GEMC Tutorial

USING GEMC AT JLAB

This Tutorial be Found at gemc.jlab.org

- Event generation
- Running GEMC
- Simulation Parameters
- Output

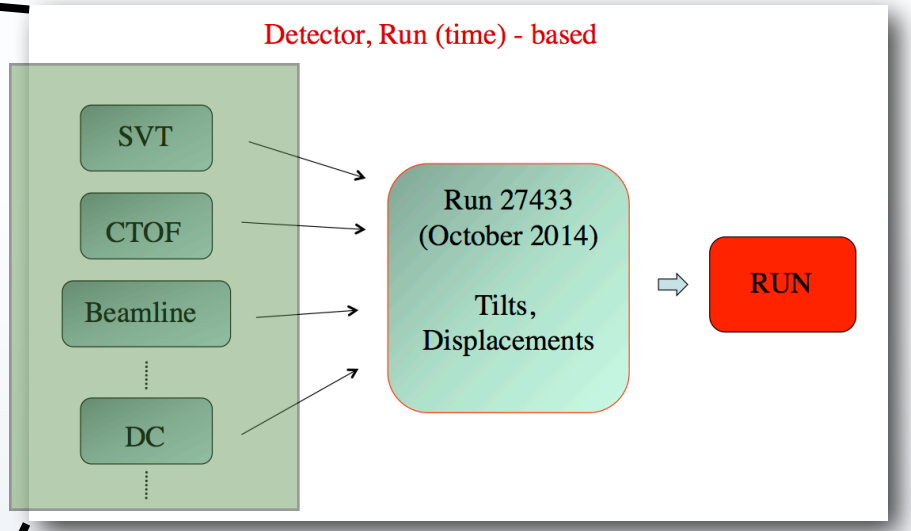
Pre-requisites:

`Terminal, ssh`

Simulation is the imitation of a real process or system

Database
MYSQL, GDML
(soon SQLITE)

The Geometry
Sensitivity
Digitization
Output Format
Magnetic Fields
Materials



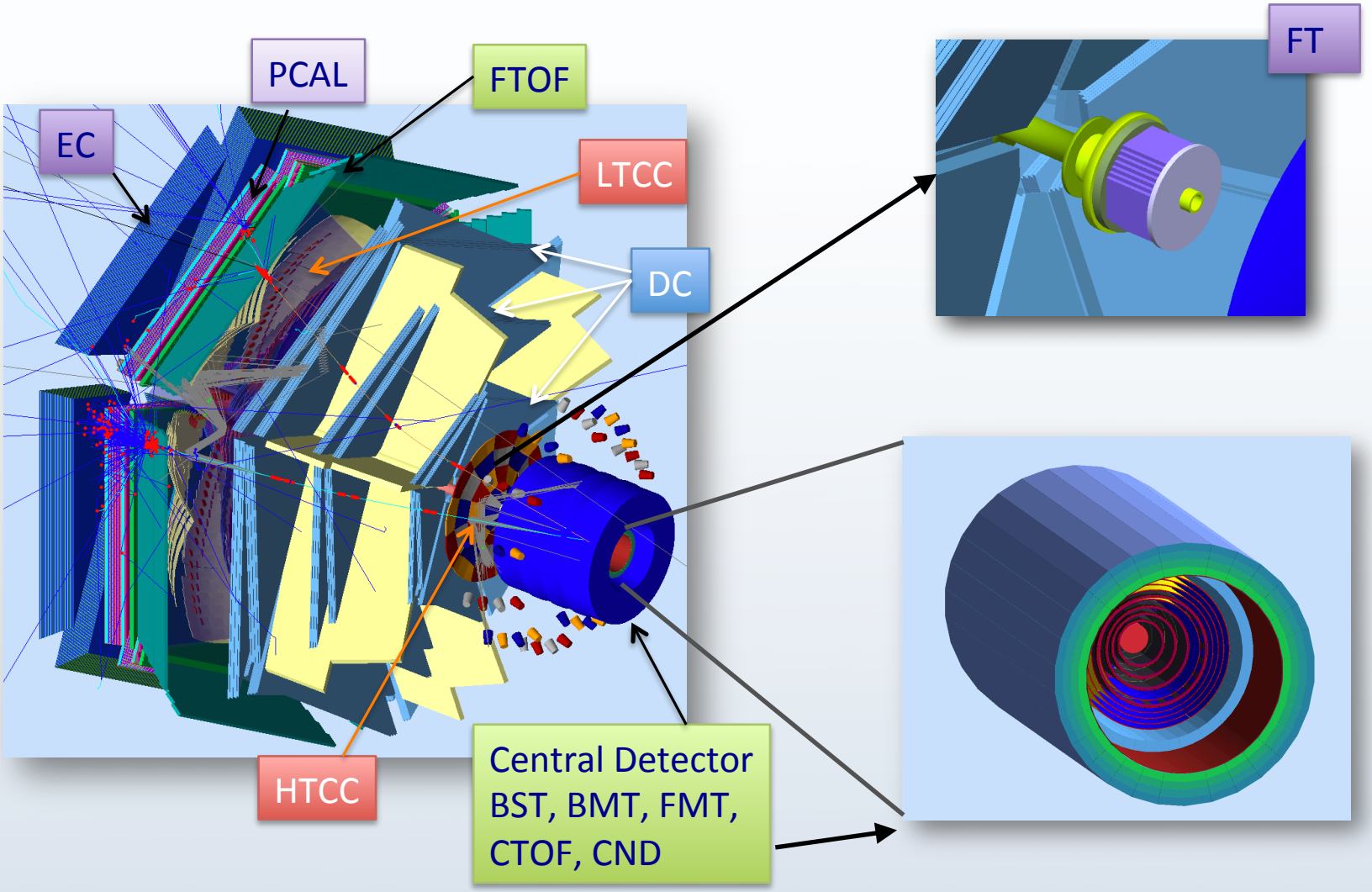
Geometry Stored on a JLAB MYSQL DB

Users need to only worry about geometry numbers and response function algorithms - NOT how these interface with geant4.

Common Parameters between simulation and reconstruction/visualization

No need to recompile code

CLAS12 in GEMC



GEMC Digitization

Detector	Sensitivity	Digitization	Time Window
BST	3 or 4 regions, 2 layers/reg, 3 modules/lay, 256 variable angle strips /lay. Charge Sharing, Electronic Noise.	3 bit ADC, region/layer/strip #	130 ns
BMT/FMT	3 or 4 regions, 2 layers/reg, 3 tiles/lay, 1000 strips /tiles. Charge Sharing, Lorentz Angle.	12 bit ADC, region/layer/tile/strip #	130 ns
CTOF	58 scintillators , (photo-sensor quantum efficiency, attenuation length, effective velocity*)	Paddle #, (ADC, TDC*)	4 ns
CND	3 or 4 layers, 48 scintillators each, photo-sensor quantum efficiency, attenuation length, effective velocity, Birks Effect, paddle resolution	Region, Paddle #, ADC, TDC	4 ns
HTCC	12 sectors, 4 layers. Wavelength-dependent PMT quantum efficiency and gas, mirrors refraction indexes.	PMT#, ADC, TDC	100 ns
DC	3 regions 2 Superlayers/reg 6 layers/SL. DOCA, drift velocity, cell resolution.	Sector, Region, SL, L, wire #, (ADC, TDC*)	250, 500 ns
LTCC	36 elliptical, 36 hyperbolical mirrors, WC*, PMT. (Wavelength-dependent PMT quantum efficiency and gas, mirrors refraction indexes*). Number of photoelectrons and timing.	Sector, PMT# L/R, (ADC, TDC*)	100 ns
FTOF	3 panels, 5, 56, 120 paddles. photo-sensor quantum efficiency, attenuation length, effective velocity*	Sector, Panel, PMT#, ADC, TDC	4 ns
PCAL	15 layers, u,v,w views, 24 scintillators/view , attenuation length, effective velocity, PMT gain, number of photons/charge	Sector, stack, view, strip, ADC, TDC	200 ns
EC	39 layers, u, v, w views, 36 scintillators/view, attenuation length, effective velocity, PMT gain, number of photons/charge	Sector, stack, view, strip, ADC, TDC	200 ns
RICH	Wavelength-dependent PMT quantum efficiency and gas, mirrors refraction indexes. Multi-channel PMT	Multi-channel PMT#, ADC, TDC	4 ns
FT	Light Yield for PbWO4, APD Quantum Efficiency, gain, noise.	PMT#, ADC, TDC	132 ns

* In progress

Step 1: Login at JLAB

Open a terminal and login into a CUE machine:

```
ssh login.jlab.org

ssh <machine>
```

where <machine> is one of

ifarm1101
ifarm1102
jlabl4
ifarm

Step 1.5: create a work directory

(optional, recommended)

```
mkdir workdir
cd workdir
```

Step 2: Copy Work Files

```
cp ~gemc/workshop/* .
```

Step 3: Source the environment

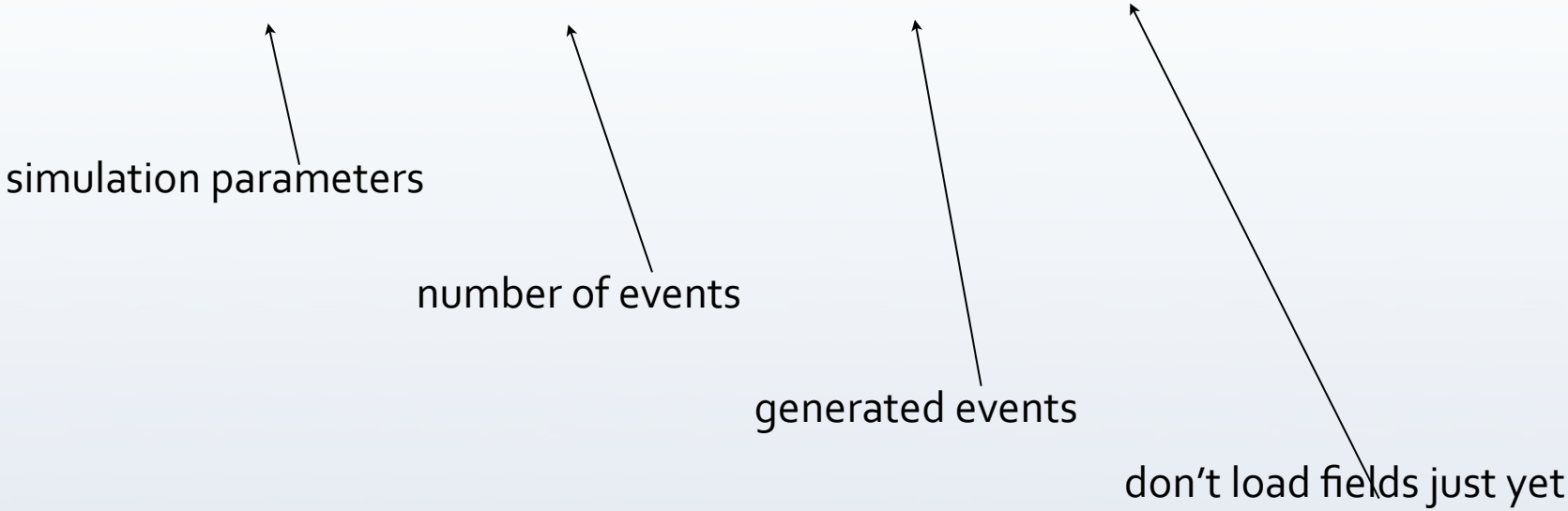
Type these 3 lines:

```
tcsh
source environment
```

Congratulations, you're now ready to use the software

Run GEMC, txt output

```
gemc -gcard=clas12.gcard -N=10 -INPUT_GEN_FILE="LUND, ePpippim.lund" -NO_FIELD=all -OUTPUT="txt, out.txt"
```

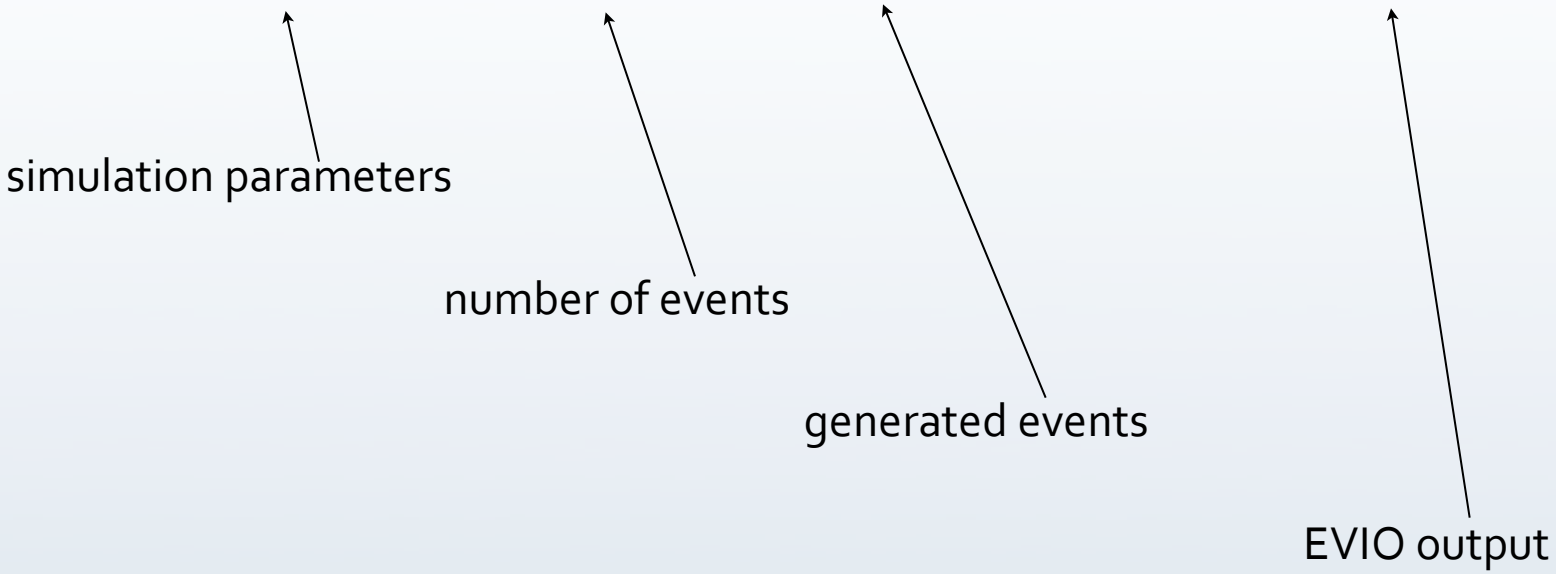


Look at output

Run GEMC with evio output, full fields

300 events this time

```
gemc -gcard=clas12.gcard -N=300 -INPUT_GEN_FILE="LUND, ePpippim.lund" -OUTPUT="evio, out.ev"
```



The gcard: clas12 detectors

```
<!-- Central Detectors: -->
<sqltable name="LH2target"/>
<sqltable name="BST"/>
<sqltable name="CTOF"/>
<sqltable name="CND"/>
<detector name="BST_SL_4">
  <existence exist="no" />
</detector>

<sqltable name="HTCC"/>


<!-- Forward Detectors: -->
<sqltable name="SECTOR"/>
<sqltable name="DC12"/>
<sqltable name="FTOF"/>
<sqltable name="EC"/>
<sqltable name="LTCC"/>
<sqltable name="LTCC_EL_Mirrors"/>
<sqltable name="LTCC_HP_Mirrors"/>
<sqltable name="LTCC_PMTS"/>
```

The gcard: options

```
<option name="DBHOST"         value="clasdb.jlab.org" />
<option name="DATABASE"       value="clas12_geometry" />
<option name="BANK_DATABASE"  value="clas12_banks" />


<!-- Magnetic Field, Hall Material: -->
<option name="HALL_FIELD"     value="srr-solenoid" />
<option name="HALL_MATERIAL"  value="G4_Galactic" />

<option name="USE_QT"         value="0" />
<option name="USE_PHYSICSL"   value="gemc" />
<option name="OPT_PH"         value="1" />
<option name="PRINT_EVENT"    value="1" />
```

The input file

N. of particles

Target, Beam polarization

Kinematic variables

```
                4       1.      1.      0       0       0.      0.      0.      0.      0.
1       -1      1       -11     0       0       -1.30   -0.333  2.718   2.718   0.00051 0.      0.      0.
2       1       1       2212    0       0       0.219   -0.487  6.258   6.258   0.93827 0.      0.      0.
3       -1      1       -211    0       0       0.790   0.548   1.866   1.866   0.13957 0.      0.      0.
4       1       1       211     0       0       0.291   0.271   0.155   0.155   0.13957 0.      0.      0.
```

type (1=active)

parent ID, ID

4 momenta, mass, vertex

Full documentation:

https://gemc.jlab.org/gemc/Documentation/Entries/2011/3/18_The_LUND_Format.html

Run GEMC with internal generator (command line)

```
-BEAM_P="proton, 5*GeV, 12*deg, 0*deg" -SPREAD_P="1*GeV, 5*deg, 180*deg"
```

5 GeV Proton

plus or minus 1GeV , 5 degrees (theta) 180 degrees (phi)

Run GEMC with internal generator (gcard)

```
<option name="BEAM_P"        value="e-, 3.0*GeV, 20*deg, 0*deg" />
<option name="SPREAD_P"      value="0.0*GeV, 12*deg, 180*deg" />
 <option name="BEAM_V"        value="(0.,0.,0.)cm" />
<option name="SPREAD_V"      value="(0.0015, 2.5)cm" />
```

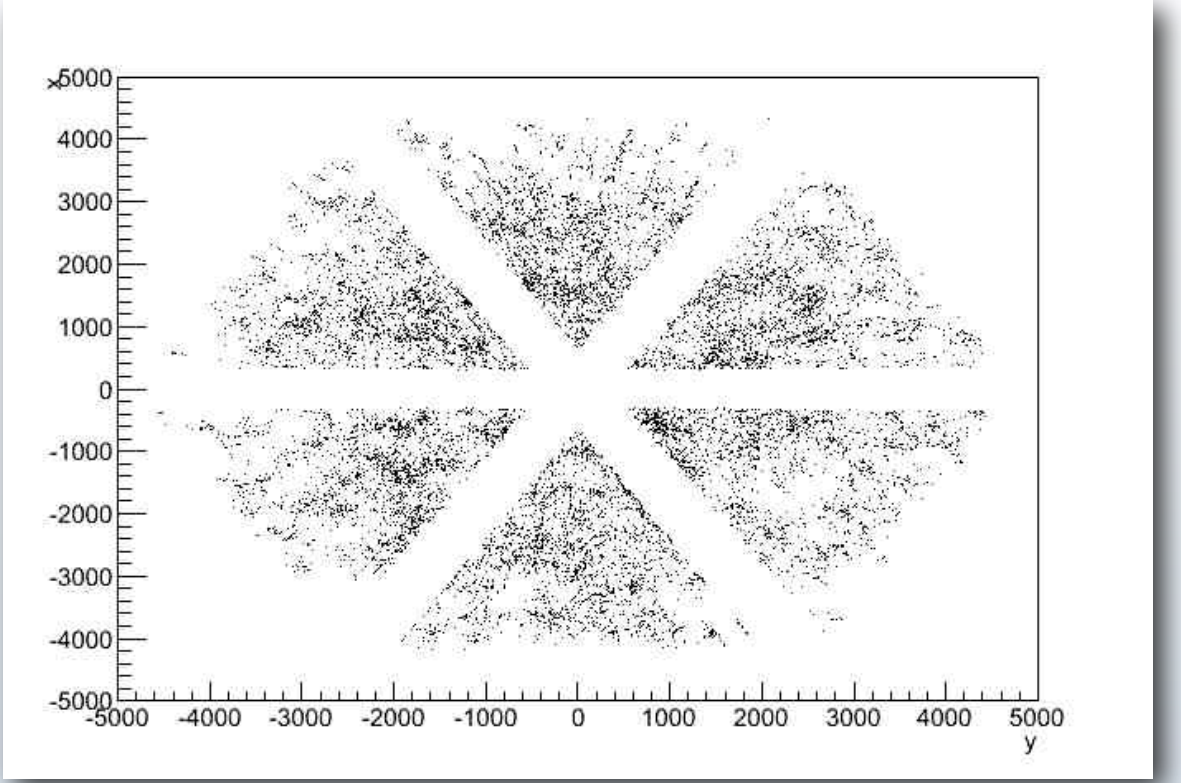
EVIO Output

```
$EVIO/bin/evio2xml out.ev  | more
```

ROOT Output

gemc_evio2root out.ev out.root

ecT->Draw("x:y")



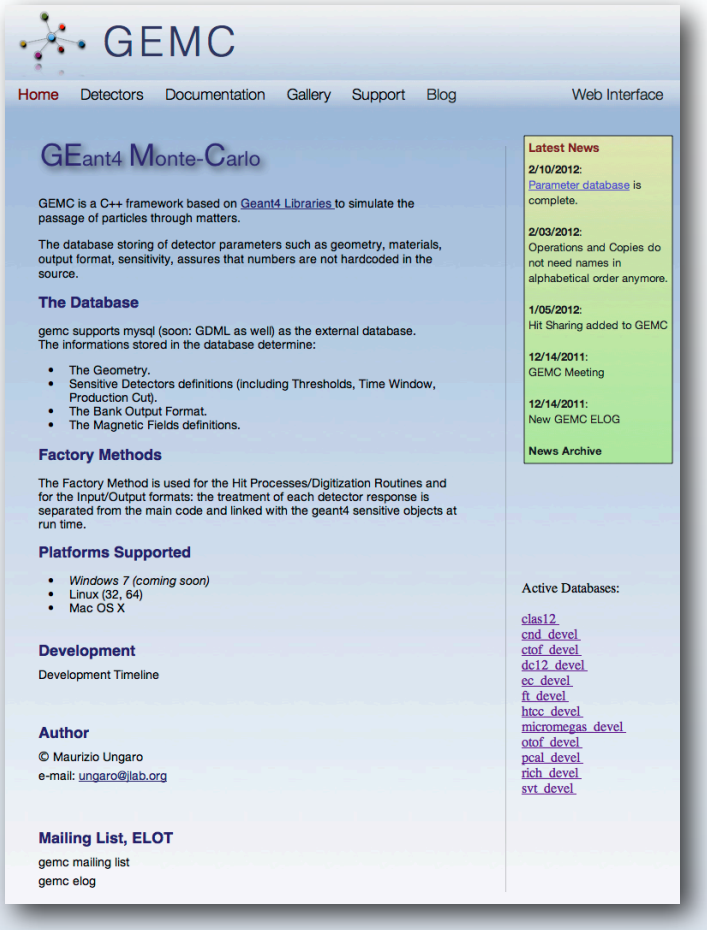
Documentation

```
gemc -help


 Help Options:

>  -help-all:  all available options.

>  -help-control              control options.
>  -help-general              general options.
>  -help-generator            generator options.
>  -help-luminosity           luminosity options.
>  -help-mysql                mysql options.
>  -help-output               output options.
>  -help-physics              physics options.
>  -help-verbosity            verbosity options.
```



gemc.jlab.org

Mailing List: gemc_software

Bug Report: Mantis

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