Measurement of the Associated Production of Z-Bosons and Jets with the DØ Detector at the TeVatron

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A measurement of the associated production of Z-bosons and jets in the decay channel $Z \to \mu^+\mu^-$ is performed using a data sample collected with the DØ experiment [1] corresponding to an integrated luminosity of $L \sim 1040\,\mathrm{pb}^{-1}$.

Besides being of interest as a precision measurement of QCD effects, a good understanding of the Z boson production associated with jets has important benefits for other measurements. Furthermore, Z production is a major background for other processes and searches, e.g. top pair and single top production, searches for the Higgs Boson and for Supersymmetric particles.

Muon tracks are detected and reconstructed with the DØ muon and the cenral tracking system. The event selection requires two oppositely charged muons identified by tracks in the central detector that are matched with tracks in the muon chambers. A cut ($p_{\mathrm{T}}(\mu) > 20\,\mathrm{GeV}$) on the transverse momenta of the muon tracks and the requirement, that the tracks have to be isolated from other tracks in the central detector as well as from jets, rejects nearly all of the background due to QCD multijet production. Cuts on the timing information of the scintillation detectors and on the distance of closest approach of the muon track to the reconstructed vertex reduce the cosmic-ray muon background. Jets are reconstructed from energy deposits in the calorimeter using an iterative cone algorithm with radius $R_{cone} = 0.7$. The jet energy is corrected to account for fragmentation losses outside the jet cone, calorimeter noise and the underlying event.

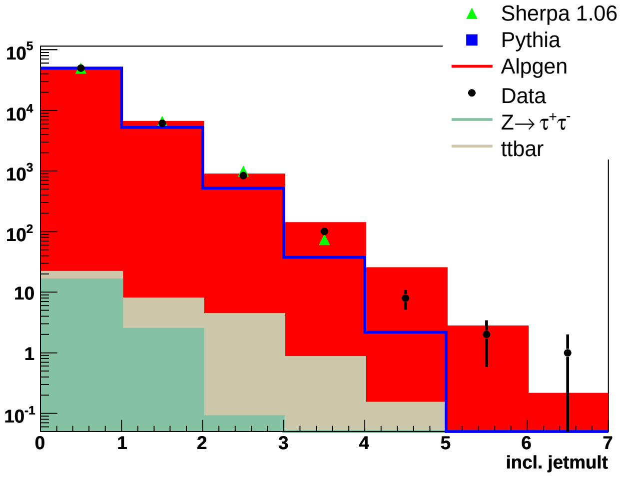

Fig. 1: The inclusive jet multiplicity: Data compared to PYTHIA, ALPGEN and SHERPA

The data has been compared with the event generators PYTHIA, SHERPA and ALPGEN. PYTHIA [2] uses the parton shower (PS) approach to generate QCD initial and final state radiation, which offers an accurate description for emissions with low transverse momenta. An alternative method to the PS is to include all QCD emissions above a certain hard scale in the matrix element (ME). The event generator SHERPA [3] uses the CKKW [4] algorithm, which combines the PS for soft/collinear emissions with ME computations for hard/well separated emissions. In ALPGEN [5] the multijet MEs are merged with the shower development by reweighting the ME weights and by a veto on shower emissions in regions of phase-space already covered by the parton-level configurations.

Figure 1 shows the inclusive jet multiplicity of the different MC generators compared to the data. For SHERPA and ALPGEN the predictions are consistent with data, whereas PYTHIA tends to produce too few multi-jet events.

The raw measurements of the $p_T(jet)$ variables have to be corrected for acceptance and resolution effects. Two methods, the iterative *bin-by-bin* correction and a technique based on regularized unfolding have been applied to obtain the true distribution. The iterative *bin-by-bin* correction is based on a scale factor ϵ_i, calculated from MC, which corrects the data in each bin i. Regularized unfolding is performed using the program *Run* [6], which uses a maximum likelihood fit including a regularization term to smoothen unwanted oscillations for the unfolding.

Figure 2 shows good agreement between the unfolded and the *bin-by-bin* corrected $p_T(jet)$ distribution.

The aim of the analysis is to measure the differential cross section of the associated production of Z-bosons and jets as function of different kinematical and topological jet variables.

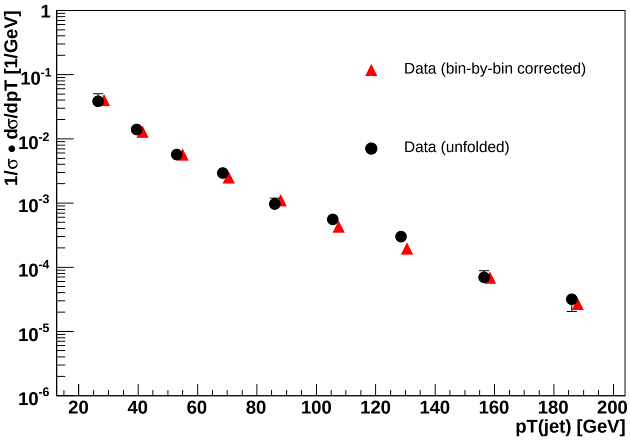

Fig. 2: The $Z+ \geq 1$jet cross-section as function of $p_T(jet)$, logarithmic scale

References

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