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Jets continued.....

“A Hard” Scattering

proton

underlying event

outgoing parton

outgoing parton

proton

underlying event

initial-state radiation

final-state radiation

A Standard Parton Level Hard Interaction Process
Different Kind Of Jets and Jet Reconstruction

- The main inputs in Jet reconstruction are Jet cone size and Jet Algorithm.

- The different algorithms used in CMS for Jet reconstruction are:
  - $k_T$
  - Anti-$k_T$
  - IterativeCone
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- The different types of jets analyzed in CMS framework are:
  - Genjet: It is the generator level jet produced from particle level information.
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A Typical Leading Jet $E_T$ Distribution (GenJet) ($p_t$ bin 800-1000)
The Same Plot With Corresponding CaloJet $E_T$
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CMS is developing a factorized multi-level jet correction in which the correction is applied in the following sequence:

- **Offset:** Required correction for pile-up and electronic noise.
- **Relative ($\eta$):** Required correction for variation in jet response with pseudorapidity ($\eta$) relative to a control region.
- **Absolute ($p_T$):** Required correction to particle level versus jet $p_T$ in the control region.
- **EMF:** Optional correction for variations in jet response with electromagnetic energy fraction.
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Jet Correction Formula

\[ E_{jet}^{Corr} = (E_{jet}^{Raw} - E_{offset}) \times C(\text{rel} : \eta) \times C(\text{abs} : p_T) \]

- For our current analysis we use the three corrections L2L3residual correction.
We use the LOOSE jet identification criteria to reject the fake jets during jet collection.
Jet-Id used

- We use the LOOSE jet identification criteria to reject the fake jets during jet collection.
- The Jet-Id for the calorimeter jets are
  - $n_{90\text{hit}} \geq 1$ for the region HBHE
  - EM-fraction $\geq 0.01$
  - $f_{HPD} \leq 0.98$
- The Jet-Id for the particle-flow jets are
  - Neutral Hadron Fraction $\leq 0.99$
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  - Number of Constituents $\geq 1$
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  - /QCD-Pt-80to120-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM
  - /QCD-Pt-120to170-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM
  - /QCD-Pt-170to300-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM
  - /QCD-Pt-300to470-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM
  - /QCD-Pt-470to600-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM
  - /QCD-Pt-600to800-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM
The Data and MC samples

• continued ..
The Data and MC samples

continued ..

• /QCD-Pt-800to1000-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM
• /QCD-Pt-1000to1400-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM
• /QCD-Pt-1400to1800-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM
• /QCD-Pt-1800-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM
The Data and MC samples

• /QCD-Pt-800to1000-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM
• /QCD-Pt-1000to1400-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM
• /QCD-Pt-1400to1800-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM
• /QCD-Pt-1800-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM

continued ..
continued ..

- \( /\text{QCD-Pt-800to1000-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM} \)
- \( /\text{QCD-Pt-1000to1400-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM} \)
- \( /\text{QCD-Pt-1400to1800-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM} \)
The Data and MC samples

continued ..

- /QCD-Pt-800to1000-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM
- /QCD-Pt-1000to1400-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM
- /QCD-Pt-1400to1800-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM
- /QCD-Pt-1800-TuneZ2-7TeV-pythia6/Spring11-PU-S3-START311-V1G1-v1/AODSIM

Dataset:/Jet/Run2011A-PromptReco-v2/AOD
$E_T$ Distribution of 1st CaloJet

$E_T$ of 1st-Calo-Jet-MC $p_T \leq 170$ GeV
$E_T$ of 1st Calo-Jet-MC $p_T \geq 170$ GeV

$E_T$ Distribution of 1st CaloJet
$E_T$ Distribution of 2nd CaloJet
$E_T$ of 2nd-Calo-Jet-MC $p_T \geq 170$ GeV

$E_T$ Distribution of 2nd CaloJet
$\eta$ of 1st-Calo-Jet-MC $p_T \leq 170$ GeV
$\eta$ of 1st Calo-Jet-MC $p_T \geq 170$ GeV

$\eta$ Distribution of 1st CaloJet
$\eta$ of 2nd-CalogenJet-MC $p_T \leq 170$ GeV

$\eta$ Distribution of 2nd CaloJet
η of 2nd-Calo-Jet-MC $p_T \geq 170$ GeV

η Distribution of 2nd CaloJet
$E_T$ Distribution of 1st PFJet

$E_T$ of 1st-PF-Jet-MC $p_T \leq 170$ GeV
$E_T$ of 1st-PF-Jet-MC $\hat{p}_T \geq 170$ GeV

$E_T$ Distribution of 1st PFJet
$E_T$ Distribution of 2nd PFJet
$E_T$ of 2nd-PF-Jet-MC $p_T \geq 170$ GeV

$E_T$ Distribution of 2nd PFJet
$\eta$ of 1st-PF-Jet-MC $p_T \leq 170$ GeV

$\eta$ Distribution of 1st PFJet
\[ \eta \text{ of 1st-PF-Jet-MC } \hat{p}_T \geq 170 \text{ GeV} \]
$\eta$ Distribution of 2nd PFJet

$\eta$ of 2nd-PF-Jet-MC $p_T \leq 170$ GeV
$\eta$ of 2nd-PF-Jet-MC $p_T \geq 170$ GeV

$\eta$ Distribution of 2nd PFJet
MDijet-MC $p_T \leq 170$ GeV

Dijet Invariant Mass Of Two Leading Jets
Azimuthal Angle Between Two Leading Jets
Azimuthal Angle Between Two Leading Jets
Comparison Of Jets $p_T \leq 170$ GeV

$E_T$ and $\eta$ Comparison Of Gen-Calo-PF Jets
Comparison Of Jets $p_T \geq 170$ GeV

$E_T$ and $\eta$ Comparison Of Gen-Calo-PF Jets
Calojet Response

Graph

1st-Calo |η|<1.3

1st-Calo |η|>1.3

2nd-Calo |η|<1.3

2nd-Calo |η|>1.3

Jet Response For CaloJets
Trigger Turn On Curve

Sanmay Ganguly Department Of High Energy Physics Tata Institute Of Fundamental Research

Jet Study In CMS Detector

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Our current physics goal is to measure the value of strong coupling constant $\alpha_s$ from 2010 and 2011 data.

We plan to study the inclusive jet $E_T$ spectrum and extract the value of $\alpha_s$.

The basic equation for extracting $\alpha_s$ is

$$\frac{d\sigma}{dE_T} = \alpha_s^2(\mu_R)\hat{X}^{(0)}(\mu_F, E_T)[1 + \alpha_s(\mu_R)k_1(\mu_R, \mu_F, E_T)]$$

$\frac{d\sigma}{dE_T}$ is the transverse energy distribution of the inclusive jets.

$\mu_R, \mu_F$, related to $E_T$ by a scale factor, are the renormalization and factorization scale respectively.

$\alpha_s^2(\mu_R)\hat{X}^{(0)}(\mu_F, E_T)$ is the leading order (LO) prediction of the inclusive jet cross section and $\alpha_s^3(\mu_R)\hat{X}^{(0)}(\mu_F, E_T)k_1(\mu_R, \mu_F, E_T)$ is the next to leading order (NLO) prediction.
We will also carry out the same exercise from different MC (both LO and NLO) and try to fit the observed running of $\alpha_s$

The effect due to pile-up and angular resolution is going to be studied.

The analysis is going to be done for both high and low $p_t$ bins

Data driven study is going to be made for Jet Energy Response using $\gamma+$Jet and $Z+$jet events.

We will also carry out the same exercise from different MC (both LO and NLO) and try to fit the observed running of $\alpha_s$
I thank Seema Sharma, Anirban Saha, Devdutta Mazumdar and Rajdeep Chatterjee for helpful discussion over several times.
$E_T$ of 1st Calo-Jet-Data

$E_T$ Distribution of 1st CaloJet
$E_T$ of 2nd-Calo-Jet-Data

$E_T$ Distribution of 2nd CaloJet
$\eta$ of 1st-Calo-Jet-Data

$\eta$ Distribution of 1st CaloJet

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Jet Study In CMS Detector

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\( \eta \) of 2nd-Calo-Jet-Data

\[\eta \text{ Distribution of 2nd CaloJet}\]
$E_T$ Distribution of 1st PFJet

Sanmay Ganguly Department Of High Energy
Jet Study In CMS Detector
$E_T$ Distribution of 2nd PFJet
$\eta$ Distribution of 1st PFJet
\( \eta \) of 2nd-PF-Jet-Data

\[ \eta \text{ Distribution of 2nd PFJet} \]
MDijet-Data

Jet Study In CMS Detector

June 7, 2011
Azimuthal Angle Between Two Leading Jets