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

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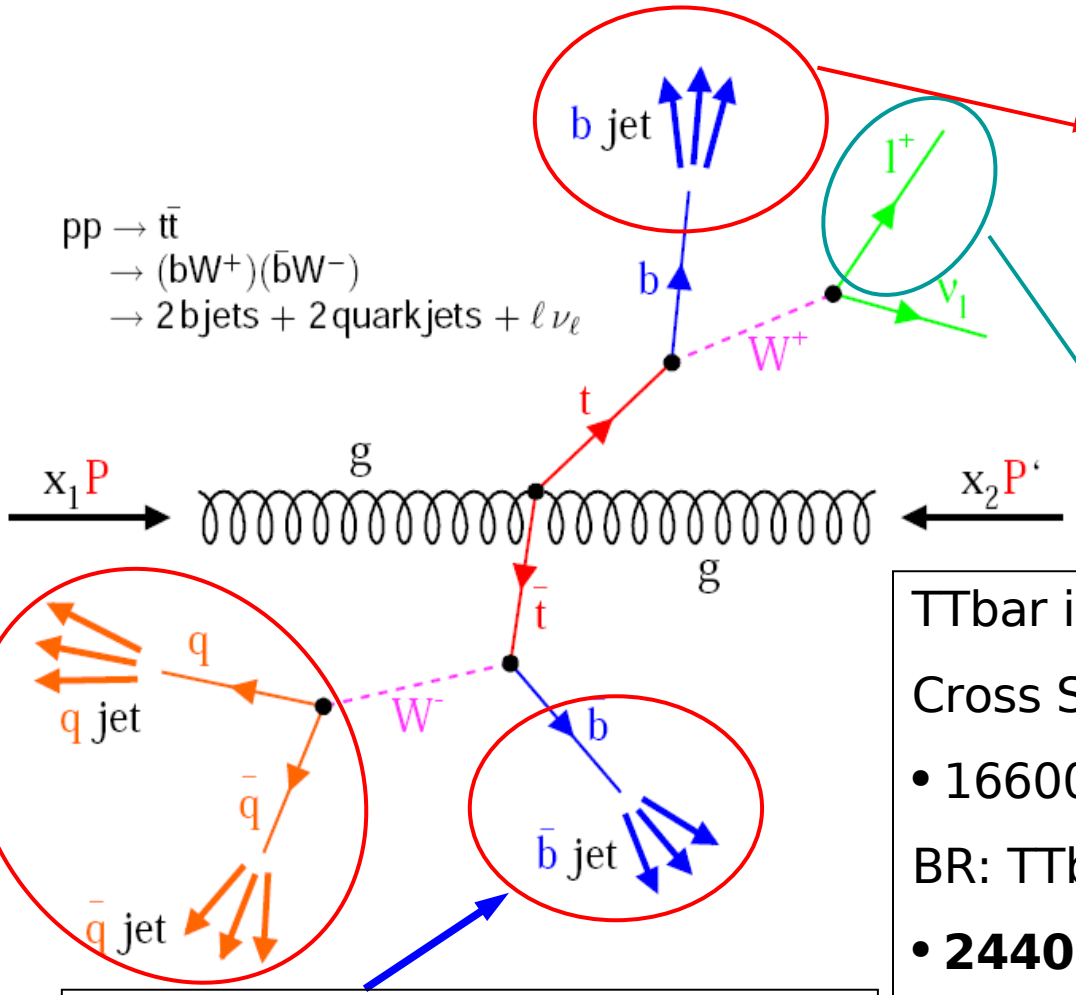
BMBF-Forschungsschwerpunkt
"Elementarteilchenphysik mit dem CMS-Experiment"
Physik an der TeV-Skala mit dem Large Hadron Collider
Compact Muon Solenoid
CMS Germany
FSP102

Overview

- Introduction to first analysis scenario
- Analysis strategy and MC samples
  - preselection
  - final selection
  - likelihood ratio method
- Results and outlook

Event Signature



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

At least 4 jets
with p_T >20 GeV

At least one isolated muon with p_T>15 GeV

No b-tagging for the first 20 pb^{-1}

TTbar inclusive sample:

Cross Section: 833pb (NLO)

- 16600 inclusive events (20 pb^{-1})

BR: TTbar --> $\mu\nu_\mu$+jets 14,7%

- **2440 signal events**

samples

- Ttbar:
  - **/Incl_ttbar/CMSSW_1_3_1-Spring07-1531/GEN-SIM-DIGI-RECO**
- W+jets:
  - **/Wjets_pt_30_50/CMSSW_1_3_1-Spring07-1477/GEN-SIM-DIGI-RECO**
  - ...
  - **/Wjets_pt_380_470/CMSSW_1_3_1-Spring07-1484/GEN-SIM-DIGI-RECO**
- QCD
  - **/QCD_pt_30_50/CMSSW_1_3_1-Spring07-1568/GEN-SIM-DIGI-RECO**
  - **...**
  - **/QCD_pt_380_470/CMSSW_1_3_1-Spring07-1660/GEN-SIM-DIGI-RECO**
- CMSSW_1_3_6
- Jet Met calibration “MCJetCorJetIcone5“
- Muons : global muons

Preselection: Cut Efficiencies

Preselection: Selection of top like event

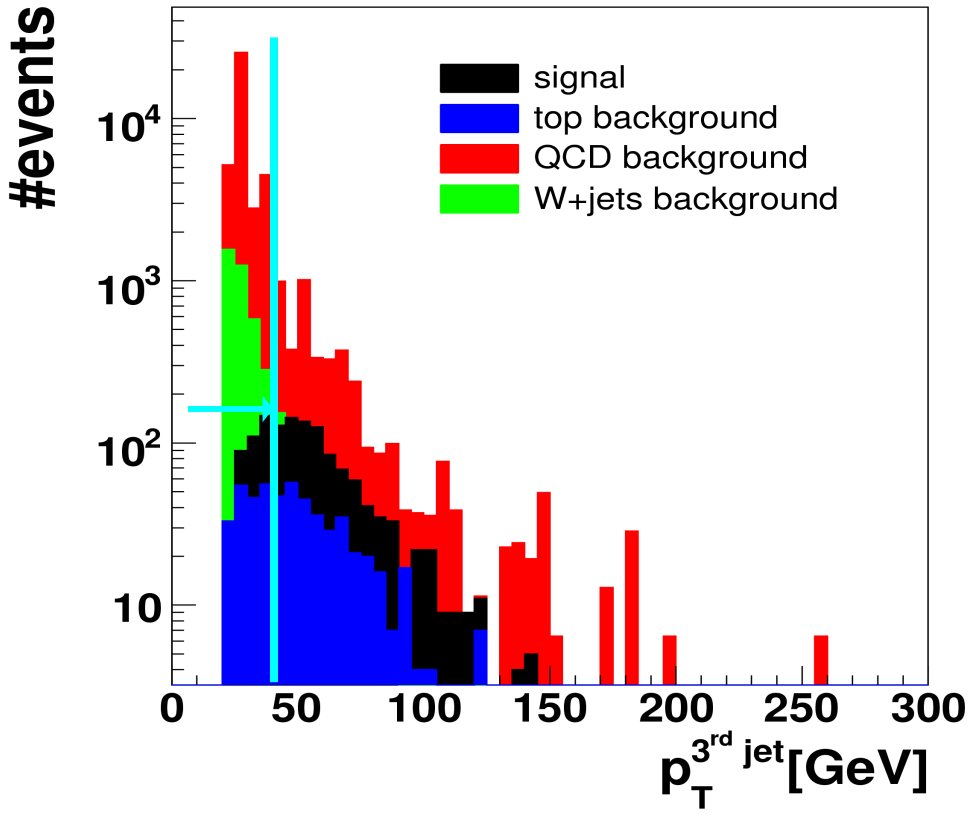
- At least 4 jets with a p_T>20GeV
- One isloated muon with p_T>15GeV
  - p_T isolation : $\frac{\sum_i p_T^i}{p_T^{muon}} < 1.1$ in a cone $\Delta R < 0.3$

Efficiencies	# events	Muon p_t>15GeV	Muon isolation	4 jets p_t >20 GeV	Efficiency %
Semi mu channel	2386	1950	1743	1360	57.0%
TopBackground	14214	2187	981	550	3.9%
W+jets	102478	13144	12440	2722	2.7%
QCD	3768150400	2453916	182513	41874	0.1%
S/B	6E-07	8E-04	9E-03	3E-02	

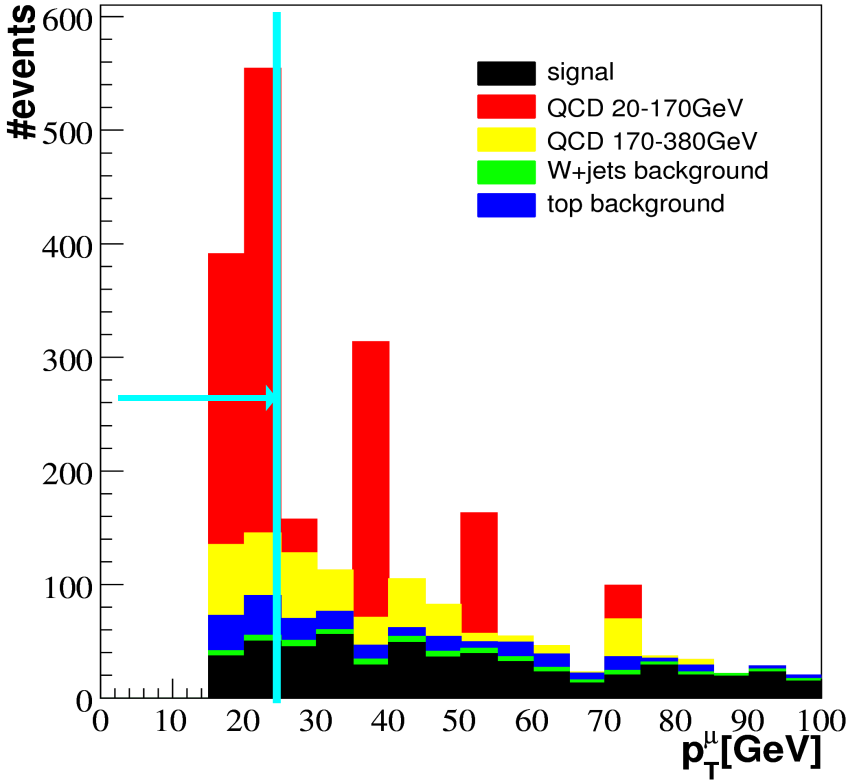
Final Selection

Cuts to reduce background (W+jets;QCD)

1. p_T (3^{rd} jet) > 45 GeV



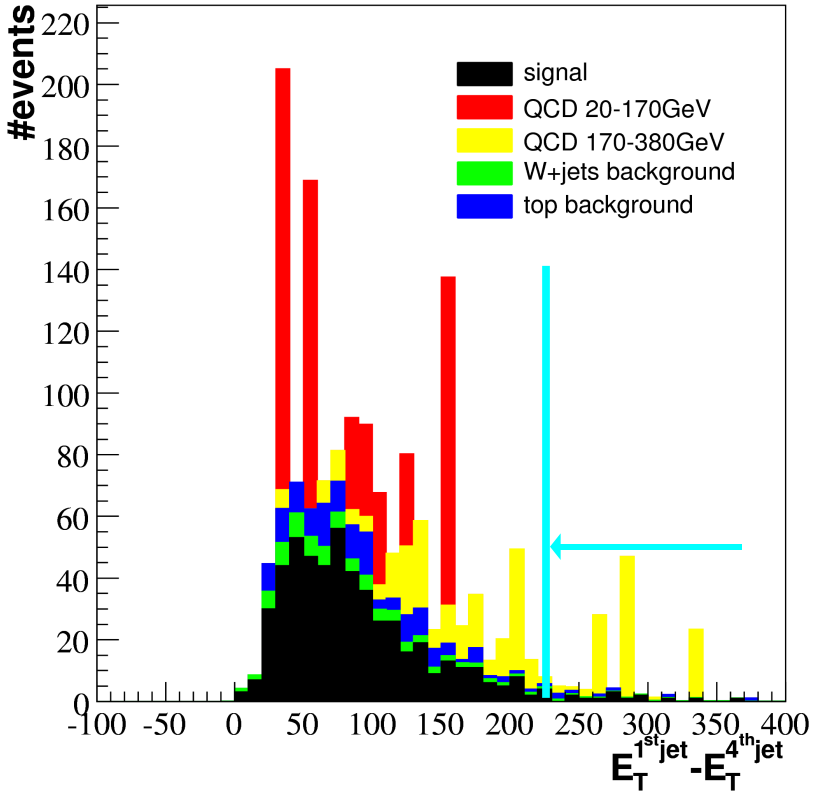
2. p_T (muon) > 25 GeV

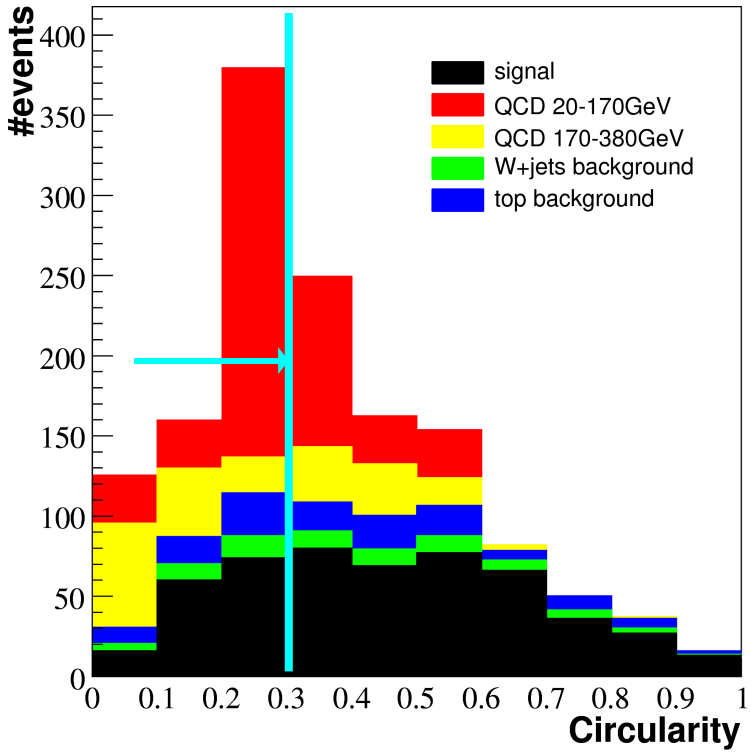


Final Selection : Final cuts

3. E_T(1st jet) – E_T(4th jet) <230 GeV

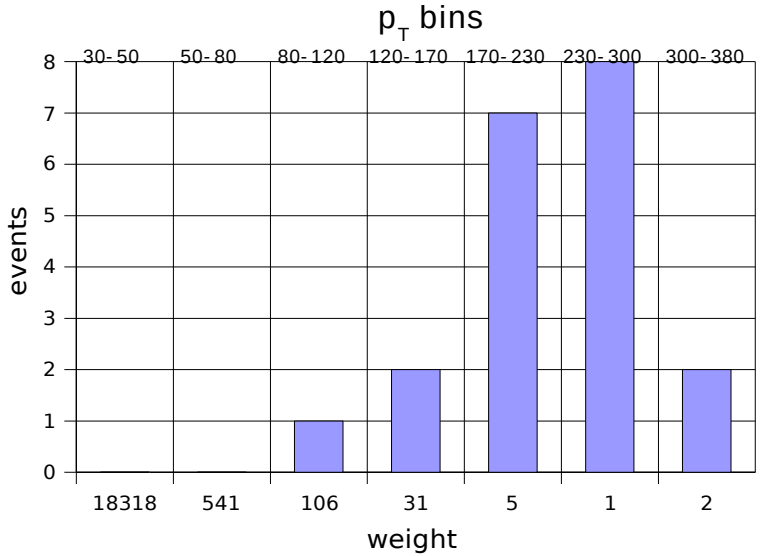
4. $$C = min \frac{\sum_i \vec{p}_{T_i} \cdot \vec{n}_i}{\sum_i |\vec{p}_{T_i}|} > 0.3$$





Final Selection: Efficiencies

Efficiencies	3rd jet p_t >45GeV	Muon p_t>25GeV	ΔE_t (1st jet, 4th jet)	Circularity>0.3
Semi mu channel	621	536	518	386
TopBG Total	202	142	135	81
W+jets	91	81	76	48
QCD	1363	631	622	207 ∓170



- QCD samples have severe lack of statistics in order to realistically estimate the QCD background

Likelihood

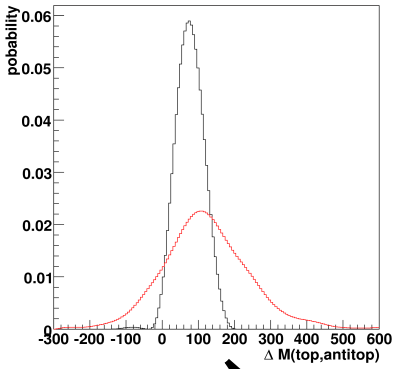
Likelihood Ratio : $$LR = \frac{\prod_i L_i^{true}}{\prod_i L_i^{true} + \prod_i L_i^{false}}$$

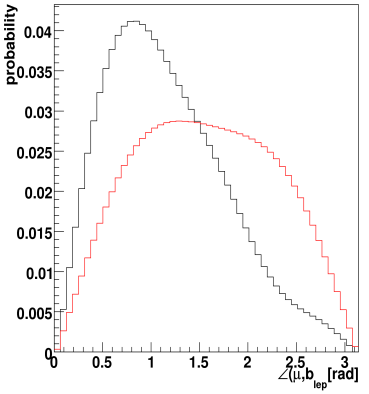
1. Probability density function (pdf) of **true** combinations from matched jets
2. Probability density function (pdf) of **false** combinations from matched jets
3. Check correlations between the variables

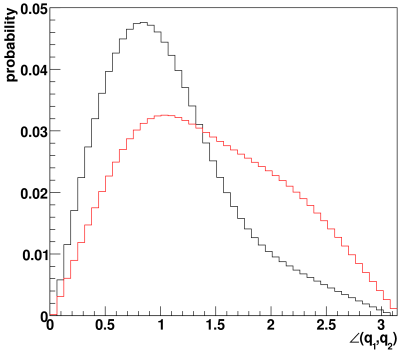
Likelihood: Variables

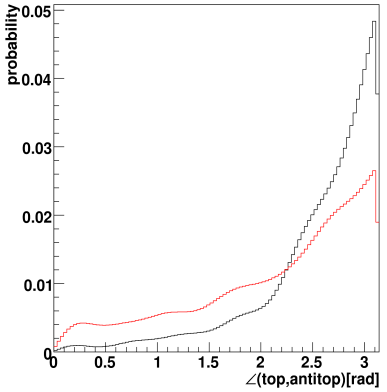
True combination

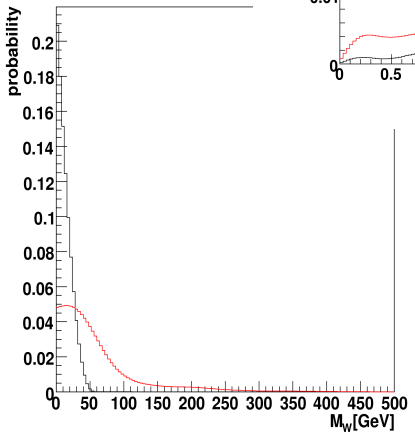
False combination











Likelihood: Correlations

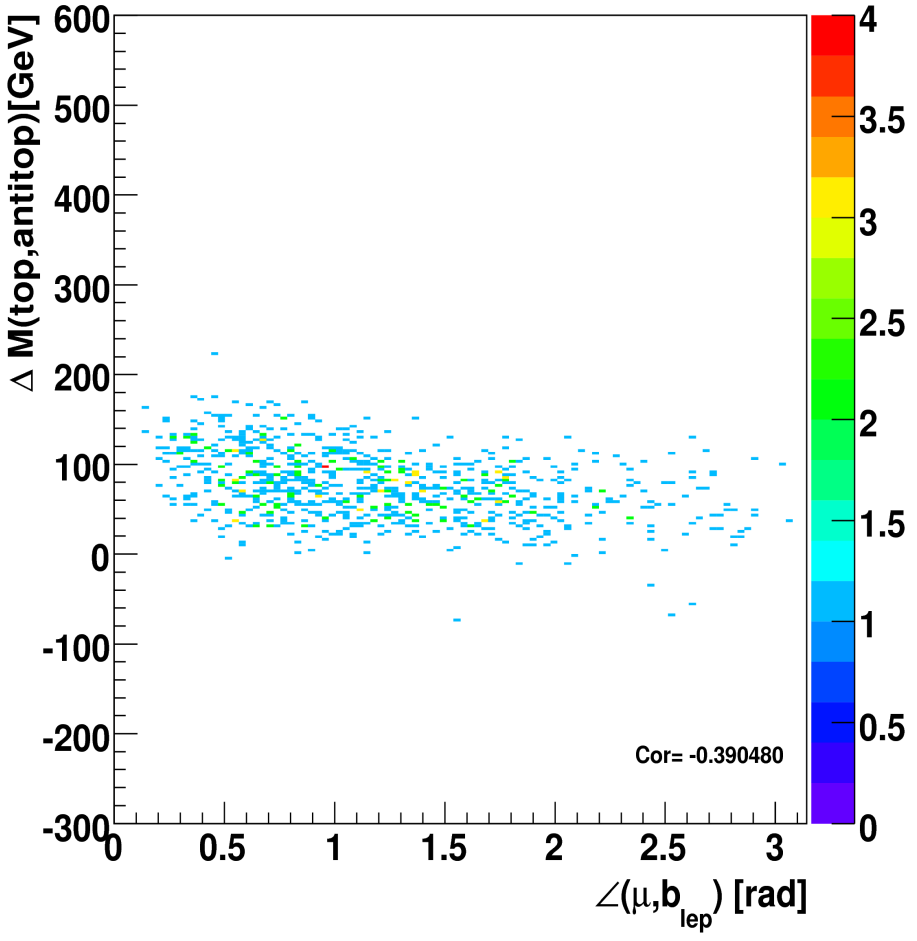
Check correlation between the likelihood variables

Highest correlation for :

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

Correlationsfactor = 0,39

Correlations ✓

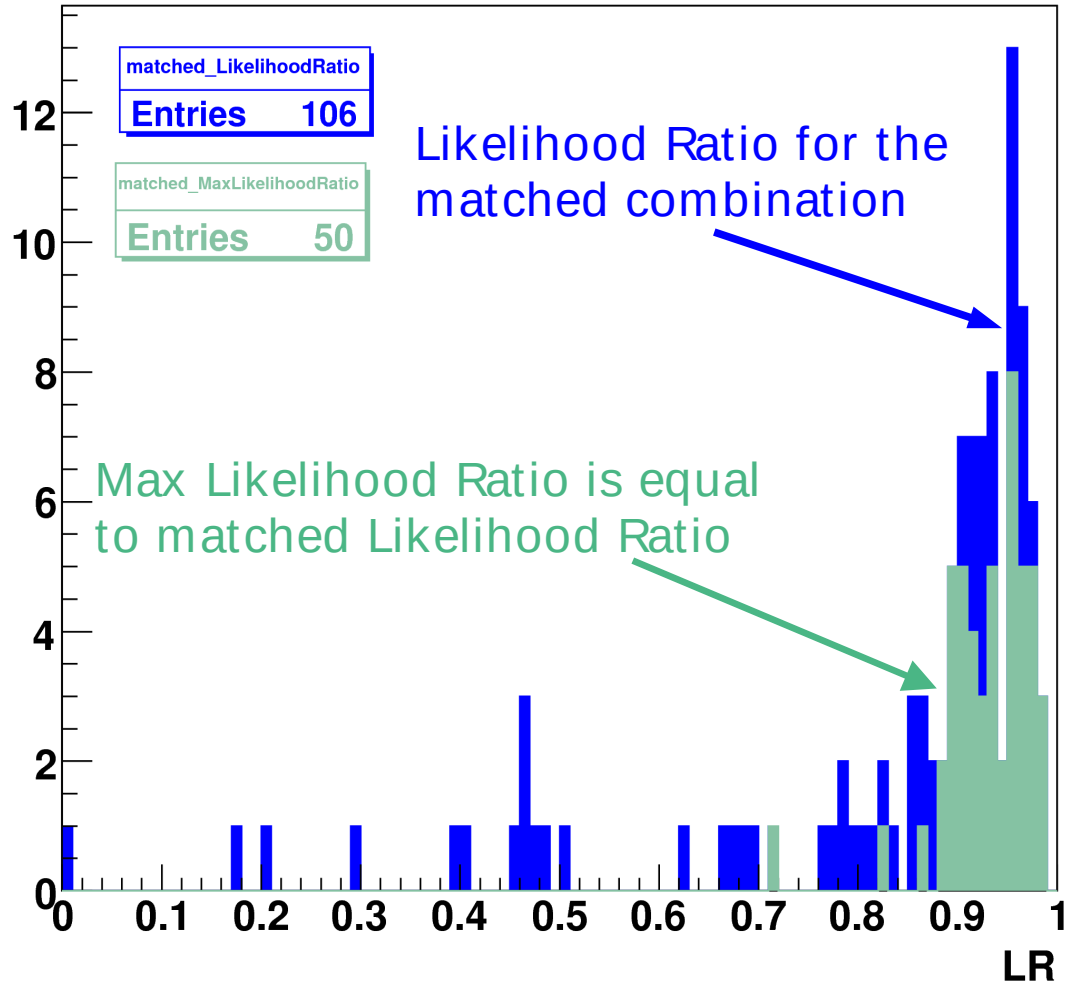


Likelihood Ratio for matched jets

In which case is the max LR the *matched* one?

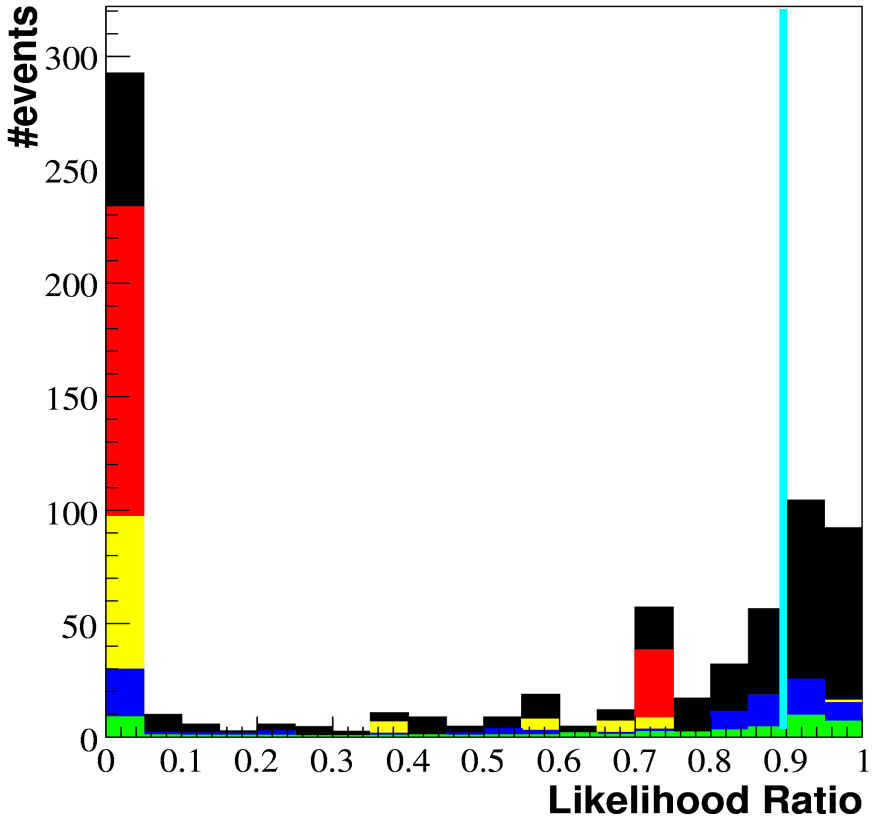
For LR > 0.90

65 % efficiency to get the t*rue* combination with max LR



LR

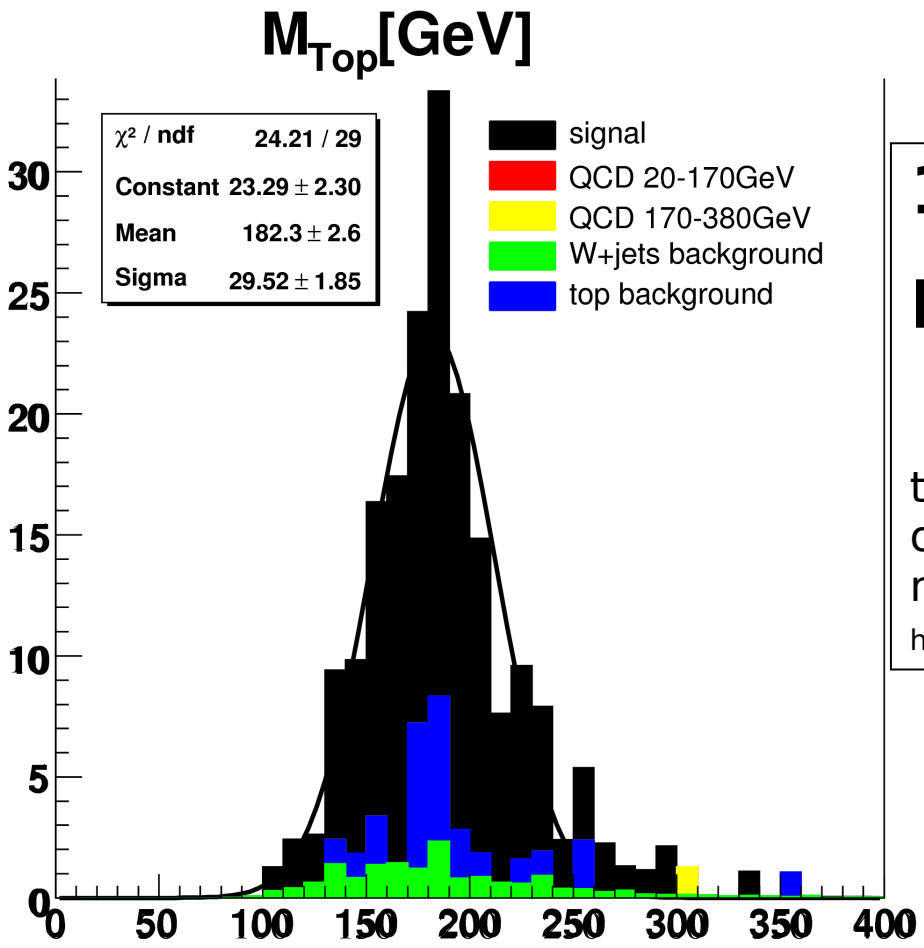
Likelihood Cut



	Likelihood>0.9	Efficiency %
Semi mu channel	155	11.4%
TopBG Total	26	4.7%
W+jets	22	0.8%
QCD	1	0.0%

Purity of the signal : 76%

Top Mass



155 signal events

M_{Top} = 182GeV∓30GeV

-->(10% overcorrected jets, see talk Frank-Peter-Schilling (University of Karlsruhe) at Joint QCD/EWK/TOP meeting, 11 September 2007 --> http://indico.cern.ch/conferenceDisplay.py?confId=18985)

Results and outlook

Results:

- It will be **possible** to **observe** the **top quark** in **20pb^{-1}** even **without b-tagging**
- **S/B=3,32** (with low QCD statistics)
- Reconstructed **top mass** of **182 GeV ∓30GeV** for **155** signal events (*overcorrected jets*)

Outlook:

- Sideband analysis could help to estimate the QCD background from data
- Estimate of cross section