

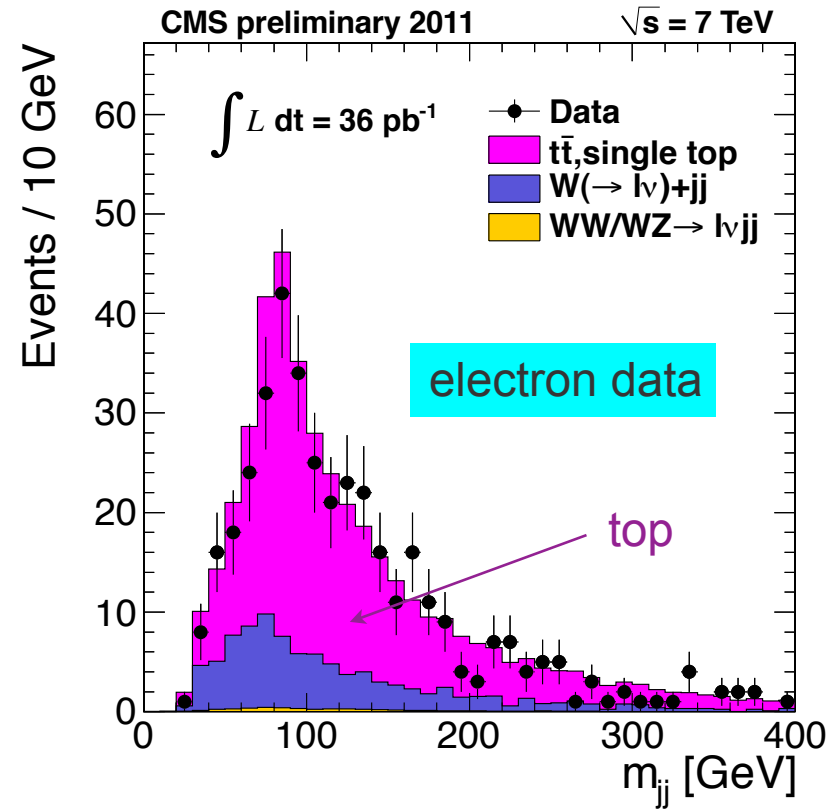
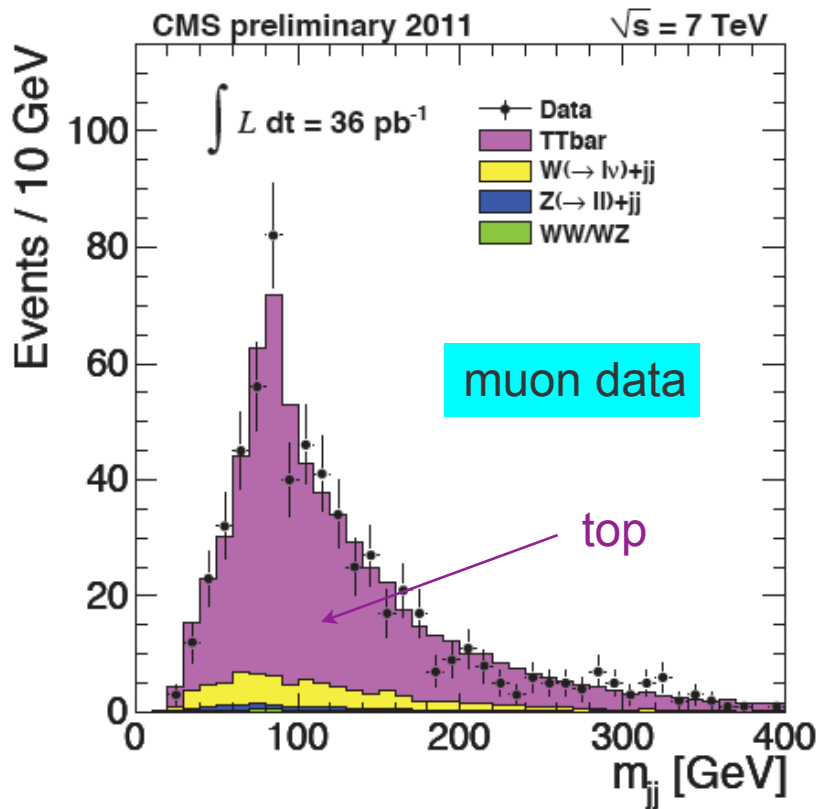


A quick look at 2011 data

Hadronic W in top events: 2010 data

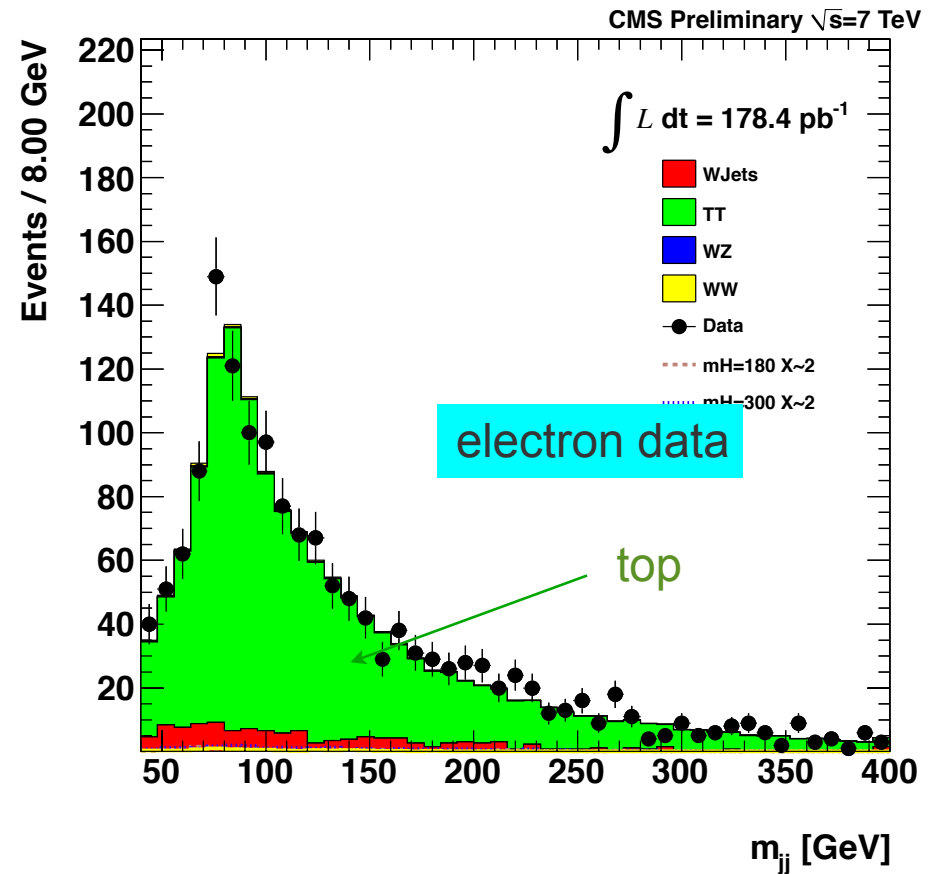
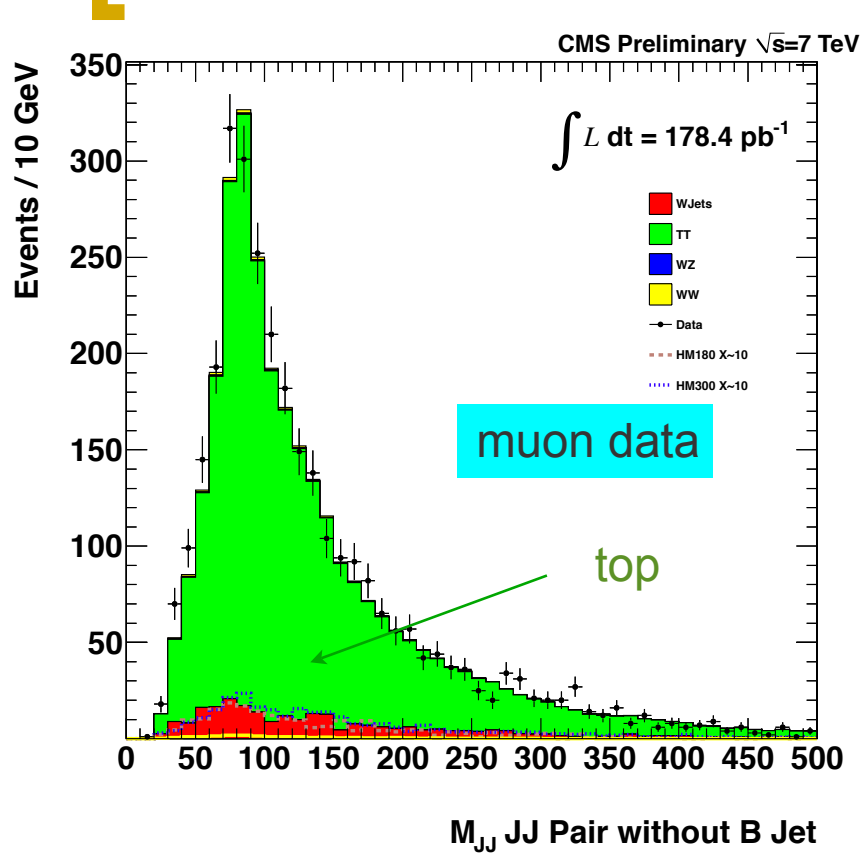


In top events reconstruct clear W peak almost “out-of-box” with good resolution



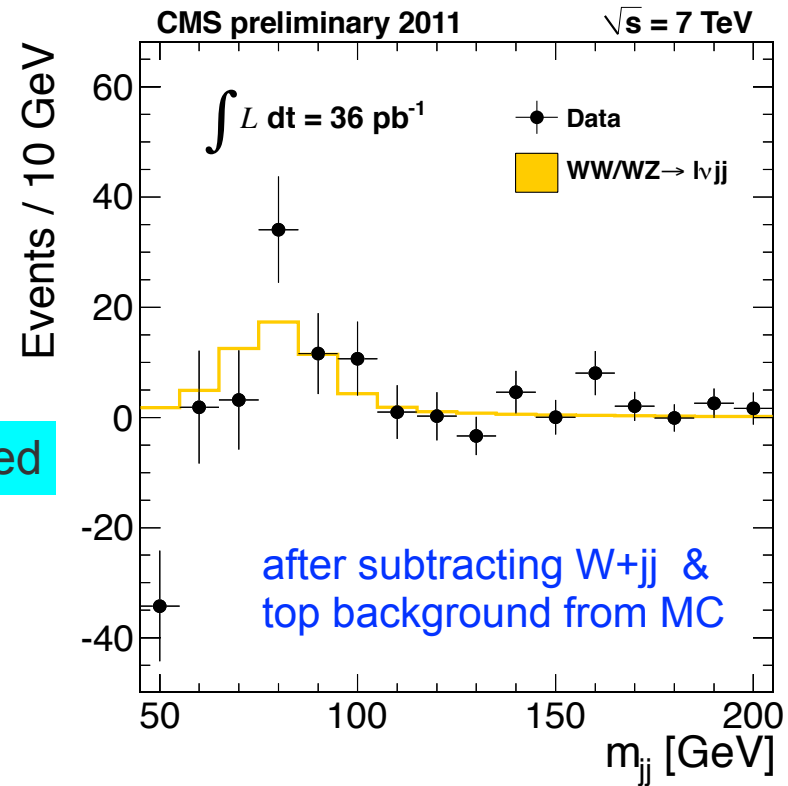
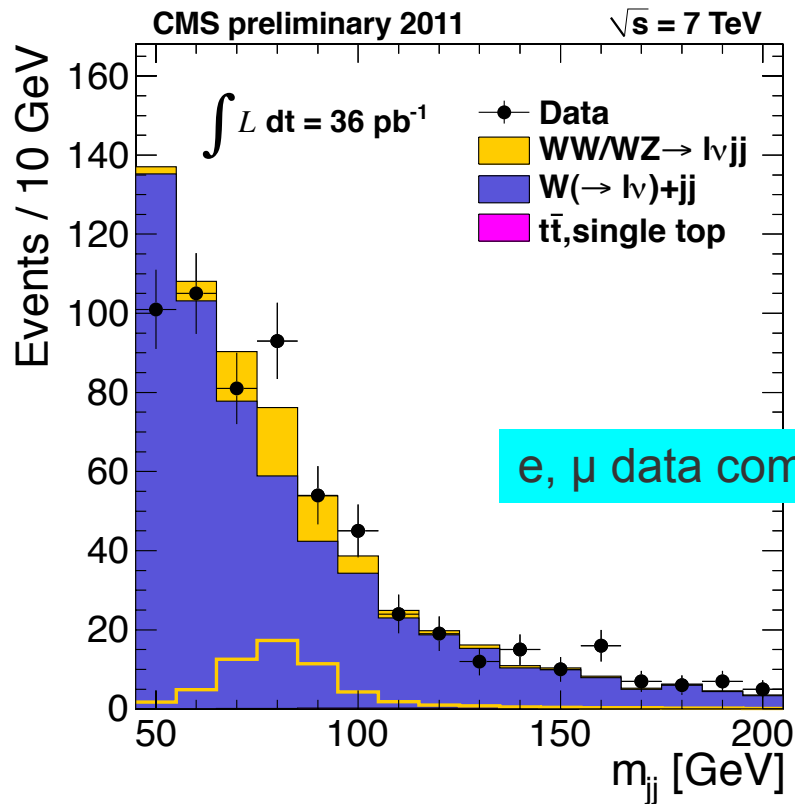
Just require ≥ 4 jets above p_T 25 GeV, ≥ 1 b tag and leptonic W (muon: $p_T > 20$ GeV, $MET > 20$ GeV; electron: $E_T > 25$ GeV, $MET > 25$ GeV). Then plot m_{jj} of the two jets which are not b-tagged. Keep all combinations.

Hadronic W in top events: 2011 data



- Overall looks good
- Can still reconstruct hadronic W in the top events in 2011 data :)

W/Z peak in W+jj events: 2010 data



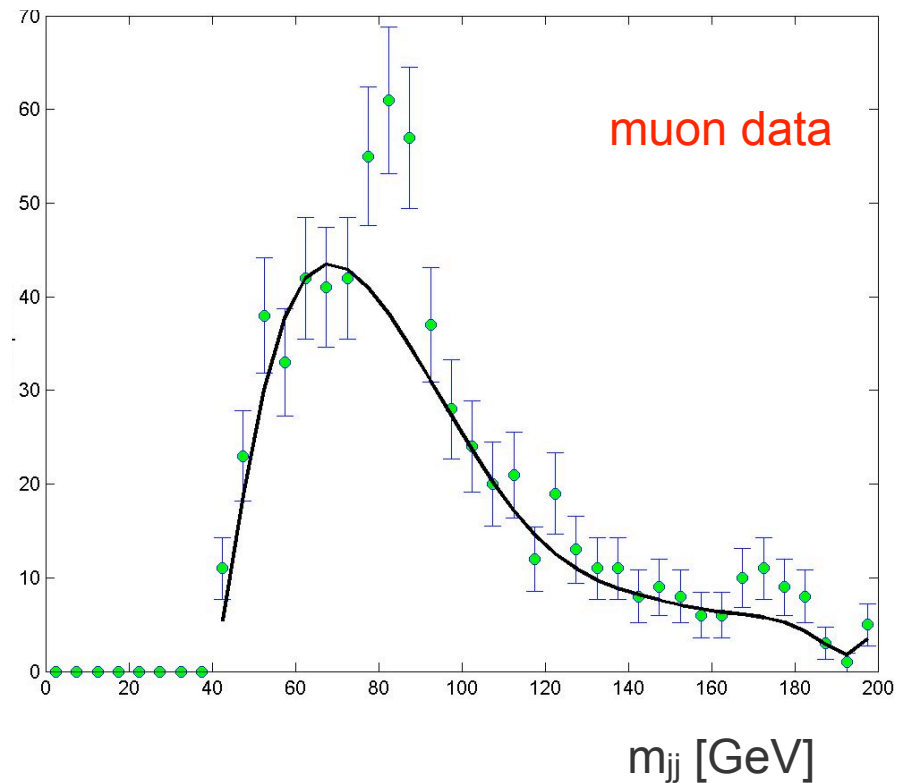
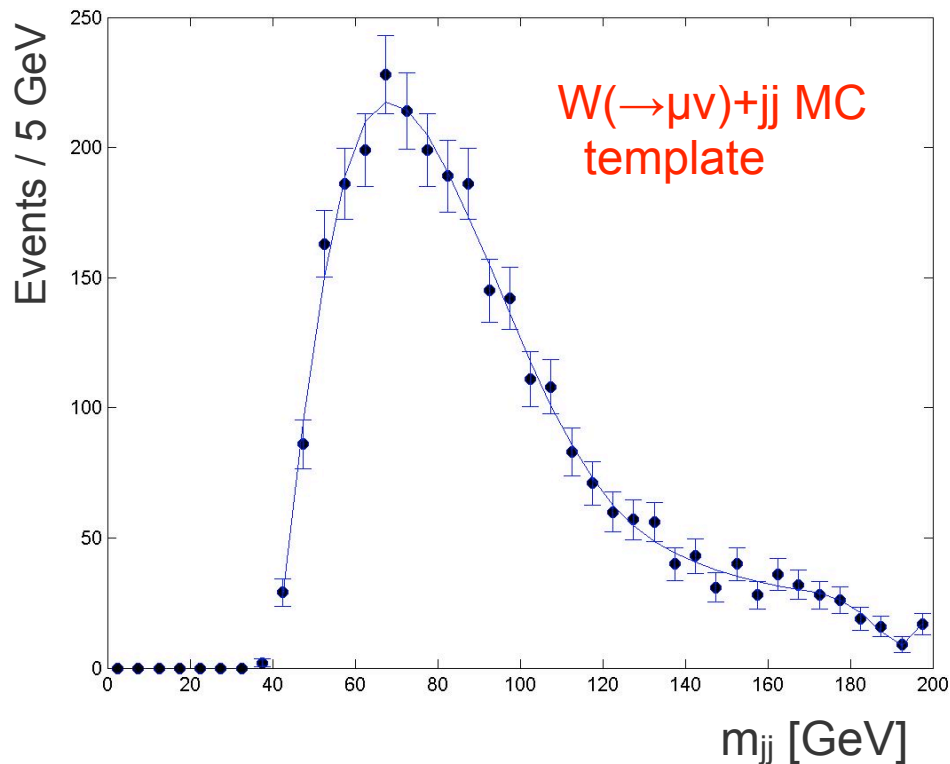
After applying top veto and few simple kinematic cuts see clear peak from hadronic W and Z. Cannot resolve between the two.

observed events in data = 600, MC predicts:
 W+jj = 554, $T\bar{t}$ + single top = 2, WW + WZ = 58

After some optimization Dan had better S/B

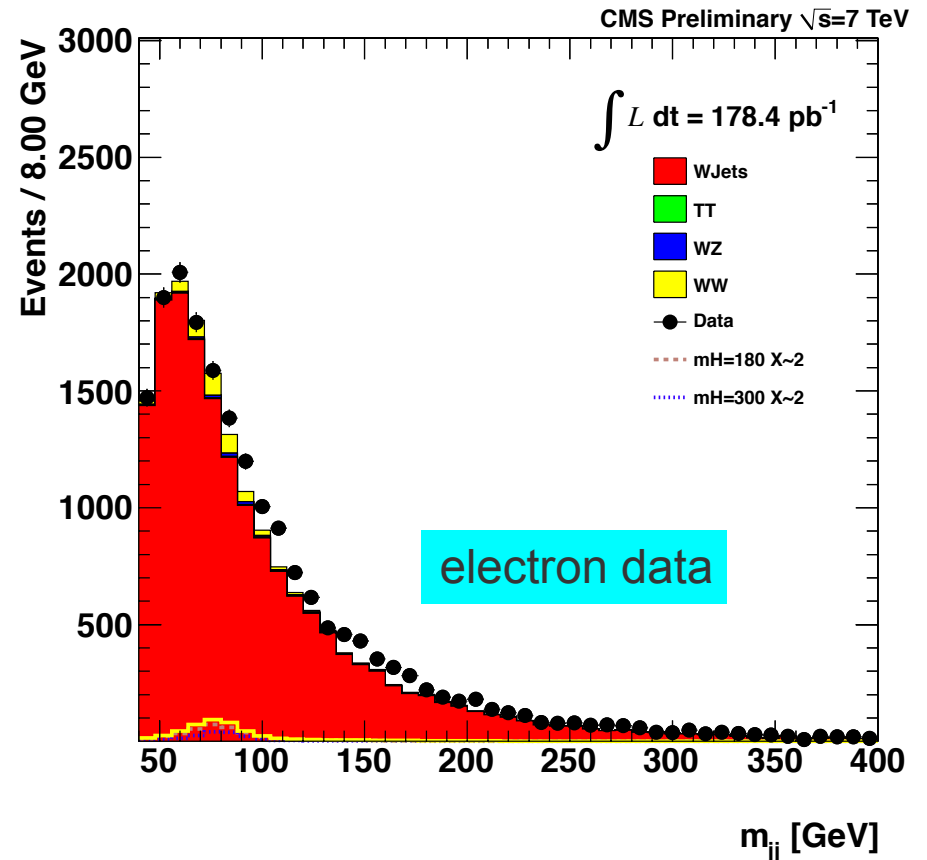
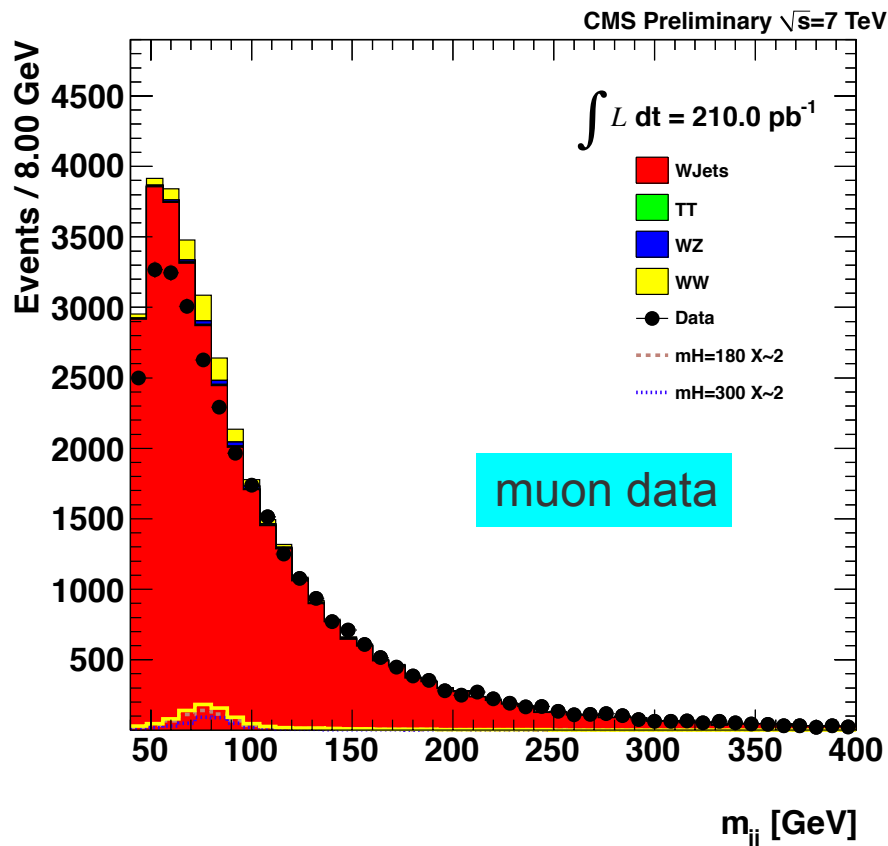


Exploit the angular variables (e.g., angle between the decay planes, Jackson angle etc.) to suppress W +jets bkg.



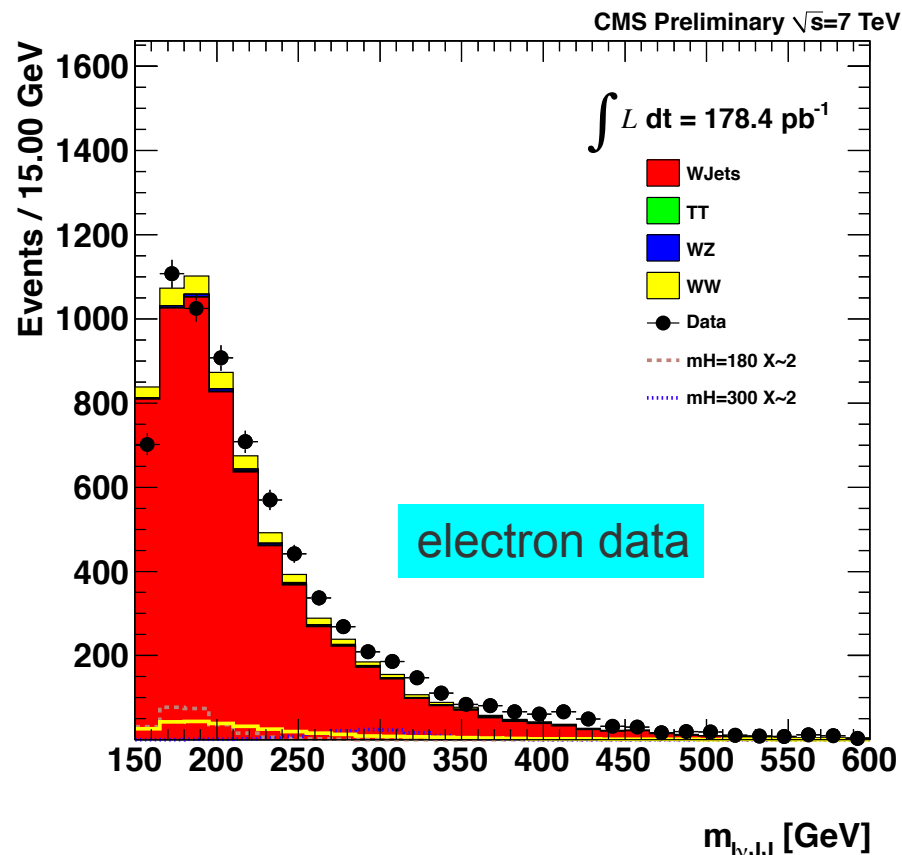
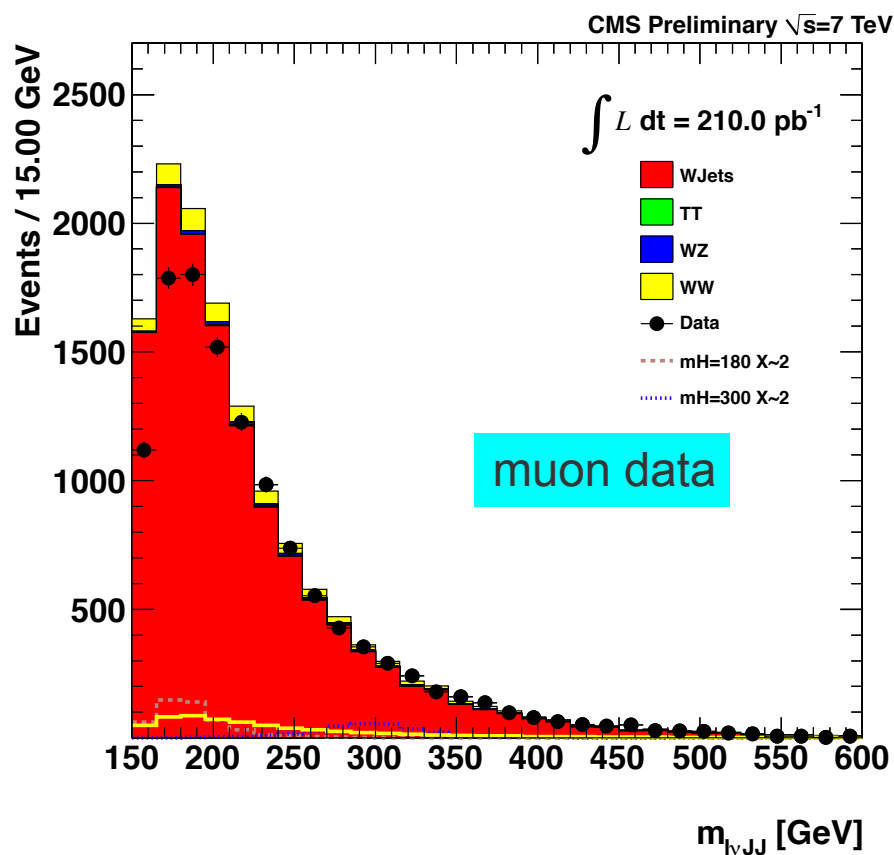
The fit after all cuts is to the W_{jj} MC shape. The evidence remains for a W signal in the μ data with $\sim 60 \pm 20$ events above a smooth background.

m_{jj} in W+jj events: 2011 data –out-of-box



Just require =2 jets above p_T 20 GeV, =0 b tag and leptonic W (muon: $p_T > 25$ GeV, electron: $E_T > 30$ GeV; MET > 25 GeV).

m_{lvjj} in W+jj events: 2011 data –out-of-box



N-1 distributions

Look at following variables after applying cut on other variables:

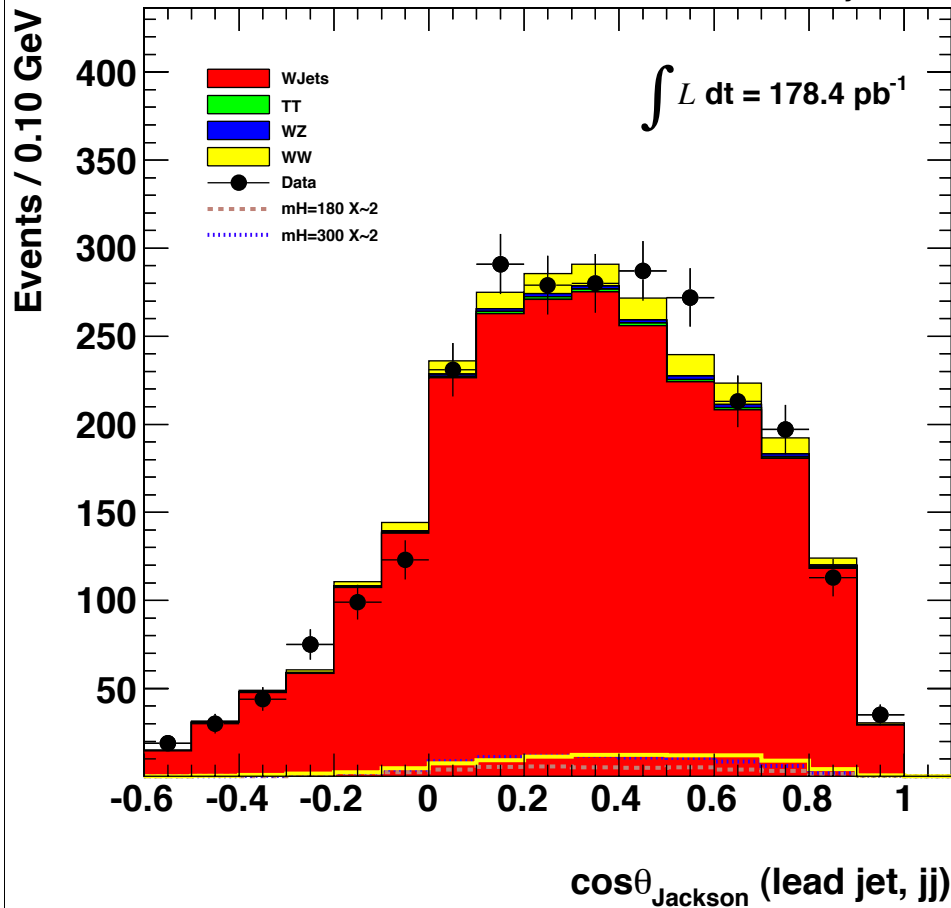
- **Three Jackson angles (in CM frame):** of lepton in $W_{l\nu}$ frame, of leading jet in W_{jj} frame, and of $W_{l\nu}$ in WW frame
- **WW kinematics:** Angle between the decay planes of the hadronic and leptonic W , $\Delta\phi$ between the two W 's, Jacobian = $W p_T / m_{l\nu jj}$
- **Jet kinematics:** centrality, $\Delta\phi(j1, j2)$, $\Delta\phi(j1, MET)$

Plots from e data: the two Jackson angles



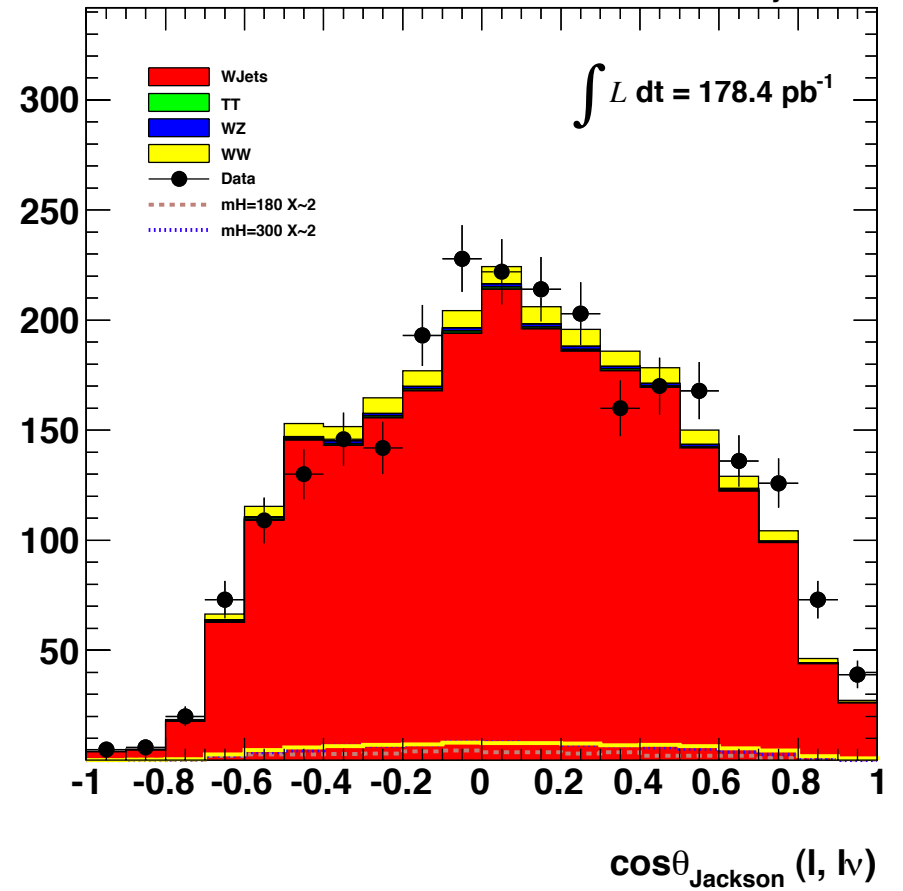
$W \rightarrow jj$

CMS Preliminary $\sqrt{s}=7$ TeV



$W \rightarrow e\nu$

CMS Preliminary $\sqrt{s}=7$ TeV

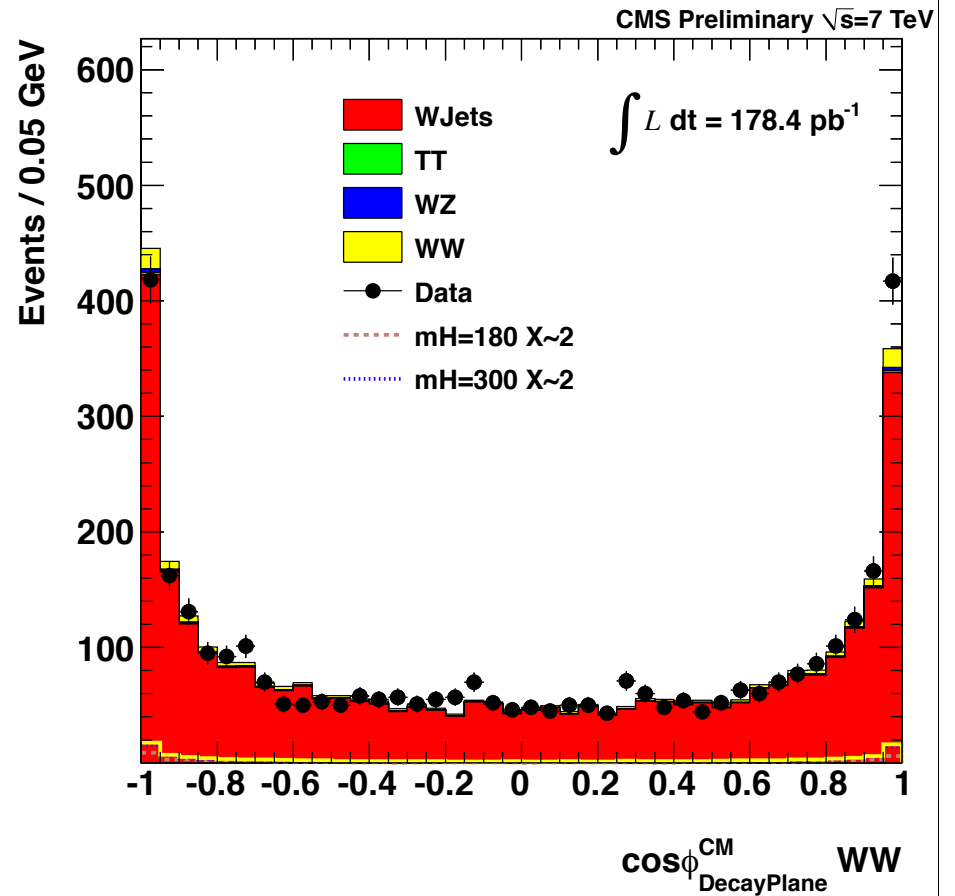
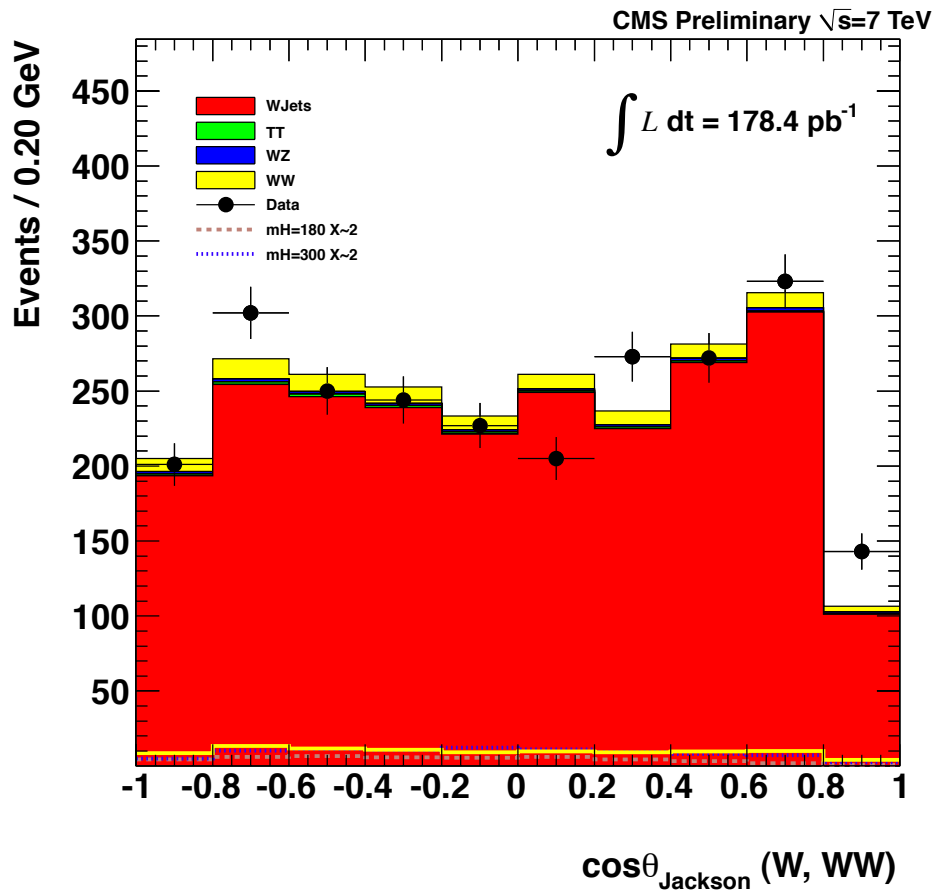


Plots from e data: WW kinematics - I



Jackson angle

Angle between decay planes

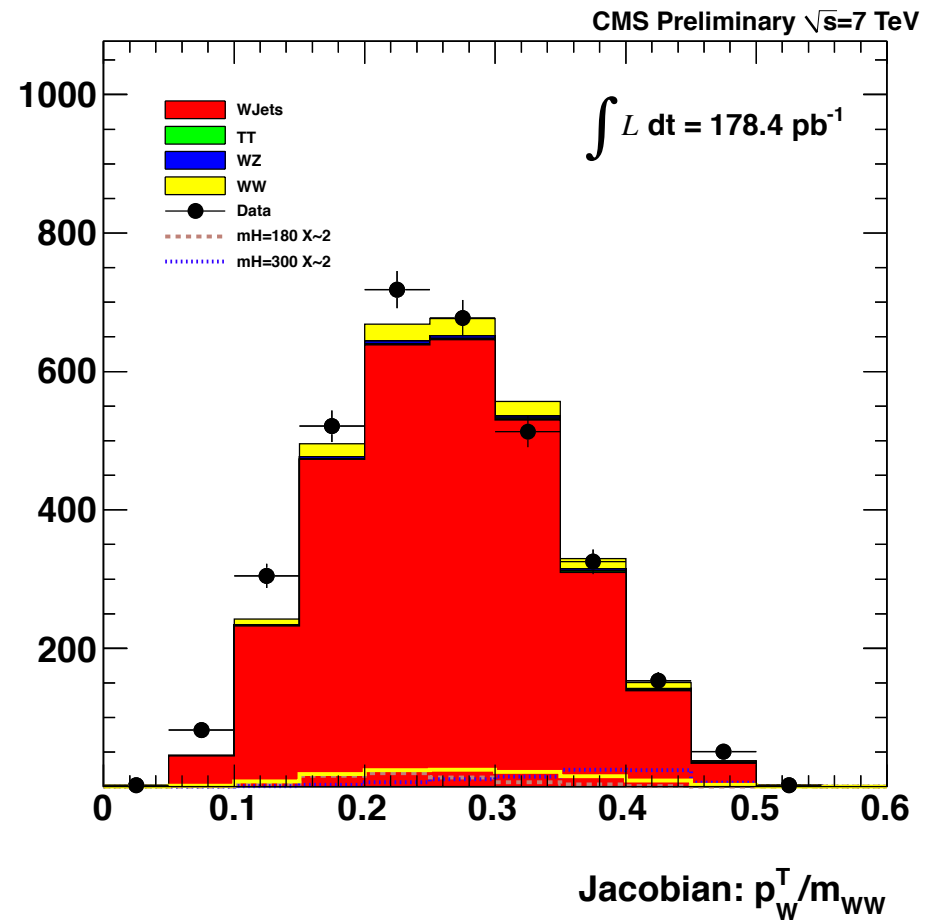
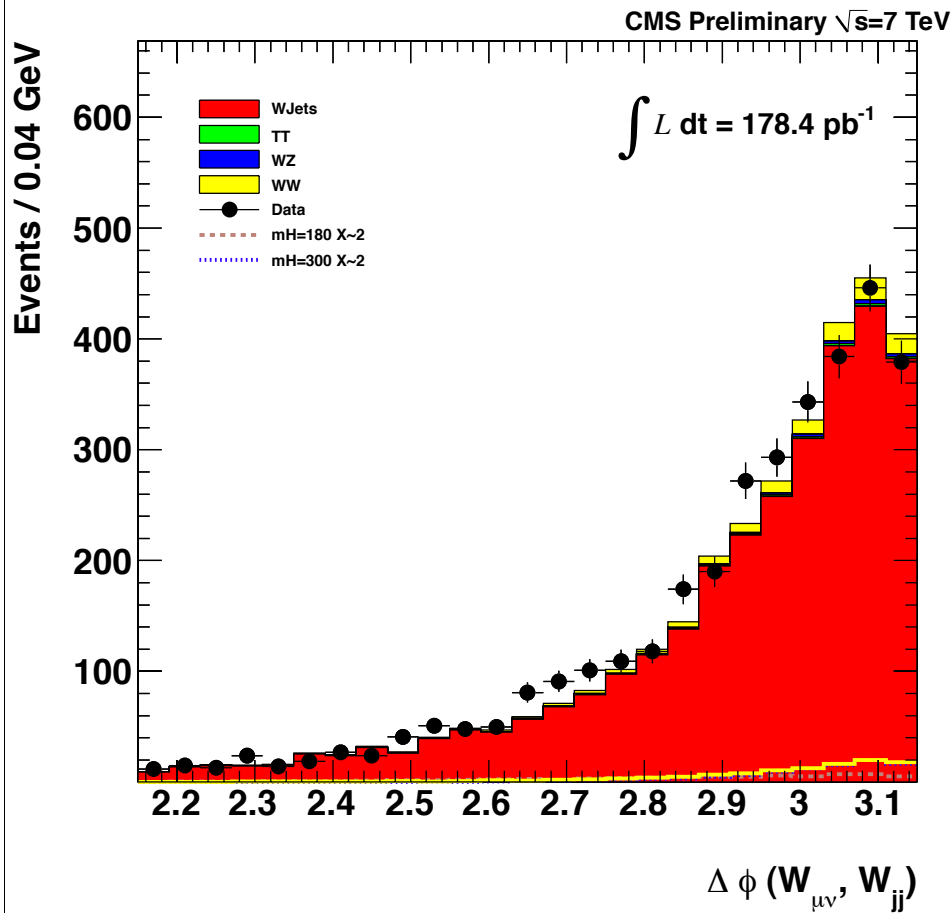


Plots from e data: WW kinematics - II



Angle between leptonic and hadronic W in the lab frame

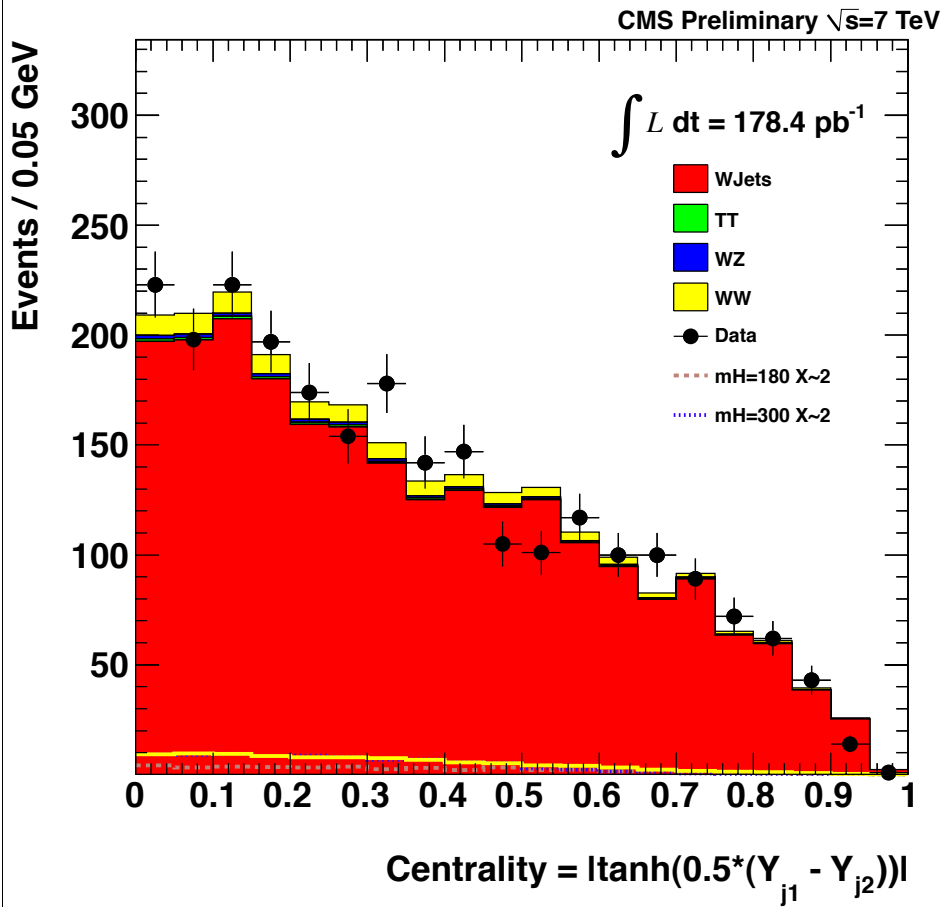
Jacobian



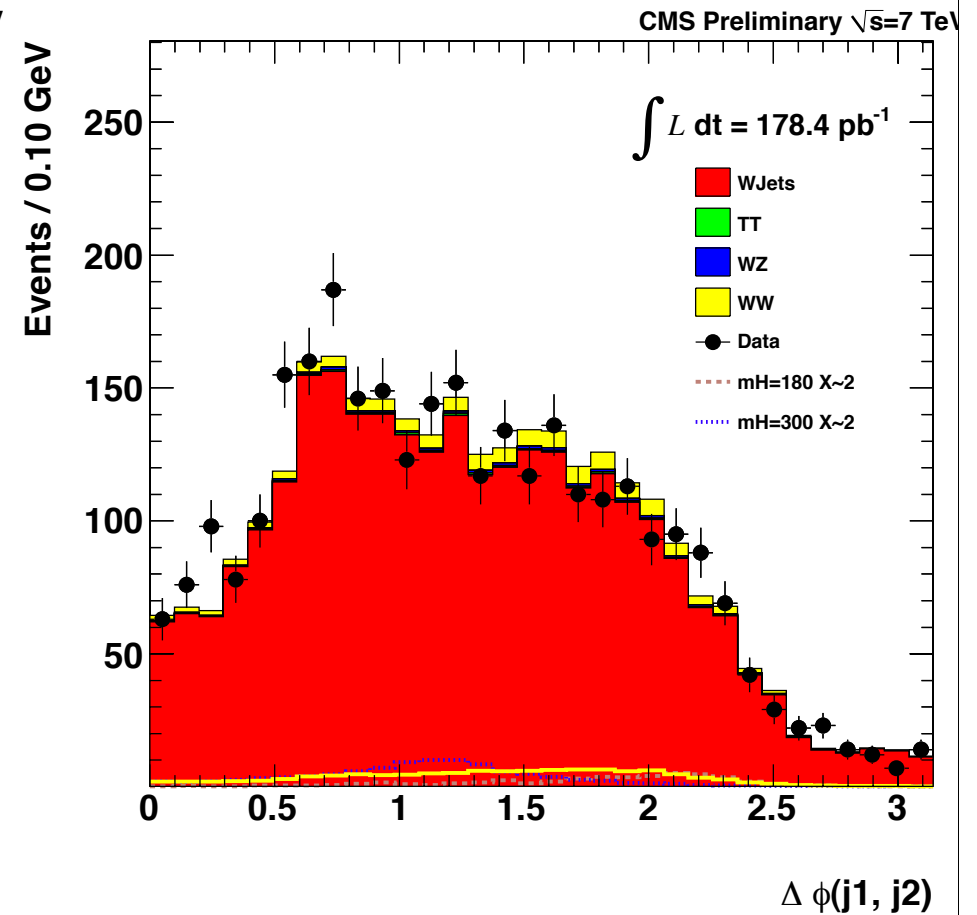
Plots from e data: jet kinematics - I



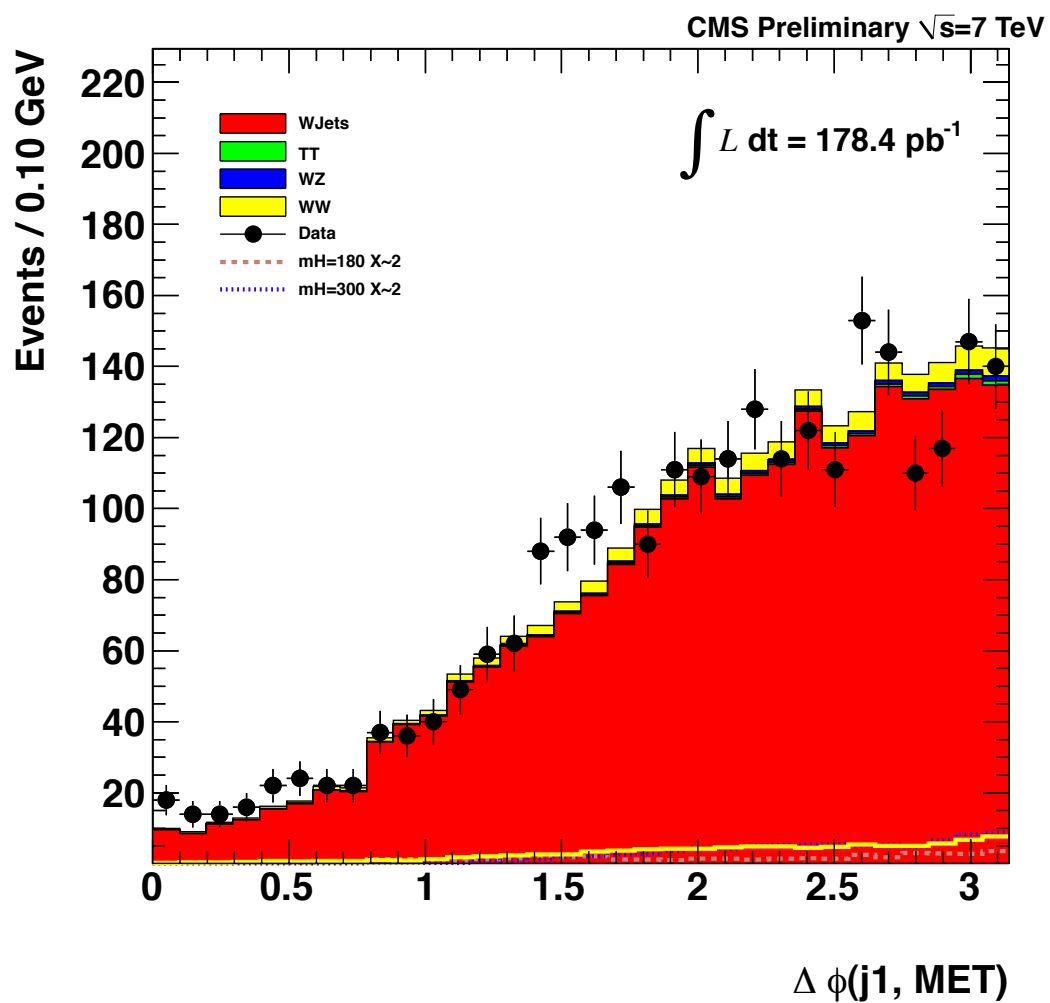
Dijet centrality



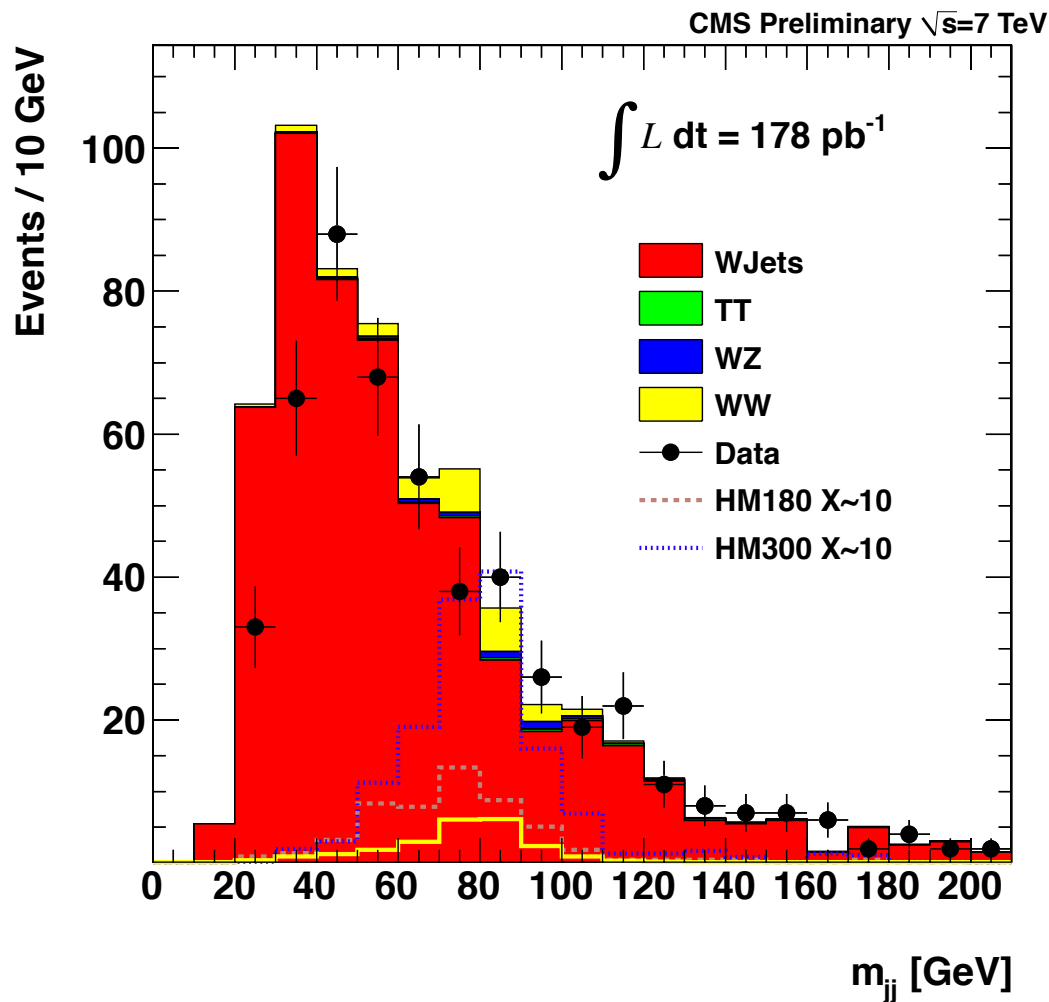
azimuthal separation



Plots from e data: jet kinematics - II

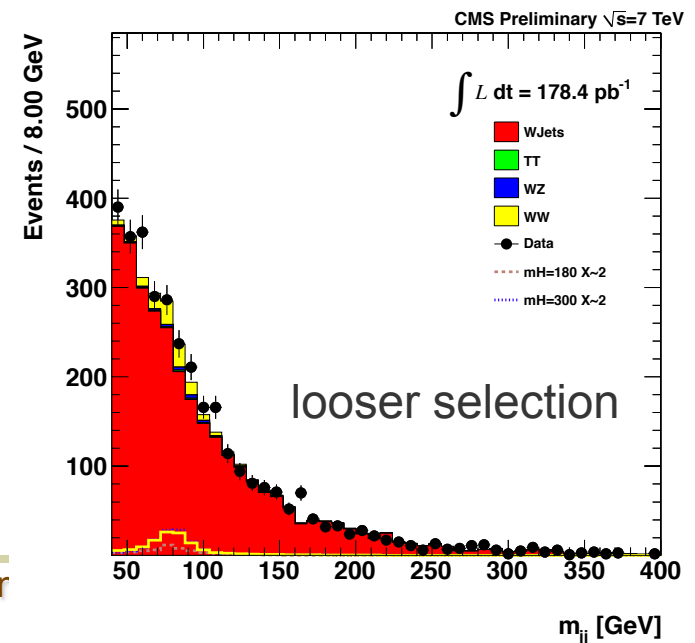


W/Z peak in W+jj events: 2011 data: ele

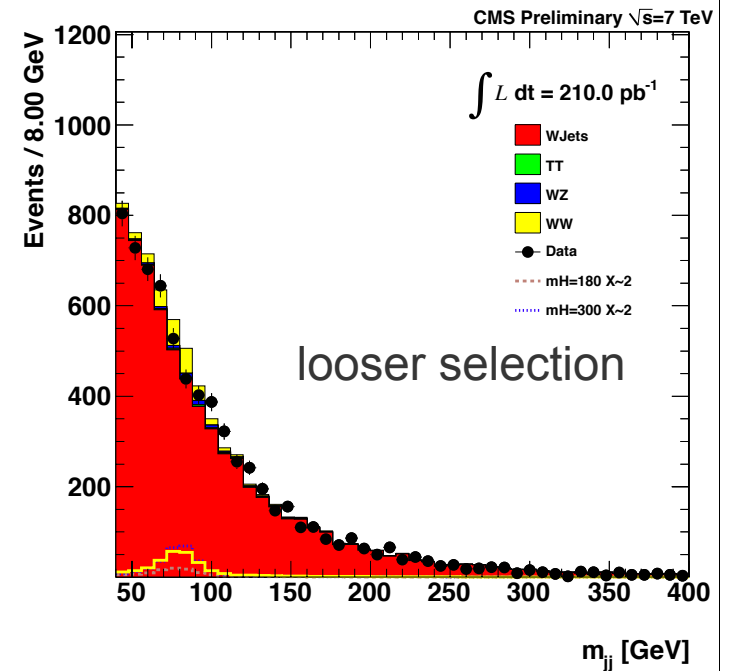
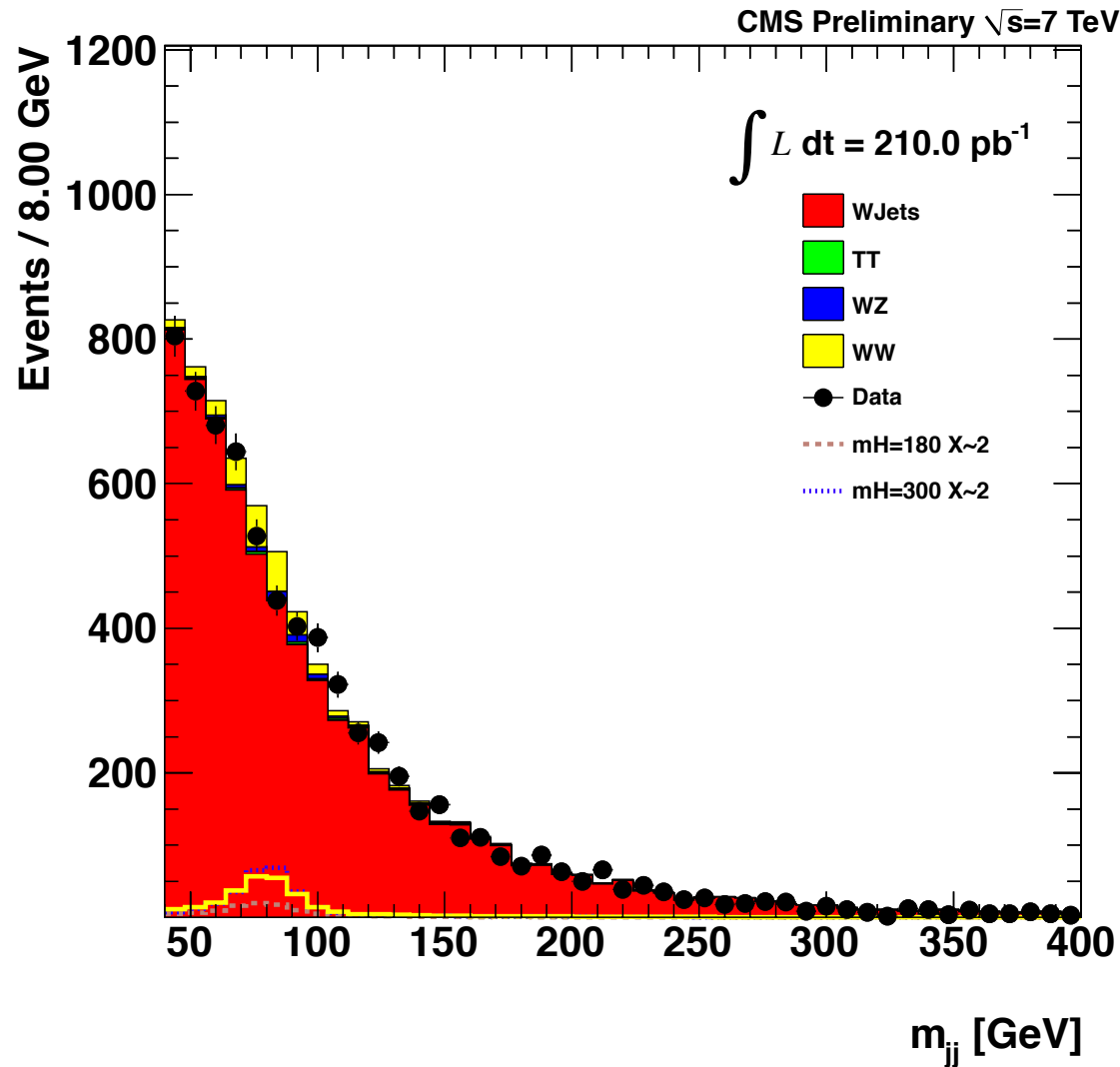


Summary of all cuts I applied:

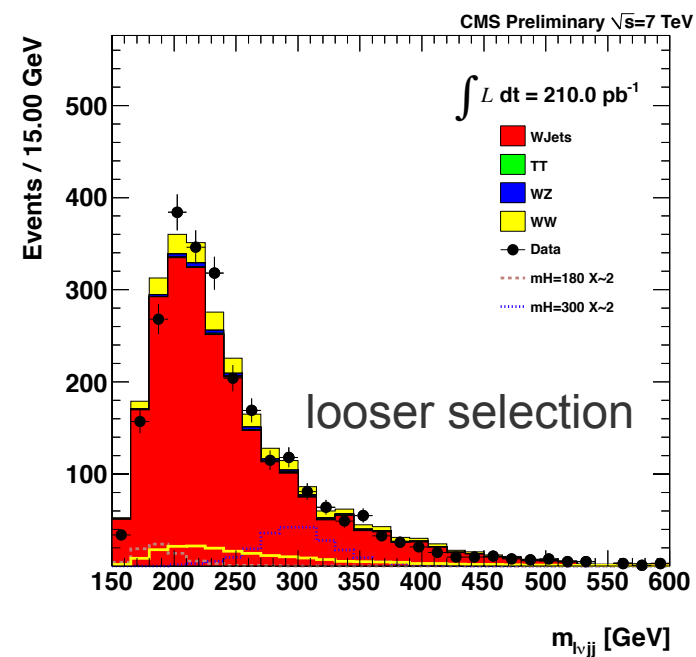
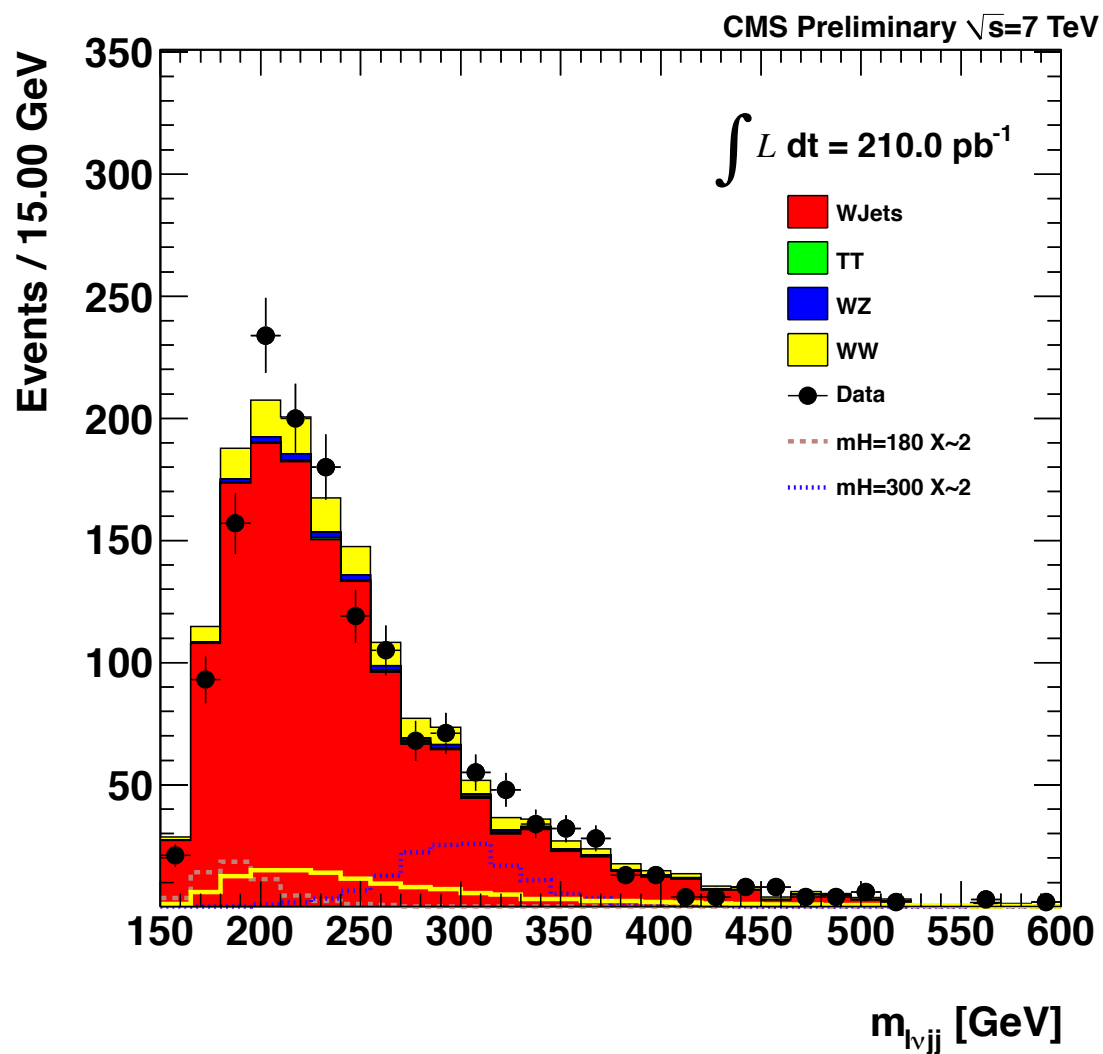
- $-0.6 < \cos\theta < 0.8$ for c_{jj}
- $-0.8 < \cos\theta < 0.8$ for c_{uv}
- $|\Delta\phi(W, W) - \pi| < 0.3$
- $\Delta\phi(j1, \text{MET}) > 0.5$
- $|\cos\phi \text{ of decay plane}| < 0.8$
- $\cos(W, W+jj) > 0.5$
- Jacobian > 0.2
- $0.5 < \Delta\phi(j1, j2) < 2.5$



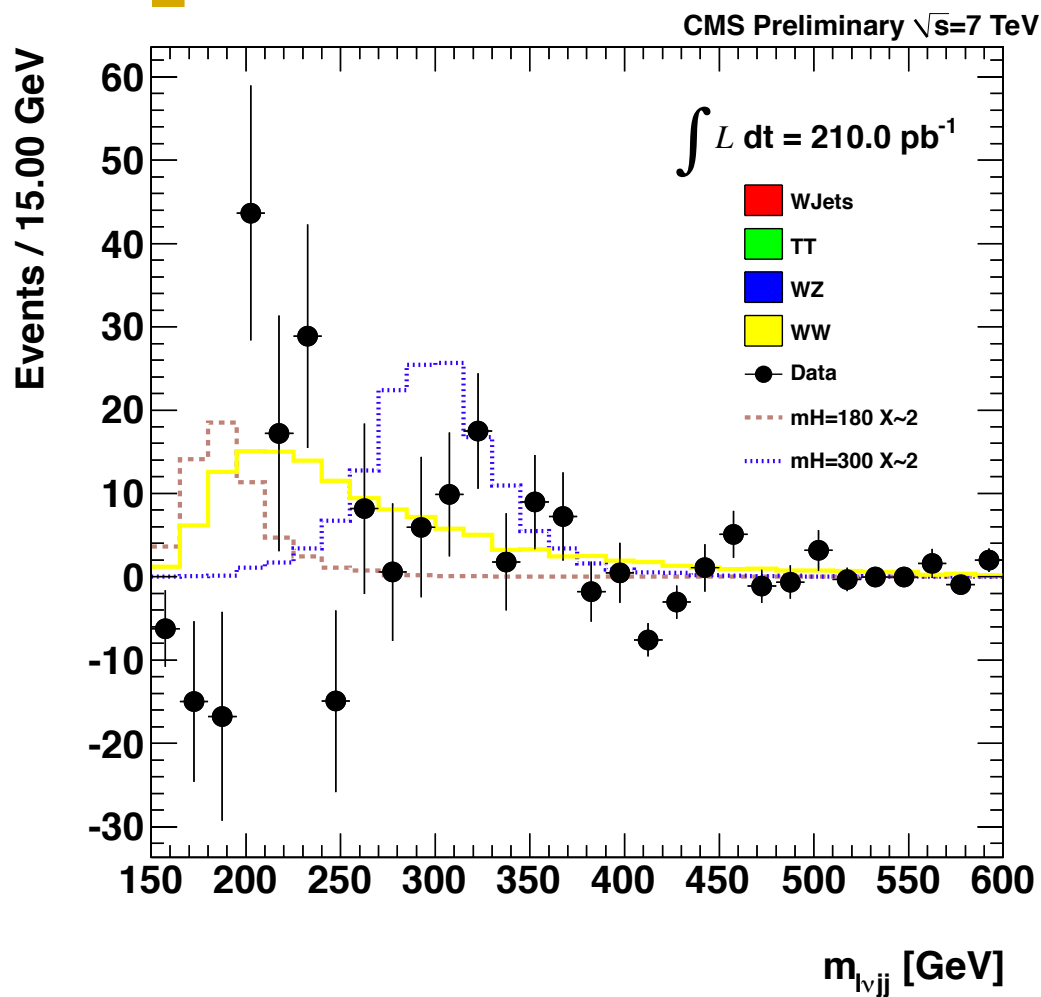
W/Z peak in W+jj events: 2011 data: μ



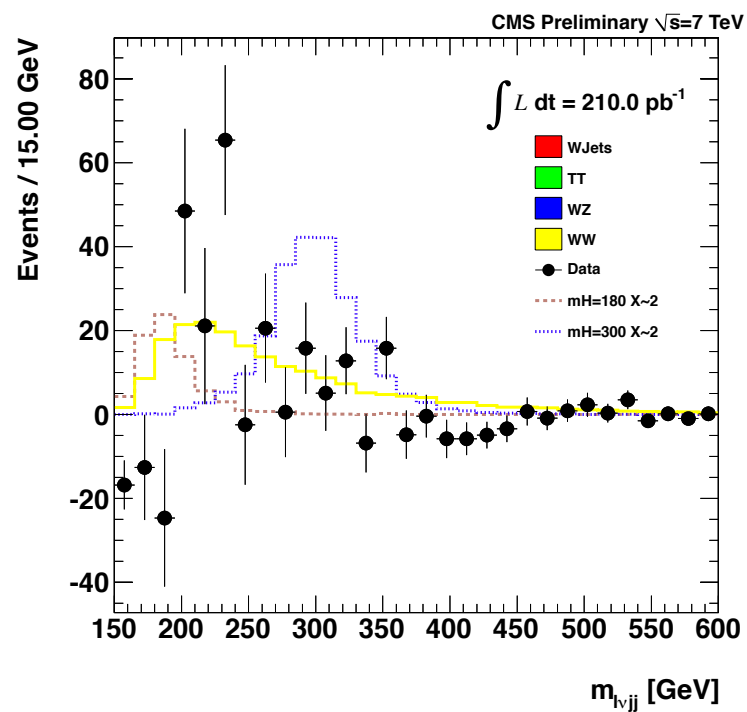
m_{lvjj} distribution: 2011 data: μ



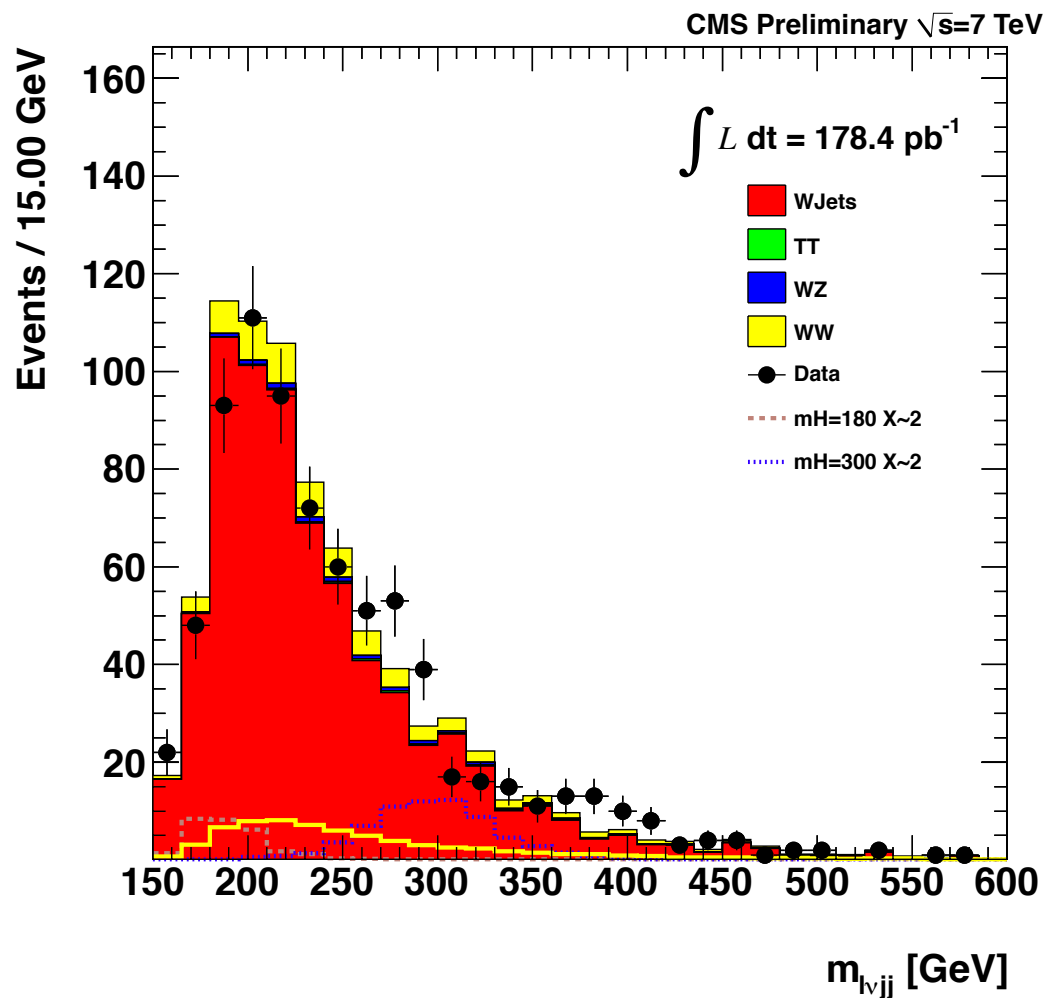
m_{lvjj} distribution: 2011 data: μ



looser selection

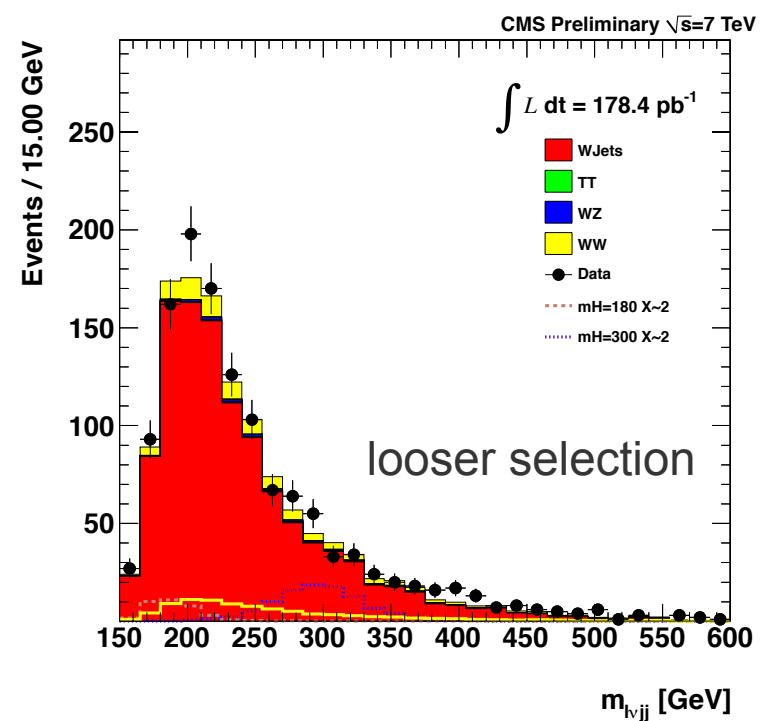


m_{lvjj} distribution: 2011 data: ele

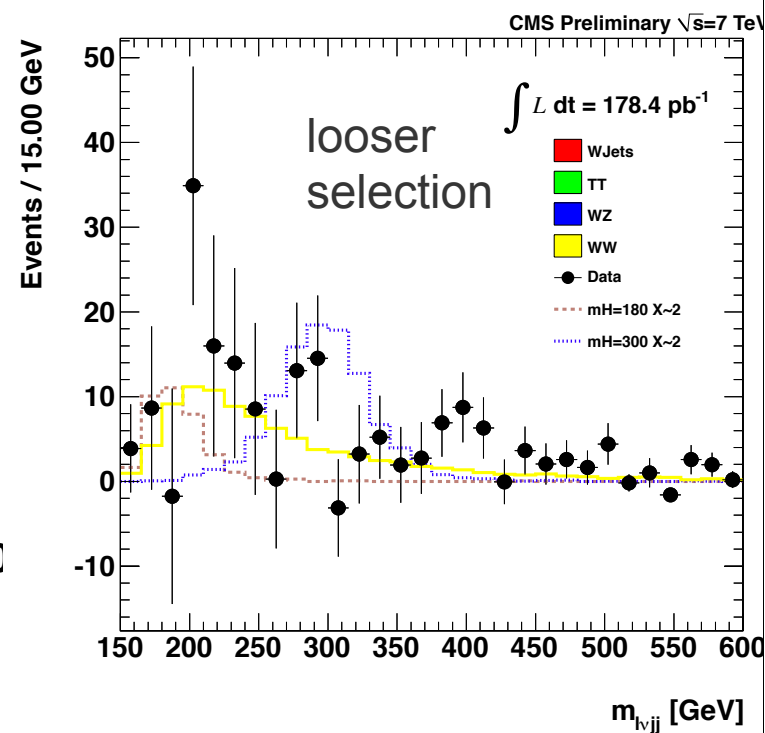
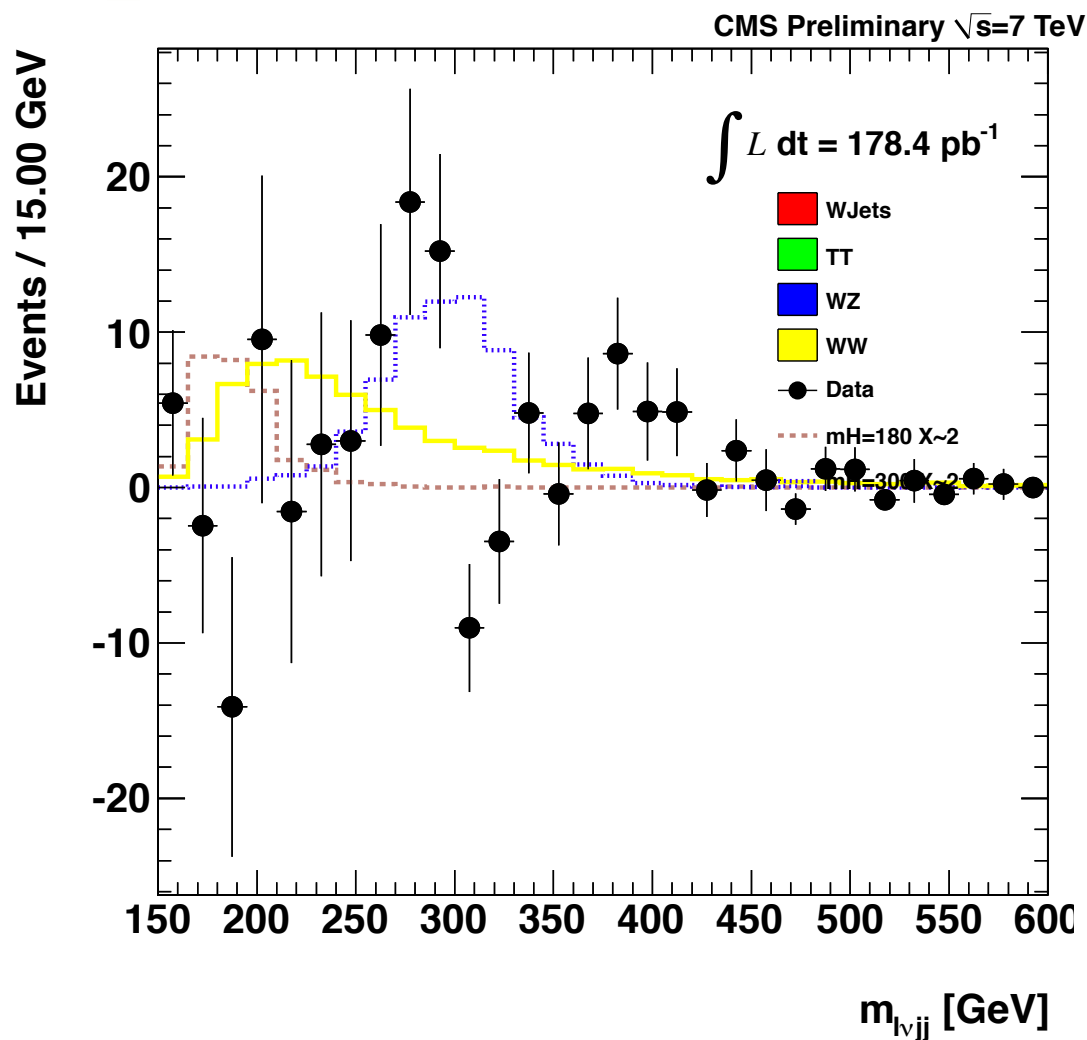


Same cuts as on previous slide and

- $60 < m_{jj} < 100$ GeV

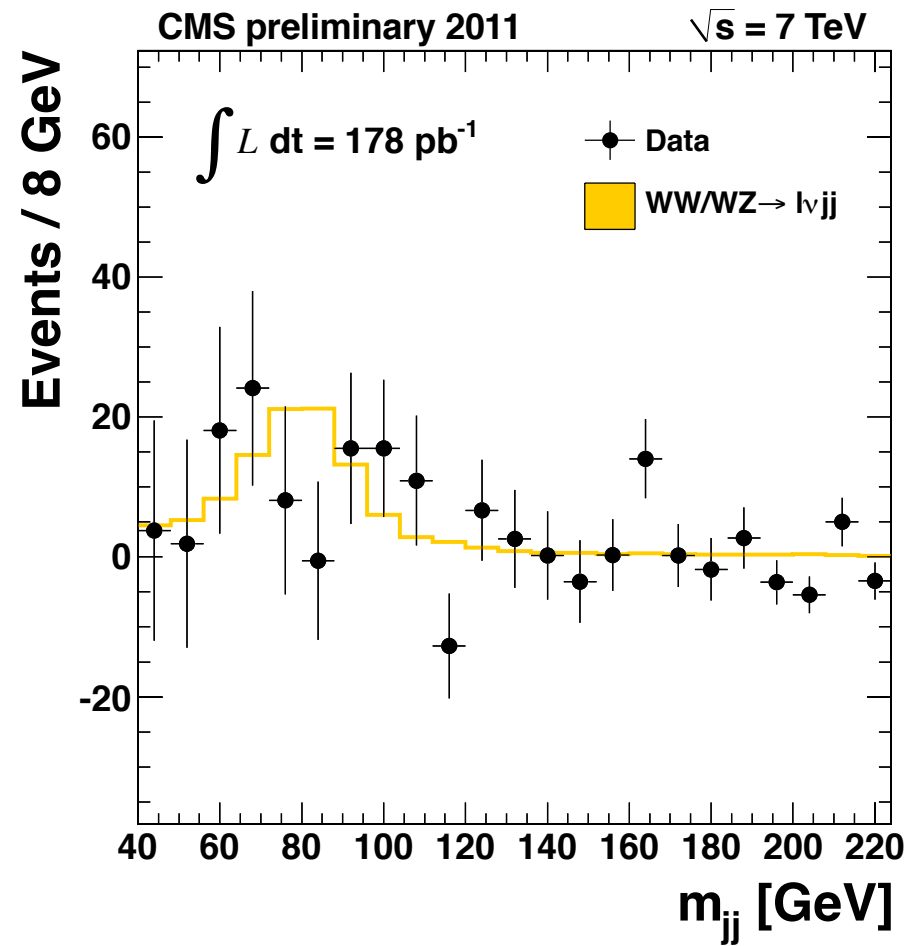
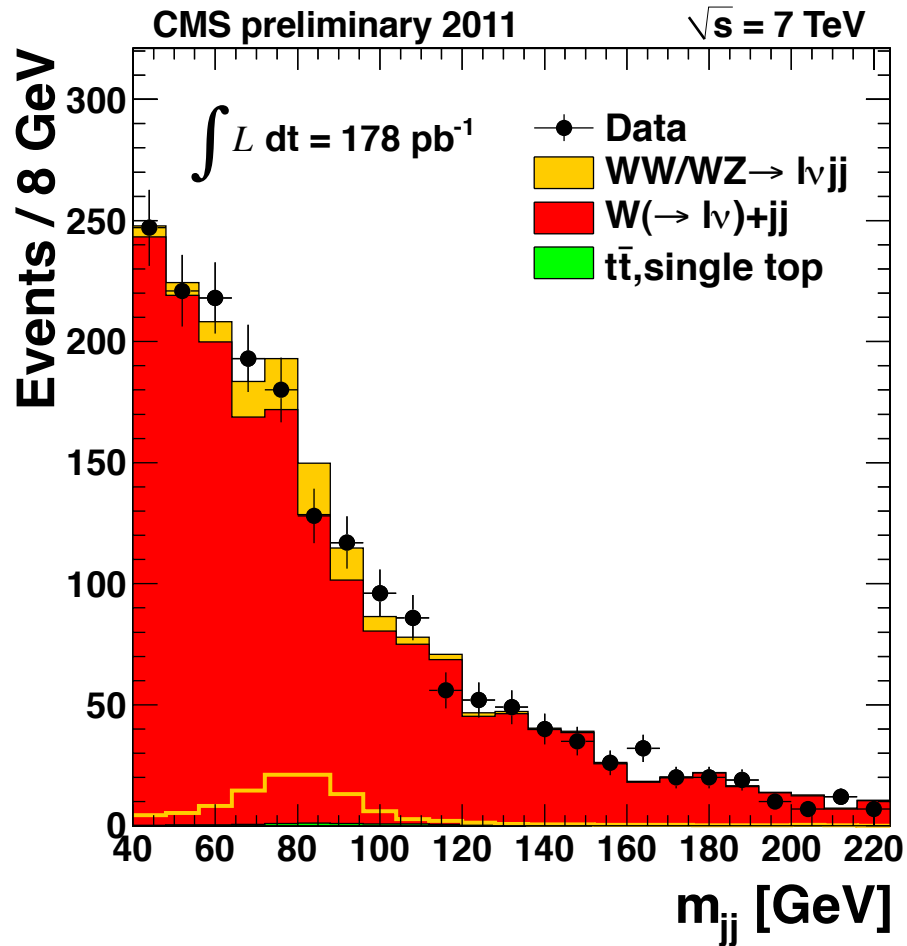


m_{lvjj} distribution: 2011 data: ele



Template fit

m_{jj} distribution: 2011 electron data

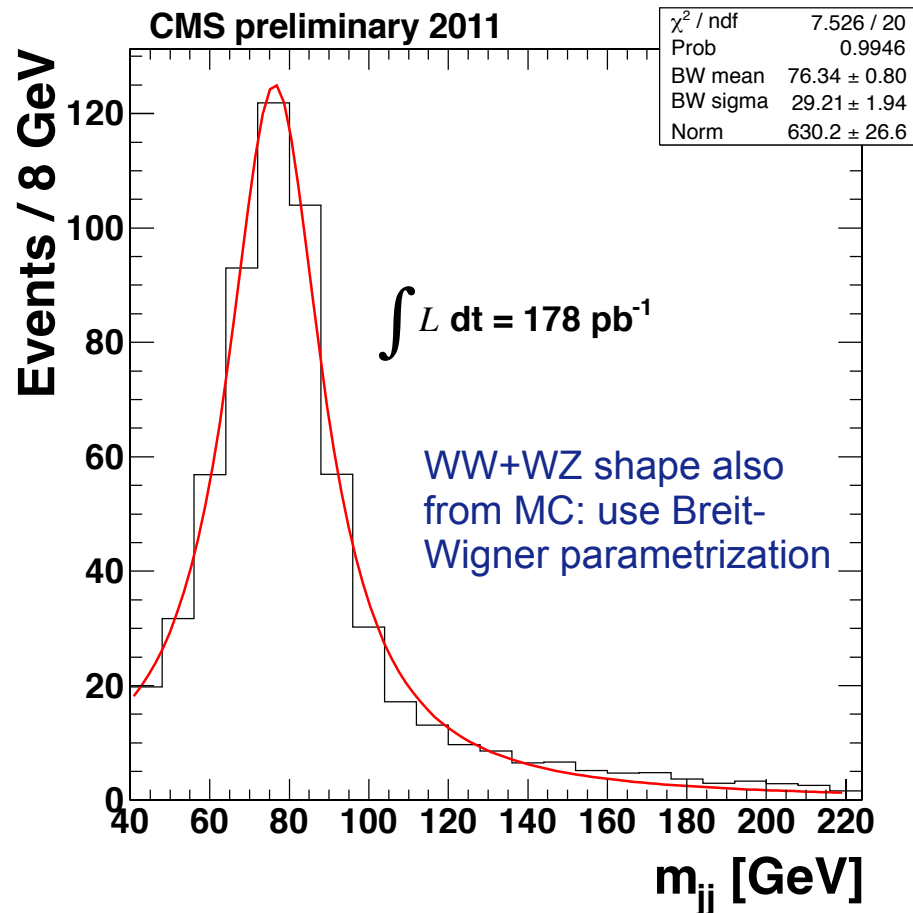
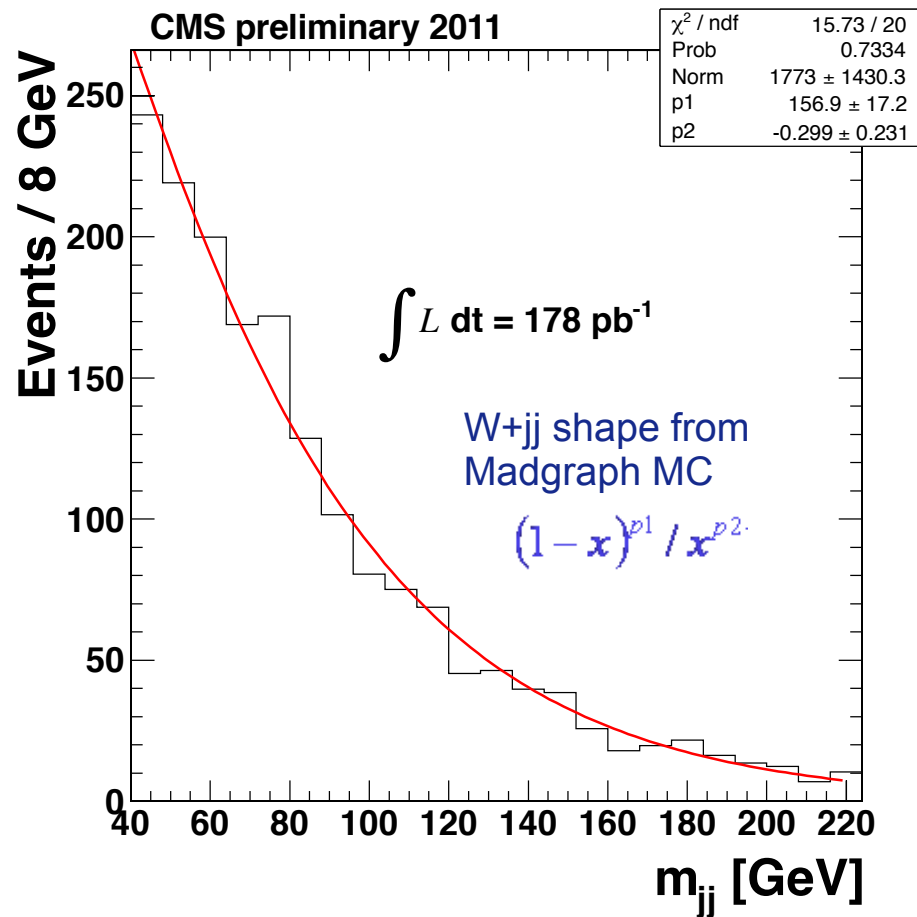


Clearly, MC subtraction not very satisfactory. Also some distortion in shape.

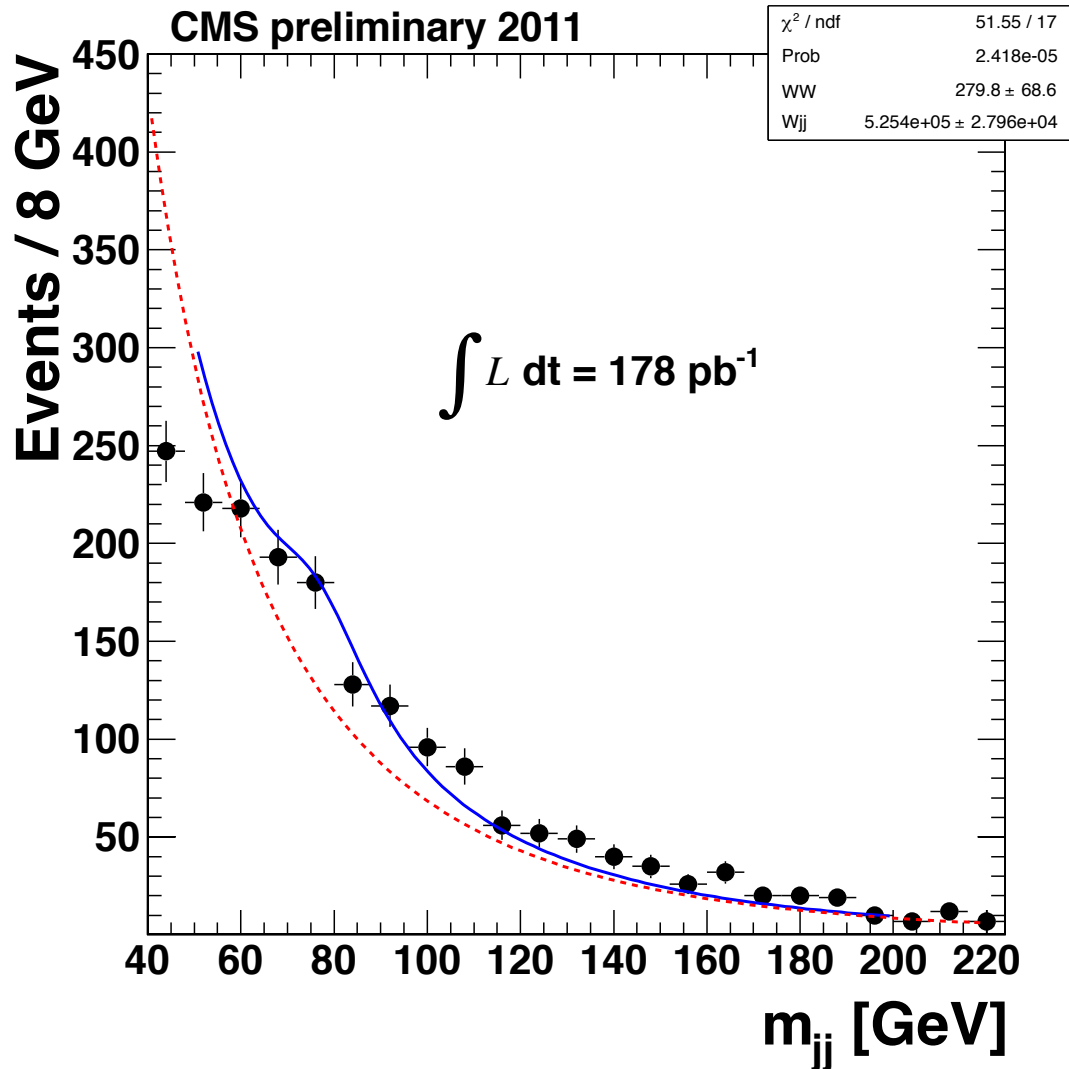
Attempt simple template fit



As a first attempt, take shape from MC. Fit for normalization in data.



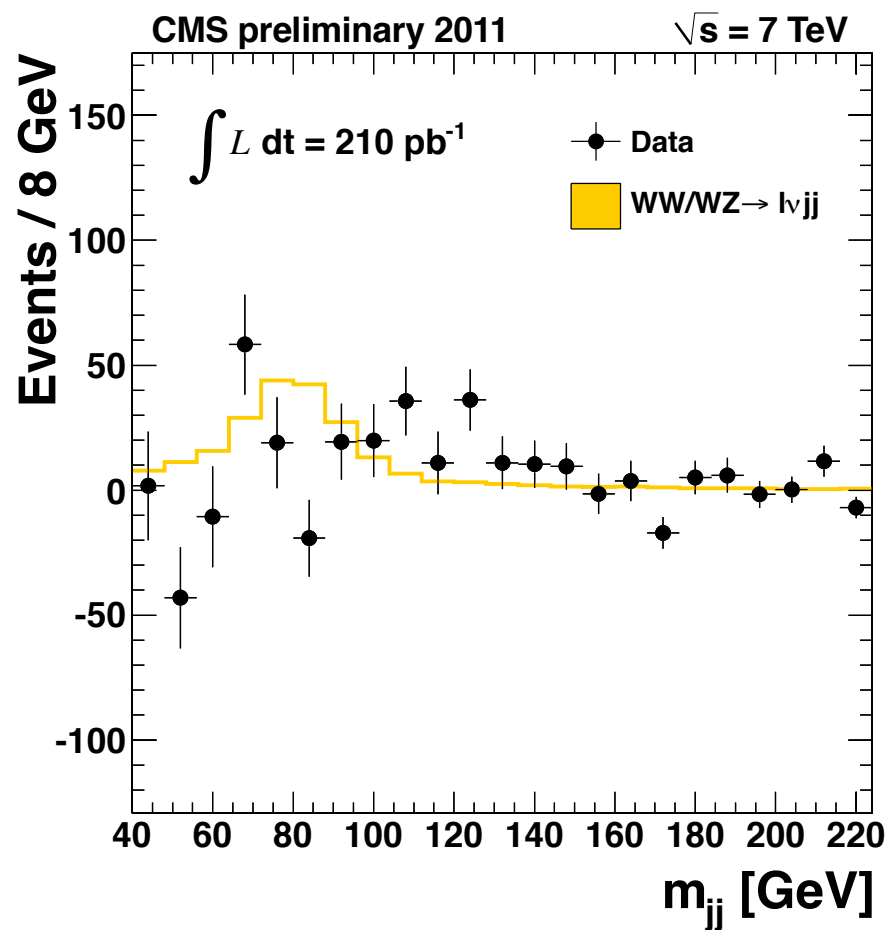
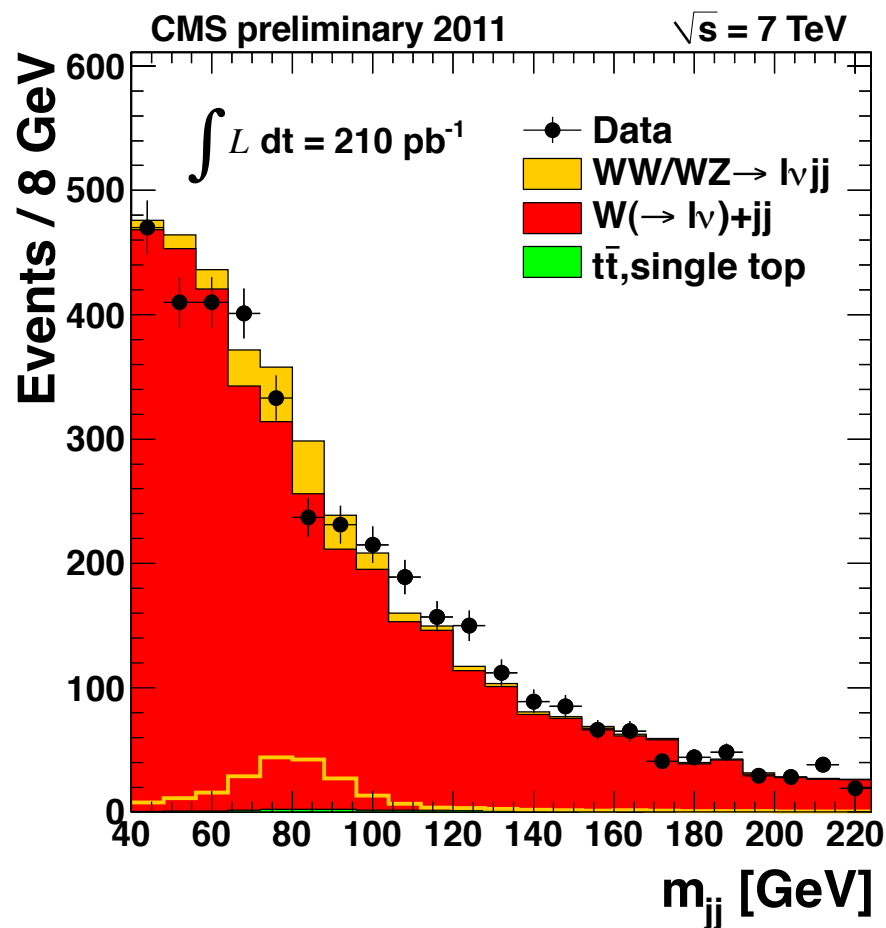
WW+WZ signal estimation from template fit



WW + WZ yield = 280 ± 68
(stat)

MC shape clearly doesn't fit data well. Need to introduce additional terms in W+jets parametrization. At low mass jet efficiency/resolution is distorting the shape in data.

m_{jj} distribution: 2011 muon data

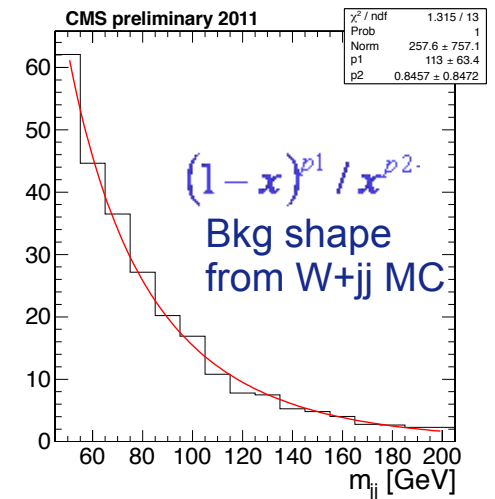
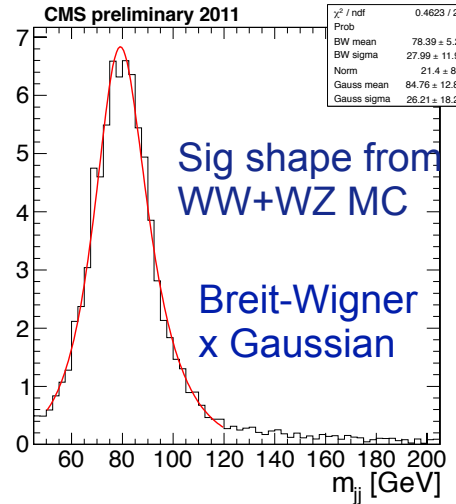
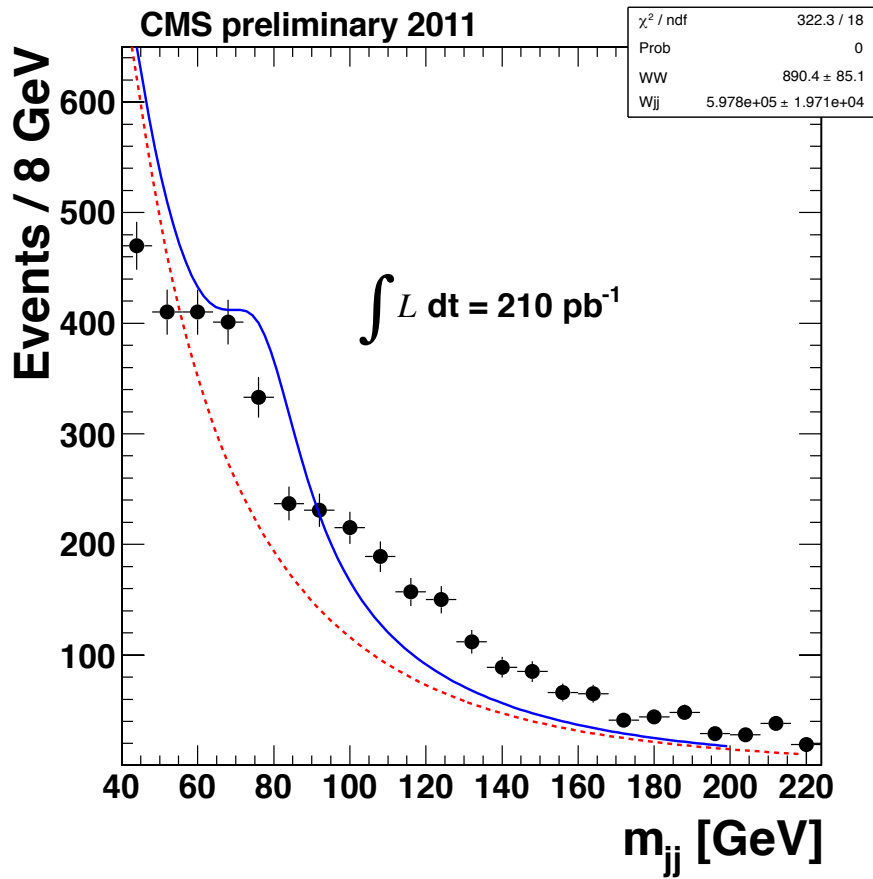


WW+WZ signal estimation from template fit



(μ data only)

Shape derived from MC.
Fit for the normalization.



WW + WZ yield = 890 ± 85 (stat)

Need to clean up muon data further, initially required loose isolation (<0.15) to avoid efficiency loss. But this leaves lot of junk.