

# **A GEANT4 Simulation Package for SHMS**

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# Why do we need a Geant4 simulation for SHMS?

- SIMC Monte Carlo is the well known physics simulation tool used by Hall A & C.
  - Specifically designed to study optics and acceptance.
  - Customized physics generators.

# Why do we need a Geant4 simulation for SHMS?

- SIMC Monte Carlo is the well known physics simulation tool used by Hall A & C.
  - Specifically designed to study optics and acceptance.
  - Customized physics generators.
- What about diagnostic studies of the setup ?
  - SIMC is not designed for diagnostic studies.  
e.g. heat deposition on the bender magnet due to fringe fields.
  - Needed a new simulation tool → shms\_geant.

# SHMS\_GEANT : overview

- A basic simulation package based on Geant 4.9.6
  - C++ object oriented programming
- Physics list simulation engine: QGSP\_BERT\_HP 3.0
- Primary event generator shoots electrons randomly into a 2mmx2mm region in the XY plane of the target.
- Geometry information are read in via GDML
- Sensitive detectors collects hit location and energy deposition information.
- Magnetic field read in from tables generated by TOSCA.
- Outputs are stored in ROOT ntuples and histograms.

# SHMS\_GEANT : overview

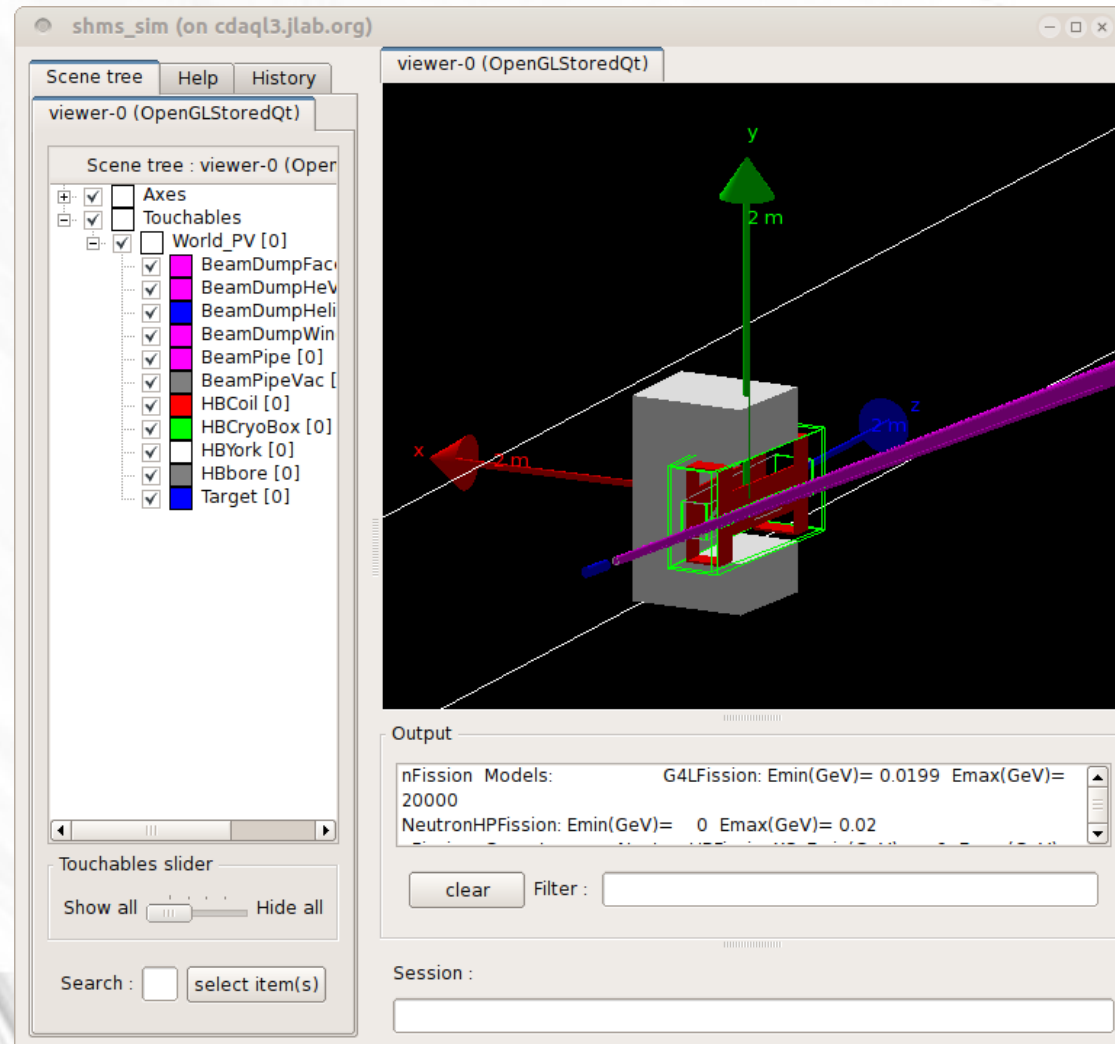
- To run the simulation
  - Compile the code
  - If not given, write a GDML file for the geometry
    - Declare sensitive detectors.  
e.g. in shms\_geom.gdml the HBCoil is declared as a sensitive detector

```
..  
..  
<structure>  
    <volume name="HBCoilLogic">  
        <materialref ref="Copper"/>  
        <solidref ref="hbCoils"/>  
        <auxiliary auxtype="SensDet"  
auxvalue="HBCoil"/>  
    </volume>  
..
```

# SHMS\_GEANT : overview

- Run the program using  
`./shms_geant <gdml file>`
- Default setup allows interactive mode visualization using OpenGL and Qt.
- Set beam energy and magnetic field (on/off)
- Run simulation
- Output will be saved as  
`[gdml file]_ntuples.root`

e.g. `./shms_geant shms_geom`

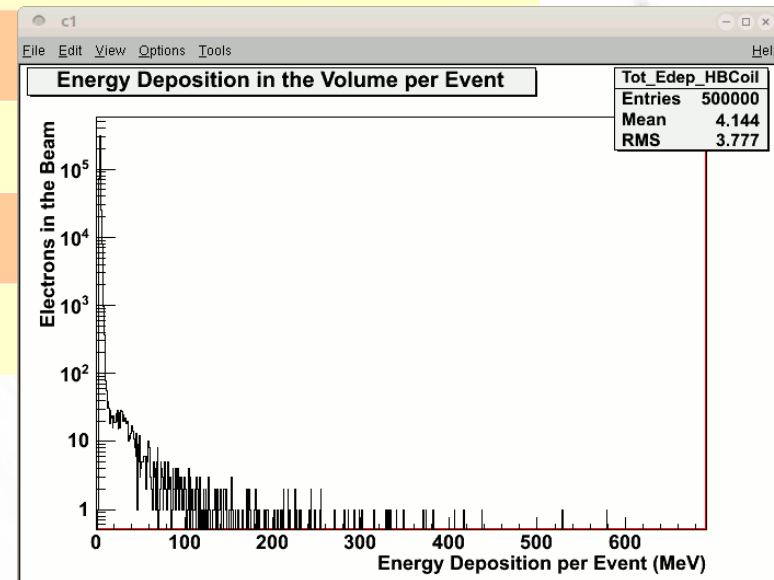
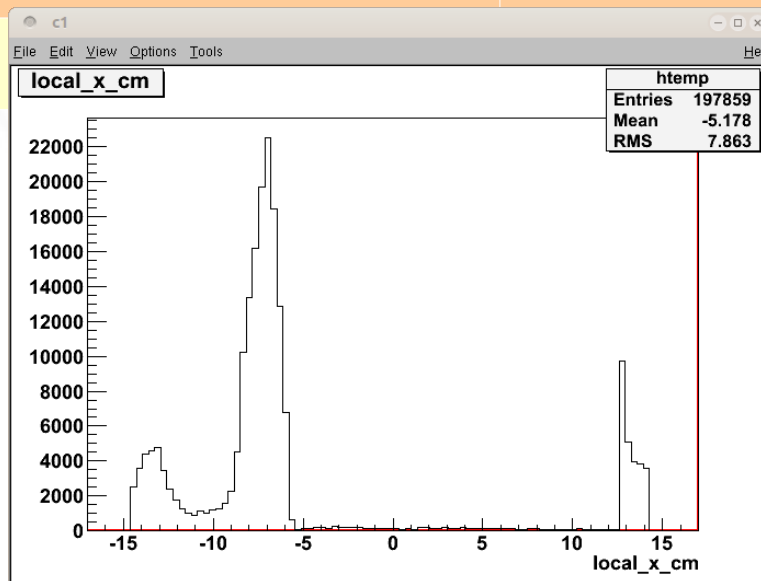




# SHMS\_GEANT : output

- Sensitive detectors measure and store:

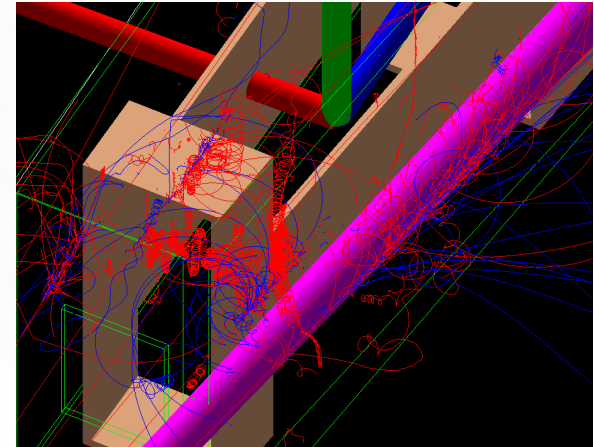
NTUPLES (step based)	HISTOGRAMS (event based)
Local hit location x,y,z (cm)	Energy deposition (MeV)
Energy deposition (MeV)	
Vertex energy (MeV)	
Kinetic energy (MeV)	
Particle ID	
Parent ID	



# SHMS\_GEANT : Summary

A geant simulation package

- designed for diagnostic studies.
- basic framework is complete.
- customizable for other projects.



- Currently, the primary function is to get energy deposition and hit location in sensitive detectors
  - Can be modified to access other track information
- Source code can be downloaded from the hallcgit repository  
[https://hallcweb.jlab.org/git/?p=buddhini/shms\\_geant.git;a=summary](https://hallcweb.jlab.org/git/?p=buddhini/shms_geant.git;a=summary)
- More information can be found in Hall C 12 GeV software wiki  
[https://hallcweb.jlab.org/wiki/index.php/SHMS\\_GEANT4\\_Simulations](https://hallcweb.jlab.org/wiki/index.php/SHMS_GEANT4_Simulations)