



Measurement of the $W+\text{jet}/Z+\text{jet}$ cross section ratio with the ATLAS detector

Author:

Sten Luyckx

Supervisor:

Gerhard Brandt

DESY Summer Student Program 2010



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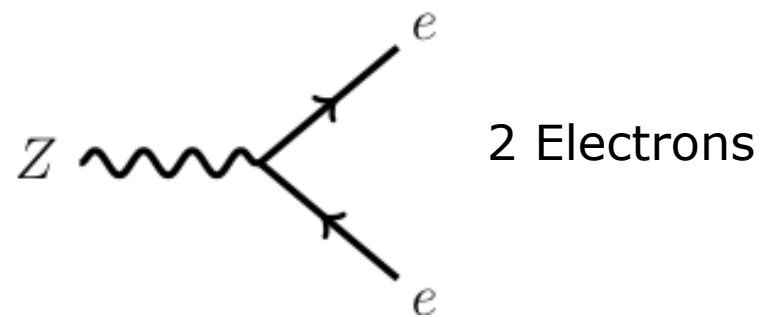
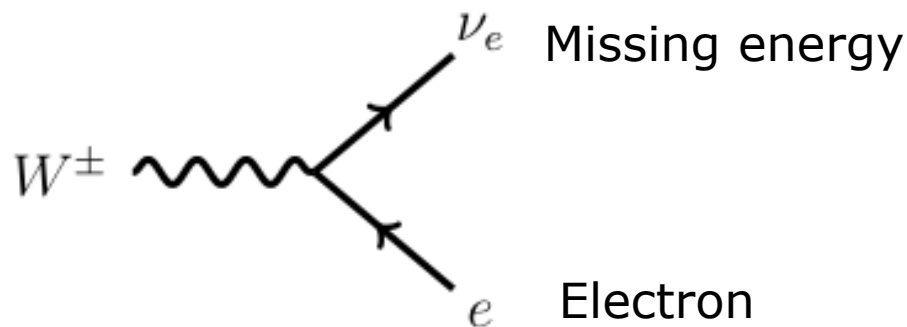
Introduction

- What?
$$R_{jets} = \frac{\sigma(W + jets)}{\sigma(Z + jets)}$$

- Show evolution of R_{jets} in terms of leading jet p_T
- Compare with theory predictions

- How?

- Using only the electron Channel





Introduction

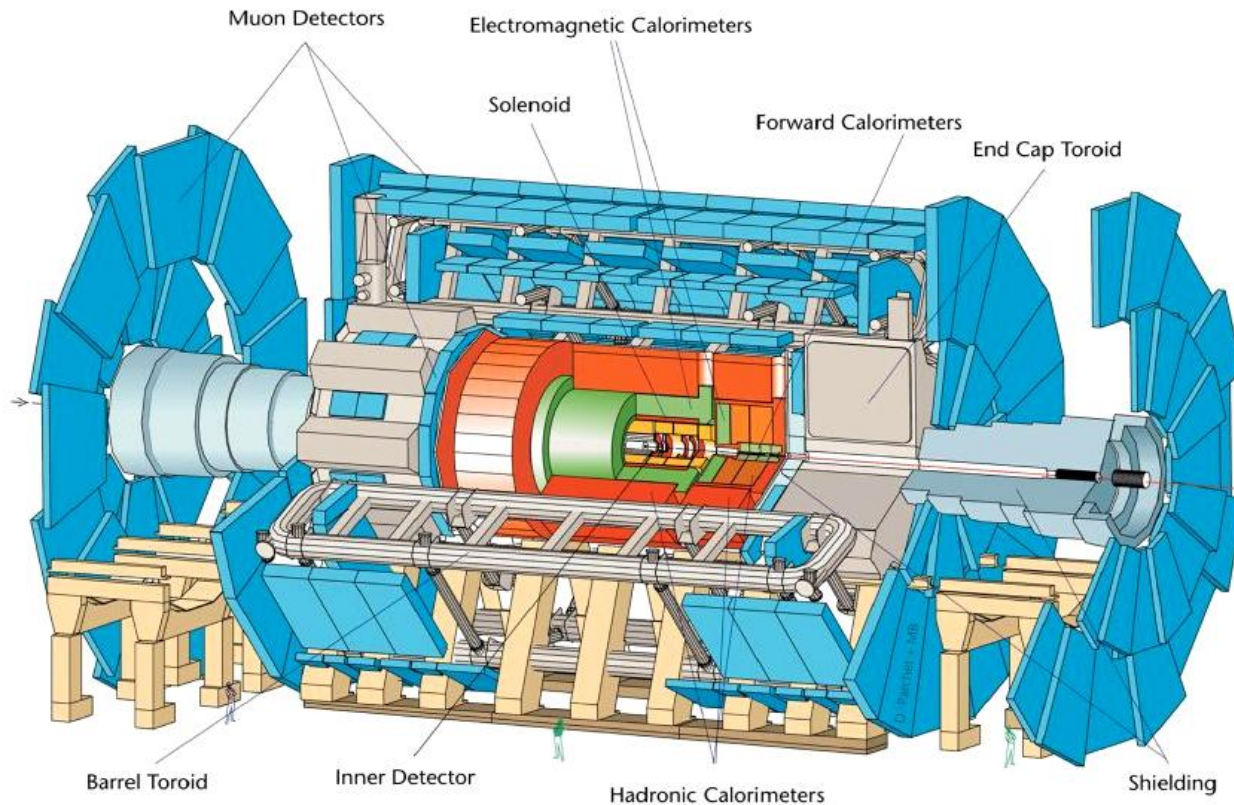
- Why?

- Many systematic uncertainties cancel in the ratio
 - Don't need precise jet model
- We can improve the theory of W / Z
 - R_{jets} is sensitive to NLO effects
- W / Z + jets is an important background process for top, higgs
 - R_{jets} can be used for background estimation
- Deviations at high p_T can indicate new physics
 - Enables searches in Jets + E_T^{miss} topology



ATLAS Detector

length = 42 m, diameter = 22 m, 7000 tons



EM Calorimeter → Electron identification + energy
Inner Detector → Charge + Transverse momentum



Data and Monte Carlo

- Data

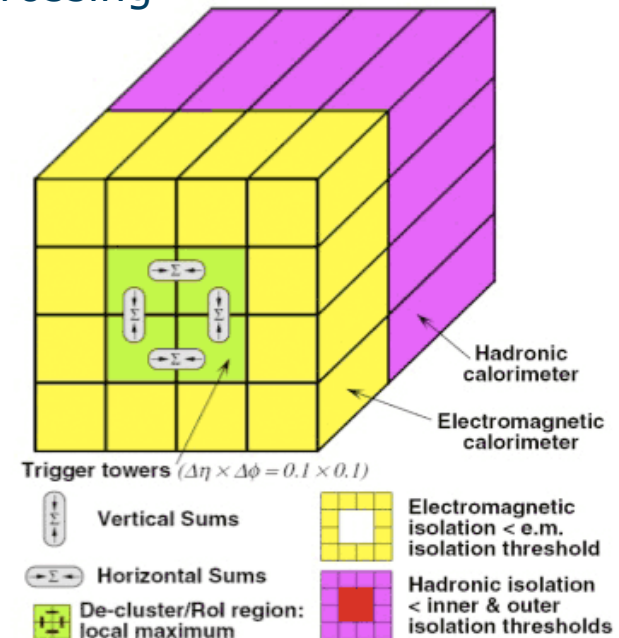
- $\sqrt{s} = 7$ TeV pp collisions at the LHC
- Period A-E7: April 18 – August 18
- 1456.9 nb^{-1}

- MC

- Simulate all W and Z decays
- Simulate background processes (e.g. top production, QCD)
- Need of different generators
 - Alpgen+Jimmy, NLO Jimmy and Sherpa
- Theory predictions: MCFM
 - Parton level MC generator

- Preselection

- Good Runlist
- Prim Vtx
 - with ≥ 3 tracks
 - Compatible with beamspot in bunch crossing
- Trigger
 - L1_EM14
 - Trigger on Electromagnetic cluster
 - » Scan with 2x2 mask
 - » Find local maximum
 - » Get highest sum inside mask
 - » Sum > 14 GeV accepted





- Electrons

- E-gamma algorithm with Author ID = 1 or 3
- $E_T > 20$ GeV,
- $|\eta| < 2.47$ but remove crack (1.37-1.52)
- OTX cleaning

- Jets

- Anti-kt4 algorithm
- $p_T > 20$ GeV, $|\eta| < 2.8$
- Remove bad and ugly jets

- Electron-Jet overlap removal

- Remove closest jet to electron



Selection

- W selection

- 1 tight electron
- No 2nd medium (Zee veto)
- Missing $E_T > 25$ GeV
- $M_T > 40$ GeV

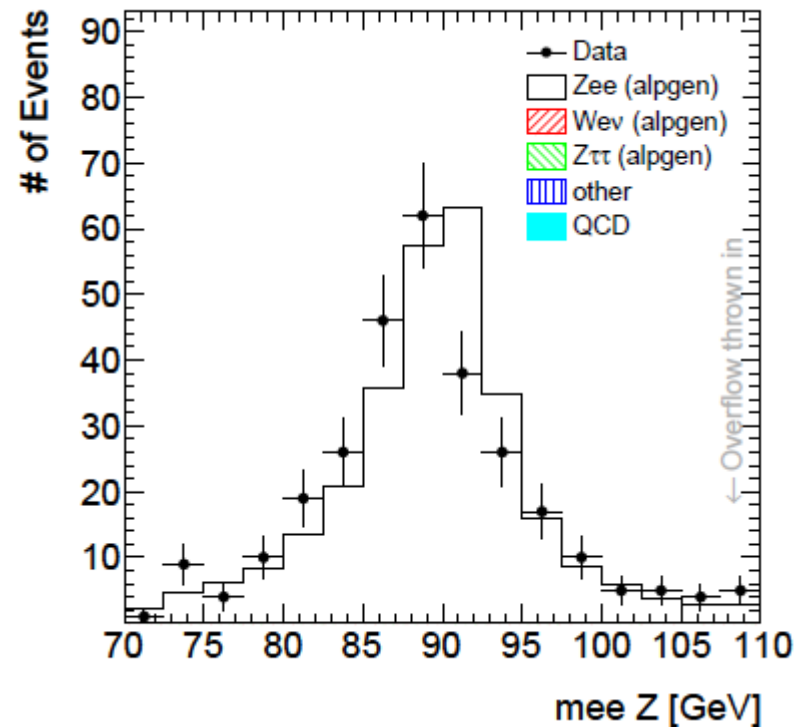
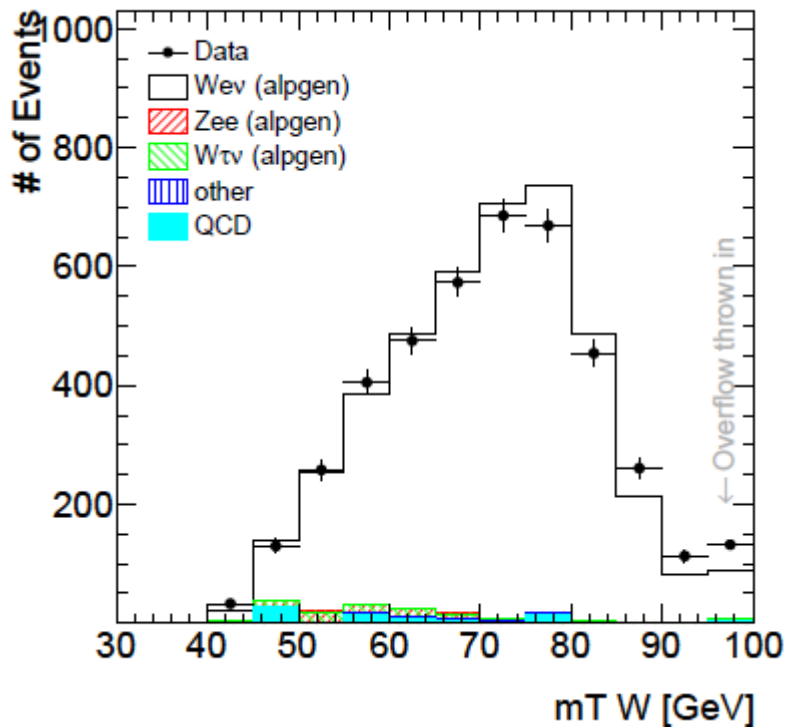
- Z selection

- 2 medium electrons
- $71 < M_{inv} < 111$ GeV

→ 4189 W and 287 Z boson candidates
selected inclusively

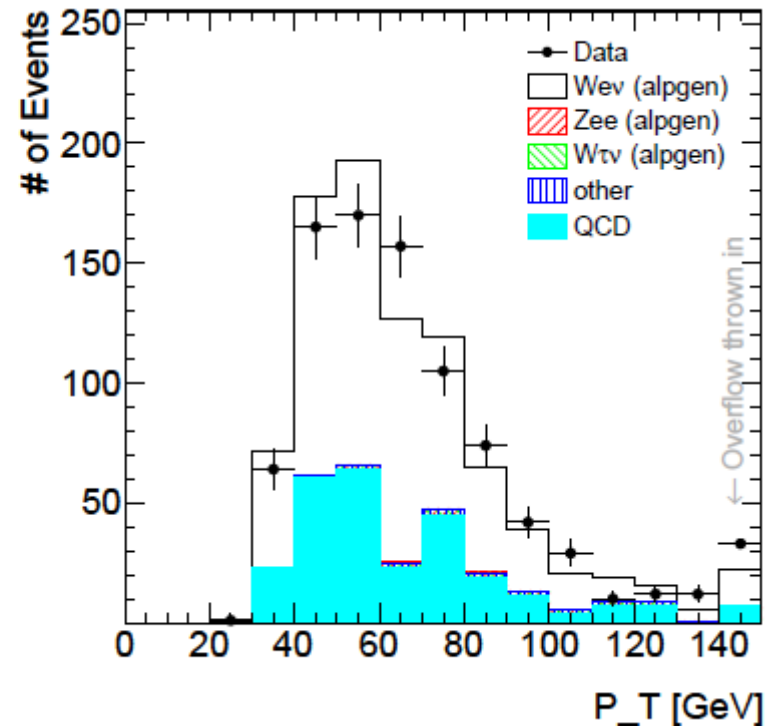
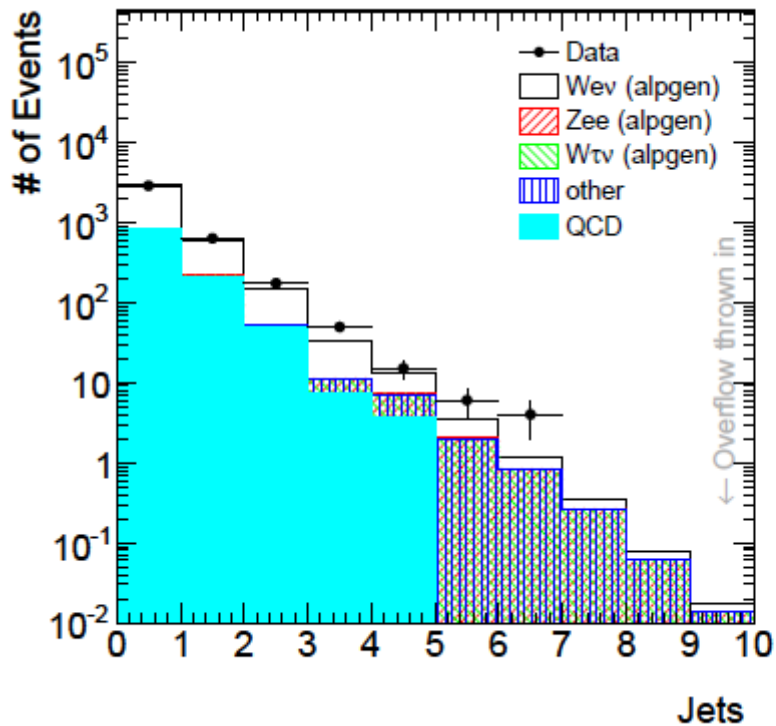


Inclusive results



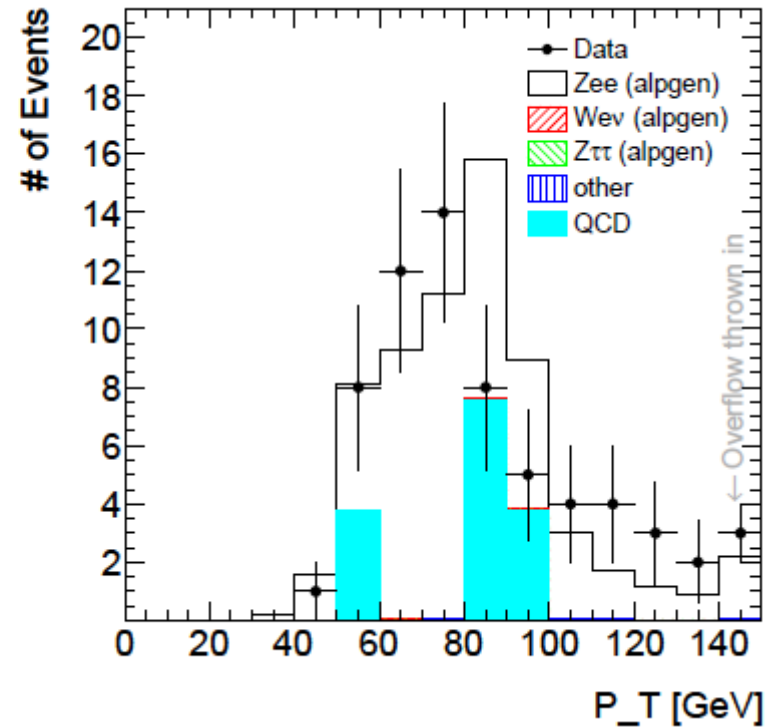
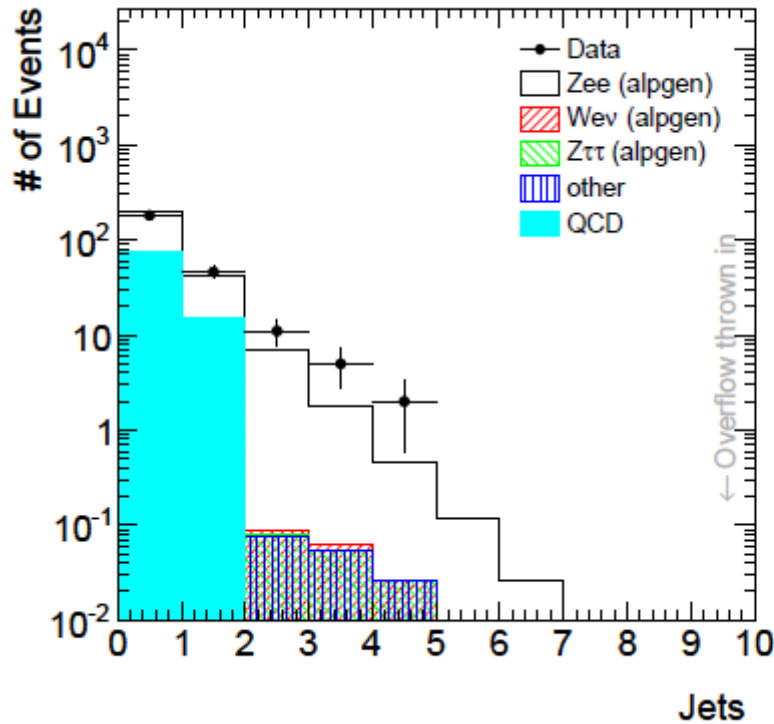


Inclusive jets in W selection





Inclusive jets in Z selection





- Correction to hadron level

$$N_V = \frac{N_{data}(1 - f_{QCD})(1 - f_{ewk})}{(A \times \epsilon) \cdot L}$$

$$A \times \epsilon = (A \times \epsilon)_{jet} \cdot A_{MET|jet} \cdot (A \times \epsilon)_{lepton|jet+MET}$$

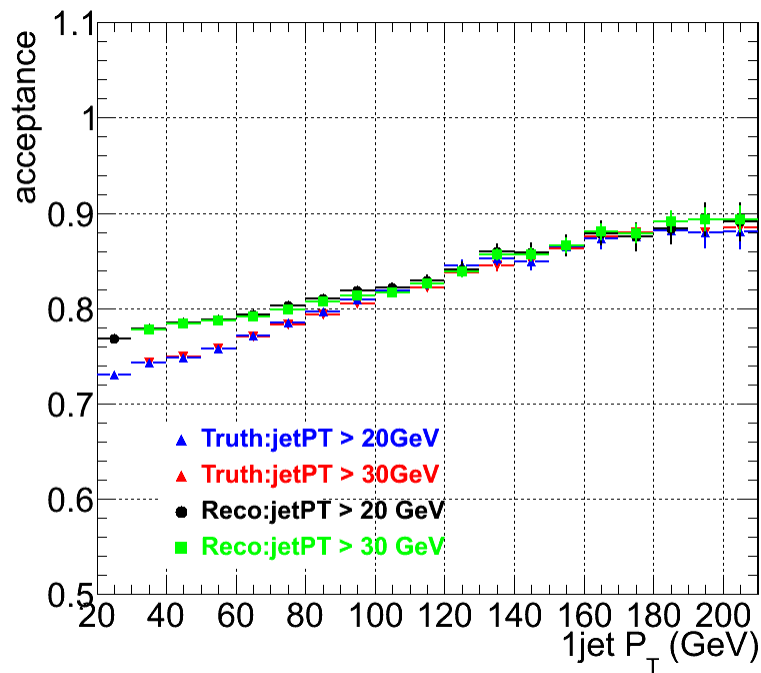
- N_{data} Selected events
- f_{QCD} QCD background fraction
- f_{ewk} Fraction of electroweak background
- $A \times \epsilon$ Electron Acceptance x Efficiency
- L Luminosity
- N_V Number of corrected events (W or Z)

→ L and $(A \times \epsilon)_{jet}$ cancel out in ratio

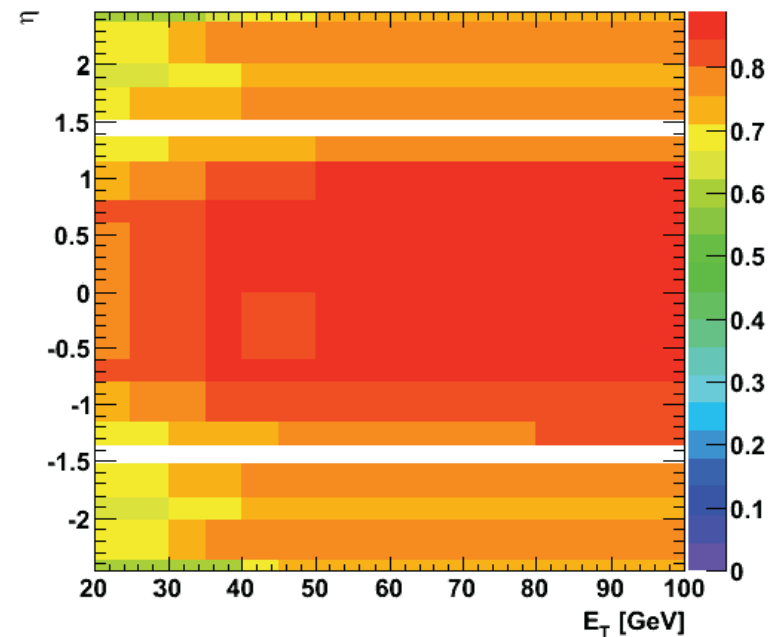


MET and lepton $A \times \epsilon$

$$A_{MET|jet}$$

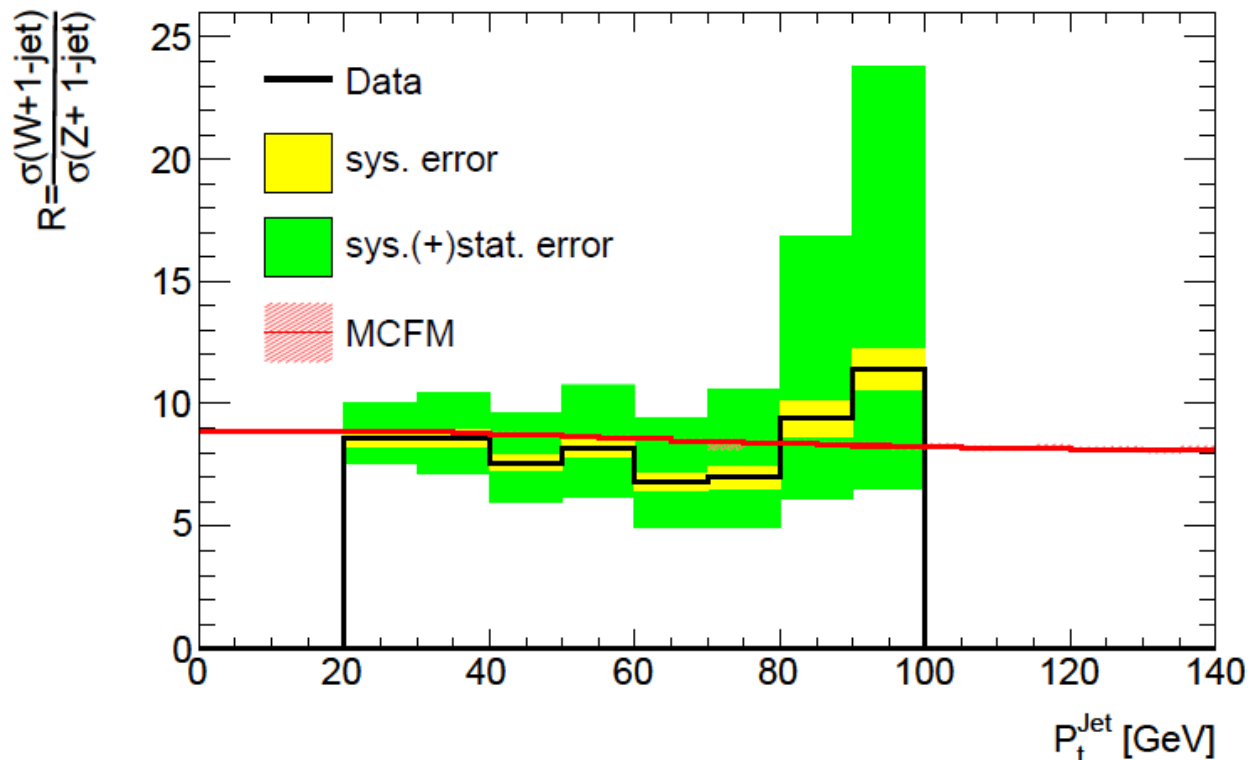


$$(A \times \epsilon)_{lepton|jet+MET}$$





- Data compared with MCFM



- Result dominated by statistical error

→ More data is needed ($\sim 100 \text{ pb}^{-1}$)



Summary

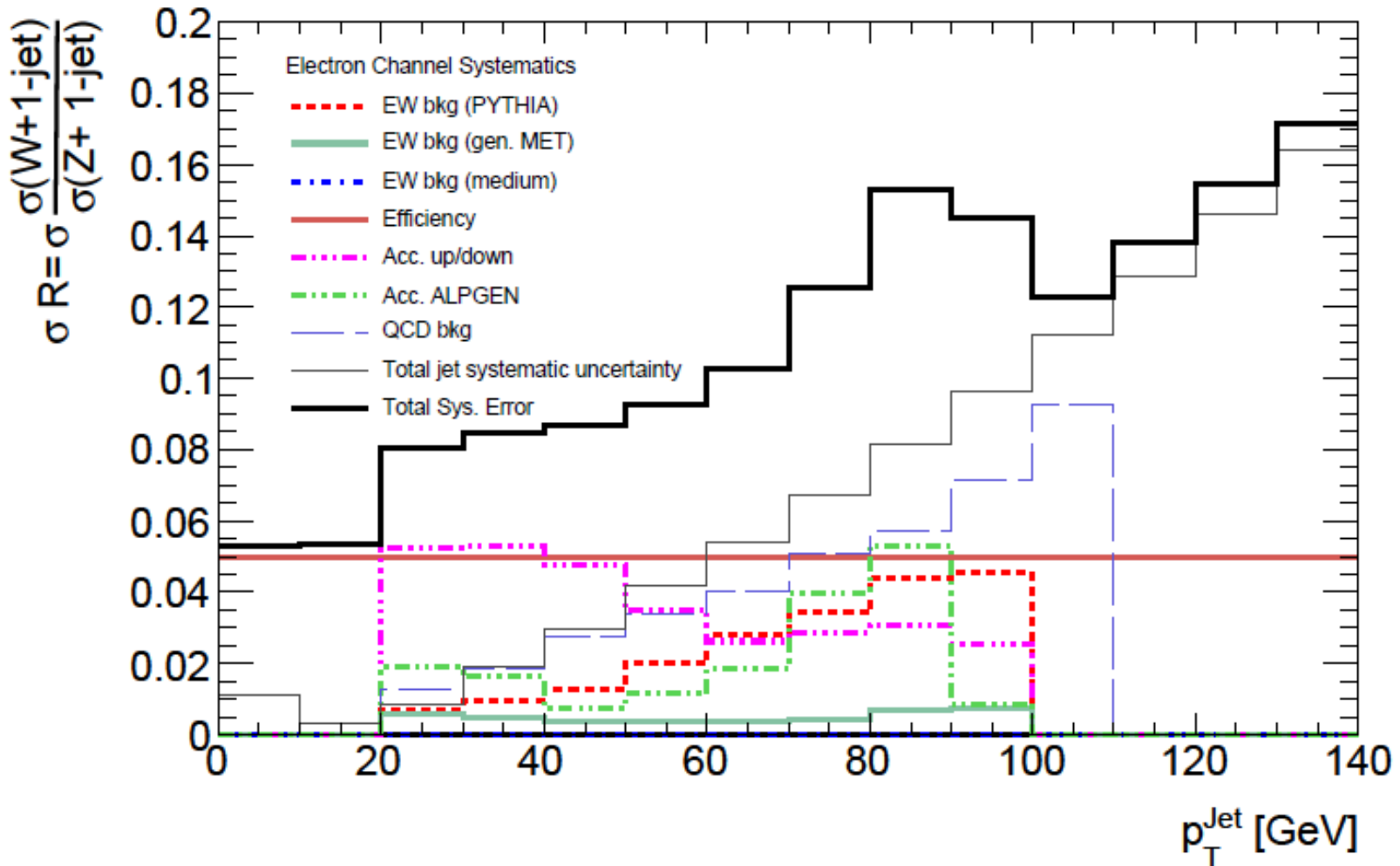
- Measured $R_{1-jet} = \frac{\sigma(W + 1 - jet)}{\sigma(Z + 1 - jet)}$ in pp collisions at LHC
- Implemented W and Z selection in the electron channel
- Result corrected to hadron level



Backup Slides



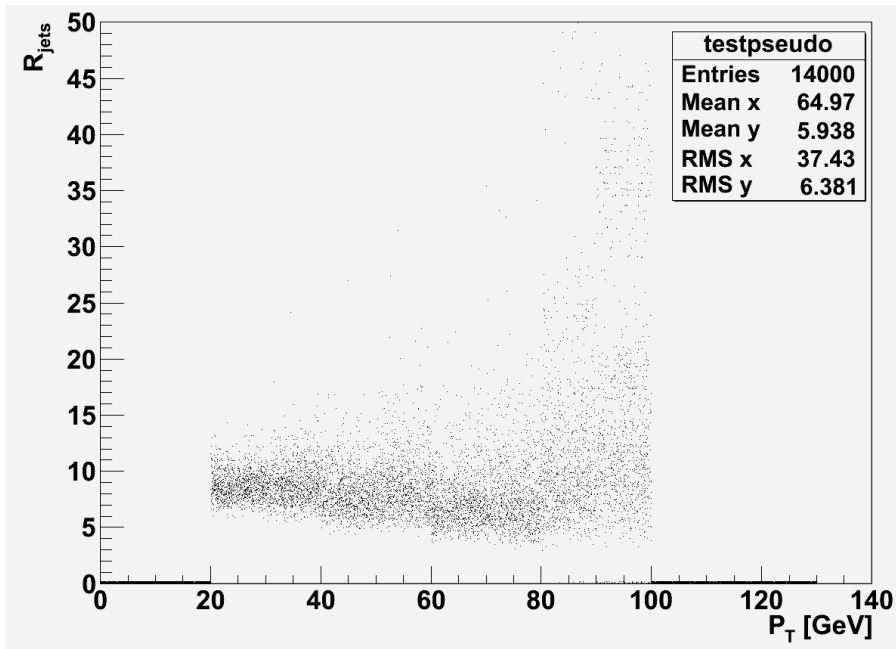
R_{jets} Systematics





R_{jets} Pseudo

2D: $P_{\text{T}} - R_{\text{jets}}$



1 vertical slice @ 80 GeV
Poisson Distribution

