
Non-W Prediction	50%	0.714%
W+HF Prediction	30%	2.56%
Other MC backgrounds	1.8%	0.055%
Luminosity	5.9%	5.74%
Total Systematic Uncertainty		12.08%

- We propagate these errors in the expression of the x-section considering correlation for efficiency, scale factor and luminosity. W$b\bar{b}$ and W$c\bar{c}$ systematics are considered correlated across all the bins. All the other errors are treated as uncorrelated

Summary Backgrounds (Single tag, JP$<$5%)

Jet Multiplicity	1 jet	2 jet	3 jet	$\geq$ 4 jets
MC Derived Backgrounds				
WW	5.87 $\pm$ 0.71	11.91 $\pm$ 1.41	1.65 $\pm$ 0.22	0.71 $\pm$ 0.11
WZ	1.59 $\pm$ 0.19	3.21 $\pm$ 0.35	0.39 $\pm$ 0.05	0.14 $\pm$ 0.03
ZZ	0.051 $\pm$ 0.009	0.135 $\pm$ 0.018	0.029 $\pm$ 0.006	0.014 $\pm$ 0.004
Single top $W-g$	5.38 $\pm$ 0.66	6.53 $\pm$ 0.78	0.91 $\pm$ 0.10	0.26 $\pm$ 0.03
Single top W^*	1.74 $\pm$ 0.22	5.19 $\pm$ 0.59	0.73 $\pm$ 0.08	0.17 $\pm$ 0.02
$Z \rightarrow \tau^-\tau^+$	3.90 $\pm$ 0.70	1.34 $\pm$ 0.34	0.33 $\pm$ 0.15	0 $\pm$ 0
Total	18.53 $\pm$ 2.22	28.32 $\pm$ 3.16	4.02 $\pm$ 0.47	1.29 $\pm$ 0.16
W + Heavy Flavour				
W$b\bar{b}$	111.4 $\pm$ 31.4	59.7 $\pm$ 16.7	7.2 $\pm$ 2.0	3.9 $\pm$ 1.1
W$c\bar{c}$	67.9 $\pm$ 20.2	35.9 $\pm$ 10.7	4.5 $\pm$ 1.3	2.7 $\pm$ 0.8
Wc	183.6 $\pm$ 45.2	38.1 $\pm$ 9.7	3.0 $\pm$ 0.8	1.5 $\pm$ 0.4
Total	363.0 $\pm$ 74.5	133.7 $\pm$ 30.5	14.7 $\pm$ 3.5	8.0 $\pm$ 2.0
Others				
Mistag	584.8 $\pm$ 40.6	193.8 $\pm$ 14.0	28.2 $\pm$ 2.0	22.1 $\pm$ 1.8
non W	68.8 $\pm$ 34.8	21.4 $\pm$ 11.1	1.32 $\pm$ 0.88	0.79 $\pm$ 0.74
Total Background	1035.1 $\pm$ 93.6	377.2 $\pm$ 36.8	48.3 $\pm$ 4.3	32.1 $\pm$ 2.7
$t\bar{t}$ (6.1 pb)	2.3 $\pm$ 0.4	18.0 $\pm$ 2.1	34.8 $\pm$ 4.0	49.5 $\pm$ 5.5
Total Background	1034.9 $\pm$ 93.6	374.4 $\pm$ 36.8	38.7 $\pm$ 4.3	16.1 $\pm$ 2.7
$t\bar{t}$ (9.05 pb)	3.4 $\pm$ 0.6	26.7 $\pm$ 3.2	51.7 $\pm$ 5.9	73.4 $\pm$ 8.1
Data	975	385	87	93

Summary Backgrounds (Single tag, JP$<$5%)



$\sigma_{t\bar{t}}$ = 9.0$^{+1.0}_{-0.9}$ (stat) $\pm$ 1.1 (syst) pb

Double tag analysis

- Same kind of analysis as single tag but...

Source	Fract. Syst. Uncert.	Contr. to $\sigma_{t\bar{t}}$
MC Acceptance	7.6%	7.2%
Tagging Scale Factor (b's/c's)	8.6/12.9%	14.7%
Left-Right Mistag Asymmetry	12.7%	0.09%
Non-W Fraction	50%	0.06%
Non-W Prediction	50%	0.13%
W+HF Prediction	30%	0.77%
Other MC backgrounds	1.8%	0.03%
Luminosity	5.9%	5.7%
Total Systematic Uncertainty		17.4%

- Mistags: events with, at least, two mistagged jets (events with one tag jet are taken into account in the other sources of background)

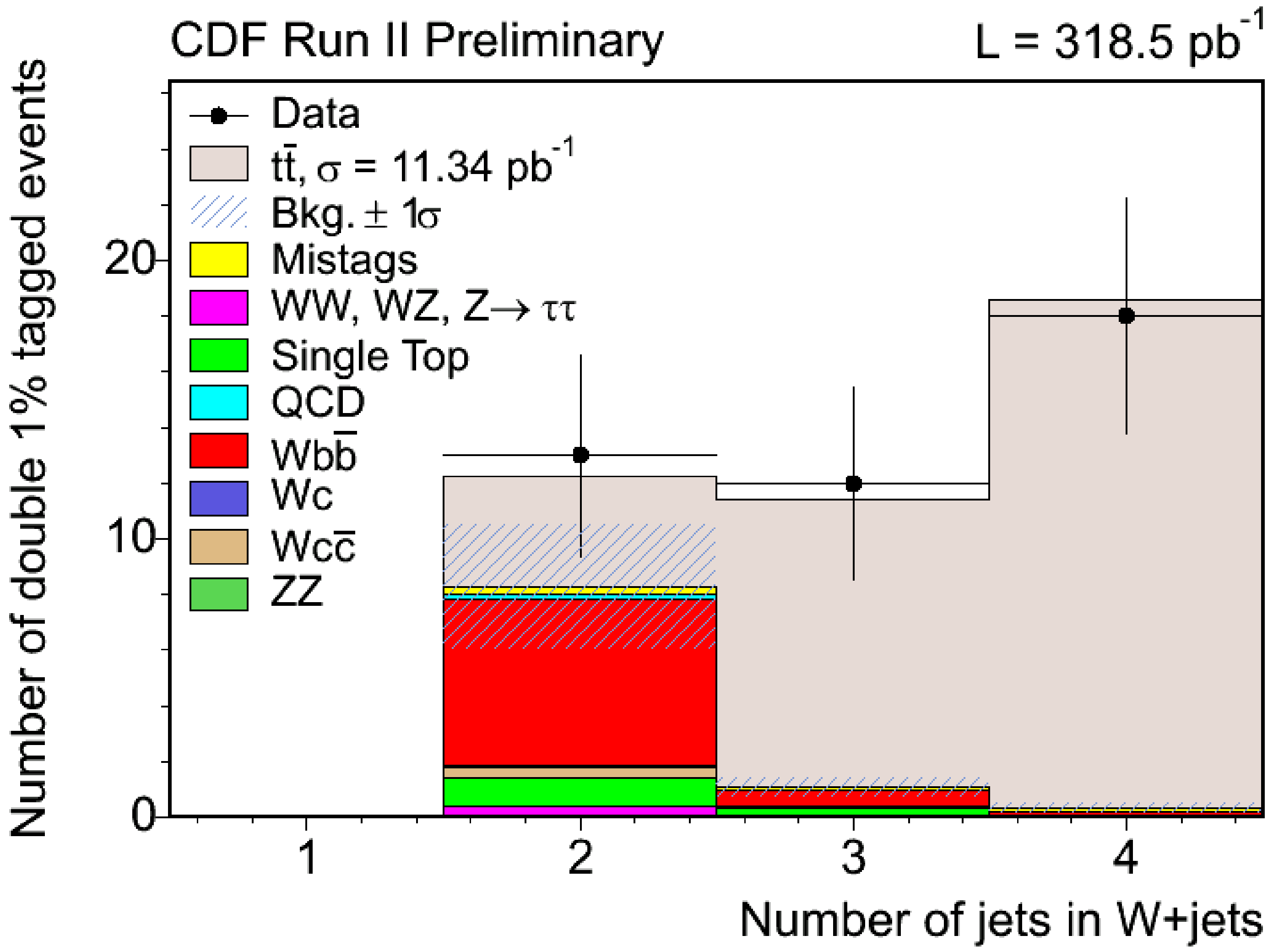
- We apply the mistag matrix to light flavor jets with one real tag so we take into account the contribution of extra mistags in the JP efficiency for the W+HF background

- Due to lack of statistics, to estimate the Non-W background, we compute an overall tag rate for the region B and apply it to the pretag QCD fraction in the signal region

Summary Backgrounds (Double tag, JP$<$1%)

Jet Multiplicity	2 jet	3 jet	$\geq$ 4 jets
MC Derived Backgrounds			
WW	0.060 $\pm$ 0.022	0.031 $\pm$ 0.015	0 $\pm$ 0
WZ	0.249 $\pm$ 0.052	0.0303 $\pm$ 0.0096	0.0117 $\pm$ 0.0055
ZZ	0.014 $\pm$ 0.004	0.00077 $\pm$ 0.00078	0.00077 $\pm$ 0.00078
Single top $W-g$	0.164 $\pm$ 0.033	0.121 $\pm$ 0.025	0.0443 $\pm$ 0.0099
Single top W^*	0.88 $\pm$ 0.17	0.138 $\pm$ 0.028	0.034 $\pm$ 0.007
$Z \rightarrow \tau^- \tau^+$	0.055 $\pm$ 0.056	0 $\pm$ 0	0 $\pm$ 0
Total	1.42 $\pm$ 0.28	0.320 $\pm$ 0.064	0.090 $\pm$ 0.019
W + Heavy Flavour			
W$b\bar{b}$	6.09 $\pm$ 1.95	0.84 $\pm$ 0.27	0.48 $\pm$ 0.17
W$c\bar{c}$	0.36 $\pm$ 0.16	0.117 $\pm$ 0.059	0.052 $\pm$ 0.035
Wc	0.076 $\pm$ 0.057	0.020 $\pm$ 0.020	0.012 $\pm$ 0.015
Total	6.52 $\pm$ 2.09	0.97 $\pm$ 0.32	0.54 $\pm$ 0.19
Others			
Mistag	0.213 $\pm$ 0.014	0.097 $\pm$ 0.006	0.118 $\pm$ 0.007
non W	0.19 $\pm$ 0.12	0.029 $\pm$ 0.018	0.045 $\pm$ 0.030
Total Background	8.4 $\pm$ 2.2	1.42 $\pm$ 0.35	0.80 $\pm$ 0.20
$t\bar{t}$ (6.1 pb)	2.2 $\pm$ 0.5	5.6 $\pm$ 1.1	9.8 $\pm$ 1.9
Total Background	8.3 $\pm$ 2.2	1.07 $\pm$ 0.35	0.32 $\pm$ 0.20
$t\bar{t}$ (11.34 pb)	4.0 $\pm$ 0.9	10.3 $\pm$ 2.0	18.2 $\pm$ 3.5
Data	13	12	18

Summary Backgrounds (Double tag, JP$<$1%)

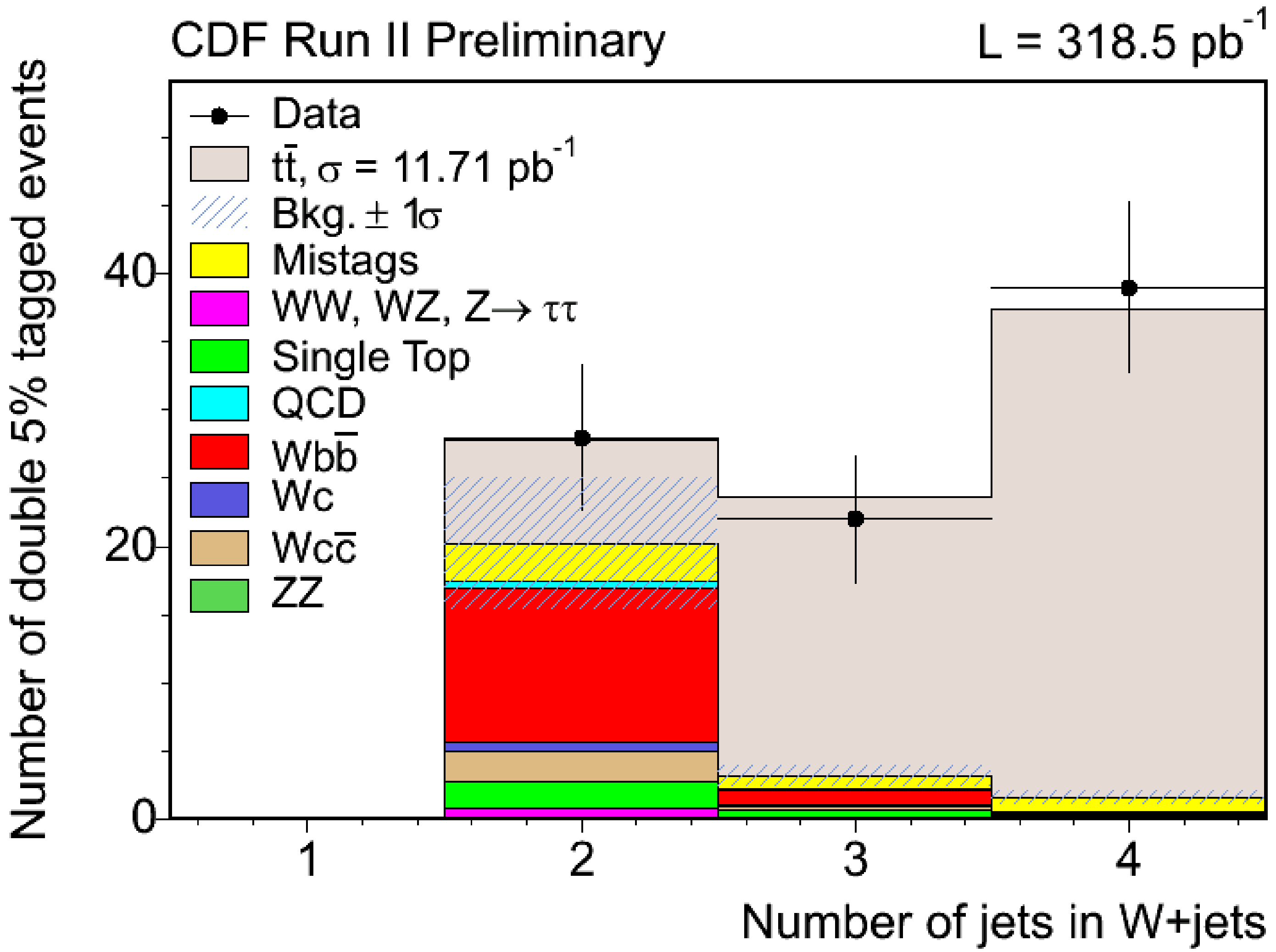


$$\sigma_{t\bar{t}} = 11.3^{+2.4}_{-2.0} \text{ (stat)} \pm 2.0 \text{ (syst) pb}$$

Summary Backgrounds (Double tag, JP$<$5%)

Jet Multiplicity	2 jet	3 jet	$\geq$ 4 jets
MC Derived Backgrounds			
WW	0.223 $\pm$ 0.057	0.107 $\pm$ 0.034	0.091 $\pm$ 0.031
WZ	0.510 $\pm$ 0.101	0.054 $\pm$ 0.015	0.028 $\pm$ 0.009
ZZ	0.0250 $\pm$ 0.0064	0.0032 $\pm$ 0.0017	0.0008 $\pm$ 0.0008
Single top $W-g$	0.355 $\pm$ 0.069	0.216 $\pm$ 0.042	0.081 $\pm$ 0.017
Single top W^*	1.548 $\pm$ 0.302	0.256 $\pm$ 0.049	0.061 $\pm$ 0.012
$Z \to \tau^-\tau^+$	0.0599 $\pm$ 0.0610	0 $\pm$ 0	0 $\pm$ 0
Total	2.721 $\pm$ 0.521	0.637 $\pm$ 0.122	0.262 $\pm$ 0.054
W + Heavy Flavour			
W$b\bar{b}$	11.4 $\pm$ 3.6	1.63 $\pm$ 0.51	1.0 $\pm$ 0.3
W$c\bar{c}$	2.3 $\pm$ 0.9	0.56 $\pm$ 0.23	0.37 $\pm$ 0.16
Wc	0.7 $\pm$ 0.3	0.18 $\pm$ 0.08	0.14 $\pm$ 0.07
Total	14.3682 $\pm$ 4.54202	2.37341 $\pm$ 0.752671	1.52091 $\pm$ 0.496176
Others			
Mistag	2.75 $\pm$ 0.30	1.02 $\pm$ 0.11	1.25 $\pm$ 0.14
non W	0.63 $\pm$ 0.34	0.09 $\pm$ 0.05	0.14 $\pm$ 0.09
Total Background	20.5 $\pm$ 4.9	4.1 $\pm$ 0.8	3.2 $\pm$ 0.5
$t\bar{t}$ (6.1 pb)	4.0 $\pm$ 0.8	10.7 $\pm$ 2.0	18.7 $\pm$ 3.4
Total Background	20.3 $\pm$ 4.9	3.2 $\pm$ 0.8	1.6 $\pm$ 0.5
$t\bar{t}$ (11.71 pb)	7.6 $\pm$ 1.5	20.4 $\pm$ 3.8	35.8 $\pm$ 6.4
Data	28	22	39

Summary Backgrounds (Double tag, JP$<$5%)



$$\sigma_{t\bar{t}} = 11.7^{+1.7}_{-1.5} \text{ (stat)} \pm 2.0 \text{ (syst) pb}$$

Summary

- We have updated the Gen4 measurement (single 1% tag) to Gen5 including optimization cuts. We have also done the study for a JetProb cut of 5% and requiring double tags for both cuts

	Single tag	Double tag
Top candidates (JP$<$1%)	120	30
σ (JP$<$1%) (pb)	$8.7\,^{+1.1}_{-1.0} \pm 1.1$	$11.3^{+2.4}_{-2.0} \pm 2.0$
Top candidates (JP$<$5%)	180	61
σ (JP$<$5%) (pb)	$9.0^{+1.0}_{-0.9} \pm 1.1$	$11.7^{+1.7}_{-1.5} \pm 2.0$

- We have selected 120 top candidates events that pass the JP$<$0.01. We found a 82.5% overlap with SecVtx candidates

- Work documented in CDF note 7697 (with all the numbers and tables)

Future plans

- Prebless next week at Top Meeting
- Bless two weeks after the preblessing
- Right after blessing, start the publication proccess

BACK-UP SLIDES

Event selection summary

- Number of selected tagged events vs jet multiplicity ($H_T > 200$ GeV if $\geq$ 3 jets, $W_{M_T} > 20$ GeV)

Single tag events (JP<1%)				
CEM	207	106	33	36
CMUP	92	58	13	24
CMX	51	27	6	8
Total	350	191	52	68

Single tag events (JP<5%)				
CEM	571	230	53	53
CMUP	256	105	24	29
CMX	148	50	10	11
Total	975	385	87	93

Double tag events (JP<1%)			
CEM	8	7	9
CMUP	3	4	8
CMX	2	1	1
Total	13	12	18

Double tag events (JP<5%)			
CEM	16	15	18
CMUP	9	4	17
CMX	3	3	4
Total	28	22	39

QCD Background (Single tag, JP$<$1%)

- We estimate this background with 3 different methods (errors are only statistical in all of them):

◇ 1. Extrapolating from region B the tagging efficiency, we predict the expected number of tags from non-W events as

$$\mathrm{N}_{non-W}^{tag} = \mathrm{F}_{non-W} \times \epsilon_B \times \mathrm{N}_{events}^{D}$$

Jet Multiplicity	1 jet	2 jets	3 jets	$\geq$ 4 jets
Electrons				
B event tag rate	0.0148 ± 0.0005	0.030 ± 0.002	0.06 ± 0.01	0.07 ± 0.03
# events in D	16897	2657	182	105
N_{non-W}^{tag}	15.1 ± 0.6	5.2 ± 0.5	0.5 ± 0.1	0.4 ± 0.2
Muons				
B event tag rate	0.016 ± 0.001	0.045 ± 0.007	0.08 ± 0.03	0.14 ± 0.08
# events in D	12442	1785	118	61
N_{non-W}^{tag}	3.9 ± 0.3	1.5 ± 0.3	0.14 ± 0.06	0.2 ± 0.2

QCD Background (Single tag, JP$<$1%)

◇ 2. Calculating the tagged event rates in each sideband and dividing by the number of jets in the bin, the predicted tag rate per jet in the signal region

$$\text{D Pred} = (\text{Tag Rate B} \times \text{Tag Rate C}) \,/\, \text{Tag Rate A} \qquad (\text{tag rate / jet})$$

and doing the average over all the bins...

Jet Mult	1 jet	2 jets	3 jets	$\geq$ 4 jets	Average
Electrons					
TR A/j	0.0256 $\pm$ 0.0005	0.0234 $\pm$ 0.0009	0.026 $\pm$ 0.002	0.021 $\pm$ 0.005	0.0251 $\pm$ 0.0004
TR B/j	0.0148 $\pm$ 0.0005	0.015 $\pm$ 0.001	0.020 $\pm$ 0.003	0.016 $\pm$ 0.006	0.0150 $\pm$ 0.0004
TR C/j	0.045 $\pm$ 0.005	0.029 $\pm$ 0.006	0.02$\pm$ 0.02	0.02 $\pm$ 0.02	0.037 $\pm$ 0.004
D Pred.	0.026 $\pm$ 0.003	0.019 $\pm$ 0.004	0.02 $\pm$ 0.01	0.02 $\pm$ 0.02	0.023 $\pm$ 0.002
Muons					
TR A/j	0.051 $\pm$ 0.001	0.042 $\pm$ 0.002	0.040 $\pm$ 0.004	0.038 $\pm$ 0.009	0.048 $\pm$ 0.001
TR B/j	0.016 $\pm$ 0.001	0.023 $\pm$ 0.003	0.027 $\pm$ 0.009	0.03 $\pm$ 0.02	0.017 $\pm$ 0.001
TR C/j	0.050 $\pm$ 0.008	0.06 $\pm$ 0.01	0.13 $\pm$ 0.05	0.02 $\pm$ 0.02	0.051 $\pm$ 0.006
D Pred.	0.016 $\pm$ 0.003	0.031 $\pm$ 0.008	0.09 $\pm$ 0.05	0.02 $\pm$ 0.02	0.018 $\pm$ 0.003

QCD Background (Single tag, JP$<$1%)

so, finally, the predicted tagged event is

Jet Multiplicity	1 jet	2 jets	3 jets	$\geq$ 4 jets
Electrons				
Pretag	1014.2 $\pm$ 26.7	174.5 $\pm$ 9.5	8.3 $\pm$ 1.8	5.6 $\pm$ 1.8
Tag Rate	0.023 $\pm$ 0.002	0.046 $\pm$ 0.005	0.069 $\pm$ 0.007	0.09 $\pm$ 0.01
Predicted Tags	23.5 $\pm$ 2.5	8.1 $\pm$ 0.9	0.6 $\pm$ 0.1	0.5 $\pm$ 0.2
Muons				
Pretag	235.8 $\pm$ 9.3	33.0 $\pm$ 2.8	1.7 $\pm$ 0.6	1.7 $\pm$ 0.8
Tag Rate	0.018 $\pm$ 0.003	0.036 $\pm$ 0.005	0.054 $\pm$ 0.008	0.07 $\pm$ 0.01
Predicted Tags	4.2 $\pm$ 0.6	1.2 $\pm$ 0.2	0.09 $\pm$ 0.03	0.12 $\pm$ 0.06

Acceptances (Double tag, JP$<$1% and JP$<$5%)

Quantity	CEM	CMUP	CMX
Acc. No Tag	$3.67 \pm 0.02 \pm 0.28$	$1.92 \pm 0.01 \pm 0.15$	$0.75 \pm 0.01 \pm 0.06$
Lum (pb^{-1})	318.5 ± 18.8	318.5 ± 18.8	318.5 ± 18.8
Double tag (JP$<$1%, SF = 0.817 ± 0.070)			
Tag Eff.	$12.46 \pm 0.13 \pm 2.05$	$12.32 \pm 0.17 \pm 2.02$	$13.16 \pm 0.30 \pm 2.16$
Average Tag Eff.	$12.49 \pm 0.098 \pm 2.05$		
Acc. with Tag	$0.457 \pm 0.005 \pm 0.083$	$0.236 \pm 0.003 \pm 0.043$	$0.090 \pm 0.002 \pm 0.018$
$\epsilon_{t\bar{t}} \int$ L dt	$1.45 \pm 0.02 \pm 0.28$	$0.75 \pm 0.01 \pm 0.14$	$0.31 \pm 0.008 \pm 0.060$
Double tag (JP$<$5%, SF = 0.852 ± 0.072)			
Tag Eff.	$23.9 \pm 0.2 \pm 3.6$	$23.5 \pm 0.2 \pm 3.6$	$24.4 \pm 0.4 \pm 3.8$
Average Tag Eff.	$23.8 \pm 0.1 \pm 3.6$		
Acc. with Tag	$0.88 \pm 0.01 \pm 0.15$	$0.45 \pm 0.01 \pm 0.08$	$0.183 \pm 0.004 \pm 0.031$
$\epsilon_{t\bar{t}} \int$ L dt	$2.79 \pm 0.02 \pm 0.50$	$1.44 \pm 0.02 \pm 0.26$	$0.583 \pm 0.011 \pm 0.106$

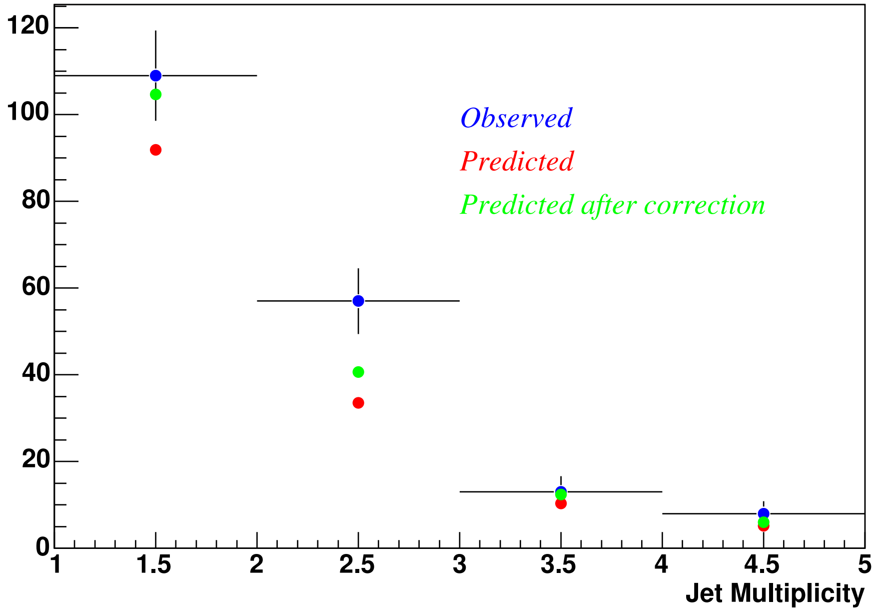
Mistags (Single tag, JP$<$1%)

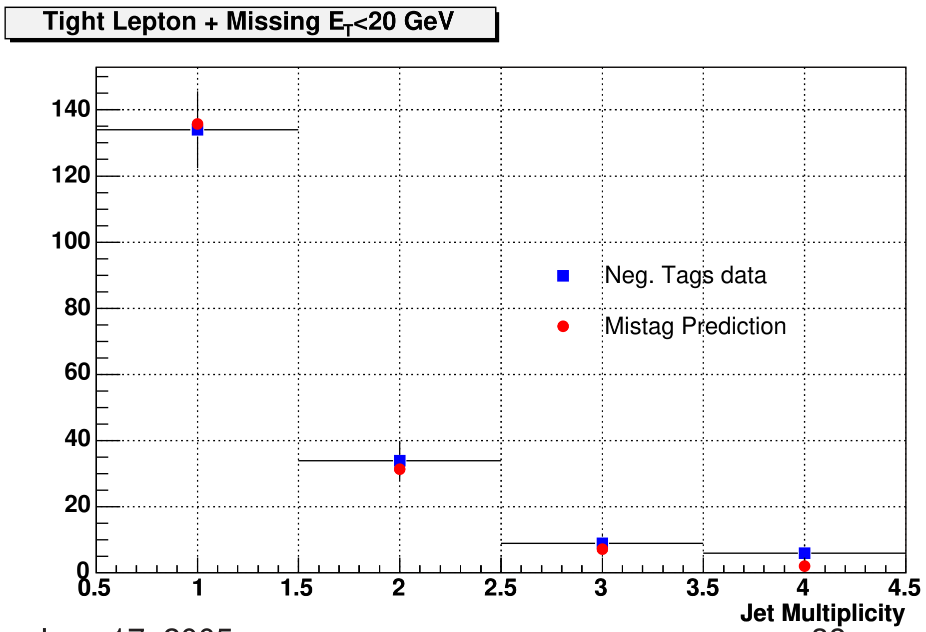
- To compare with the mistag prediction (before corrections), we also estimate the negative tag on the data sample $\Rightarrow$ bad agreement!

- Very good agreement in a QCD-like sample ($\not\!\!E_T < 20$ GeV)

- Discrepancy due to higher fraction of heavy flavor in events with $\not\!\!E_T > 20$ GeV respect to the inclusive jet sample where the matrix was built

- We correct the prediction with the fraction of W+HF in MC and the agreement is better





Tag composition studies (CDF note 7696)

- Want to measure the ratio of positive and negative tags from light jets
- We substract the negative tag distibution to the positive one $\Rightarrow$ we construct templates for c, b and no matched jets in MC
- Fit in data and obtain the flavor composition of the excess of positive tags in data
- Normalize separarately the sum of positive and negative tags to data