The Dijet Ratio at 10 TeV CM Energy

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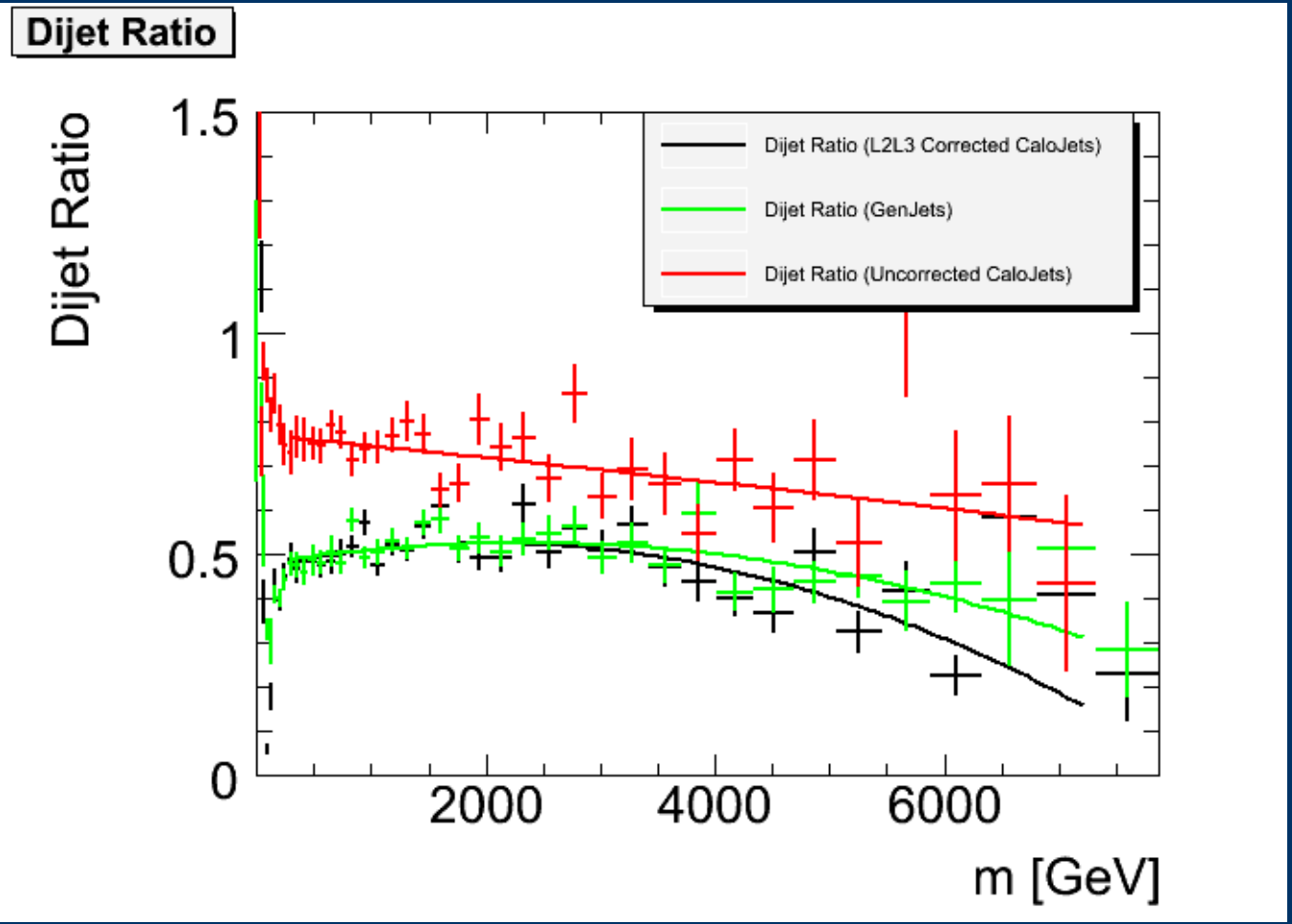
The Dijet Ratio: What is it?

- The angular distributions of jets is sensitive to new physics, including resonances and contact interactions
  - we focus here on resonances
- We want an observable that can be parametrized as a function of mass, but contains more or different information than a simple count
- The dijet ratio provides this: it summarizes the angular distribution of jets in the barrel
- A dijet is the two highest p_T jets in an event
- The Dijet Ratio is defined as ratio of “inner” to “outer” dijet events
  - “inner” dijet has both jets with $|\eta|<0.7$
  - “outer” dijet has both jets with $0.7<|\eta|<1.3$

The Dijet Ratio: What are we doing with it?

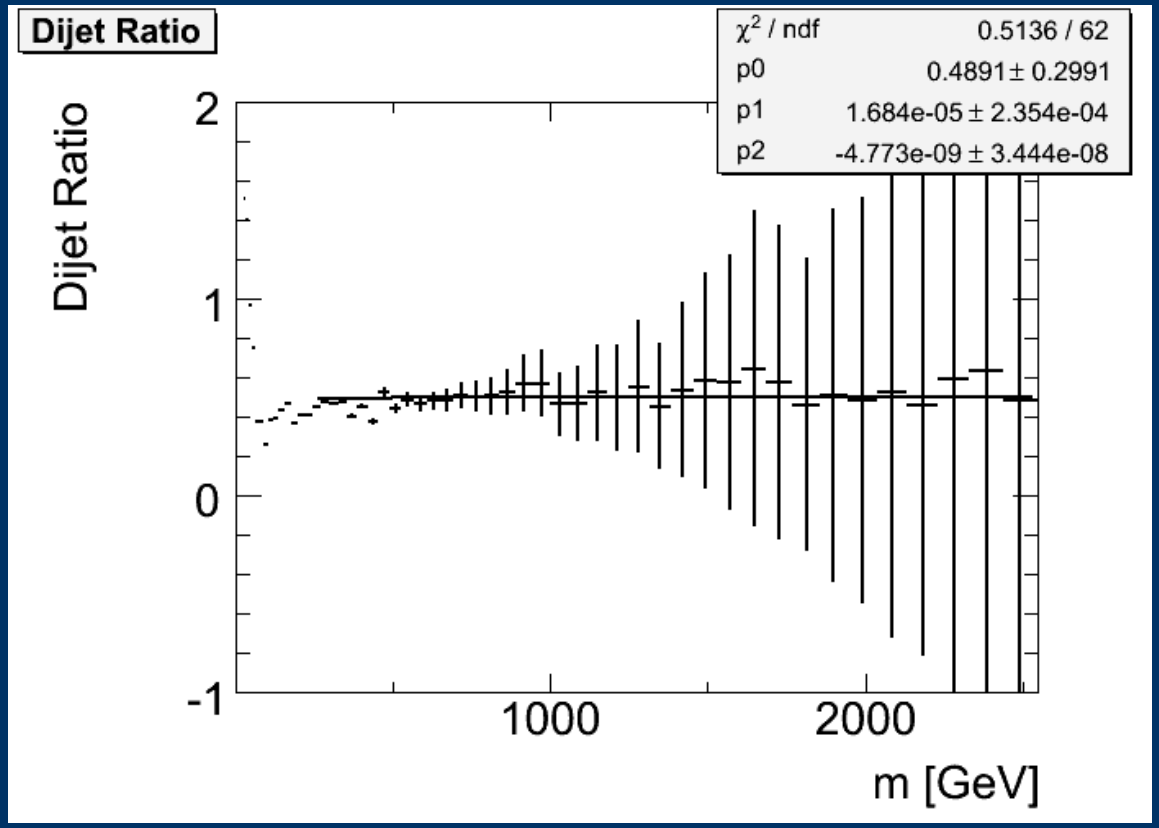
- Summer08 sample is ~ 1 million Pythia-generated QCD jet events split into 21 subsamples by pt_hat bin
  - 10 TeV CM energy
  - smaller exotica samples also generated
  - each subsample weighted by cross section / number of events when recombining
- Jets reconstructed using SisCone7 algorithm
- L2L3 jet corrections applied unless otherwise noted
  - L2: Relative corrections – flattens jet response in eta
  - L3: Absolute corrections – flattens jet response in p_T
- Fit to 2^{nd} order polynomial unless otherwise noted
- m is the dijet invariant mass

QCD Background



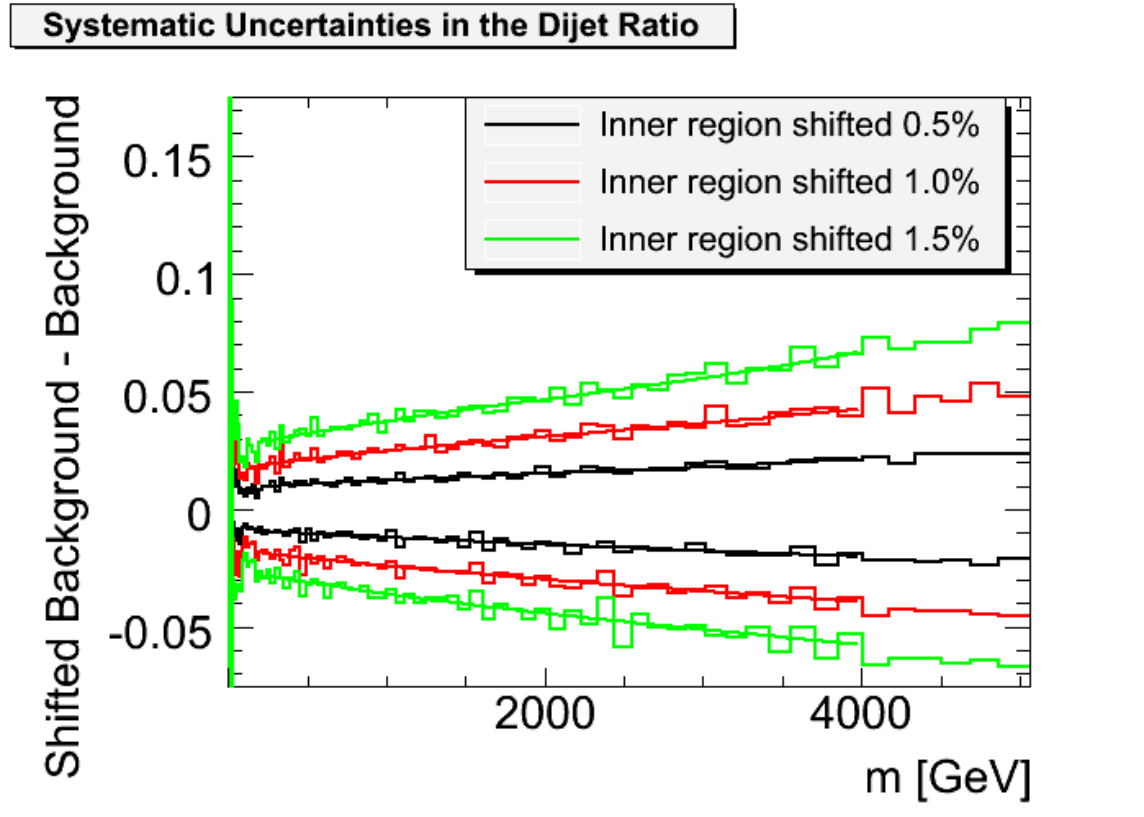
- Dijet ratio from L2L3 Corrected Calojets and from GenJets consistent to within 0.0138

QCD Background: L2L3 Corrected Calojets with Fit



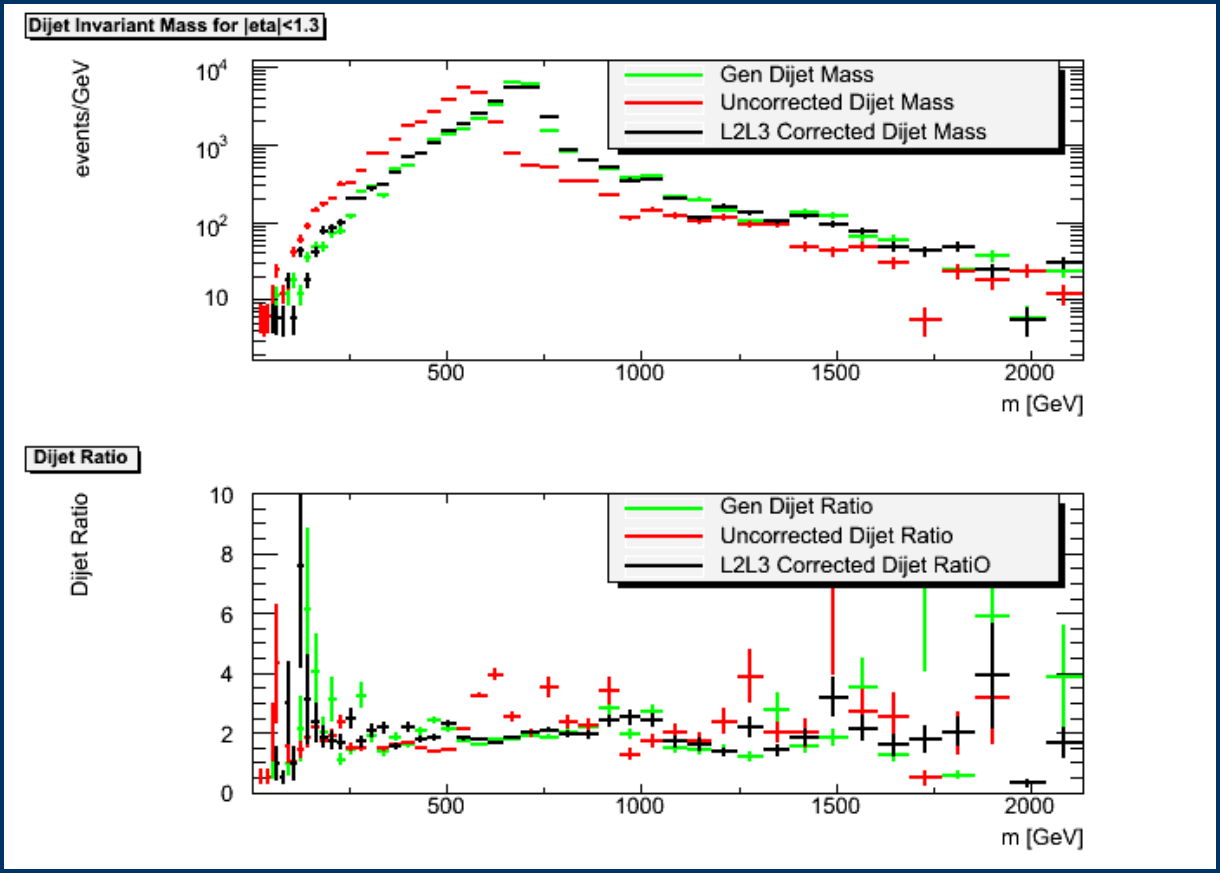
- L2L3 Corrected Calojets from above fit to 2nd order polynomial
- Error bars adapted to 1 inverse pb integrated luminosity
- Fluctuations, however, retain MC statistics

Systematics



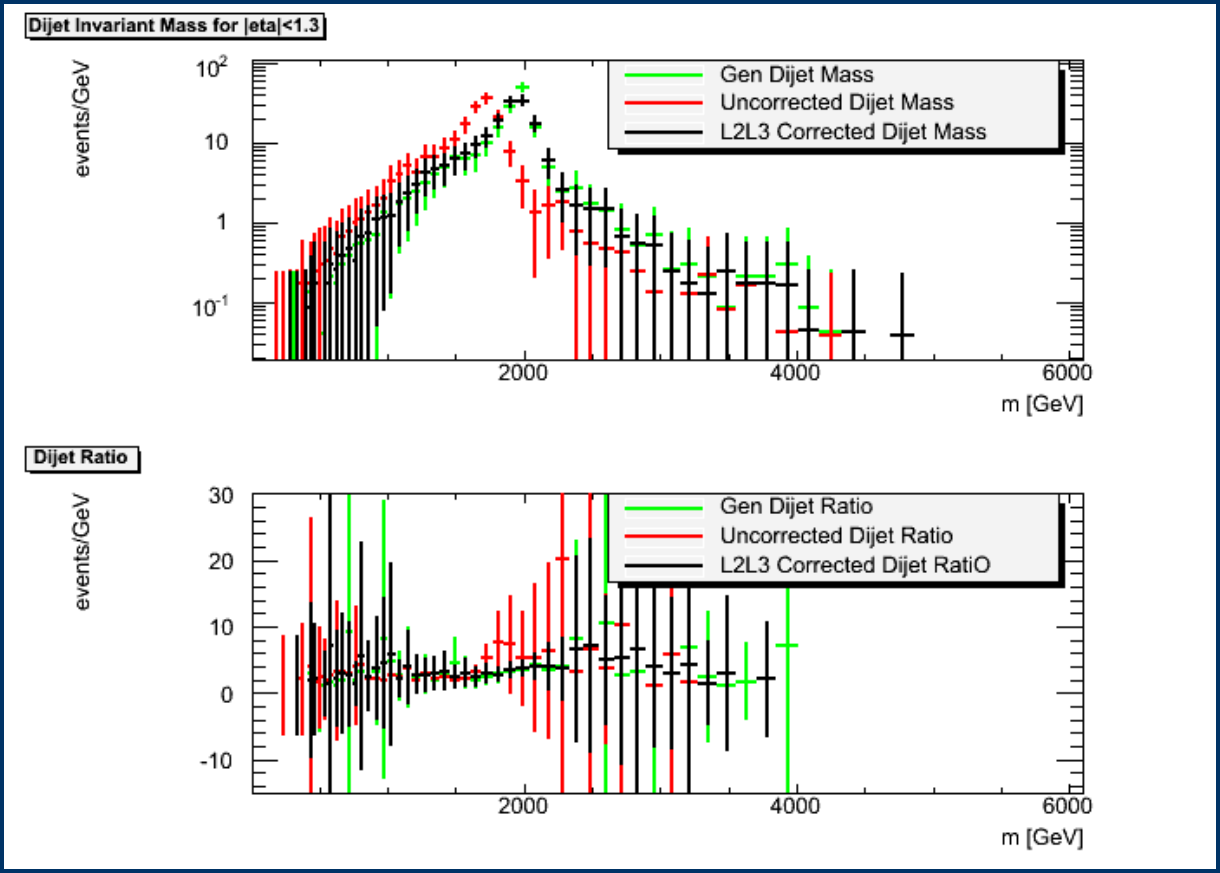
- Initial minimal systematic uncertainty estimates come from MC dijet balance studies (AN 2005/034) and correspond to the achievable uncertainty obtainable after one day of data taking
  - estimated as 0.5% uncertainty in relative jet energy scale as a function of η in the barrel

700 GeV q* Mass Spectra and Ratio



- 700 GeV q* used as test signal
- Counts and errors normalized to 100 inverse pb integrated luminosity; fluctuations, however, retain MC statistics
- q* 700 Gev Dijet Ratio fitted as 1.869 +/- 0.01851

2000 GeV q* Mass Spectra and Ratio

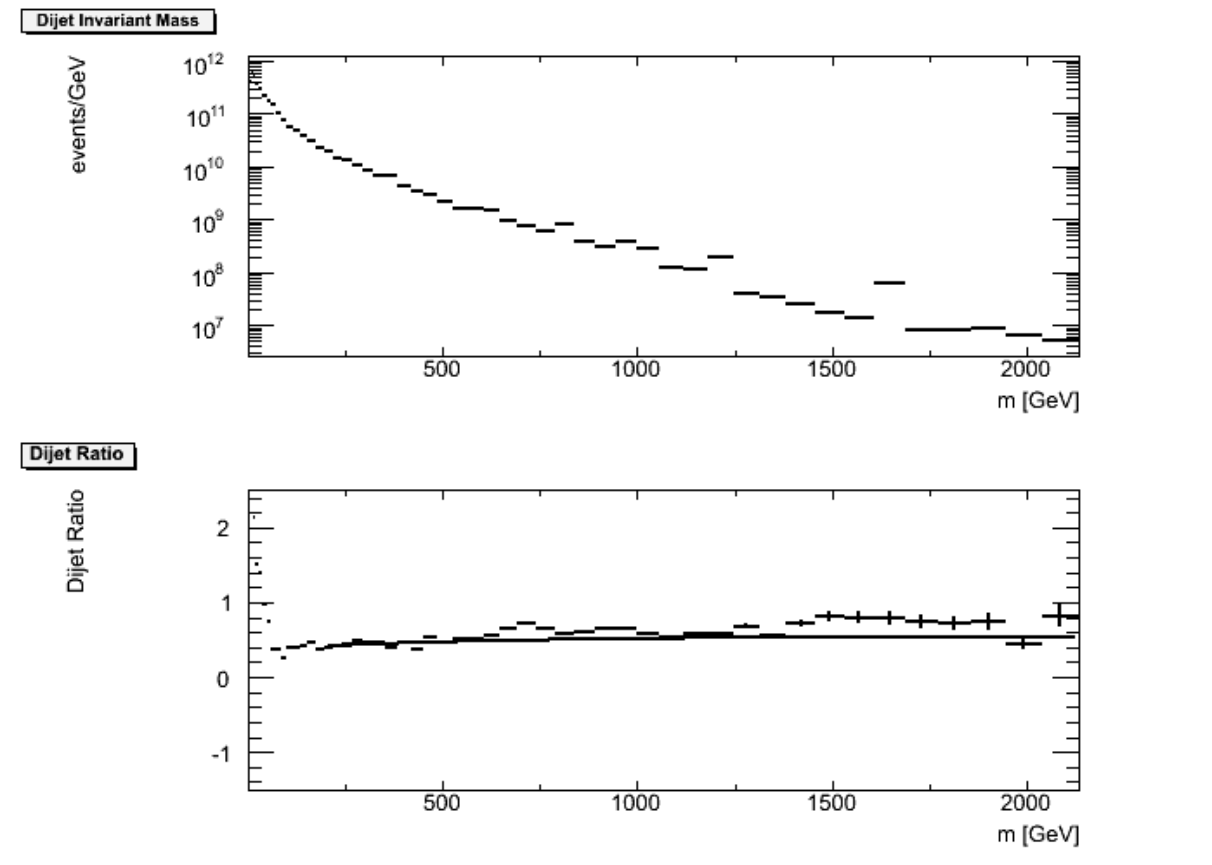


- 2000 GeV q* used as test signal
- Counts and errors normalized to 100 inverse pb integrated luminosity; fluctuations, however, retain MC statistics
- q* 2000 Gev Dijet Ratio fitted as 3.008 +/- 0.4714

Signal Properties

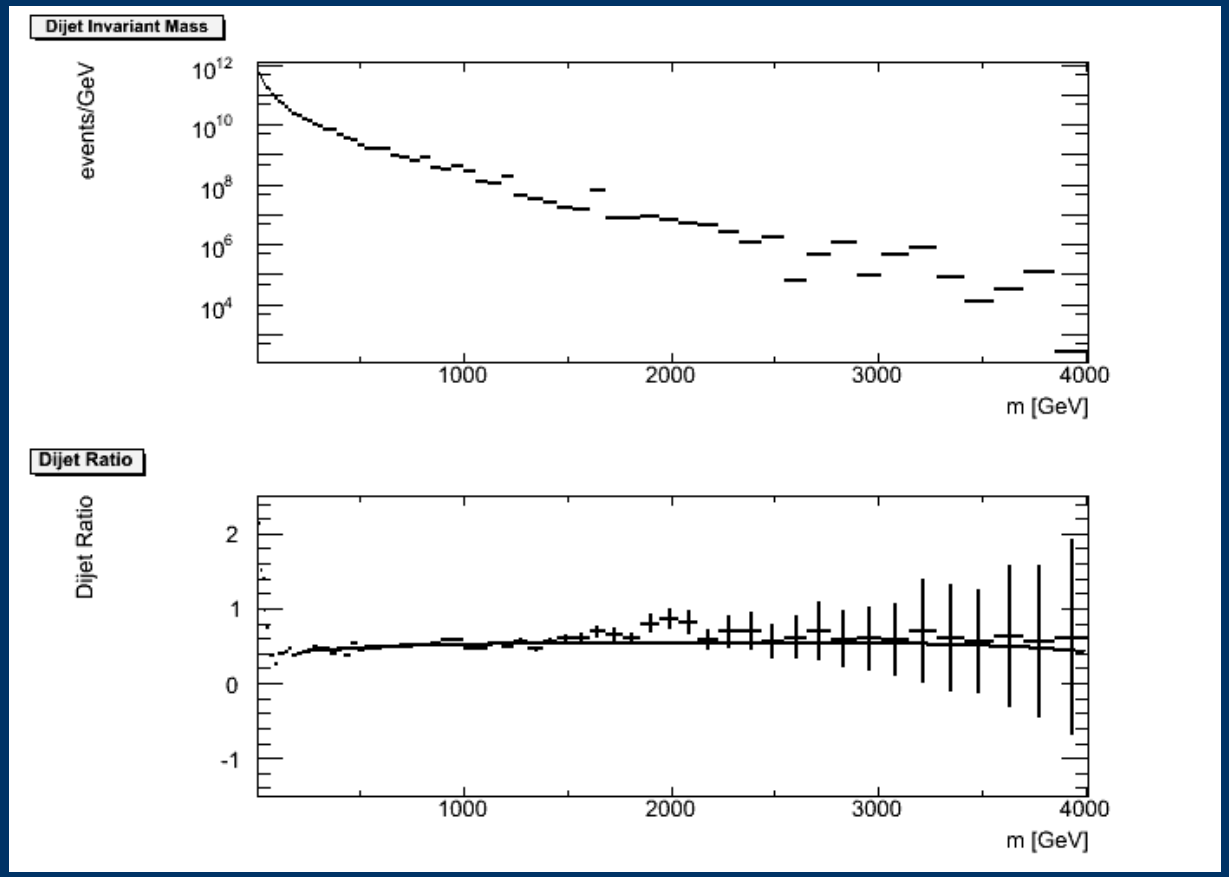
- Note that for the q*, the dijet ratio has a value of between 2 and 3
  - the q* angular distribution tends to be more isotopic (central)
- The QCD background has a dijet ratio value of ~0.5
  - the QCD angular distribution is dominated by t-channel scattering, which tends to be more forward
- Thus, where the number of signal events is high (i.e. around the mass peak), the dijet ratio will tend to rise above the background

700 GeV q* + QCD Background Mass Spectra and Ratio



- L2L3 Corrected CaloJets
- Counts and errors normalized to 100 inverse pb integrated luminosity; fluctuations, however, retain MC statistics

2000 GeV q* + QCD Background Mass Spectra and Ratio



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Future Plans

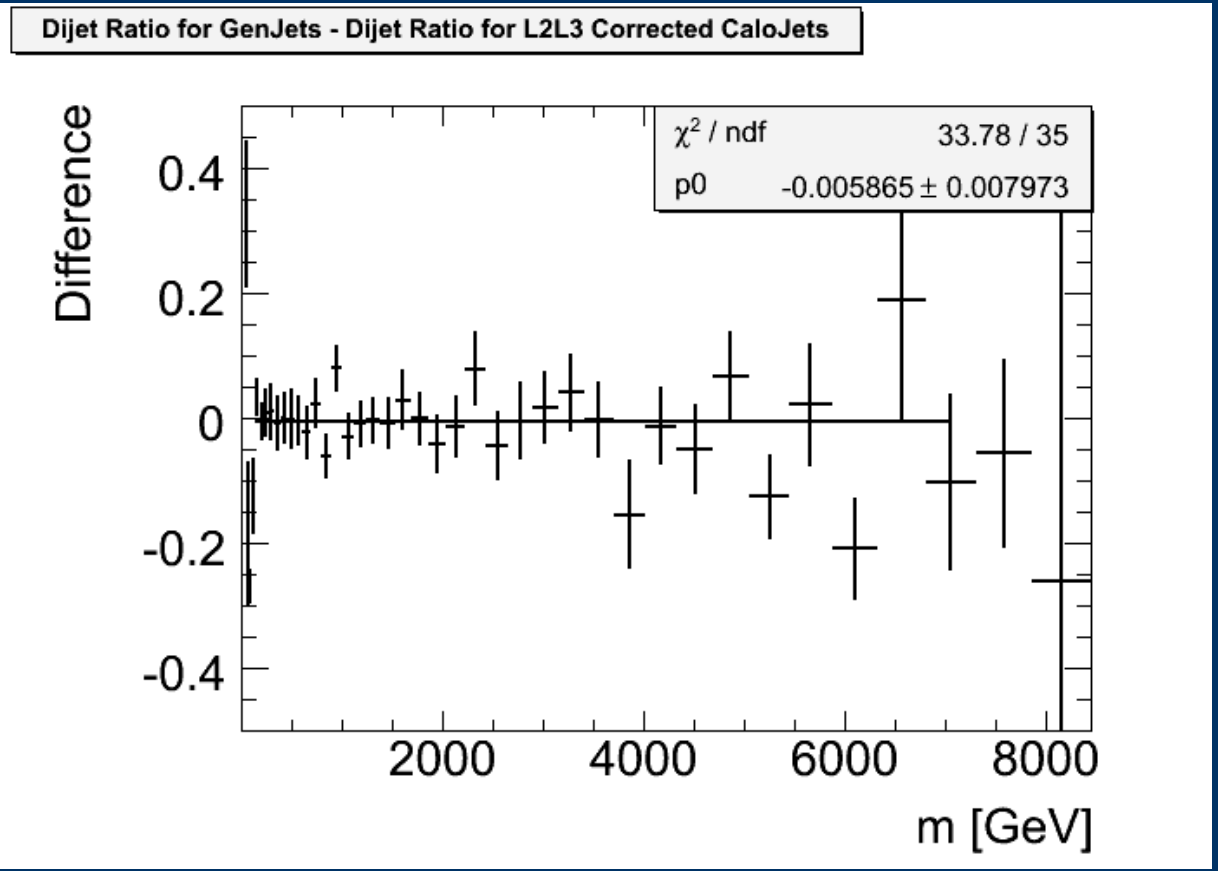
- Signal significance:
  - as this is not a simple counting exercise, methods for evaluating the signal significance are still being studied
    - chi-squared and modified chi-squared methods are being studied with particular interest
  - results will be released to JetMet and QCD High p_T groups as soon as they are available
- Evaluation of spin-sensitivity (via sensitivity to angular distribution) of the dijet ratio

Conclusions

- With data from Pythia, it appears that the dijet ratio for the QCD background is roughly 0.5, and falls slowly with increasing mass
- The Dijet ratio provides a sensitive complementary observable to looking for a simple mass peak in resonance searches
  - provides a peak that occurs when there is a tendency toward a different angular distribution than that of the QCD background
- I'd like to thank Rob Harris, Regina Demina, Philipp Schieferdecker, Marek Zielinski and Amnon Harel for their assistance

Backup Slides

L2L3 Corrected CaloJet vs GenJet Difference



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