PROCEEDINGS OF SCIENCE

A Study of the Production of Vector Bosons and Jets at $\sqrt{s}$ = 7 TeV

Jordan Damgov for the CMS Collaboration*
Texas Tech University
E-mail: Jordan.Damgov@cern.ch

The production of vector bosons with jets is important for testing QCD and for estimating backgrounds for top quark production and for new physics studies. Deviations of the measurements from the standard model predictions can signal the onset of new physics. We present first results on the measurement of cross sections for the production of vector bosons and jets for proton-proton collisions at 7 TeV based on data taken with the CMS detector. Prospects for more precise measurements are also shown.

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*Speaker.

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1. Introduction

The study of the associated production of W and Z plus jets allows for investigations and measurements both in the Standard Model scenario and in the area of searches for new physics phenomena.

In the standard model scenario it allows for testing of perturbative QCD and it is an important background for all measurements with week boson in the final state. In the context of beyond the standard model studies, the V+Jets process constitutes a relevant SM background to SUSY, and it also represents a direct search ground for deviations from the Standard model expectations.

Standard Model predicts a constant scaling (known as Berends-Giele scaling) of the cross section versus the jet multiplicity.

2. Production of Vector Bosons and Jets

We study the production of hadronic jets along with W bosons reconstructed in leptonic decay modes. The complete description of the lepton selection and background suppresion can be found in [1]. Selection on the transverse mass is used for the jet counting in the W channels: $M_T > 50$ GeV/c2.

Hadronic jets are reconstructed by clustering charged and neutral hadrons and photons identified by the Particle Flow method [3]. In the Particle Flow procedure stable particles result from combining information from all CMS[2] sub-detectors and are calibrated depending on their type.

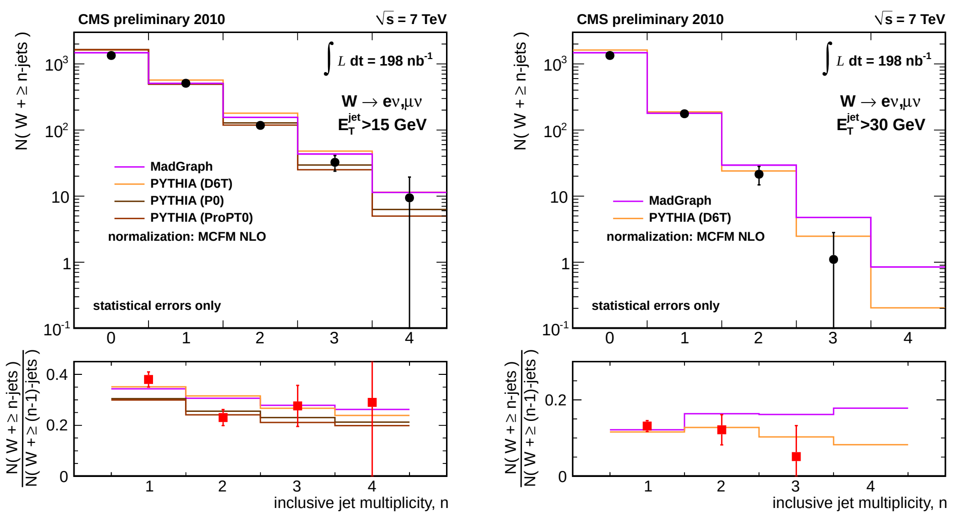

Figure 1: As a function of the inclusive jet multiplicity n, number of $W \to l\nu$ events ($l = e, \mu$) containing n jets above threshold or more (top plots) and ratio $N(W \to l\nu, \geq n\,\text{jets})/N(W \to l\nu, \geq (n-1)\,\text{jets})$ (bottom plots). Predictions obtained with PYTHIA (D6T [4]) and MadGraph [7] are shown, normalized to the NLO cross section from MCFM. On the left, the jet E_T threshold is 15 GeV; predictions obtained from PYTHIA with different tunes (P0 [5] and ProPT0 [6]) are also shown. On the right, the jet E_T threshold is 30 GeV. The error bars are statistical only.

We consider jets within the tracker acceptance $|\eta| < 2.5$ with two different energy thresholds: $E_T > 15$ GeV and $E_T > 30$ GeV . Events are classified according the number of jets above a threshold: the jet multiplicity in bin n containing n jets or more (fig. 1). The rate of low E_T jets is sensitive to the tuning of the parton shower generator. The rate of high E_T jets is sensitive directly to the matrix element of the hard scattering at the parton level.Measured transverse momentum of the leading jet, produced in association with W is shown on fig. 2.

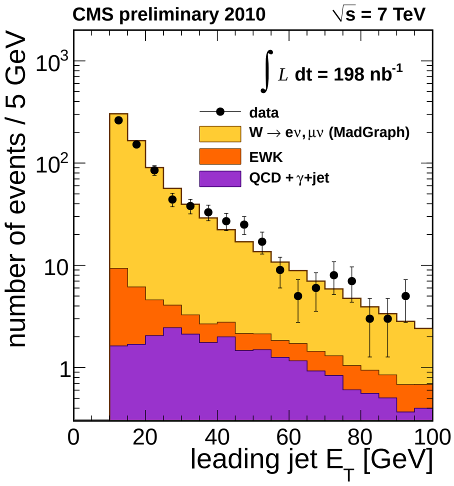

Figure 2: Leading jet p_T for jets in $W \to \mu\nu$ and $W \to e\nu$ events with $M_T > 50$ GeV/c2. Jets with $E_T > 10$ GeV are considered.

The systematic uncertainty on the jet rate above a certain transverse energy threshold is dominated by the jet energy scale. Jet energy scale uncertainties are estimated at the level of $\pm 5\%$ on the absolute scale, and of $\pm 2\%$ on the relative scale over the range in pseudorapidity [8]. This leads to systematic uncertainties on event counts in the one- and two-jet multiplicity bins of, respectively, 10% and 20% for $E_T > 15$ GeV, and 11% and 15% for $E_T > 30$ GeV.

More details on the study could be found at [1].

References

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