

MC generators and future challenges

SHERPA Tutorial: h+Jets

1 Running the example set-up

This is an example for a merged sample for Higgs production in association with up to 2 jets, where 0 and 1 jets are at NLO and the second jet is at LO. The loop matrix element for $pp \rightarrow h + X$ and $pp \rightarrow h + j + X$ are included in SHERPA.

SHERPA and the loop generators have been installed in the tutorial directory on lxplus (`/afs/cern.ch/project/theory/LPCC_MC_Workshop/tutorial2`). There is also a shell script that sets the paths:

```
source /afs/cern.ch/project/theory/LPCC_MC_Workshop/tutorial2/env.sh
```

The matrix elements for the NLO processes are generated with AMEGIC, which writes process libraries that have to be compiled. For this process, there are no precompiled libraries on `afs`, they will have to be generated and compiled. To this end you should create a run directory `RUNDIR` and copy the run card there:

```
cd RUNDIR
cp /afs/cern.ch/project/theory/LPCC_MC_Workshop/tutorial2/setups/h+jets/Run.dat .
```

SHERPA can now be run to generate the process libraries one NLO multiplicity at a time, i.e.:

```
Sherpa
./makelibs
Sherpa
./makelibs
...
```

The last step (run Sherpa and makelibs) has to be repeated for every jet multiplicity (in this case 2) at NLO and for each process (in this case just one: $pp \rightarrow h + X$ and $pp \rightarrow h + j + X$).

Once the libraries are compiled the individual cross section can be integrate and event generation can be commenced. This is done by simply running the same run card as before asking for as many events as you require:

```
Sherpa -f Run.dat EVENTS=100000
```

In this example the events are analysed with RIVET, which is interfaced to SHERPA so that the events can be handed over directly. If more events are required run the above command with an increased number of events. The cross-sections have been stored and do not need to be reintegrated and event generation begins right away. The histograms are written into a file `hjets.aida`. The plots are created and compiled into a neat html-page by running the command.

```
rivet-mkhtml -o hjets-plots hjets.aida
```

This creates a directory called 'plots' containing an `index.html`, which can be viewed with any web browser, e.g.

```
firefox hjets-plots/index.html
```

2 Proposals for variations

Now you can either run one of the other example set-ups, or try some variations of this one. As the integration of the high multiplicity processes takes rather long, it is advisable to try only variations that do not require integration the cross sections again during the tutorial. Here are a few suggestions:

- vary the number of jets that are computed at NLO by varying the LJET tag in the run card (LJET=0 corresponds to MEPS@LO, LJET=1 to MENLOPs)
- vary the scales (when generating weighted events this does not require to integrate the cross sections again)
- generate unweighted events for the MEPS@LO or MENLOPs (unweighting MEPS@NLO events works, but is still somewhat inefficient for higher multiplicities of NLO jets)
- switch on the hadronisation and/or underlying event