The POWHEG-BOX-ZZ manual

1 Introduction

The POWHEG-BOX-ZZ program [1] can be used to generate the QCD production of ZZ events, with the Z bosons decaying into leptons, in hadronic collisions, with NLO accuracy in QCD, in such a way that matching with a full shower program is possible. It is based upon the calculation of refs. [2], [3], [4]. The effect of Z-γ interference, as well as the effect of off-shell singly resonant graphs, are fully included in the calculation.

This document describes the input parameters that are specific to this implementation. The parameters that are common to all `POWHEG BOX` implementation are given in the `manual-BOX.pdf` document, in the `POWHEG-BOX/Docs` directory.

2 Generation of events

Do
```
$ cd POWHEG-BOX/ZZ
$ make pwhg_main
```
Then do (for example)
```
$ cd test
$ ../pwhg_main
```
At the end of the run, the file `pwgevents.lhe` will contain events for Z pair production in the Les Houches format. In order to shower them with `PYTHIA`:
```
$ cd POWHEG-BOX/ZZ
$ make main-PYTHIA-lhef
$ cd test
$ ../main-PYTHIA-lhef
```

3 Input parameters

Parameters in `powheg.input` that are specific to ZZ pair production:
```
vdecaymodeZ1 11      !  decay mode of 1st Z (11=electron, 12=nue, etc)
vdecaymodeZ2 13      !  decay mode of 2nd Z (13=muons, etc.)
```
Only leptonic decay modes are implemented at this stage. In the case of decay into neutrino, a neutrino flavour must be indicated explicitly. It is up to the user to multiply the whole cross section by three to include all neutrino flavour decays.
```
mllmin 50            !  minimum mass of lepton pair in decay is 50 GeV
zerowidth 0          !  If 1 (true) use zerowidth approximation (default 0)
withinterference 1   !  If 1 (true) include interference for identical leptons
                     !  (default 1)
dronly   0           !  If 1 (true) include only double resonant contributions
                     !  (default 0)
```
If `zerowidth` is absent or equal to zero, the Z's are given finite width, Z-γ interference is accounted for. Singly resonant graphs are also included by default, unless the `dronly` flag is set to 1.

Bibliography

[1] T. Melia, P. Nason, R. Rontsch, and G. Zanderighi.

[2] L. J. Dixon, Z. Kunszt, and A. Signer, *Helicity amplitudes for O(alpha-s) production of W^+W^-, $W^\pm Z$, ZZ, $W^\pm \gamma$, or $Z\gamma$ pairs at hadron colliders*, *Nucl.Phys.* **B531** (1998) 3–23, [`hep-ph/9803250`].

[3] J. M. Campbell and R. Ellis, *An Update on vector boson pair production at hadron colliders*, *Phys.Rev.* **D60** (1999) 113006, [`hep-ph/9905386`].

[4] J. M. Campbell, R. Ellis, and C. Williams, *Vector boson pair production at the LHC*, `arXiv:1105.0020`. * Temporary entry *.