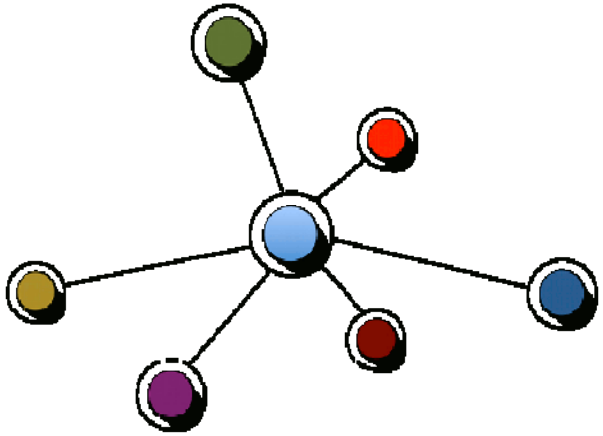


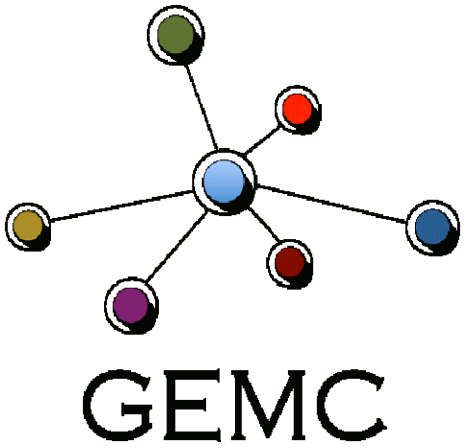
GEMC Overview

Status, Future of GEMC

Maurizio Ungaro

GEMC (GEant4 MonteCarlo)

gemc is a C++ program that simulates particles through matter using the geant4 libraries.



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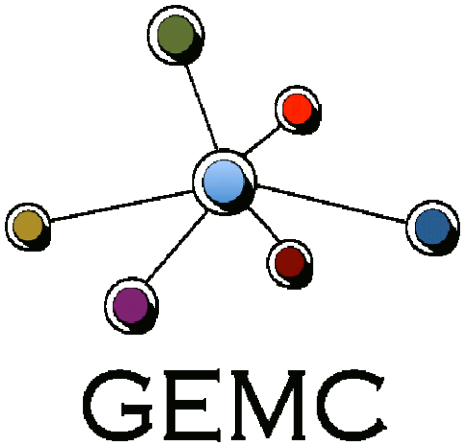

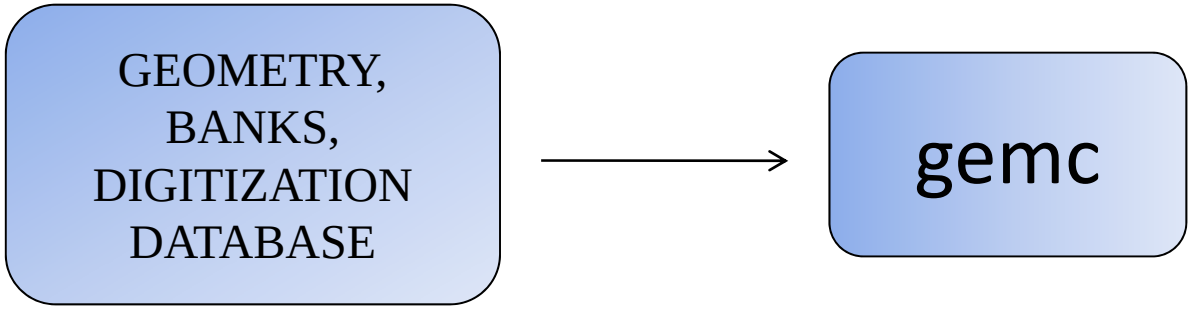

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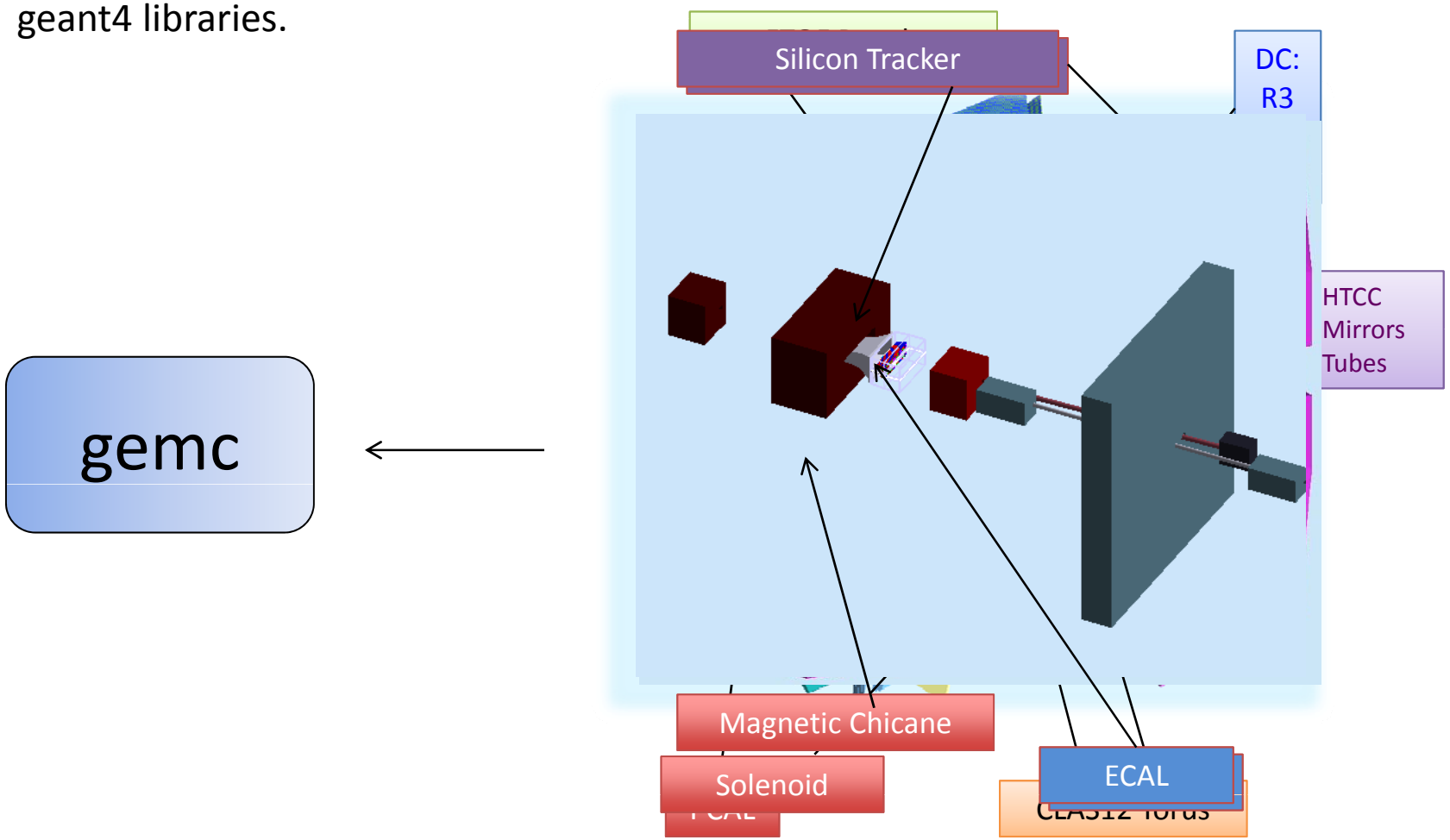


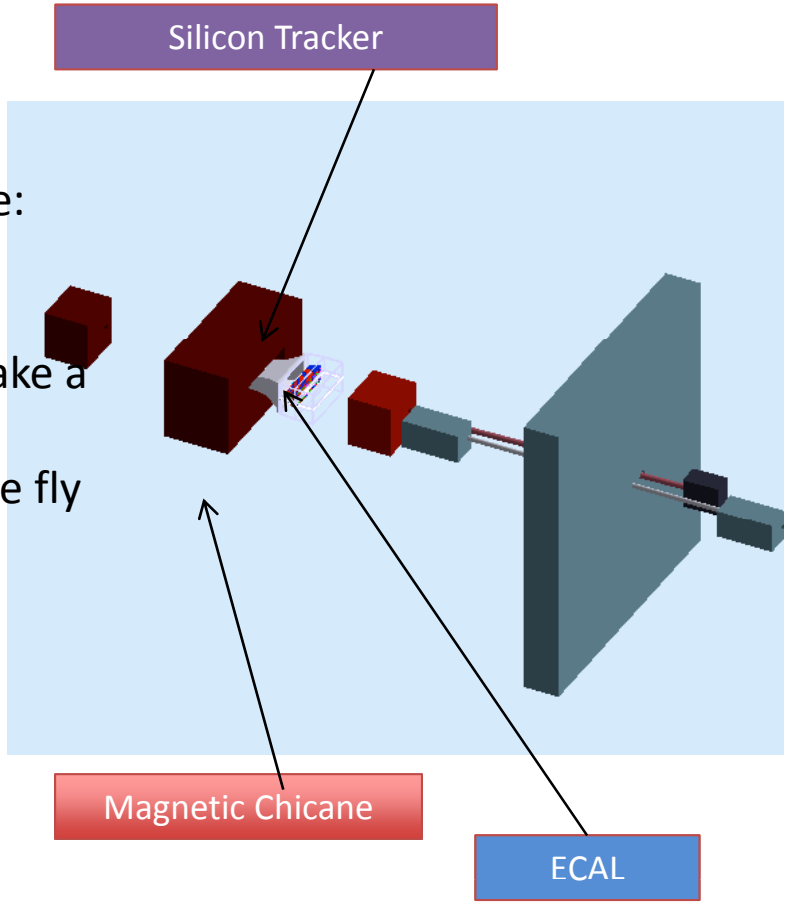
GEMC (GEant4 MonteCarlo)

Advantages:

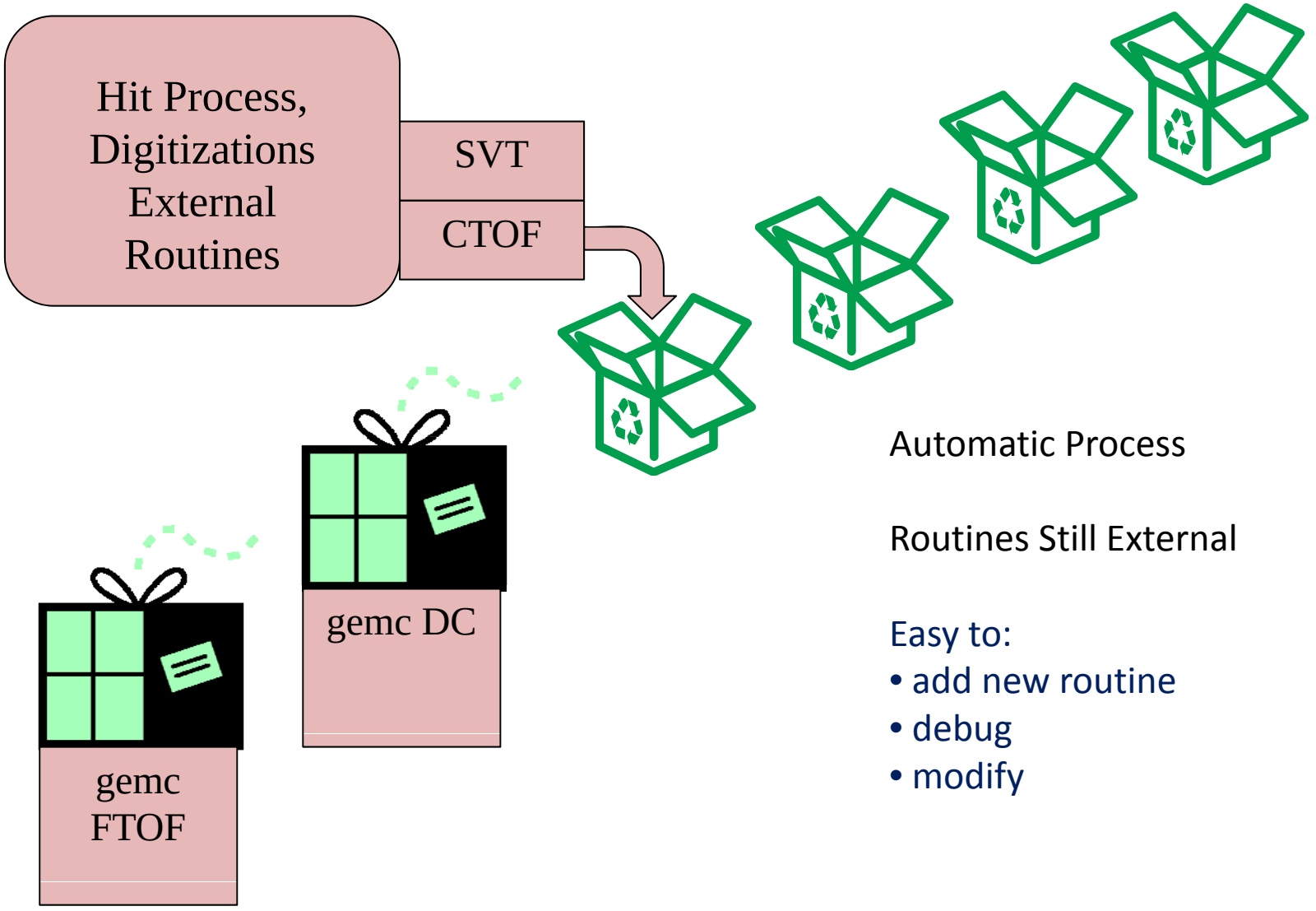
User:
• Change parameters w/o touching the code: very fast R/D and deployment
•Abstract Objects instantiated thousands of times ~~ensures they are~~ "correct": "can't" make a mistake
• Can make "alignment, ~~kinematic fit~~" on the fly (tilts, shifts)
• No need to know C++ or Geant4

gemc

Development:
• Easy to debug (table → reproducibility)
• Can concentrate on "core" code.



Factory Method for Hit Processes



Automatic Process

Routines Still External

Easy to:
- add new routine
- debug
- modify

Output (factory)

TXT output:

-OUTPUT="txt, data.txt"

EVIO OUTPUT:

-OUTPUT="evio, data.ev"

Event Generation

1) With gemc internal generator
2) LUND Format for physics events:

```
8 34406 0  0.  0.  0.  0.  0.  0.  0.
      1  0  1    2212   0   0     0.000    0.000    0.000    0.938    0.938    0.000    0.000    0.000
      2  0  1      11   0   0     0.401   -0.605    5.517    5.565    0.001    0.000    0.000    0.000
      3  0  1     211   0   0    -0.305    0.296    3.417    3.446    0.140    0.000    0.000    0.000
      4  0  1    2112   0   0    -0.379   -0.062    1.627    1.918    0.940    0.000    0.000    0.000
      5  0  1    -211   0   0    -0.015    0.114    0.098    0.205    0.140    0.000    0.000    0.000
      6  0  1     211   0   0     0.137    0.406    0.306    0.545    0.140    0.000    0.000    0.000
      7  0  1      22   0   0     0.162   -0.070    0.041    0.181    0.000    0.000    0.000    0.000
      8  0  1      22   0   0    -0.001   -0.078   -0.006    0.079    0.000    0.000    0.000    0.000
9 34407 0  0.  0.  0.  0.  0.  0.  0.
      1  0  1    2212   0   0     0.000    0.000    0.000    0.938    0.938    0.000    0.000    0.000
      2  0  1      11   0   0     0.340    0.384    2.811    2.857    0.001    0.000    0.000    0.000
      3  0  1    -211   0   0    -0.114    0.357    3.700    3.721    0.140    0.000    0.000    0.000
      4  0  1    2212   0   0    -0.002   -0.776    1.742    2.126    0.938    0.000    0.000    0.000
      5  0  1     211   0   0     0.336   -0.200    0.941    1.029    0.140    0.000    0.000    0.000
      6  0  1      22   0   0    -0.141    0.107    0.033    0.180    0.000    0.000    0.000    0.000
      7  0  1      22   0   0    -0.044    0.118   -0.067    0.143    0.000    0.000    0.000    0.000
      8  0  1      22   0   0    -0.150    0.021    0.455    0.480    0.000    0.000    0.000    0.000
      9  0  1      22   0   0    -0.225   -0.010    1.384    1.402    0.000    0.000    0.000    0.000
```

To all these “primary” particles, a luminosity beam can be added

Luminosity Beam

- Number of Beam Particle / One single Event
- Time Window of the event
- Time Structure of the Event: “bunches” time separation

60000 electrons / event
1 event = 120 nanoseconds
Bunches every 2 nanoseconds (60 bunches, 500 electron each bunch)
Physics event generated in the middle (60 ns)

Physics Processes Databases

LHEP Physics Lists

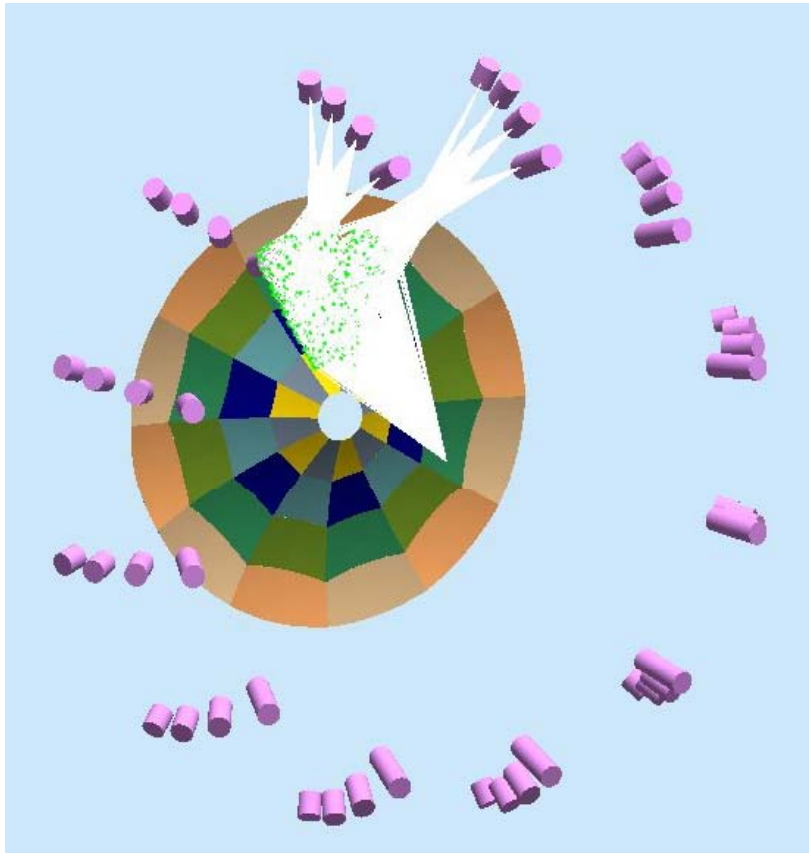
The LHEP Physics lists are based on a parameterized modeling for all hadronic interactions for all particles. Based on Geisha model.
Example:
LHEP_BERT (Bertini Cascade)

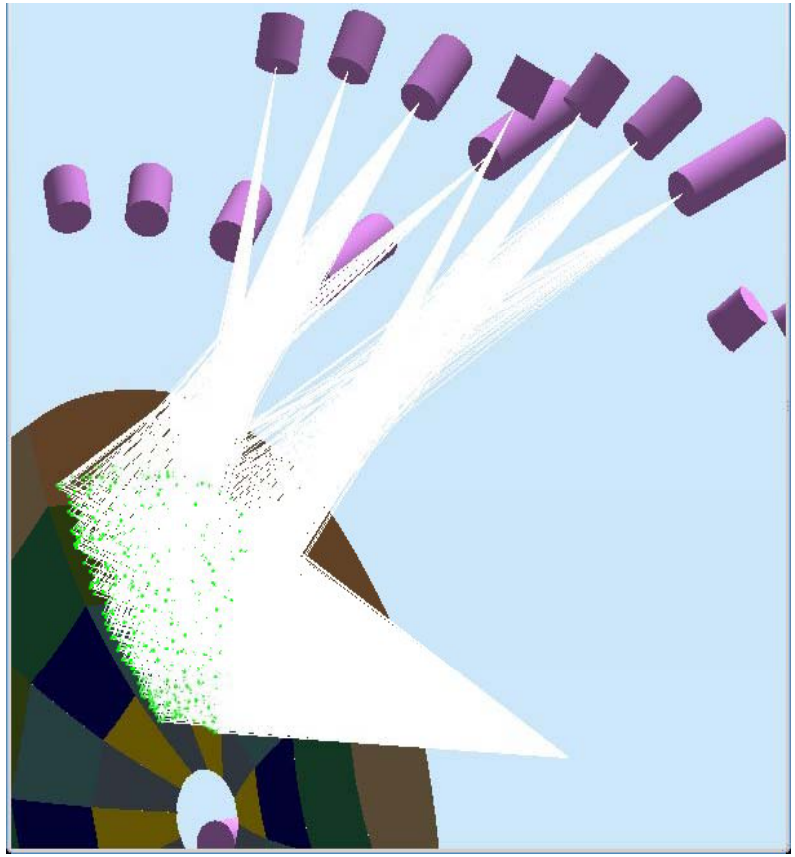
String model based physics lists

These Physics lists apply a string models for the modeling of interactions of high energy hadrons, i.e. for protons, neutrons, pions and Kaons above ~(5-25) GeV. Examples:

QGSP: quark gluon string model
QGSC: CHIPS modeling for the nuclear de-excitation
QGSC_BERT: Bertini cascade for primary protons, neutrons, pions and Kaons below ~10GeV. (recommended for CLAS12)

Optical Processes in GEMC





Physics Processes Databases

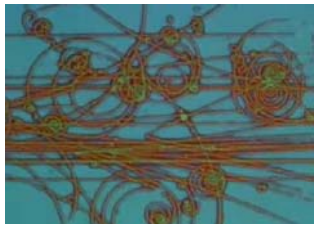
Future: factory process

Model the physics processes in the external database:

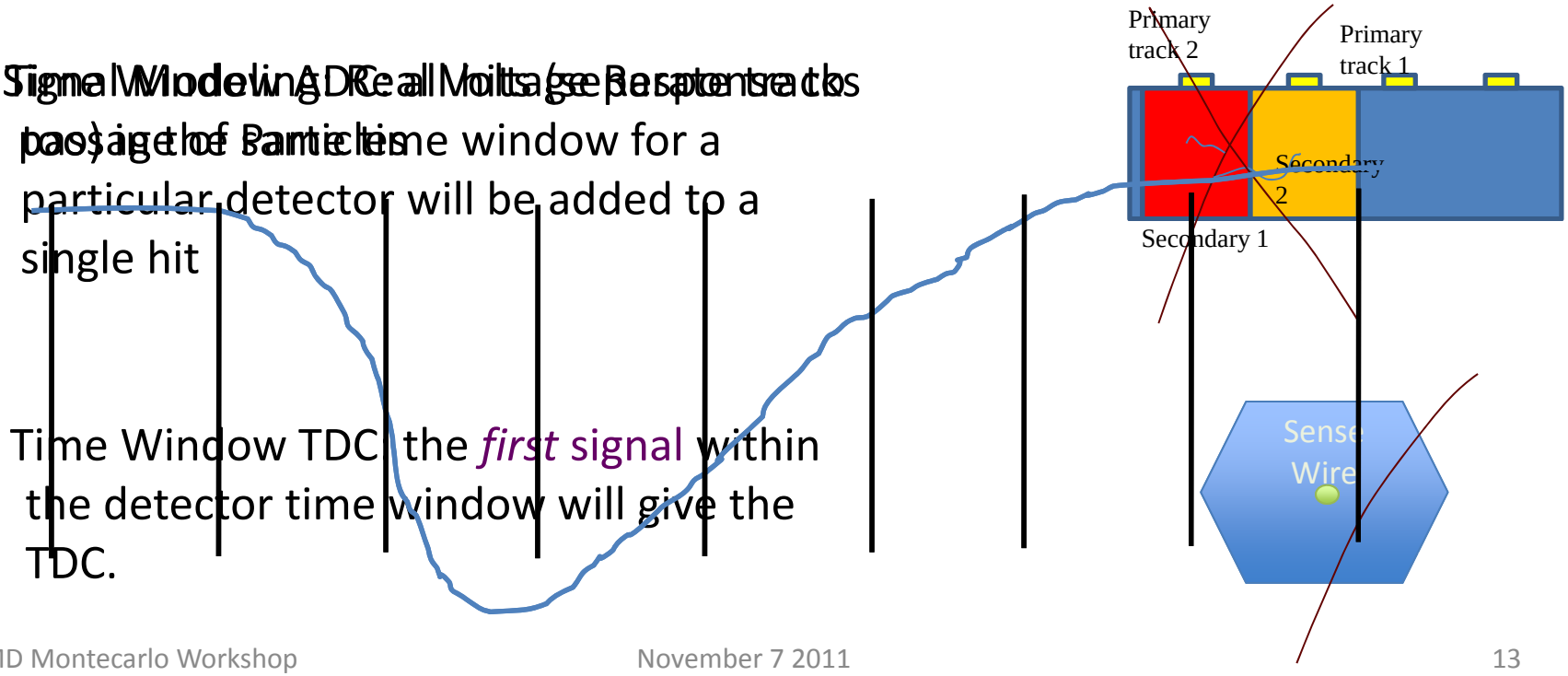
- Can turn on/off single processes for all/individual particles
  (very useful for eg5 comparison and debugging in general)
- Can modify energy range of applicability of processes
  (e.g. Bertini cascade model, Low energy parameterization, etc)

Hit Types Databases

1) “FLUX” type: every track has its own hit. Good for counting purposes (i.e. how many protons pass through a detector, etc)



2) Time Window ADC: all voltage perturbations passing the Particle time window for a particular detector will be added to a single hit



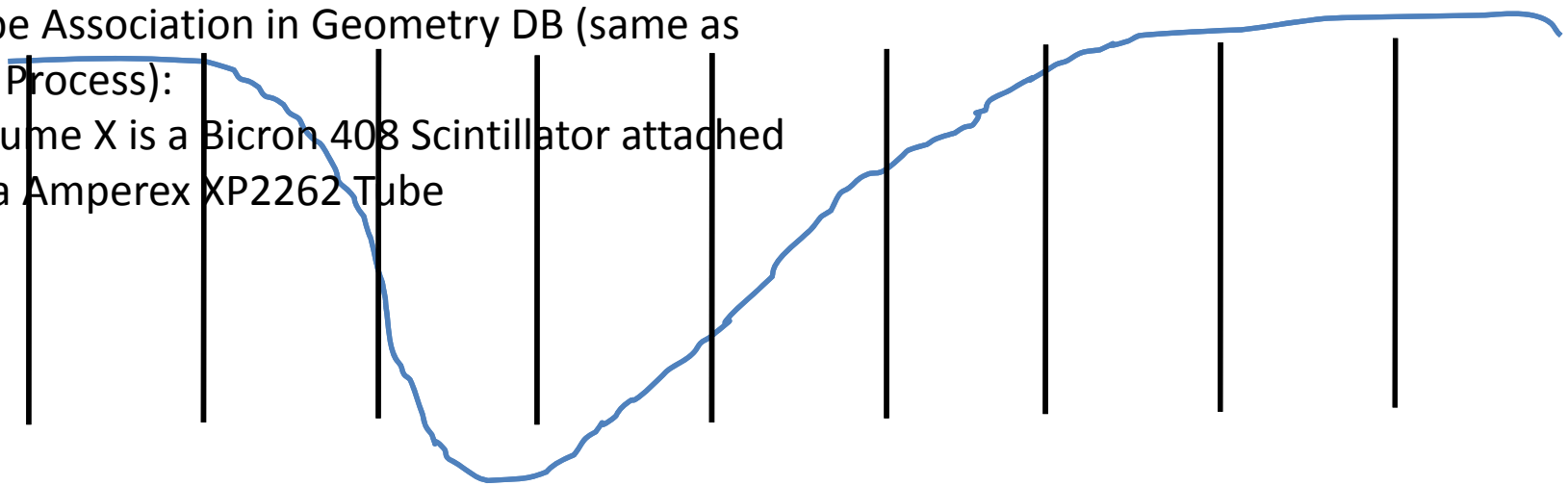
3) Time Window TDC: the *first* signal within the detector time window will give the TDC.

Hit Types Databases

Signal Modeling Parameterization:

Each Scintillator, Tube, etc, modeled by a few parameters in DB

Tube Association in Geometry DB (same as Hit Process):
Volume X is a Bicron 408 Scintillator attached to a Amperex XP2262 Tube



Geometry Database

Extension to GDML input
(output is supported thanks to Maurik)
Hall-D extension?
LCSIM extension?

Materials Database

Future: Factory Method

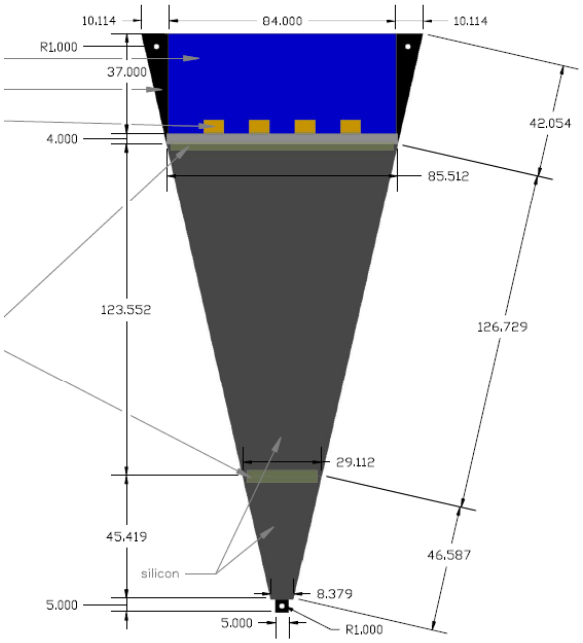
Materials will be defined in DB
GDML Extension

(last hurdle to complete the code-writing independence)

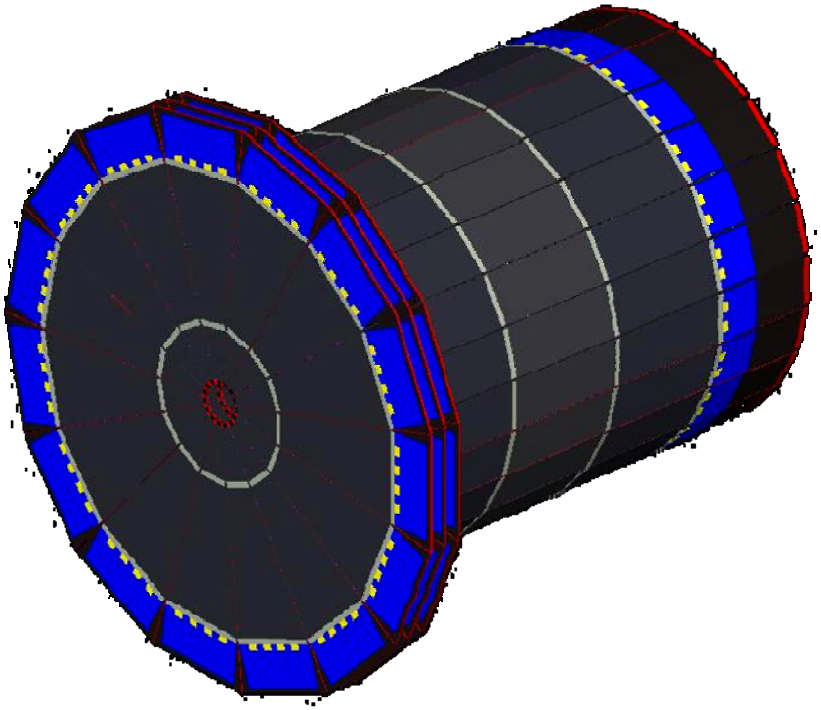
Geometry Overview

Geometry: FST Implementation

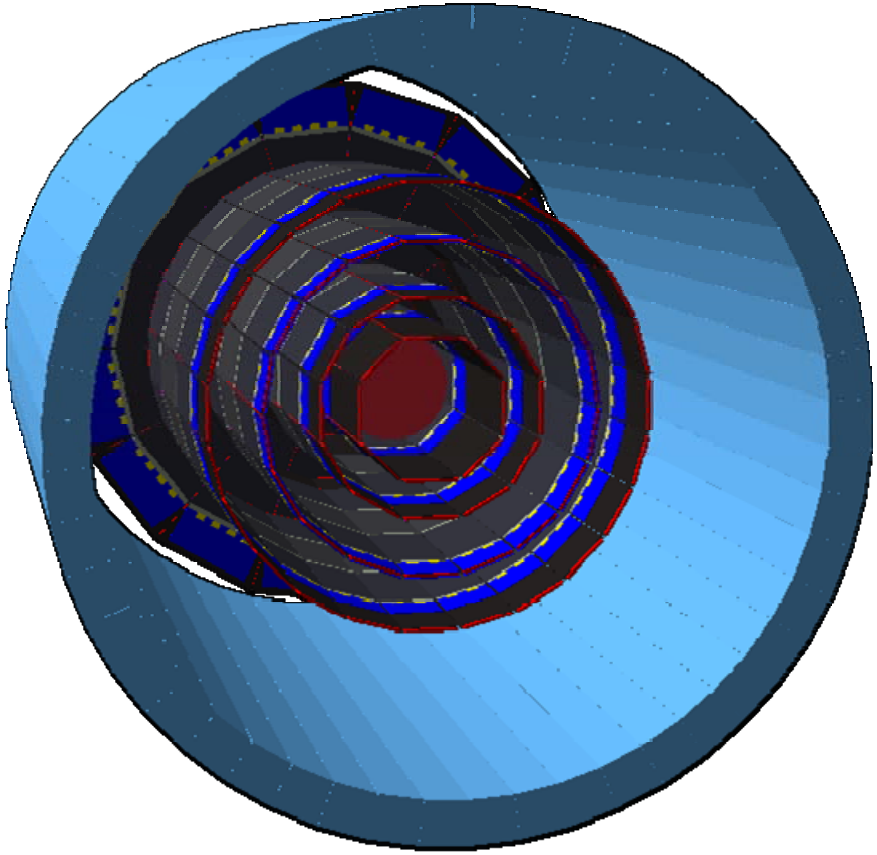
Engineering Design



Geant4 Implementation



Geometry: CTOF

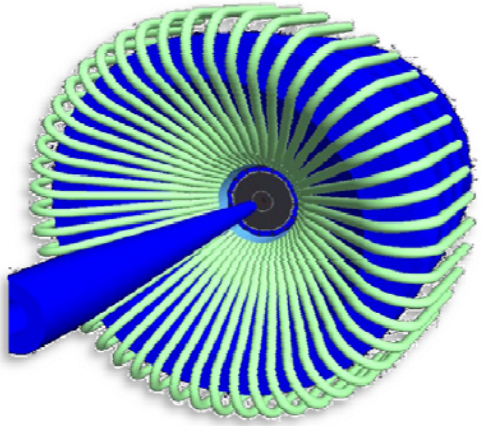


50 Trapezoidal Paddles

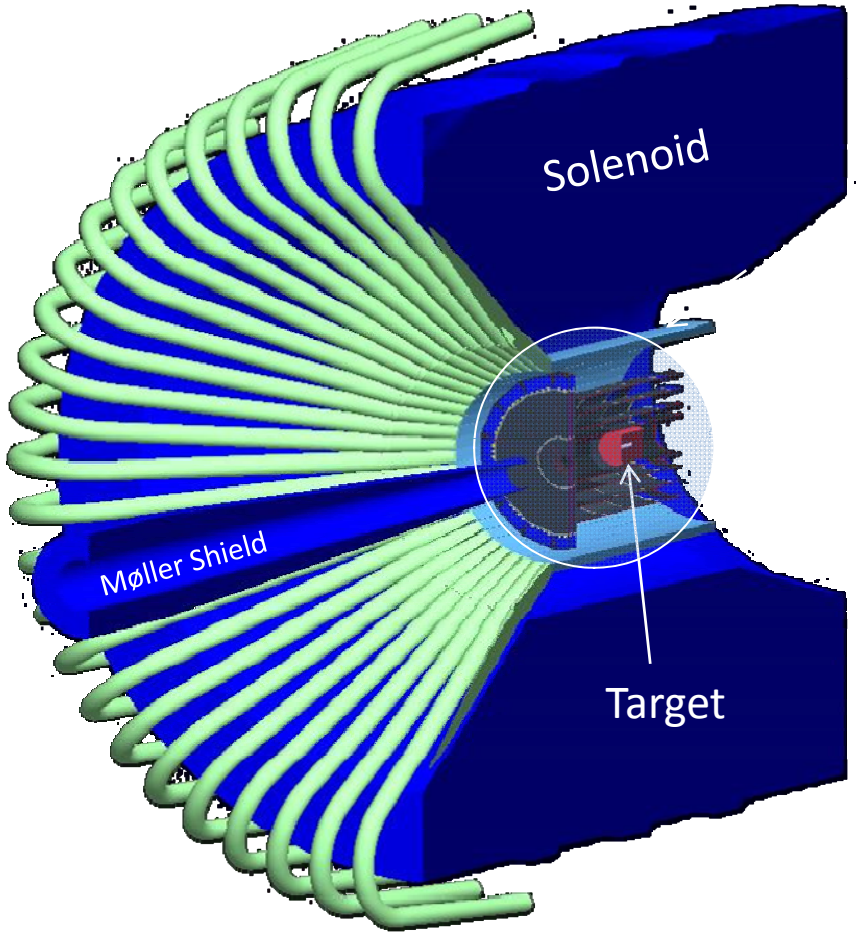
Thickness: 1.24’’

Geometry Parameters:
Same as designers

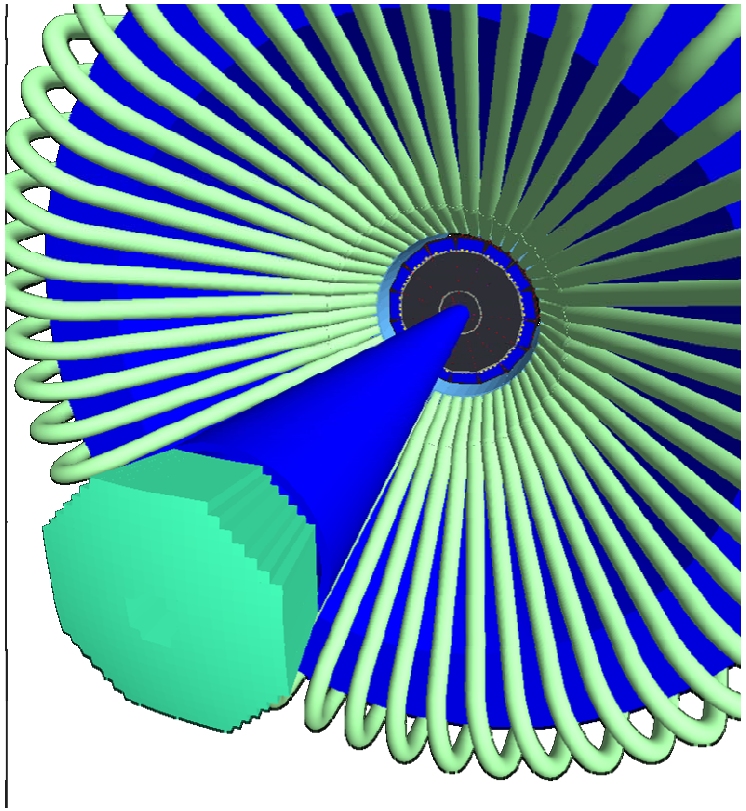
Geometry: Central Detector

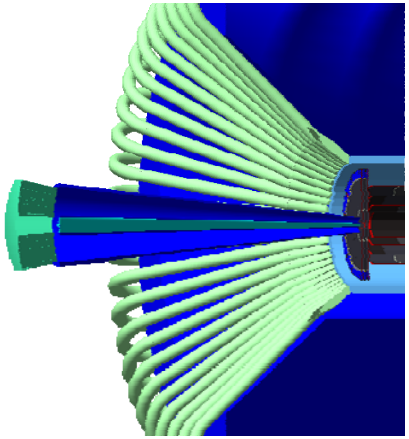


SVT
CTOF
Light Guides
Solenoid
Møller Shield



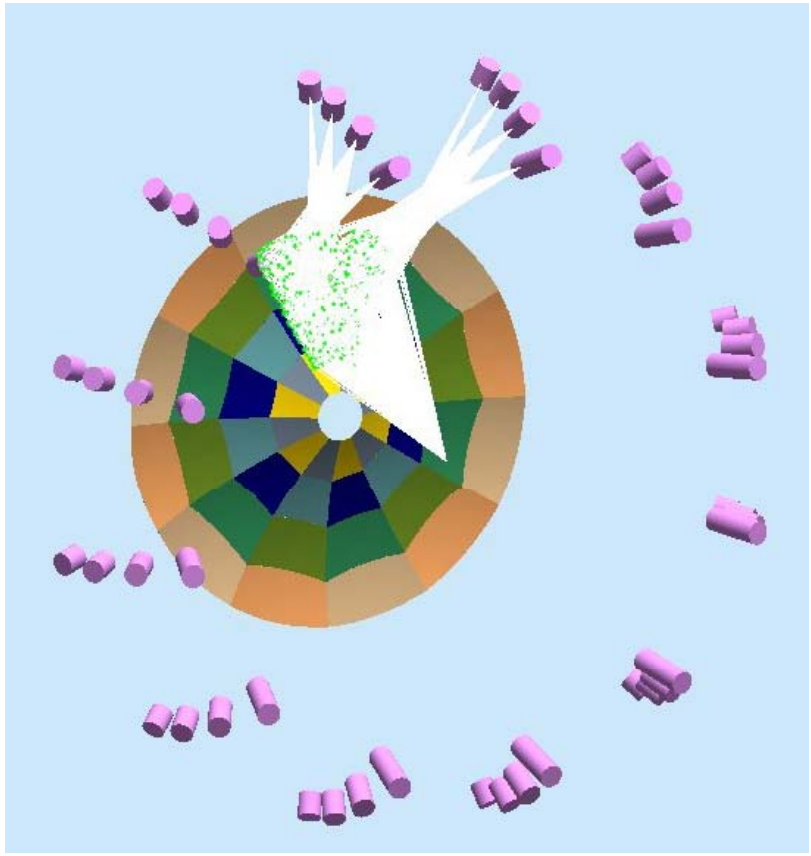
Geometry: FT Configuration

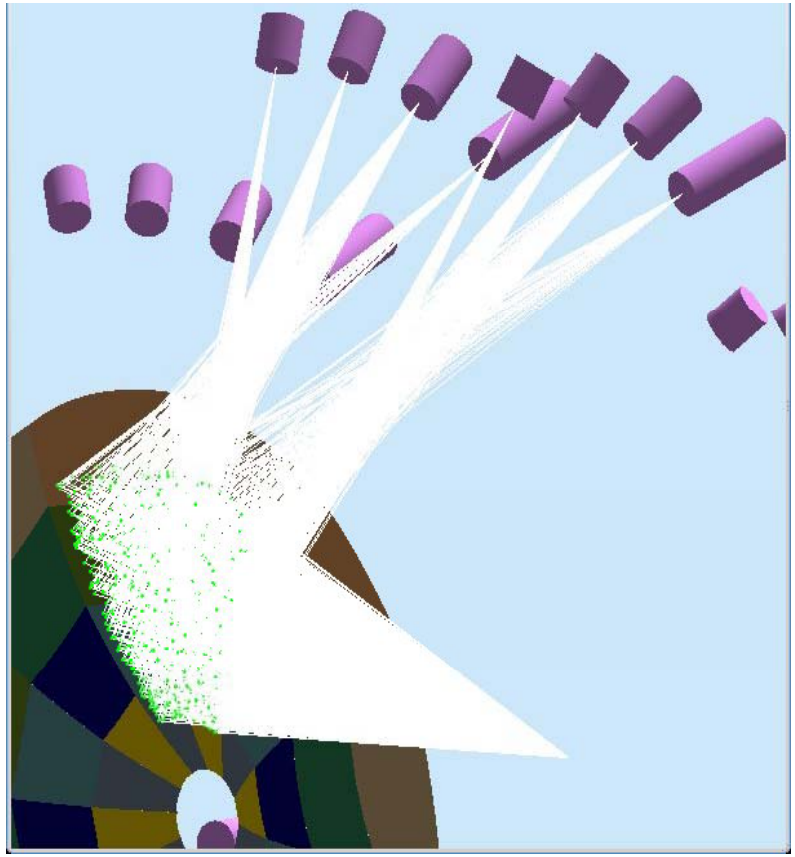




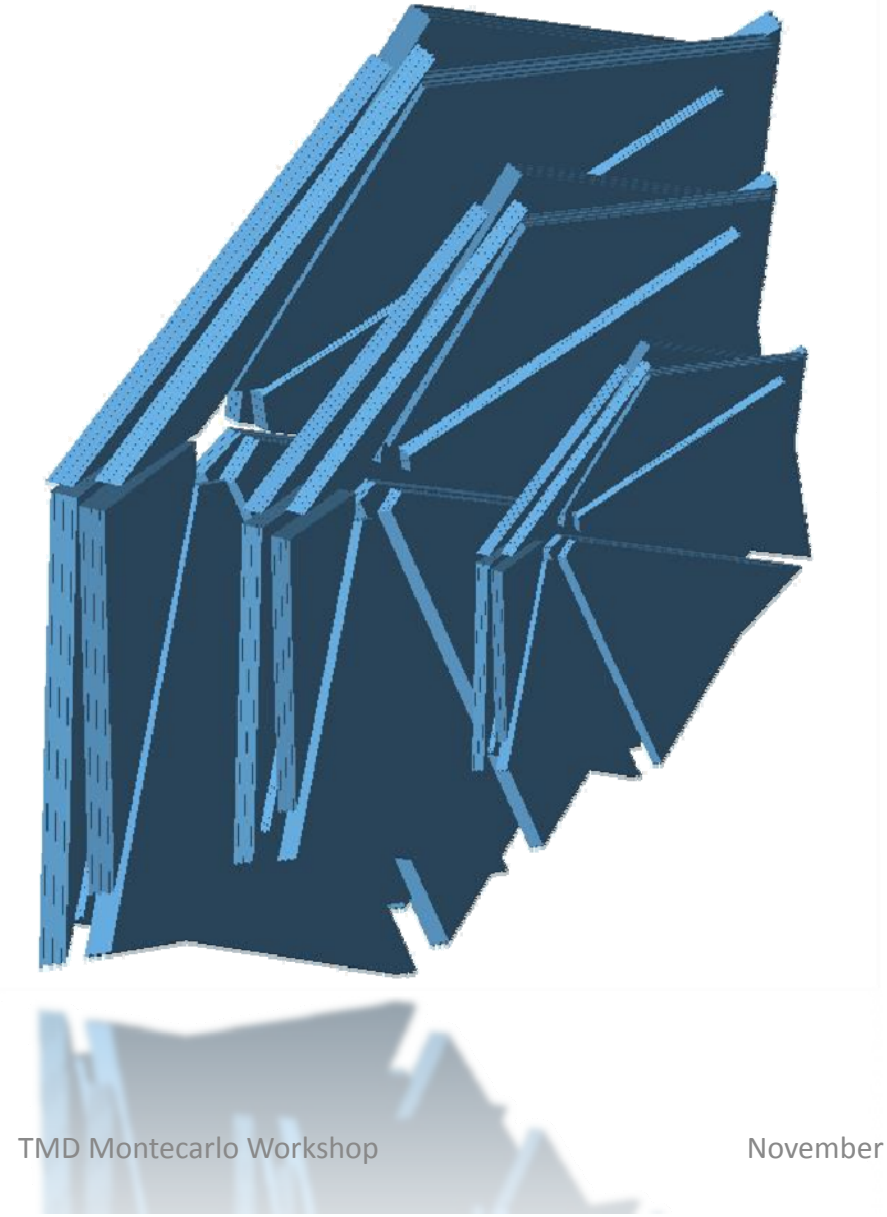
1.5 and 5.5 deg
shields
allow DVCS
gammas into IC
(optimization in progress)

HTCC in GEMC





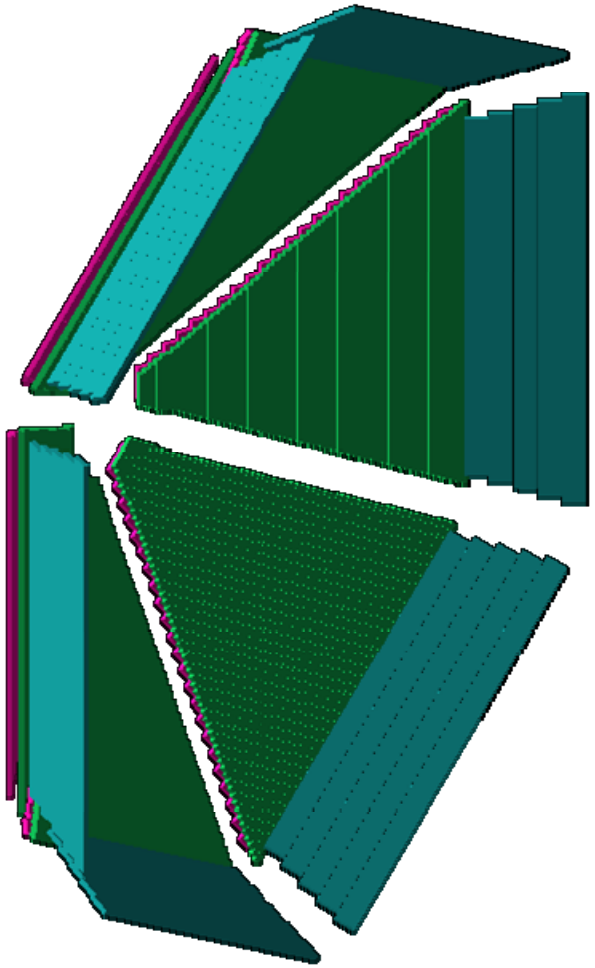
Geometry: DC

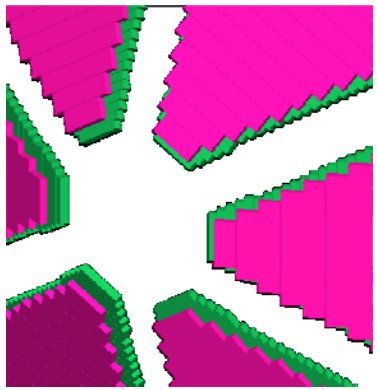


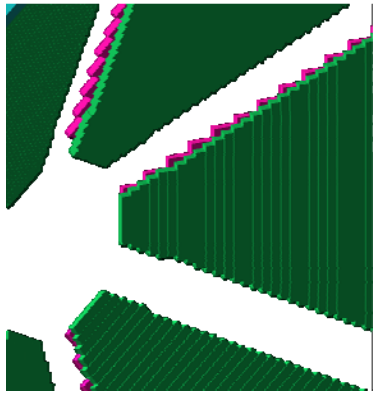
3 Regions
2 SuperLayers per Region
6 Layers per SuperLayer

Geometry Parameters:
same as designers

Geometry: FTOF







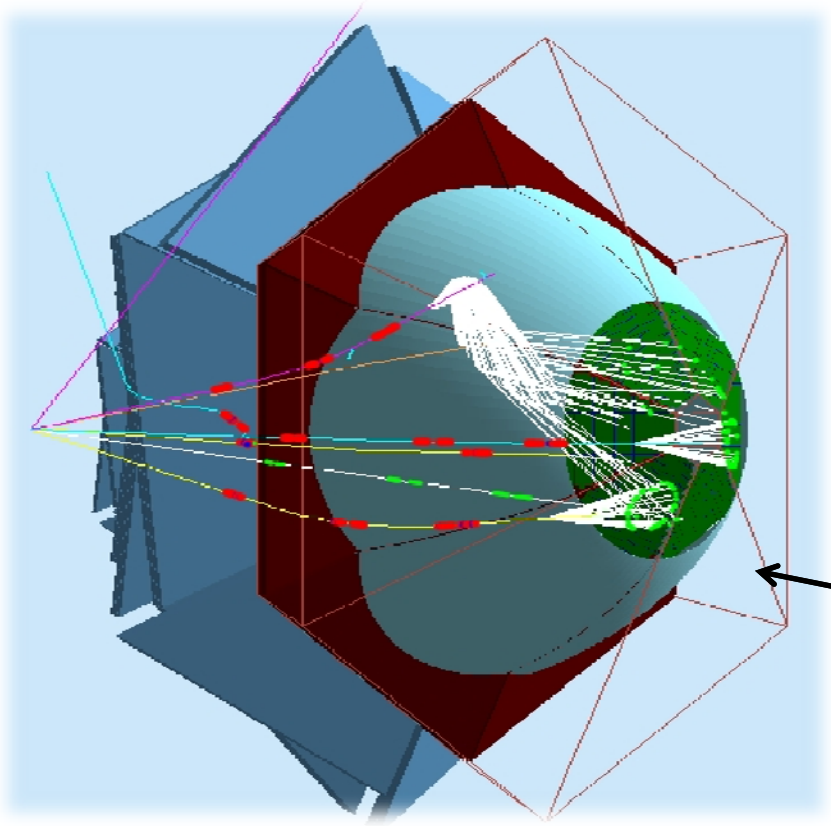
Panel 1a:
23 paddles

Panel 1B:
58 paddles

Panel 2B:
5 paddles

RICH for CLAS12

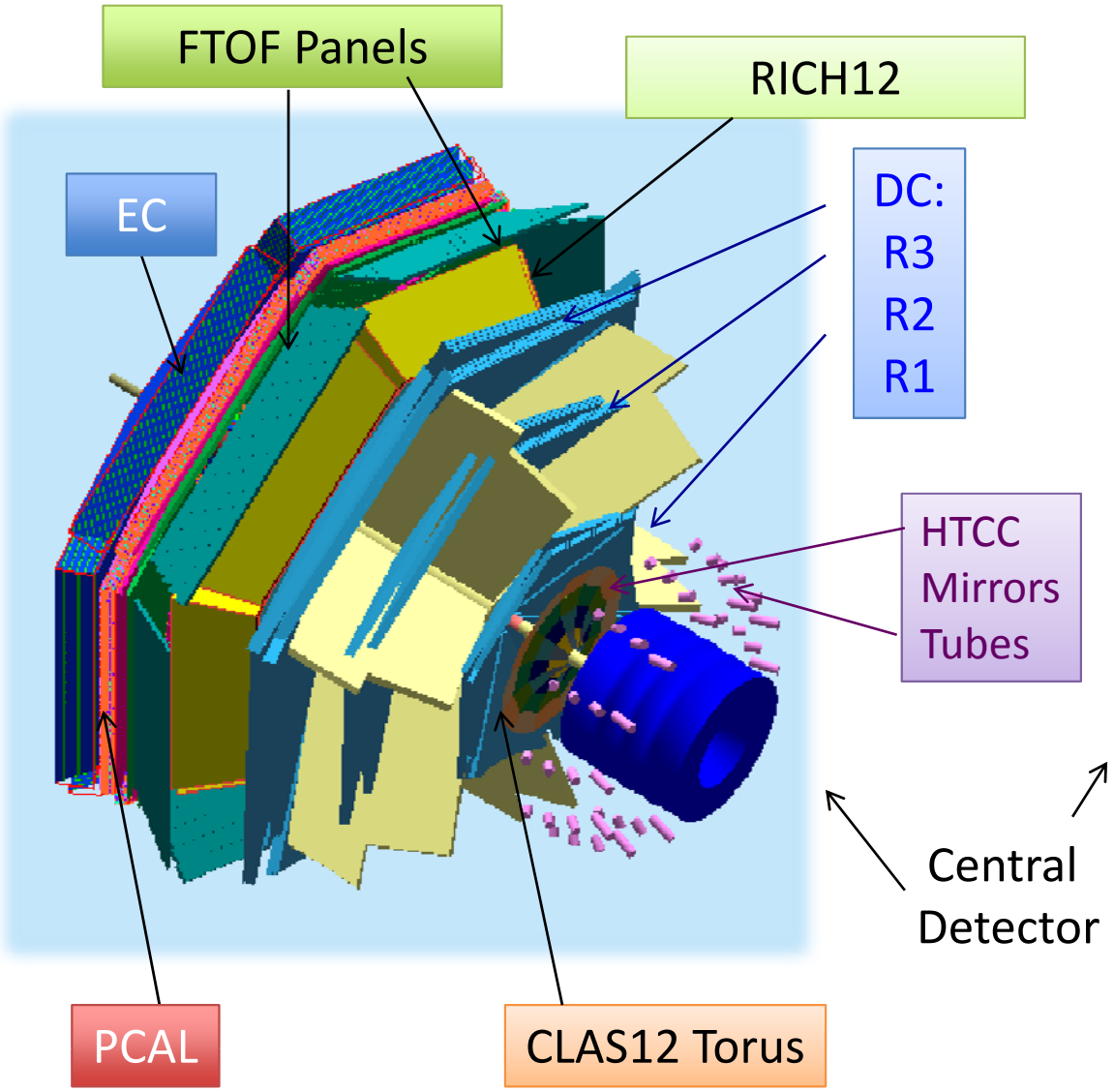
RICH Detector

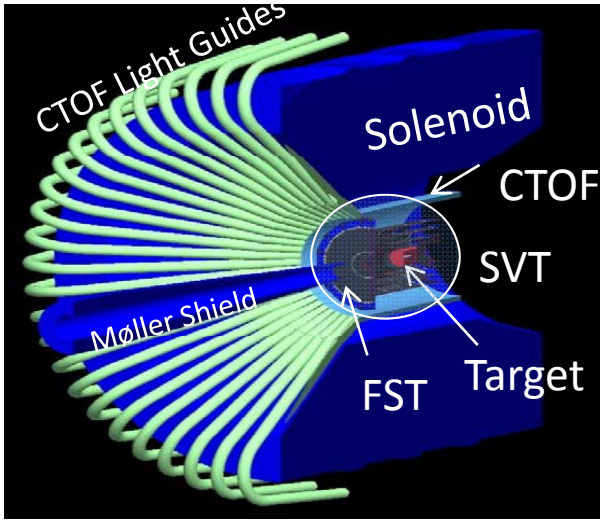


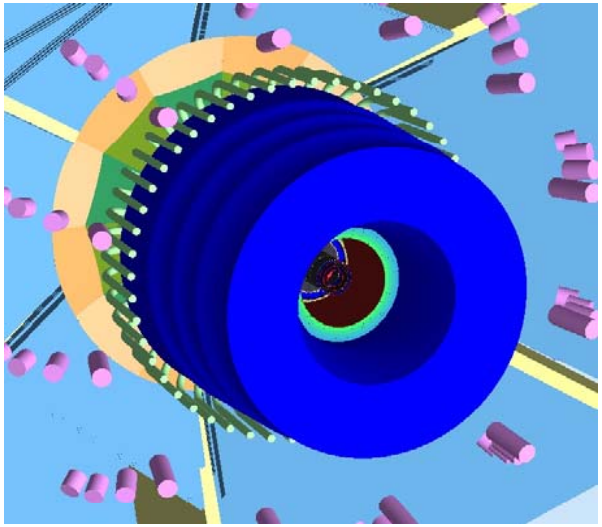
Rossi Patrizia, Osipenko Mikhail, Nathan Harrison, Pappalardo Luciano, Cisbani Evaristo, Contalbrigo Marco, Alaoui Ahmed, Maurizio Ungaro, De Leo Raffaele, Hafidi Kawtar

Pions, kaons producing rings directly on PMTs, or reflected by mirrors

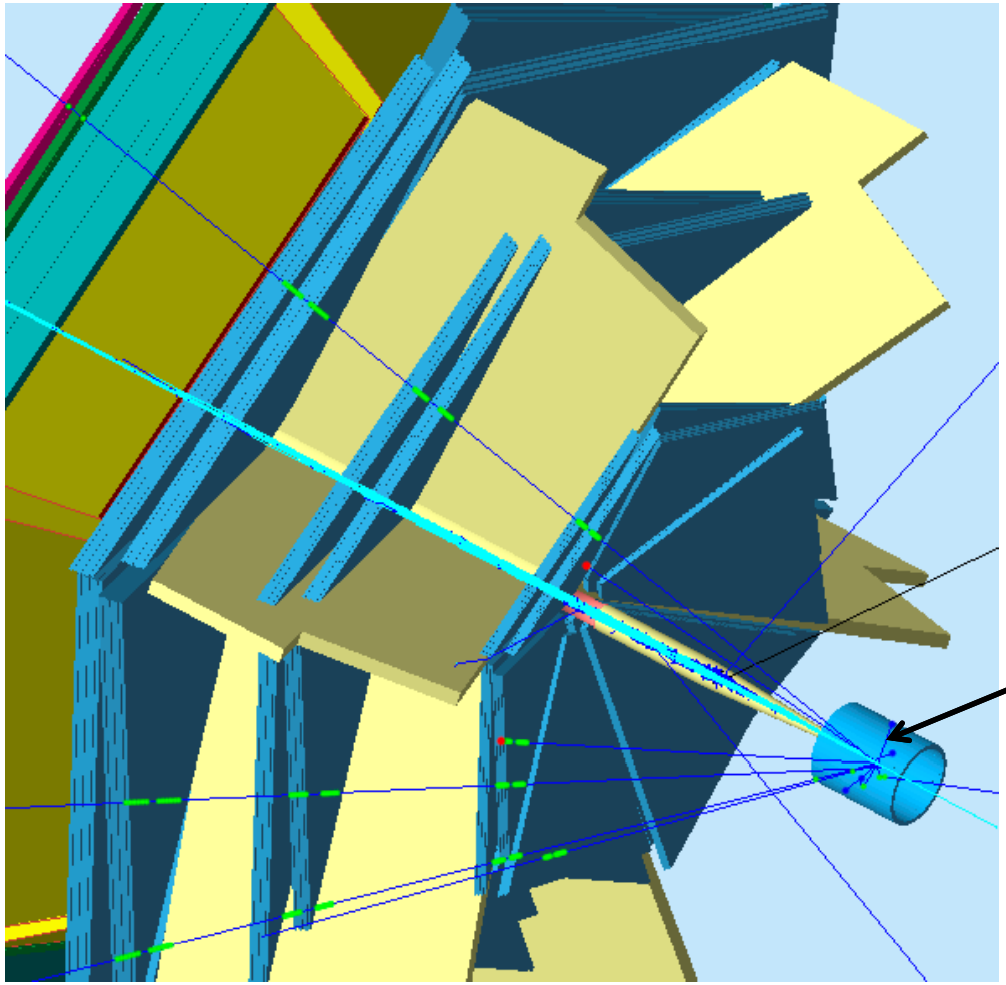
CLAS12 Geometry







Background Studies



10^{35} Luminosity
5 cm LH2 Target
4.7 10^{11} e-/s

120K e- (250ns Window)

2K e-

Magnetic Fields

Definitions in DB
Association to volume by name
Map based

Currently:

Torus
Solenoid
Transverse Polarized Target
Dipoles (Frascati Magnets, Pair Spectrometer)

Summary: gemc.jlab.org