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Manual: An event generator for same-sign W-boson scattering at the LHC including electroweak corrections

Mauro Chiesa[1]*, Ansgar Denner[1]†, Jean-Nicolas Lang[2]‡, Mathieu Pellen[3]§

[1] *Universität Würzburg, Institut für Theoretische Physik und Astrophysik, Emil-Hilb-Weg 22, 97074 Würzburg, Germany*

[2] *Universität Zürich, Physik-Institut, CH-8057 Zürich, Switzerland*

[3] *University of Cambridge, Cavendish Laboratory, Cambridge CB3 0HE, United Kingdom*

Abstract

In this article, we present the technical details of the program used in Ref. [1] to generate NLO EW corrections matched to PS for same-sign W vector-boson scattering. It is part of the POWHEG-BOX project and the code can be found `http://powhegbox.mib.infn.it/`.

*E-mail: `mauro.chiesa@physik.uni-wuerzburg.de`
†E-mail: `ansgar.denner@physik.uni-wuerzburg.de`
‡E-mail: `jlang@physik.uzh.ch`
§E-mail: `mpellen@hep.phy.cam.ac.uk`

Contents

1 Pre-requisites

In this section, we list the external tools that have to be downloaded before using the code.

- POWHEG-BOX [2–4]
  It has to be downloaded from `http://powhegbox.mib.infn.it/`. In particular, the present code is only compatible with the *RES* version [5].

- RECOLA-COLLIER package [6–8]
  The program recola2-collier has to be downloaded from `https://recola.hepforge.org/`. It is used to provide tree and one-loop matrix element. Installation instructions are provided on the corresponding web page.

In addition, we recommend to use LHAPDF (`https://lhapdf.hepforge.org/`) [9] as well as sc FastJet (`http://fastjet.fr/`) [10]. These are by default use in our implementation but can be switched off if needed.

Once these are downloaded, the code `vbs-ssww-nloew` can be downloaded from `http://powhegbox.mib.infn.it/` and put in the the Powheg-box repository.

2 Installation

Once all the external tools are installed, the installation of the code can be performed (Powheg will be be locally compiled upon compilation of the program). Before this, in the file `Makefile`, the following variables have to be set:

- RECOLALOCATION=YOURFOLDER/recola2-collier-X.X.X/recola2-X.X.X
- LHAPDF_CONFIG=YOURFOLDER/bin/lhapdf-config
- FASTJET_CONFIG=YOURFOLDER/bin/fastjet-config

3 Exemplary folder

In the process folder `vbs-ssww-nloew`, there is the generation folder which has been used to generate the results presented in Refs. [1, 11].[1] For the article, stage 1, 2, and 3 have been ran locally on a desktop machine. While stage 4 where the `LHE` files are generated has been performed on a cluster with about one million events.

The runpar script allows to run the first 3 (4) stages on a desktop machine with 5 cores. This can be adapted at will. The path to the recola2-collier directory has to be made explicitly:

- export LD_LIBRARY_PATH=YOURFOLDER/recola2-collier-X.X.X/recola2-X.X.X

In the powheg-input-save file (which is used by the script to produce the powheg-input file used by Powheg) the number of events required for the stage 1 (ncall1) is rather high. This is to ensure a smooth integration in stage 2 where the virtual contributions are used.

TODO: Make comments on the python reweighting script.

[1] There is one difference: in the original article, the PDF NNPDF3.0QED has been used. This PDF does not have a `lhaid` identifier. Therefore we have put the lhapdf id of NNPDF3.0.

4 Flags

- Flag for channels (flavour and sign)
- `fakevirt`
  This flag when set to 1, set the virtual matrix elements to the Born times the electromagnetic coupling. In particular, it is used in the stage 1 which serve the production of smooth grid for the integration of the full NLO EW corrections in stage 2.

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