Top quark charge determination analysis of 10 TeV data using weighting technique

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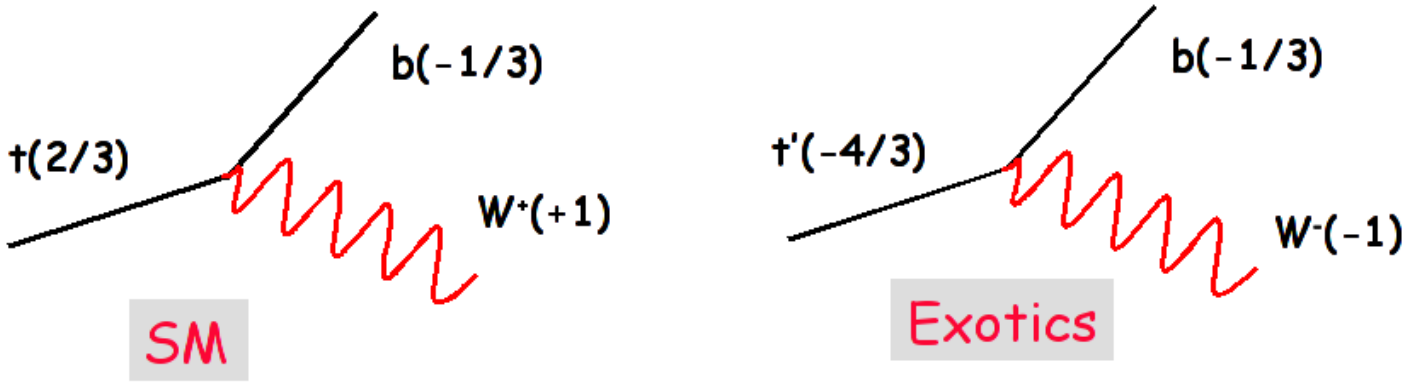
Motivation

- CDF and D0 analyzes + precision EW data do not exclude: quark seen in Fermilab is an exotic quark with Qtop= - 4/3. (D. Chang et al., Phys. Rev. D59, 091503)



- D0 and CDF: top charge gives preference for SM prediction

- Tevatron experiments are capable to distinguish between SM and exotics but ATLAS wants more: the value of top charge!

Top quark charge reconstruction

The jet track charge weighting approach

Two basic steps:

- to find a correct b-jet - lepton pair(s) (the lepton and the b-jet should be produced by the same top quark decay).
- to assign of a charge to the b-jet selected by the pairing criterion*.
- We use weighting technique to assign b-jet charge and invariat mass criterion (W+IMC) to do so (explanation follows on the next slides...)

* *In the SM a b-jet, coming from a b quark, should be associated with a positive lepton (ℓ^+), while in the exotic case it should be associated with a negative one (ℓ^-).*

Effective b-jet charge

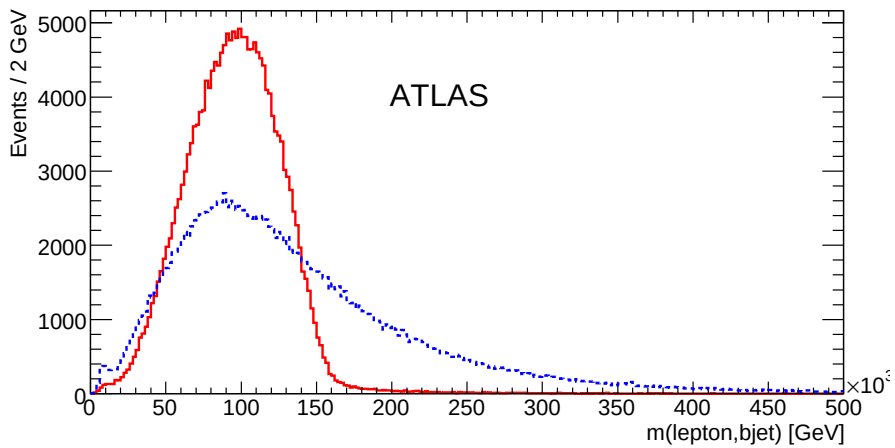
The determination of the average b-jet charge was done using a weighting technique in which the b-jet charge is evaluated as the weighted sum of the b-jet track charges:

$$Q_{bjet} = \frac{\sum_i q_i |\vec{j} \cdot \vec{p}_i|^\kappa}{\sum_i |\vec{j} \cdot \vec{p}_i|^\kappa}$$

where $q_i(p_i)$ is the charge (momentum) of the ith track inside the jet and $\vec{j}$ is the b-jet axis unit vector. The κ parameter was optimized for the best separation between b- and $\bar{\mathrm{b}}$-jets and the optimum value was found to be $\kappa = 0.5$.

The lepton and b-jet pairing algorithm

The lepton and b-jet pairing was done using the invariant mass distribution of the lepton and the b-tagged jet, $m(l, b_{\rm jet})$.
If they originated from the same t or $\bar{t}$, $m(l, b_{\rm jet})$ is limited by the top quark mass (red), otherwise there is no such restriction (blue).



For double b-tagged events, only the b-jets that satisfy

$$m(l, b_{jet}^{(1,2)}) < m_{cr} \quad \text{and} \quad m(l, b_{jet}^{(2,1)}) > m_{cr}$$

were accepted.
The optimal value for the pairing mass cut, $m_{\rm cr} = 160$ GeV is a trade-off between the efficiency (ϵ) and purity (P) of the pairing method. The factor $\epsilon(2P-1)^2$ was maximized to find the optimum working point.
The efficiency of the method is small but this criterion gives a high purity sample

Content of this talk...

- Data for our analysis (D3PD format)
- 10 TeV $t\bar{t}$ D3PD data analysis using W+lMC
- Background
- Systematics
  - trigger
  - b-tagging method
  - generator uncertainty
  - top - mass
- Conclusions and todo list

D3PD data production

- for our analysis we use D3PD data format (root TTree)
- no proper D3PD datasets (no tracking information) for the both $t\bar{t}$ and background were available therefore we started our own production (responsible: Pavol Federic)
- we produced D3PD for $t\bar{t}$ samples with different generators (5200, 5205, 5206), single top samples, all available W+jets, Z+jets, diboson and QCD background processes and $t\bar{t}$ samples with different top mass
- all the data were validated checking the distributions of the most important variables
- data are available on castor and will be registered to DQ2 soon
- the more details can be found at twiki (at present on temporary location https://twiki.cern.ch/twiki/bin/view/Sandbox/TestTopic193)
- we will be grateful for any help with validation and/or any comments or suggestions

W+IMC analysis - standard event selection criteria (cuts)

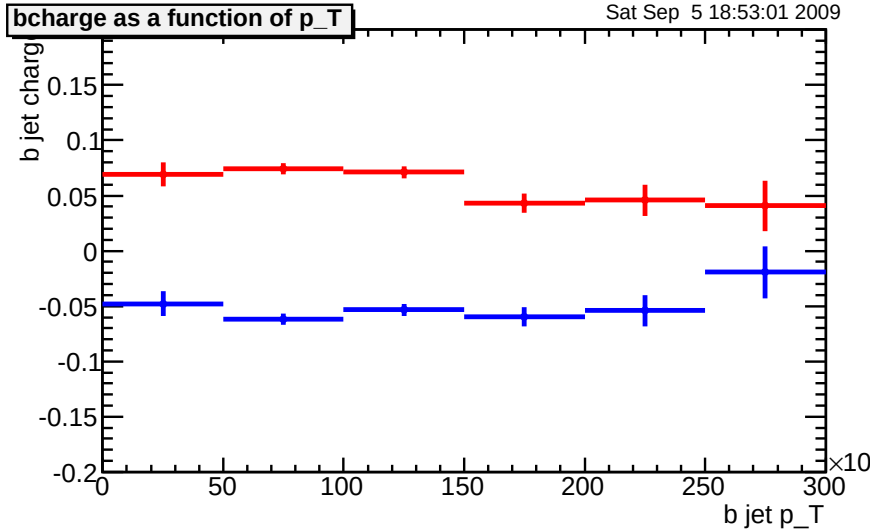
We have analyzed 685099 events of 105200 signal sample ($3.2\ fb^{-1}$)

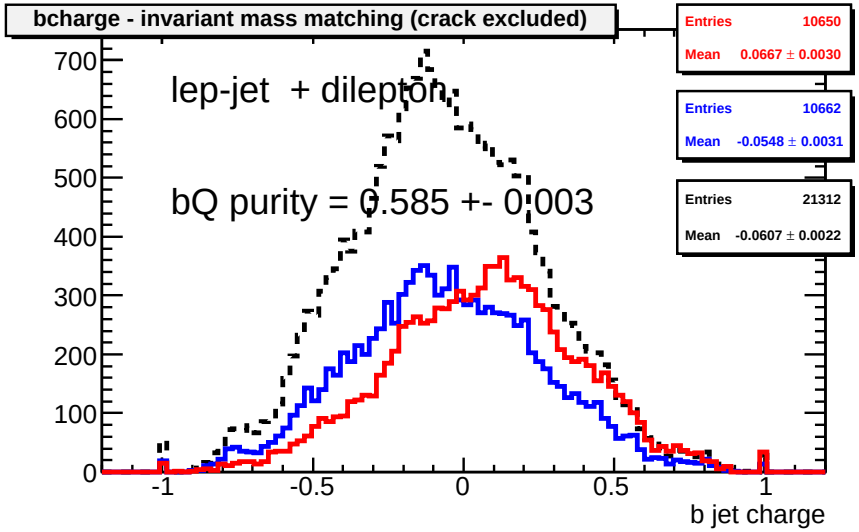
to choose the proper events we use the following cuts (*basic configuration*):

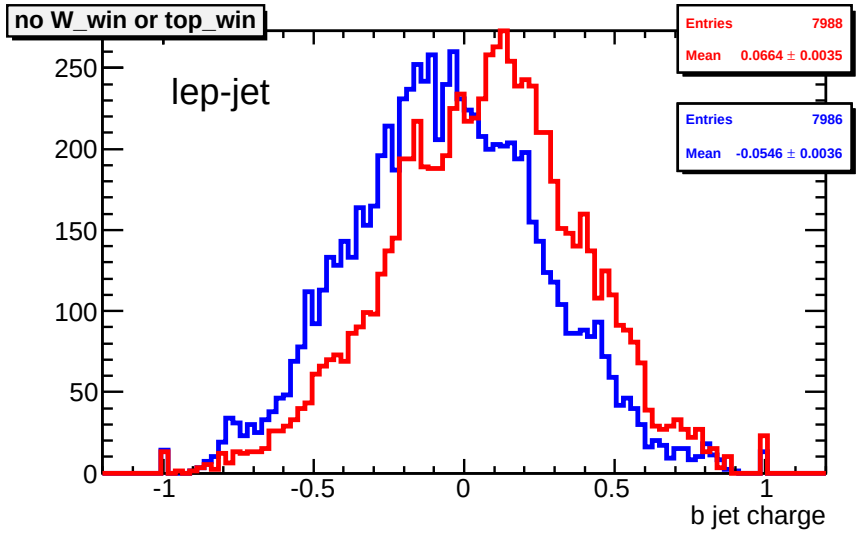
- $|\eta| < 2.5$, without crack
- $Jet\ p_T > 25GeV$
- $e\ p_T > 25GeV$
- $\mu\ p_T > 20GeV$
- standard b-tagging: $IP3D + SV1 > 4.2$
- bjet cone = 0.40 or 0.25

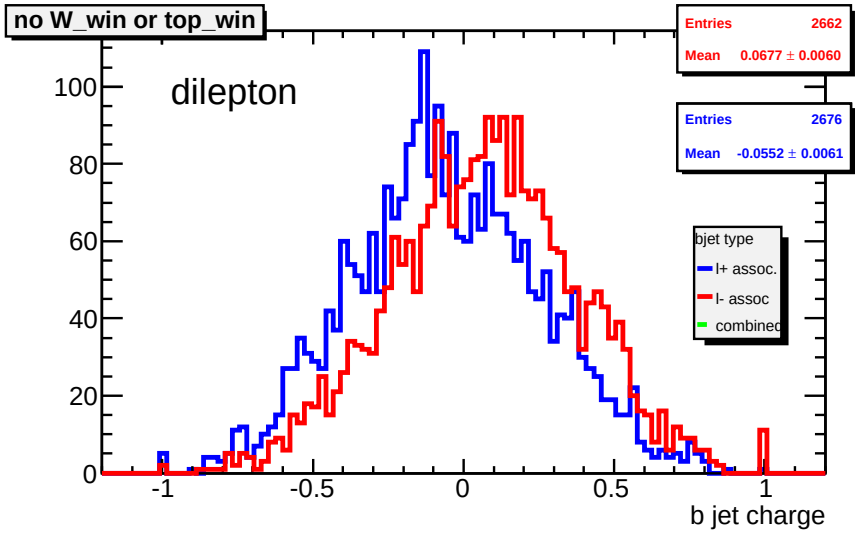
for background suppression we can require compatibility of the selected topology with top mass (*mass window*)

10 TeV $t\bar{t}$ D3PD data analysis using W+lMC









Cumulative efficiencies of the selection criteria

e, μ (Efficiency of IMC = 28%, Purity of IMC = 87%)

Trig OFF					
	N	%		N	%
LJ	365984	100,00%	DL	60593	100,00%
1 isol.lept.	227205	62,08	2 isol.lept.	25304	41,76
>= 4jets	167490	45,76	>= 2jets	23995	39,6
>= 2 b-tagged	46706	12,76	= 2 b-tagged	5910	9,75
missing E_t	41749	11,41	missing E_t	5063	8,36
imass bjet	10843	2,96	imass bjet	1907	3,15
Trig ON					
	N	%		N	%
LJ	365984	100,00%	DL	60593	100,00%
1 isol.lept.	190599	52,08	2 isol.lept.	24631	40,65
>= 4jets	142104	38,83	>= 2jets	23374	38,58
>= 2 b-tagged	39674	10,84	= 2 b-tagged	5768	9,52
missing E_t	35358	9,66	missing E_t	4939	8,15
imass bjet	9320	2,55	imass bjet	1859	3,07

parton level vs. reco level

type gen	type rec	Q^+	Q^-	Q^{comb}	Nevent	ϵ%
LJ (e,mu)	LJ+DL	-0.049 $\pm$ 0.003	0.062 $\pm$ 0.003	0.055 $\pm$ 0.002	18806	100
	LJ	-0.050 $\pm$ 0.003	0.063 $\pm$ 0.003	0.056 $\pm$ 0.002	18244	97
	DL	-0.013 $\pm$ 0.020	0.021 $\pm$ 0.018	0.017 $\pm$ 0.014	562	3
DL (e,mu)	DL+LJ	-0.067 $\pm$ 0.006	0.071 $\pm$ 0.006	0.069 $\pm$ 0.004	6499	100
	DL	-0.063 $\pm$ 0.007	0.072 $\pm$ 0.006	0.067 $\pm$ 0.005	4730	72.8
	LJ	-0.079 $\pm$ 0.011	0.069 $\pm$ 0.011	0.074 $\pm$ 0.008	1769	27.2
LJ (tau)	DL+LJ	-0.037 $\pm$ 0.016	0.044 $\pm$ 0.017	0.040 $\pm$ 0.012	822	100
	LJ	-0.030 $\pm$ 0.016	0.044 $\pm$ 0.017	0.037 $\pm$ 0.012	802	97.6
	DL	-0.346 $\pm$ 0.101	0.047 $\pm$ 0.088	0.182 $\pm$ 0.074	20	2.4
DL (tau,e or mu)	DL+LJ	-0.083 $\pm$ 0.013	0.065 $\pm$ 0.014	0.074 $\pm$ 0.010	1041	100
	LJ	-0.084 $\pm$ 0.018	0.063 $\pm$ 0.019	0.073 $\pm$ 0.013	557	53.5
	DL	-0.083 $\pm$ 0.020	0.067 $\pm$ 0.021	0.075 $\pm$ 0.015	484	46.5
DL (tau,tau)	DL+LJ	-0.111 $\pm$ 0.112	0.013 $\pm$ 0.077	0.057 $\pm$ 0.066	29	100
	LJ	-0.109 $\pm$ 0.126	0.006 $\pm$ 0.110	0.055 $\pm$ 0.084	19	65.5
	DL	-0.116 $\pm$ 0.227	0.023 $\pm$ 0.093	0.060 $\pm$ 0.107	10	34.5

Influence of b-tagging method

trigger OFF				
bTag	Limit	cone R	Qcomb	Nev
IP3D + SV1	4,200	0.40	-0,058 ± 0,0023	19428
IP3D + SV1	4,200	0.25	-0,065 ± 0,0023	19420
SV0	6,000	0.40	-0,047 ± 0,0021	23465
SV0	6,000	0.25	-0,056 ± 0,0022	23455
SV0	9,350	0.40	-0,048 ± 0,0025	17153
SV0	9,350	0.25	-0,058 ± 0,0025	17149
SV0	20,000	0.40	-0,042 ± 0,0038	6965
SV0	20,000	0.25	-0,050 ± 0,0040	6964
JetProb	0,038	0.40	-0,029 ± 0,0049	5198
JetProb	0,038	0.25	-0,035 ± 0,0051	5197
JetProb	0,078	0.40	-0,012 ± 0,0041	7979
JetProb	0,078	0.25	-0,016 ± 0,0043	7977
JetProb	0,100	0.40	-0,007 ± 0,0039	9242
JetProb	0,100	0.25	-0,012 ± 0,0041	9238

JetProb b-tagging requires very high statistics - not very promissing

SV0 can be used

Influence of b-tagging method + trigger

trigger ON				
bTag	Limit	cone R	Qcomb	Nev
IP3D + SV1	4,200	0.40	-0,067 ± 0,0025	17134
IP3D + SV1	4,200	0.25	-0,060 ± 0,0024	17141
SV0	6,000	0.40	-0,048 ± 0,0023	20610
SV0	6,000	0.25	-0,058 ± 0,0023	20601
SV0	9,350	0.40	-0,050 ± 0,0026	15068
SV0	9,350	0.25	-0,059 ± 0,0027	15064
SV0	20,000	0.40	-0,045 ± 0,0041	6103
SV0	20,000	0.25	-0,054 ± 0,0042	6102
JetProb	0,038	0.40	-0,030 ± 0,0053	4559
JetProb	0,038	0.25	-0,036 ± 0,0054	4558
JetProb	0,078	0.40	-0,013 ± 0,0044	7012
JetProb	0,078	0.25	-0,017 ± 0,0046	7010
JetProb	0,100	0.40	-0,007 ± 0,0041	8113
JetProb	0,100	0.25	-0,012 ± 0,0043	8110

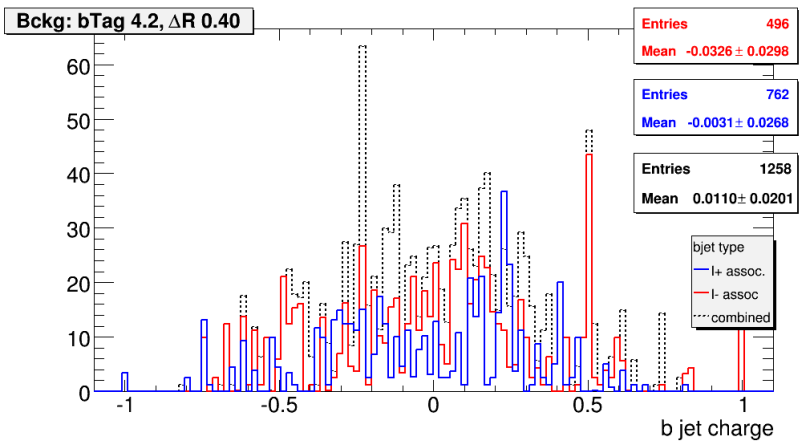
Background

The expected background for the integral luminosity 1fb^{-1}

background	Y	B/S (%)	B/S_{WM}(%)
W+HF	81.2 $\pm$ 4.9	1.33 $\pm$ 0.08	0.23 $\pm$ 0.13
W+partons	88.2 $\pm$ 9.9	1.44 $\pm$ 0.16	0.31 $\pm$ 0.16
Z+partons	12.0 $\pm$ 4.5	0.20 $\pm$ 0.07	0.31 $\pm$ 0.28
QCD fakes	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0
Dibosons	0.6 $\pm$ 0.3	0.01 $\pm$ 0.004	0.0 $\pm$ 0.0
Single top	441.6 $\pm$ 29.9	7.23 $\pm$ 0.49	2.22 $\pm$ 0.58
Total w/o S.t.	182.0 $\pm$ 11.9	2.98 $\pm$ 0.19	0.85 $\pm$ 0.35
Total	623.6 $\pm$ 32.2	10.21 $\pm$ 0.52	1.07 $\pm$ 0.68
Signal	6109.4 $\pm$ 76.2	100.	100.

QCD processes still not finished...

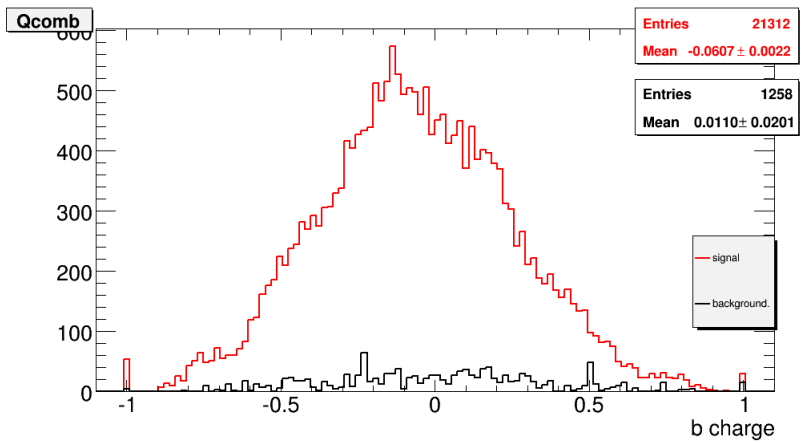
Background



Background distribution

Note the background has no asymmetry (it is compatible with zero) unlike the signal sample

The background is rescaled to the signal sample size ($3.2\ fb^{-1}$), cone = 0.4



signal + background

Systematics

Influence of different top mass

The systematic uncertainty caused by the top quark mass was estimated from the average absolute difference between the Q_{comb} reconstructed at the nominal value (172.5 GeV) and at the masses m_{t}=160, 170, 180 and 190 GeV that has been rescaled to an effective 2 GeV uncertainty. The estimated effect is about 2.3 % .

m_{top} GeV	Q_+	Q_-	$\mid Q_{\mathrm{comb}} \mid$	Nevent
160	-0.064 $\pm$ 0.011	0.059 $\pm$ 0.010	0.061 $\pm$ 0.008	1955
170	-0.066 $\pm$ 0.013	0.074 $\pm$ 0.013	0.070 $\pm$ 0.009	1397
180	-0.050 $\pm$ 0.011	0.061 $\pm$ 0.012	0.055 $\pm$ 0.008	1689
190	-0.049 $\pm$ 0.009	0.072 $\pm$ 0.010	0.060 $\pm$ 0.007	2338

Table: The mean b-jet charge associated with positive (Q_+) and negative (Q_-) lepton and combined b-jet charge (Q_{comb}) for different top quark masses; R=0.25, two b-tags required, trigger not applied

Influence of MC generator and pileup

This is the summary on the b-jet charge for the $t\bar{t}$ signal MC@NLO and AcerMC samples for two values of cone variable, R =0.25 and 0.40 and the signal pileup sample (part of analysis not finished)

type gen	R	trigger	Q_+	Q_-	$\mid Q_{\mathrm{comb}} \mid$	P_{Q} [%]
MC@NLO	0.25	off	-0.060 ± 0.0033	0.069 ± 0.0033	0.065 ± 0.0023	59.2±0.4
–	0.25	on	-0.064 ± 0.0036	0.070 ± 0.0036	0.067 ± 0.0025	59.5±0.4
–	0.40	off	-0.050 ± 0.0042	0.060 ± 0.0041	0.055 ± 0.0029	57.4±0.5
–	0.40	on	-0.051 ± 0.0044	0.063 ± 0.0044	0.057 ± 0.0031	57.6±0.5
AcerMC (P)	0.25	off	-0.0 ± 0.0	0.040 ± 0.0	0.0 ± 0.0	0. ±0.0
–	0.25	on	-0.0 ± 0.0	0.066 ± 0.0	0.0 ± 0.0	0. ±0.0
–	0.40	off	-0.054 ± 0.0085	0.040 ± 0.0082	0.047 ± 0.0059	56.1±0.9
–	0.40	on	-0.059 ± 0.0091	0.044 ± 0.0087	0.051 ± 0.0063	56.7±1.0
AcerMC (H)	0.25	off	-0.0 ± 0.039	0.0 ± 0.0	0.0 ± 0.0	0.0 ±0.0
	0.25	on	-0.0 ± 0.039	0.0 ± 0.0	0.0 ± 0.0	0.0 ±0.0
–	0.40	off	-0.062 ± 0.0080	0.070 ± 0.0081	0.066 ± 0.0057	59.2±0.9
–	0.40	on	-0.060 ± 0.0087	0.073 ± 0.0087	0.067 ± 0.0061	59.6±1.0
Pileup	0.25	off	-0.050 ± 0.004	0.059 ± 0.004	0.055 ± 0.003	57.6±0.5
–	0.40	off	-0.042 ± 0.004	0.051 ± 0.004	0.047 ± 0.003	56.5±0.5

The systematic uncertainties - summary

Source	Syst. error (%)
jet + b-jet scale	1.5
Δm_{t}	2.3
PDF	?
ISR	?
FSR	?
MC modelling	14.0 $\pm$ 9
Pile-up	15.4 $\pm$ 5.8
Background uncertainty	?
total	21.0

The systematic uncertainties (%) of the mean reconstructed charge, Q_{comb}, the weighting technique and b-decay approaches.

The systematic uncertainty stemming from uncertainty of jet/b-jet scales was obtained by 10% variation of the corrresponding scales

The systematic uncertainties due to Monte Carlo modeling of $\mathrm{t\bar{t}}$ signal were studied by comparing samples with different fragmentation parameters

The pileup associated systematic uncertainty was evaluated by comparing the standard sample to a dedicated $\mathrm{t\bar{t}}$ sample including pileup

The systematic uncertainty caused by the top quark mass was estimated from the average absolute difference between the Q_{comb} reconstructed at the nominal value (172.5 GeV) and at the masses m_{t}=160, 170, 180 and 190 GeV that has been rescaled to an effective 2 GeV uncertainty.

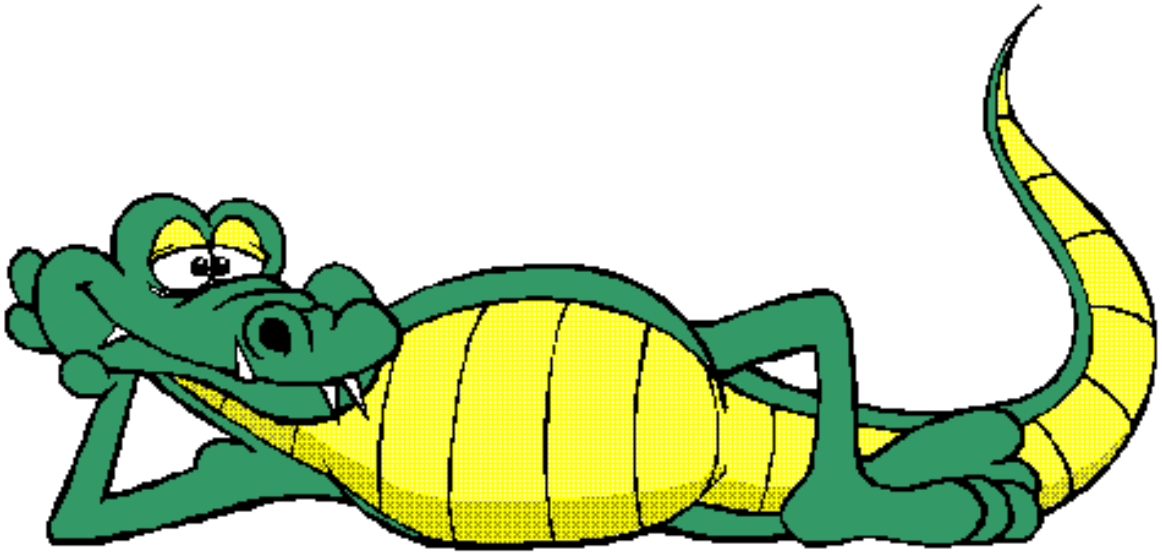
Conclusions

- 10 TeV signal sample was analyzed - using weighting approach we are able to reconstruct b-jet charge associated with positive and negative leptons
- we have analyzed dependence b-jet charge on b-jet p_T - no strong dependence observed
- influence of trigger and b-tagging method was also analyzed, IP3D+SV1 seems to work well, SV0 also could be used
- we have also analyzed systematics - results are summarized at the table above
- background study almost finished (only QCD processes must be included - expected to be finished in a few days)
- the preliminary expectation from this study is that to estimate top charge sign with the uncertainty of 5σ we need top quark sample $0.1\ fb^{-1}$ (rescaled from $3.2\ fb^{-1}$ sample)

todo list

- to include QCD processes into background study
- finish systematics
  - PDF
  - ISR
  - FSR
- to find more efficient method for pileup suppression

... still a lot of work to be done



Thank you !

BACKUP SLIDES

Estimation of sample required for top charge sign determination

$$Q_c^{eff} = \frac{21312}{22570} Q_c^{signal} + \frac{1582}{22570} Q_c^{bkgd} = -0.0567$$

$$\sigma_Q^2 = \left(\frac{21312}{22570}\right)^2 \sigma_{signal}^2 + \left(\frac{1582}{22570}\right)^2 \sigma_{bkgd}^2 \Rightarrow \sigma_Q = 0.01335$$

Simple scaling gives:

Size (fb^{-1})	σ_Q	Q_c^{eff}/σ_Q
3.2	0.00236	24.0 σ
1.0	0.00422	13.4 σ
0.1	0.01335	4.2 σ

Cumulative efficiencies of the selection criteria

e, μ, τ

Trig OFF					
	N	%		N	%
LJ	548598	100,00%	DL	136297	100,00%
1 isol.lept.	245908	44,82	2 isol.lept.	29552	21,68
>= 4jets	181409	33,07	>= 2jets	27988	20,53
>= 2 b-tagged	50471	9,2	= 2 b-tagged	6790	4,98
missing E_t	45168	8,23	missing E_t	5833	4,28
imass bjet	11496	2,1	imass bjet	2168	1,59
Trig ON					
	N	%		N	%
LJ	548598	100,00%	DL	136297	100,00%
1 isol.lept.	203038	37,01	2 isol.lept.	28624	21
>= 4jets	151127	27,55	>= 2jets	27130	19,91
>= 2 b-tagged	42164	7,69	= 2 b-tagged	6600	4,84
missing E_t	37622	6,86	missing E_t	5668	4,16
imass bjet	9762	1,78	imass bjet	2108	1,55

b-tagging and trigger influence

run	Channel	bjet_cone	bTag	Limit	N, Basic	N, Basic + trigger	N, Basic + mass window
5200	No Full Had (e, mu, tau)	0,4	IP3D + SV1	4,200	19428	17141	4629
5200	No Full Had (e, mu, tau)	0,4	SVO	6,000	23465	20610	5006
5200	No Full Had (e, mu, tau)	0,25	SVO	6,000	23455	20601	5002
5200	No Full Had (e, mu, tau)	0,4	SVO	9,350	17153	15068	3795
5200	No Full Had (e, mu, tau)	0,25	SVO	9,350	17149	15064	3793
5200	No Full Had (e, mu, tau)	0,4	SVO	20,000	6965	6103	1537
5200	No Full Had (e, mu, tau)	0,25	SVO	20,000	6964	6102	1536
5200	No Full Had (e, mu, tau)	0,4	JetProb	0,038	5198	4559	1314
5200	No Full Had (e, mu, tau)	0,25	JetProb	0,038	5197	4558	1314
5200	No Full Had (e, mu, tau)	0,4	JetProb	0,078	7979	7012	1919
5200	No Full Had (e, mu, tau)	0,25	JetProb	0,078	7977	7010	1918
5200	No Full Had (e, mu, tau)	0,4	JetProb	0,100	9242	8113	2195
5200	No Full Had (e, mu, tau)	0,25	JetProb	0,100	9238	8110	2195

more detailed table concerning b-tagging and trigger influence

trigger	bTag	Limit	cone R	Qcomb	eQcomb	Nev	Qbjet(l+)	eQbjet(l+)	Nev+	Qbjet(l-)	eQbjet(l-)	Nev-
off	IP3D + SV1	4,200	0.40	-0,058	0,0023	19428	-0,052	0,0032	9682	0,064	0,0032	9746
on	IP3D + SV1	4,200	0.40	-0,067	0,0025	17134	-0,064	0,0035	8565	0,070	0,0036	8569
off	IP3D + SV1	4,200	0.25	-0,065	0,0023	19420	-0,060	0,0033	9680	0,069	0,0033	9740
on	IP3D + SV1	4,200	0.25	-0,060	0,0024	17141	-0,055	0,0034	8566	0,065	0,0034	8575
off	SV0	6,000	0.40	-0,047	0,0021	23465	-0,041	0,0030	11666	0,052	0,0030	11799
on	SV0	6,000	0.40	-0,048	0,0023	20610	-0,041	0,0032	10268	0,055	0,0032	10342
off	SV0	6,000	0.25	-0,056	0,0022	23455	-0,053	0,0031	11662	0,060	0,0031	11793
on	SV0	6,000	0.25	-0,058	0,0023	20601	-0,054	0,0033	10264	0,062	0,0033	10337
off	SV0	9,350	0.40	-0,048	0,0025	17153	-0,041	0,0035	8530	0,055	0,0035	8623
on	SV0	9,350	0.40	-0,050	0,0026	15068	-0,042	0,0038	7513	0,057	0,0037	7555
off	SV0	9,350	0.25	-0,058	0,0025	17149	-0,053	0,0036	8529	0,062	0,0036	8620
on	SV0	9,350	0.25	-0,059	0,0027	15064	-0,054	0,0039	7512	0,064	0,0038	7552
off	SV0	20,000	0.40	-0,042	0,0038	6965	-0,031	0,0054	3497	0,053	0,0054	3468
on	SV0	20,000	0.40	-0,045	0,0041	6103	-0,035	0,0058	3062	0,056	0,0058	3041
off	SV0	20,000	0.25	-0,050	0,0040	6964	-0,038	0,0055	3497	0,062	0,0056	3467
on	SV0	20,000	0.25	-0,054	0,0042	6102	-0,043	0,0059	3062	0,065	0,0060	3040
off	JetProb	0,038	0.40	-0,029	0,0049	5198	-0,024	0,0069	2589	0,035	0,0071	2609
on	JetProb	0,038	0.40	-0,030	0,0053	4559	-0,027	0,0073	2268	0,033	0,0076	2291
off	JetProb	0,038	0.25	-0,035	0,0051	5197	-0,030	0,0071	2589	0,040	0,0073	2608
on	JetProb	0,038	0.25	-0,036	0,0054	4558	-0,034	0,0076	2268	0,037	0,0078	2290
off	JetProb	0,078	0.40	-0,012	0,0041	7979	-0,004	0,0059	3946	0,020	0,0059	4033
on	JetProb	0,078	0.40	-0,013	0,0044	7012	-0,006	0,0062	3464	0,020	0,0063	3548
off	JetProb	0,078	0.25	-0,016	0,0043	7977	-0,012	0,0061	3946	0,021	0,0061	4031
on	JetProb	0,078	0.25	-0,017	0,0046	7010	-0,014	0,0065	3464	0,020	0,0065	3546
off	JetProb	0,100	0.40	-0,007	0,0039	9242	0,002	0,0055	4594	0,016	0,0055	4648
on	JetProb	0,100	0.40	-0,007	0,0041	8113	0,002	0,0058	4032	0,017	0,0059	4081
off	JetProb	0,100	0.25	-0,012	0,0041	9238	-0,006	0,0058	4594	0,018	0,0057	4644
on	JetProb	0,100	0.25	-0,012	0,0043	8110	-0,007	0,0061	4032	0,017	0,0061	4078

Background

						N_ev			N_ev / ttbar				1 event
run	Channel	Sample x-sec	K-factor	Cross section [pb]	N_bckg	Basic	B+trg	B+win	Basic	B+trg	B+win		
	Wxx												
7650	Zee Np0	898,18	1,22	1095,78	260794	0	0	0	0	0	0		13,26
7651	Zee Np1	206,57	1,22	252,02	61767	1	1	1	12,88	12,88	12,88		12,88
7652	Zee Np2	72,5	1,22	88,45	167116	3	3	1	5,01	5,01	1,67		1,67
7653	Zee Np3	21,08	1,22	25,72	63412	3	3	0	3,84	3,84	0,00		1,28
7654	Zee Np4	6	1,22	7,32	18314	0	0	0	0,00	0,00	0,00		1,26
7655	Zee Np5	1,73	1,22	2,11	5500	3	3	0	3,63	3,63	0,00		1,21
7660	Zmumu Np0	900,21	1,22	1098,26	270098	0	0	0	0,00	0,00	0,00		12,83
7661	Zmumu Np1	205,21	1,22	250,36	61686	0	0	0	0,00	0,00	0,00		12,81
7662	Zmumu Np2	69,35	1,22	84,61	180285	0	0	0	0,00	0,00	0,00		1,48
7663	Zmumu Np3	21,63	1,22	26,39	64706	0	0	0	0,00	0,00	0,00		1,29
7664	Zmumu Np4	6,08	1,22	7,42	18470	2	2	0	2,54	2,54	0,00		1,27
7665	Zmumu Np5	1,7	1,22	2,07	5471	1	1	0	1,20	1,20	0,00		1,20
7670	Ztautau Np0	902,71	1,22	1101,31	260299	0	0	0	0,00	0,00	0,00		13,35
7671	Ztautau Np1	209,26	1,22	255,3	62678	0	0	0	0,00	0,00	0,00		12,86
7672	Ztautau Np2	70,16	1,22	85,6	21249	0	0	0	0,00	0,00	0,00		12,71
7673	Ztautau Np3	21,07	1,22	25,71	63434	5	5	0	6,40	6,40	0,00		1,28
7674	Ztautau Np4	6,04	1,22	7,37	18500	2	2	0	2,51	2,51	0,00		1,26
7675	Ztautau Np5	1,71	1,22	2,09	5479	0	0	0	0,00	0,00	0,00		1,20
								all Zxx	38	38	14,55		
	Wxx												
8240	Wenu Np2	148,5	1,22	181,17	158815	7	7	1	25,20	25,20	3,60		3,60
8241	Wenu Np3	104,08	1,22	126,98	120372	21	20	1	69,92	66,59	3,33		3,33
8242	Wenu Np4	41,71	1,22	50,89	42458	8	8	0	30,26	30,26	0,00		3,78
8243	Wenu Np5	14,78	1,22	18,03	14997	9	8	1	34,15	30,36	3,79		3,79
8244	Wmunu Np2	7,23	1,22	8,82	8981	1	1	0	3,10	3,10	0,00		3,10
8245	Wmunu Np3	47,63	1,22	58,11	52238	3	3	0	10,53	10,53	0,00		3,51
8246	Wmunu Np4	30,03	1,22	36,64	31193	8	4	1	29,66	14,83	3,71		3,71
8247	Wmunu Np5	13,11	1,22	15,99	14999	13	11	0	43,75	37,02	0,00		3,37
8248	Wtaunu Np2	62,11	1,22	75,77	74930	1	1	0	3,19	3,19	0,00		3,19
8249	Wtaunu Np3	70,76	1,22	86,33	86988	3	1	0	9,40	3,13	0,00		3,13
8250	Wtaunu Np4	34,43	1,22	42	38952	3	3	0	10,21	10,21	0,00		3,40
8251	Wtaunu Np5	14,11	1,22	17,21	14721	3	2	0	11,07	7,38	0,00		3,69
6280	WbbNp0	5,13	1,22	6,26	15500	4	4	0	5,10	5,10	0,00		1,27
6281	WbbNp1	5,01	1,22	6,11	29414	100	80	1	65,59	52,47	0,66		0,66
6282	WbbNp2	2,89	1,22	3,53	8953	82	67	5	101,92	83,28	6,21		1,24
6283	WbbNp3	1,61	1,22	1,96	5000	69	53	3	85,55	65,72	3,72		1,24
								all Wxx	538,62	448,38	25,02		
	DIBOSON												
5921	WpWm_enuenu	0,83	1	0,83	24981	1	1	0	0,10	0,10	0,00		0,10
5922	WpWm_enumunu	0,83	1	0,83	24958	4	4	0	0,42	0,42	0,00		0,10
5923	WpWm_enutaunu	0,83	1	0,83	24984	0	0	0	0,00	0,00	0,00		0,10
5924	WpWm_munumunu	0,83	1	0,83	4973	2	2	0	1,05	1,05	0,00		0,53
5925	WpWm_munuenu	0,83	1	0,83	25000	2	2	0	0,21	0,21	0,00		0,10
5926	WpWm_munutaunu	0,83	1	0,83	6976	0	0	0	0,00	0,00	0,00		0,37
5927	WpWm_taunutaunu	0,83	1	0,83	7000	0	0	0	0,00	0,00	0,00		0,37
5928	WpWm_taunuenu	0,83	1	0,83	6959	0	0	0	0,00	0,00	0,00		0,38
5929	WpWm_taunumunu	0,83	1	0,83	7000	0	0	0	0,00	0,00	0,00		0,37
5931	ZZ_lll	0,04	1	0,04	20000	0	0	0	0,00	0,00	0,00		0,01
5932	ZZ_llnunu	0,25	1	0,25	19950	4	4	0	0,16	0,16	0,00		0,04
5941	WpZ_lnull	0,27	1	0,27	15000	0	0	0	0,00	0,00	0,00		0,06
5971	WmZ_lnull	0,16	1	0,16	10457	0	0	0	0,00	0,00	0,00		0,05
								all dibos	1,94	1,94	0		
	Single Top												
5500	Wt No All Had	14,41	0,99	14,27	8999	71	65	11	355,25	325,23	55,04		5,00
5502	tchan -> l	41,12	1,05	43,18	29961	209	175	10	950,62	795,97	45,48		4,55
5503	Wt -> ll	2,79	0,99	2,76	32240	364	346	8	98,43	93,56	2,16		0,27
								all S-Top	1407,65	1218,12	102,69		