Dijet Measurements at Forward Rapidity

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for the

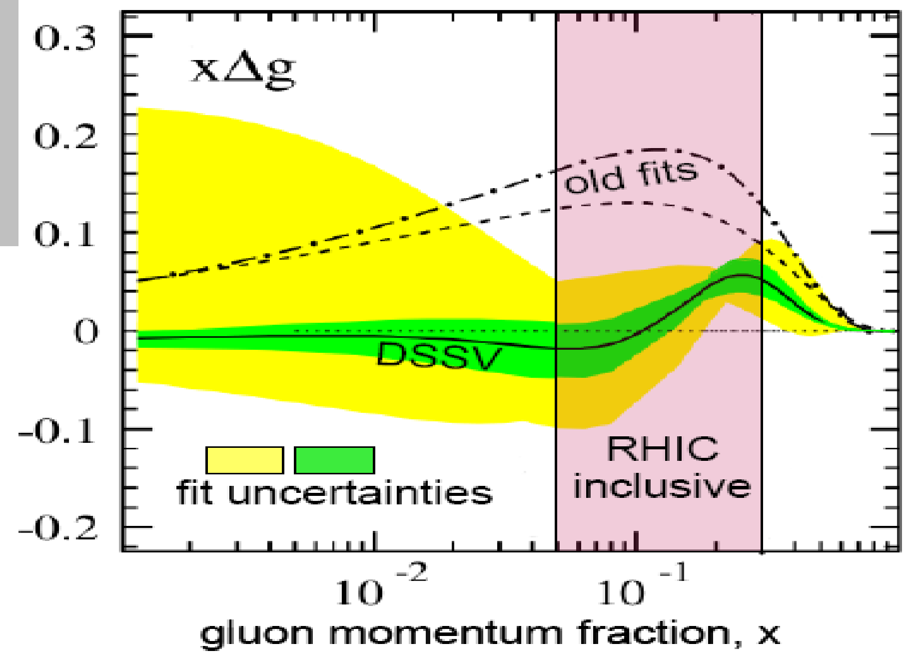
STAR Collaboration

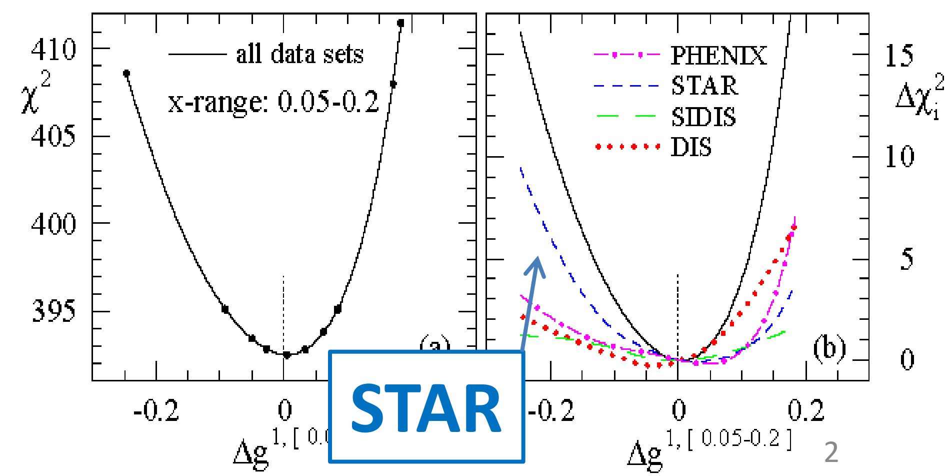
Motivation: Constraining ΔG

$$S = \frac{1}{2} = \frac{1}{2}\Delta\Sigma + \Delta G + L$$

- Workhorse of STAR ΔG program to date has been inclusive measurements
- These measurements place strong constraints on ΔG in the partonic momentum range of 0.05 to 0.2
- The low x behavior and shape of ΔG are still poorly constrained

de Florian *et al.*, PRL **101**, 072001 (2008)

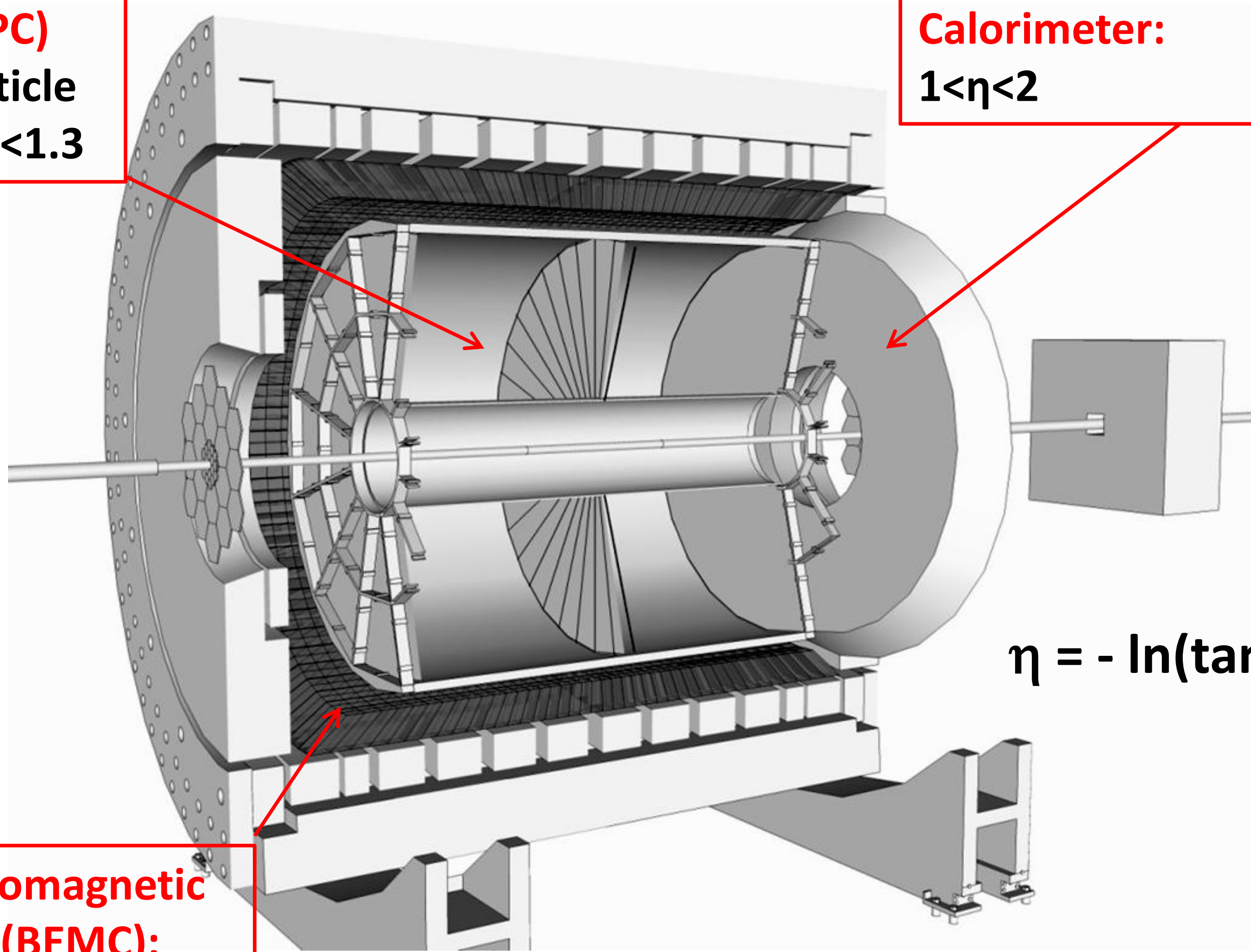




STAR Detector

Time Projection Chamber (TPC)
Charged Particle Tracking $|\eta|<1.3$

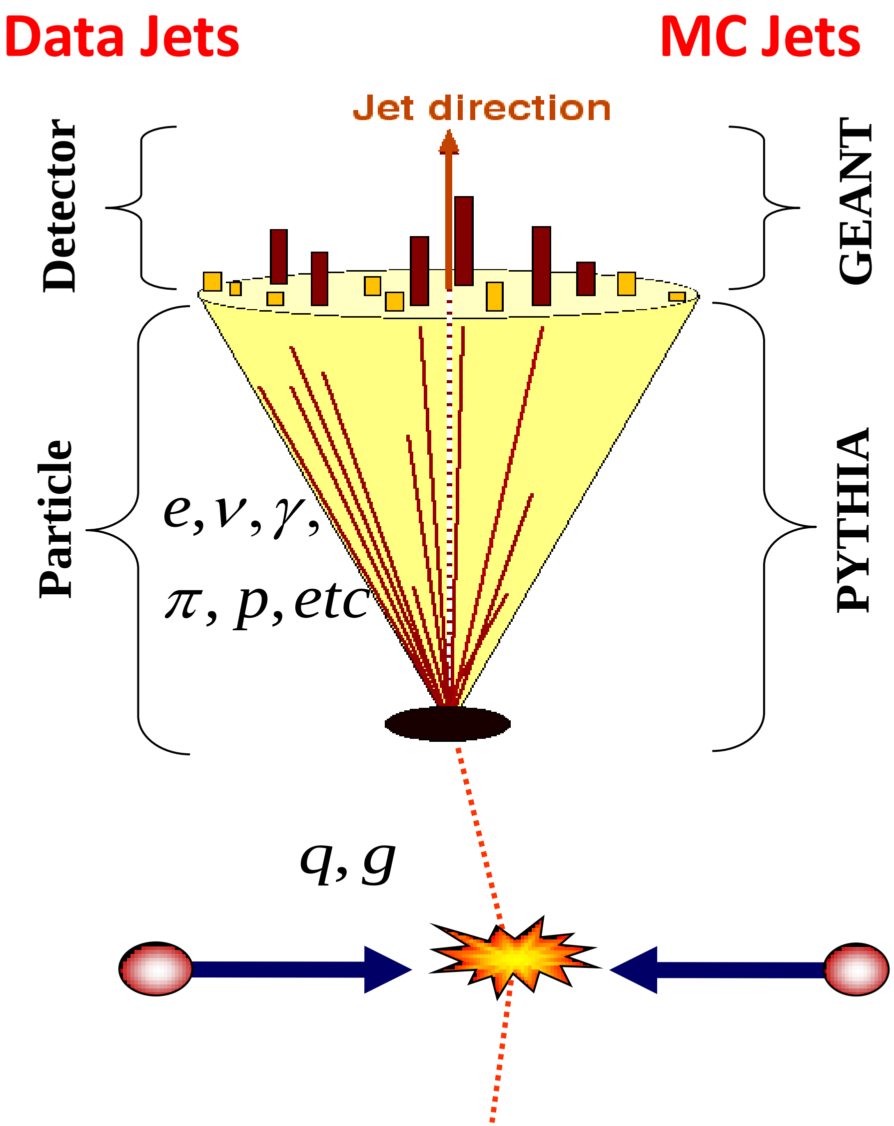
Endcap Electromagnetic Calorimeter:
$1<\eta<2$



$$\eta = -\ln(\tan(\theta/2))$$

Barrel Electromagnetic Calorimeter (BEMC):
$|\eta|<1$

Jet Reconstruction



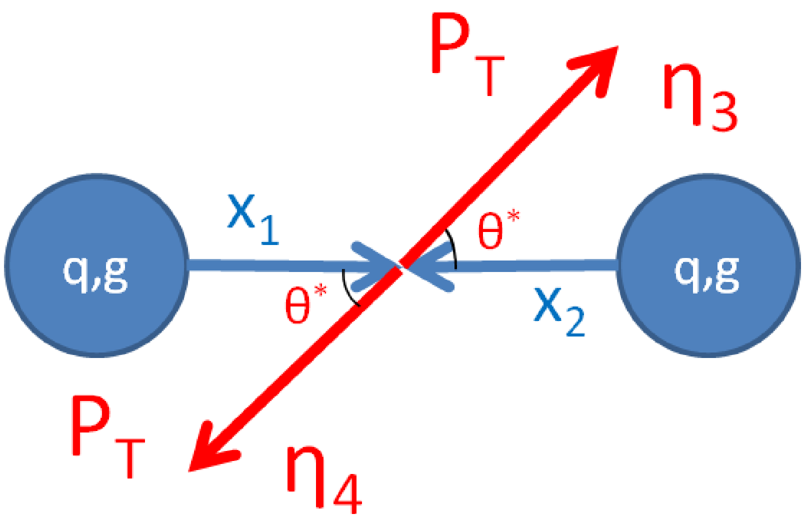
Midpoint Cone Algorithm:
- Adapted from Tevatron II (hep-exp/0005012
- Cone radius = $\sqrt{(\Delta\eta^2+\Delta\phi^2)}$ = 0.7
- Split / Merge fraction = 0.5

Anti-K_T Algorithm:
- Radius = 0.6
- Less sensitive to underlying event effects

STAR Detector has:
- Full azimuthal coverage
- Charged particle tracking from TPC for $|\eta| < 1.3$
- E/BEMC provide electromagnetic energy reconstruction for $-1 < \eta < 2.0$

STAR well suited for jet measurements

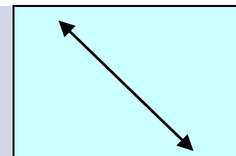
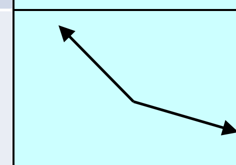
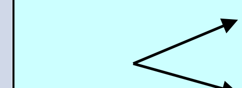
Dijet Kinematics



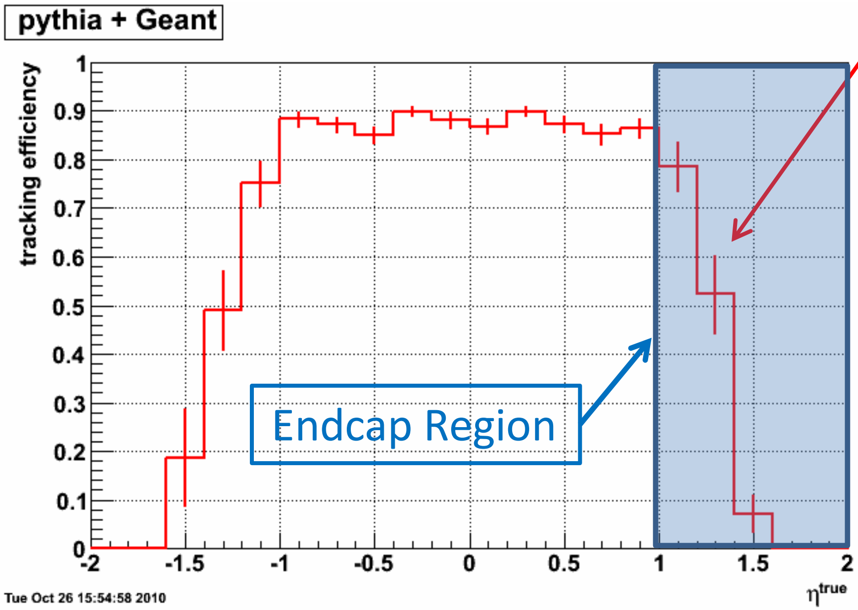
- Correlation measurements which sample the full final state are sensitive to partonic kinematics at leading order
- Forward rapidity jets arise from asymmetric partonic collisions and probe lower momentum gluons

$$x_1 = \frac{P_T}{\sqrt{s}}(e^{\eta_3} + e^{\eta_4})$$

$$x_2 = \frac{P_T}{\sqrt{s}}(e^{-\eta_3} + e^{-\eta_4})$$

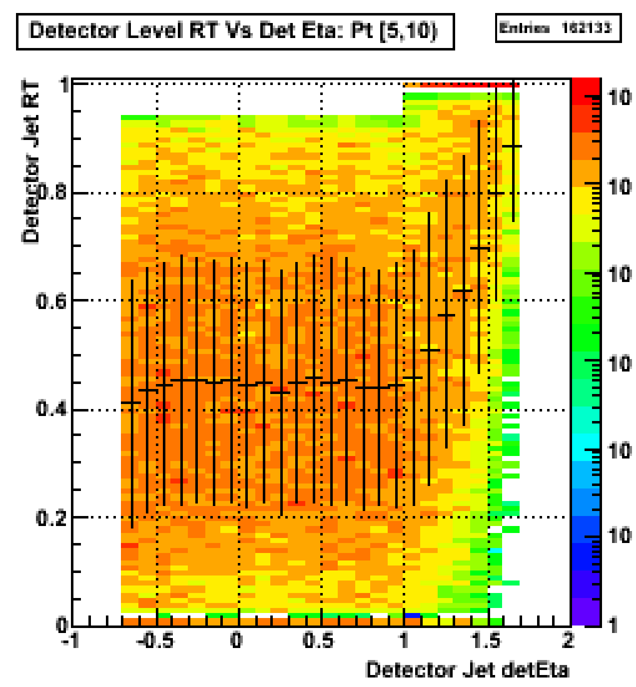
Jet Configuration	Minimum X	
Symmetric Barrel	0.17 – 0.06	
East-Barrel Endcap	0.10 – 0.05	
Endcap Endcap	0.01	

Challenges at Forward Rapidity

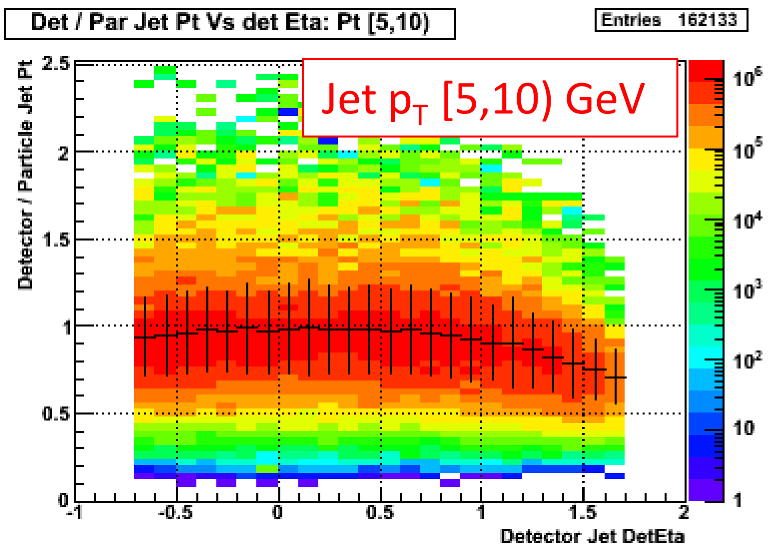


- TPC efficiency decreases in forward region
- Fewer tracks means reconstructed jets will have lower p_T on average
- Inaccurate p_T reconstruction skews extraction of partonic momenta

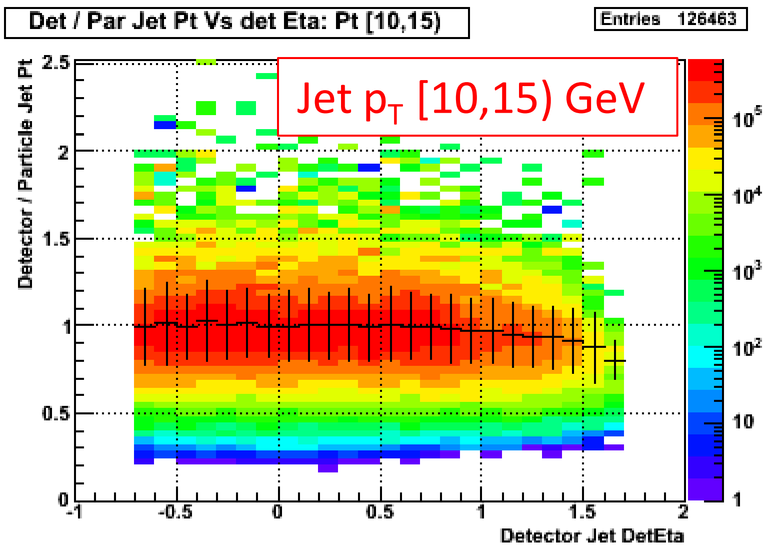
- Less tracking information will also lead to a biased sample of jets
- Jets with high percentage of neutral energy (RT) will be preferentially selected in the Endcap
- Jets with high percentage of charged energy may not reconstruct

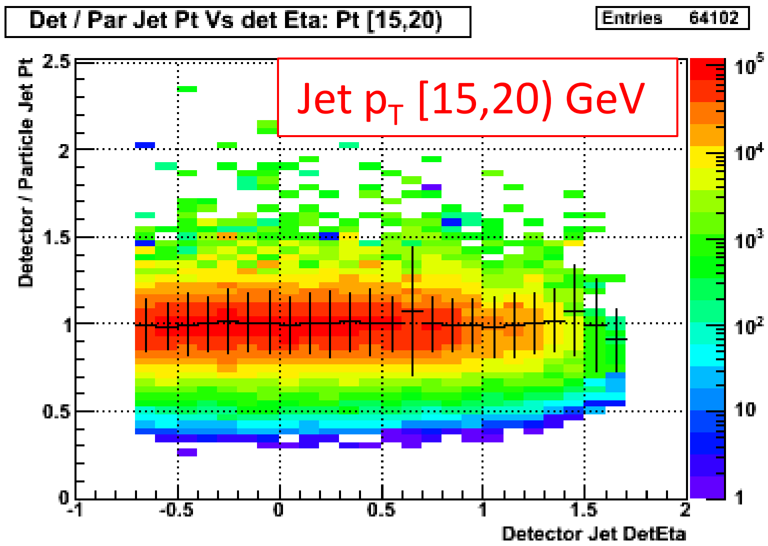


Corrections at Forward Rapidity

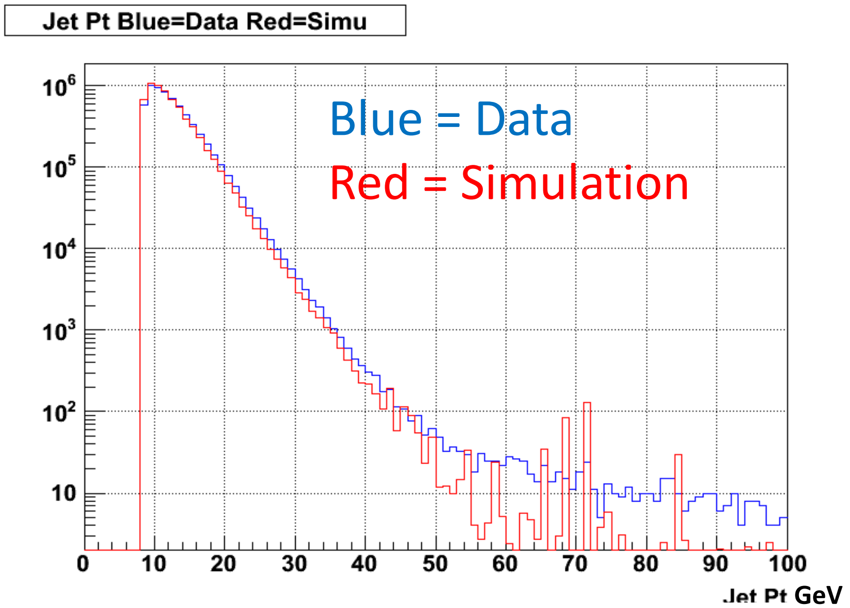


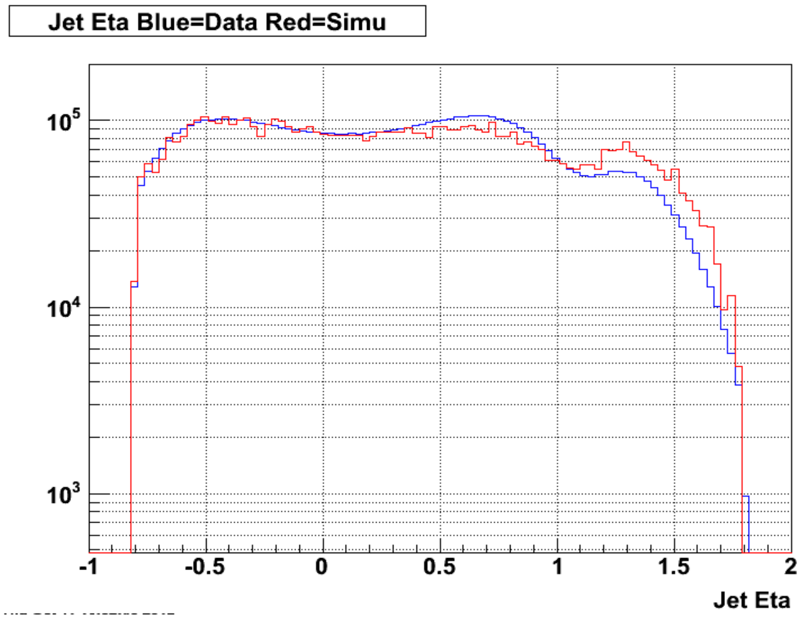
- The effect of falling TPC efficiency can be quantified using simulation
- Look at the ratio of detected to true jet p_T as a function of jet pseudorapidity
- Use this information to make p_T and eta dependent jet corrections
- Studies of these corrections are currently ongoing

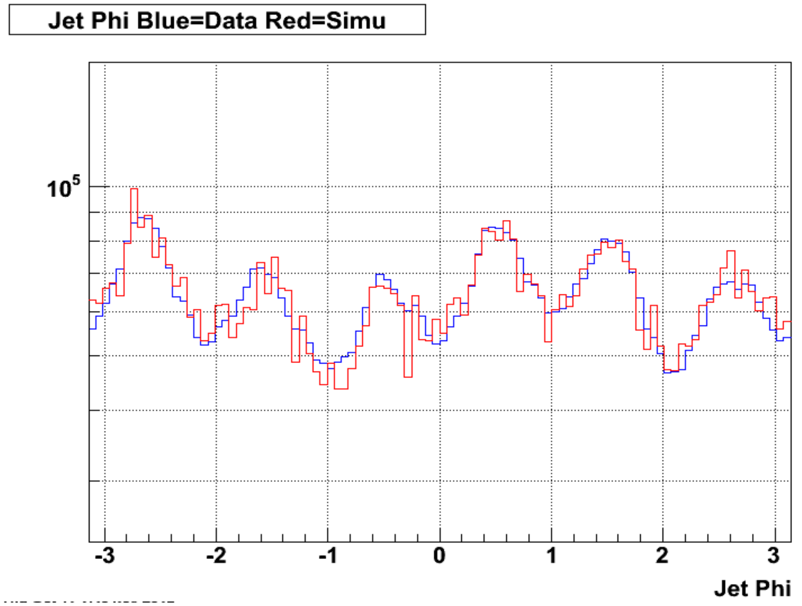




Data – Simulation Comparison

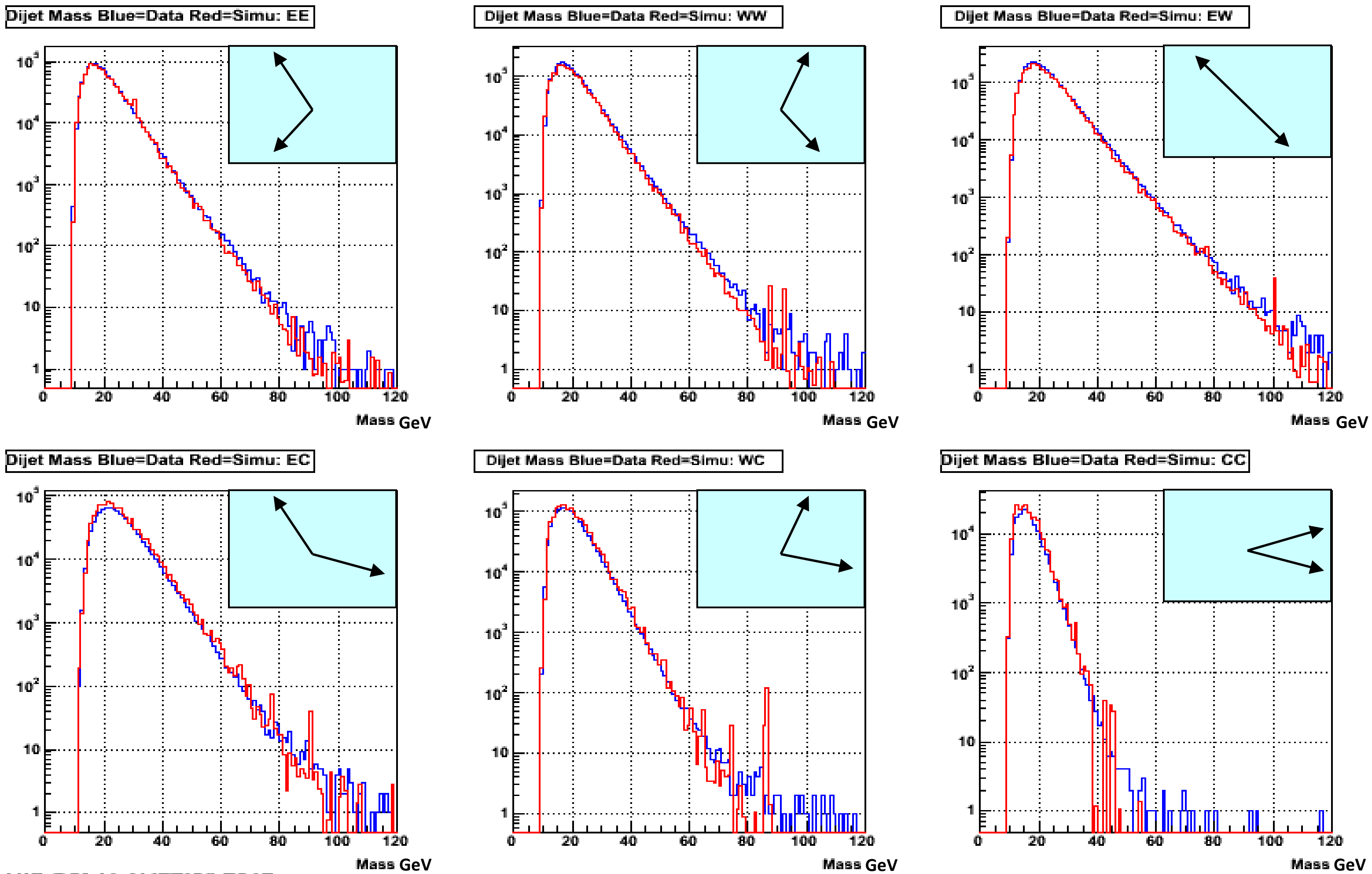






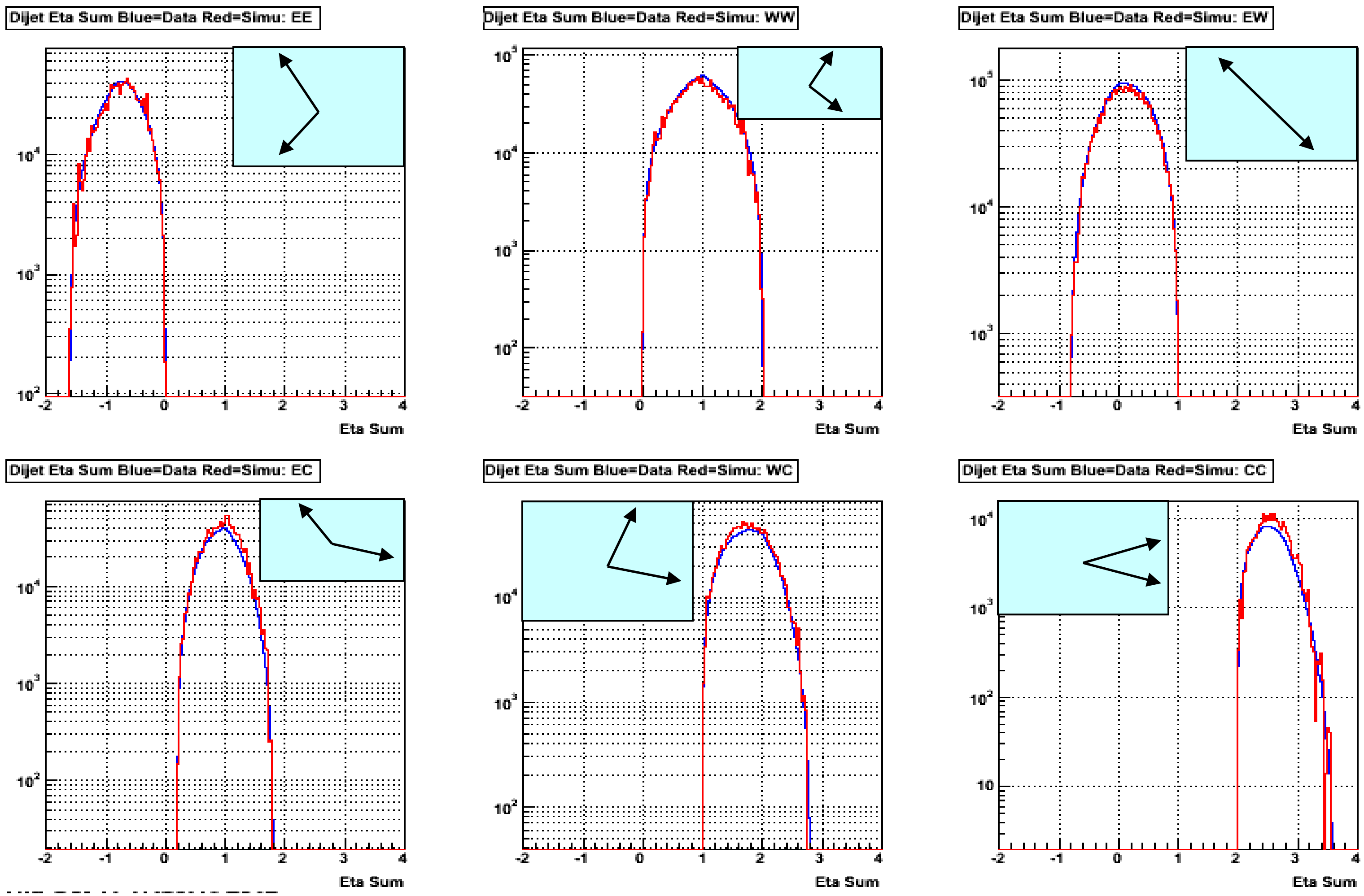
- Simulation = Pythia 6.4.26 (Tune 320 – Perugia 0) + Geant + Embedding
- In general, we see good agreement between Run 9 data and simulation for single jet kinematic quantities
- Cause of Eta spectrum mismatch is likely due to small gain uncertainty in Endcap

Data – Simulation Comparison: Dijet Mass



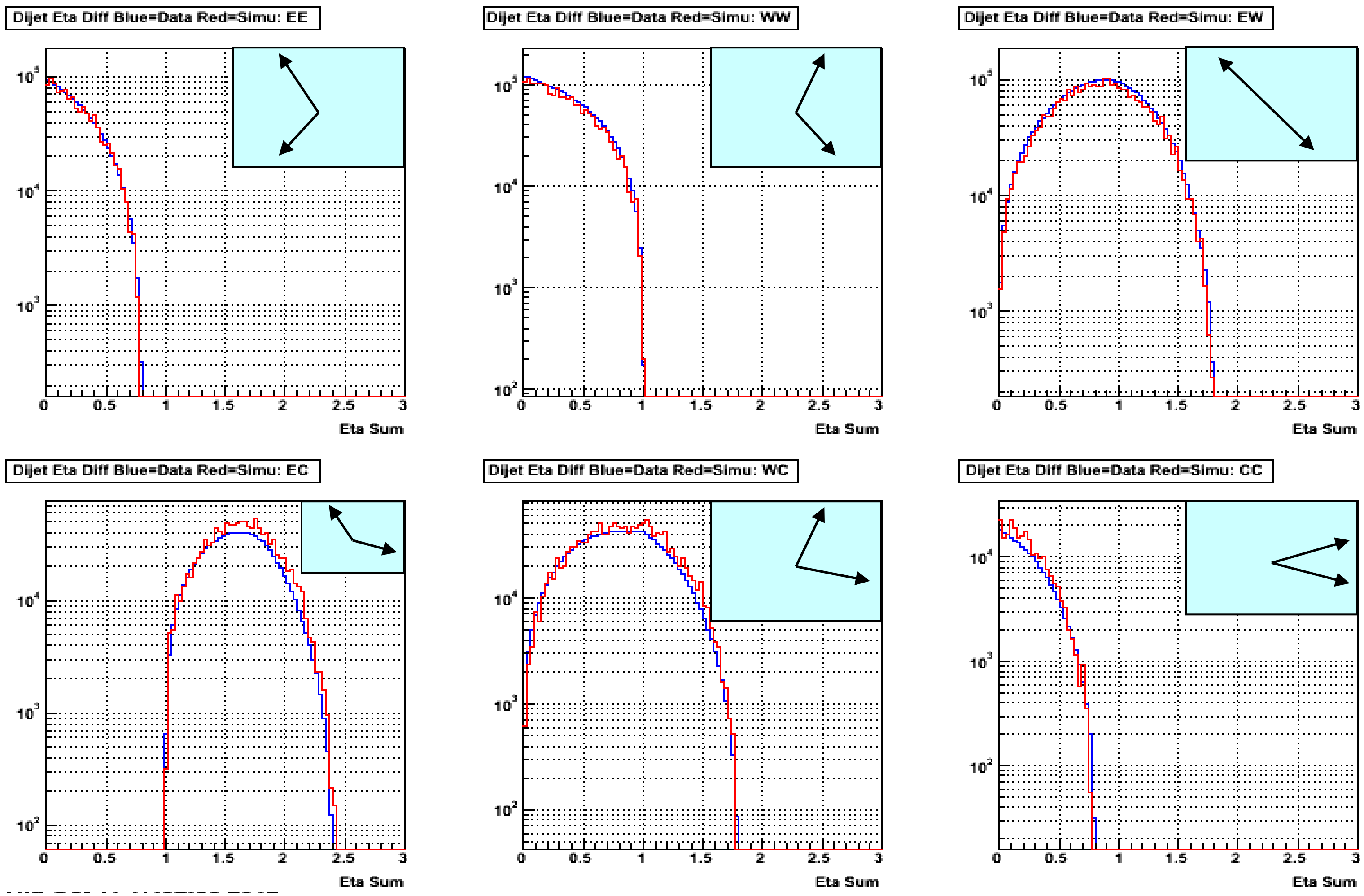
- Dijet Mass Spectra for data and simulation in 6 topological arrangements
- Good agreement seen over many orders of magnitude

Data – Simulation Comparison: Dijet Eta Sum



- Jet η_3 + Jet η_4 for data and simulation in 6 topological arrangements
- Eta sum is related to rapidity of the system as well as the ratio of the momentum fractions of the colliding partons

Data – Simulation Comparison: Dijet Eta Diff



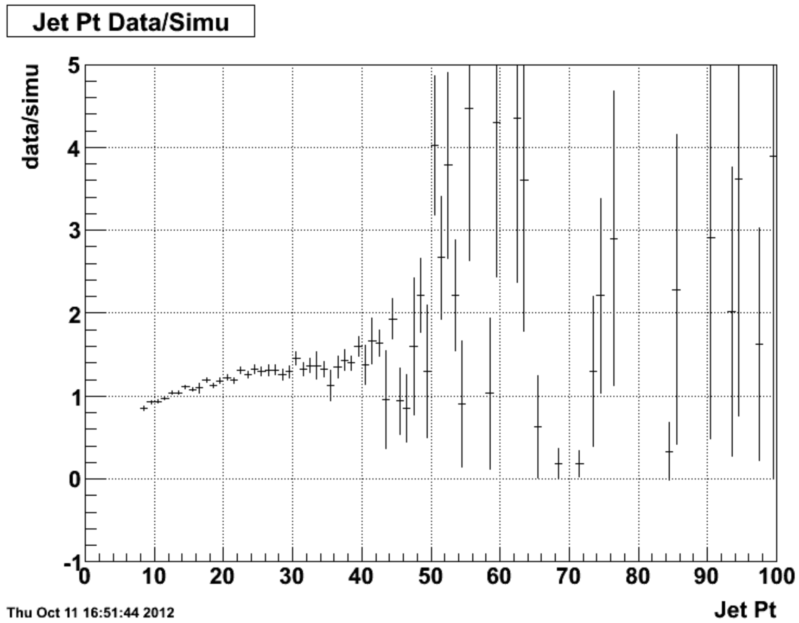
- Jet $|\eta_3 - \eta_4|$ for data and simulation in 6 topological arrangements
- This quantity is related to the center of mass scattering angle

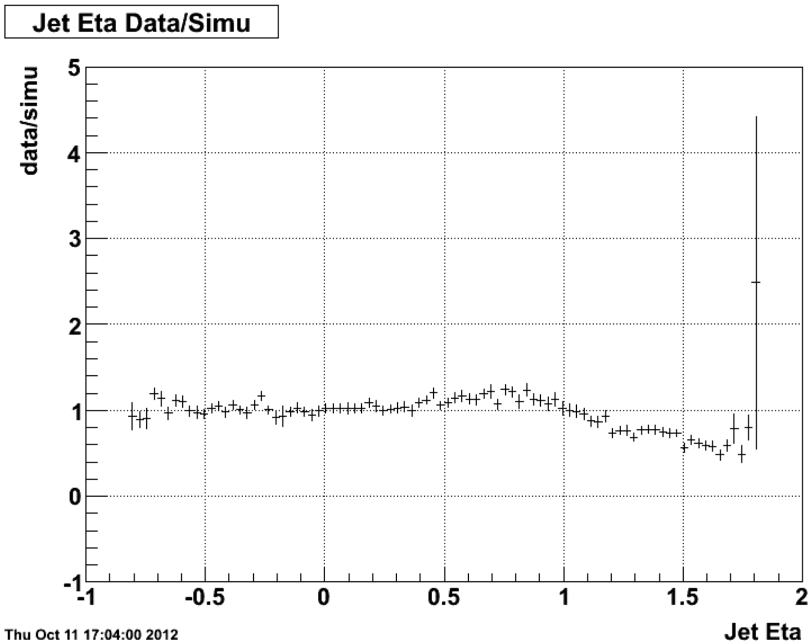
Conclusions

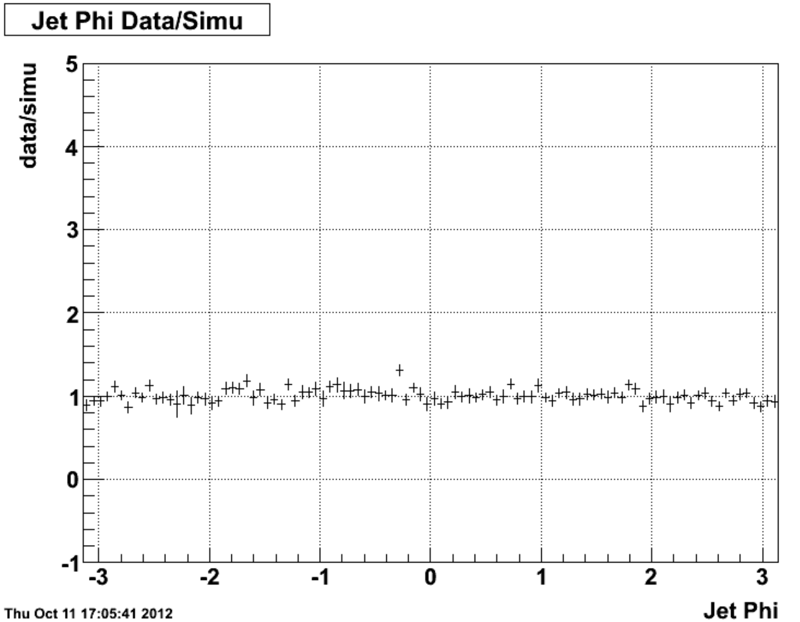
- To date, inclusive measurements at STAR have placed strong constrains on Δg for a partonic momentum fraction of $0.05 < x < 0.2$
- Correlation measurements such as Dijet A_{LL} will better constrain the shape of Δg as a function of x and the extension of these measurements to forward rapidity will allow access to lower values of x
- Simulations for full Run 9 dataset have been generated and show good agreement with data for many observable quantities
- Work on methods to correct jet p_T, needed for reliable extraction of partonic kinematics, in forward regions is ongoing

Back-Up Slides

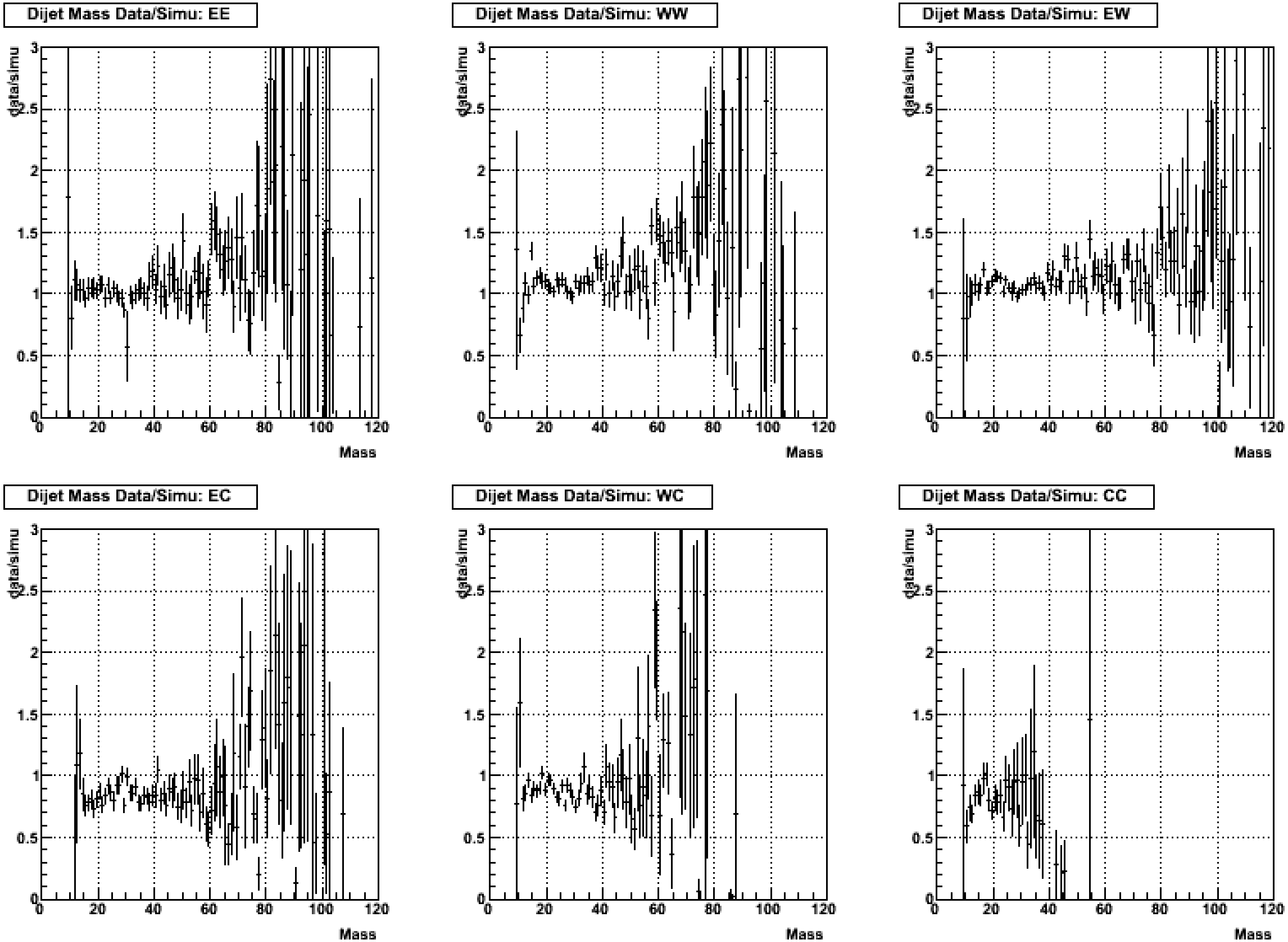
Data / Simulation Ratio: Single Jet



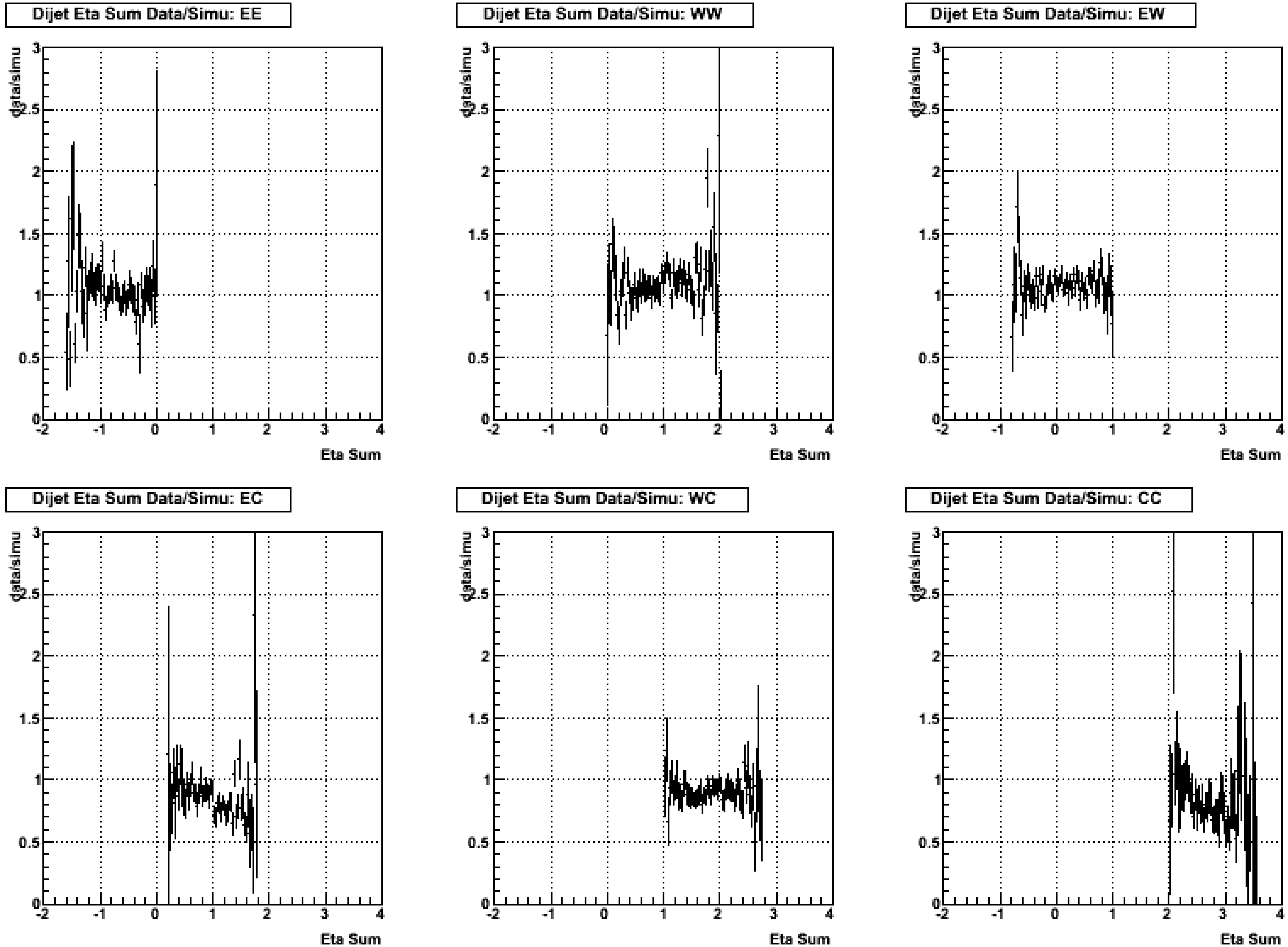




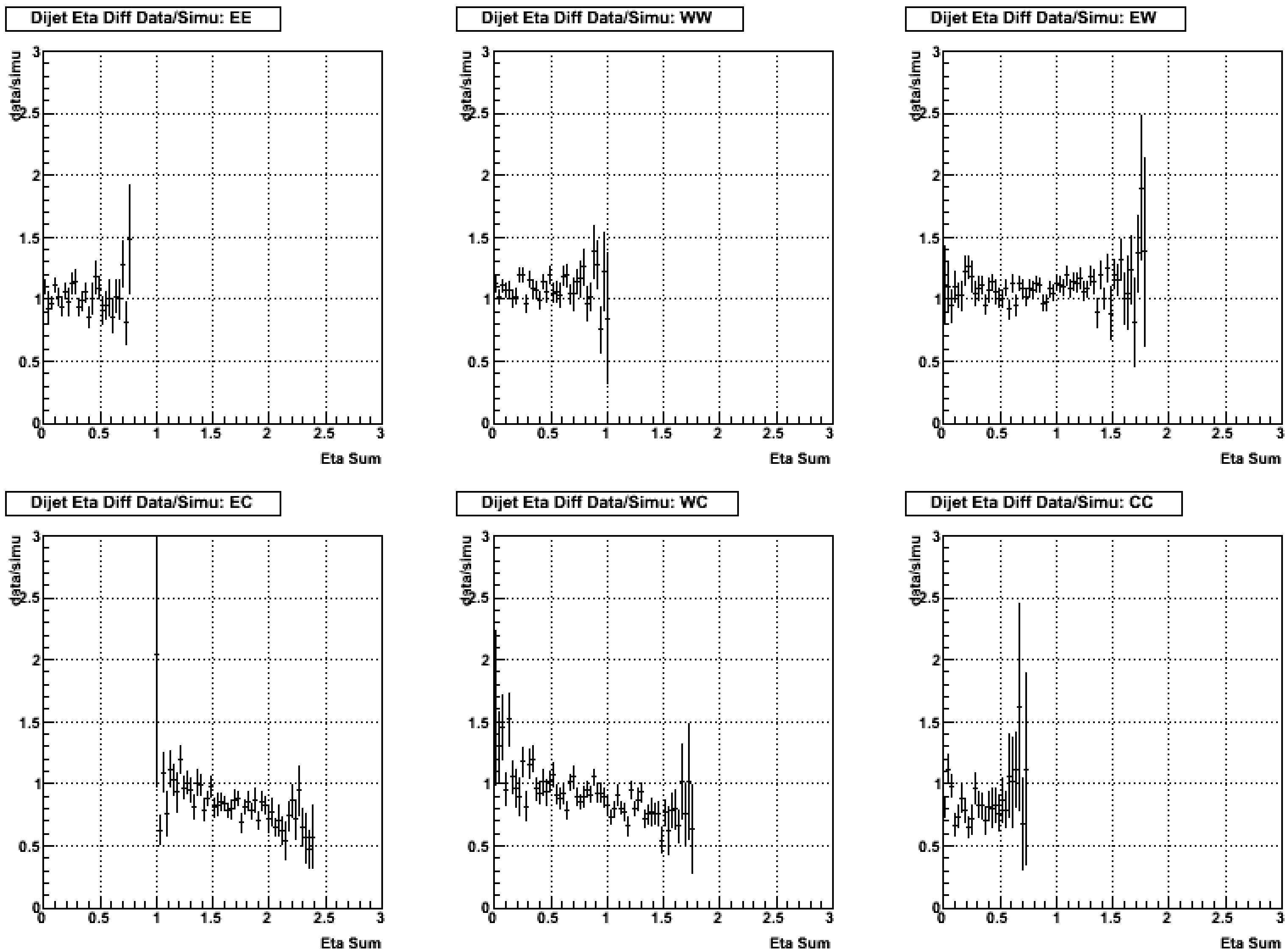
Data / Simulation Ratio: Dijet Mass



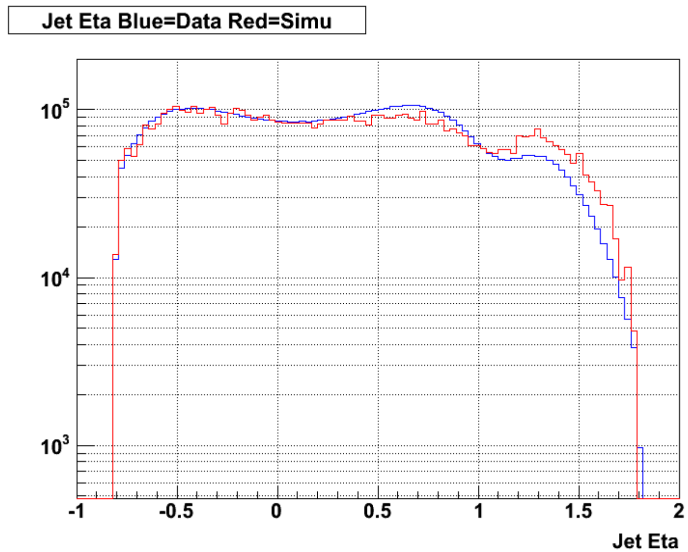
Data / Simulation Ratio: Dijet Eta Sum



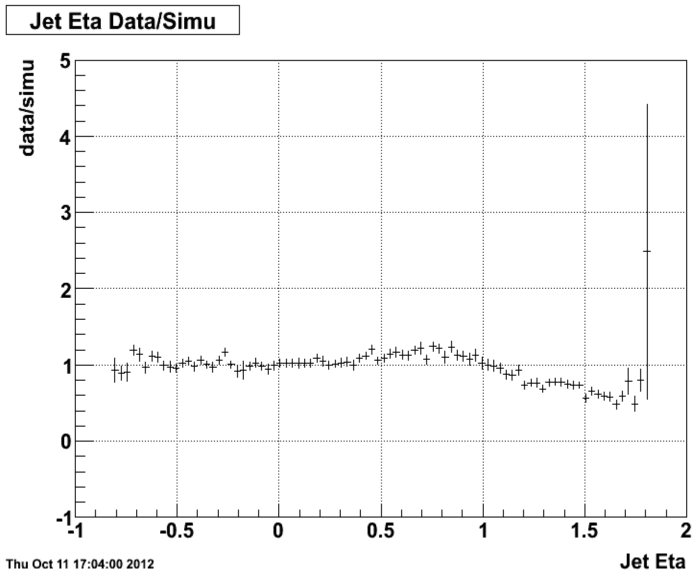
Data / Simulation Ratio: Dijet Eta Diff

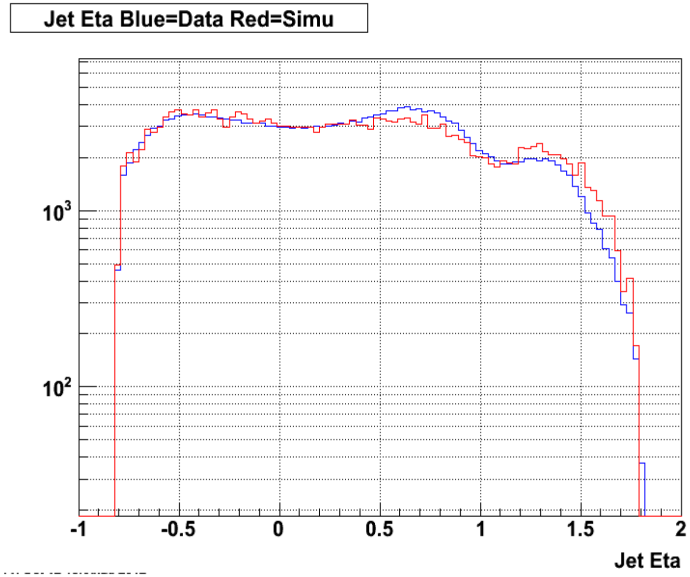


Effect of Lower Gains on Eta

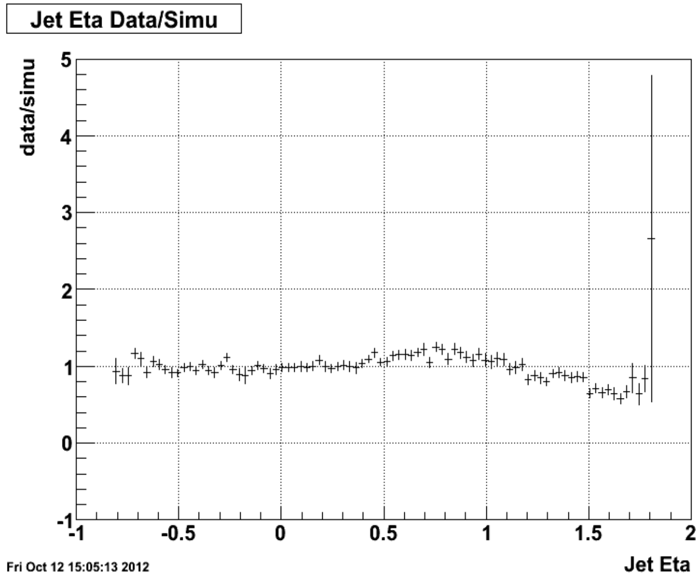


Original

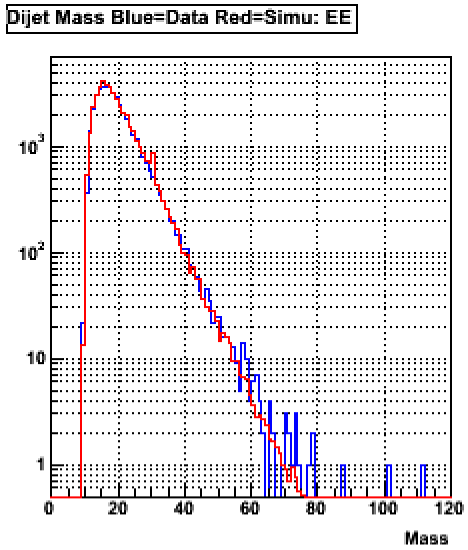


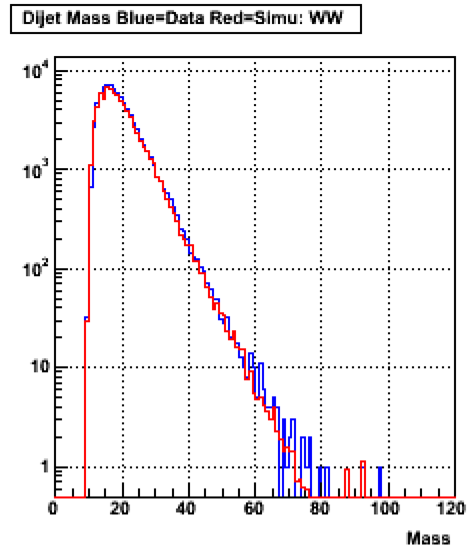


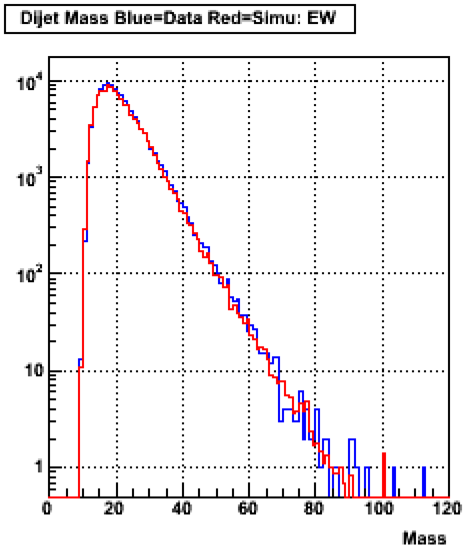
Lowered

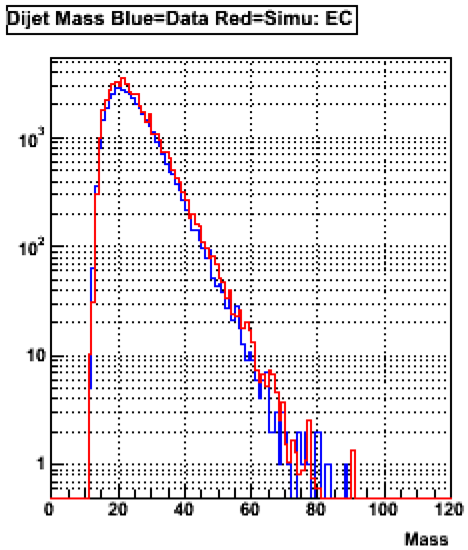


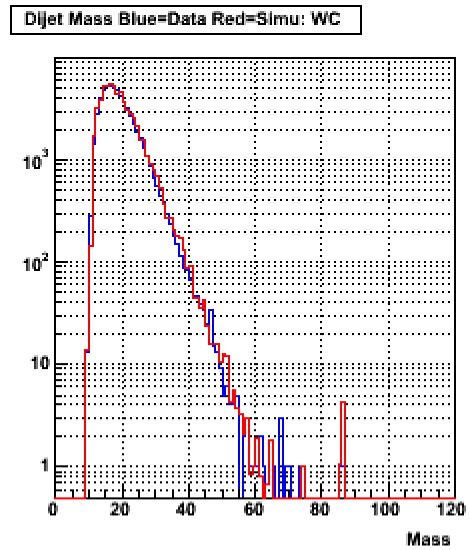
Dijet Mass: Lower Gain

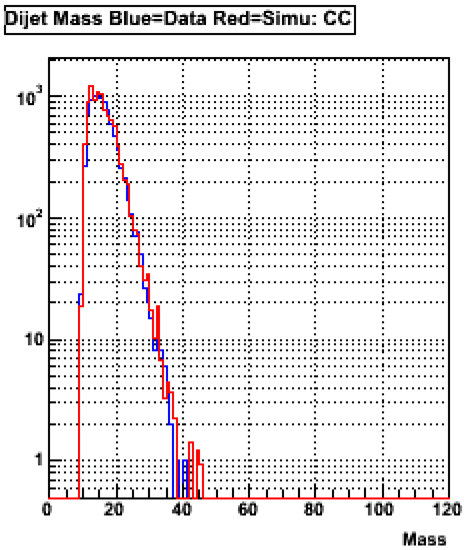












Dijet Mass Ratio: Lower Gain