A quick study of W(→ev) +jj events: reconstructed m_{jj} distribution

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Fermilab

Candidate events selection

✦W→ev reconstruction
- -GsfElectron passing tight WP70 criteria
- -Electron E_T > 20 GeV
- -W transverse mass: m_T > 40 GeV
- -PF MET > 25 GeV
- -Z veto

In sync with CDF analysis except for m_T cut (CDF requires m_T > 30 GeV)

✦Require <u>two</u> PF jets in the event
- -each jet with corrected p_T >30 GeV and $|\eta|$ <2.4
- -dijet p_T > 40 GeV, $|\Delta\eta|$ < 2.5
- -if any 3rd jet in the event then p_T^{3rd} < 25 GeV

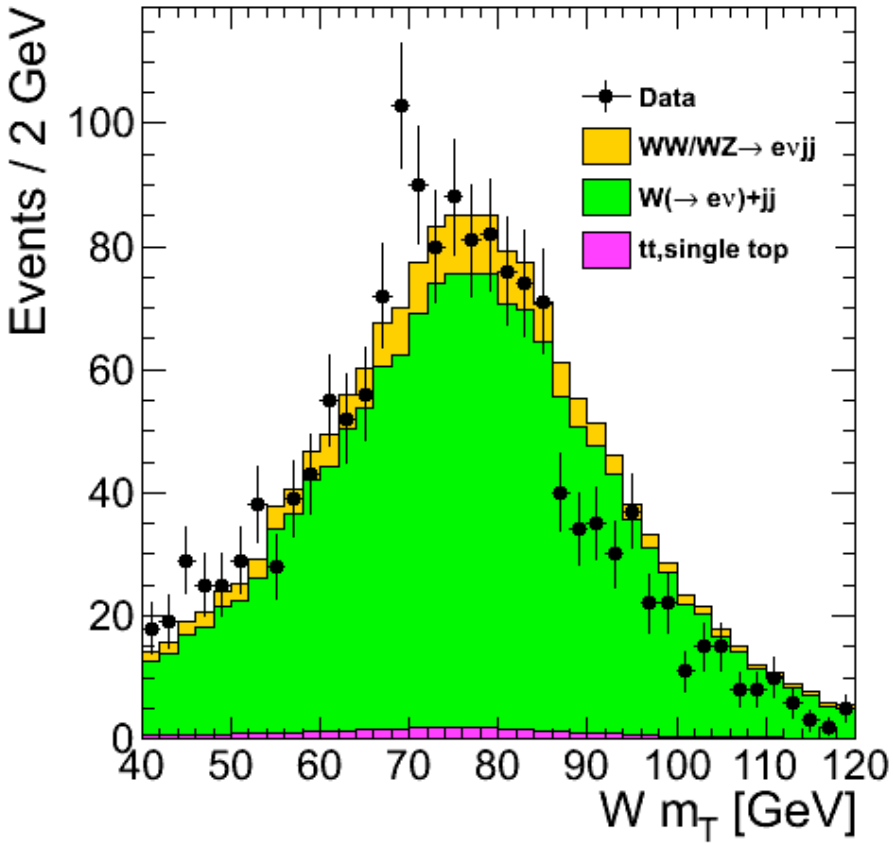
Apply standard "L2 L3" correction and "residual correction" in data

Using 36 pb^{-1} data from 2010 run

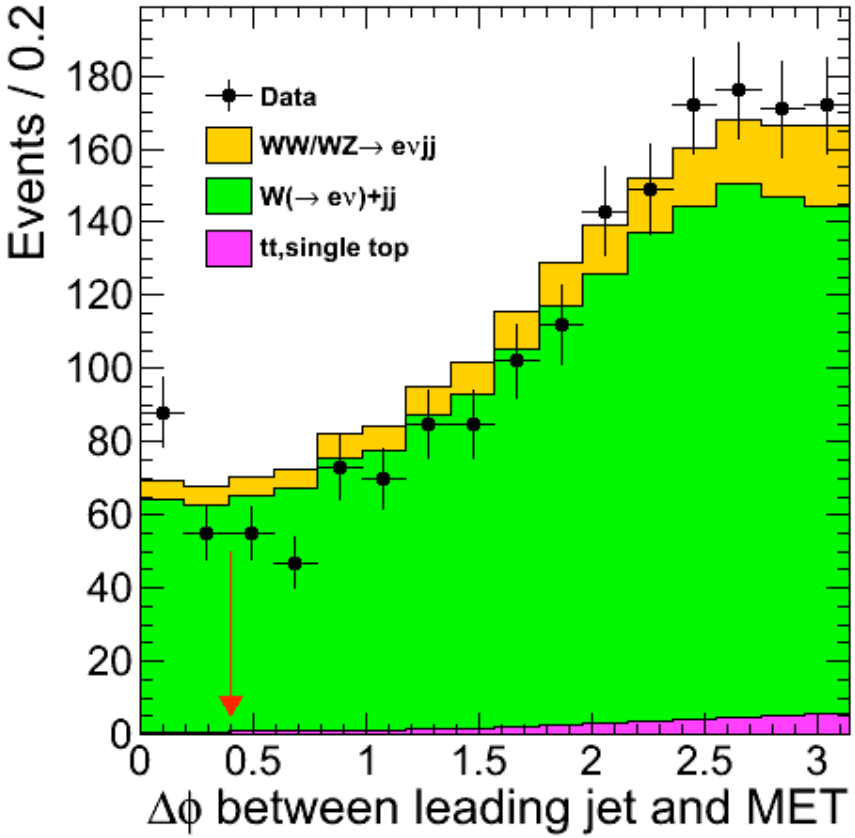
- •Start with ~92000 W(→ev) + N jets (where N ≥2) events where p_T^{jet} > 20 GeV
- •1600 events pass the above-listed W+jj criteria

MC: W+jets: Madgraph, Top: Powheg, WW+WZ: Pythia (all with pileup conditions observed in 2010 data)

Leptonic W and pfMET quality



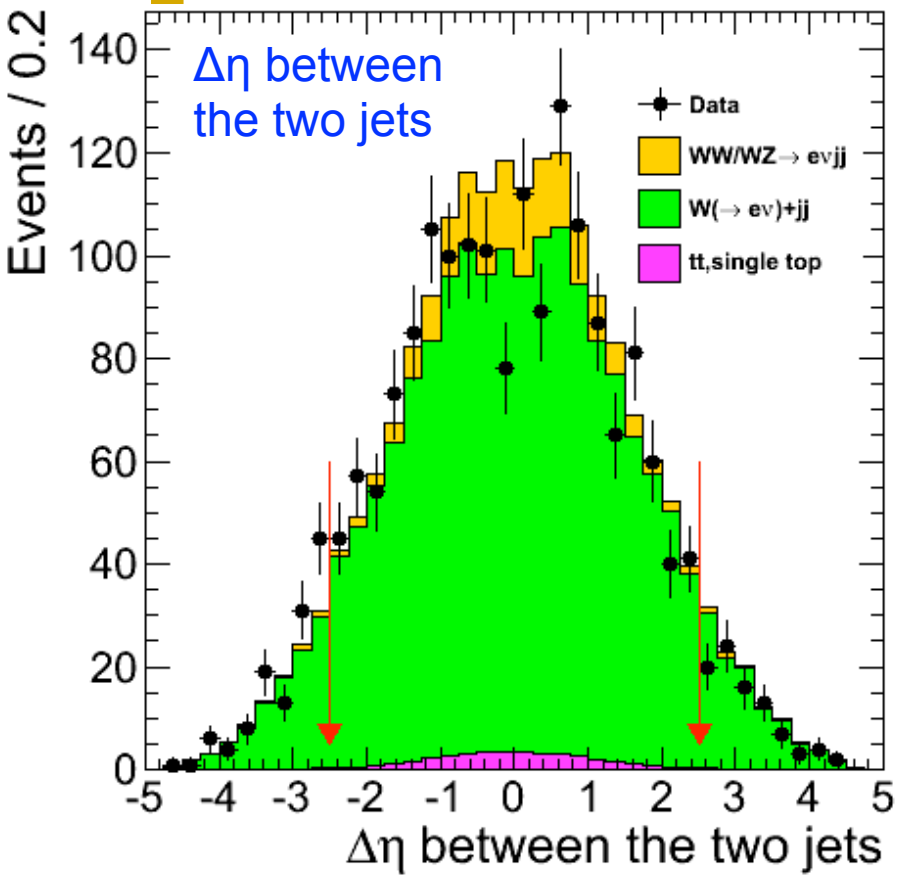
W transverse mass

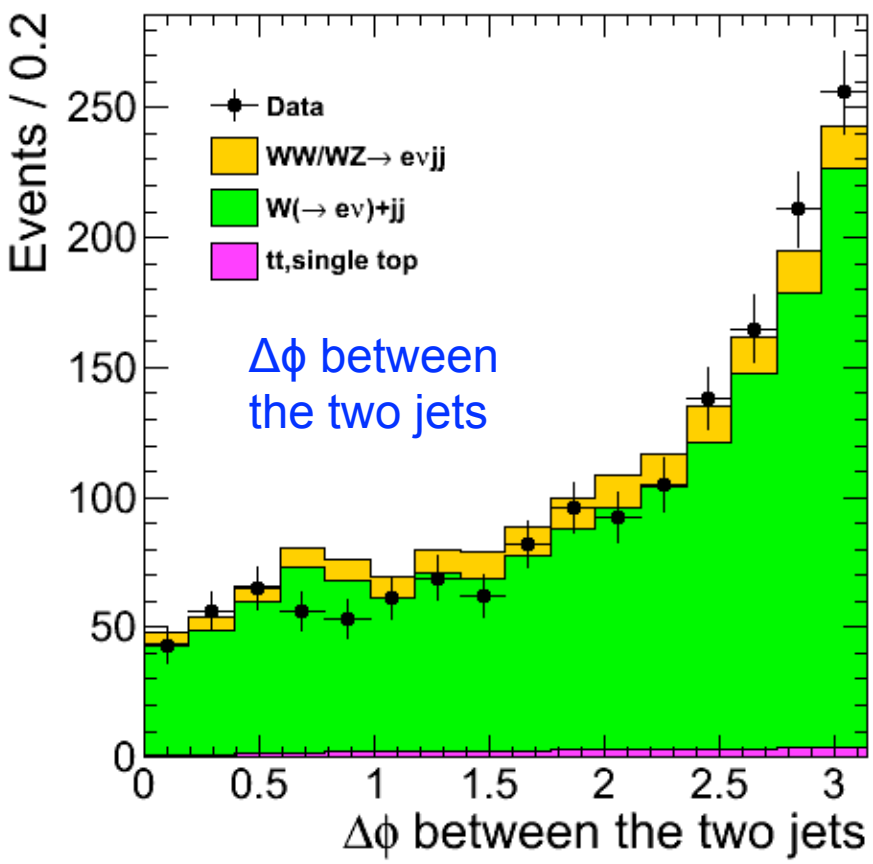


Δϕ (jet1, pfMET)

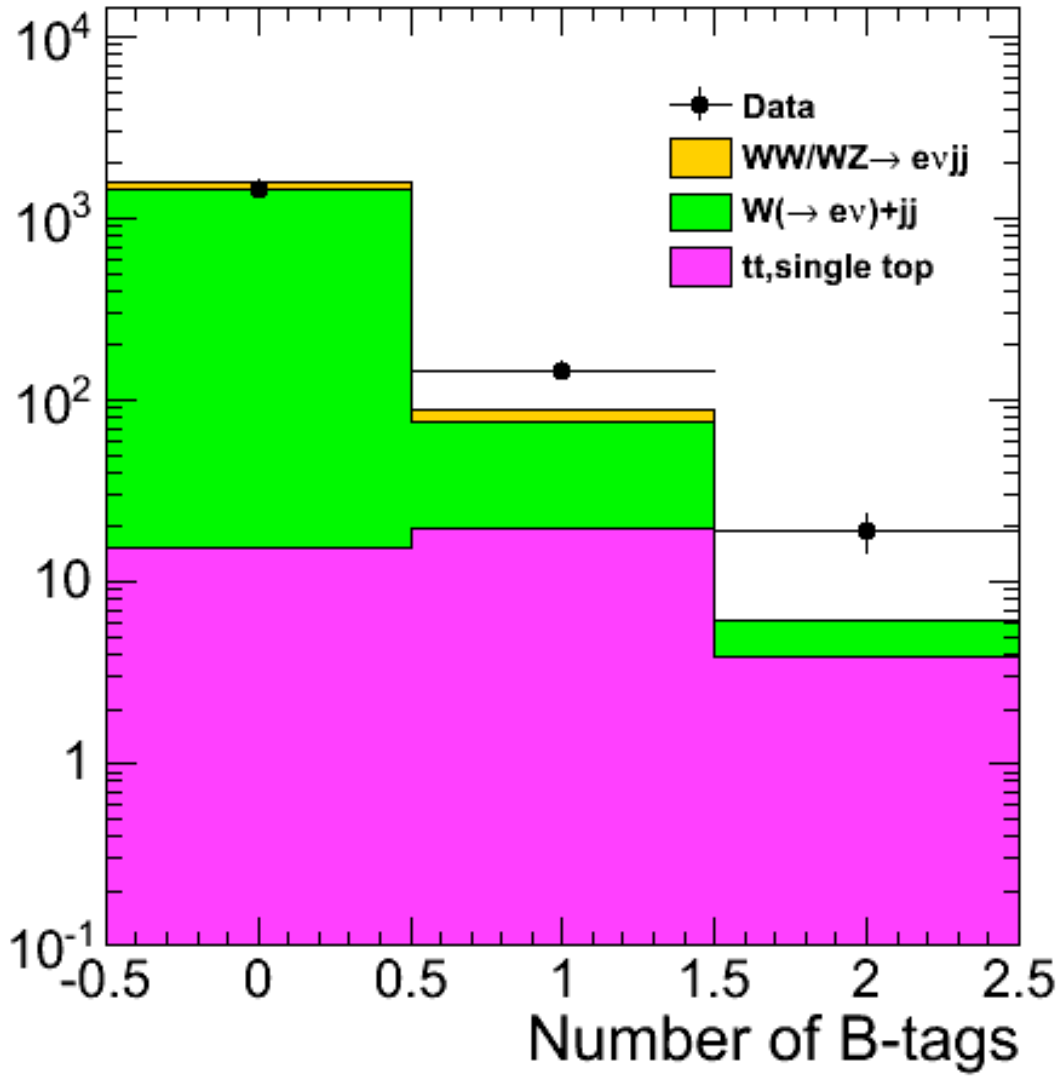
QCD multi-jet background is small after m_T>40 GeV cut and using super tight "WP70" electron Id. I haven't run over it yet, so this background is not shown here.

Angular information in dijet system





How many jets are b-tagged ?

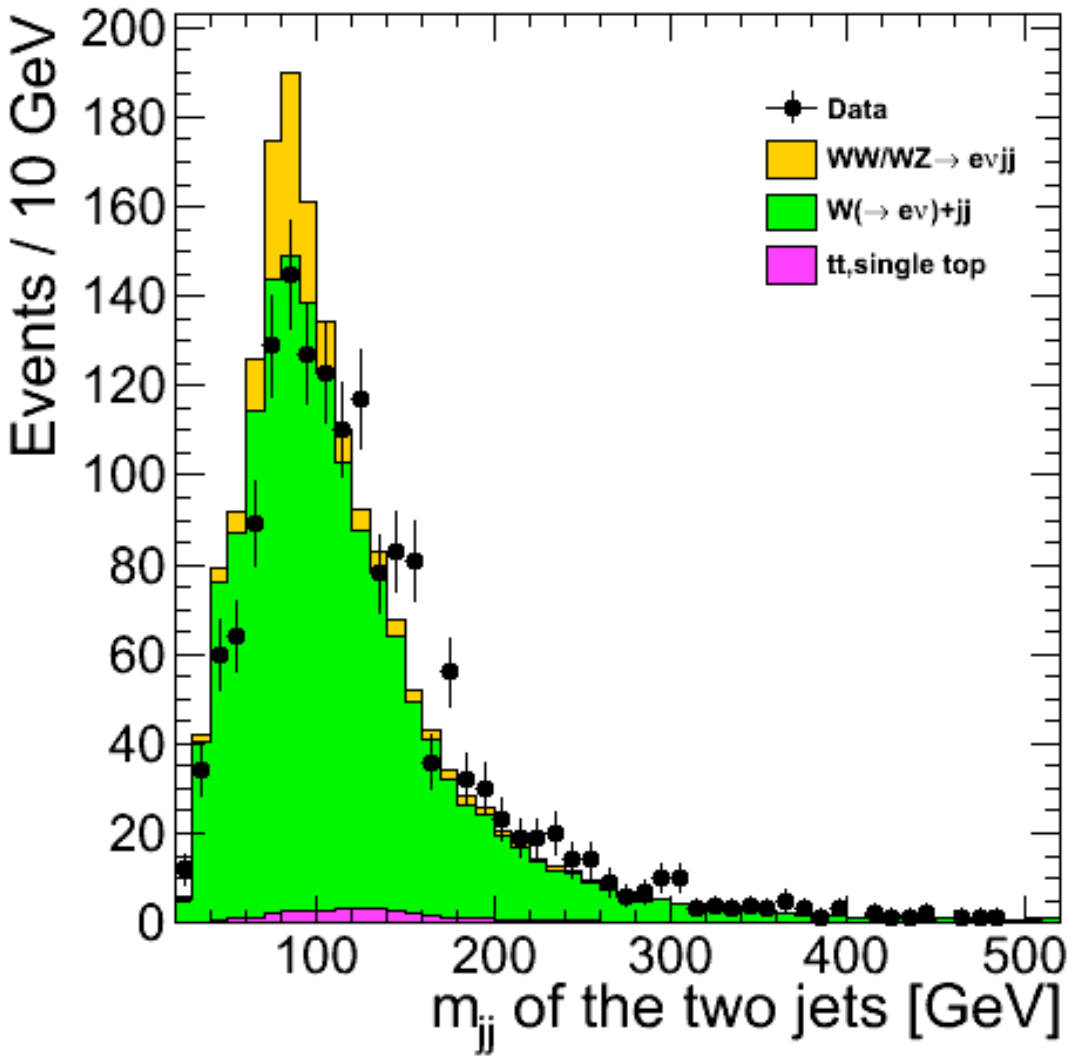


Using “simple secondary vertex (high efficiency)” medium working point.

SSV-HE medium

Potentially one can use the b-tag information to reduce/ eliminate top background. But we will NOT do so in the following slides.

m_{jj} distribution for W+jj events



observed events in data = 1595

MC predicts:

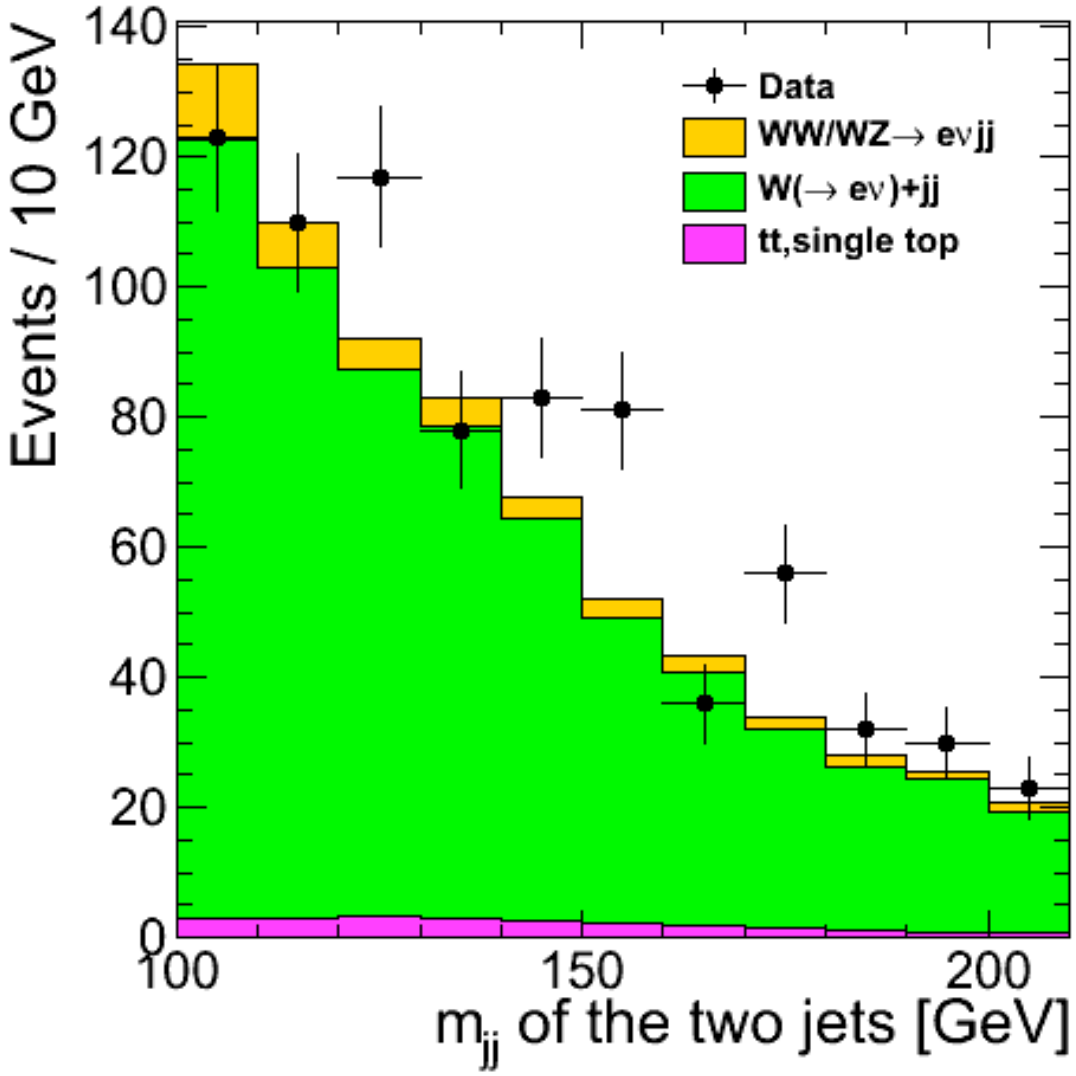
- W+jj = 1488
- WW + WZ = 165
- Ttbar + single top = 39

- Data-MC agreement depends crucially on the third jet cut
- Tighter cut on third jet makes the disagreement worse

(more on this in a later slide)

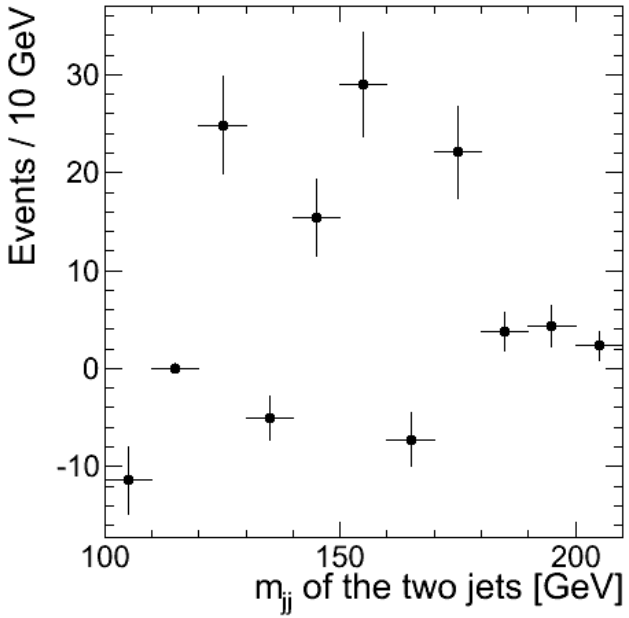
Zoomed-in version of this plot on next slide ➠➠➠

m_{jj} distribution in narrow range 100-200 GeV

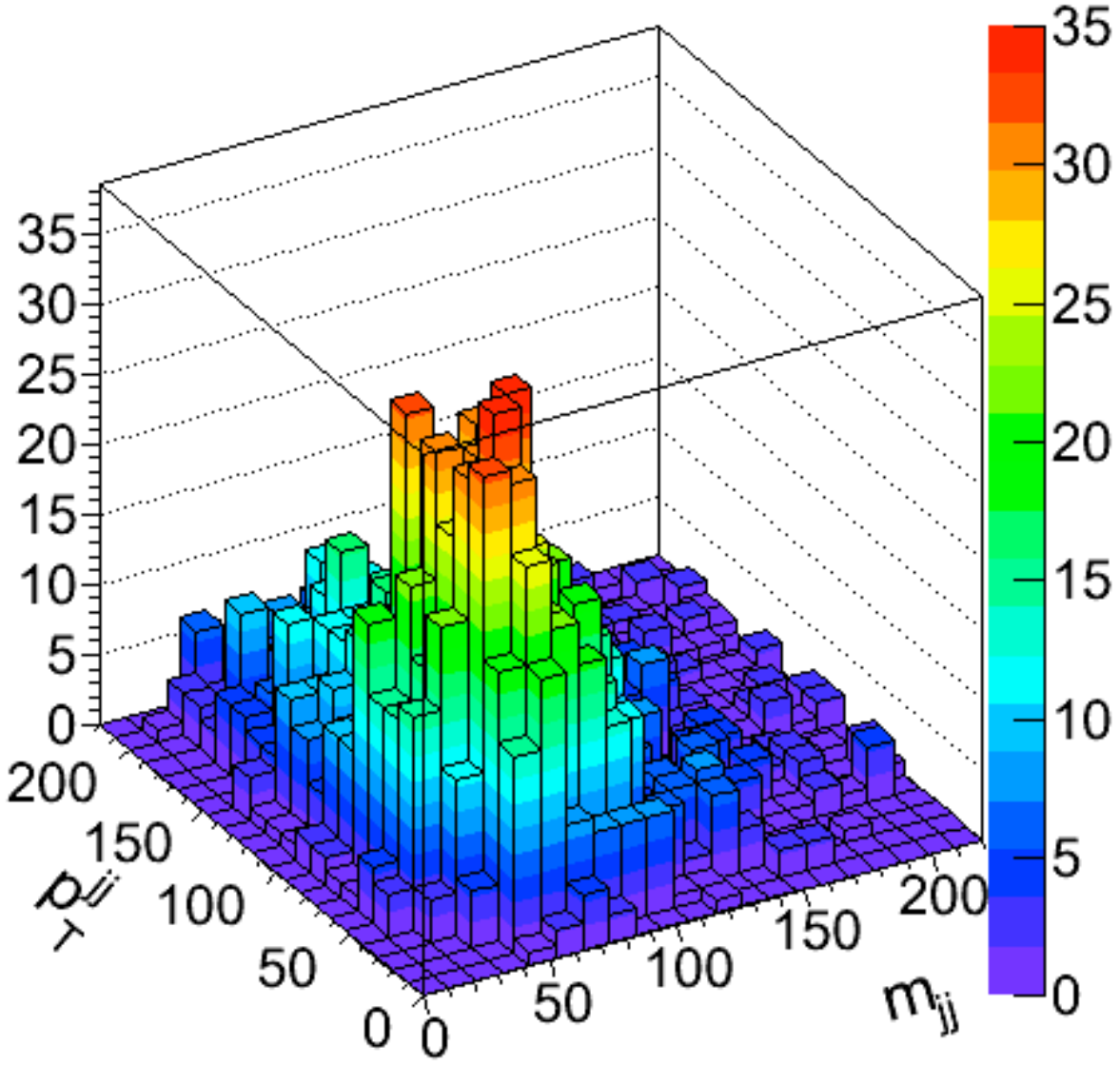


No clear evidence of peak in data. Error bar on data shows statistical uncertainty.

after Bkg subtraction

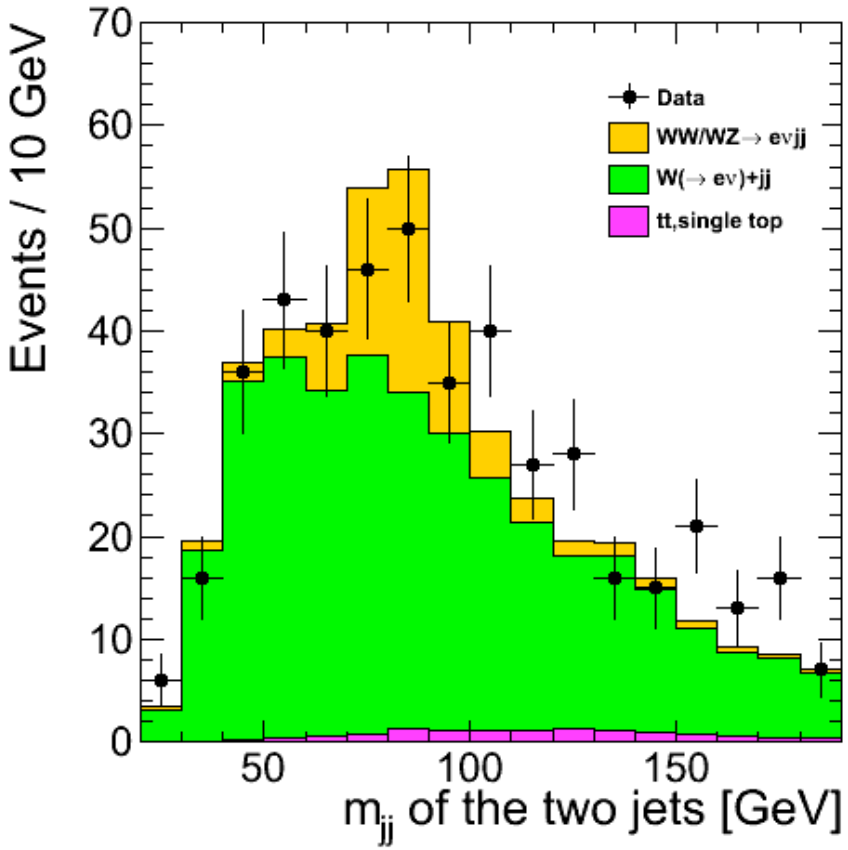


m_{jj} versus p_T^{dijet}



Why I didn't see W/Z peak in m_{jj} distribution?

Because the sample is dominated by W+jj events. In order to see hadronic W peak from WW events one needs to increase their relative fraction by tightening the Δη cut and requiring the hadronic and leptonic W's to be back-to-back in ϕ, i.e., $\Delta\Phi(W^{lept}, W^{had}) \approx 180°$



Require:

$|\Delta\eta| < 1.3,$
$|\Delta\Phi(W^{lept}, W^{had}) - \pi| < 0.2$

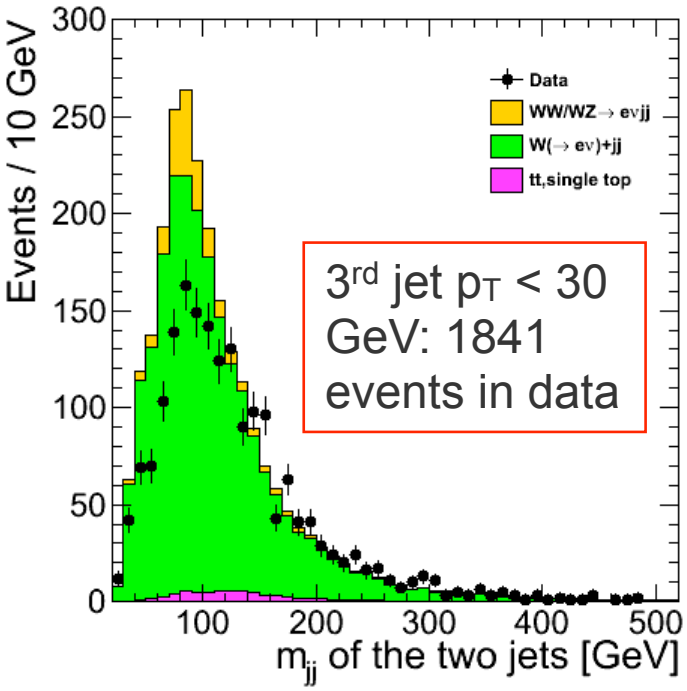
We get:

observed events in data = 455
MC predicts:
- W+jj = 351
- WW + WZ = 74
- Ttbar + single top = 12

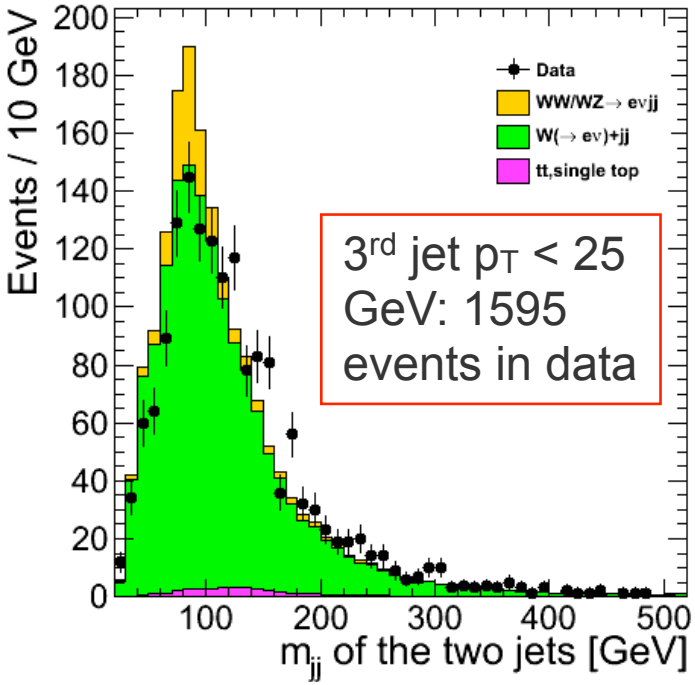
The shoulder from hadronic W/Z is clearly visible (S/B ≈ 1/5−1/6).

What is the dependence on 3rd jet cut ?

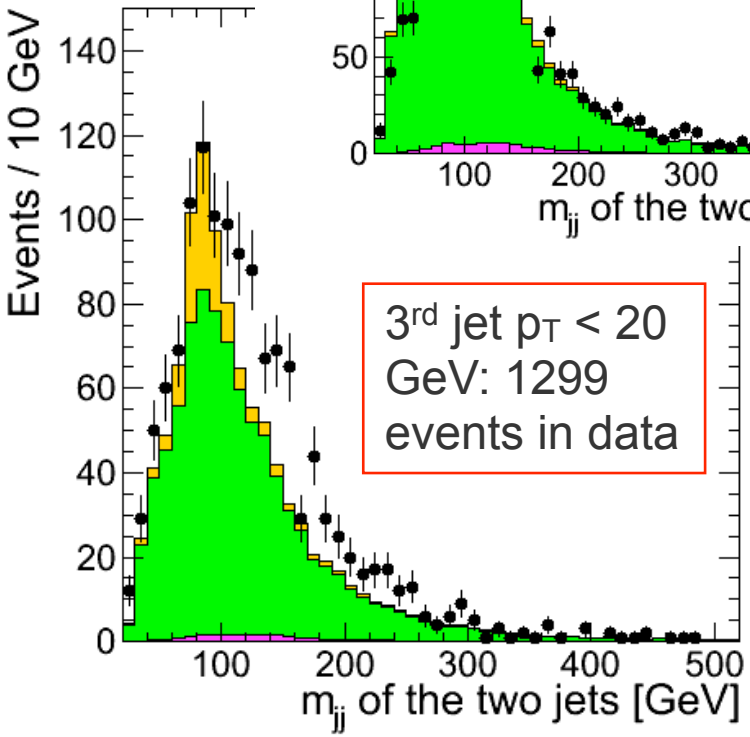
A lot ! Both normalization & shape depend on it. Data-MC agreement gets worse w/ tighter 3rd jet cut.



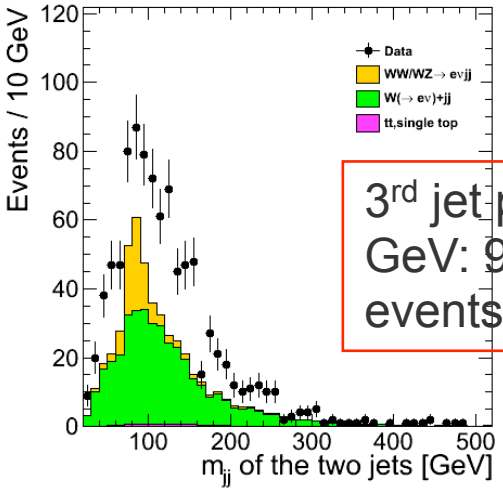
3rd jet p_T < 30 GeV: 1841 events in data



3rd jet p_T < 25 GeV: 1595 events in data



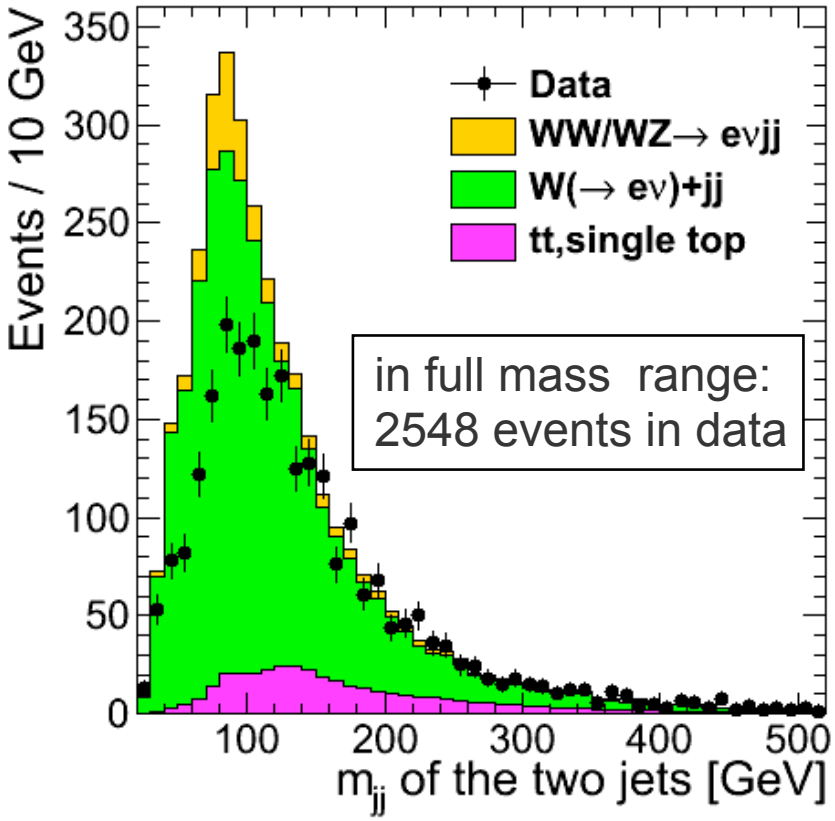
3rd jet p_T < 20 GeV: 1299 events in data

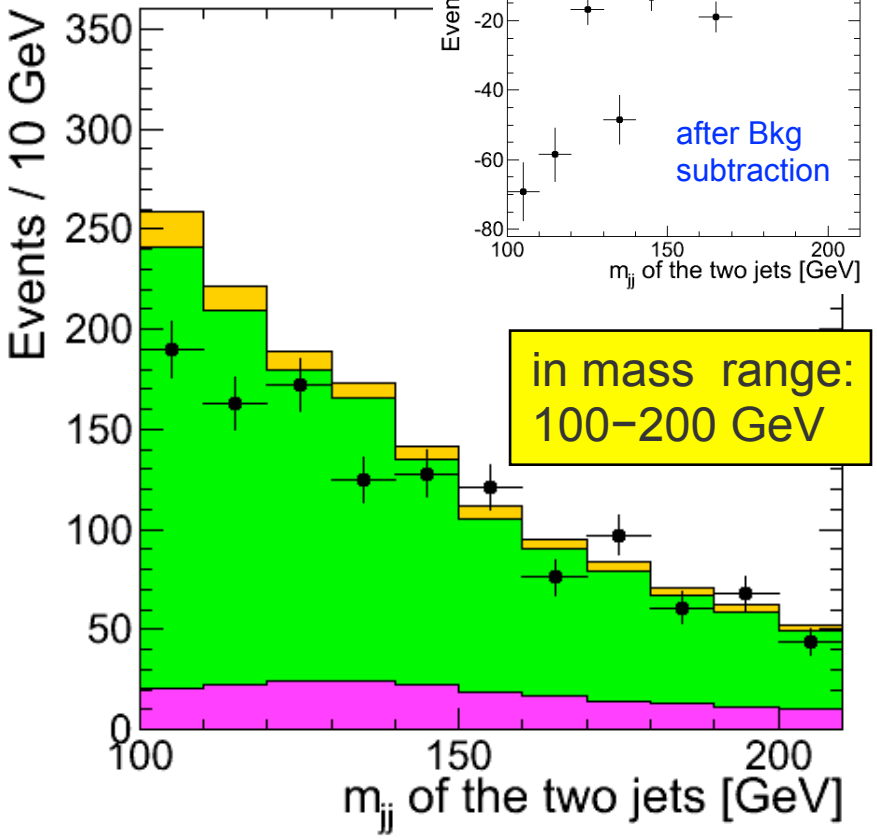


3rd jet p_T < 15 GeV: 931 events in data

What if I do not apply 3rd jet cut ?

Now looking at m_{jj} distribution in W+N jets (where N ≥ 2) events





See no excess in the mass range 100−120 GeV.