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POWHEG BOX 1.0

The POWHEG BOX user manual: $t\bar{t} + 1$ jet production

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Abstract: This note documents the use of the package POWHEG BOX for $t\bar{t}$+1 jet production processes. Results can be easily interfaced to shower Monte Carlo programs, in such a way that both NLO and shower accuracy are maintained.

Keywords: POWHEG, Shower Monte Carlo, NLO.

Contents

1. Introduction

The POWHEG BOX program is a framework for implementing NLO calculations in Shower Monte Carlo programs according to the POWHEG method. An explanation of the method and a discussion of how the code is organized can be found in refs. [1, 2, 3]. The code is distributed according to the "MCNET GUIDELINES for Event Generator Authors and Users" and can be found at the web page

http://powhegbox.mib.infn.it.

In this manual, we describe the POWHEG NLO implementation of $t\bar{t}+1$ jet hadroproduction, as described in ref. [5]

2. Generation of events

The executable needs FASTJET installed. If the lhapdf-config script is already installed in a common path, then the linking should be automatic. Otherwise the user needs to modify the Makefile appropriately.

Build the executable

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

The make process will first build a library for the virtual amplitudes, named libvirtual.so and then link it to the main POWHEG executable.

Then do (for example)

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

At the end of the run, the file `pwgevents.lhe` will contain events for $t\bar{t}+1$ jet hadroproduction in the Les Houches format.
In order to shower them with `PYTHIA` do

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

3. Process specific input parameters

The $t\bar{t}+1$ parton process is already divergent at the LO, so a generation cut or a Born suppression factor is needed in order to get finite results. We refer to the corresponding manual under `POWHEG-BOX/Docs/GenerationCut.pdf` for details.
The decay of the t quark is controlled by the token `topdecaymode`, in this way:

```
$ topdecaymode 20000 !  an integer of 5 digits representing the decay mode.
```

The top-quark is assumed to go to a b and a W, with the W decaying according to a diagonal CKM matrix.The meaning of the token is the following: each digit represents the maximum number of the following particles in the (parton level) decay of the $t\bar{t}$ pair: $e^{\pm}, \mu^{\pm}, \tau^{\pm} u^{\pm}, c^{\pm}$. Thus, for example, 20000 means the $t \to e^{+}\nu_e b, \bar{t} e \bar{\nu}_e \bar{b}$, 22222 means all decays, 10011 means one goes into eletron or antielectron, and the other goes into any hadron, 00022 means fully hadronic, 00011 means fully hadronic with a single charm, 00012 fully hadronic with at least one charm. The value 0 means that the t and t are not decayed. Values that imply only one t decay (for example 10000) are not implemented consistently. If the flag `semileptonic` is set to 1, only semileptonic decays are kept by the program. In case `topdecaymode` is different from 0 more parameters are needed for the decay kinematics, and are used exclusively for decays.
The top-quark mass value can be set by

```
$ topmass 173.2 !  top mass value in GeV.
```

Also, in case an analysis routine is linked, the process requires some parameters to specify the jet

```
$ R_jet 0.5 !  jet radius.
$ ptmin_jet 25 !  jet min pt in GeV.
```

Since the calculation is quite intensive from a computational point of view, the calculation and the event generation can be parallelized on a cluster. We refer to the `POWHEG-BOX/Docs/ManySeeds.pdf` manual for details.

References

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