

# GEMC Tutorial

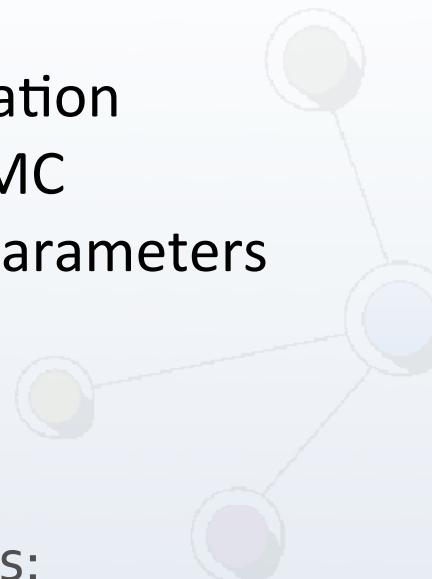
## USING GEMC AT JLAB

This Tutorial be Found at [gcmc.jlab.org](http://gcmc.jlab.org)

- ♦ Event generation
- ♦ Running GEMC
- ♦ Simulation Parameters
- ♦ Output

Pre-requisites:

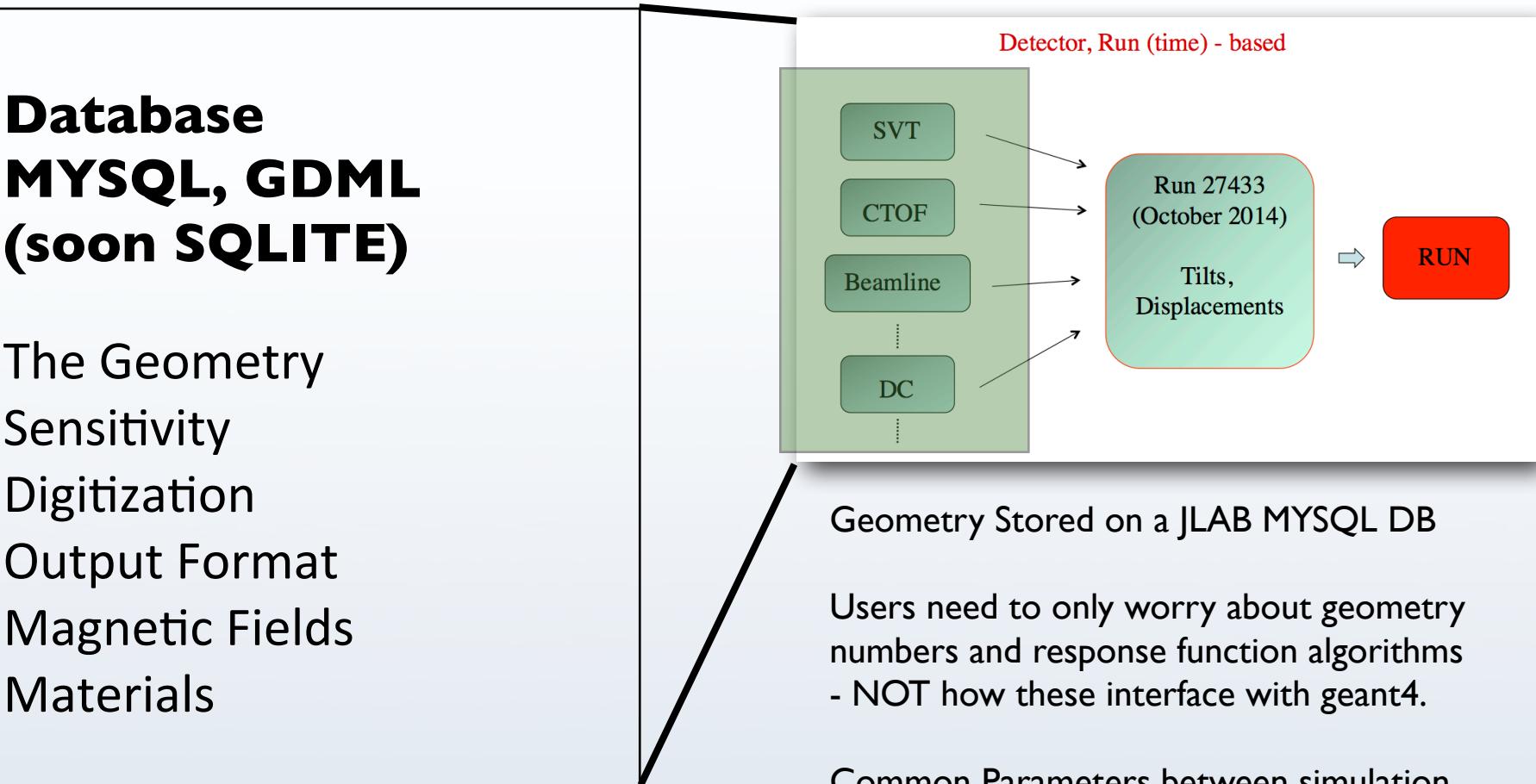
Terminal, ssh



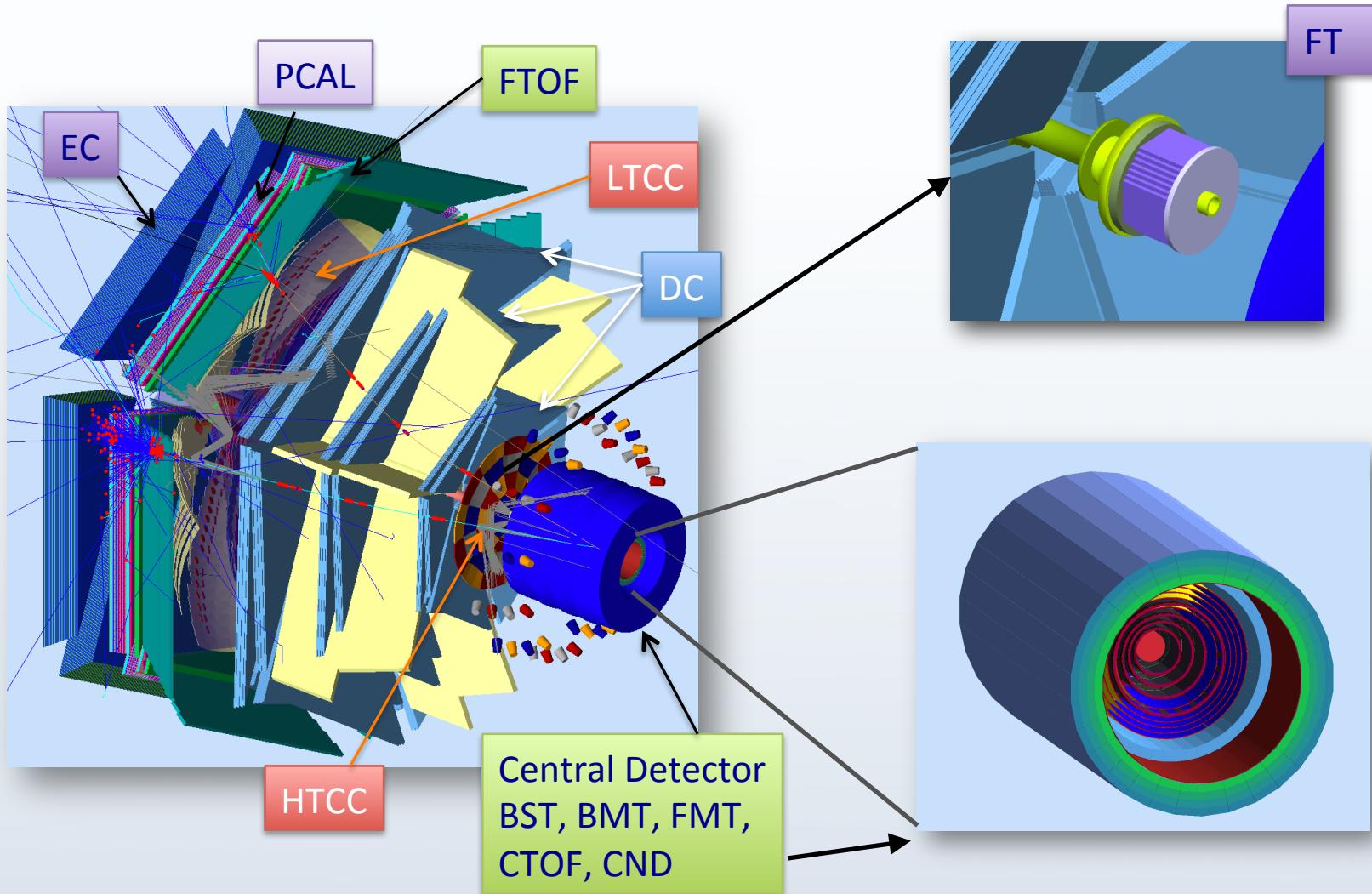
**Simulation** is the imitation of a real process or system

## Database MySQL, GDML (soon SQLITE)

The Geometry  
Sensitivity  
Digitization  
Output Format  
Magnetic Fields  
Materials



# 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

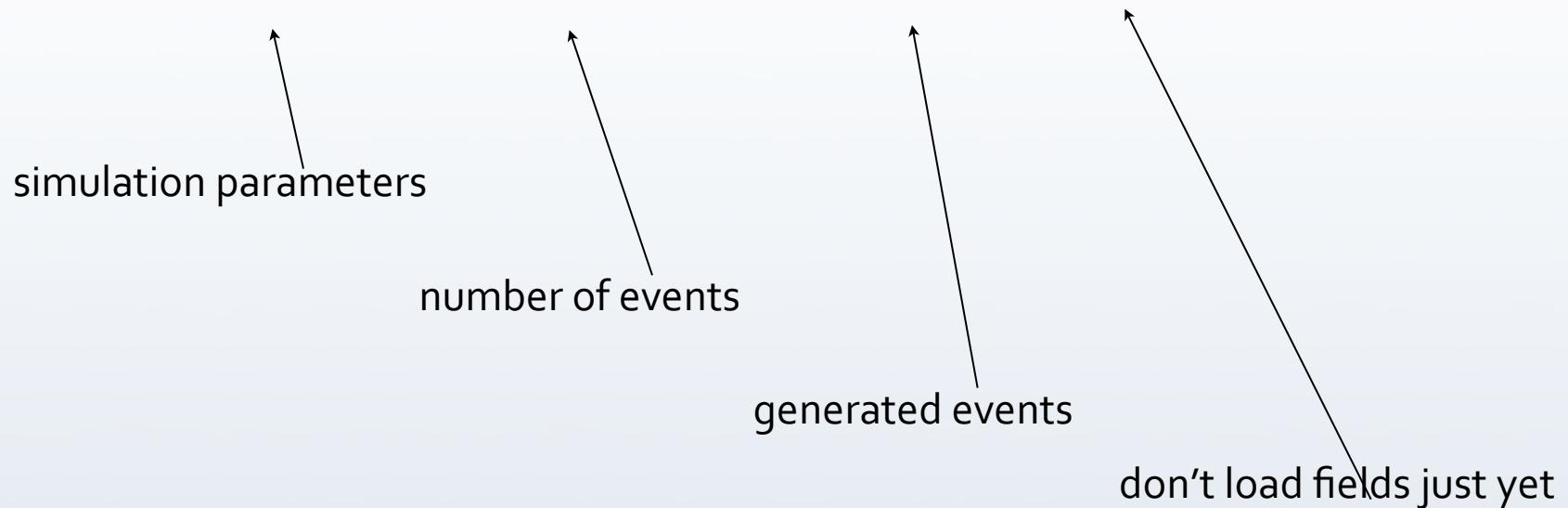
Type these 3 lines:

```
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, ePippim.lund" -NO_FIELD=all -OUTPUT="txt, out.txt"
```

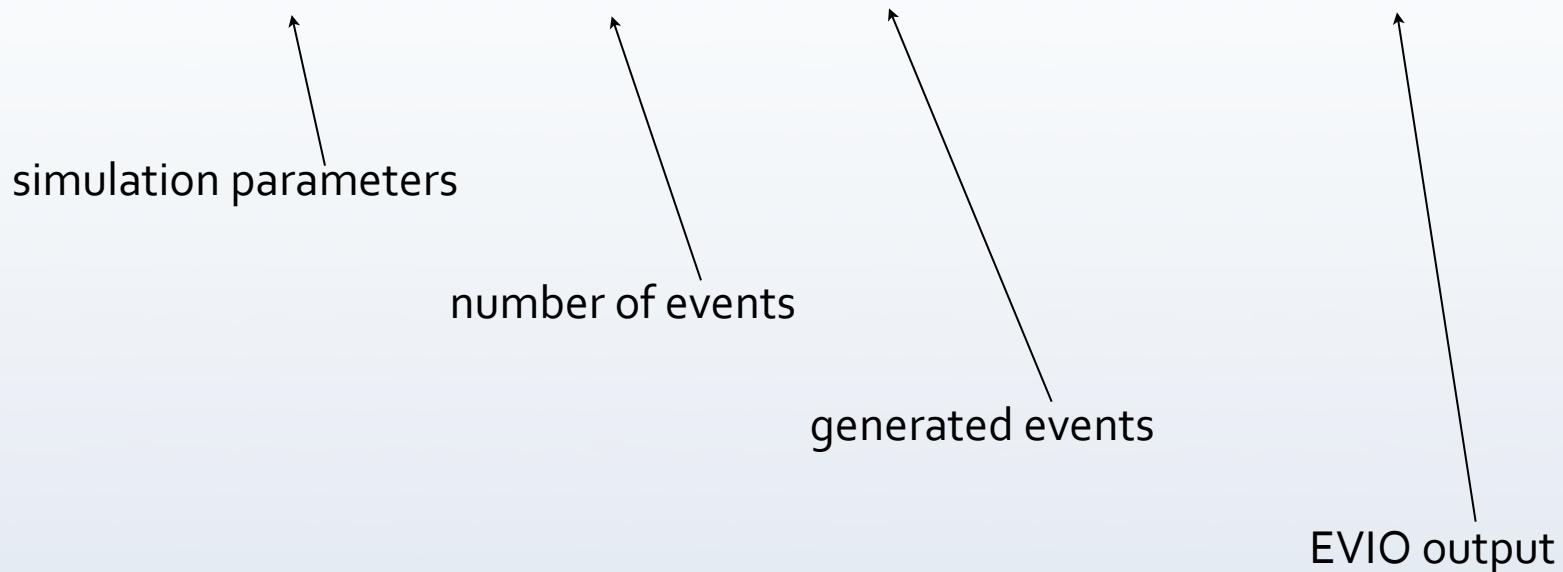


# Look at output

# Run GEMC with evio output, full fields

300 events this time

```
gemc -gcard=clas12.gcard -N=300 -INPUT_GEN_FILE="LUND, ePippim.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.	0.	0.	0.	0.
1	-1	1	-11	0	0	-1.30	-0.333	2.718	2.718	0.00051	0.	0.	0.	0.	0.	0.	0.
2	1	1	2212	0	0	0.219	-0.487	6.258	6.258	0.93827	0.	0.	0.	0.	0.	0.	0.
3	-1	1	-211	0	0	0.790	0.548	1.866	1.866	0.13957	0.	0.	0.	0.	0.	0.	0.
4	1	1	211	0	0	0.291	0.271	0.155	0.155	0.13957	0.	0.	0.	0.	0.	0.	0.

type (1=active)

parent ID, ID

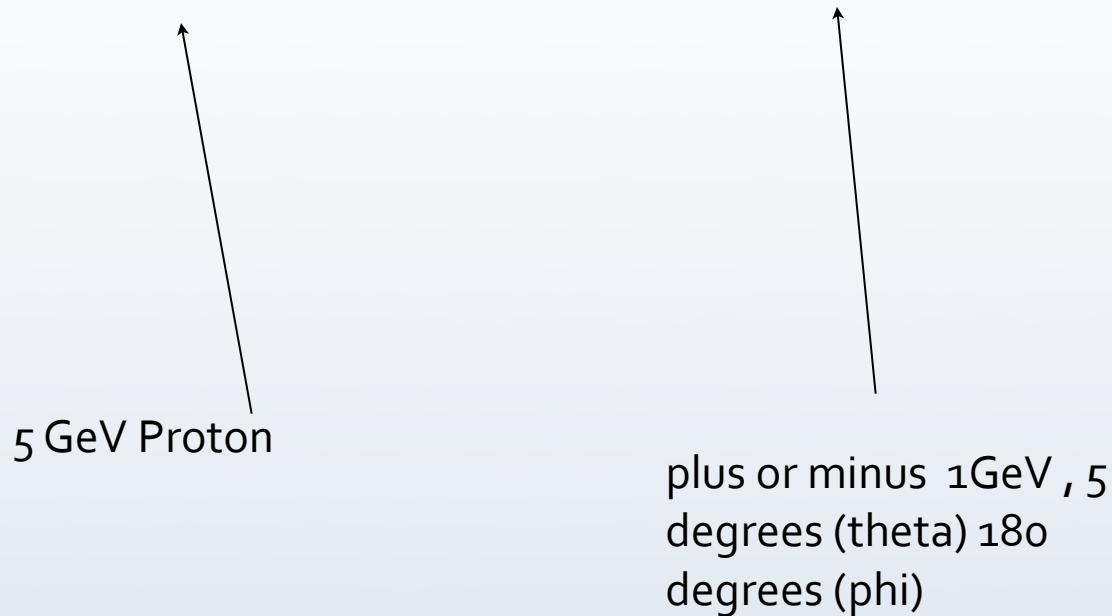
4 momenta, mass, vertex

Full documentation:

[https://gcmc.jlab.org/gcmc/Documentation/Entries/2011/3/18\\_The\\_LUND\\_Format.html](https://gcmc.jlab.org/gcmc/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"
```



# 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" />
```



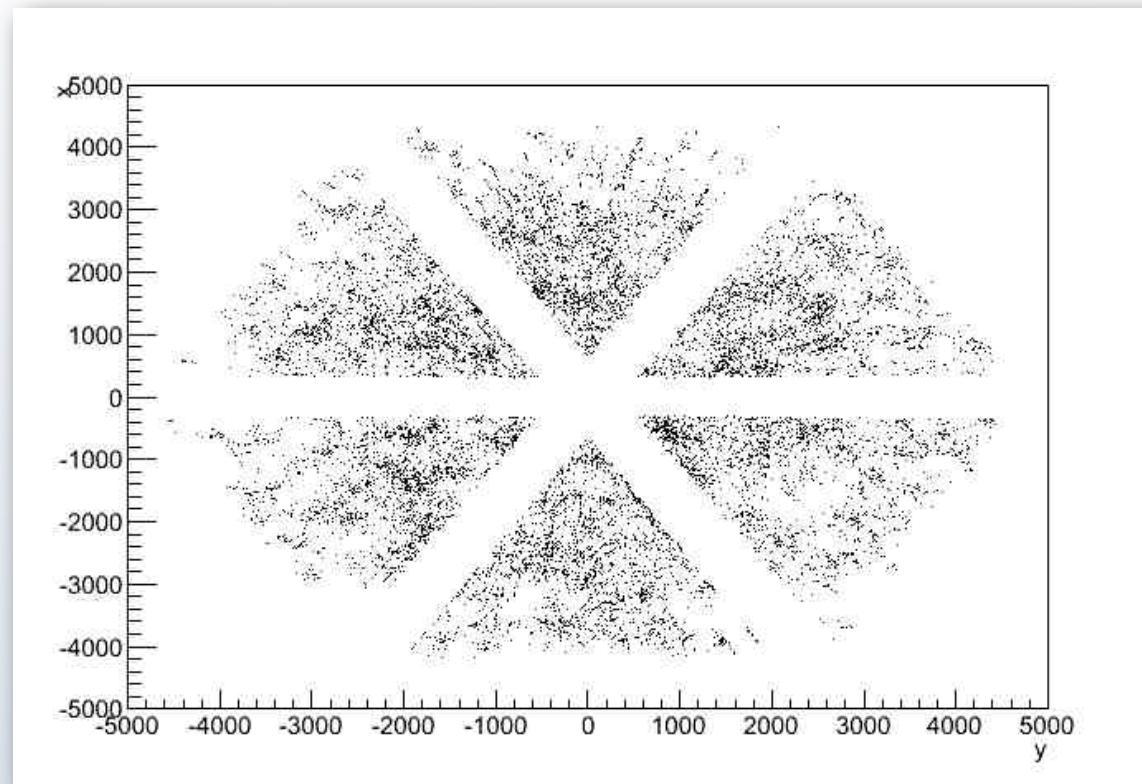
# EVIO Output

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

# ROOT Output

```
gemc_evio2root out.ev out.root
```

```
ecT->Draw("x:y")
```



# Documentation

```
gemc -help
```

## Help Options:

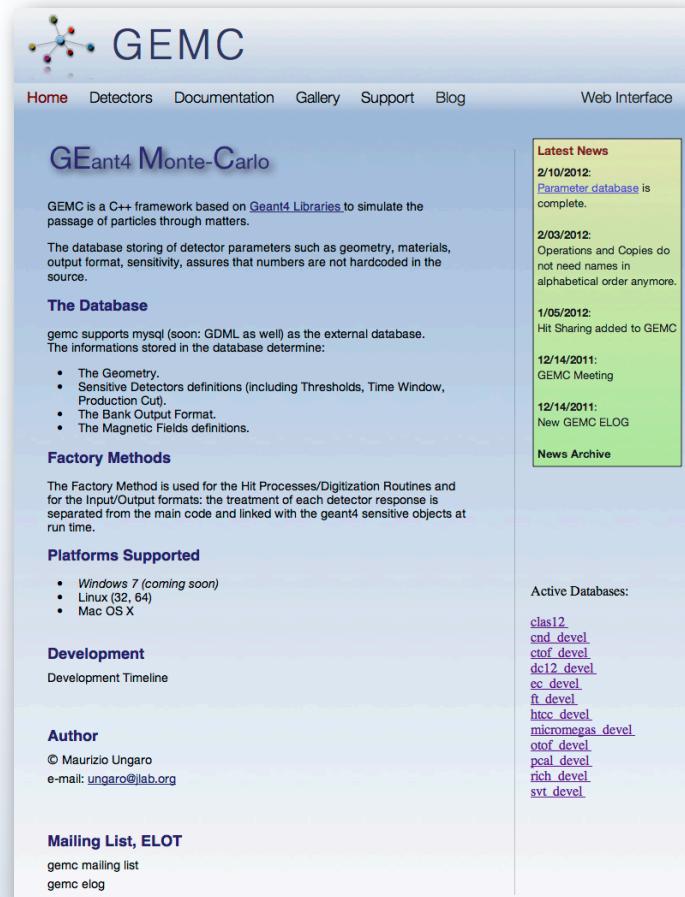
```
> -help-all: all available options.  
  
> -help-control control options.  
> -help-general general options.  
> -help-generator generator options.  
> -help-luminosity luminosity options.  
> -help-mysql mysql options.  
> -help-output output options.  
> -help-physics physics options.  
> -help-verbosity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

[gemc.jlab.org](http://gemc.jlab.org)

Mailing List: [gemc\\_software](mailto:gemc_software)

Bug Report: Mantis

Doxxygen



The screenshot shows the GEMC website homepage. At the top, there's a navigation bar with links for Home, Detectors, Documentation, Gallery, Support, Blog, and Web Interface. A molecular model icon is positioned above the 'Home' link. Below the navigation, the title 'GEant4 Monte-Carlo' is displayed. A brief description states: 'GEMC is a C++ framework based on [Geant4 Libraries](#) to simulate the passage of particles through matters.' A section titled 'The Database' explains that gemc supports mysql (soon: GDML as well) as the external database. It lists several bullet points about geometry, detector definitions, and output formats. Another section, 'Factory Methods', describes how it's used for hit processes and digitization routines. A 'Platforms Supported' section lists Windows 7 (coming soon), Linux (32, 64), and Mac OS X. The 'Development' section links to a development timeline. An 'Author' section credits Maurizio Ungaro with an e-mail address. A 'Mailing List, ELOT' section provides links to the mailing list and ELOT. On the right side, a 'Latest News' sidebar lists recent updates: 'Parameter database is complete.', 'Operations and Copies do not need names in alphabetical order anymore.', 'Hit Sharing added to GEMC', 'GEMC Meeting', and 'New GEMC ELOG'. A 'News Archive' link is also present. A sidebar on the far right lists 'Active Databases' with links to various database components like clas12, cnd-devel, etc.