Search for Contact Interactions @ 8 TeV Plans
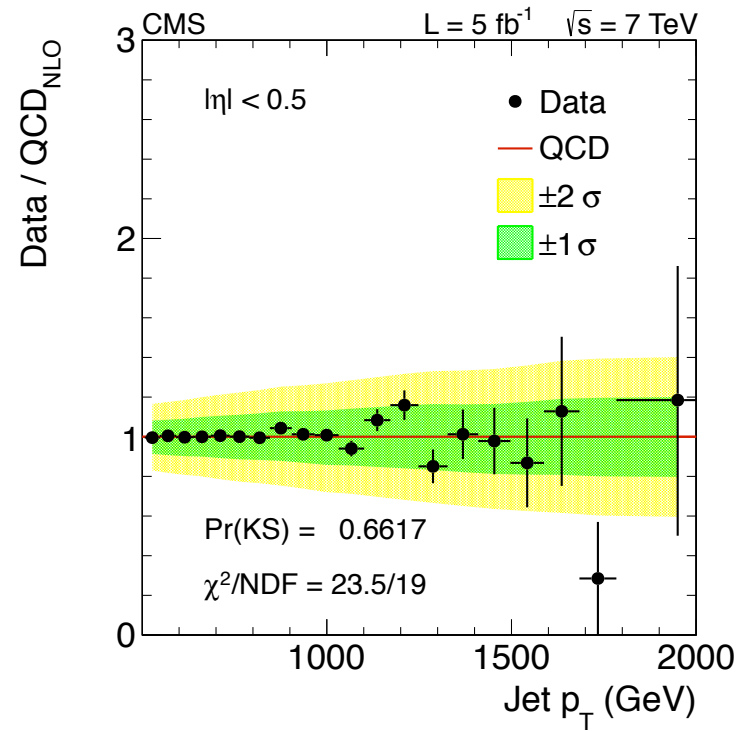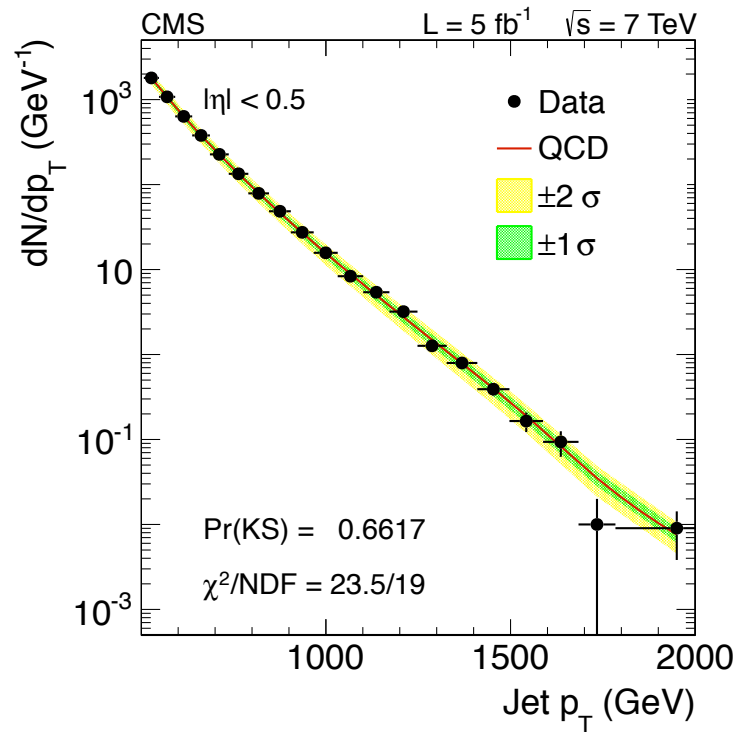
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Exotica-Multijets Meeting

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Reminder: 7 TeV Results

$$\Lambda > 9.9 \text{ TeV}, 14.3 \text{ TeV @ 95 C.L.}$$

7 TeV Results

Proof-reading, expect to be published soon!

Search for contact interactions using the inclusive jet p_T spectrum in pp collisions at $\sqrt{s} = 7$ TeV

S. Chatrchyan *et al.*

(CMS Collaboration)

Results are reported of a search for a deviation in the jet production cross section from the prediction of perturbative quantum chromodynamics at next-to-leading order. The search is conducted using a 7 TeV proton-proton data sample corresponding to an integrated luminosity of 5.0 fb^{-1}, collected with the Compact Muon Solenoid detector at the Large Hadron Collider. A deviation could arise from interactions characterized by a mass scale Λ too high to be probed directly at the LHC. Such phenomena can be modeled as contact interactions. No evidence of a deviation is found. Using the CL$_s$ criterion, lower limits are set on Λ of 9.9 TeV and 14.3 TeV at 95% confidence level for models with destructive and constructive interference, respectively. Limits obtained with a Bayesian method are also reported.

Outline

1. Overview

2. Plan

3. Status

Overview

Goal

- Using the full 8 TeV data set, compare measured inclusive jet p_T spectrum of central jets to CI models aiming for a preliminary result by early summer.

What do we need? Experimental input:

- Measured inclusive jet p_T spectrum
- A high p_T region where trigger efficiency is constant
- Jet energy resolution vs. jet p_T
- Jet energy scale uncertainty
- Jet energy resolution uncertainty

Overview

What do we need? Theoretical input:

- Program to calculate QCD @ NLO

    fastNLO (2.1.0-1360 + fnl3323y0.tab)

- Program to calculate CI @ NLO

    CIJET (Gao, arXiv:1301.7263v1)

Overview: Models

The effective Lagrangian may be written as

$$L = L_{\text{QCD}} + \frac{\lambda}{2} \sum_{i=1}^{6} c_i O_i$$

where $\lambda = 1/\Lambda^2$ and c_i are free parameters, and O_i are dimension six operators. This Lagrangian yields a cross section of the form

$$\sigma = \sigma_{\text{QCD}} + [b(c) + b'(c,\lambda)]\lambda + [a(c) + a'(c,\lambda)]\lambda^2$$

The primed terms depend logarithmically on λ.

Proposed Analysis

We shall follow the approach of the 7 TeV analysis, but with
the following changes:

1. Compute all models at next-to-leading order.

2. Drop use of simulated events.

3. Drop use of ansatz for the ratio (QCD+CI)/QCD.

4. Raise p_T threshold (if this proves advantageous)

5. Compute limits using a Bayesian method *only*

Proposed Analysis

Analysis Steps

1. Generate ensembles of MSTW2008 PDF sets using the procedure described at http://mstwpdf.hepforge.org/random/. Apply same procedure to CTEQ6.6.

2. For each PDF set, and random choices of the renormalization and factorization scales, calculate inclusive jet p_T spectrum.

3. Convolve these spectra with jet response function using randomly sampled (JES, JER) pairs.

Proposed Analysis

Analysis Steps

5. Compute the marginal multinomial likelihood as before:
$$p(D \mid \lambda) = \frac{1}{M} \sum_{m=1}^{M} p(D \mid \lambda, \theta_m)$$

where θ denotes all the nuisance parameters. This time implement likelihood in RooFit/RooStats

6. Compute reference prior $\pi(\lambda)$

7. Compute limit using $\displaystyle\int_{0}^{\lambda *} p(\lambda \mid D) d\lambda = 0.95$

Status

➢ We have exercised the fastNLO and CIJET programs

➢ The RooFit/RooStats implementation of the likelihood will be tested soon

➢ Work on the reference prior will start soon (Supriya Jain)

➢ The random sampling of MTSW2008 PDF sets not yet exercised, but example code exists

➢ Waiting for experimental input