



Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

W/Z properties (ATLAS and CMS)

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Outline

- Introduction
- Inclusive boson production
- W/Z properties
- Conclusions





EWK studies are...

• ...interesting for:

- 1. Measurement of SM param.
- 2. Better underst. of QCD

processes (PDFs, α_s)





http://gfitter.desy.de/Standard_Model/

EWK studies are...

- ...also important to look for new physics
- 1. It is background of important searches
- 2. It places strong constraints on SM parameters

SUSY search (Dijet+E_T^{miss}) squarks and gluinos

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3. Sensitive to new physics effects





Introduction

• And...

- 1. W/Z bosons copiously produced in the collisions
- Leptons are easily detected (working with leptonic modes)
- Channels studied $W^{\pm} \rightarrow \ell^{\pm}v$ (ℓ =electron,muon,tau) $Z \rightarrow \ell^{+}\ell^{-}$ (ℓ =electron,muon,tau)



W/Z boson selection

• W signature

- High momentum, isolated lepton
- Large E_T^{miss}



$$M_T \equiv \sqrt{2 p_T^{\ell} E_T^{\text{miss}} \left(1 - \cos(\phi_{\mu} - \phi_{E_T^{\text{miss}}})\right)}$$



- W selection
 - Pt > 20-25 GeV and isolated
 - Selected by inclusive lepton trigger
 - Quality requirement on lepton reco and id
 - $M_T > 40-50 \text{ GeV}$
 - DY veto

W/Z boson selection

• Z signature

Two high momentum, isolated leptons





- Two high p_T isolated leptons
- Quality requirement on lepton reco and id
- Selected by inclusive lepton trigger
- Invariant mass window ~[60,120] GeV 7

W inclusive production (µ or e)



W/Z inclusive production (µ or e)



W inclusive production (τ)



Z inclusive production (τ)



Z inclusive production (τ)



Z rapidity distribution



W charge asymmetry



W charge asymmetry



Z momentum distribution



W momentum distribution (ATLAS)

/ RESBOS

RESBO!

50

100

150

200

250

p^w_T [GeV]

300

Fixed-order pQCD calculations Important for M_w Combined Data 2010 ATLAS Stat. Uncert. Underestimation by DYNNLO $O(\alpha_{c})$ Ldt ≈ 31 pb⁻¹ 1.8 DYNNLO $O(\alpha_e^2)$ arXiv:1108.6308 **NLO** computations √s = 7 TeV MCFM O(a) Data, Prediction) 1.6 ---- MCFM O(α²_s) (30%) RESBOS • Underestimation at intermediate pT values, 1.4 1.2 $W \rightarrow Iv$ ATLAS 1.5 **--** Z → II $Ldt = 30-40 \text{ pb}^{-1}$ m by NNLO predictions Data 2010, √s = 7 TeV 0.8 Data (general good 1.3 0.6 agreement) 50 100 150 200 250 300 1.2 p^w_T [GeV] Parton shower + Matrix element gen 1. Combined Data 2010 ATI AS Stat. Uncert. • Bad agreement with Ldt ≈ 31 pb⁻¹ ALPGEN+HERWIG 1.8 MC@NLO 0.9 MC@NLO and POWHEG ∖s = 7 TeV POWHEG+PYTHIA (Data, Prediction) 1.6 ---- PYTHIA • SHERPA, ALPGEN, RESBOS 0.8 SHERPA **RESBOS and PYTHIA:** 0.7 250 300 50 100 150 200 general good p_{T}^{V} [GeV] agreement Universality of strong interactions 0.8 effects in W/Z production 0.6

Syst. unc. ranges from 3% (low p_{T}) to 10% (high p_{T})

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W polarization (CMS)



W polarization (CMS)



Variable sensitive to W polarizationElectron and muon channels

Observation of polarization at LHC
Left polarization dominant, but reduced due to kinematic effects and other subprocesses

Conclusions

- EWK processes largely studied in CMS and ATLAS.
- Interesting results to constraint PDFs, check standard model and for other studies.
- Processes studied so far are in good agreement with SM prediction at this new energy scale.
- More interesting results still to come
- All EWK ATLAS and CMS results are available:
 - Atlas:

https://twiki.cern.ch/twiki/bin/view/AtlasPublic/Stan dardModelPublicResults

-CMS:

https://twiki.cern.ch/twiki/bin/view/CMSPublic/Physics ResultsEWK

BACK UP

Forward backward asymmetry

• Drell-Yan cross section $\frac{d\rho}{d\cos\theta^{*}} = \frac{3}{8}(1 + \cos^{2}\theta^{*}) + A_{FB} \cos\theta^{*}$



• A_{FB} depends on the quark type and on $sin^2\theta_W$



$\sin \theta_{w}$

Sin θ_w is the only free parameter to test fermion/boson couplings



cos0*