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# Installation / usage of GENIE, done for the pilot run analysis

## Note

This is Aki's memo when the FASERnu LOI and pilot run analysis. GENIE has a relatively strong dependence on the versions. v2\_12\_10, which is rather widely used version, is used for this study. However, this version doesn't have a good implementation of charmed particle productions. If one wants to study numu induced charm production channels (and so the background to nutau CC events) he should use GENIE  $\geq 3.2.0$  (Not released yet as of July 2020).

GENIE web page: <http://www.genie-mc.org/>

## Third-party software packages

### GSL

May be not necessary. Use builtin in ROOT

```
cmake -DGSL_ROOT_DIR=/usr/local ..
```

```
wget ftp://ftp.gnu.org/gnu/gsl/gsl-2.6.tar.gz
```

```
./configure
```

```
make
```

```
(sudo) make install
```

### Pythia

```
wget http://home.thep.lu.se/~torbjorn/pythia8/pythia8243.tgz
```

```
./configure
```

```
make
```

```
cd examples
```

```
make main01
```

```
./main01
```

### ROOT

```
wget https://root.cern/download/root_v6.18.04.Linux-ubuntu14-x86_64-gcc4.8.tar.gz
```

```
gunzip root_v6.18.04.Linux-ubuntu14-x86_64-gcc4.8.tar.gz
```

## GENIE < FASER < TWiki

```
tar xvf root_v6.18.04.Linux-ubuntu14-x86_64-gcc4.8.tar
```

```
source root/bin/thisroot.sh
```

6.18 needs cmake 3.9 but it cannot be installed in Ubuntu16.04? Try to install 6.14.

Enable builddin-gsl, mathmore, pythia6, pythia6\_nolink through `./configure`

```
./configure --enable-builitn_gsl
```

```
--enable-pythia6
```

```
--with-pythia6-libdir=/home/scanner/GENIE/pythia6/lib
```

```
--enable-mathmore
```

```
cd obj
```

```
ccmake .
```

## lhpdf

lhpdf-5.9.1

This was difficult to install for Aki. He got the package directly from Callum.

## GENIE installation

GENIE web page: <http://www.genie-mc.org/> . Files/instractions are there.

```
export GENIE=/home/scanner/GENIE/Generator
./configure
```

```
export LD_LIBRARY_PATH=\$LD_LIBRARY_PATH:/home/scanner/GENIE/pythia6/v6_428/lib
export LD_LIBRARY_PATH=\$LD_LIBRARY_PATH:/home/scanner/GENIE/
```

## Environmental variable settings

```
source $HOME/GENIE/root-6.14.06/obj/bin/thisroot.sh
export GENIE=$HOME/GENIE/Generator/
export LHAPATH=$HOME/GENIE/lhapdf-5.9.1/include/LHA
export PYTHIA6=/usr/local/lib
export GSL_LIB=$HOME/GENIE/gsl-2.6/lib
export GSL_INC=$HOME/GENIE/gsl-2.6/include
export LOG4CPP_INC=$HOME/GENIE/log4cpp/include
export LOG4CPP_LIB=$HOME/GENIE/log4cpp/lib
export LHAPDF_INC=$HOME/GENIE/lhapdf-5.9.1/include
export LHAPDF_LIB=$HOME/GENIE/lhapdf-5.9.1/lib
export LIBXML2_INC=/usr/include/libxml2
export LIBXML2_LIB=/usr/lib64
export PATH=$PATH:$GENIE/bin
export LD_LIBRARY_PATH=\$LD_LIBRARY_PATH:\$LOG4CPP_LIB:\
```

```

$LIBXML2_LIB:\
$LHAPDF_LIB:\
$PYTHIA6:\
$GENIE/lib
source $HOME/GENIE/nuisancegit/build/Linux/setup.sh

```

## Usage

### Make splines

The default GENIE doesn't have the cross section splines above 100 GeV. The cross section splines should be calculated in advance

```
#!/bin/bash
```

```

GENIE_DIR=~generators/GENIE/v2_12_10
THIS_DIR=$GENIE_DIR/making_splines
cfgname=ValenciaQE BergerSehgalCOHRES

```

```

if [ -z $GENIE ]; then source $GENIE_DIR/environment_setup.sh; fi;
export GXMLPATH=${GENIE_DIR}/genie_xsec/v2_12_10/NULL/${cfgname}/data

```

```
## Event properties
```

```
outFile="FASER_numu_2.5M.root"
```

```
nuType="14"
```

```
# TARG=1000822080
```

```
TARG=1000741840
```

```
outFile=${nuType}_${TARG}_spline.xml
```

```
logFile=${outFile}/.xml/.log
```

```

gmkspl -p ${nuType} -t ${TARG} -n 200 -e 10000 -o $outFile --event-generator-list Default+CCMEC+1K
&> ${logFile} &

```

### Generate events at 1

```
#!/bin/bash
```

```
GENIE_DIR=~GENIE/Generator
```

```
THIS_DIR=.
```

```
cfgname=ValenciaQE BergerSehgalCOHRES
```

```
# source $GENIE_DIR/environment_setup.sh
```

```
export GXMLPATH=${GENIE_DIR}/genie_xsec/v2_12_10/NULL/${cfgname}/data
```

```
## Event properties
```

```
outFile="numu_1TeV_1M.root"
```

```
nuType="14"
```

```
NEVENTS=1000000
```

```
TARG=1000741840
```

```
logFile=${outFile}/.root/.log
```

```
#nohup
gevgen -n ${NEVENTS} -t ${TARG} -p ${nuType} --cross-sections
$THIS_DIR/${nuType}_${TARG}_spline.xml --event-generator-list Default+CCMEC+1K -e 1000 -o
${outFile} > ${logFile} &
```

## Generate events with a flat flux (0,9999)

```
#!/bin/bash

GENIE_DIR=~/.GENIE/Generator
THIS_DIR=.
cfgname=ValenciaQEBergerSehgalCOHRES

# source $GENIE_DIR/environment_setup.sh

export GXMLPATH=${GENIE_DIR}/genie_xsec/v2_12_10/NULL/${cfgname}/data

## Event properties
outFile="numu_flat_1M.root"
nuType="14"
NEVENTS=1000000
TARG=1000741840

logFile=${outFile}/.root/.log
```

```
#nohup
gevgen -n ${NEVENTS} -t ${TARG} -p ${nuType} --cross-sections
$THIS_DIR/${nuType}_${TARG}_spline.xml --event-generator-list Default+CCMEC+1K -f
${inFlux},${fluxHist} -e 0.02,9999 -o ${outFile} > ${logFile}
```

## Generate events with FASERnu spectrum

```
#!/bin/bash

GENIE_DIR=~/.GENIE/Generator
THIS_DIR=.
cfgname=ValenciaQEBergerSehgalCOHRES

# source $GENIE_DIR/environment_setup.sh

export GXMLPATH=${GENIE_DIR}/genie_xsec/v2_12_10/NULL/${cfgname}/data

## Event properties
inFlux="FASERnu_EnergySpectrum_Incoming.root"
NEVENTS=1000000
TARG=1000741840

outFile="numu_faser_1M.root"
fluxHist="hnumu"
nuType="14"
logFile=${outFile}/.root/.log
```

```
echo ${outFile}
date
gevgen -n ${NEVENTS} -t ${TARG} -p ${nuType} --cross-sections ../${nuType}_${TARG}_spline.xml \
--event-generator-list Default+CCMEC+1K -f ${inFlux},${fluxHist} -e 0.02,9999 -o ${outFile} > ${logFile}
```

## Read GENIE output

GENIE's output is not easy to read. This code (dump\_genie) dumps the relevant information into root files.

The Event.C, .h might further help you to deal the data.

- Makefile: Sample code to read GENIE outputs. This code is modified by Aki from GENIE's sample code "gevscan"
- dump\_genie.cpp: Sample code to read GENIE outputs. This code is modified by Aki from GENIE's sample code "gevscan"
- Event.C: Event.C
- Event.h: Event.h

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This topic: FASER > GENIE

Topic revision: r1 - 2020-07-23 - AkitakaAriga



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