

# Finding Charged Pions and Calculating Their Cross Section

## Editing the XML file:

```
ssh into ACCRE
shell into singularity
cd into myX-SCAPE/X-SCAPE/build
emacs ../config/jetscape_user.xml
```

Edit to have this info:

```
<nEvents> 100000 </nEvents>
```

Before <JetScapeWriterAscii> on </JetScapeWriterAscii> write:

```
<outputFilename> pion_pp_pTHat5_10_out </outputFilename>
```

```
<JetScapeWriterFinalStateHadronsAscii> on </JetScapeWriterFinalStateHadronsAscii>
```

Then, in <pTHatMin> change the value to 5, and in <pTHatMax> change value to 10, and in <eCM> change the value to 200

(Make sure that you change your output filename to be descriptive enough so that you can understand what exactly is in the file after it is output)

Then Save and exit emacs (Control-x Control-c)

## Running the XML file:

Then (in same directory), run:

```
./runJetscape ../config/jetscape_user.xml
```

It will run for 100000 events, so it may take a while

When it's done, make an analysis directory

```
mkdir Analysis
```

## Moving to Analysis:

Move all of the output files to the Analysis directory by typing the command

```
mv pion_pp_pTHat5_15_out* Analysis/
```

```
cd Analysis
```

```
emacs pionpluscross_secv4.cpp (creates a new file)
```

(This file will be used to find negative and positive pions and combine their cross section)

On my GitHub, search for a file of the same name and download the file or copy the contents of that file onto your new file.

Look through the file for `int main(){` and look for `std::string filename`

Edit the filename to be the same as the one that you had just moved into your analysis directory

Save and exit emacs (Control-x Control-c)

Make the cpp file using this command:

```
g++ -o pionpluscross_secv4 pionpluscross_secv4.cpp -lgsl -lgslcblas -lm
```

(make sure you have GSL installed, if you don't, then just run the command:

```
apt-get install libgsl-dev
```

And it should download and install, then try to make the cpp file again)

Once it makes, and there are no errors, run this command:

```
./pionpluscross_secv4
```

And it should print out values in these columns:

pT	Cross Section	Cross Section Error
----	---------------	---------------------

Then copy and paste the values into a text file on your laptop

If any of them have

pT	0	-nan
----	---	------

That is fine, still copy and paste the entire thing, but change the -nan values to 0

## Plot Using Jupyter Notebook:

Now, go into my GitHub again, and download or copy the Jupyter Notebook file

Once you have that text file saved somewhere, preferably in the same directory as the Jupyter Notebook, then you can open Jupyter and edit the python code to load your text file by changing the filename in `np.loadtxt`, and then run the cell under Charged Pion Cross Section

## Finding Neutral Pions and Calculating Their Cross Section

## Editing the XML file:

cd back into the build directory (if you are in Analysis, then the command is `cd ../`)  
`emacs ../config/jetscape_user.xml`

Rename the output filename to include that these are neutral pions, so it could be `pi0_pp_pTHat...`

In the `<JetHadronization>` section, add these lines below `<name> colorless </name>`:  
`<LinesToRead>`

`111:mayDecay = off`

`</LinesToRead>`

(This ensures that the `pi0` particle will not decay into two photons, and therefore we can calculate its cross section)

Save and exit emacs

## Running the XML file:

Following the same steps as before:

`./runJetscape ../config/jetscape_user.xml`

## Moving to Analysis:

Wait for the run to finish, and then move all output files to Analysis directory  
`cd Analysis`

`emacs pioncross_secv1.cpp` (creates new file, or you can download mine from the GitHub)

Copy the information from the code with the same name on my GitHub

Edit the filename under the `int main(){` function again to match yours

Make the file using this command:

`g++ -o pionplusscross_secv4 pionplusscross_secv4.cpp -lgsl -lgslcblas -lm`

Then run the file:

`./pioncross_secv1`

The output information will be the same as before, with columns of  
`pT`      `Cross Section`      `Cross Section Error`

Copy and Paste these values down on a text file on your local machine (laptop), and save in the same directory that you have your Jupyter Notebook in

## Plot Using Jupyter Notebook:

Open the Jupyter Notebook and edit the cell under Neutral Pion Cross Section to contain the name of your file after the np.loadtxt, then run the cell

## PYTHIA Analysis:

Getting Started:

PYTHIA is already downloaded and installed in the singularity shell (located in myX-SCAPE/X-SCAPE/external\_packages/pythia8309)

So, go to the PYTHIA directory and cd into examples

Make a new file:

```
emacs main999.cc
```

Then copy the contents of the file I have under the name main100.cc

Then save and exit emacs

Then, use the make command:

```
g++ -o main999 main999.cc -lgsl -lgslcblas -lm -I../include -O2 -std=c++11 -pedantic -W -Wall  
-Wshadow -fPIC -pthread -L../lib -Wl,-rpath,../lib -lpythia8  
-ldl -I/home/sleethmr/jetbox/myX-SCAPE/X-SCAPE/external_packages/fastjet-install/include  
-Wl,-rpath,/home/sleethmr/jetbox/myX-SCAPE/X-SCAPE/external_packages/fastjet-install/lib  
-L/home/sleethmr/jetbox/myX-SCAPE/X-SCAPE/external_packages/fastjet-install/lib  
-lfastjettools -lfastjet -lm
```

Then run the file:

```
./main999
```

It will run for a while, and then you will get output that is structured the same as the XSCAPE output, so it can be copied and put into a text file that can then be used to plot in python