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Electroweak corrections for W/Z+ n jet production

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In the era of the LHC experiments the analysis of vector boson together with n jet production becomes very important. On the one hand these processes serve as a testing environment for perturbative QCD calculations as well as detector understanding. On the other hand, W/Z+n jet production is used for new physics searches and thus one has to deal with a huge amount of irreducible Standard Model background. Therefore we need to understand these processes thoroughly. With the increasing center of mass energy s, electroweak corrections become more important. Especially Sudakov type logarithms of the form \alpha_{ew} \ln^2[M_{W/Z}^2/s] can appear and potentially become large in the differential cross section. These logarithms stem from infrared and collinear divergences for M\rightarrow 0, as e.g. in QCD and QED processes involving a real gluon or photon emission, regularized by the finite gauge boson mass.

I will review the general methods presented in [1-3] and extend them to re-sum the electroweak and QCD logarithms of W/Z+1(2) jet production explicitly as well as discuss the necessary input to generalize the computation to n jets. The starting point for this analysis is the unbroken full Standard Model, which is matched onto a SCET like theory SCET_EW to describe all particles as collinear fields. At M\sim 100-200 GeV the electroweak symmetry is broken and SCET_EW is consequently matched onto SCET_\gamma, in which the heavy gauge bosons as well as the top quark are integrated out and remain as static fields. This approach allows to compute the anomalous dimension for the running between the high and low scale as well as low scale matching systematically for each process.

The soft degrees of freedom can interact between different particles and depend on the gauge quantum numbers, only. The collinear degrees of freedom instead do not interact with each other - which actually depends on the regulator choice - and thus depend only on the type of the particle. Therefore we obtain both soft and collinear corrections. In turn we are able to re-sum the logarithms between the high scale at the center of mass energy and the low scale at which the symmetry is broken using the anomalous dimension and additionally obtain the low scale matching corrections at the same time. This correction can be computed analytically as the Wilson coefficient matrix for the operator basis at the low scale up to NLL precision.

I outline the automizable (numerical) calculation as well as necessary input for a general process. Then I will discuss the specific W/Z+1(2) jet production and changes to several observables due to this corrections, especially I will mention the importance for distinguished analysis. The possible generalization to more final state vector bosons and jets is discussed. In the end I present an approach to implement these corrections into automatic Monte Carlo generators, at the example of the framework Geneva.

[1] J.~-y.~Chiu, F.~Golf, R.~Kelley and A.~V.~Manohar, Phys.\ Rev.\ Lett.\ {\bf 100} (2008) 021802
[2] J.~-y.~Chiu, F.~Golf, R.~Kelley and A.~V.~Manohar, Phys.\ Rev.\ D {\bf 77} (2008) 053004
[3] J.~-y.~Chiu, A.~Fuhrer, R.~Kelley and A.~V.~Manohar, Phys.\ Rev.\ D {\bf 81} (2010) 014023

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