Study of Z^0/γ^*+Jet via Electron Decay mode at $\sqrt{s}$ = 7 TeV in CMS @ LHC

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(For CMS Collaboration)

Abstract: The area-normalized angular distributions in events containing a Z^0 boson and a jet, using the electron decay mode are presented. The data samples correspond to ~5fb^{-1} of proton-proton collisions at $\sqrt{s}$=7 TeV, collected by the CMS detector. Events in which there is a Z boson and at least one jet, with a jet transverse momentum threshold of 30~GeV/c and absolute jet rapidity less than 2.4, are selected for this analysis. We compare our measurements with a next-to-leading-order perturbative QCD calculation and two generator programs that combine tree-level matrix element calculations with parton showers.

Introduction

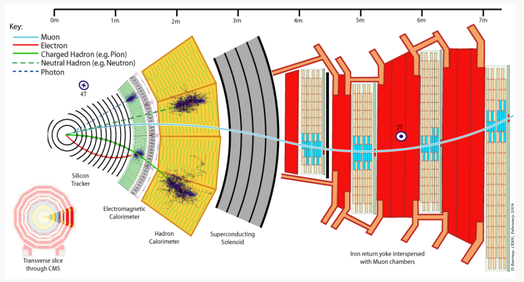
Motivation

- An important process for understanding perturbative quantam chromodynamics (pQCD).
- A significant source of background for many standard model measurements and in searches for new phenomena (e.g., SUSY).
- Important for developing the Monte Carlo (MC) simulation programs.
- The end-states where the Z boson decays to charged leptons constitute a very clean signal and are used as candle for other several processes.

What Do We Measure?

- Rapidity distribution of the vector boson: $|Yv|$
- Rapidity distribution of the leading jet: $|Y_{jet}|$
- Rapidity difference: $Y_{diff} = 0.5|Y_v - Y_{jet}|$
  Related to the scattering angle at the center of momentum frame: $\tanh(Y_{diff}) = \beta^*\cos\theta^*$
- Rapidity average: $Y_{sum} = 0.5|Y_v + Y_{jet}|$
  Rapidity boost from the center of momentum frame to the lab frame.

CMS Detector



- Immediately around the interaction point the inner tracker serves to identify the tracks of individual particles and match them to the vertices from which they originated.
- The curvature of charged particle tracks in the magnet field allows their charge and momentum to be measured.

Selection Criteria

$Z \rightarrow e^+e^-$

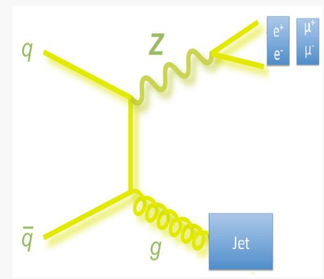
- Integrated luminosity of 4.9 fb^{-1}
- **Trigger**: un-prescaled dielectron triggers
- **Acceptance Cuts:** $p_T(Z) > 40$ GeV, $p_T(\text{electron}) > 20$ GeV, $|\eta(\text{lepton})| < 2.1$
- Combined Rel. PF Isolation (ΔR=0.4) <0.2
- Electrons are required to satisfy the standard CMS identification criteria.
- Select Z events with two electrons passing selection requirements and mass window ($76 < M_z < 106$ GeV).

Jet Reconstruction

- Clusterization algorithm: anti-kT (cone size $\Delta R = 0.5$) applied to Particle Flow candidates. Isolated lepton removed from jet collection.
- Acceptance: $|\eta| < 2.4$ (i.e. tracker acceptance).
- Transverse momentum: $p_T > 30$ GeV.
- ΔR (e,jet) > 0.5
- Pass loose jet ID criteria.

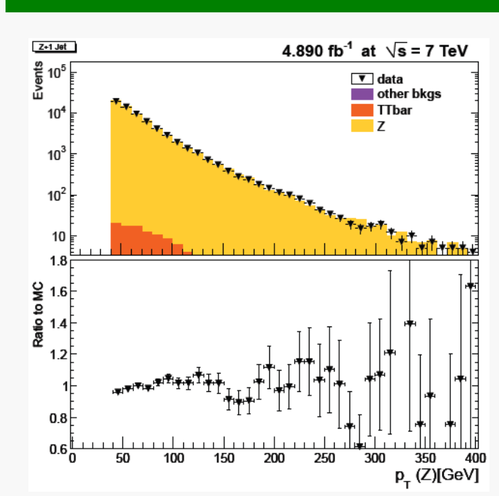
Z Boson Production and Decay

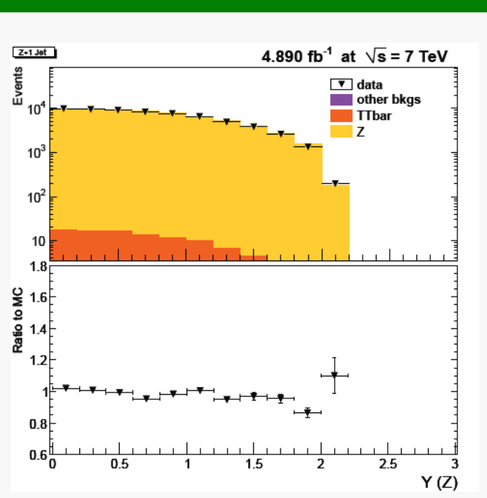
hadronic	leptonic	
	visible	invisible
$Z^\circ \rightarrow q\bar{q}$	$Z^\circ \rightarrow e^+e^-$	$Z^\circ \rightarrow \nu\bar{\nu}$
	$Z^\circ \rightarrow \mu^+\mu^-$	
	$Z^\circ \rightarrow \tau^+\tau^-$	

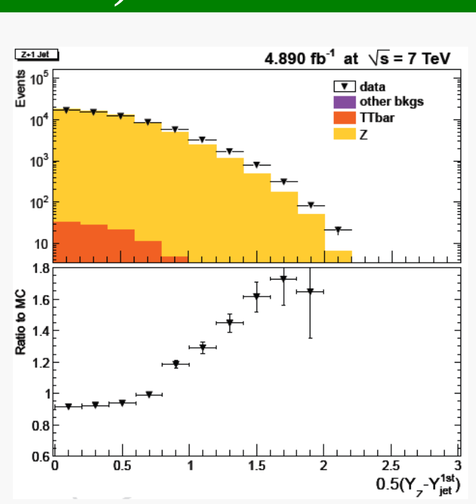


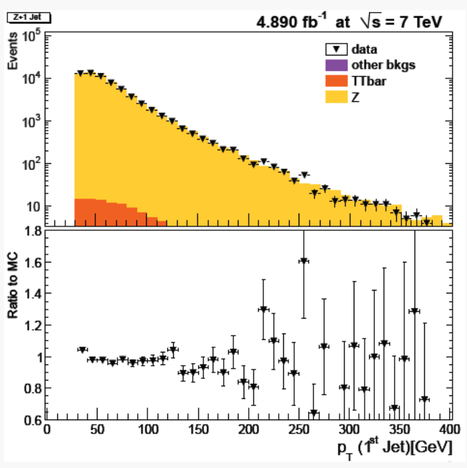
Decay channel	Branching fraction
e^+e^-	3.363±0.004
$\mu^+\mu^-$	3.366±0.007
$\tau^+\tau^-$	3.370±0.008
neutrinos	20.000 ±0.06
hadrons	69.910 ± 0.06

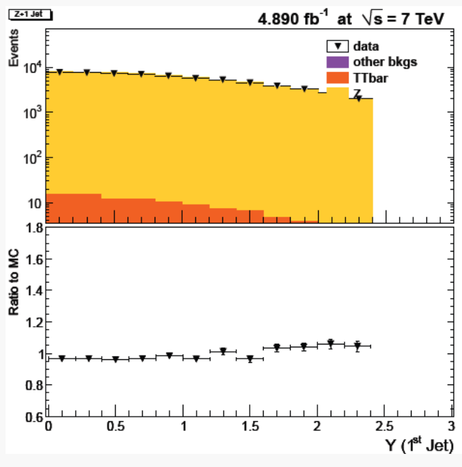
Z(->e^+e^-) +Jet

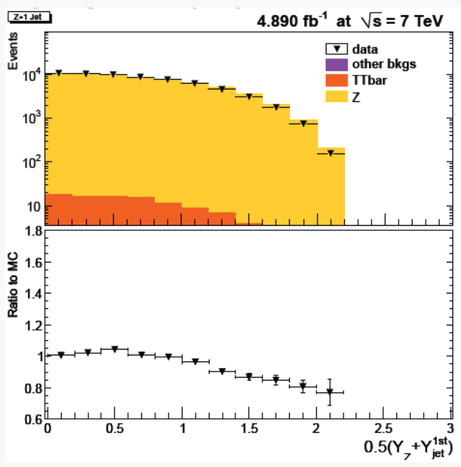












Summary

- Results presented here are approved by Collaboration and are public.
- The data sample corresponds to an integrated luminosity of ~4.9 fb^{-1}.
- Area-normalized distributions of the angular correlation in events containing $Z \rightarrow e^+e^-$ and exactly one jet are presented.
- Good agreement between data/MC.
- Work is continued for $\sqrt{s}$ = 8 TeV and will be reported soon.

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