

A First look at Pythia8

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1 Installation etc.

1.1 Where to find more information

The latest version of Pythia 8 can always be found at:

<http://home.thep.lu.se/~torbjorn/Pythia.html>

The online manual is at:

<http://home.thep.lu.se/~torbjorn/pythia82html/Welcome.html>

The manual is also available in your local distribution at:

[your pythia8 installation directory]/share/Pythia8/html/doc/Welcome.html

1.2 Installation

For installation, unzip the tarball, change to the directory, do:

```
./configure
make
make install
```

For all configure options:

```
./configure --help
```

For CheckMATE, you will need:

```
./configure --enable-shared \  
--with-hepmc2=/Users/nishita/Code/HepMC/ \  
--with-fastjet3=/Users/nishita/Code/ \  

```

```
--with-root=/Users/nishita/Code/root \  
--with-lhapdf5=/Users/nishita/Code/
```

Other useful option

```
./configure --prefix=/your/dir/name
```

This will “make install” it in that location

2 Hello World!

For your first program, let us write a simple code that generates $pp \rightarrow Z \rightarrow \ell^+ \ell^-$. Many examples are available in the `[py8dir]/examples` folder. Look at “Sample Main Programs” in main menu of HTML manual for a list of what they do.

For the first program, we will start with `main02.cc`

1. Change from Tevatron to LHC 8 TeV energy (hint: change `idB`, `eCM`).
2. Change open decay modes of Z to $\ell^+ \ell^-$ (hint: use `"23:onIfAny = 11 13"`)
3. Add histogram to calculate invariant mass
4. Print the histograms table to a file for later plotting

3 Using internal Pythia8 processes: SUSY

Look at `main24.cc` and `main24.cmnd`

1. Turn on all processes that have the gluino
2. Calculate and plot missing energy (hint: as a shortcut, sum the p_T of the LSP.)

4 Reading in LHE files and writing out hepmc

Look at `main101.cc` below. You can use this tomorrow to generate events from the next exercise to pass it to CheckMATE.

To compile, you will need to add `"main101"` to the end of the list

```
# HEPMC2.
```

```
main41 main42 main43 main85 main86 main87 main88 main89 main101:
```

```
// Example for Les Houches 2015
```

```
// Original Author: Mikhail Kirsanov, Mikhail.Kirsanov@cern.ch
```

```
// This program illustrates how HepMC can be interfaced to Pythia8.
```

```
// It studies the charged multiplicity distribution at the LHC.
```

```
// HepMC events are output to the hepmc41.dat file.
```

```
// WARNING: typically one needs 25 MB/100 events at the LHC.
```

```

// Therefore large event samples may be impractical.

#include "Pythia8/Pythia.h"
#include "Pythia8Plugins/HepMC2.h"

using namespace Pythia8;

int main() {

    // Interface for conversion from Pythia8::Event to HepMC event.
    HepMC::Pythia8ToHepMC ToHepMC;

    // Specify file where HepMC events will be stored.
    HepMC::IO_GenEvent ascii_io("hepmcout.dat", std::ios::out);

    // Generator. Process selection. LHC initialization. Histogram.
    Pythia pythia;

    pythia.readString("Beams:frameType = 4");
    pythia.readString("Beams:LHEF = z_1jet.lhe");

    pythia.init();

    // Begin event loop. Generate event. Skip if error.
    for (int iEvent = 0; ; ++iEvent) {
        if (!pythia.next()) {
            if (pythia.info.atEndOfFile()) break;
            else continue;
        }

        // Construct new empty HepMC event and fill it.
        // Units will be as chosen for HepMC build; but can be changed
        // by arguments, e.g. GenEvt( HepMC::Units::GEV, HepMC::Units::MM)
        HepMC::GenEvent* hepmcevt = new HepMC::GenEvent();
        ToHepMC.fill_next_event(pythia, hepmcevt );

        // Write the HepMC event to file. Done with it.
        ascii_io << hepmcevt;
        delete hepmcevt;

    // End of event loop. Statistics. Histogram.
    }
    pythia.stat();

    // Done.

```

```
    return 0;  
}
```

5 Using matching: CKKWL

5.1 Part 1: Z+jets

Look at main80.cc and main80.cmd

1. Modify to merge Z+jets (up to 3 jets); samples are available online.
2. Plot pT of Z
3. Restrict Z decay to $\nu\bar{\nu}$
4. Plot missing energy

5.2 Part2: Use the BSM model from MC4BSM $pp \rightarrow U\bar{U}$

1. Read LHE file; samples are available online.
2. Plot missing energy (Φ is stable)