Dijet Analysis Plan

Robert M. Harris
Fermilab

Jane Nachtman
Iowa

LPC Conveners Meeting
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Steps in the Plan

1. Trigger
2. Data Flow
3. Event Display
4. DPG Calibration
5. Simulation
6. Dijet Background Removal
7. Jet Corrections
8. Trigger Efficiency & Prescale
9. Tests of QCD with Dijets
10. Searches for New Physics

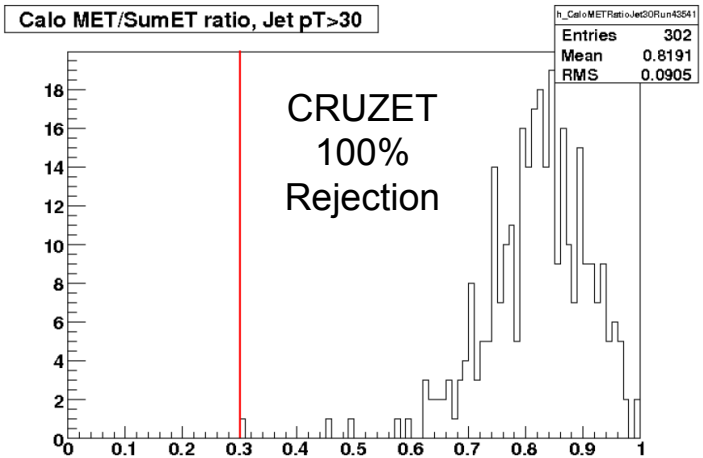
Foundational Steps (prior talk)

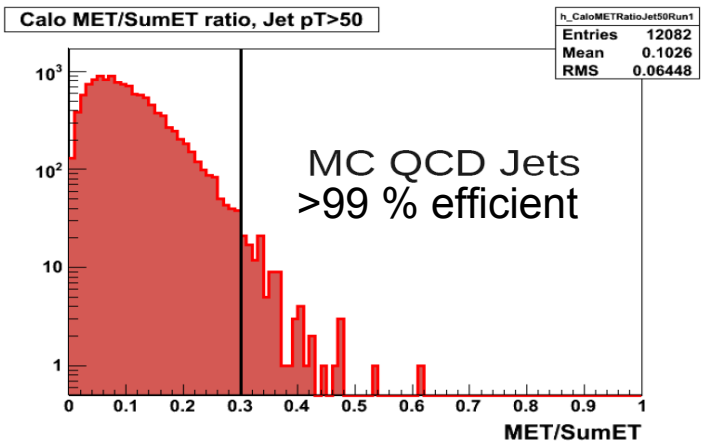
DiJet Analysis Steps (this talk)

Dijet Background Cleanup

- Planned cuts for cleanup of cosmic and noise backgrounds to dijets.

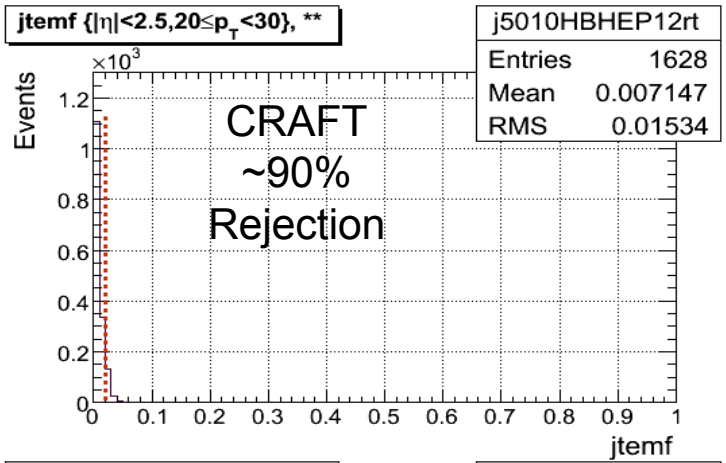
Primary Cut: MET / ΣE_T < 0.3

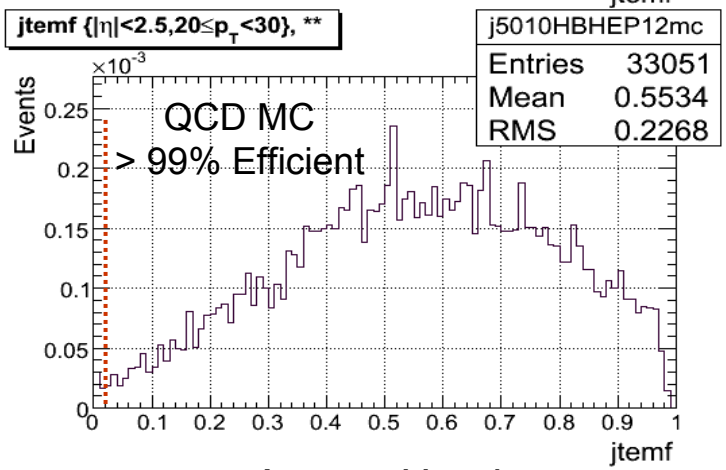




Dave Mason

Secondary Cut: Jet EMF > 0.02



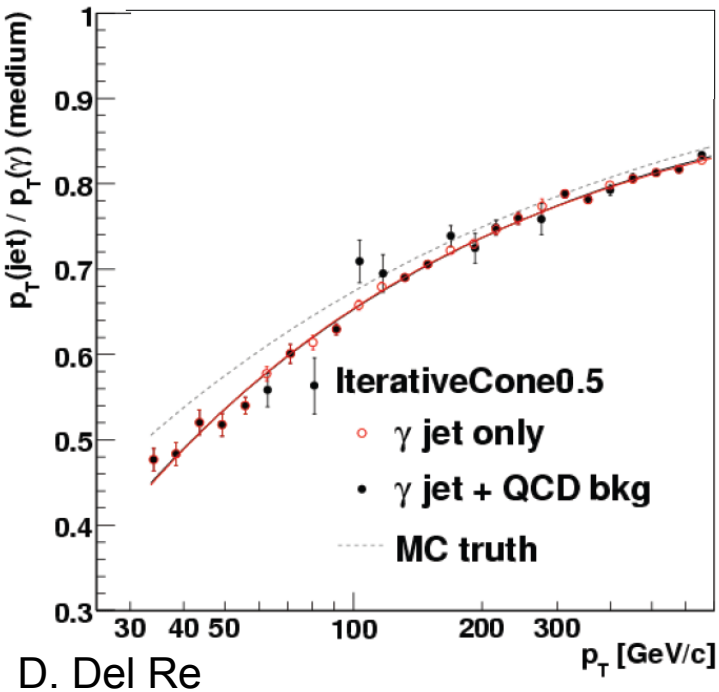


Amnon Harel

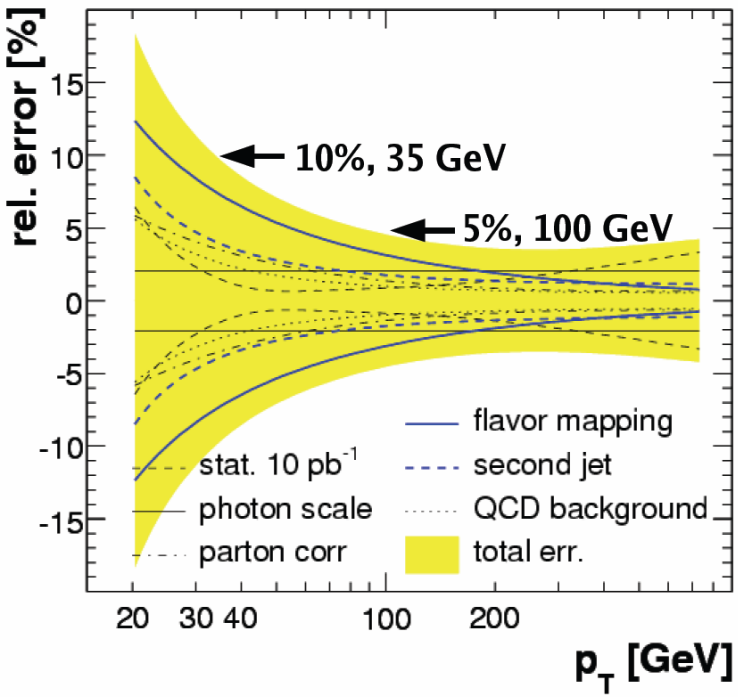
Data-Driven Jet Energy Corrections
(Plans for Absolute Jet Correction vs. p_T)

- Photon + Jet p_T Balance (CMS AN-2009/012)
  - Used to measure the absolute jet response vs p_T in barrel calorimeter
  - Bias, statistics and systematics have been studied for early running.

Jet Response from γ + Jet Balance



Uncertainties



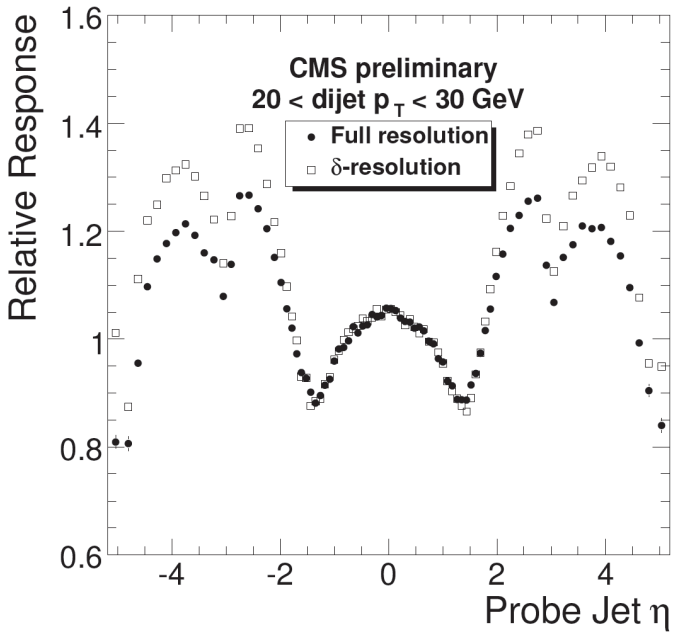
D. Del Re
M. Voutilainen

Data-Driven Jet Energy Corrections

(Plans for Relative Jet Correction vs. η)

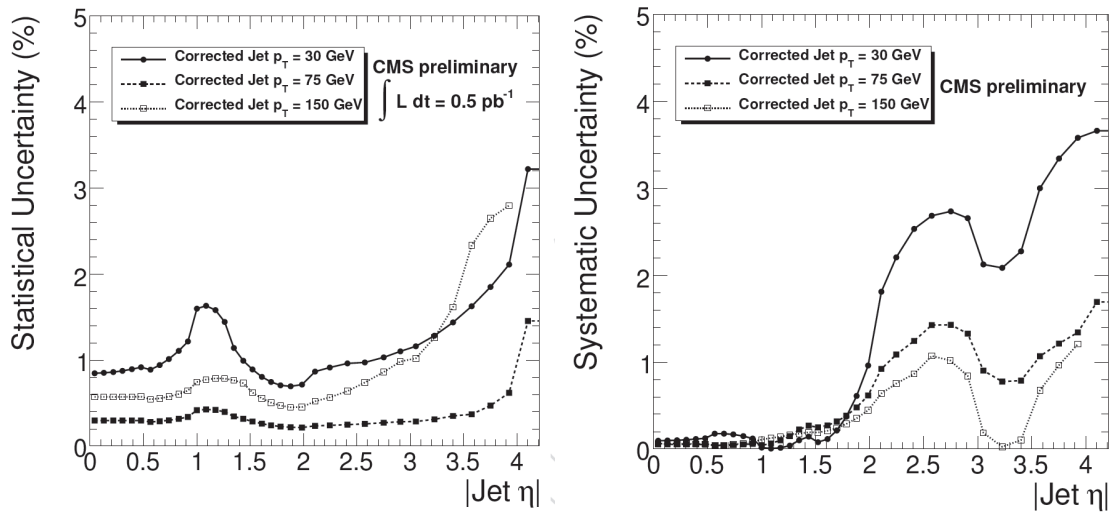
- Dijet p_T Balance (CMS AN-2008/031, CMS PAS JME-08-003)
  - Used to measure the relative jet response vs η.
  - Bias, statistics, and systematics have been studied for early running.

Relative Jet Response from Dijet Balance



Preapproved by JetMET

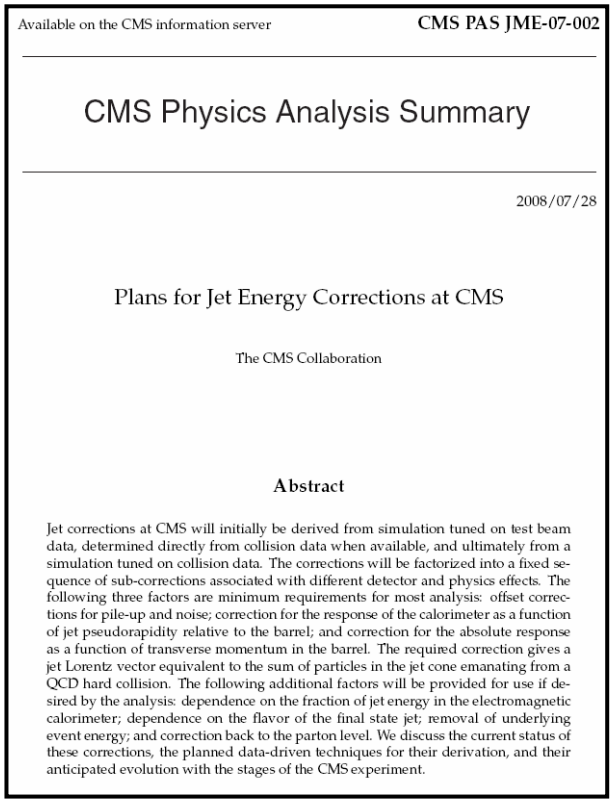
Statistical and Systematic Uncertainties



Kostas Kousouris

Jet Energy Correction Plan

- CMS Approved Plans
  - Multiple levels of corrections
  - Data driven methods inherited from Tevatron and explored for CMS environment
  - Corrections and their uncertainty will be a challenging CMS wide effort.



Available on the CMS information server CMS PAS JME-07-002

CMS Physics Analysis Summary

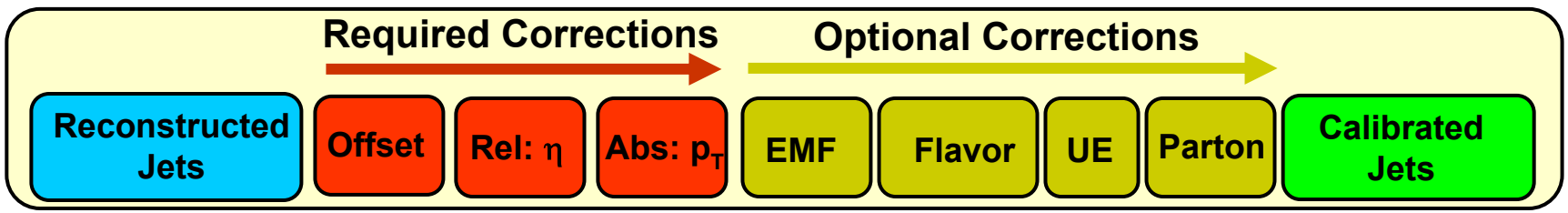
2008/07/28

Plans for Jet Energy Corrections at CMS

The CMS Collaboration

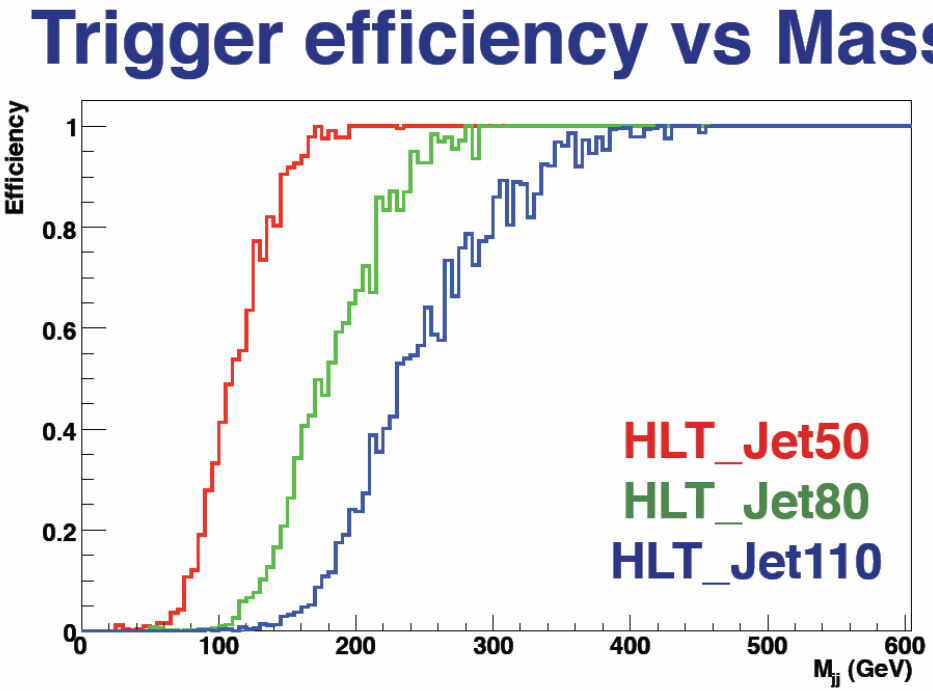
Abstract

Jet corrections at CMS will initially be derived from simulation tuned on test beam data, determined directly from collision data when available, and ultimately from a simulation tuned on collision data. The corrections will be factorized into a fixed sequence of sub-corrections associated with different detector and physics effects. The following three factors are minimum requirements for most analysis: offset corrections for pile-up and noise; correction for the response of the calorimeter as a function of jet pseudorapidity relative to the barrel; and correction for the absolute response as a function of transverse momentum in the barrel. The required correction gives a jet Lorentz vector equivalent to the sum of particles in the jet cone emanating from a QCD hard collision. The following additional factors will be provided for use if desired by the analysis: dependence on the fraction of jet energy in the electromagnetic calorimeter; dependence on the flavor of the final state jet; removal of underlying event energy; and correction back to the parton level. We discuss the current status of these corrections, the planned data-driven techniques for their derivation, and their anticipated evolution with the stages of the CMS experiment.



Trigger Efficiency and Prescales

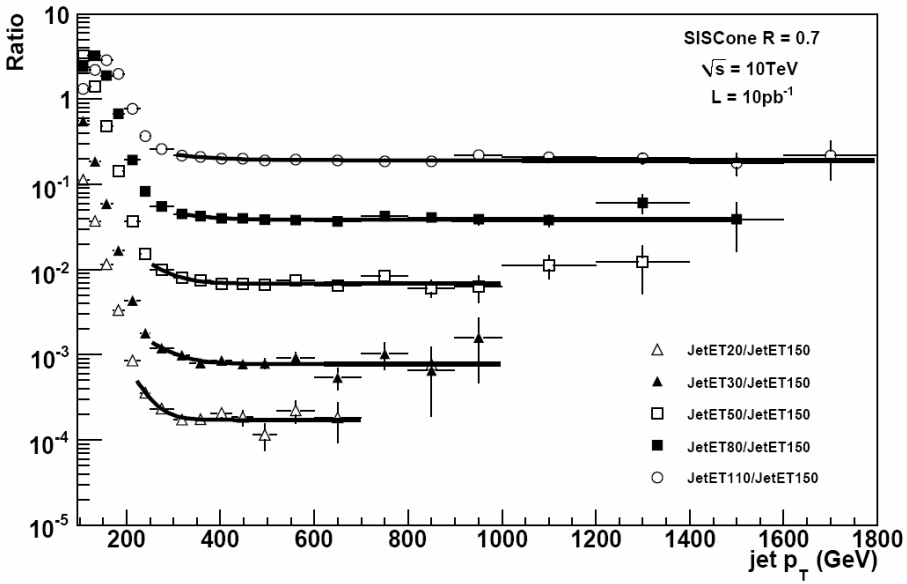
- Plan to measure the trigger efficiency and prescales from data



Kostas Kousouris

CMS AN-2008/080

Prescale Factors

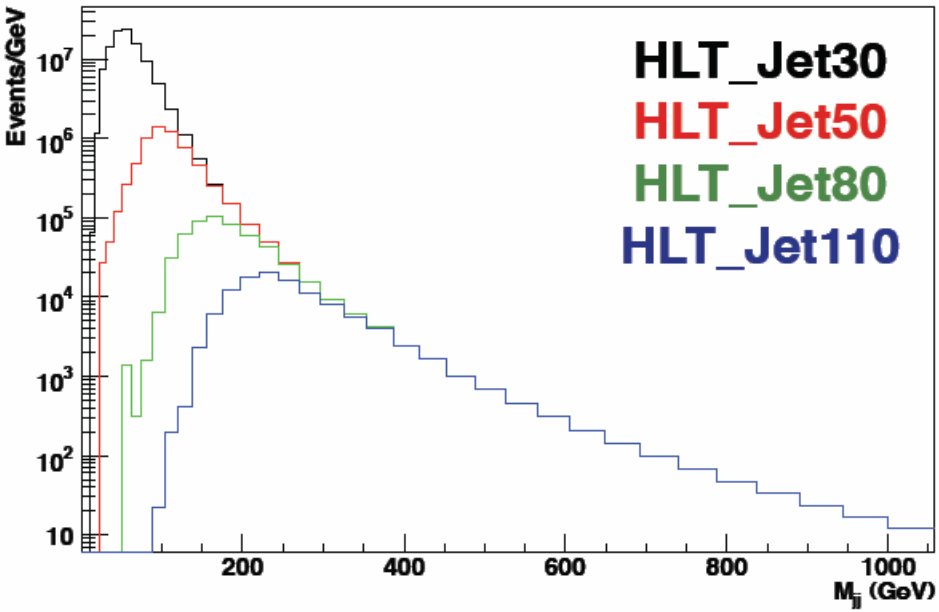


Mass Spectra

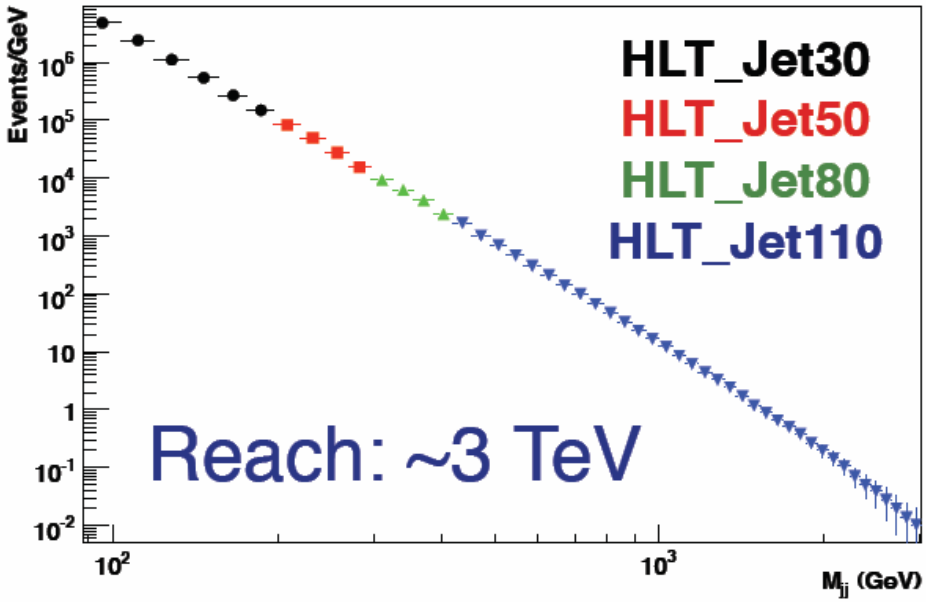
- Plan to measure spectra corrected for prescales and visually verify trigger turn-on and prescales
- Plan to combine trigger samples to form efficient spectrum

CMS AN-2008/080

Normalized Spectra, corrected for Prescale



Combined Spectrum

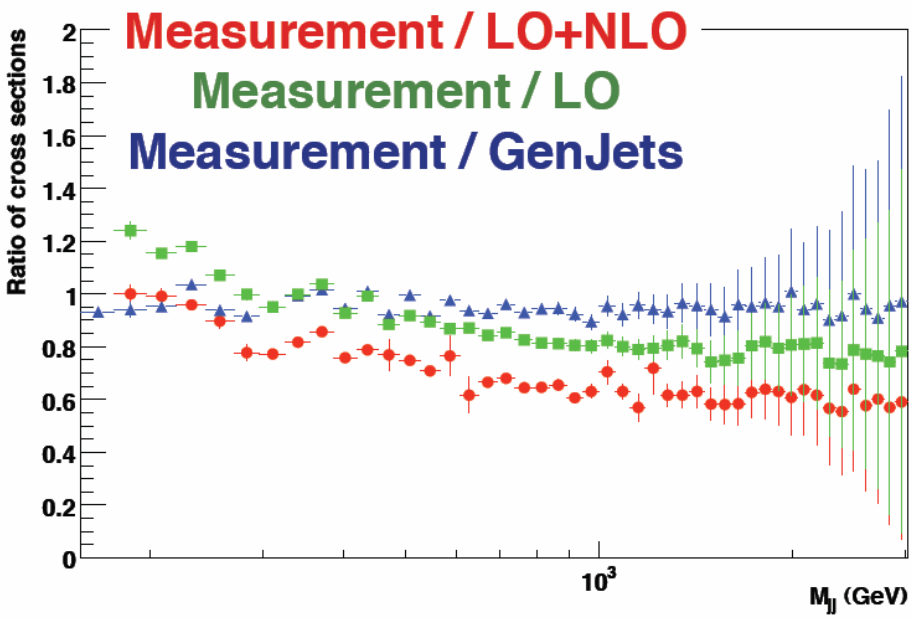


Kostas Kousouris

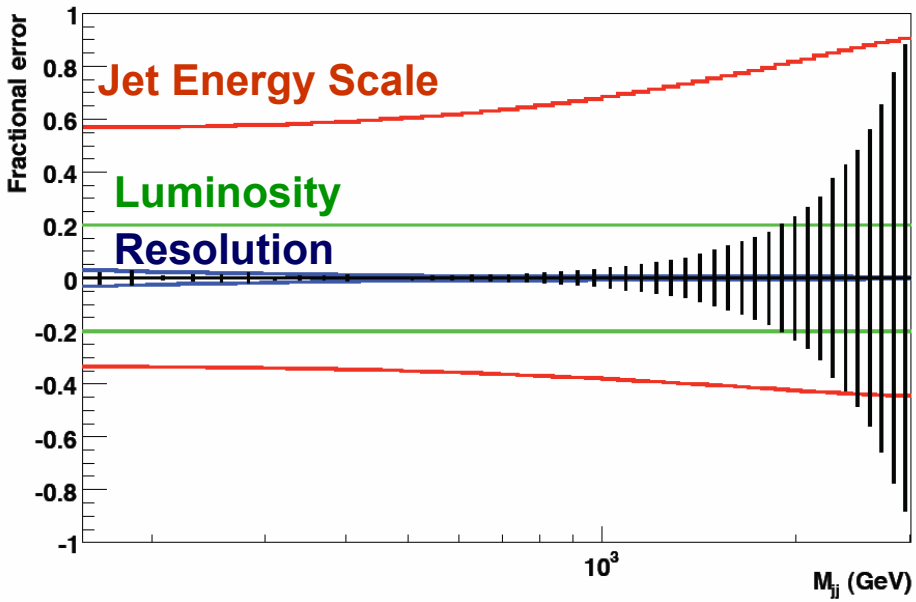
Dijet Mass Spectrum compared to Theory

- Plan to get QCD theory from Pythia, LO & NLO (NLOJET++)
  - QCD High P_T Jet group has formed a Theory Task Force
  - QCD spectrum is an important standard candle for jets.
    - Goal is to reproduce QCD at low mass within uncertainties.

Mass Spectrum compared to QCD



Experimental Systematic Uncertainty

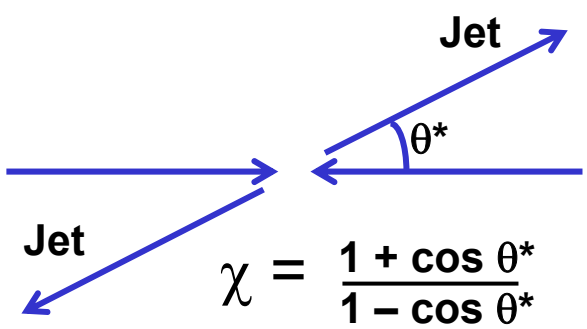


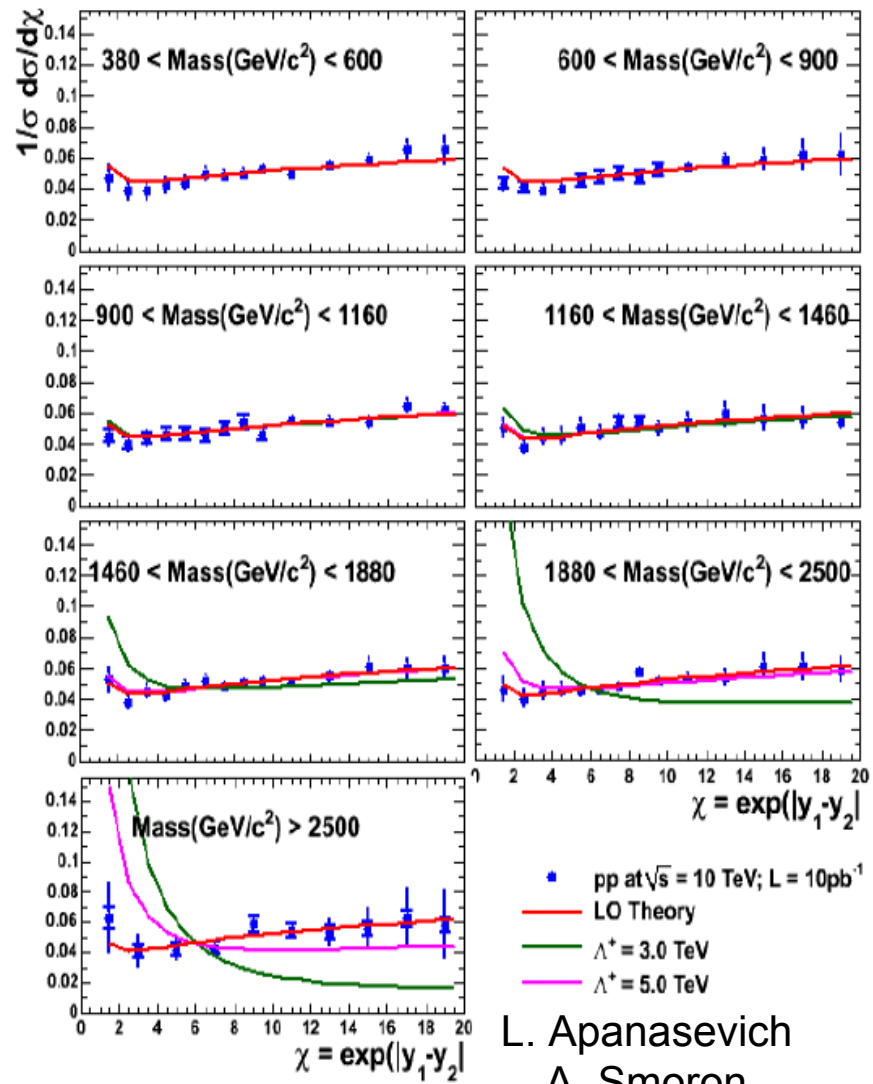
Kostas Kousouris

Dijet Angular Distribution

- QCD is a standard candle
  - Should be angle to reproduce QCD with little systematic uncertainty at low mass
  - Search for affects of new physics at high mass
- Plan to measure and compare with QCD

Center of Momentum Frame



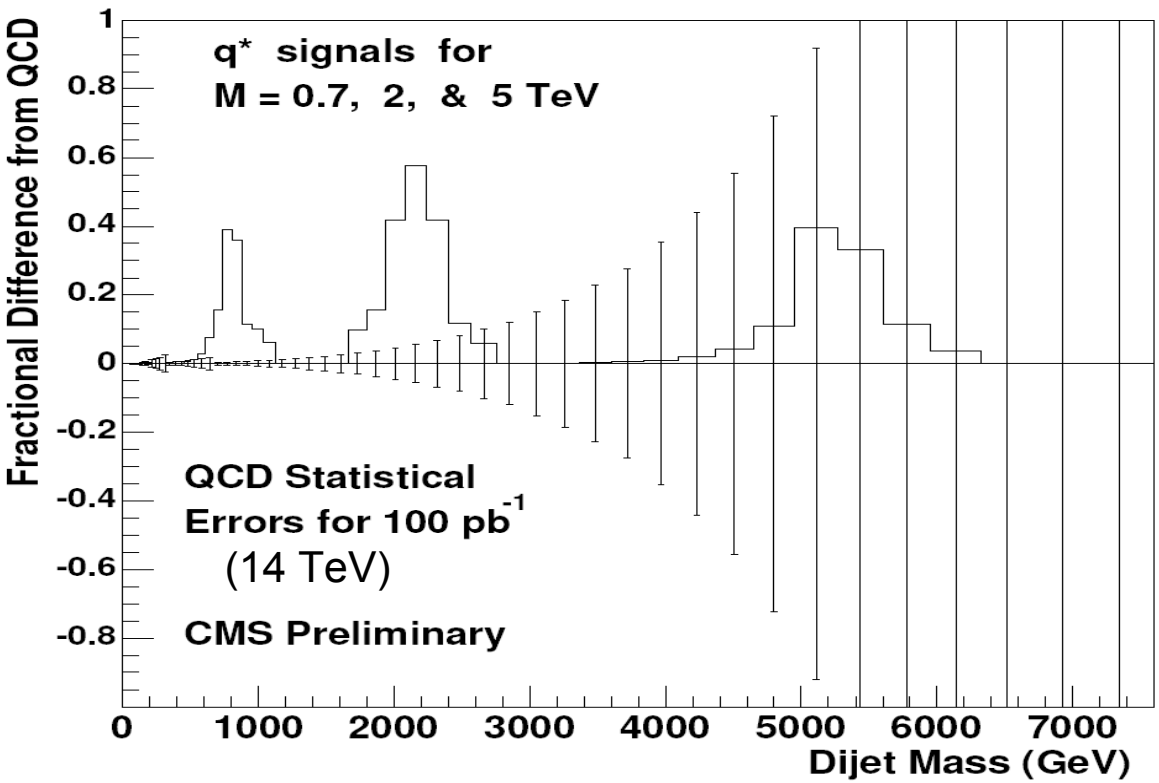


L. Apanasevich
A. Smoron

Resonance Search with Rate

- Plan to search the dijet mass distribution for bumps
  - Use a smooth parameterized fit or QCD prediction for background
  - Plan to use PYTHIA + CMS simulation of jet response for signal.

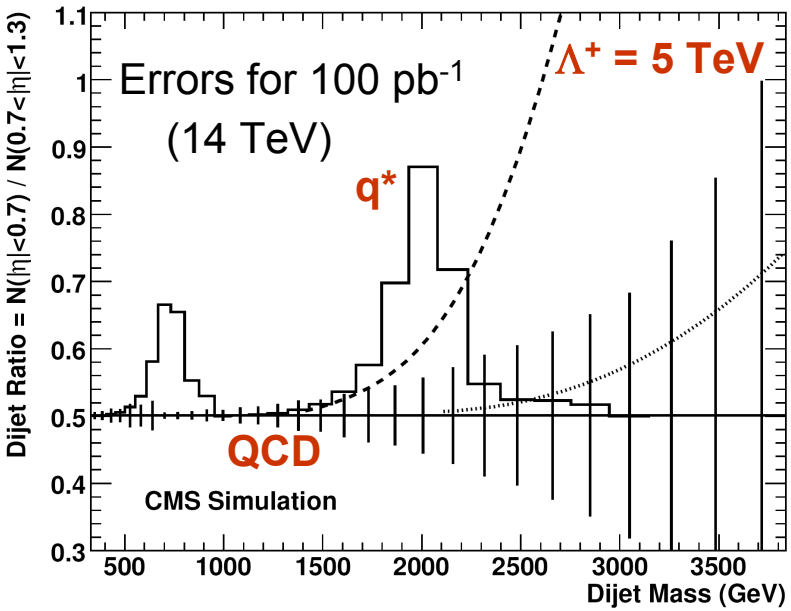
J. Phys. G: Nucl. Part. Phys. 36 (2009) 015004

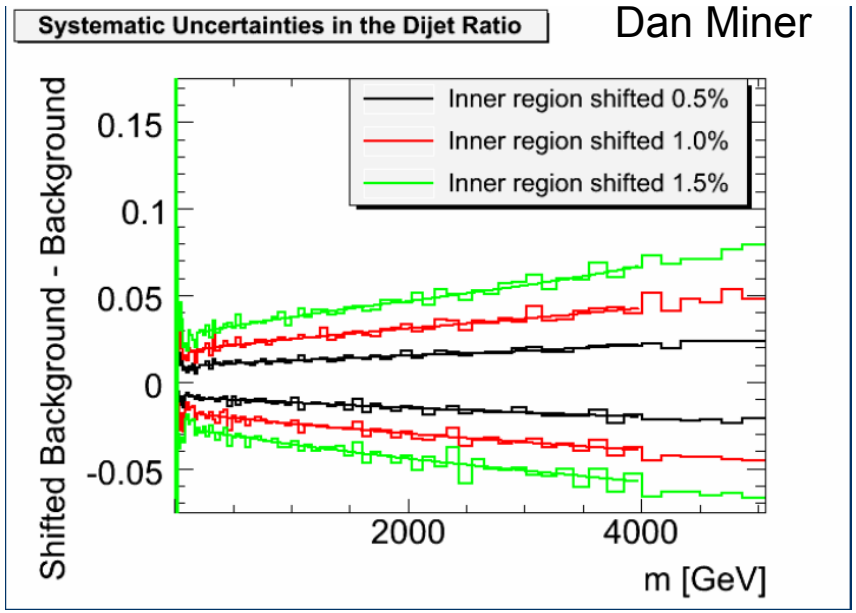


Resonance Search with Dijet Ratio

- Plan to confirm resonances and measure their spin with dijet ratio
  - Dijet Ratio = $N(|\eta|<0.7) / N(0.7<|\eta|<1.3)$ is simple measure of angular dist.
  - Sensitive to both contact interactions and dijet resonances.
  - Insensitive to systematic uncertainties in the absolute jet energy scale
  - Plan to model signals with PYTHIA.

J. Phys. G: Nucl. Part. Phys. 36 (2009) 015004





Dan Miner

People

- Dijet Cleanup
  - K. Cankocak, A. Harrel, P. Jindal, D. Mason
- Jet Corrections
  - V. Buege, D. Del Re, D. Ferencek, R. Harris, I. Iashvilli, K. Kousouris, K. Mishra, M. Voutilainen.
- Jet Trigger Efficiency & Prescales
  - L. Apanasevich, K. Chung, K. Kousouris
- Dijet Mass Distribution & Resonances
  - K. Cankocak, R. Harris, C. Jeong, K. Kousouris, S. Ozturk,
- Dijet Angular Distributions
  - L. Apansevich, A. Smoron, N. Varelas
- Dijet Ratio & New Physics
  - A. Harrel, R. Harris, D. Miner, M. Zielinski

Conclusions

- We have presented the basic steps in the plan to discover new physics in dijets at CMS
  - Cleanup of unphysical backgrounds
    - Efficient cuts on MET/ΣE_T and jet EMF, study in global run & collider data.
  - Measure jet energy corrections
    - Will be a lot of work, but we have a data-driven plan.
  - Measure trigger efficiencies and prescales
    - Straight forward once we have the data.
  - Test QCD with mass spectrum, angular distributions and dijet ratio.
    - QCD is our standard candle at low dijet mass.
  - Search for New Physics
    - New physics seen in dijet rate must be quickly confirmed by angular measurement (dijet ratio).

- We are preparing to execute this plan.