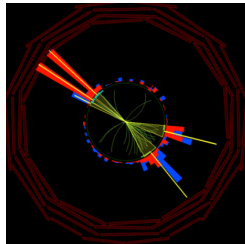
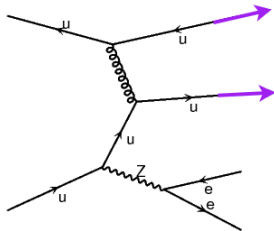


# W,Z + Jets production with CMS detector

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On behalf of the **CMS collaboration**





We present a study of jet production in association with  $W$  and  $Z$  bosons in *proton-proton* collisions at  $\sqrt{s} = 7$  TeV using the full 2010 data set collected by CMS corresponding to an integrated luminosity of  $35.9 \pm 1.4 \text{ pb}^{-1}$ .

CMS EWK-10-012

## **V + Jets** at the LHC:

- is a test of perturbative QCD calculations;
- is a background in the search for the SM Higgs boson, new physics and studies of the *top* quark.
- provides important SM candles for commissioning of the detectors;

For MC comparison, samples of  $Z$  and  $W$  events are generated with MADGRAPH interfaced with PYTHIA.

Principal backgrounds:

- **W + Jets:**  $t\bar{t}$ , QCD multi-jet events.
- **Z + Jets:**  $t\bar{t}$ ,  $W$  + Jets.



# Signal Selection and Signal Extraction



- W and Z **signal selections** are kept as similar as possible.

For example, both signal selection start with the individuation of a charged **Leading Lepton**:

**Muons:**

$$P_T > 20 \text{ GeV};$$
$$|\eta| < 2.1.$$

**Electrons:**

$$P_T > 20 \text{ GeV};$$
$$|\eta| < 2.5, \text{ with } 1.44 < |\eta| < 1.57 \text{ excluded.}$$

For Z signal selection, we search for a charged **Second Lepton**:

**Muons:**

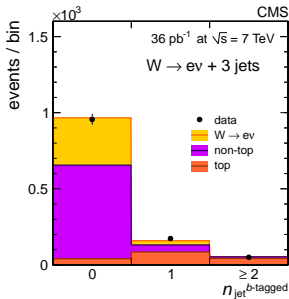
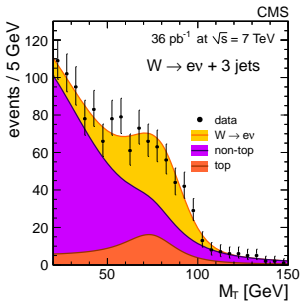
$$P_T > 10 \text{ GeV};$$
$$|\eta| < 2.5.$$

**Electrons:**

$$P_T > 10 \text{ GeV};$$
$$|\eta| < 2.5, \text{ with } 1.44 < |\eta| < 1.57 \text{ excluded.}$$

- For **signal extraction** we use data-driven techniques.

For example, in W + Jets analysis we extract the *top* background contribution with an extended likelihood fit:



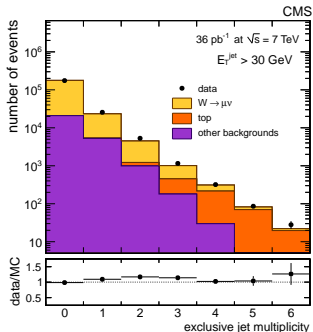
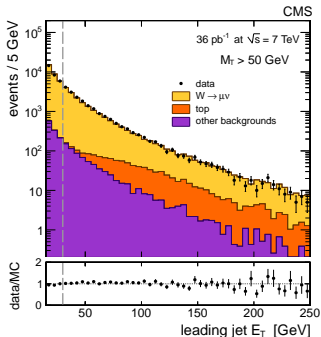


# Jet Rates



- **Jets reconstruction** uses the **Particle Flow** algorithm. Clustering algorithm: **anti- $k_T$**  (size parameter  $R = 0.5$ ).
- Jet energy corrections (JEC) are applied.
- **Kinematic cuts:**  
 $E_T > 30$  GeV;  
 $|\eta| < 2.4$ .
- Jet counting is corrected by the Pile-up subtraction (Phys.Lett.**B659**:119-126,2008).

## $W \rightarrow \mu\nu$ results:



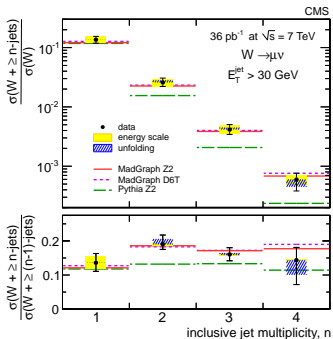
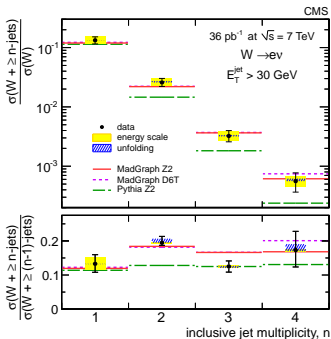


# Inclusive Jet Multiplicities



- Results are presented in terms of ratios, in order to cancel systematic effects (shown as error bands in the plots).

## W results:



- PYTHIA alone fails to describe the data, while MADGRAPH + PYTHIA agrees well.

Z results are reported in the poster.

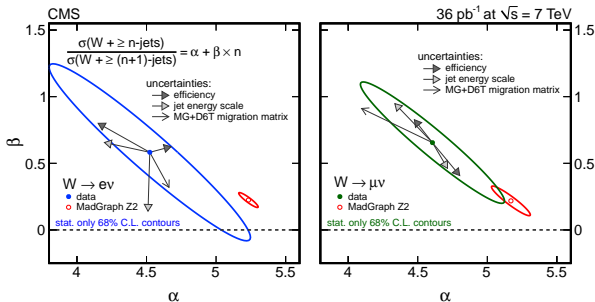


# Berends-Giele scaling fit



- We tested the scaling hypothesis  $\frac{\sigma(V + \geq n \text{ jets})}{\sigma(V + \geq (n+1) \text{ jets})} = \alpha + \beta n$  ( $n = \text{jet multiplicity}$ ).

W results:



- Results are in reasonable agreement with MADGRAPH expectations and compatible with  $\beta = 0$ .

Z results are reported in the poster.