Sherpa tutorial Allianz MCschool 2008

Getting started

Sherpa version 1.1.0 is already installed and compiled for you under

`/afs/desy.de/group/alliance/mcg/public/MCGenerators/sherpa/1.1.0/i586_rhel40`

To be able to run Sherpa copy the file `sherpa.tar.gz` from

`/afs/desy.de/group/alliance/mcg/public/mcschool2008/examples/Sherpa`

into your home directory, `<your_dir>`. Now run

```
tar -zxvf sherpa.tar.gz
```

and then excute

```
source ./sherpa_setup
```

such all the relevant paths should be set up. When opening a new shell you will have to run `source ./sherpa_setup` again.

$t\bar{t}$ production with Sherpa

- In `<your_dir>` there should reside a directory `Sherpa_tt/` containing a bunch of parameter files corresponding to $t\bar{t}$ production at the LHC. Make yourself familiar with those. Identify the enforced decay mode of the produced top-quarks.
- Go back to `<your_dir>` and open the script file `./sherpa_run`. Adapt the command to produce just one event, and specify a file name for the HepMC event output.
- Now execute `./sherpa_run`. From the output infer the assumed top mass and width. Sherpa will stop after having produced process libraries that need to be compiled and linked by excuting `./makelibs` in `<your_dir>/Sherpa_tt`.
- After successfull compilation run `./sherpa_run` again. The program will evaluate the matrix elements and store the results in `<your_dir>/Sherpa_tt/Results_tt_01j`. Subsequently one event in native Sherpa output (`blobs`) is printed on the screen. Try to interpret the format and search for the different occurrences of the top decay products.
- Now generate a sizeable number of events for later analyses. To avoid the screen output of events set `OUTPUT=2`.
- The inclusive cross section of the process and some event statistics can be found in `<your_dir>/Sherpa_tt/Ana_Xsec/Statistics_Observable_FinalState`.

Analysing Sherpas HepMC event output

In `<your_dir>/Analysis_Sherpa/` you find all the necessary ingredients to perform an analysis of your produced event sample. The actual analysis routine resides in `hepmc_sh_analysis.cc`. There a reconstruction of the top and anti-top quarks in the events is provided. Using this information generate histograms of the following quantities:

- the p_T and η distribution of the top and the anti-top, respectively
- the p_T distribution of the $t\bar{t}$ system
- the p_T and η distribution of the leptonic top-decay products
- the p_T and η distribution of all stable particles in the event
- the $\not{p}_T$ distribution of the top decay products and the full final state
- the azimuthal angle between the leptonic top decay products
- the events charged multiplicity distribution

Load the produced `hemmc_sh_histos.root` file in root and plot the histograms.

Add on

Starting from your $t\bar{t}$ Sherpa setup, try to generate Higgs production in WBF, with $h^0 \to e^+\nu_e\mu^-\bar{\nu}_\mu$. Having produced an event sample, modify the analysis routines accordingly and compare the relevant distributions with the $t\bar{t}$ sample.