

# Dijet invariant mass distribution in $pp \rightarrow w + jj$ final states

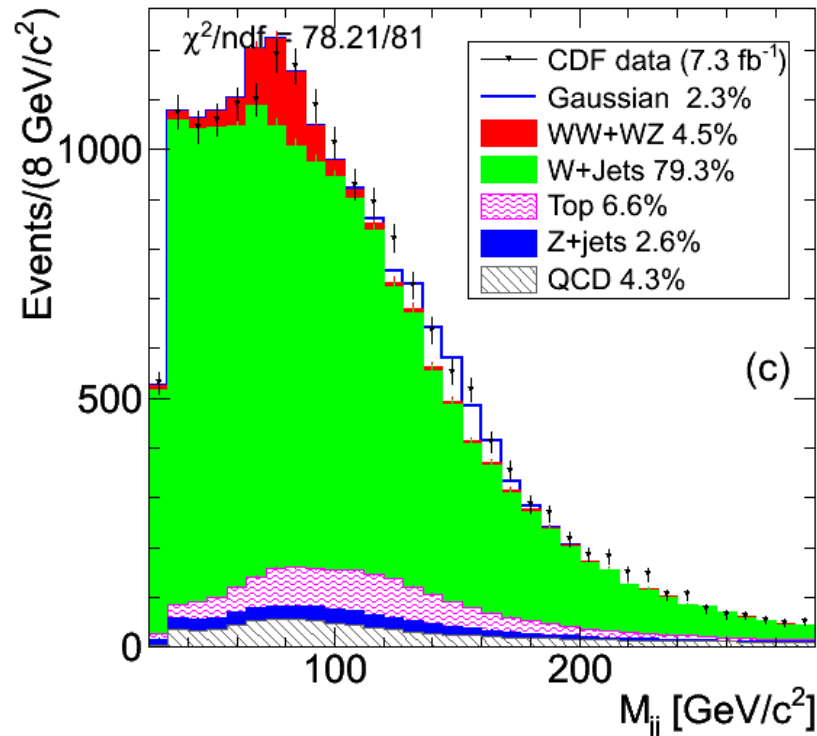
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Jets with new physics

# The CDF-Anomaly

$$pp \rightarrow W + jj \rightarrow l + \nu + 2\text{jets}$$

Dijet mass spectrum in W+2 jets events



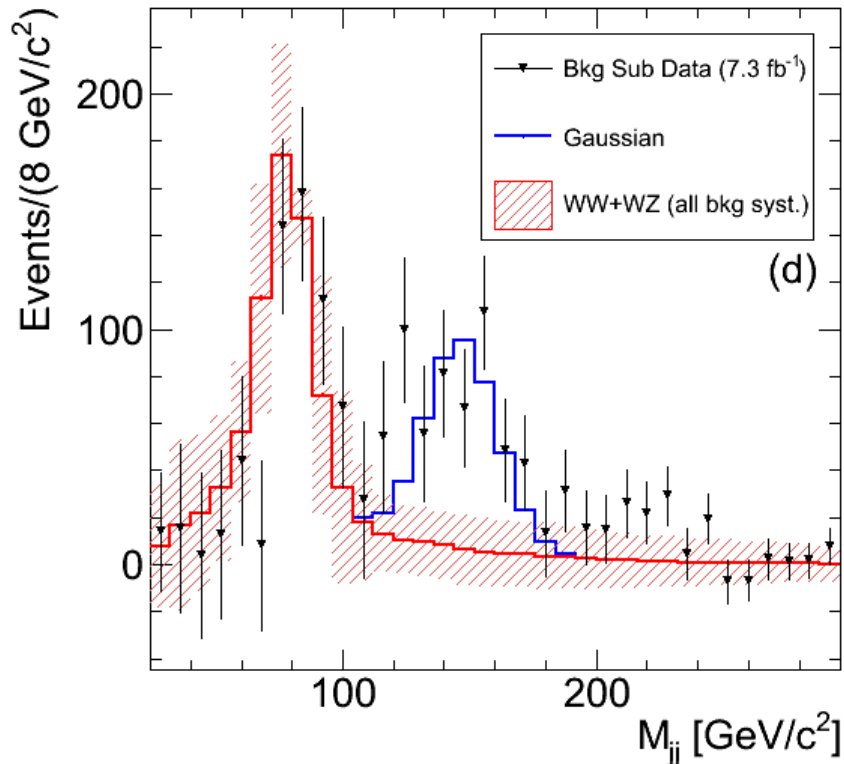
An excess of 253 events around 145 GeV

Significance of  $3.2 \sigma$  at  $4.3 \text{ fb}^{-1}$   
and  $4.1 \sigma$  at  $7.3 \text{ fb}^{-1}$

NOT explained by SM physics

# The CDF-Anomaly

$$pp \rightarrow W + jj \rightarrow l + \nu + 2\text{jets}$$

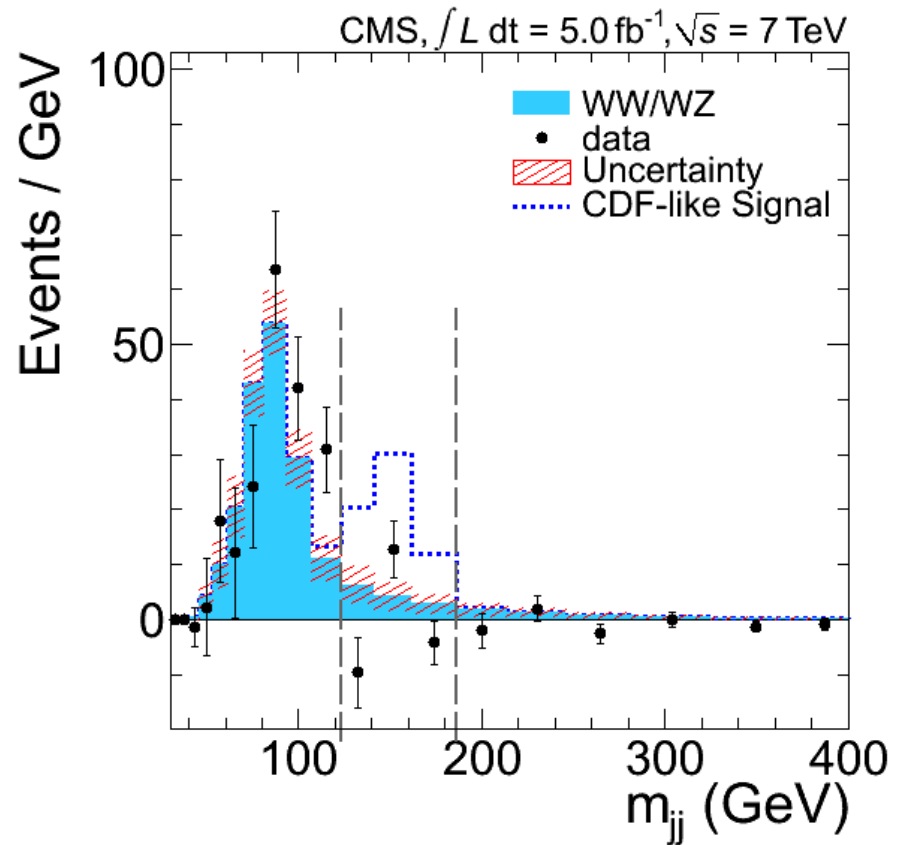
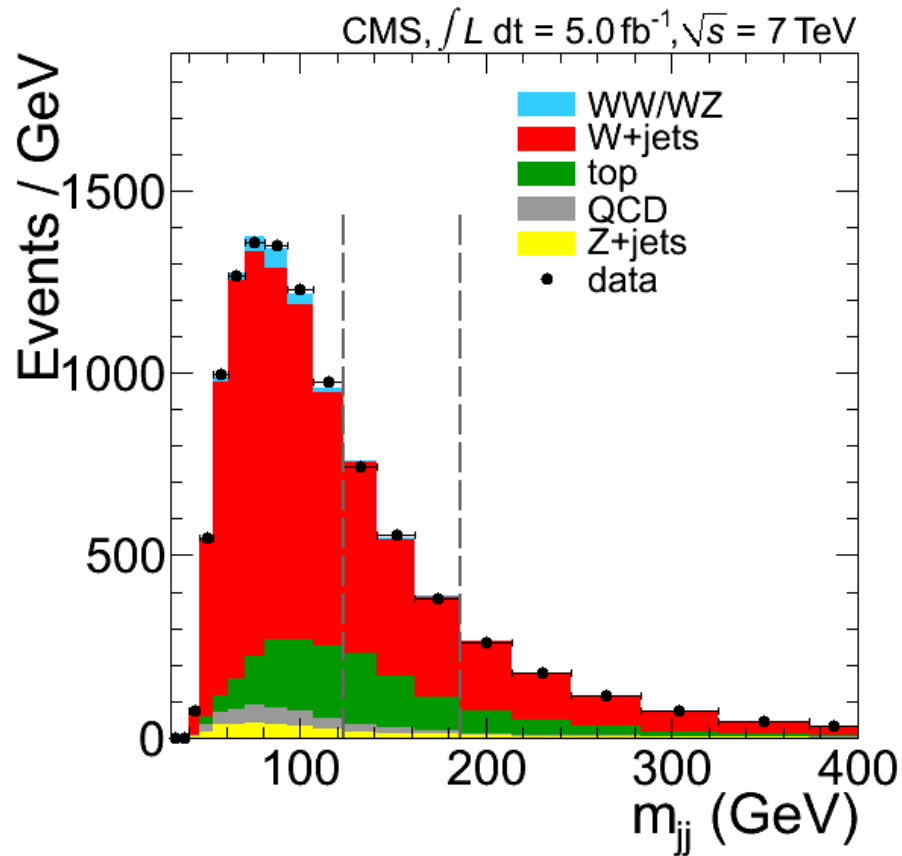


Excess at 145 GeV,  $\sigma = 15 \text{ GeV}$   
(Fitted by Gaussian)

Several extension to SM predicts  
a peak in such a range, including  
a new  $Z'$  and Technicolor.

Did CMS see it?

# CMS Results at 7 TeV, 5fb<sup>-1</sup>



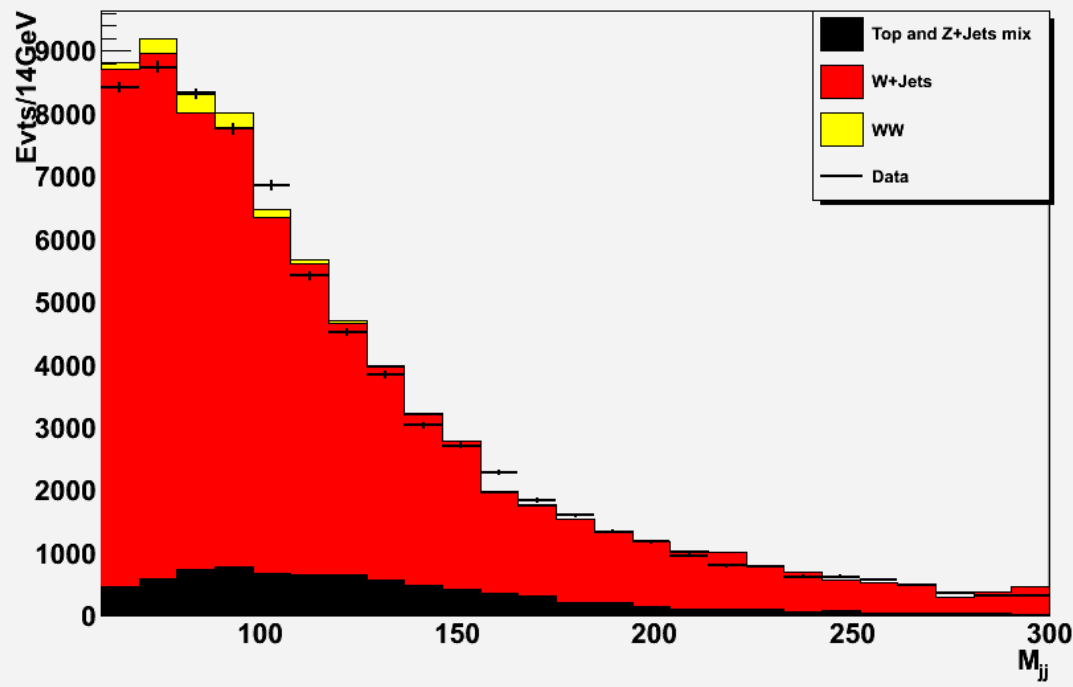
HOW ABOUT 8TeV ??

# Our contribution

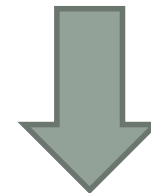
Data collected at 8 TeV, 5 fb<sup>-1</sup>

Extension project:

Weighted Sum of All Processes



1. Better Fit
2. Look at electron channel.
3. Look at three jets final state.



More convincing  
result !

# 1. Improving the fit quality

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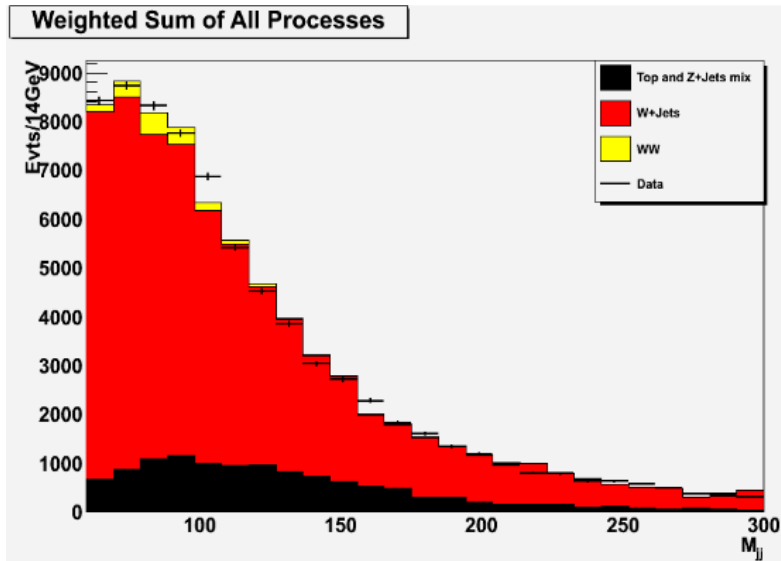
- **Improving the fit quality involves the following**

**“Trigger efficiency corrections”**

- **“The WZ contribution”**
- **“The W+Jets shape”**

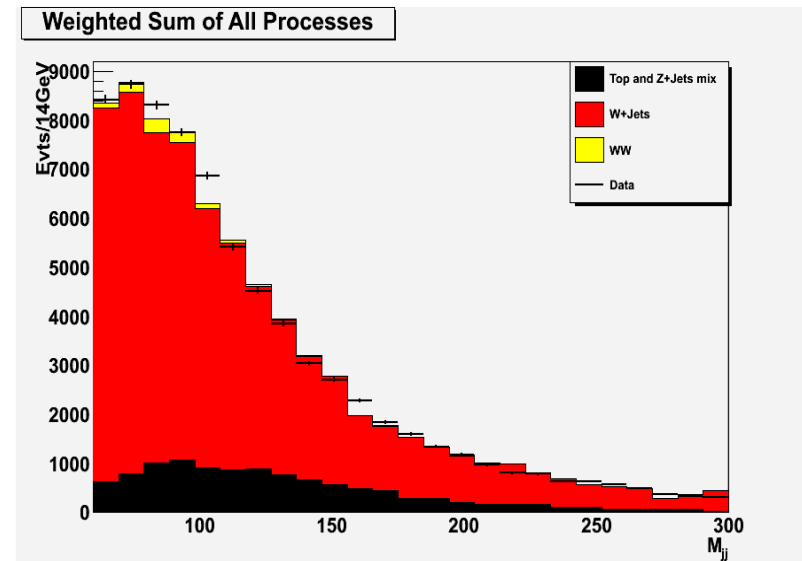
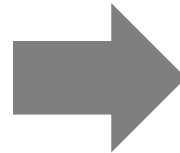
# 1. Improving the fit quality

- Trigger efficiency corrections



```
*** chi^2/dof = 25.0641/14 = 1.79029 ***  
*** chi^2 probability = 0.0339397 ***
```

Floating Parameter	InitialValue	FinalValue +/- Error
nMixed	8.1498e+03	1.1875e+04 +/- 8.27e+02
nWW	1.2716e+03	1.7326e+03 +/- 2.20e+02
nWjets	6.6010e+04	6.0308e+04 +/- 8.56e+02

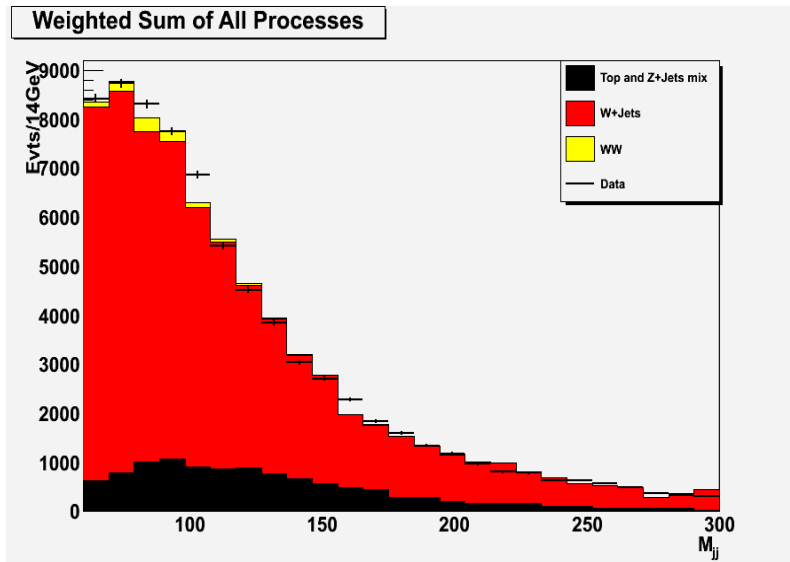


```
*** chi^2/dof = 25.2014/14 = 1.8001 ***  
*** chi^2 probability = 0.0326304 ***
```

Floating Parameter	InitialValue	FinalValue +/- Error
nMixed	7.1056e+03	1.0927e+04 +/- 8.02e+02
nWW	1.1029e+03	1.4913e+03 +/- 1.97e+02
nWjets	5.6970e+04	6.1429e+04 +/- 8.28e+02

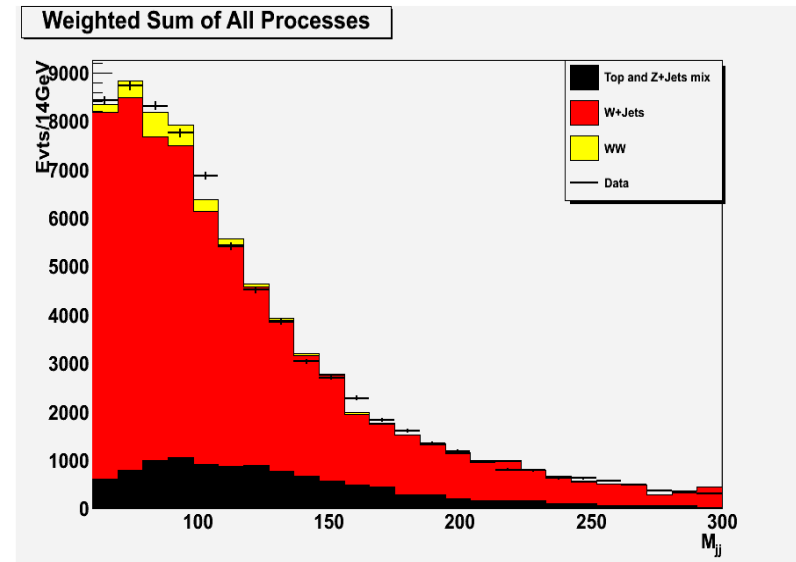
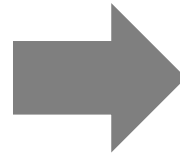
# 1. Improving the fit quality

- Trigger efficiency corrections & WZ contribution



```
*** chi^2/dof = 25.2014/14 = 1.8001 ***
*** chi^2 probability = 0.0326304 ***
```

Floating Parameter	InitialValue	FinalValue +/- Error
nMixed	7.1056e+03	1.0927e+04 +/- 8.02e+02
nWW	1.1029e+03	1.4913e+03 +/- 1.97e+02
nWjets	5.6970e+04	6.1429e+04 +/- 8.28e+02



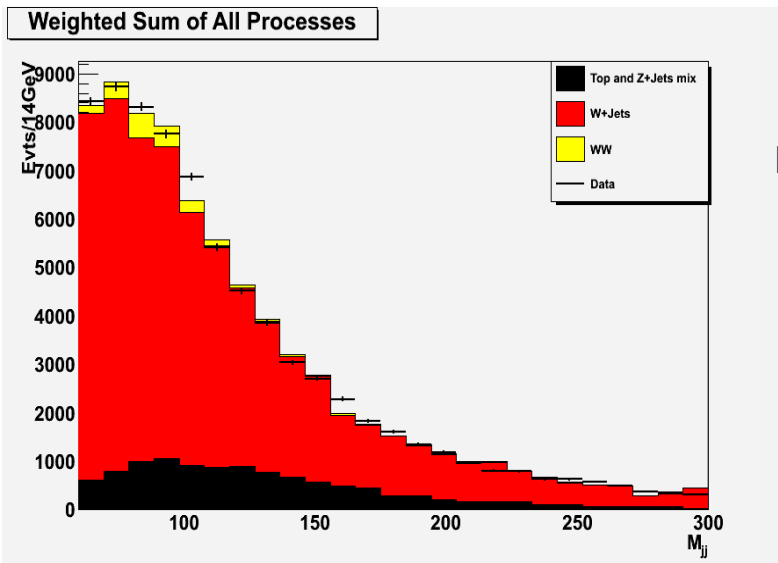
```
*** chi^2/dof = 24.1865/14 = 1.72761 ***
*** chi^2 probability = 0.0435012 ***
```

Floating Parameter	InitialValue	FinalValue +/- Error
nMixed	7.1056e+03	1.0932e+04 +/- 7.96e+02
nWW	1.4829e+03	2.0806e+03 +/- 2.49e+02
nWjets	5.6970e+04	6.0770e+04 +/- 8.41e+02

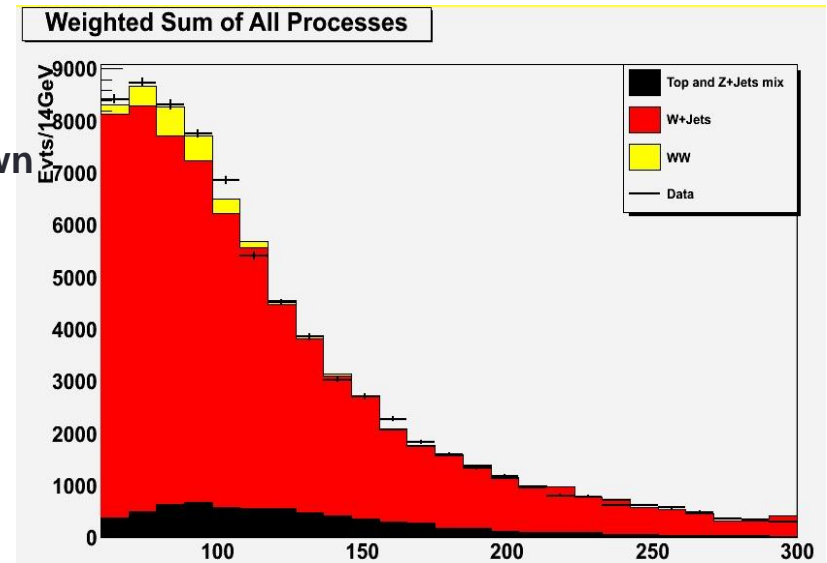


# 1. Improving the fit quality

- Trigger efficiency corrections & WZ contribution



Matchingdown  
&  
Scaleup



```
*** chi^2/dof = 24.1865/14 = 1.72761 ***
*** chi^2 probability = 0.0435012 ***
```

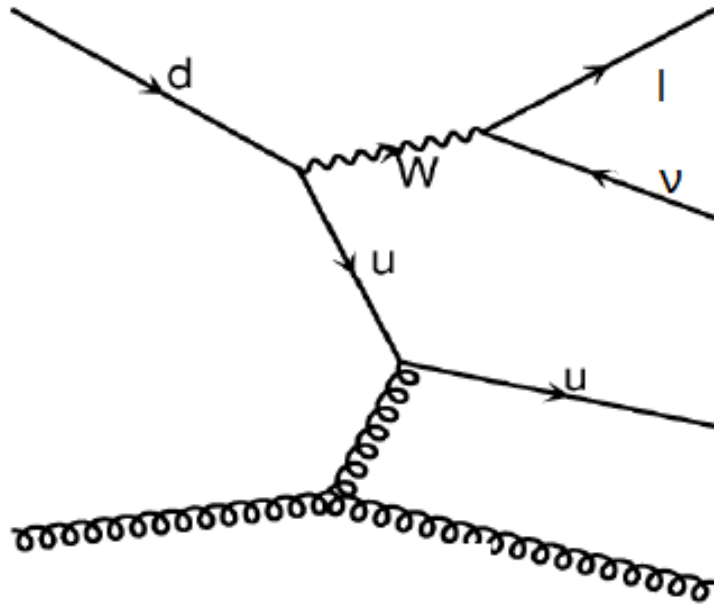
Floating Parameter	InitialValue	FinalValue +/- Error
nMixed	7.1056e+03	1.0932e+04 +/- 7.96e+02
nWW	1.4829e+03	2.0806e+03 +/- 2.49e+02
nWjets	5.6970e+04	6.0770e+04 +/- 8.41e+02

```
*** chi^2/dof = 22.1741/12 = 1.84784 ***
*** chi^2 probability = 0.0356146 ***
```

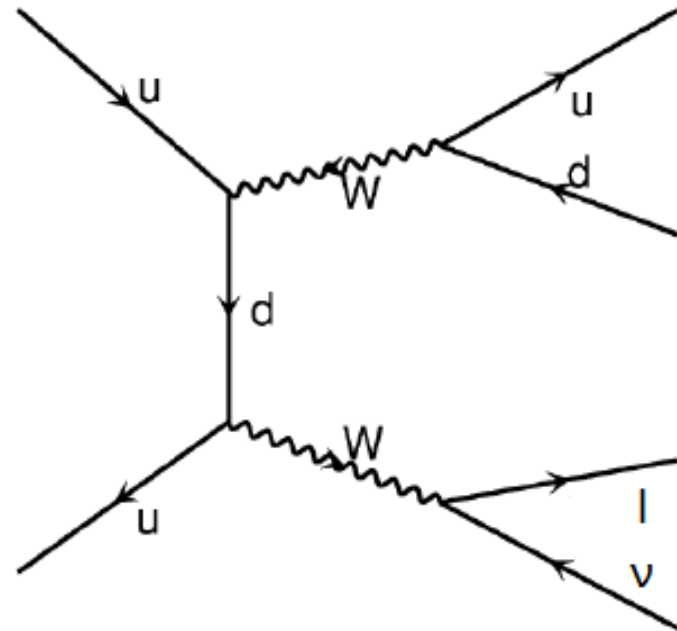
Floating Parameter	InitialValue	FinalValue +/- Error	GblCorr.
nMixed	7.1056e+03	6.9258e+03 +/- 1.06e+03	<none>
nWW	1.4829e+03	2.3005e+03 +/- 2.52e+02	<none>
nWjets	5.6970e+04	4.4737e+04 +/- 3.10e+03	<none>
nWpJMatching	5.0802e+04	5.4623e+03 +/- 2.39e+03	<none>
nWpJScale	3.3930e+04	1.4265e+04 +/- 4.01e+03	<none>

# Electron

W+jj production via quark-gluon scattering



WW production via q-q annihilation



l stands for muon or electron

# Background Considering

Similar to Muon:

Single Top, Z+Jet, W+Jet, WW

New Background

QCD : Misidentify charged jet to electron

WZ: To check the resonance of W and Z mass

# QCD Background

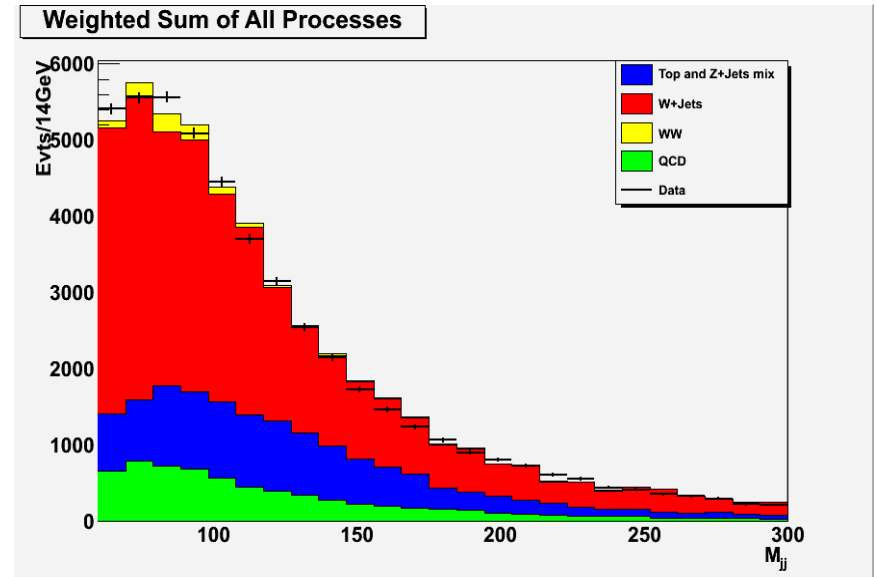
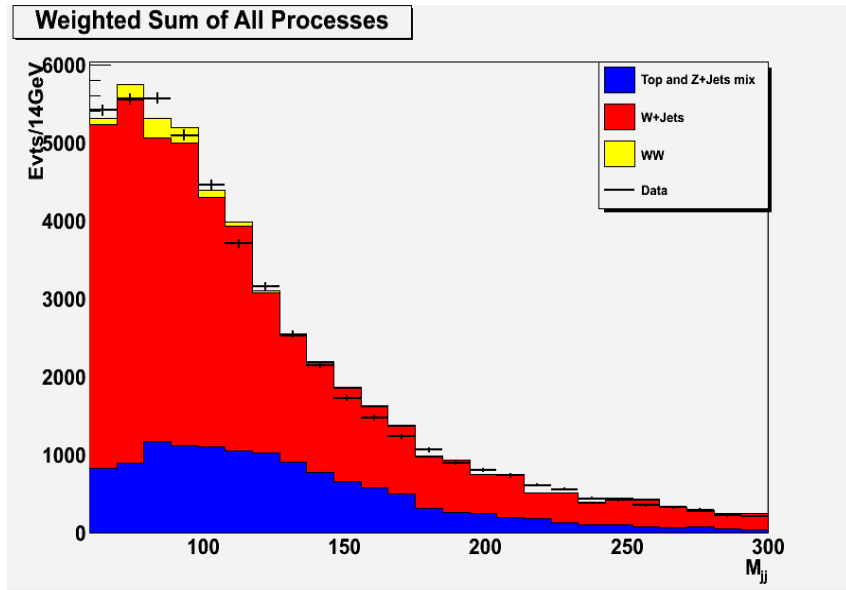
- Process to identify an electron

Tracker + ECAL  $\rightarrow$  e

- False Identification

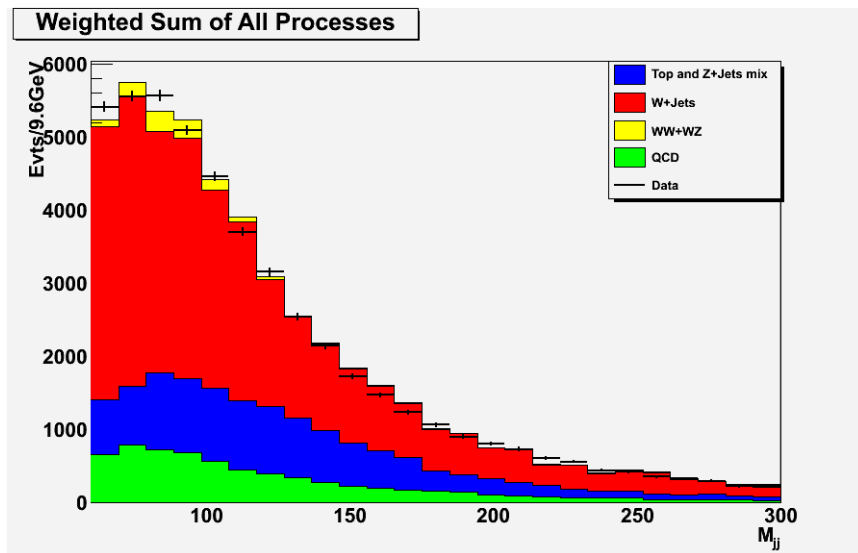
Low Energy Charge Jets  $\rightarrow$  Not enough energy

HCAL  $\rightarrow$  e



Muon  $\rightarrow$  Electron  $\chi^2/\text{ndf} : 3.09549$

Add QCD background  $\chi^2/\text{ndf} : 2.54159$



Add WZ to WW background  $\chi^2/\text{ndf} : 2.68631$



# Electron

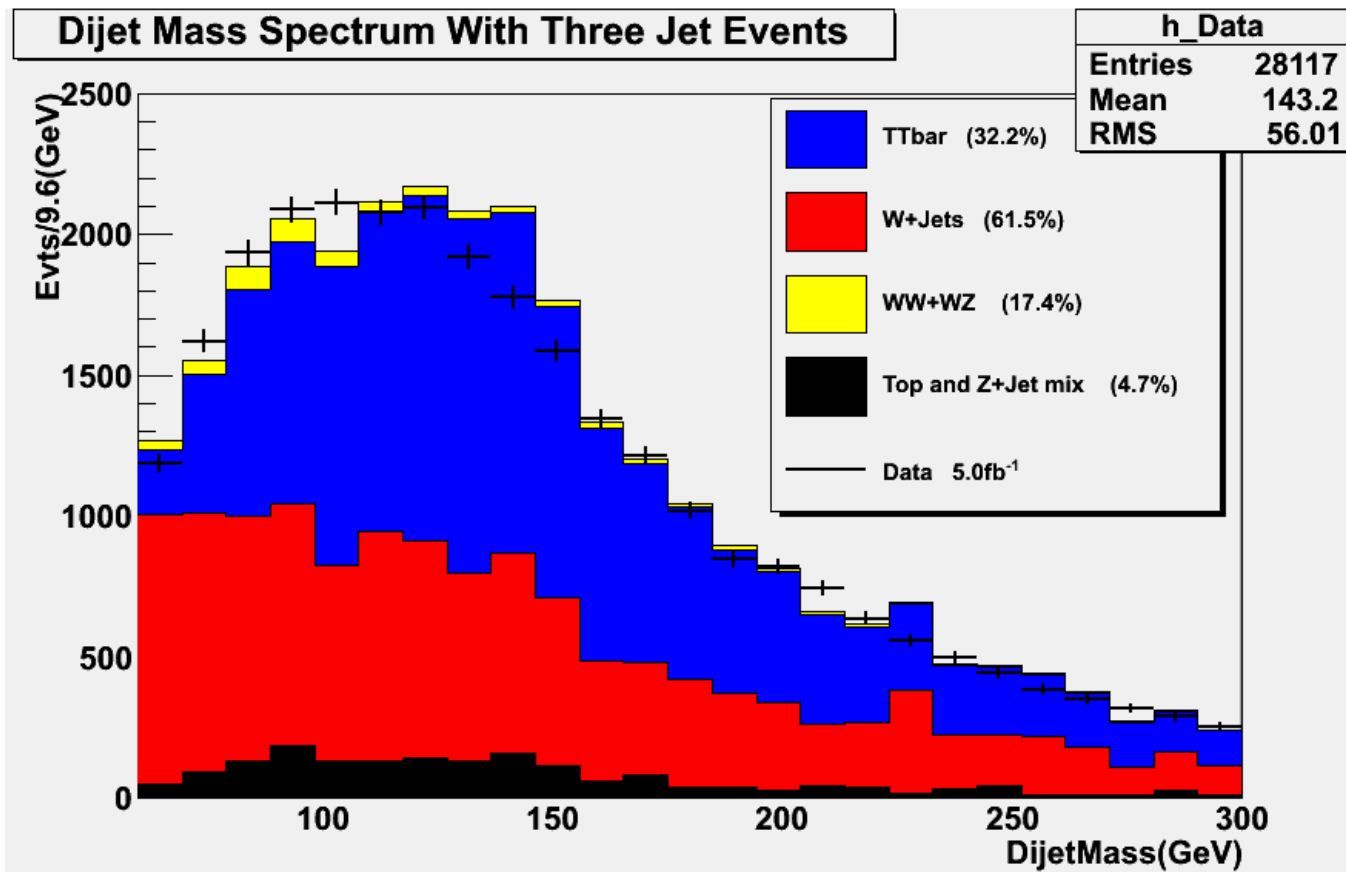
table	ttbar	Singl e top	Z+jet s	Mixed	W+jet s	WW	QCD	WZ	scale	data
Origin al	4224	1432	254	5910	47049	914			49500	48969
+QCD	4224	1432	254	5910	47049	914	3427		49453	48969
+WZ	4224	1432	254	5910	47049	914	3427	305	49430	48969

# The three-jet events

- Why we need study this kind of events?
- What are the results expected?

# The three-jet events

- The value of chi-square is about 3.37695
- Some discrepancies due to the fluctuations in MC
  - Need more amounts of MC





# The three-jet events

- The subtraction between data and background
- No peak at mass around 150 GeV/c
  - No evidence of new physics according to the result

**Subtracted Dijets mass spectrum**

