# Dijet Mass Spectra and Search for Quark Compositeness

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QCD MEETING

# Overview

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- **Trigger Efficiency**
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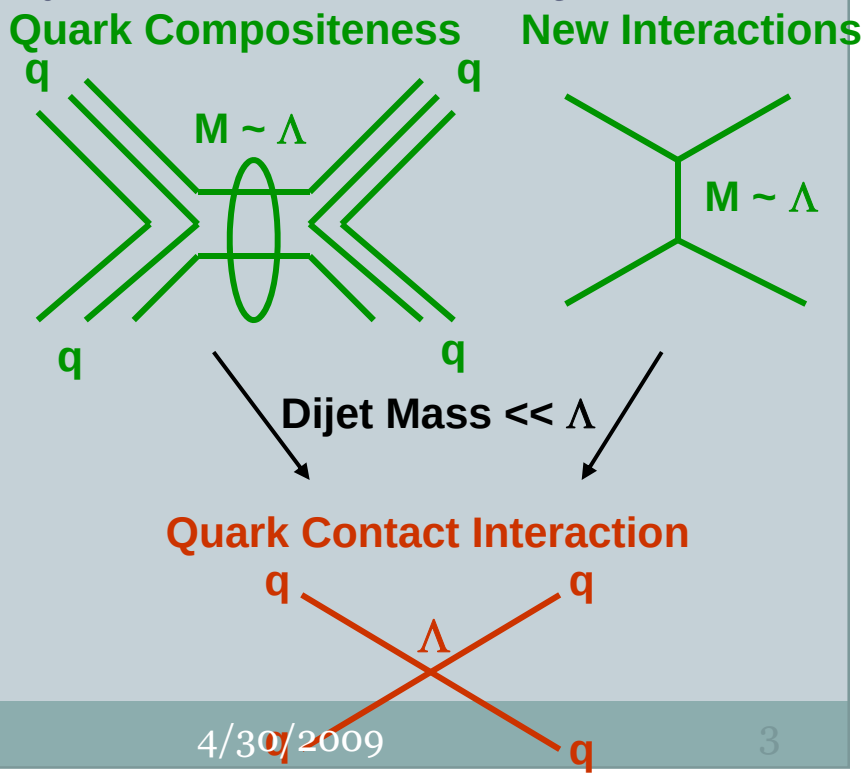
# Motivation

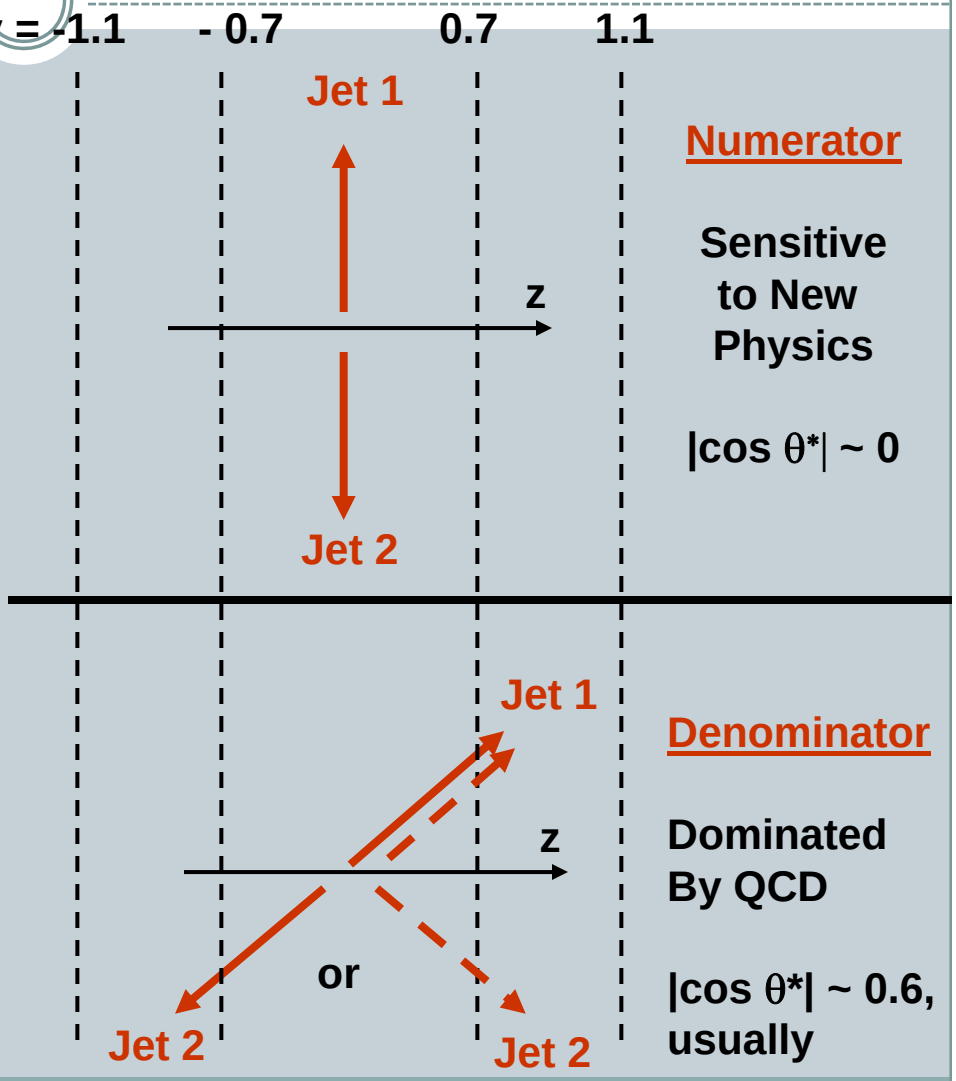
- Test of perturbative QCD
  - Measurement of the dijet mass spectrum provides fundamental tests of pQCD over many order of magnitude in cross section: complimentary analysis of the inclusive jet cross section measurement.

- Search for new physics:
  - Quark compositeness
  - New interactions from massive particles exchanged between partons.



# Dijet Ratio: Simple Angular Measurment

- Dijet Ratio =
  N(|y|<0.7) / N(0.7<|y|<1.1)
  - Number of events in which each leading jet has |y|<0.7, divided by the number in which each leading jet has 0.7<|y|<1.1
- Simple measurement of angle distribution
  - The numerator and denominator are defined based on their rapidities. Easy control of systematic uncertainties.



# Data and MC Samples

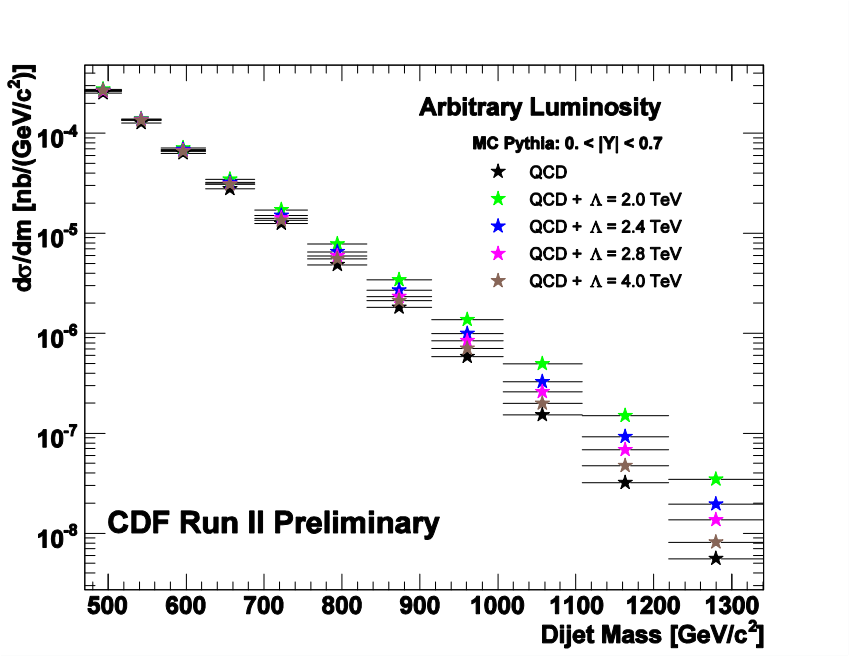
- **Data: Jet 100 triggers**
  - **Up to run number 261005 (up to period 17)**
  - **Luminosity: 3.03 fb-1**
    (with DQM QCD no-silicon good run list v24)
- **MC**
  - **QCD: Pythia 6.2, Tune A**
  - **Use NLOJET++** to understand higher order effects (NLO vs LO), study scale dependence, and PDF uncertainty (CTEQ66)
  - **Quark compositeness signals generated with Pythia 6.2**
    - Canonical model among left handed composite quarks given by Eichten, Lane and Peskin.
    - All quarks participating in contact interaction.
    - Different values of $\Lambda$ = 2.0, 2.4, 2.8 , and 4.0 TeV

# Event Selection and Jet Corrections

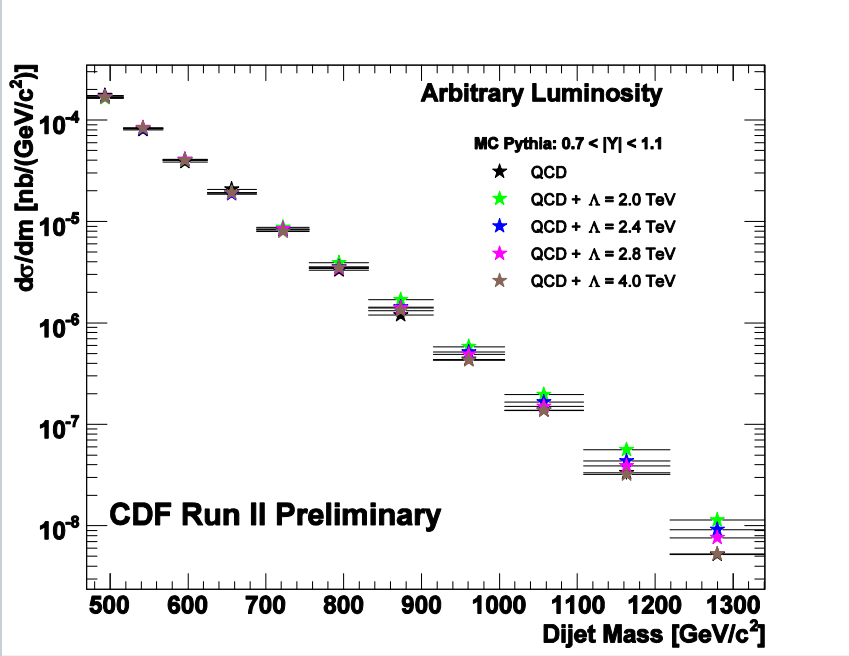
- In this analysis, we use the similar strategy as in inclusive jet cross section measurement.
  - Reconstruct jets using the Midpoint algorithm with R=0.7
  - Basic event selections:
    - Primary vertex |z| < 60 cm
    - Missing Et significance cut: $MET/\sqrt{\sum E_T} < \min(3 + (5/400) * P_T^{jet1}, 6)$
  - Jet corrections:
    - Relative correction:
      - To make the jet energy response uniform in rapidity.
    - Pileup correction:
      - Correction for additional p-p- interactions in same bunch crossing.
    - Absolute correction:
      - Correction for non-linear response of calorimeter jet energy.

# Signal Xsec for Different Values of Λ

**0. < |Y| < 0.7**



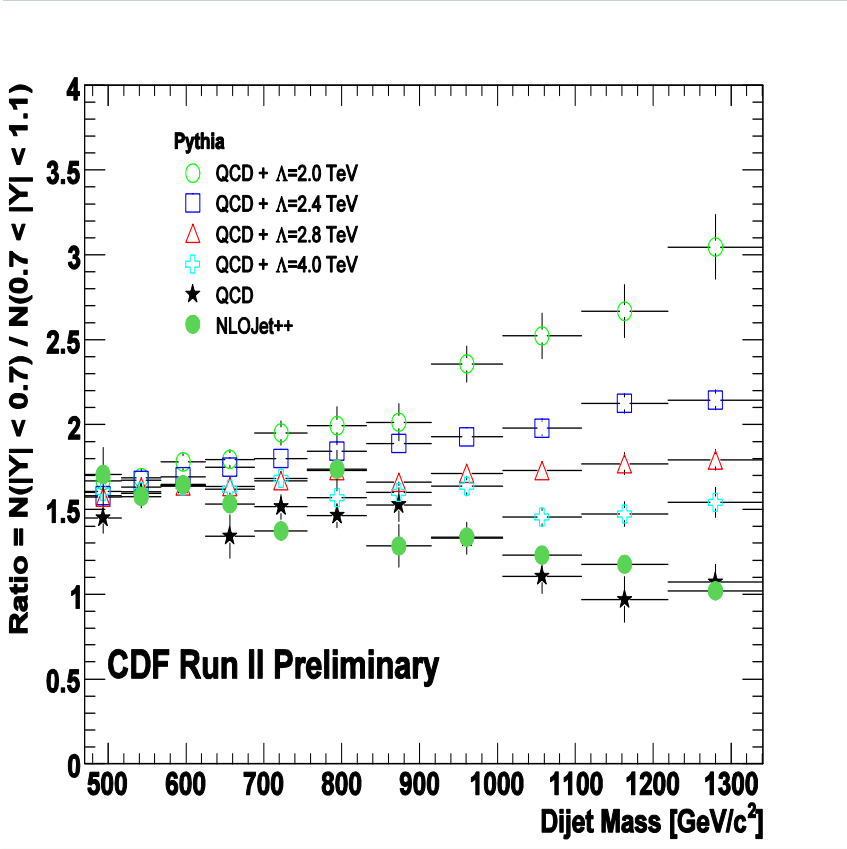

**0.7 < |Y| < 1.1**



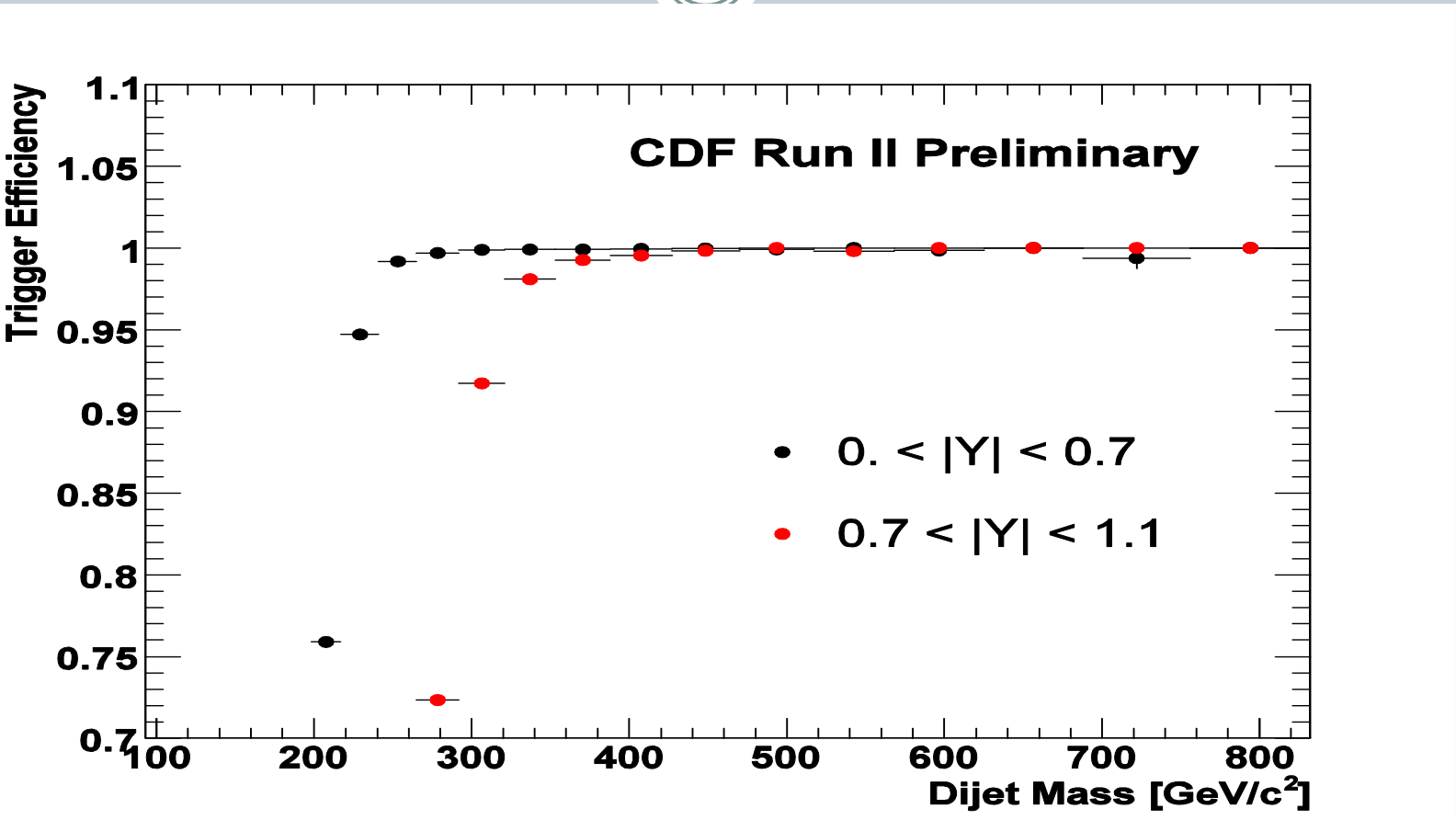

- **Signal cross sections increases with dijet mass.**
- **Lower the compositeness scale higher the cross sections.**

# Dijet Ratio

- Ratio from Pythia & NLOJet++ shows the similar behavior (large theoretical uncertainty cancel out to some extent).
- Dijet ratio from signal increases with dijet mass.
- Smaller compositeness scale have larger effect on dijet ratio.



# Trigger Efficiency

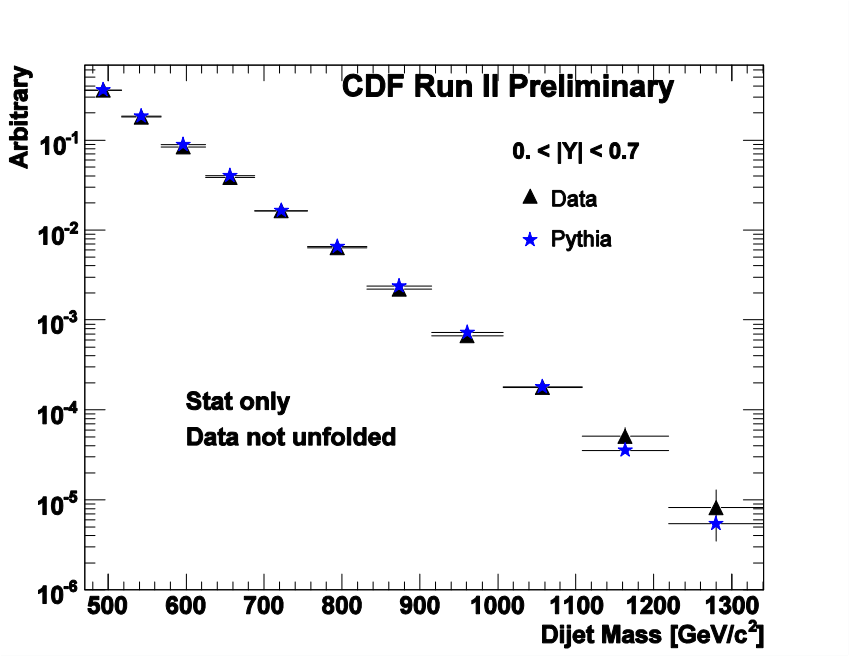



- **Only bins in which trigger efficiencies are greater than 99.5% are used for the measurement.**

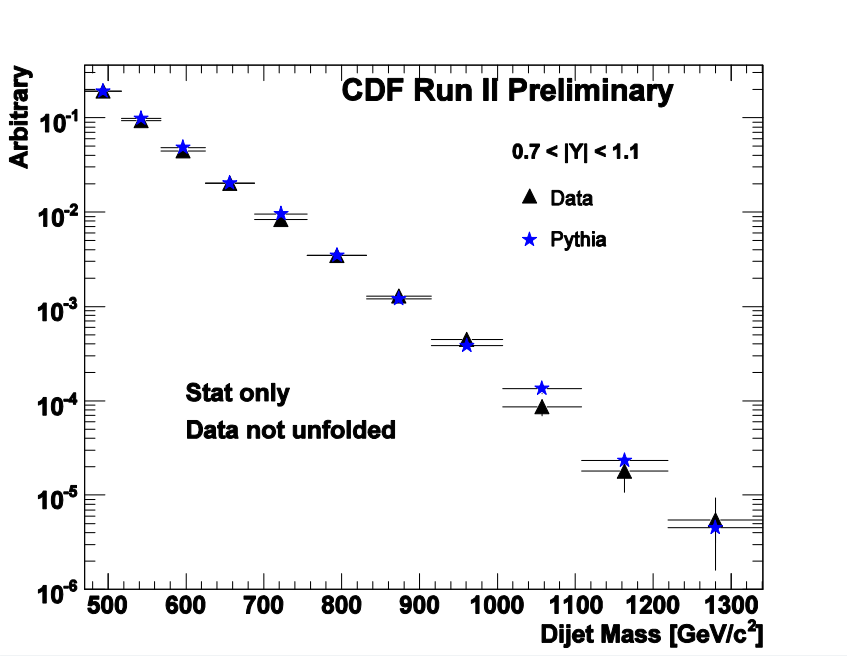
# Dijet cross sections



**0. < |Y| < 0.7**




**0.7 < |Y| < 1.1**




- Error bars are only statistical.
- Data has not been corrected which removes smearing effects in the energy measurement of the calorimeter.

# Next Plan

- Apply jet energy corrections which has not been applied, like unfolding, etc
- Consider  systematics from all other sources, like
  - PDF, Unfolding, Pileup , dijet mass spectra reweighing
- Obtain final results on compositeness