Rediscovery of the top in 20^{-1}pb

Status quo of the analysis

$$pp \rightarrow t\bar{t}$$
$$\rightarrow (bW^+)(\bar{b}W^-)$$
$$\rightarrow 2\,bjets + 2\,quarkjets + \ell\,\nu_\ell$$

At least 4 jets
with p_T >20 GeV

At least one isolated
muon with p_T>15 GeV

TTbar inclusive sample:

Cross Section: 833pb (NLO)

→16600 inclusive events (20 pb^{-1})

BR: TTbar → $\mu\nu_\mu$+jets   14,7%

→ 2440 signal events
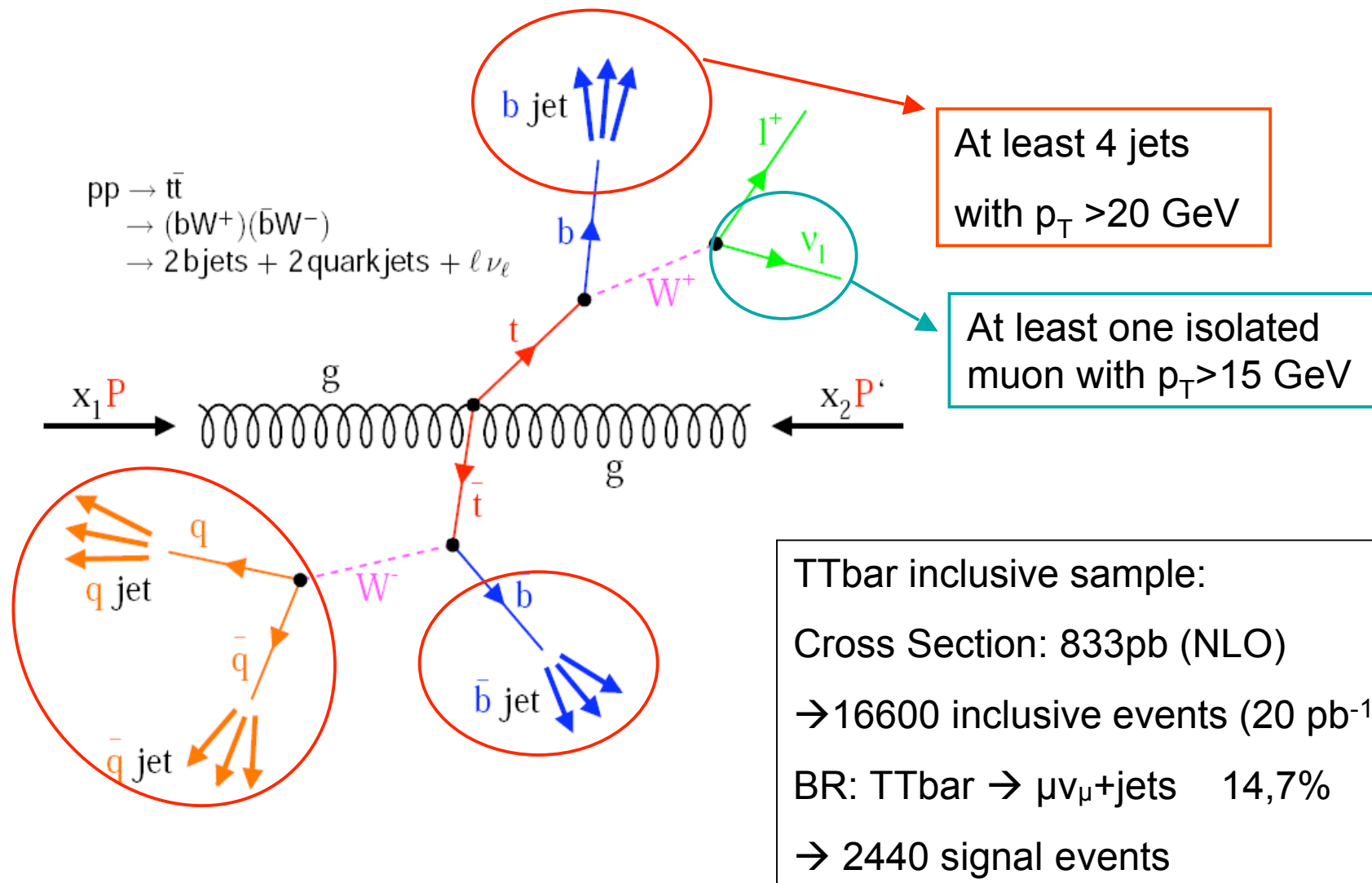
Preselection: Cut Efficiencies

Efficiencies	# events	Muon pt>15GeV	Muon isolation	4 jets pt >20 GeV	Efficiency %
Semi mu channel	2386	1654	1260	956	**40,07%**
Hadronic channel	7703	696	20	19	**0,25%**
Dileptonic channel	1742	932	693	332	**19,06%**
Semilep. Elec. channel	2337	198	8	8	**0,34%**
Semilep. Tau channel	2432	361	128	97	**3,99%**
W+jets	102478	30601	26804	2407	**2,35%**
QCD	3768114800	4308303	437746	97781	**0,00%**
Z+jets	7310	4033	3687	347	**4,75%**
S/B	**6,332E-07**	**4,488E-04**	**3,095E-03**	**1,097E-02**	

Cuts against background (W+jets;QCD)
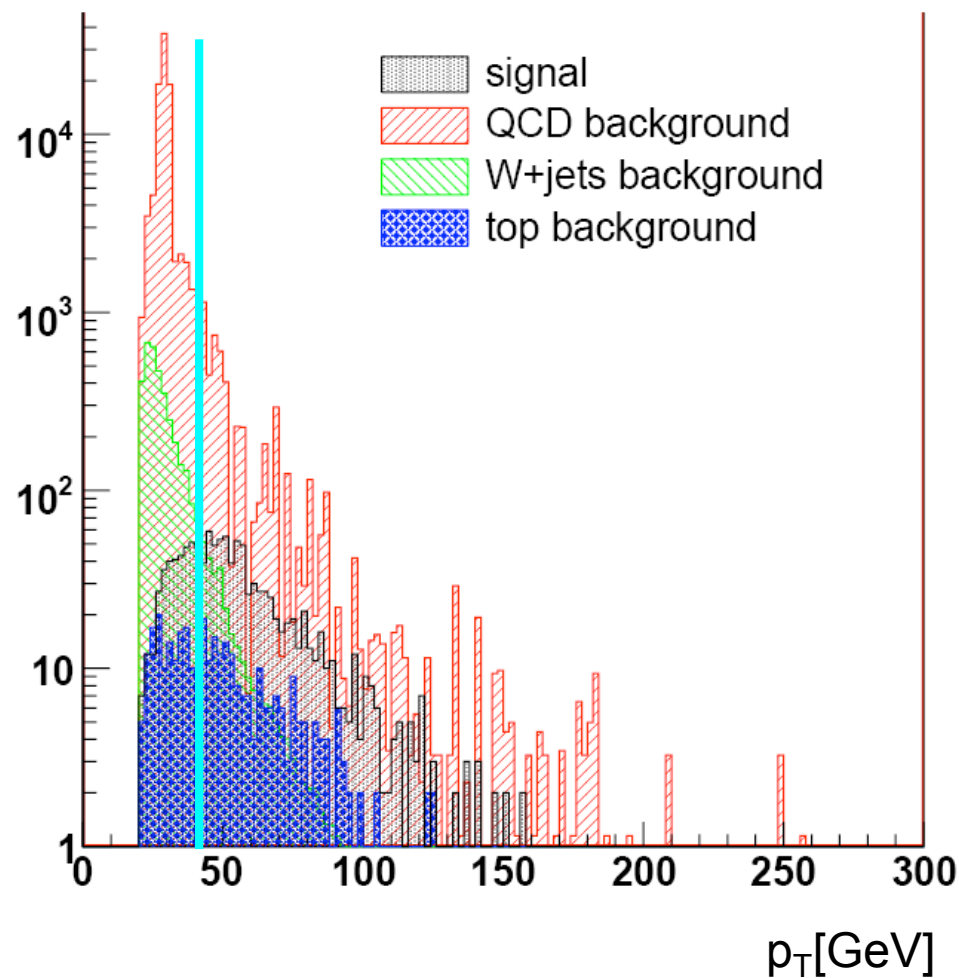
- pT (3rd jet) > 45 GeV

- pT (muon) > 25 GeV

- ET(1st jet) – ET(4th jet) <240 GeV

- Circularity > 0.2

Cut against combinatorial background

- Likelihood Ratio LR >0.9

Final Selection : Hard jet cut

p_T(3rd jets>45 GeV)

Cut after preselection:

Signal   : 51,88%

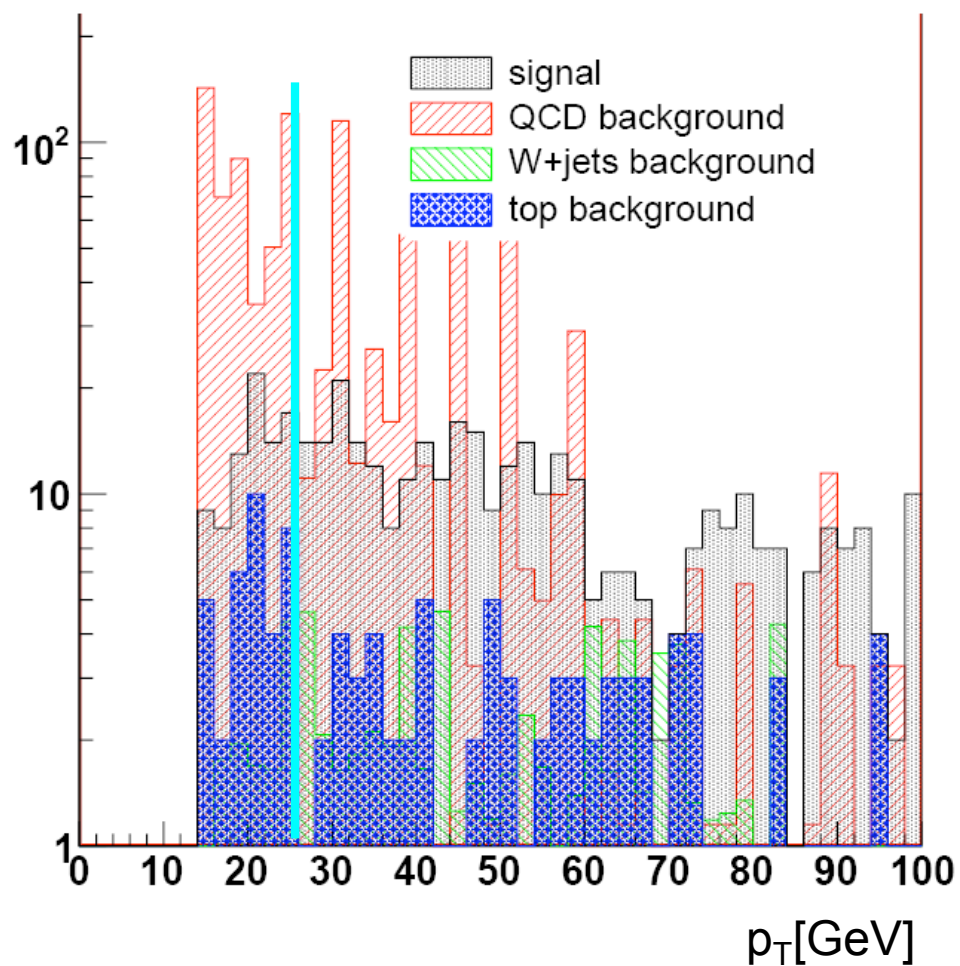Top background : 25,22%

W+jets   : 5,62%

QCD   : 1,49%

p_T(muon) > 25GeV

Cut after hard jet cut:

Signal   : 44,25%

Top background   : 19,74%

W+jets   : 2,57%

QCD   : 1,02%
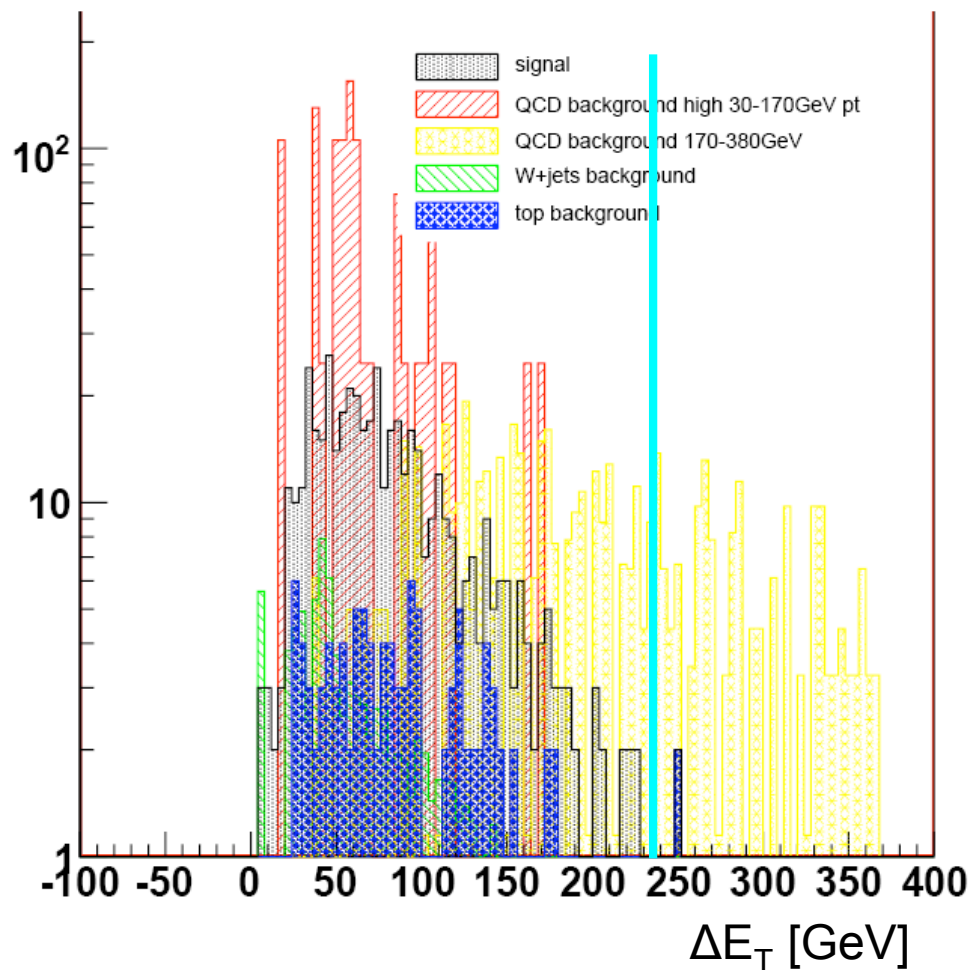
Cut against QCD (high p$_T$ bins)

p$_T$(1st jet)-p$_T$(4th jet) < 230 GeV

Cut Efficiency (n-1):

Signal	: 42,68%
Top background	: 19,08%
W+jets	: 2,42%
QCD	: 0,98%

Def: Circularity

$$C = \min \frac{\sum\limits_{i} \vec{p}_{Ti} \cdot \vec{n}}{\sum\limits_{i} \vec{p}_{Ti}}$$

Especially effective against high pT bins:

170 – 380 GeV

Circularity > 0.2

Cut Efficiency (n-1):

Signal   : 23,74%
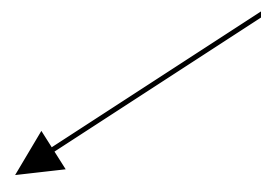
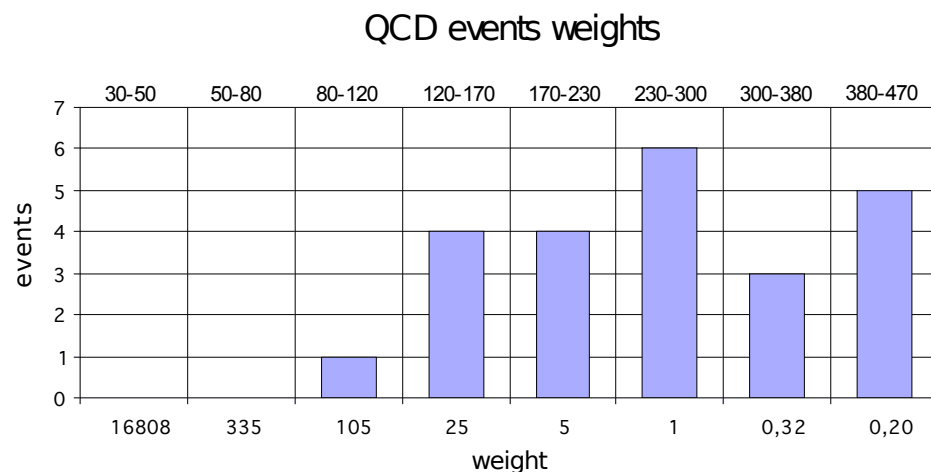Top background   : 8,77%

W+jets   : 1,44%

QCD   : 0,39%

signal

QCD background high 30-170GeV pt

QCD background 170-380GeV

W+jets background

top background

Circularity
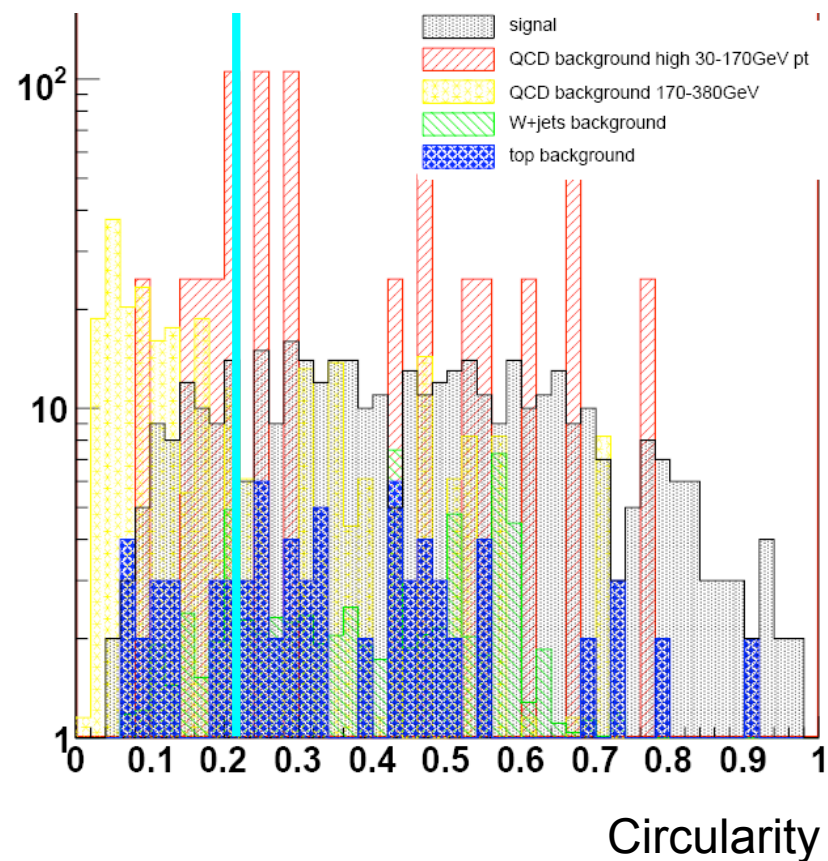
Final Selection: Efficiencies

Cuts	3rd jet p_t >45GeV	_ p_t >25GeV	_ E_t (1st jet, 4th jet)	Cir >0.2
Signal	496	423	408	227
Top backg.	115	90	87	40
W+jets	135	62	58	35
QCD	1460	997	963	380

QCD events weights
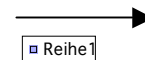
QCD production CSA07?!?

$$\text{Likelihood Ratio}: LR = \frac{\prod_i L_{\text{True}_i}}{\prod_i L_{\text{True}_i} + \prod_i L_{\text{False}_i}}$$
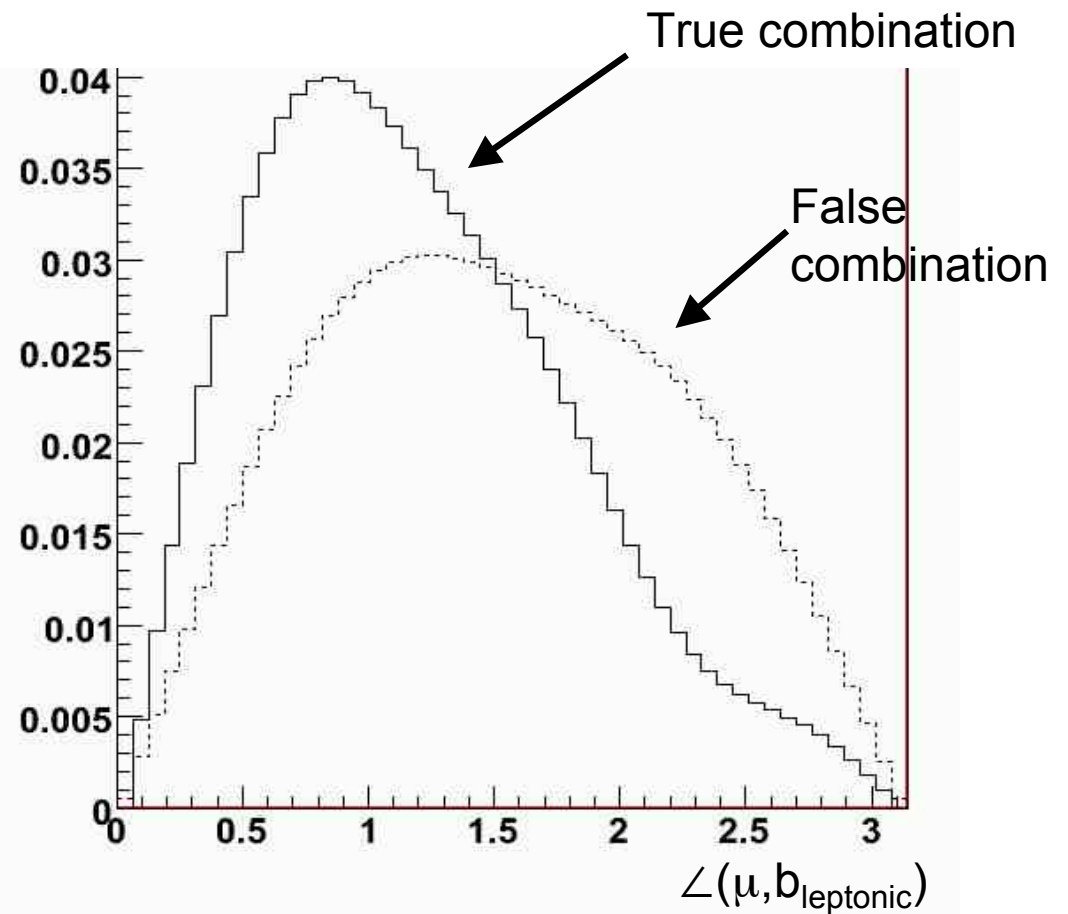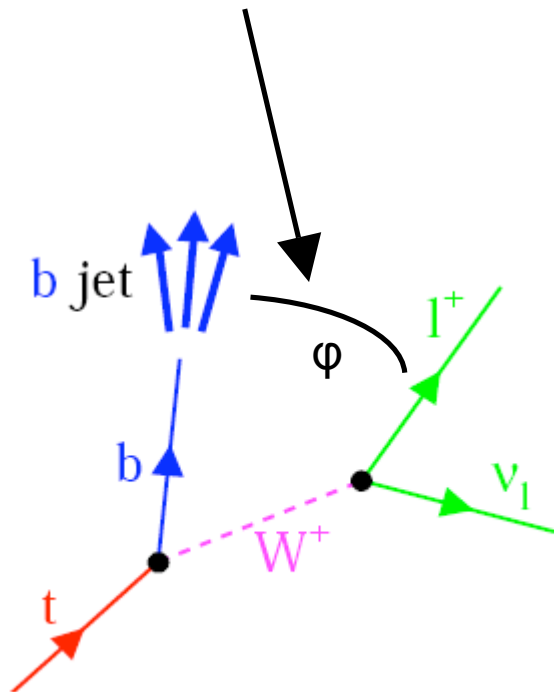
1. Probability density function (pdf) of **true** combinations from matched jets

2. Probability density function (pdf) of **false** combinations from matched jets

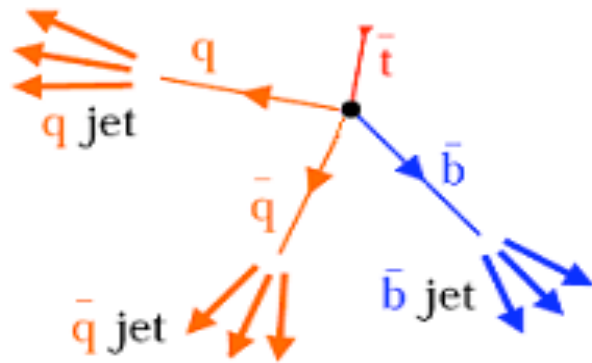3. Correlations between the variables

Leptonic decay branch:
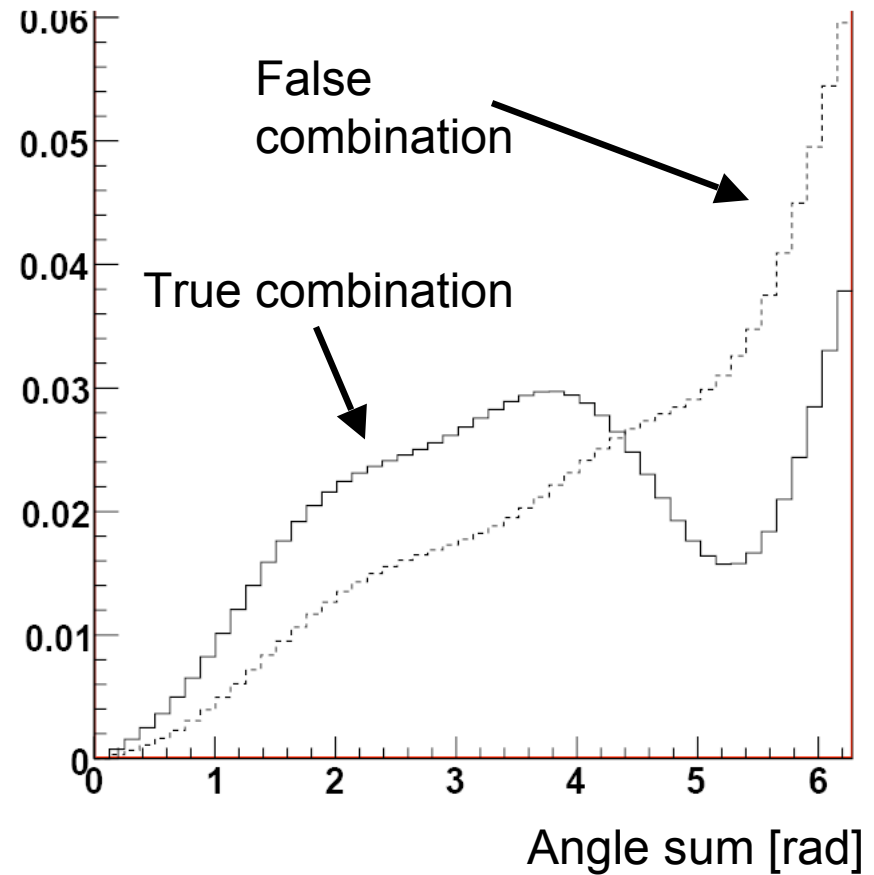
Variable : angle between the muon
and the leptonic b jet

Hadronic branch: quarks from W
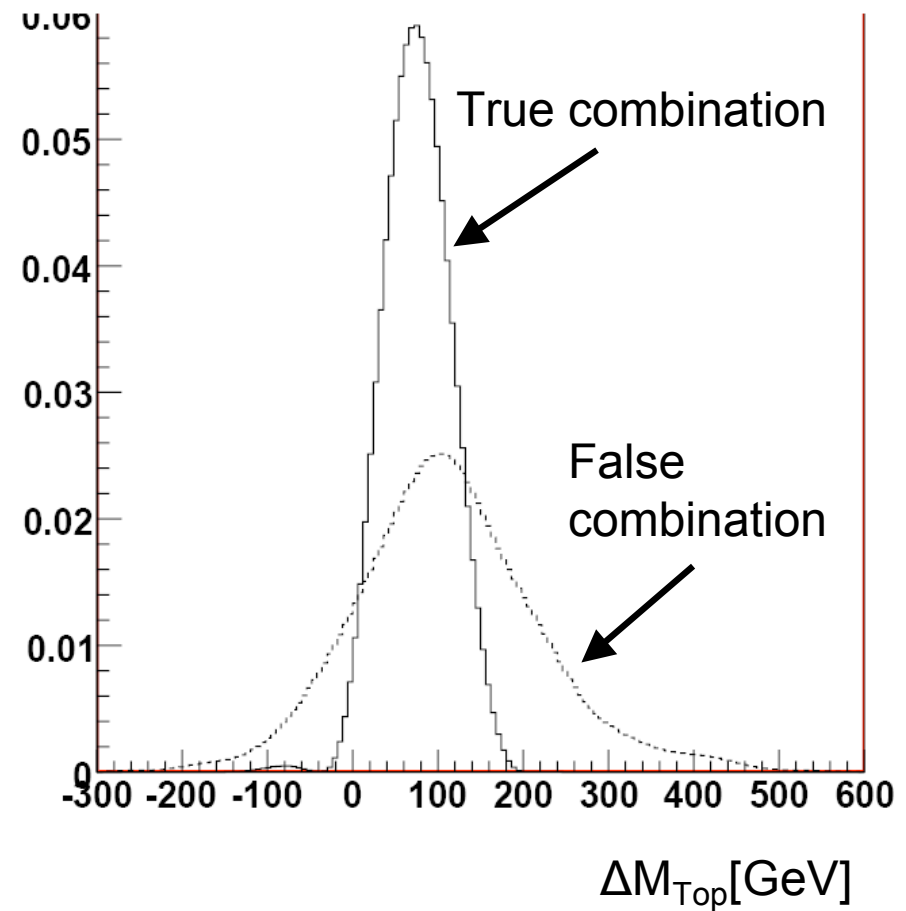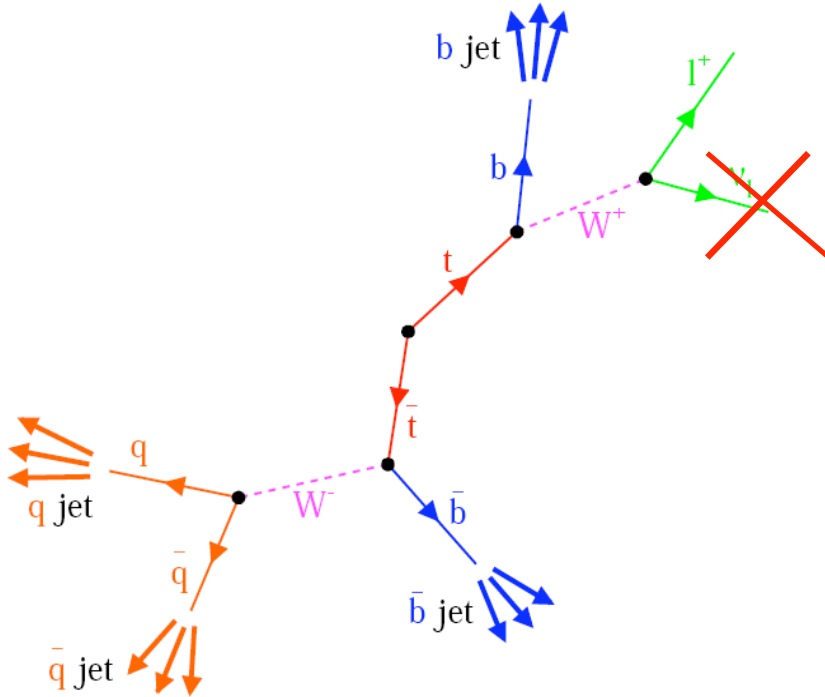decay boosted → smaller angle

Variable : Angle sum

$$\angle(q1, q2) + \angle(q1, b_{had}) + \angle(q2, b_{had})$$
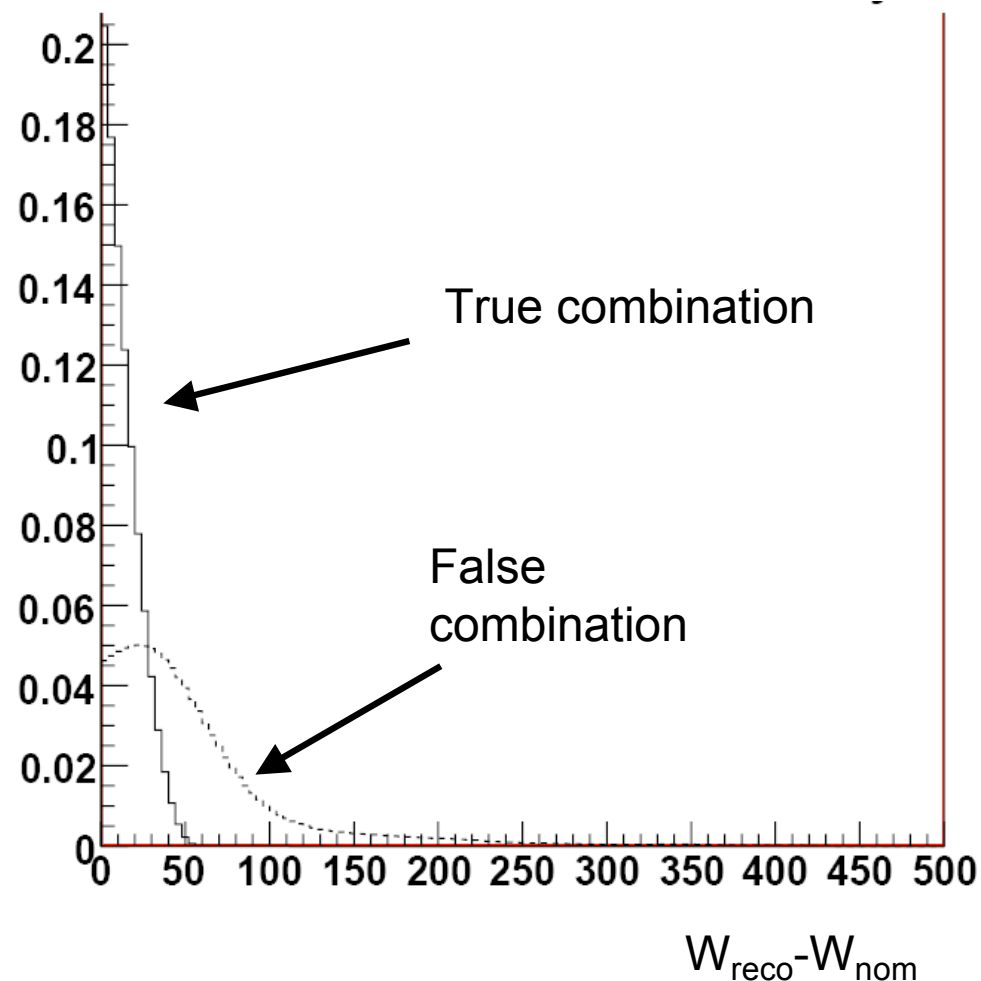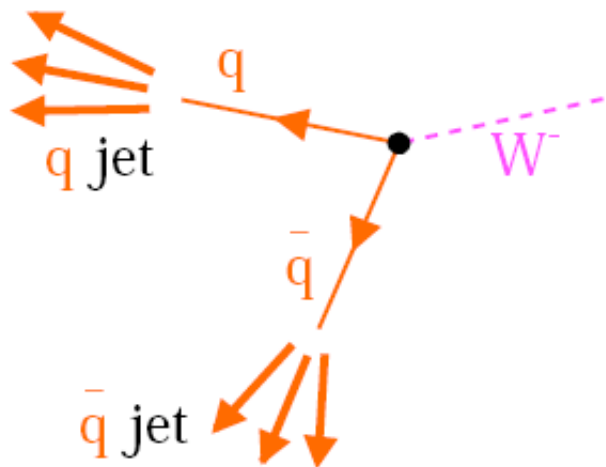

False
combination

True combination

Angle sum [rad]

Variable : mass difference between reconstructed top from hadronic branch and leptonic branch (neglecting neutrino)

True combination

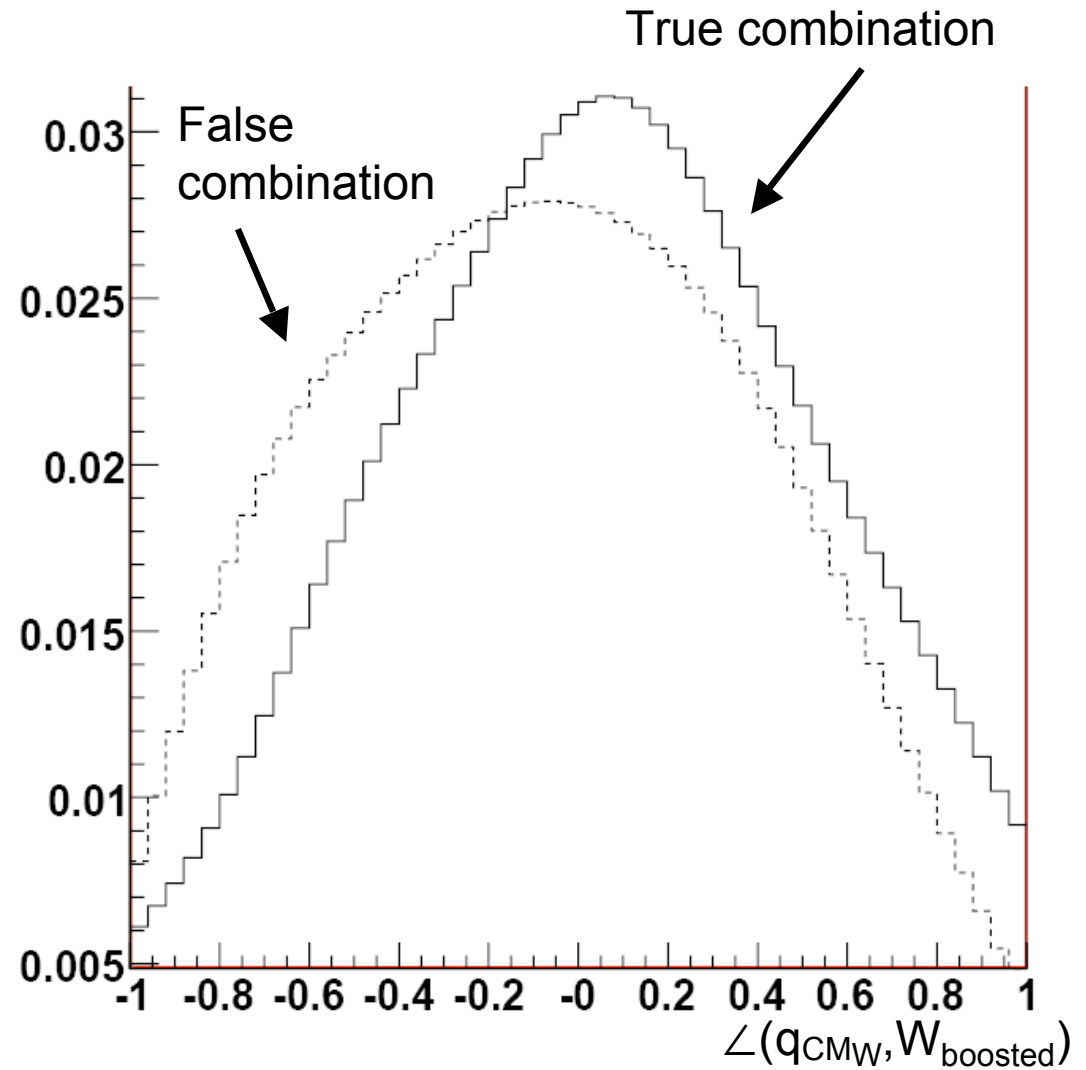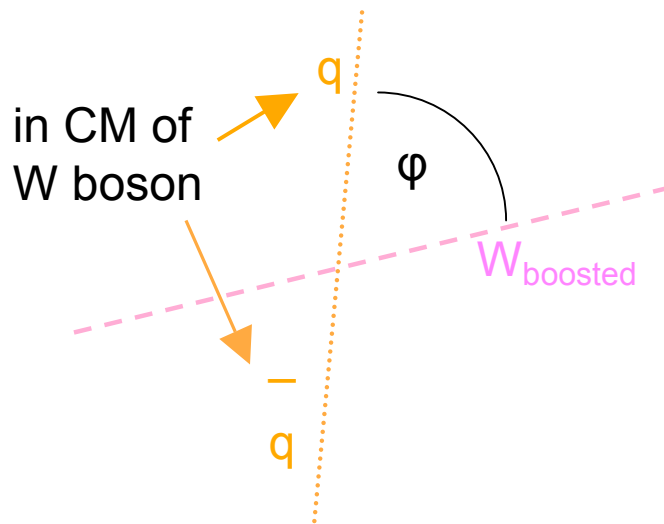False combination

ΔM_{Top}[GeV]

Variable 4: reconstructed W mass – nominal W mass

True combination

False combination

$W_{reco} - W_{nom}$
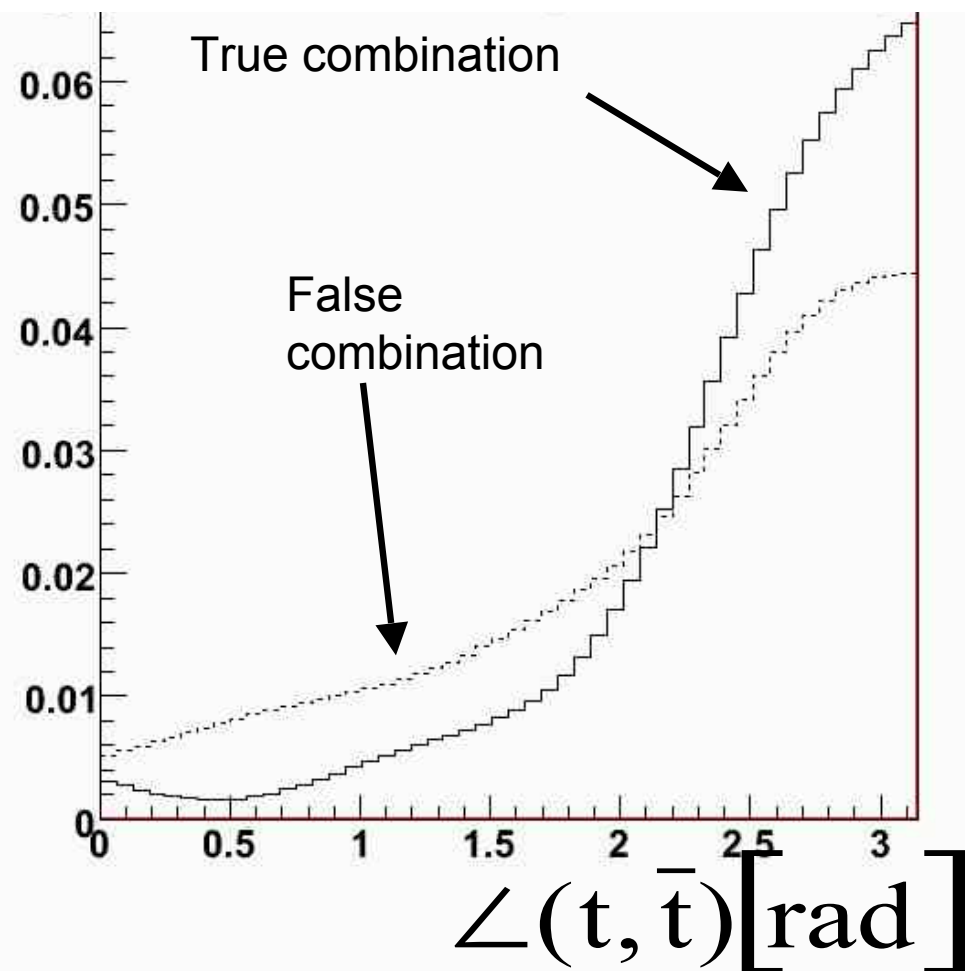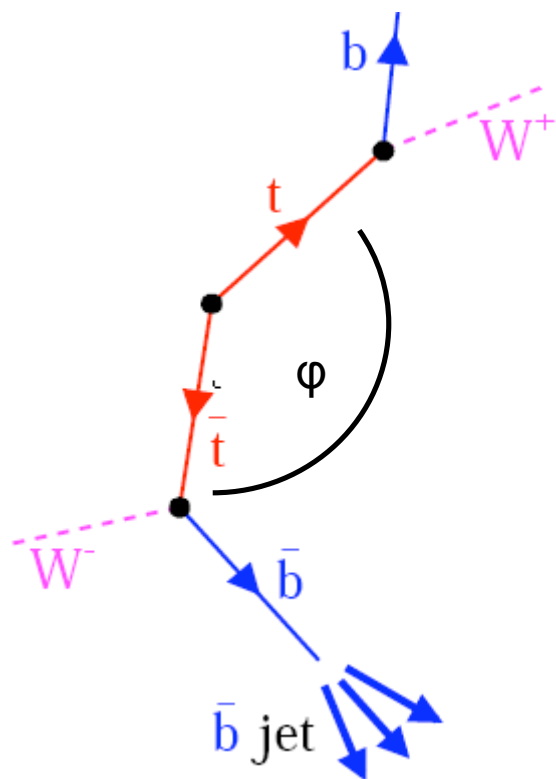
Variable 5: angle between the reconstructed W and the Quarks in the Centre of mass system of the W boson

Variable 6: angle between top and antitop
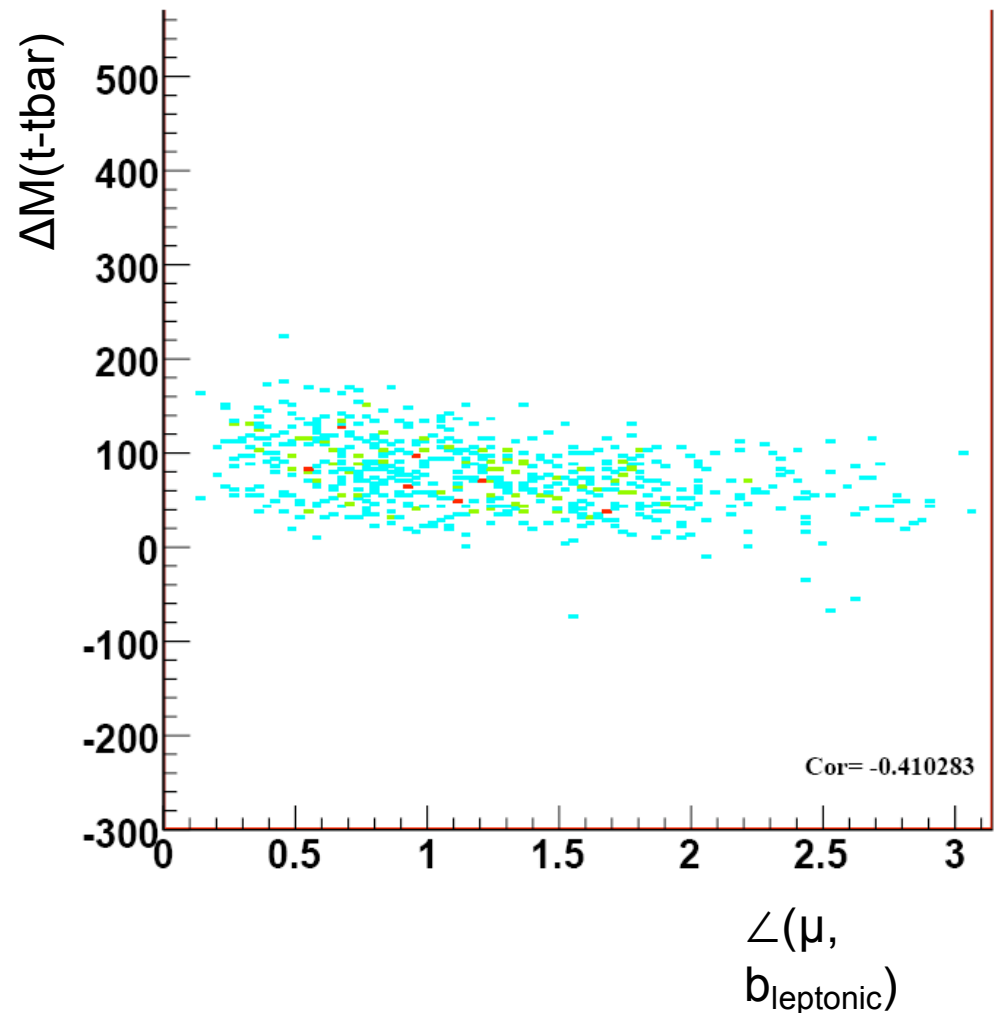
Check correlation between the likelihood variables

Highest correlation for :

Angle between muon and leptonic b and ΔM(t-tbar).

Correlationsfactor = 0,410

Use seperated samples for signal and background

$\Delta M(t\text{-}tbar)$

$\angle(\mu, b_{leptonic})$

Cor= -0.410283
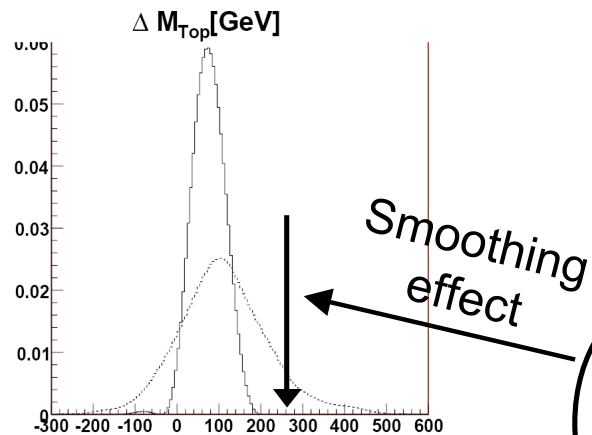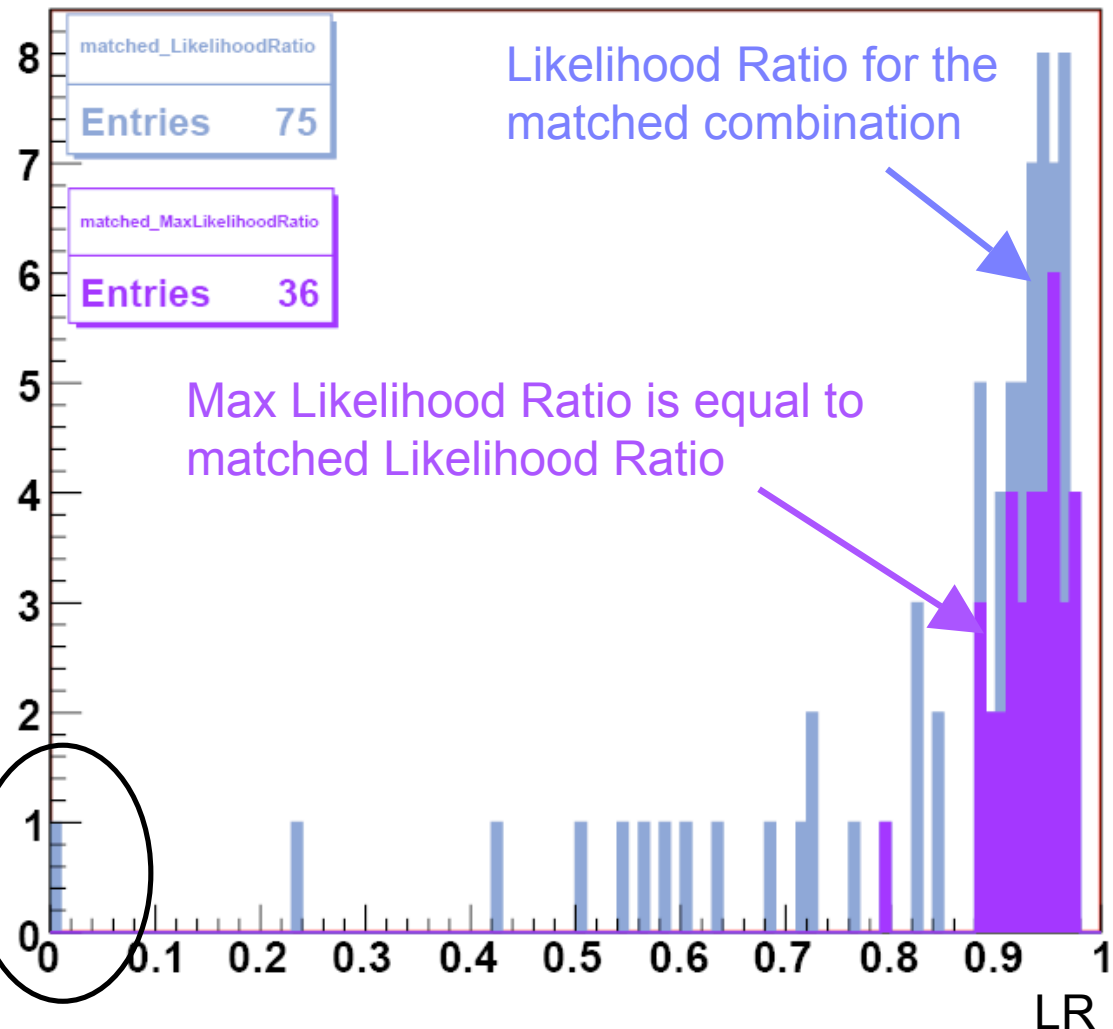
In which case is the max LR the *matched* one?

→LR > 0.9

60 % Efficiency to get the t*rue* combination with max LR

Δ M$_{Top}$[GeV]

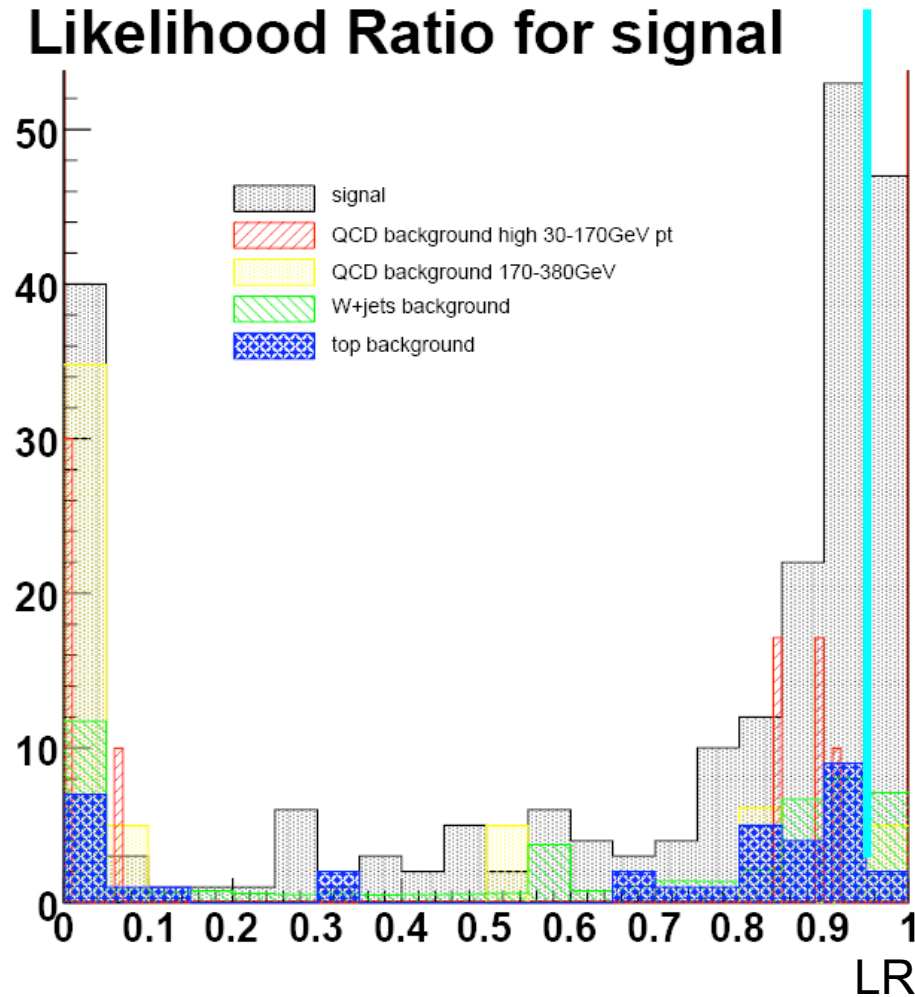Smoothing effect

Likelihood Ratio for signal

matched_LikelihoodRatio

Entries   75

matched_MaxLikelihoodRatio

Entries   36

Likelihood Ratio for the matched combination

Max Likelihood Ratio is equal to matched Likelihood Ratio

LR

Likelihood Cut

Likelihood Ratio for signal

Legend:
- signal
- QCD background high 30-170GeV pt
- QCD background 170-380GeV
- W+jets background
- top background

	Likelihood	Eff %
Signal	100	4,19%
Top backg	11	0,08%
W+jets	10	0,01%
QCD	30	0,00%

Purity of the signal : 66,27% (82,49% without QCD)

Top Mass

Legend:
- signal (black)
- QCD background high 30-170GeV pt
- QCD background 170-380GeV (yellow)
- W+jets background (green)
- top background (blue)

X-axis: M_{TOP} [GeV]
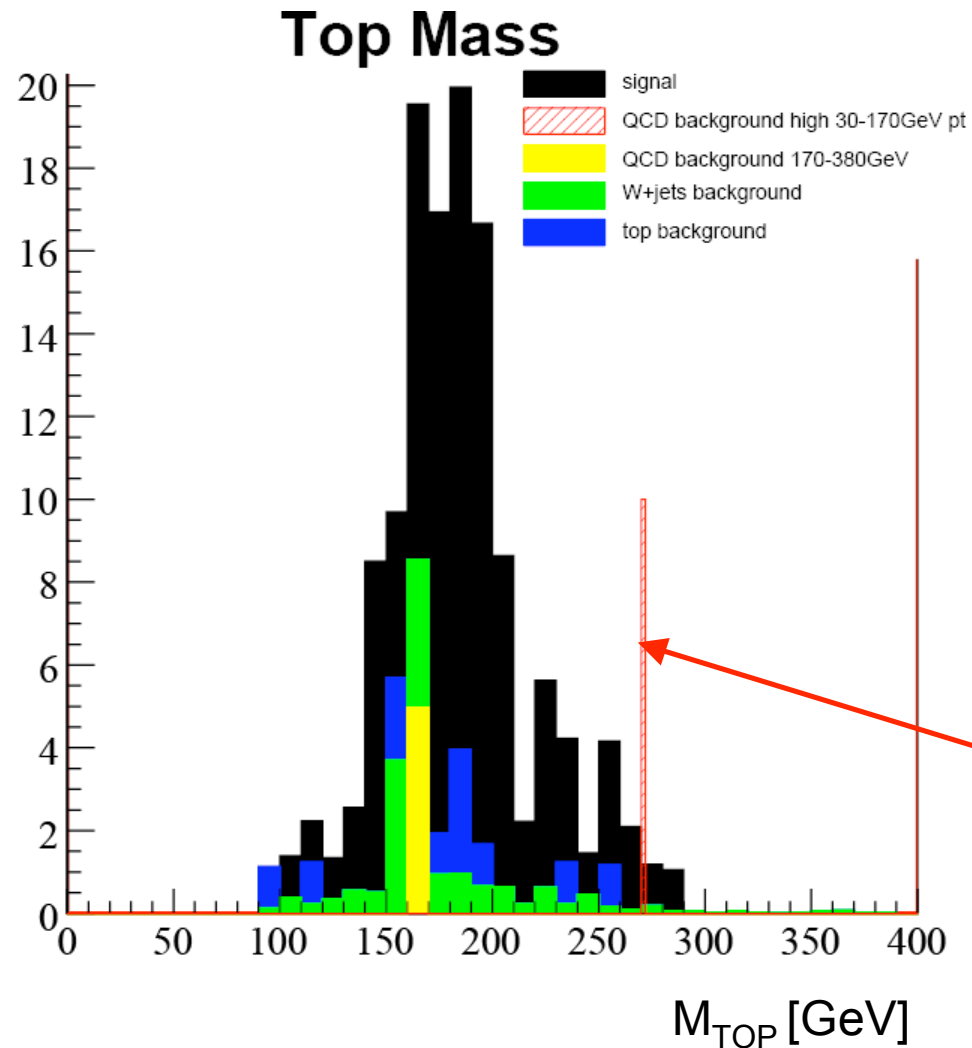
100 signal events :

M_{Top} : **187GeV ± 33GeV** (but 10% overcorrected jets, calibration for gluon showering, not for light jets)

1 event weighted with factor 25

Results:

- $\dfrac{S}{B} = 1{,}97$ including QCD, $\dfrac{S}{B} = 4{,}71$ without QCD

- Reconstructed **top mass** of **187 GeV** for 100 signal events (*overcorrected jets*)

Outlook:

- Improovement of likelihood method:
    - with **higher statistics** → less falsification by smoothing
    - **seperated events** for the signal and combinatorial background to reduce correlation