Differential cross-section measurements of W+jets using CMS detector at LHC energy

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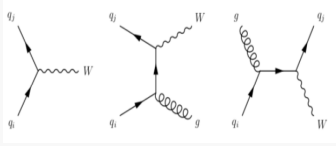
(For CMS Collaboration)

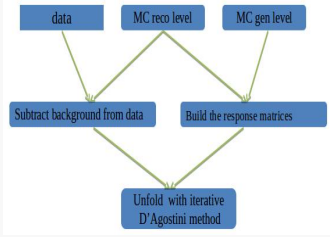
Abstract: Study and measurement of the differential cross-sections of W+jets is presented. The analysis is based on proton-proton collisions data recorded by the CMS detector at LHC. The differential cross-section measurements in the muon channel are presented as a function of several variables including the jet multiplicity, the jet transverse momentum and pseudorapidity, the scalar sum of the jets transverse momentum and several angular correlations among jets. The measurements are compared with the predictions from leading-order (LO) generators, next-to-leading-order (NLO) and next-to- next-to-leading-order (NNLO) theoretical predictions.

Introduction & Motivation

- An important process for understanding perturbative quantam chromodynamics
- Important background to:
  - standard-model processes such as ttbar & single top production
  - to Higgs boson searches & measurements,
  - to searches for new physics including SUSY and a variety of exotic signatures.
- Uncertainty on W+Jets cross-section in the tails of jet p_T distributions & in the high jet multiplicity region can often contribute significantly to the systematics of new physics searches.

- Differential cross-sections for W boson produced in association with jets are measured with the CMS detector at $\sqrt{s}$ = 8 TeV.
- Data recorded corresponds to an integrated luminosity of 19.6 fb^{-1} .
- W bosons are identified through muon decay mode, $\mathbf{W \rightarrow \mu\nu}$.
- Differential cross-sections are measured as a functions of jet multiplicity, transverse momenta, and the scalar sum of jet transverse momenta (H_T) for different jet multiplicities.
- Distributions of the angular correlations between the jets and the muon as well as the average no. of jets as a function of H_T and as a function of angular variables are examined.





Selection Criteria

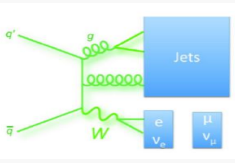
Reference:SMP-14-023

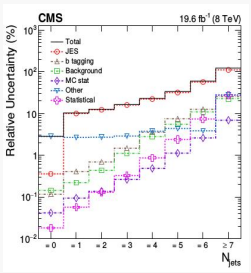
- **Trigger**: Un-prescaled single muon trigger.
- **Muon Acceptance Cuts:** p_T > 25 GeV,|η| < 2.1
- Combined Relative Particle Flow Isolation < 0.12
- Standard CMS muon identification criteria.
- Missing energy corrections.

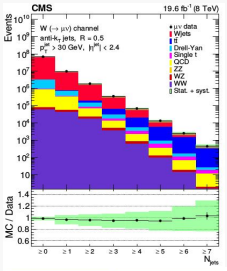
- Exactly one muon passing all muon requirements.
- M_T (μ, Emiss) > 50 GeV where $M_T = \sqrt{2 p_T^{\mu} E_T^{miss} (1 - \cos\Delta\phi)}$
- One or more jets depending on distribution.

- Jet Clusterization algorithm: anti-kT (cone size ΔR = 0.5) applied to Particle Flow candidates.
- **Jet Acceptance cuts**: p_T > 30 GeV, |η| < 2.4
- ΔR (μ, jet) > 0.5.
- Standard loose jet ID criteria.

- Veto events with one or more b-tagged jets using CSV medium tagger.
- Veto events with 2nd lepton: p_T > 15 GeV, |η| < 2.4.





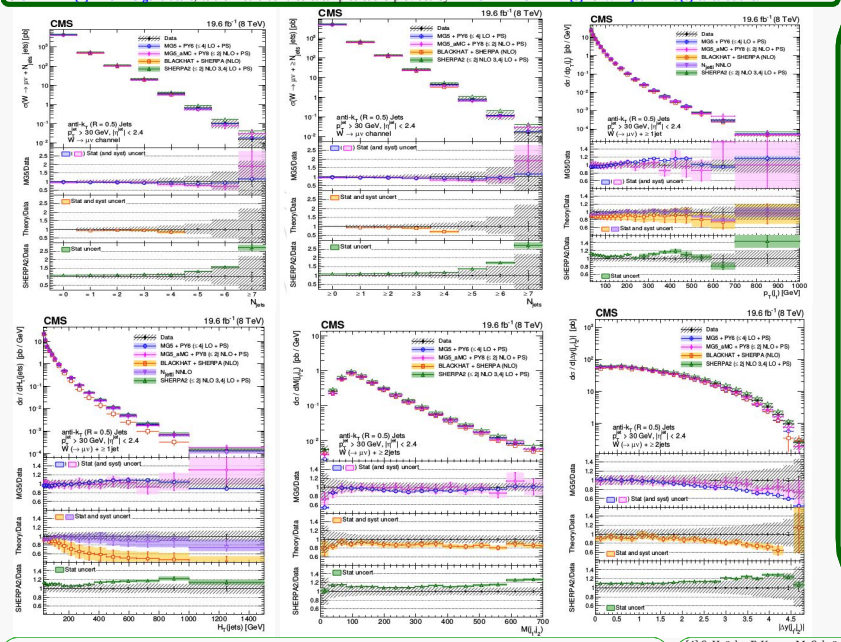


leptonic	hadronic
$W^+ \rightarrow l^+\nu$	$W^+ \rightarrow q\bar{q}$
$W^- \rightarrow l^-\bar{\nu}$	$W^- \rightarrow q\bar{q}$

Decay Mode	Fraction
e^+e^-	10.75±0.13 %
$\mu^+\mu^-$	10.57±0.15 %
$\tau^+\tau^-$	11.25±0.20 %
hadrons	67.60±0.27 %

Results

Measured differential cross-sections are compared with theoretical predictions of : **LO MC generator MADGRAPH5[1]+PYTHIA6[2], MADGRAPH5_AMC@NLO[3] & SHERPA 2[4] NLO MC generators**, to the fixed-order theoretical predictions provided by **BLACKHAT+SHERPA[5] & W+1 jet NNLO[6] calculations.**



Summary & Conclusion

- Differential cross-sections of W+jets in pp collisions at $\sqrt{s}$ = 8 TeV are measured.
- Integrated luminosity = 19.6 fb^{-1}.
- Predictions describe the jet multiplicity within the uncertainties with increasing deviations observed in SHERPA 2 for Njets > 4.
- Cross-sections in the p_T of the three leading jets are overestimated by MADGRAPH5+PYTHIA6 in a region of intermediate p_T and by SHERPA 2 at low p_T whereas predictions from BLACKHAT+SHERPA & MADGRAPH5_AMC@NLO+PYTHIA8 agree with the measurements within uncertainties.
- Cross-section as a function of H_T is underestimated by BLACKHAT+SHERPA for Njets ≥ 1 whereas predictions from SHERPA 2 overestimate the cross - section particularly at high H_T .
- Predictions for the jet |η| distribution deviate from the measurements for large values of |η| as do the predictions for the angular correlation distributions in rapidity for large rapidity differences.

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