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Non-Top Background Estimate for Single Top in 162 pb^{-1}

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Abstract

We present the estimates for the non-top background in our single top search using 162 pb^{-1} of CDF Run II data.

While the $t\bar{t}$ and di-boson background can be estimated using the theoretical cross-section predictions and acceptance from Monte Carlo, this method does not work for W plus multi-jet backgrounds because those cross-sections are not reliably predicted by theory. The selection cuts of our single top analysis are described in Ref. [1]. Five different classes of events contribute to our non-top background (other than di-boson) events: $Wb\bar{b}$, $Wc\bar{c}$, Wc, mis-tags and non-W events.

For the lepton+jets $t\bar{t}$ cross section measurement a background estimate was performed which is partly based on CDF data and partly on Monte Carlo simulations (known as method 2) [2]. We base our background numbers on this estimate. To take into account differences between the $t\bar{t}$ cross-section analysis and our analysis we re-scale the numbers by cut-efficiencies obtained from Monte Carlo events ($Wb\bar{b}$, $Wc\bar{c}$, Wc, mis-tags) or data (non-W). We use the following Monte Carlo samples generated by Alpgen:
$We\nu BB0p$ (atop40), $W\mu\nu BB0p$ (atop46), $W\tau\nu BB0p$ (atop4c),
$We\nu CC0p$ (atop43), $W\mu\nu CC0p$ (atop49), $W\tau\nu CC0p$ (atop4f),
$We\nu C1p$ (atop1w), $W\mu\nu C1p$ (atop4w),
$We\nu 2p$ (atop02), $W\mu\nu 2p$ (atop08), $W\tau\nu 2p$ (atop2e).
When we use the same cuts as used in the $t\bar{t}$ analysis, we obtain a certain number of events $N_{\eta 2}$. We then apply the different cut-scenarios we want to evaluate: extended jet definition up to $|\eta| < 2.8$ ($N_{\eta 2.8}$), $M_{\ell\nu b}$ ($N_{M\ell\nu b}$), E_T(jet 1) > 30 GeV (N_{jet1}), exactly one b-tag (N_{1tag}), exactly one b-tag and E_T(jet 1) > 30 GeV ($N_{1tag,ET}$, exactly two b-tags

Process	Wbb0p	Wcc0p	Wc	Mis-tags	non-W
$N_{\eta 2}$	4169	967	1389	9121	1198
$N_{\eta 2.8}$	4388	1021	1524	9900	1219
$N_{M\ell\nu b}$	2036	439	679	4036	359
N_{jet1}	1731	375	597	3276	328
N_{1tag}	1646	426	673	–	327
$N_{1tag,ET}$	1394	365	591	–	298
N_{2tag}	390	13	6	–	32

Table 1: Number of events for different cut scenarios.

(N_{2tag}). The numbers of events for these cut scenarios are given in Tab. 1. Based on these numbers we calculate scale factors for the different scenarios which are shown in Tab. 2. We evaluate errors due to a change in jet energy scale on these scale factors. Those numbers are given in Tab. 3 The background estimate for the $t\bar{t}$ analysis is presented in

Process	Wbb0p	Wcc0p	Wc	Mis-tags	non-W
$\epsilon_{\eta 2.8}$	1.0525	1.0558	1.0972	1.0854	1.0175
$\epsilon_{M\ell\nu b}$	0.4640	0.4300	0.4455	0.4077	0.2945
ϵ_{jet1}	0.3945	0.3673	0.3917	0.3309	0.2691
ϵ_{1tag}	0.3751	0.4172	0.4416	–	0.2682
$\epsilon_{1tag,ET}$	0.3177	0.3575	0.3878	–	0.2445
ϵ_{2tag}	0.0889	0.0127	0.0039	–	0.0263

Table 2: Scale factor for different cut scenarios.

Process	Wbb0p	Wcc0p	Wc	Mis-tags	non-W
$N_{M\ell\nu b}$	11.5%	10.8%	11.0%	16.1%	15.5%
N_{jet1}	13.0%	12.4%	12.9%	17.9%	15.9%
N_{1tag}	13.0%	11.2%	11.2%	–	15.9%
$N_{1tag,ET}$	14.5%	12.7%	13.2%	–	16.3%

Table 3: Relative errors on scale factors for different cut scenarios.

Tab. 4. The resulting number of non-top events predicted for the single top analysis are given in Tab. 5.

References

[1] Catalin Ciobanu et al., *Event detection efficiency for single top events in CDF*, CDF note 7057, Version 1.0, June 2004.

Process	Wbb0p	Wcc0p	Wc	Mis-tags	non-W
N	14.1 ± 4.7	6.1 ± 2.4	9.2 ± 3.4	16.8 ± 2.2	12.5 ± 1.9

Table 4: Predicted number of background events for $t\bar{t}$ cross-section analysis.

Process	Wbbar	Wccbar	Wc	Mistags	non-W
N_{btag}	14.84± 4.95	6.44± 2.53	10.09± 3.73	18.23± 2.39	12.72± 1.93
$N_{M\ell\nu b}$	6.89± 2.43	2.77± 1.13	4.50± 1.73	7.43± 1.54	3.75± 0.81
N_{jet1}	5.85± 2.09	2.37± 0.98	3.95± 1.55	6.03± 1.34	3.42± 0.75
N_{1tag}	5.57± 1.99	2.69± 1.10	4.46± 1.72	7.43± 1.54	3.41± 0.75
$N_{1tag,ET}$	4.71± 1.71	2.30± 0.95	3.91± 1.54	6.03± 1.34	3.11± 0.69
N_{2tag}	1.32± 0.47	0.08± 0.03	0.04± 0.02	0.00± 0.00	0.33± 0.07

Table 5: Number of expected non-top events in single top analysis.

[2] H. Bachacou, J. Nielsen and W. Yao, *Optimized Measurement of the $t\bar{t}$ Production Cross Section in the SECVTX Tagged Sample*, CDF note 6902, Version 3.0, March 2004.