Forward Z+jet production in $\sqrt{s} = 7$ TeV pp collisions

Valdir Salustino Guimarães, Albert Bursche, William Barter on behalf of the LHCb Collaboration
IF - Universidade Federal do Rio de Janeiro, Universität Zürich, University of Cambridge

Introduction

A measurement of the $Z(\rightarrow \mu^+\mu^-)+$ jet production cross-section at $\sqrt{s} = 7$ TeV is presented. The $Z +$ jet cross-section in the forward region is sensitive to the PDFs at low Bjorken-x, and can be used to test different parameterisations. It also provides a benchmark measurement of a standard model process, validating jet reconstruction at LHCb [1].

LHCb detector

The LHCb detector is a single-arm forward spectrometer covering the pseudorapidity range $2.0 < \eta < 5.0$, designed for the study of particles containing $b$ or $c$ quarks.

Selection

- Trigger: at least 1 muon with $p_T > 10$ GeV;
- Z boson requirements the same as for the inclusive measurement:
  - two reconstructed muons with $p_T > 20$ GeV;
  - within acceptance $2 < \eta < 4.5$;
  - invariant mass of the dimuon pair $60 < M_{\mu\mu} < 120$ GeV;
- in total $53182$ $Z \rightarrow \mu^+\mu^-$ candidates are selected;
- Jet selection:
  - jet separated from Z muons decay: $\Delta R > 0.4$.
  - jet within $2 < \eta < 4.5$ and $p_T > 10$ GeV or $20$ GeV;
- in total $10576$ Z+jet events with $p_T > 10$ GeV are selected.

Jet Reconstruction and Performance

Jets Reconstruction

- FastJet implementation of the anti-$k_T$ with radius $R = 0.5$;
- Particle Flow algorithm with inputs:
  - Charged particles - well reconstructed tracks from PV;
  - Neutral particles - energy deposits in the calorimeters not matched to tracks;
  - $2 < \eta^{jet} < 4.5$.

Jet ID

- at least two tracks matched to the same PV;
- at least one track with $p_T > 1.8$ GeV;
- no single particle with $\geq 75\%$ of the jet’s transverse momentum.

Jets Energy Correction

- correct the energy for detector effects with simulation;
- correction factor varies between 0.9 and 1.1;
- energy resolution typically 10 - 15 %.

Results

Cross-section ratio $\sigma(Z+jet)/\sigma(Z)$ measured at the Born level in QED (left) and differential in the leading jet pseudorapidity (right).

Differential cross-section in the leading jet $p_T^{jet}$ (left) and in the difference in rapidity between the Z and the leading jet (right).

Summary

The total and differential cross-sections are measured for Z+jet production, as a function of variables describing the jet and Z boson kinematic properties and correlations between them. The measured cross-section shows reasonable agreement with expectation from QCD calculations, for all the PDF parametrisations studied.

Reference

1. LHCb collaboration.
2. Study of forward Z+jet production in pp collisions at $\sqrt{s} = 7$ TeV.

Contact: vsalusti@cern.ch