

# proVFBH-inclusive v.1.0.1 manual

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This document provides a short documentation for the `proVFBH-inclusive` code.

## 1 Installation

To run `proVFBH-inclusive`, you will need an installation of the following packages:

- `hoppet/struct-func-devel`: <http://hoppet.hepforge.org/>. Note that it is specifically the `struct-func-devel` branch of `hoppet` that is required. It can be downloaded using:

```
svn checkout http://hoppet.hepforge.org/svn/branches/struct-func-devel/
```

- `LHAPDF`: <http://lhapdf.hepforge.org/>.

With these installed, `proVFBH-inclusive` can be compiled by going to the base directory and running

```
./configure [options]  
make
```

Available options in the `configure` script can be accessed through the `--help` or `-h` argument, as well as being described in the `INSTALL` text file.

## 2 Setting up a run

To run `proVFBH-inclusive`, you can simply call the executable `provbhf_incl` created by the installation steps above. All parameters are passed as command line options, with the full list of settings detailed in the section below, or accessible in `src/parameters.f90`. Since executing the code will produce several files, the recommended usage is to start individual runs in dedicated subfolders.

An example setup:

```
mkdir nlo-14tev; cd $_  
../provbhf_incl -nlo -sqrts 14000 -iseed 2
```

This will produce three files, two files `grids_0002.dat` and `grids_0002.top` containing the grid and an output file `xsct_nlo_seed0002.dat` containing the results of the run. Different seed numbers and orders in  $\alpha_s$  can be executed in the same location, as they will result in distinct output files.

### 3 Input parameters

All accessible parameters can be specified as command line arguments.

The available options, and their default value (in **bold**), are:

- **-lo**, **-nlo**, **-nnlo**, **-n3lo**: Order in  $\alpha_s$ .
- **-sqrts 13000**: Center-of-mass energy in GeV.
- **-scale-choice 1**: Scale choice to use, with the options
  - 0: Fixed scale at  $\mu_0^2 = m_h^2$ .
  - 1: Vector boson momentum  $\mu_0^2(Q_i^2) = Q_i^2 = -q_i^2$ .
  - 2: Common scale given by  $\mu_0^2(Q_1, Q_2) = Q_1 Q_2$ .
  - 3:  $\mu_0^2(p_{t,H}) = \frac{m_H}{2} \sqrt{\left(\frac{m_H}{2}\right)^2 + p_{t,H}^2}$  from [?].
- **-xmuf 1.0**: Factor  $x_{\mu_F}$  multiplying the factorisation scale  $\mu_F = x_{\mu_F} \mu_0$ .
- **-xmur 1.0**: Factor  $x_{\mu_R}$  multiplying the renormalisation scale  $\mu_R = x_{\mu_R} \mu_0$ .
- **-pdf PDF4LHC15\_nnlo\_mc**: Choice of PDF set (by name).
- **-nmempdf 0**: Member of the PDF.
- **-mh 125.**: Higgs mass.
- **-hwidth 0.00402964**: Higgs width.
- **-mw 80.398**:  $W$  mass.
- **-wwidth 2.141**:  $W$  width.
- **-mz 91.187**:  $Z$  mass.
- **-zwidth 2.4952**:  $Z$  width.
- **-nf 5**: number of quark flavours.
- **-mt 172.4**: top mass.
- **-mb 4.75**: bottom mass.
- **-readinggrid**: Use available grid if possible.
- **-higgsbreitwigner**: Use a Breit-Wigner propagator for the higgs.
- **-higgsmasswindow 30.**: Number of width to integrate around the BW peak.
- **-ncall1 100000**: Number of calls for the initialisation of the integration grid.
- **-itmx1 12**: Number of iterations for the grid initialisation.
- **-ncall2 100000**: Number of calls for evaluating the integral.

- `-itmx2 12`: Number of iterations for the integration.
- `-iseed 10`: Random seed.
- `-pdfuncert`: Compute PDF uncertainties on the fly. Significantly increases computation time (scales linearly with the number of PDF members). Also computes alphas uncertainty if this is included in the PDF.
- `-3scaleuncert`: Compute 3 point (ie symmetric) scale variation.
- `-7scaleuncert`: Compute 7 point scale variation.