# The POWHEG BOX manual for Higgs + 1 jet

## 1 Introduction

The part of the POWHEG BOX program that generates Higgs boson plus 1 jet in hadronic collisions is described in ref. [1]. Here we document its usage.

The svn version containing the AAA-README-Version-pre2 includes all improvements and features documented in ref. [2], including MiNLO. Instruction for the use of these features are found in the manual of the Z2jet and W2jet processes. In particular, the MiNLO version implemented here by default, is the improved one of ref. [3], that can be applied to processes (like the present one) involving a single jet at the Born level.

## 2 Generation of events

Do

```
$ cd POWHEG-BOX/HJ
$ make pwhg_main
```

Then do (for example)

```
$ cd testrun-lhc
$ ../pwhg_main
```

At the end of the run, the file pwgevents.lhe will contain events for $H + 1$ jet production in the Les Houches format. In order to shower them with PYTHIA:

```
$ cd POWHEG-BOX/HJ
$ make main-PYTHIA-lhef
$ cd testrun-lhc
$ ../main-PYTHIA-lhef
```

In the directory testparallel-lhc there are sample files for performing runs in parallel, according to the method described in the manual of the Z2jet and W2jet processes.

## Input parameters

Parameters in powheg.input that are specific to HJ:

```
hmass 120           !  Higgs mass in GeV
hwidth 5.753e-3     !  Higgs width in GeV
runningscales 0     !  (default 0), if 0 use hmass as central
                    !  factorization and renormalization scale;
                    !  if 1 use the Ht/2
bwcutoff   15       !  Higgs Breit-Wigner is probed between hmass +-
                    !  bwcutoff*hwidth
higgsfixedwidth 1   !  (default 0), If 1 uses standard, fixed width Breit-Wigner
                    !  formula, if 0 it uses the running width Breit-Wigner
#bornktmin  5       !  (default 0), generation cut: minimum transverse momentum
                    !  of the Higgs at the underlying Born level.
#bornsuppfact 1     !  (default 1), If 1 the Born suppression factor is included.
                    !  Weighted events are generated.  If 0 no suppression
                    !  factor is included, and events are unweighted.  A
                    !  generation cut bornktmin>0 must be supplied in this case
                    !  unless minlo is used.
#ckkwscalup 1       !  (default 1), If 1 compute the scalup scale for subsequent
                    !  shower using the smallest kt in the final state;
                    !  If 0, use the standard POWHEG BOX scalup (see section 5.3
                    !  of ref [1] for details)
withnegweights 1    !  Default 1; If 1 include negative weighted events
minlo 1             !  Default 0; If 1, use minlo.
```

For the use of the `bornktmin` and of the `bornsuppfact`, consult the general `POWHEG BOX` manual in the `POWHEG-BOX/Docs` directory. By default, the program uses a Born suppression factor and no generation cut, and it thus produces weighted (possibly signed) events. By setting `bornsuppfact` to 0 and `bornktmin` to a value larger than zero, unweighted events are generated, but one should make sure that the results are insensitive to a decrease of `bornktmin`.

The Born suppression factor can be modified by editing the `born_suppression` routine in the `Born_phsp.f` file. At the moment it is given by $p_T^2/(p_T^2 + p_{\min}^2)$, with $p_{\min} = 20\,\text{GeV}$.

# Bibliography


**[1]** J. M. Campbell, R. K. Ellis, R. Frederix, P. Nason, C. Oleari, *et al.*, *NLO Higgs Boson Production Plus One and Two Jets Using the POWHEG BOX, MadGraph4 and MCFM*, *JHEP* **1207** (2012) 092, [1202.5475].

**[2]** J. M. Campbell, R. K. Ellis, P. Nason, and G. Zanderighi, *W and Z bosons in association with two jets using the POWHEG method*, 1303.5447.

**[3]** K. Hamilton, P. Nason, C. Oleari, and G. Zanderighi, *Merging H/W/Z + 0 and 1 jet at NLO with no merging scale: a path to parton shower + NNLO matching*, 1212.4504.