1. Study of associated production of vector bosons and b-jets in pp collisions at the LHC [1]

1.1 Introduction

1.2 Event generators

1.21 Results with SHERPA

In this section we present results obtain with the SHERPA event generator [1]. In particular we consider three different classes of samples: 4F MC@NLO, 5F MEPS and a 5F MEPS@NLO one.

4F MC@NLO: This first set of results is obtained in the four-flavour scheme, and based on the MC@NLO technique [2], as implemented in SHERPA [3]. In a four-flavour scheme calculation, b–quarks can only be produced as final state massive particles. They are, therefore, completely decoupled from the evolution of the strong coupling, α_S and that of the PDFs. In this scheme the associated production at tree-level starts from processes such as $jj \to b\bar{b}Z$ where j can be either a light quark or a gluon. No specific cuts are applied on the b–quarks, their finite mass regulates collinear divergences that would appear in the massless case. In most cases, therefore, a b-jet actually originates from the parton shower evolution and hadronization of a b–quark produced by the matrix element.

5F MEPS: In a 5F scheme b–quarks are treated as massless partons. Collinear logs are resummed into a b–PDF and they can appear as initial state particles as well as final state ones. In order to account for 0 and 1 b–jets bins as well as to cure the collinear singularity that would arise with a massless final state parton, we use a multi-jet merging. In SHERPA, the well- established mechanism for combining into one inclusive sample towers of matrix elements with increasing jet multiplicity at tree–level [4]. For this sample we merge together LO samples of $jj \to Z$, $jj \to Z + j$, $jj \to Z + jj$, $jj \to Z + jjj$ where now j can be a light quark, a b–quark or a gluon, and all these samples are further matched to the SHERPA parton shower CSS [5]. Merging rests on a jet-criterion, applied to the matrix elements. As a result, jets are being produced by the fixed–order matrix elements and further evolved by the parton shower. As a consequence, the jet criterion separating the two regimes is typically chosen such that the jets produced by the shower are softer than the jets entering the analysis. This is realised here by a cut-off of $\mu_{\text{jet}} = 10$ GeV.

5F MEPS@NLO: In this scheme we use the extension to next–to leading order matrix elements, in a technique dubbed MEPS@NLO [6]. In particular, we merge $jj \to Z$, $jj \to Z + j$, $jj \to Z + jj$ calculated with NLO accuracy and we further merge this sample with $jj \to Z + jjj$ at the LO. As in the previous case matching criterion as to be chosen, and this realised by a cut-off of $\mu_{\text{jet}} = 10$ GeV.

In SHERPA, tree–level cross sections are provided by two matrix element generators, AMEGIC++ [7] and COMIX [8], which also implement the automated infrared subtraction [9] through the Catani–Seymour scheme [10, 11]. For parton showering, the implementation of [5] is employed with the difference that for $g \to b\bar{b}$ splittings the invariant mass of the $b\bar{b}$ pair, instead of their transverse momentum, is being used as scale. NLO matrix elements are instead obtained from OPENLOOPS [12][13]

1.3 Z+b(b) production

1.31 Z+b 4F rescaled results

...4F MC@NLO rescaled to MCFM...

1.4 W+b production

1.5 Conclusions

References

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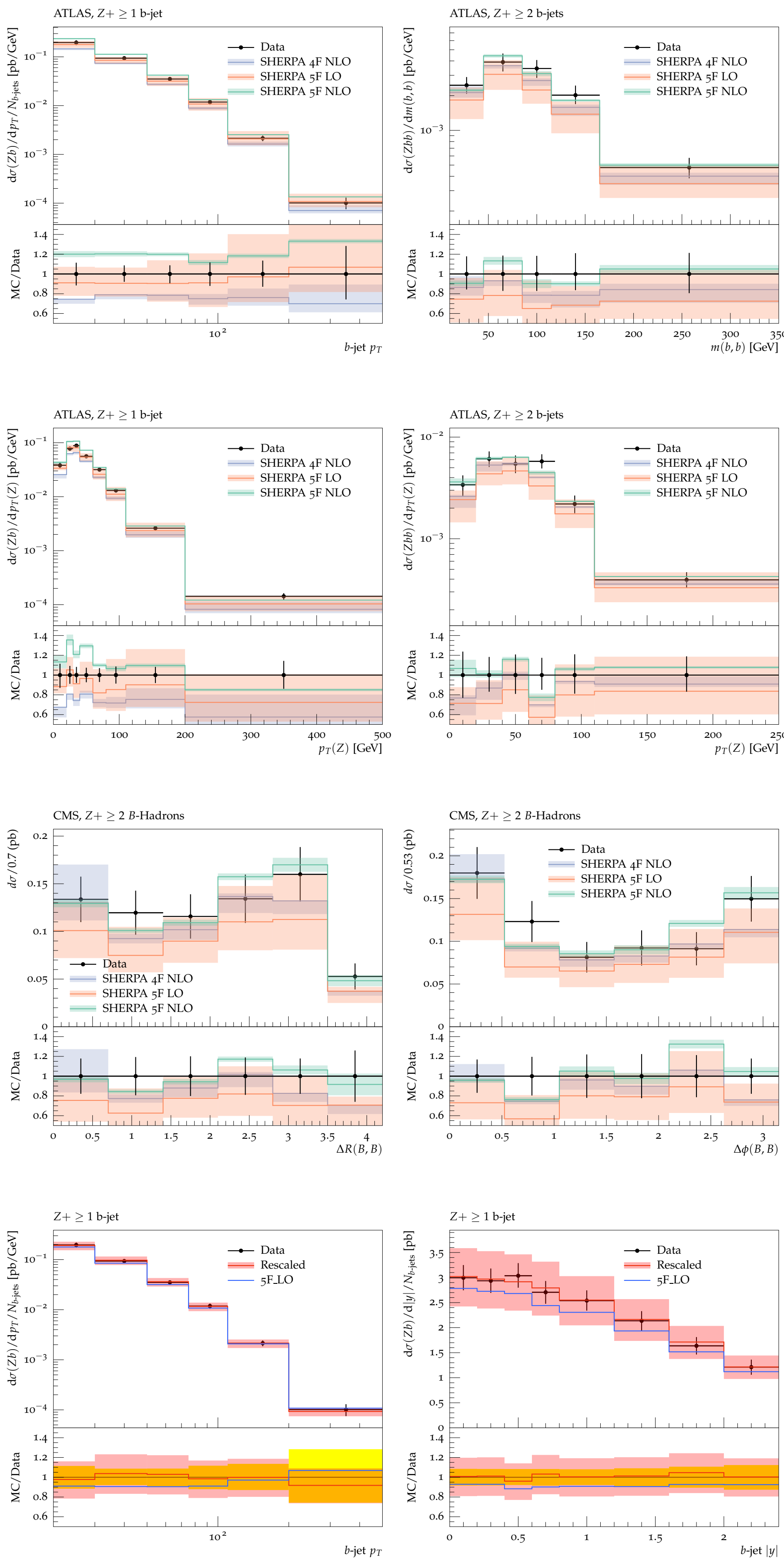
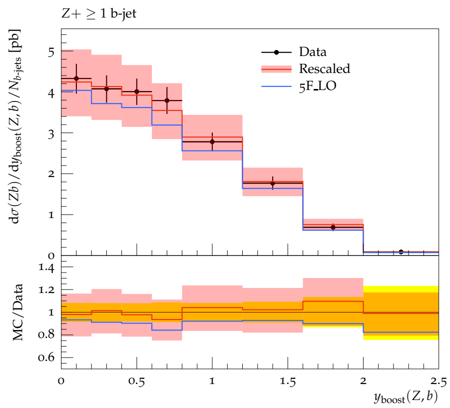
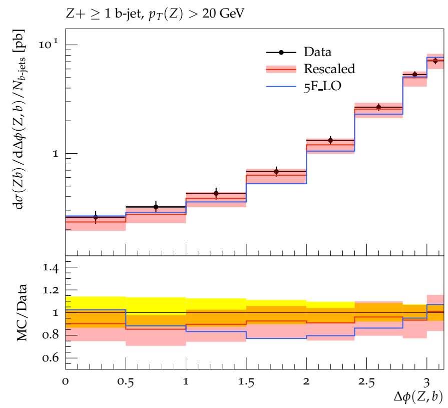
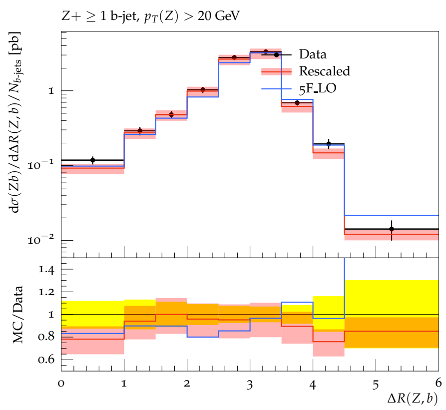

ATLAS, Z+ ≥ 1 b-jet
dσ(Zb)/dp_T/N_b-jets [pb/GeV]
Data
SHERPA 4F NLO
SHERPA 5F LO
SHERPA 5F NLO
MC/Data
b-jet p_T
ATLAS, Z+ ≥ 2 b-jets
dσ(Zbb)/dm(b,b) [pb/GeV]
m(b,b) [GeV]
dσ(Zb)/dp_T(Z) [pb/GeV]
p_T(Z) [GeV]
dσ(Zbb)/dp_T(Z) [pb/GeV]
CMS, Z+ ≥ 2 B-Hadrons
dσ/0.7 (pb)
ΔR(B,B)
dσ/0.53 (pb)
Δφ(B,B)
Z+ ≥ 1 b-jet
Rescaled
5F_LO
dσ(Zb)/d|y|/N_b-jets [pb]
b-jet |y|







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