Superchic_i: An interface between SuperChic MC event generator for CEP and Athena version in release 21.6

Prabhakar Palni (Prabhakar.Palni@cern.ch)

September 5, 2019

1 Introduction

SuperChic 3 Monte Carlo event generator for central exclusive production

This interface package runs SuperChic MC Generator (v3.05) within Athena framework, and stores the events output into the transient store in HepMC format.

SuperChic MC event generator is dedicated for Central exclusive production (CEP) processes in high-energy hadron-hadron collisions (pp, pA, and AA beams) for both photon and QCD-initiated production. This documentation gives you some details about setting up the Superchic interface (which is prepared using the latest available Superchic version 3.05) and activating the module using the JobOptions.

In order to initialize and calculate input parameters like such as opacity,screening amplitude,sudakov factor, and skewed PDF the subroutine calcparam.F is used. To generate events superchicrun.F subroutine is used which inheritates from the superchic.f subroutine.

2 Usage of Job Options

The example job option file can be found under the following path.

Superchic_i/share/jobOptions.Superchic.py

Before running this script, first setup the athena

asetup 21.6,latest,AthGeneration,slc6

Above command sets up the latest AthGeneration cache.

The Superchic input parameters can be set from the job options service. The default parameters initializes the Superchic for PbPb beams at center-of-mass energy per nucleon of 5.02 TeV for the light by light scattering process [$\gamma\gamma \rightarrow \gamma\gamma$ (process no. 59)].

All the parameters passed to Superchic are in the units specified in the Superchic manual https://superchic.hepforge.org/superchic3.pdf

The default jobOptions.Superchic.py file can be copied to your test run directory. The initialization parameters can be changed via the following line in the jobOptions.py

```
Superchic.Initialize = ["parameter_1 value_1", "parameter_2 value_2"]
```

Each quoted string sets one parameter value in the fortran variable format. You can set all the input parameters separated by commas, however, the important ones are listed below.

parameter_1: must be one of the following variable names, an error message is returned if the specified variable is not in the input parameter list.

value_1: is the input parameter's value.

JO Example:
The following command generates 10 events for Pb+Pb collisions at 5.02 TeV center-of-mass energy along with important input parameters for process 59 i.e $\gamma\gamma \to \gamma\gamma$.

Running the Job Option to produce events

```
Generate_tf.py --ecmEnergy=5020.0 --maxEvents=10  --firstEvent=1  --randomSeed=14
 --outputEVNTFile=test.pool.root --jobConfig  jobOptions.Superchic.py
```

Example of the initialization of the input parameters in the JO is shown below.

```
genSeq.Superchic.Initialize = \
["rts 5.02d3",                     # set the COM collision energy (in fortran syntax)
"isurv 4",                         # Model of soft survival
"intag 'in5'",                     # for input files
"PDFname 'MMHT2014lo68cl'",        # PDF set name
"PDFmember 0",                     # PDF member
"proc 59",                         # Process number (59:gg->gg, 56:gg->ee, 57:gg->mumu)
"beam 'ion'",                      # Beam type ('prot', 'ion','ionp')
"outtg 'out'",                     # for output file name
"sfaci .false."                    # Include soft survival effects
]
```

One can also add the kinematical cuts to the outgoing particles or the system, details can be found in the manual.

3 Running SuperChic in Standalone way

One can directly carry out following commands in the fresh terminal to produce superchic events in standalone way.

```
source /cvmfs/sft.cern.ch/lcg/releases/LCG_88/MCGenerators/superchic/3.05/x86_64-slc6-gcc49-opt/superchicenv-genser.sh
cp -rf /cvmfs/sft.cern.ch/lcg/releases/LCG_88/MCGenerators/superchic/3.05/x86_64-slc6-gcc49-opt/bin /tmp/cern_username/
cd /tmp/cern_username/bin/
export LHAPATH=/cvmfs/sft.cern.ch/lcg/external/lhapdfsets/current/
./init < input.DAT
./superchic  < input.DAT
```

You can change the input.DAT file to change the C.O.M collision energy for the particular process, process no., numberof events etc. Above commands will produce output stored under the directory **'evrecs'** .