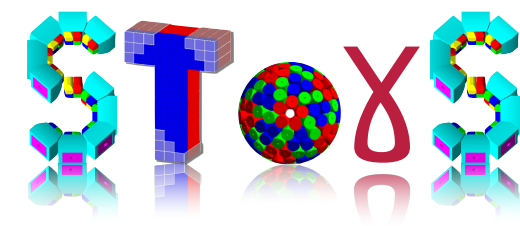


Simulation Toolkit for γ -ray Spectrometry

0. Stezowski, C. Ducoin, I. Companis

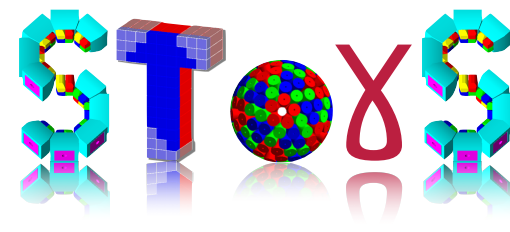


Outlines

SToGS
Objectives

SToGS
Configuration

Conclusions/
Challenges



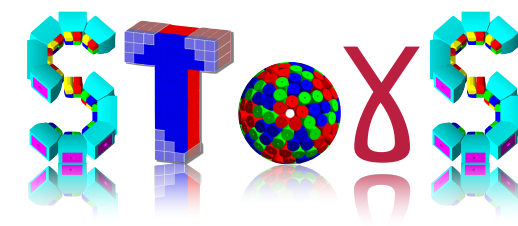
Objectives

1. Modular
2. Versatile
3. Flexible
4. Extensible

- ♦ design and study of response functions of new detectors

- ♦ prepare experiments with realistic simulations and analysis

- ♦ supply and improve physics generators



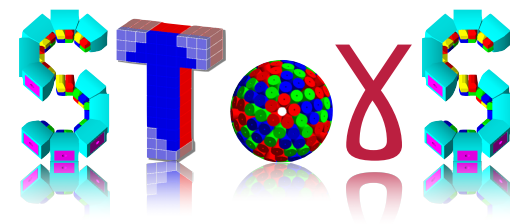
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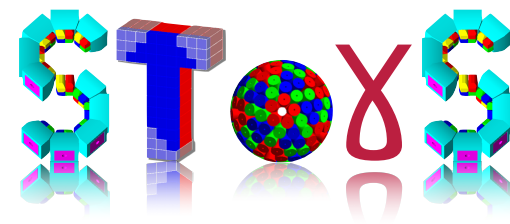
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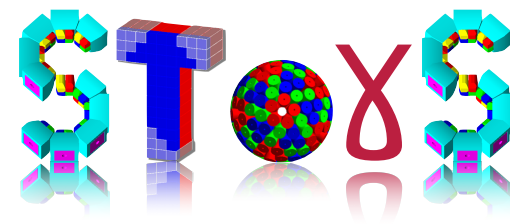
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The idea of SToGS

Inherited from PARIS Geant4 package



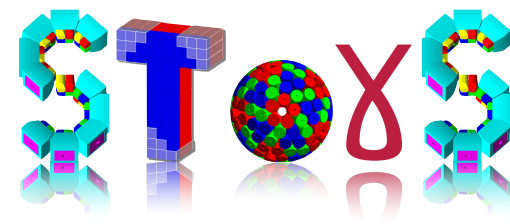
modified/ new elements added



Geant4.10 using Multi-threading

<https://twiki.cern.ch/twiki/bin/view/Geant4/QuickMigrationGuideForGeant4V10>

and previously Geant4.9 versions



The idea of SToGS

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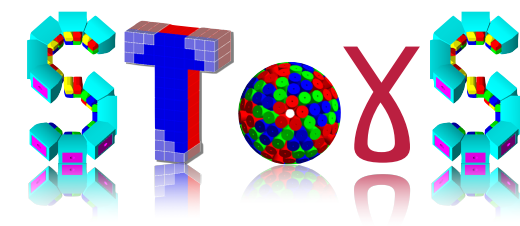
Geant4.10 using Multi-threading

<https://twiki.cern.ch/twiki/bin/view/Geant4/QuickMigrationGuideForGeant4V10>

and previously Geant4.9 versions

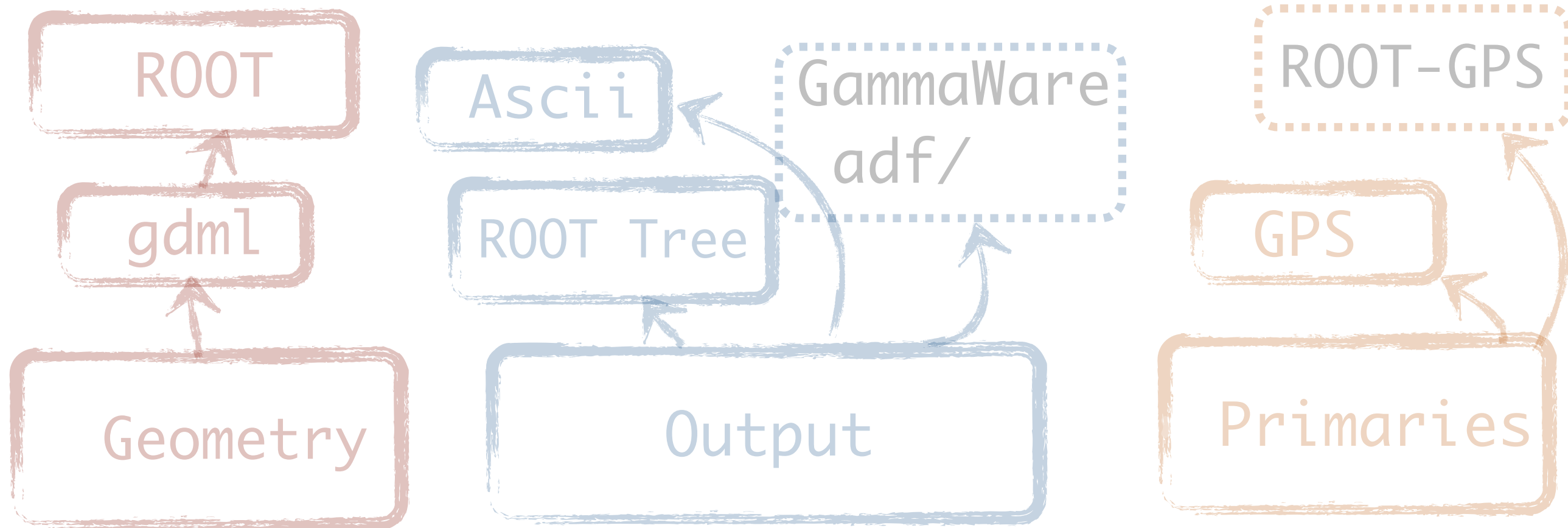
Configured using ascii file to select the Geant4:

- ◆ Physics generator
- ◆ Physics list
- ◆ Geometry under study
- ◆ Action Manager (physics is pulled out of Geant4)



Configuration

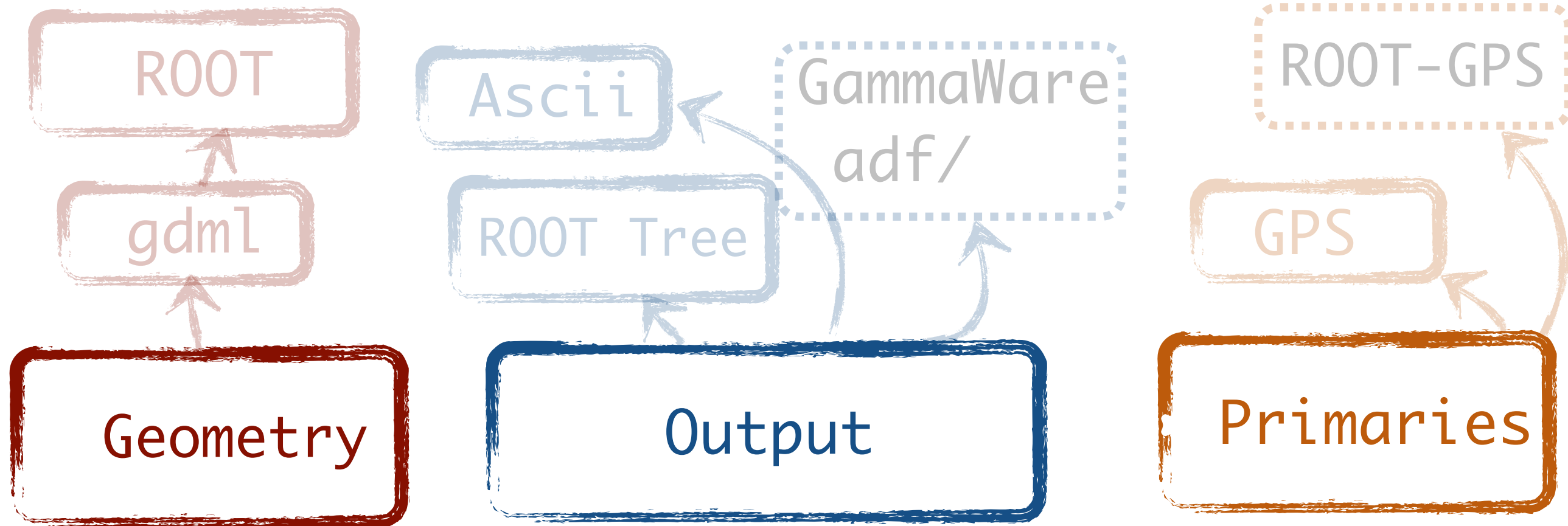
General structure of SToGS package



Geant4 ↔ USER

Configuration

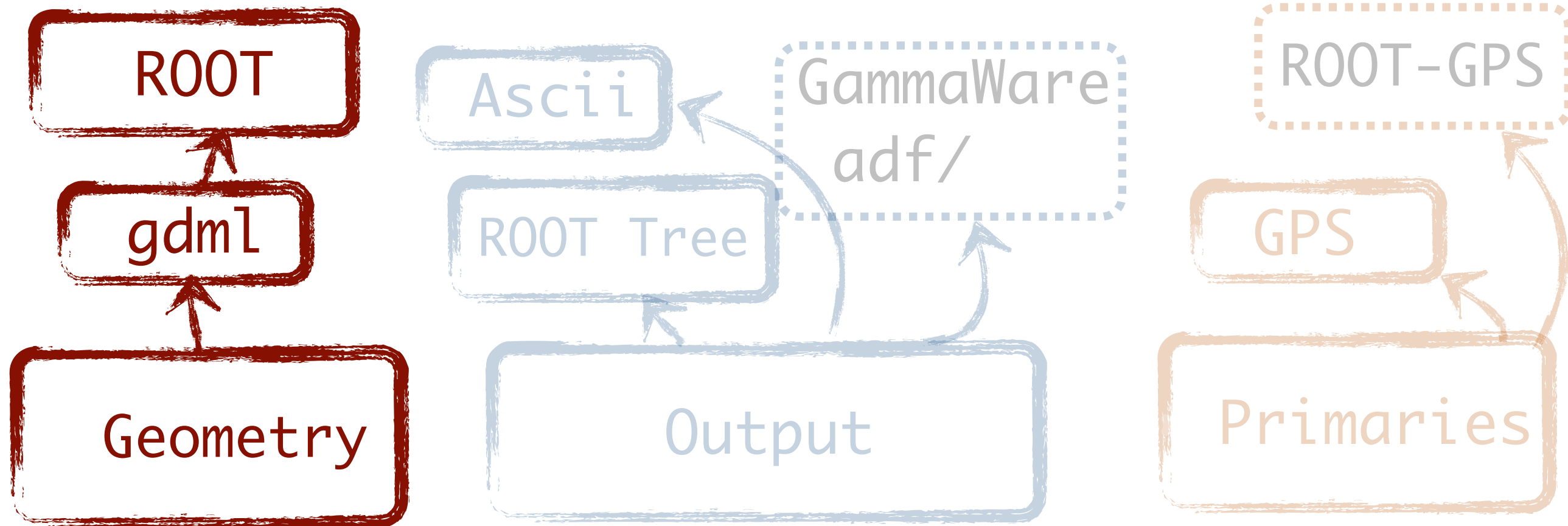
General structure of SToGS package



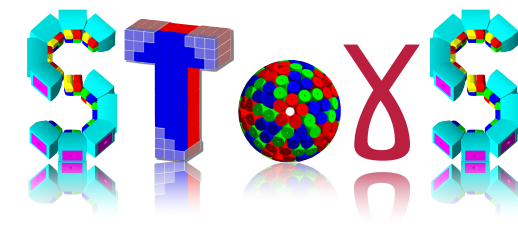
Geant4 ↔ USER

Configuration

General structure of SToGS package

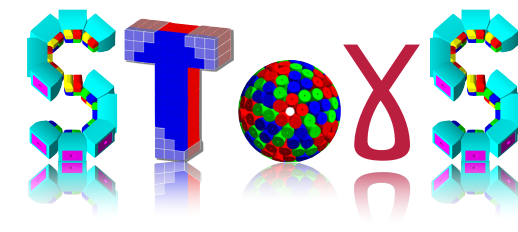


Geant4 ↔ USER



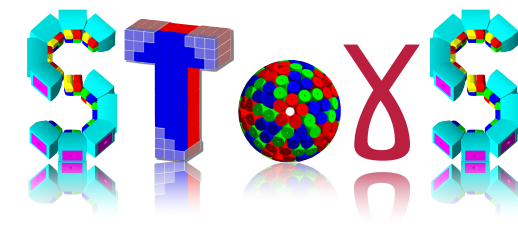
Configuration

SToGS_DetectorBuilder



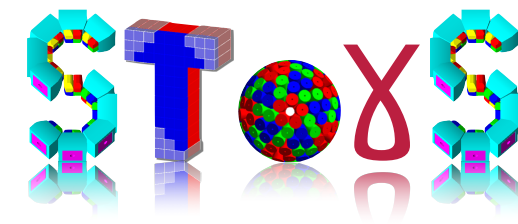
Configuration

SToGS_DetectorBuilder

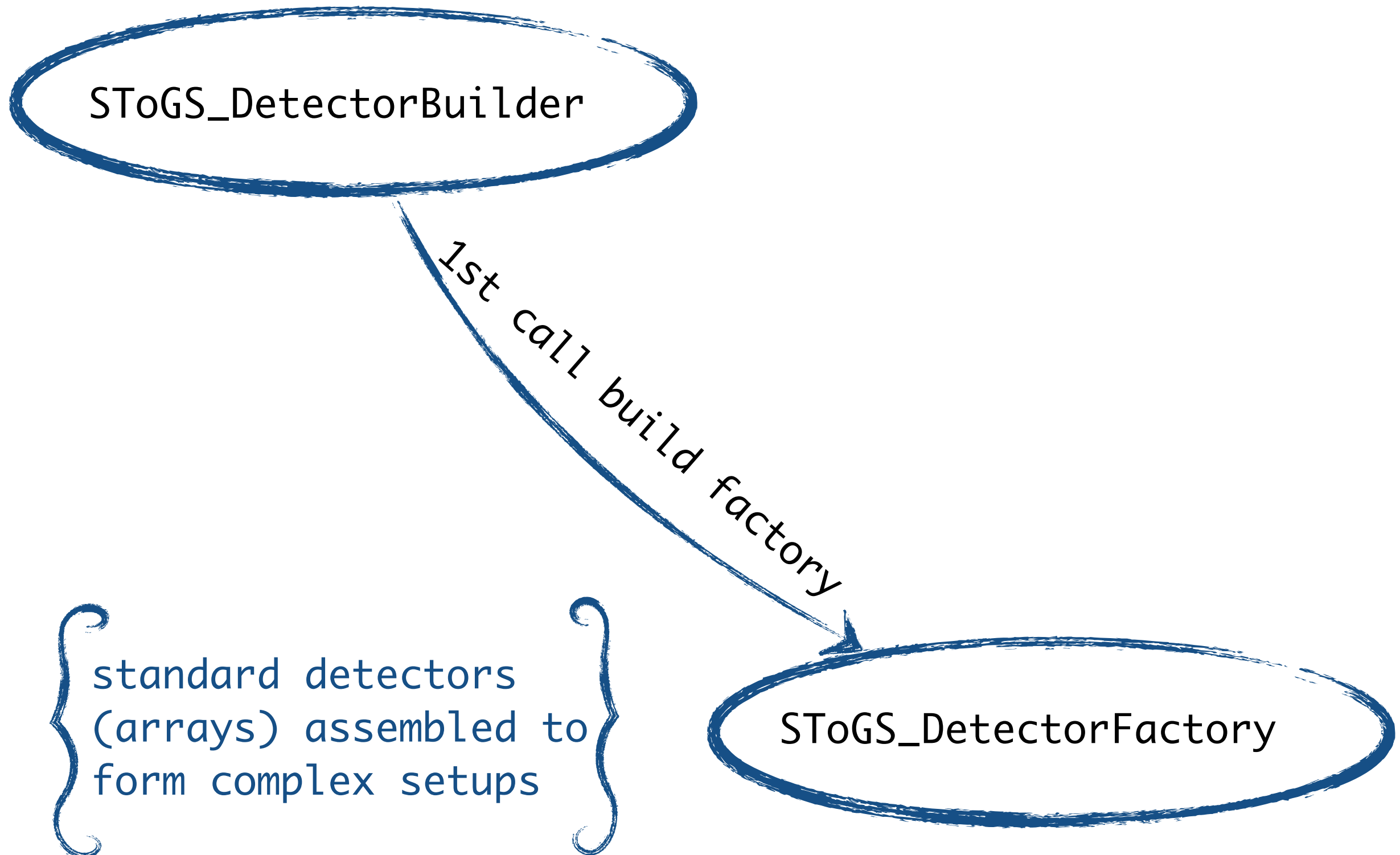


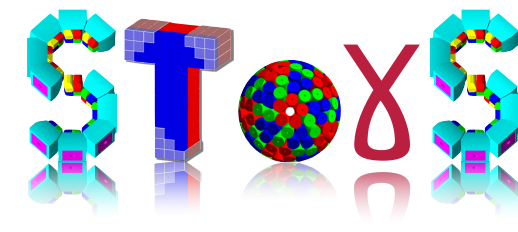
Configuration

SToGS_DetectorBuilder



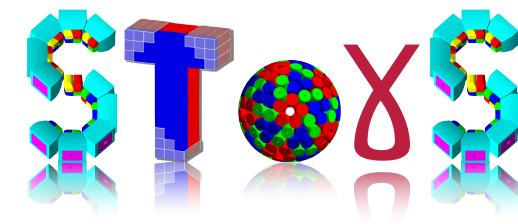
Configuration



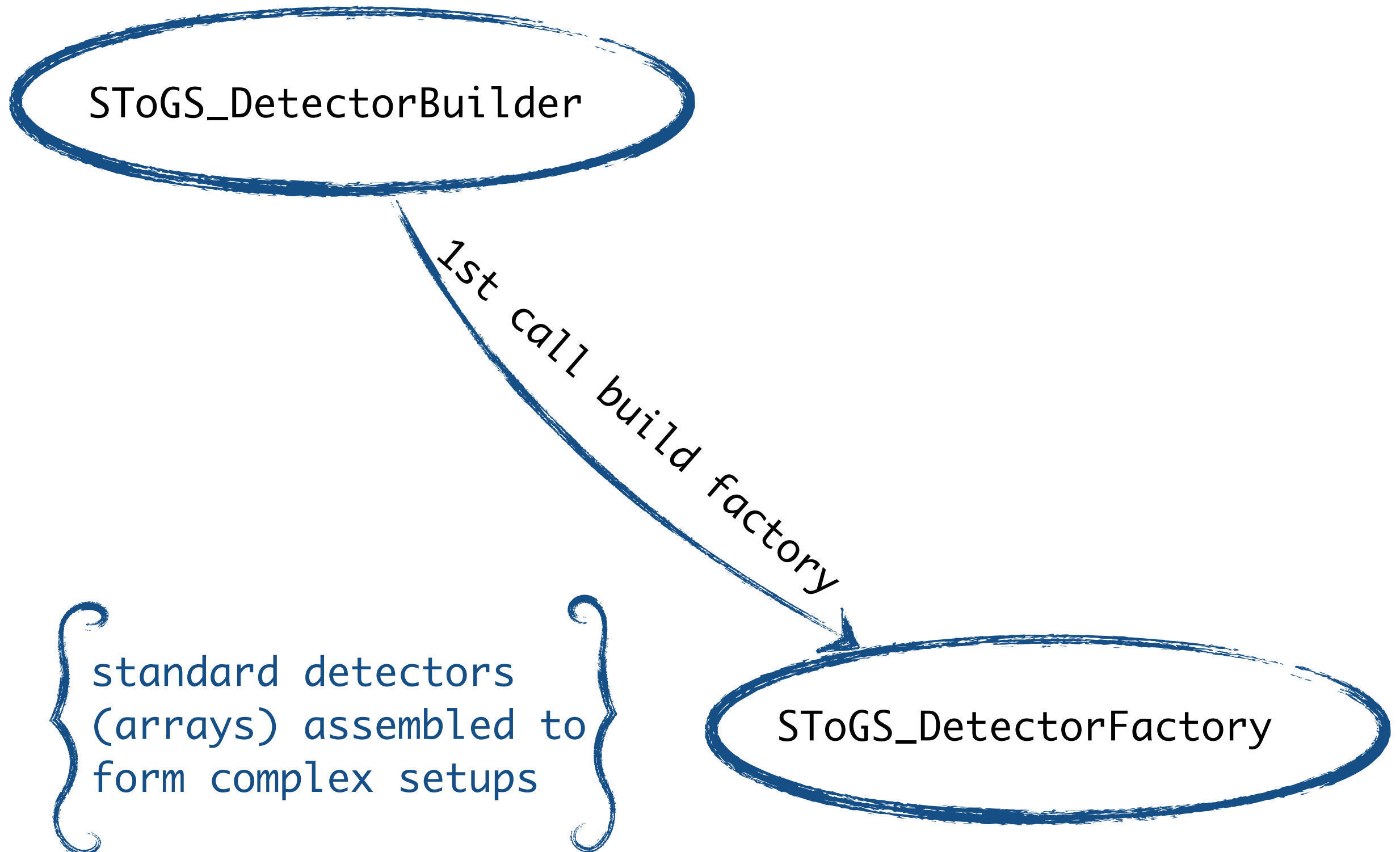


Configuration

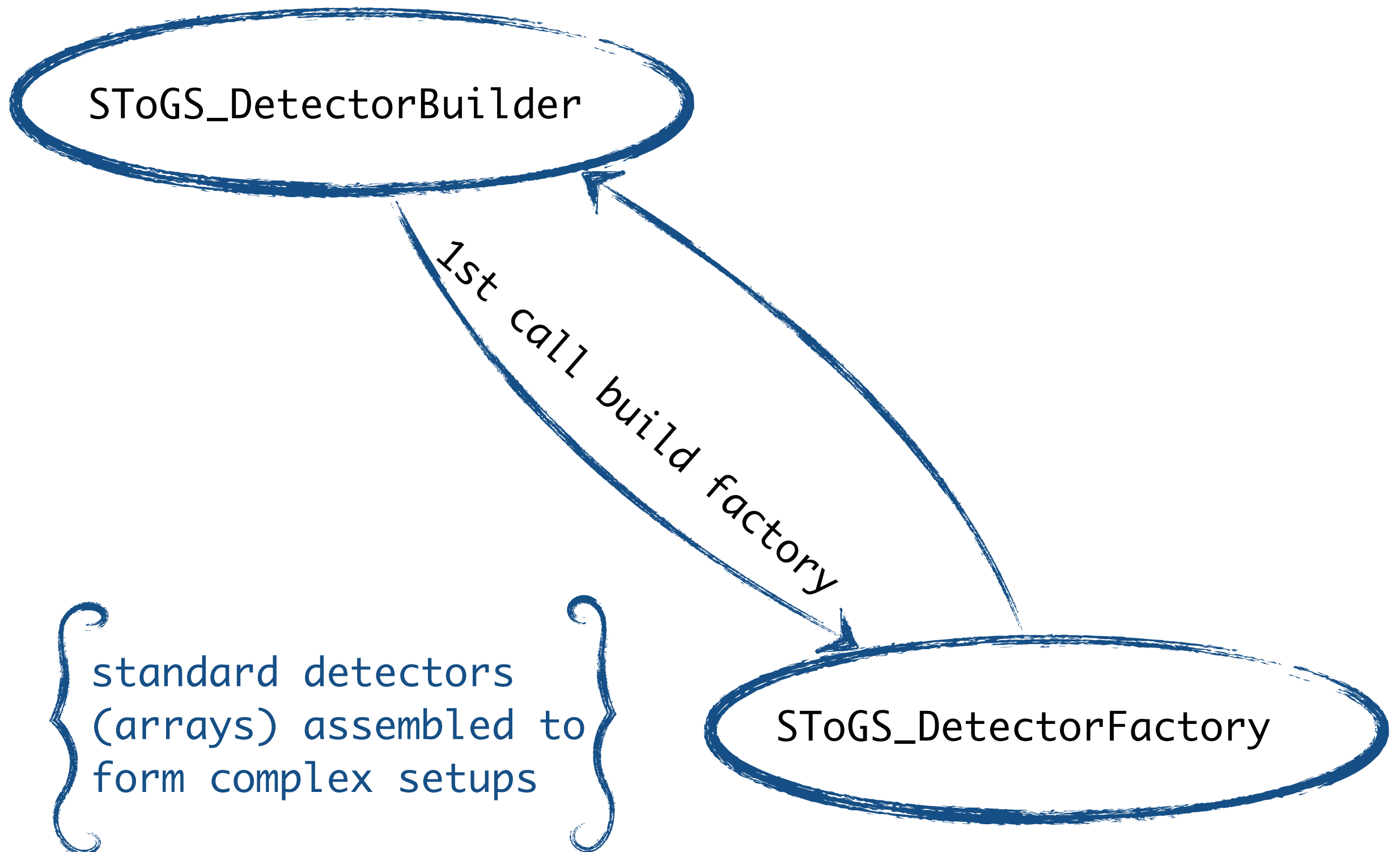
SToGS_DetectorBuilder

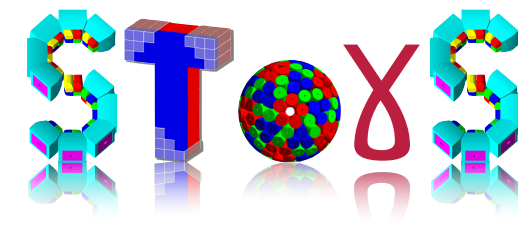


Configuration



Configuration





Configuration

SToGS_DetectorBuilder

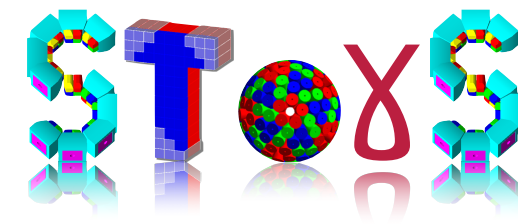
Configuration

SToGS_DetectorBuilder

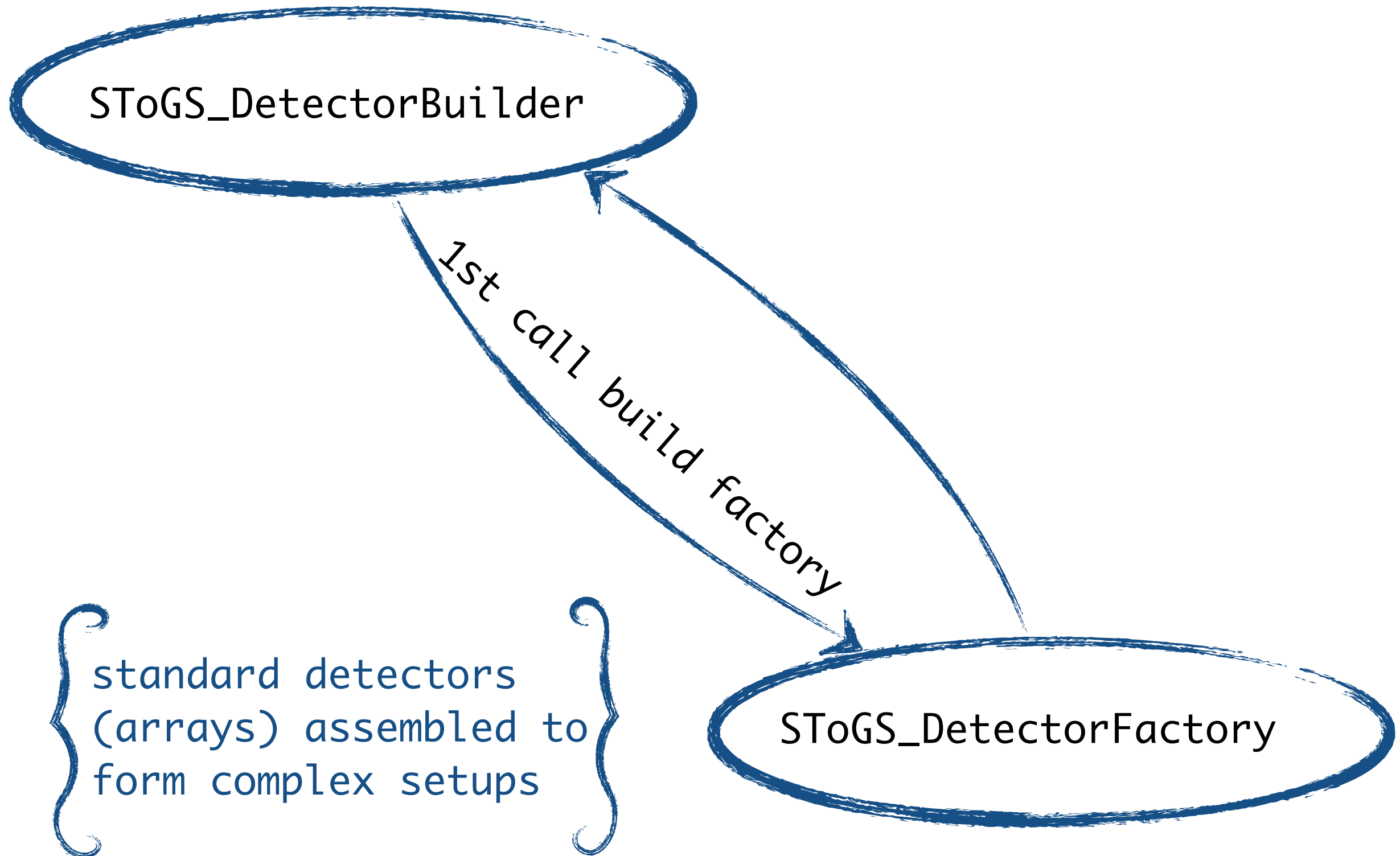
1st call build factory

SToGS_DetectorFactory

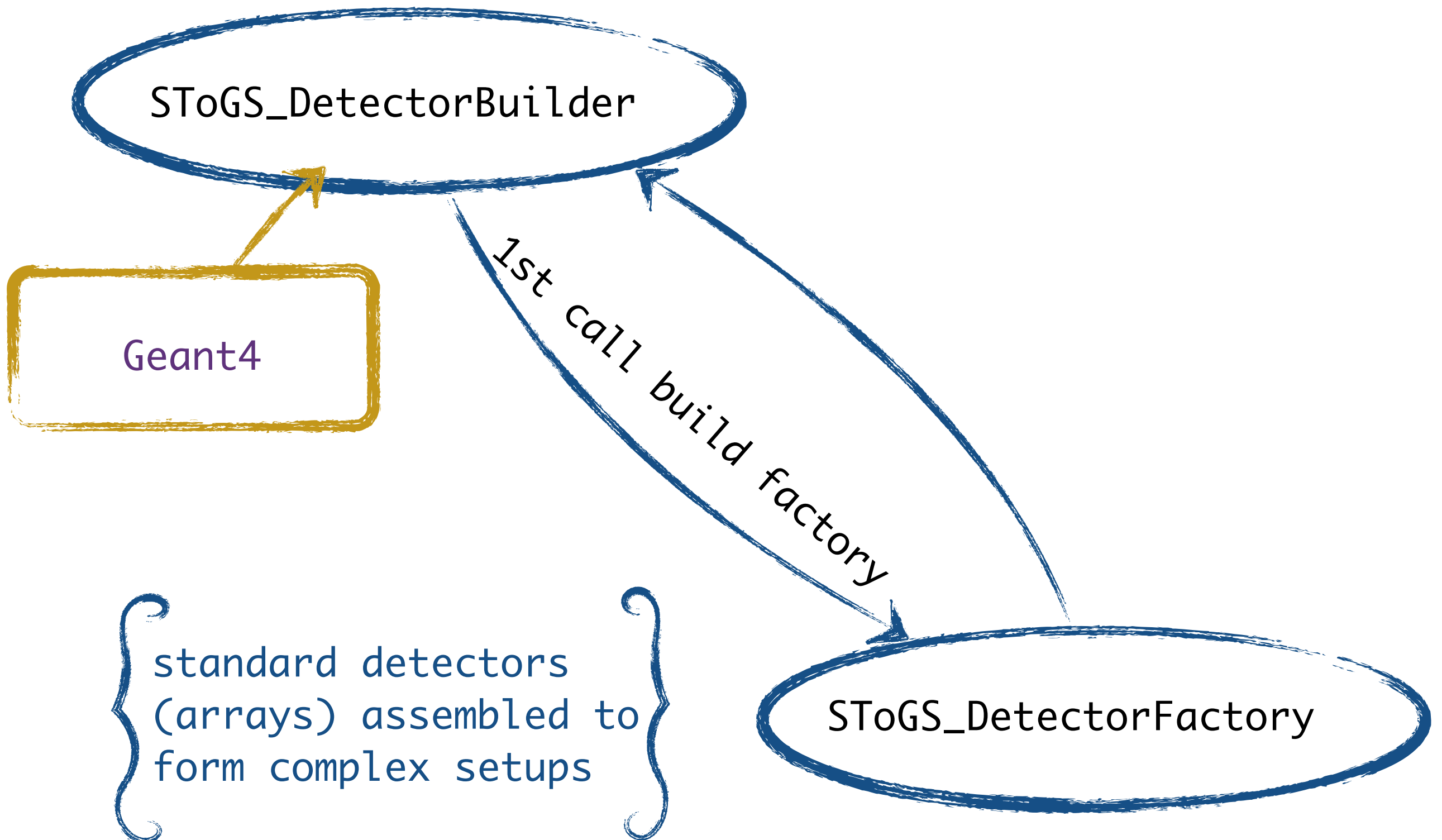
standard detectors
(arrays) assembled to
form complex setups

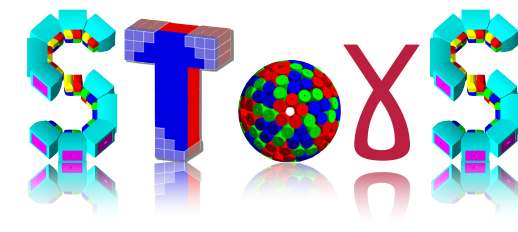


Configuration



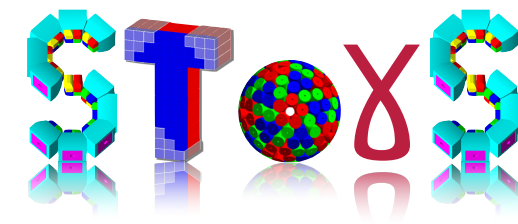
Configuration





Configuration

SToGS_DetectorBuilder



Configuration

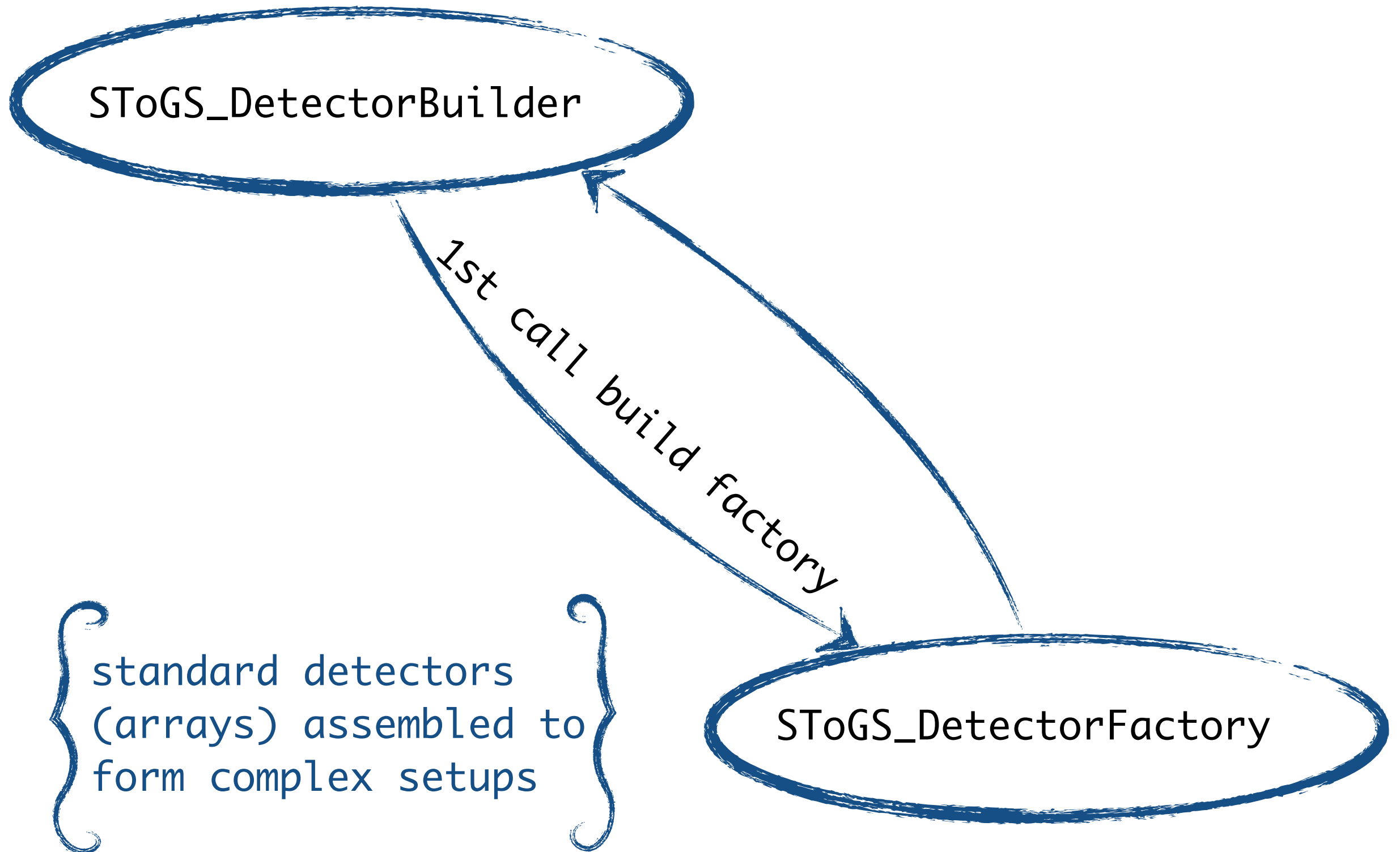
SToGS_DetectorBuilder

1st call build factory

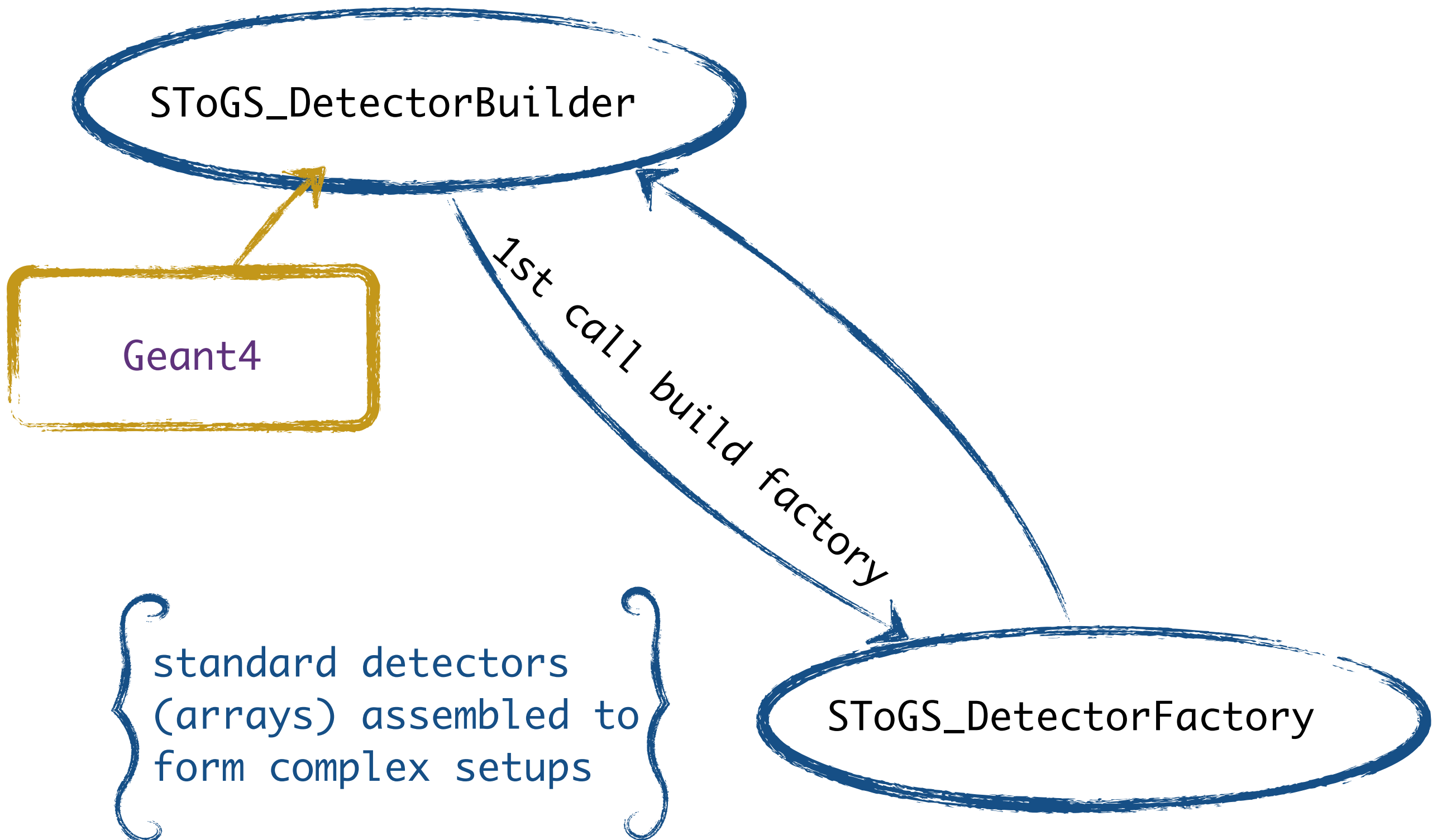
SToGS_DetectorFactory

standard detectors
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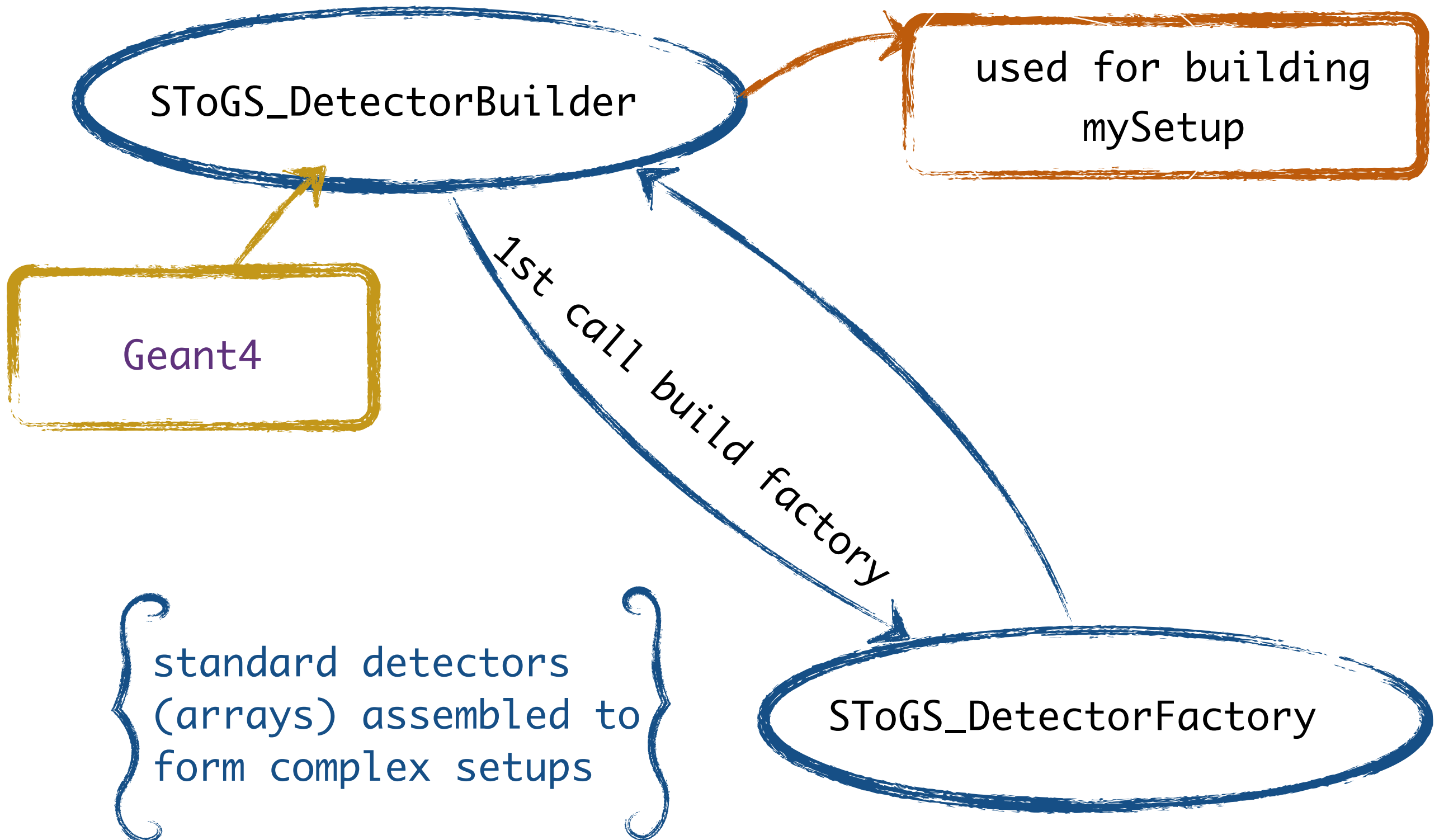
Configuration

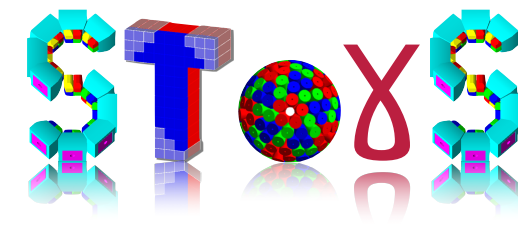


Configuration



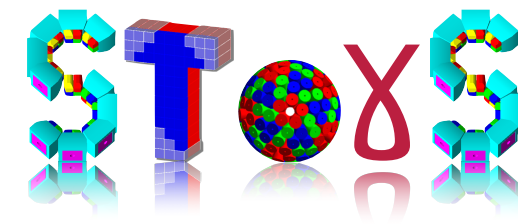
Configuration



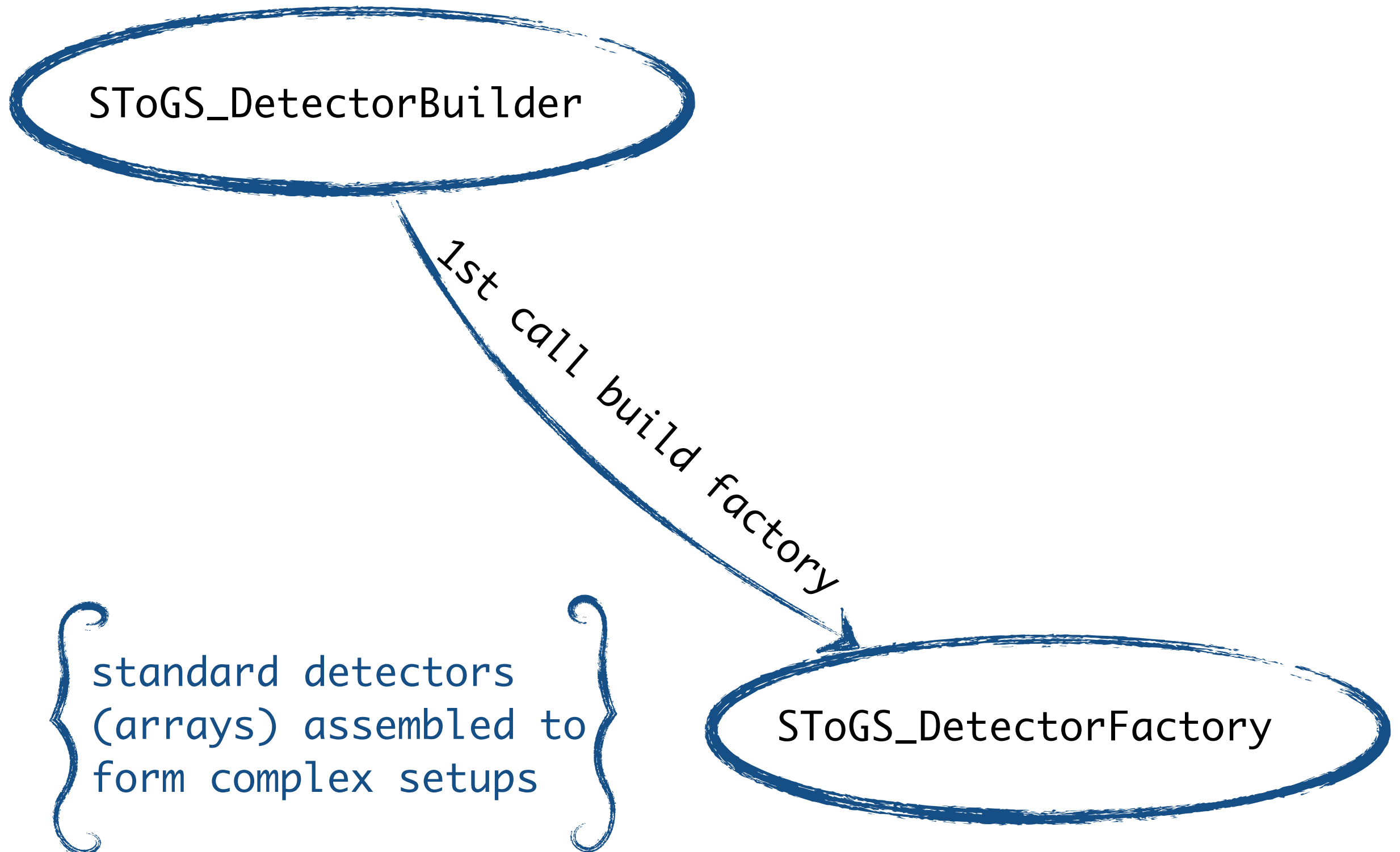


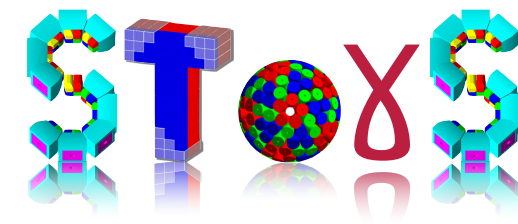
Configuration

SToGS_DetectorBuilder

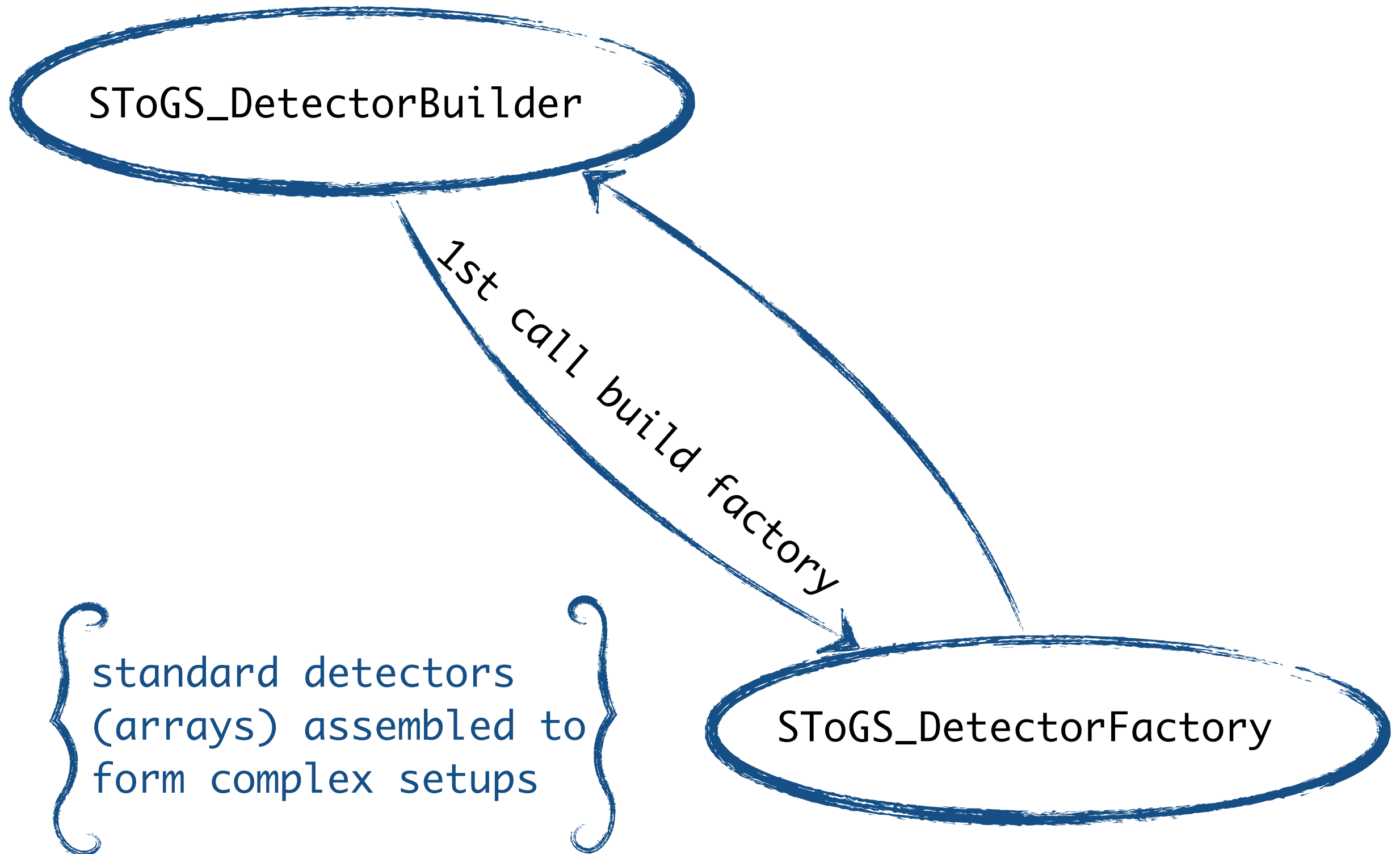


Configuration

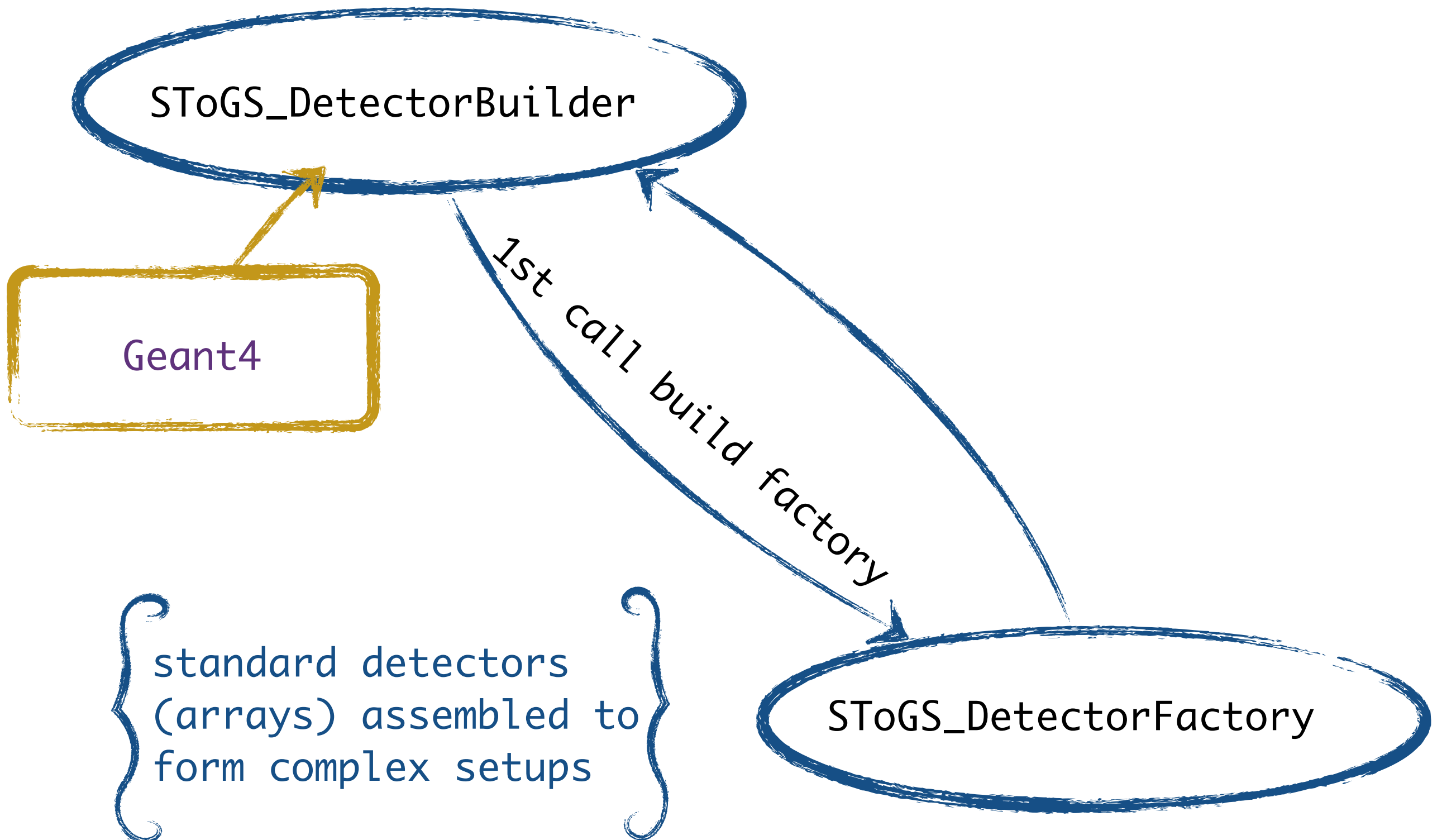




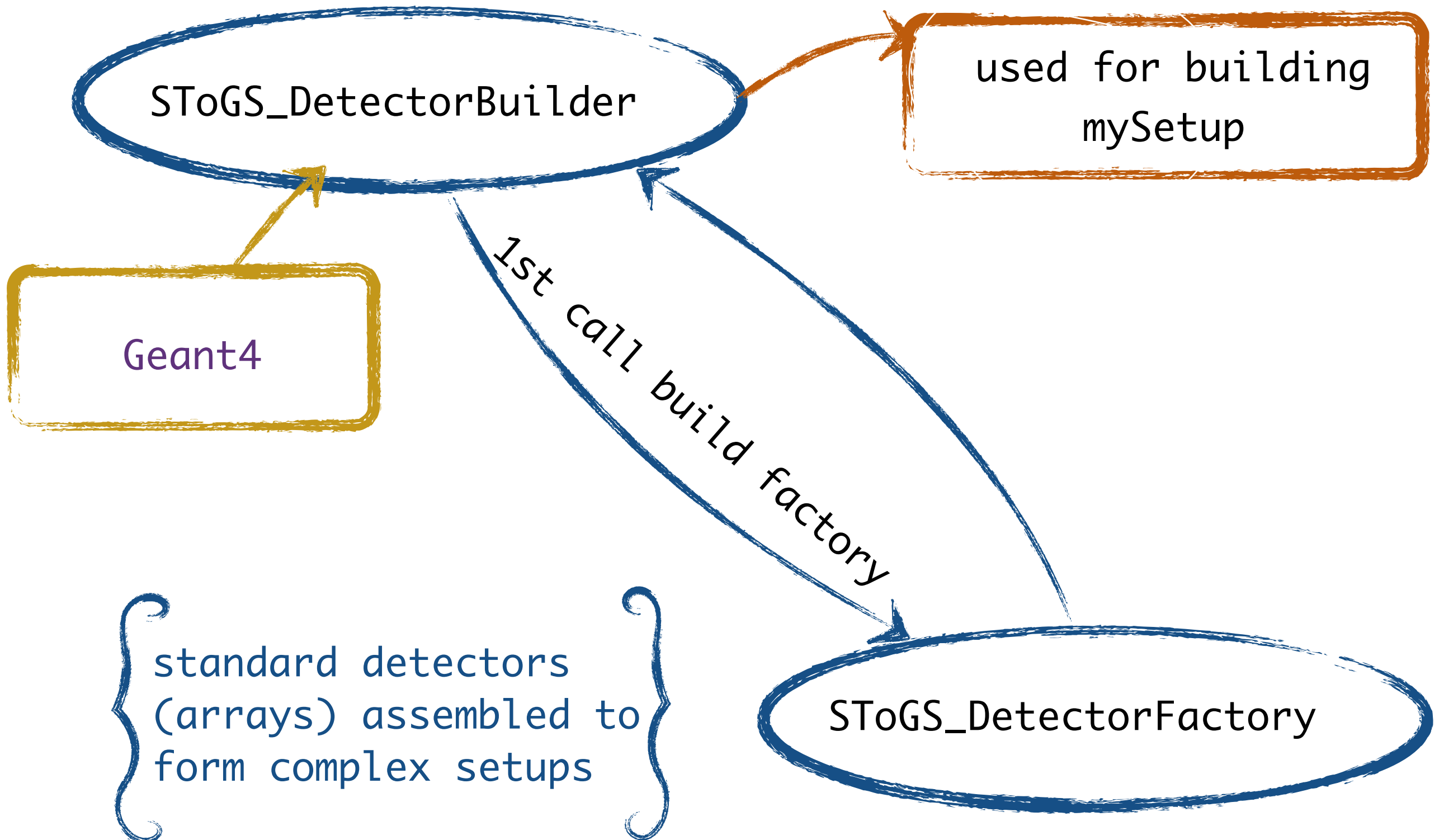
Configuration

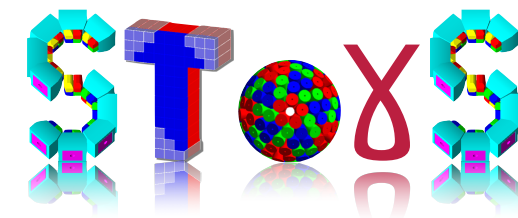


Configuration

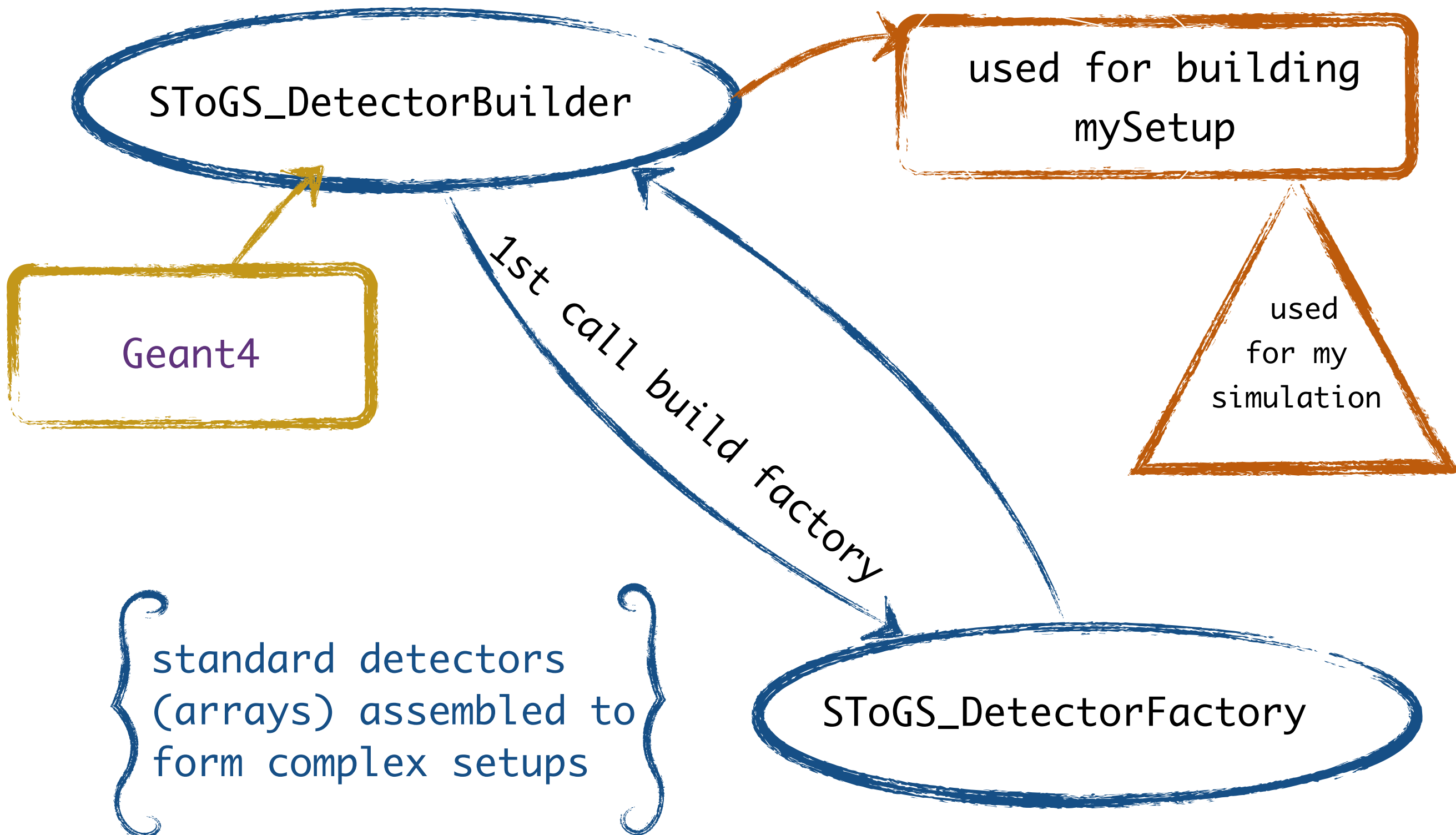


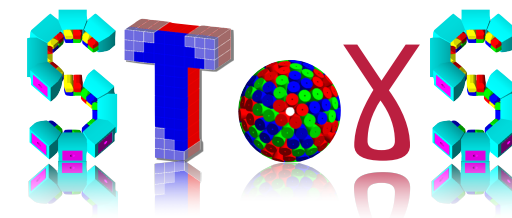
Configuration



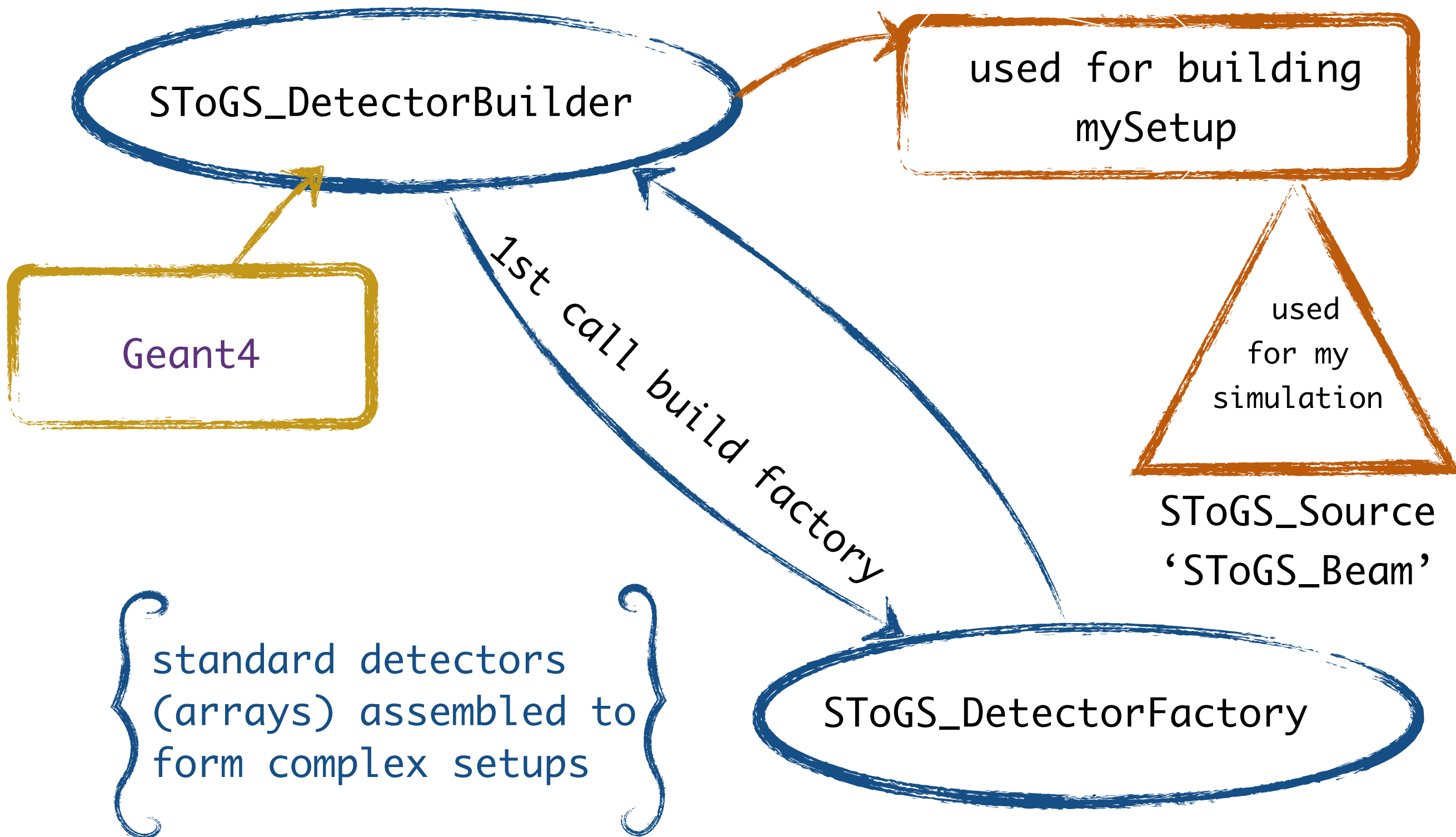


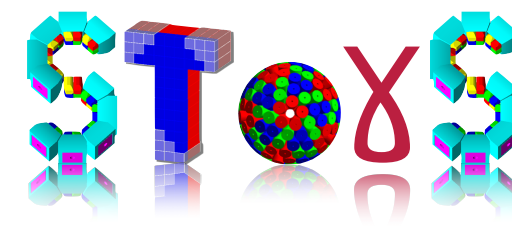
Configuration





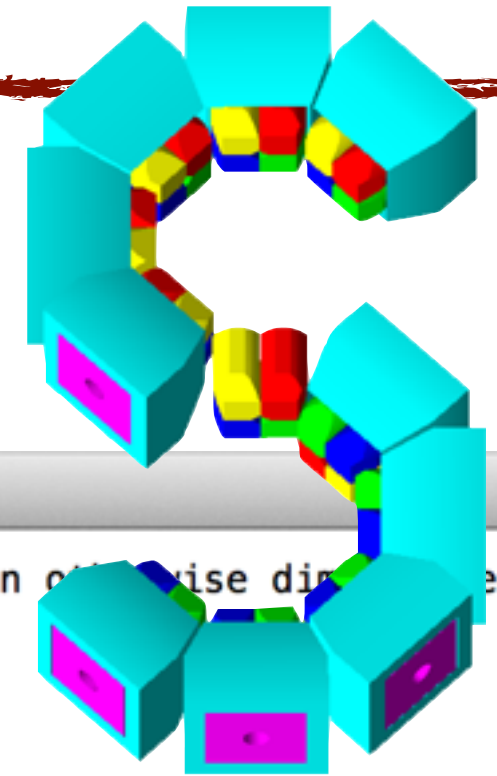
Configuration



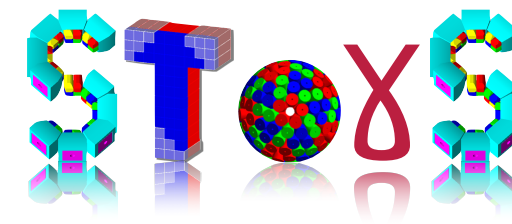


Configuration

mySetup file example



```
mySetup.dfb — SToGS (git: master)
1 # First the world / detector envelop. if detector does not exist, box with dim given otherwise dimmed
2 w EXOGAM_bare +10. +10. +10. m
3 #
4 #
5 @ 0 ->
6 # |
7 * DetectorFactory/SemiConductors/Ge/EXOCLOVER_A-bare 0.0 0.0 11.35 cm Rz +0 Ry 0 Rt
8 * DetectorFactory/SemiConductors/Ge/EXOCLOVER_A-bare 0.0 0.0 11.35 cm Rz +0 Ry -45 Rt
9 * DetectorFactory/SemiConductors/Ge/EXOCLOVER_A-bare 0.0 0.0 11.35 cm Rz +0 Ry -90 Rt
10 * DetectorFactory/SemiConductors/Ge/EXOCLOVER_A-bare 0.0 0.0 11.35 cm Rz +0 Ry -135 Rt
11 * DetectorFactory/SemiConductors/Ge/EXOCLOVER_A-bare 0.0 0.0 11.35 cm Rz +0 Ry +45 Rt
12 * DetectorFactory/SemiConductors/Ge/EXOCLOVER_A-bare 0.0 0.0 -23.35 cm Rz +0 Ry -90 Rt
13 * DetectorFactory/SemiConductors/Ge/EXOCLOVER_A-bare 25.35 0.0 -15.35 cm Rx 180 Ry 45 Rt
14 * DetectorFactory/SemiConductors/Ge/EXOCLOVER_A-bare 37. 0.0 10.35 cm Rx 180 Ry -0 Rt
15 * DetectorFactory/SemiConductors/Ge/EXOCLOVER_A-bare 27. 0.0 37.35 cm Rx 180 Ry -45 Rt
16 * DetectorFactory/SemiConductors/Ge/EXOCLOVER_A-bare 0.7 0.0 49.35 cm Rx 180 Ry -90 Rt
17 * DetectorFactory/SemiConductors/Ge/EXOCLOVER_A-bare -26.35 0.0 39.0 cm Rx 180 Ry -135 Rt
18 # end
Line: 6:3 | Plain Text | Tab Size: 4
```



Configuration

FullSetup in Geant4

The screenshot displays the Geant4 configuration interface, divided into two main panels: a scene tree on the left and a 3D visualization on the right.

Scene Tree (Left Panel): The scene tree is titled "viewer-1 (OpenGLStoredQt)". It lists various components of the detector setup, including:

- ATC:000:AGATA-ARed:000:ARedCaps [0]
- ATC:000:AGATA-BGreen:000:BGreenCaps [0]
- ATC:000:AGATA-CBlue:000:CBlueCaps [0]
- CPParisPW_2-bare:000:ParisPW_2-bare:000:PW:0: [3]
- CPParisPW_2-bare:000:ParisPW_2-bare:000:PW:1: [4]
- CPParisPW_2-bare:000:ParisPW_2-bare:000:PwCaps [-1]
- CPParisPW_2-bare:000:ParisPW_2-bare:000:PwCapsTaps [-1]
- CPParisPW_2-bare:000:ParisPW_2-bare:001:PW:0: [5]
- CPParisPW_2-bare:000:ParisPW_2-bare:001:PW:1: [6]
- CPParisPW_2-bare:000:ParisPW_2-bare:001:PwCaps [-1]
- CPParisPW_2-bare:000:ParisPW_2-bare:001:PwCapsTaps [-1]
- CPParisPW_2-bare:000:ParisPW_2-bare:002:PW:0: [7]
- CPParisPW_2-bare:000:ParisPW_2-bare:002:PW:1: [8]
- CPParisPW_2-bare:000:ParisPW_2-bare:002:PwCaps [-1]
- CPParisPW_2-bare:000:ParisPW_2-bare:002:PwCapsTaps [-1]
- CPParisPW_2-bare:000:ParisPW_2-bare:003:PW:0: [9]
- CPParisPW_2-bare:000:ParisPW_2-bare:003:PW:1: [10]
- CPParisPW_2-bare:000:ParisPW_2-bare:003:PwCaps [-1]
- CPParisPW_2-bare:000:ParisPW_2-bare:003:PwCapsTaps [-1]
- CPParisPW_2-bare:000:ParisPW_2-bare:004:PW:0: [11]
- CPParisPW_2-bare:000:ParisPW_2-bare:004:PW:1: [12]
- CPParisPW_2-bare:000:ParisPW_2-bare:004:PwCaps [-1]
- CPParisPW_2-bare:000:ParisPW_2-bare:004:PwCapsTaps [-1]
- CPParisPW_2-bare:000:ParisPW_2-bare:005:PW:0: [13]
- CPParisPW_2-bare:000:ParisPW_2-bare:005:PW:1: [14]
- CPParisPW_2-bare:000:ParisPW_2-bare:005:PwCaps [-1]
- CPParisPW_2-bare:000:ParisPW_2-bare:005:PwCapsTaps [-1]
- CPParisPW_2-bare:000:ParisPW_2-bare:006:PW:0: [15]
- CPParisPW_2-bare:000:ParisPW_2-bare:006:PW:1: [16]

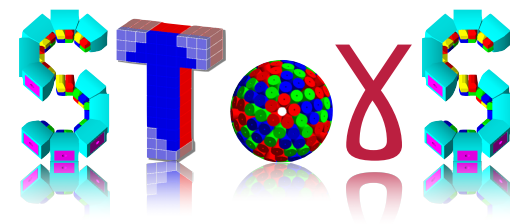
At the bottom of the scene tree, there is a "Touchable slider" with a "Show all" button and a "Hide all" button. A search bar is also present with a "select item(s)" button.

3D Visualization (Right Panel): The 3D visualization shows a complex detector setup in a 3D coordinate system. The x-axis is red, the y-axis is green, and the z-axis is blue. The setup includes a large red and blue structure, a cyan structure, and several smaller colored structures (yellow, red, green, blue, purple, brown). Dimensions are indicated: 30 cm along the y-axis, 30 cm along the x-axis, and 70 cm along the z-axis.

Output Panel (Bottom Right): The output panel shows the following text:

```
Visualization verbosity changed to warnings (3)
#
# For file-based drivers, use this to create an empty detector view
#/vis/viewer/flush
#
#/run/beamOn 10
Matching directories :
/vis/scene/
/vis/sceneHandler/
/vis/scene/add/axes 0 0 0 20 cm
/vis/scene/notifyHandlers
/vis/scene/add/axes 0 0 0 30 cm
/vis/scene/notifyHandlers
```

There is a "clear" button and a "Filter:" input field below the output panel. At the very bottom, there is a "Session:" label and an empty input field.



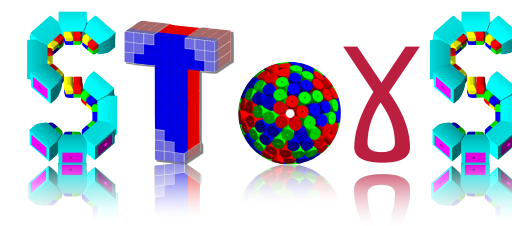
Configuration

Files associated to DetectorFactory

.gdml file → Full description of the Geometry

.amap file → Detector attributes (colours, sensitivity, fields, etc...)

.dmap file → Mapping of the detector (mandatory for the analysis)

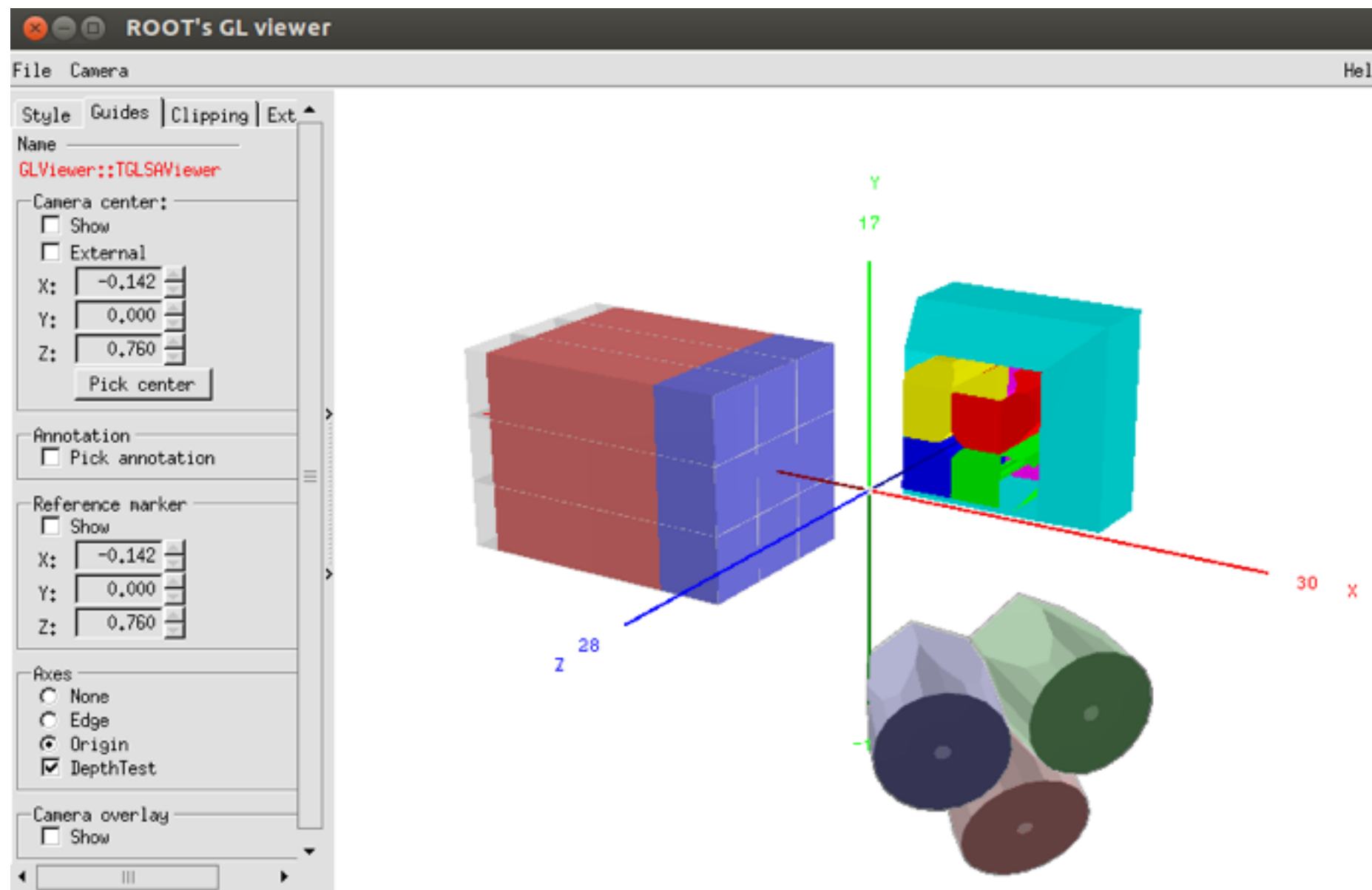


Configuration

Geometry: ROOT macro

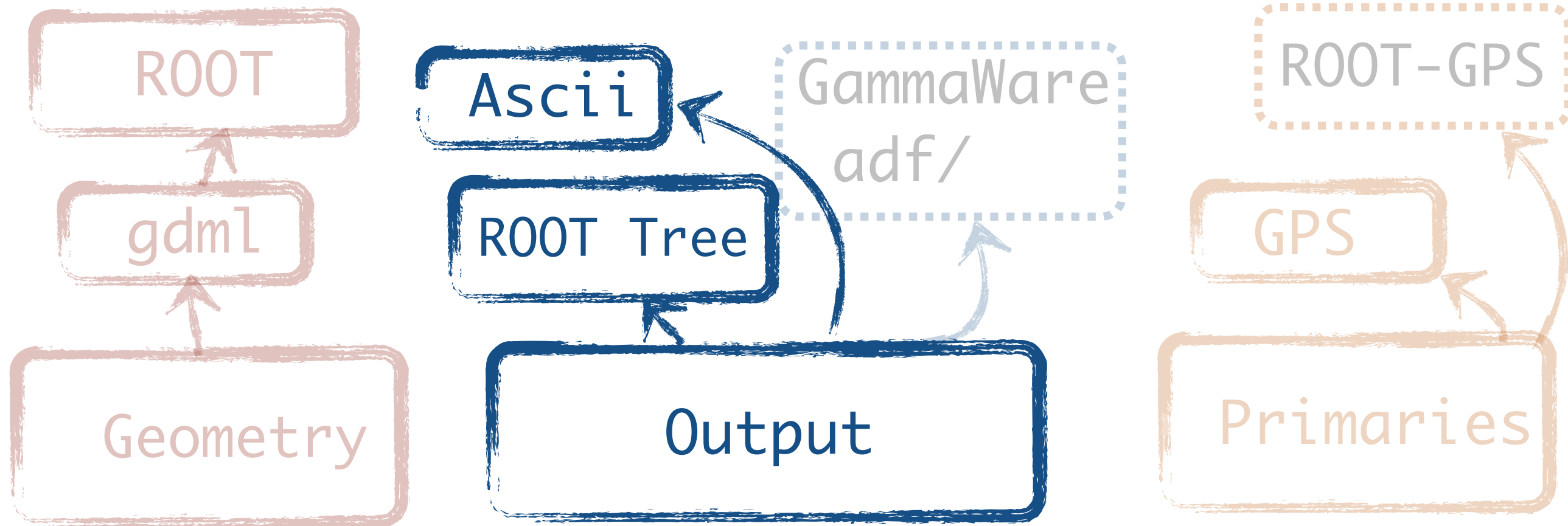
```
.L DetectorFactory/BrowserFactory.C
```

```
ShowDetector("DetectorFactory/MyStore/MySetup")
```



Configuration

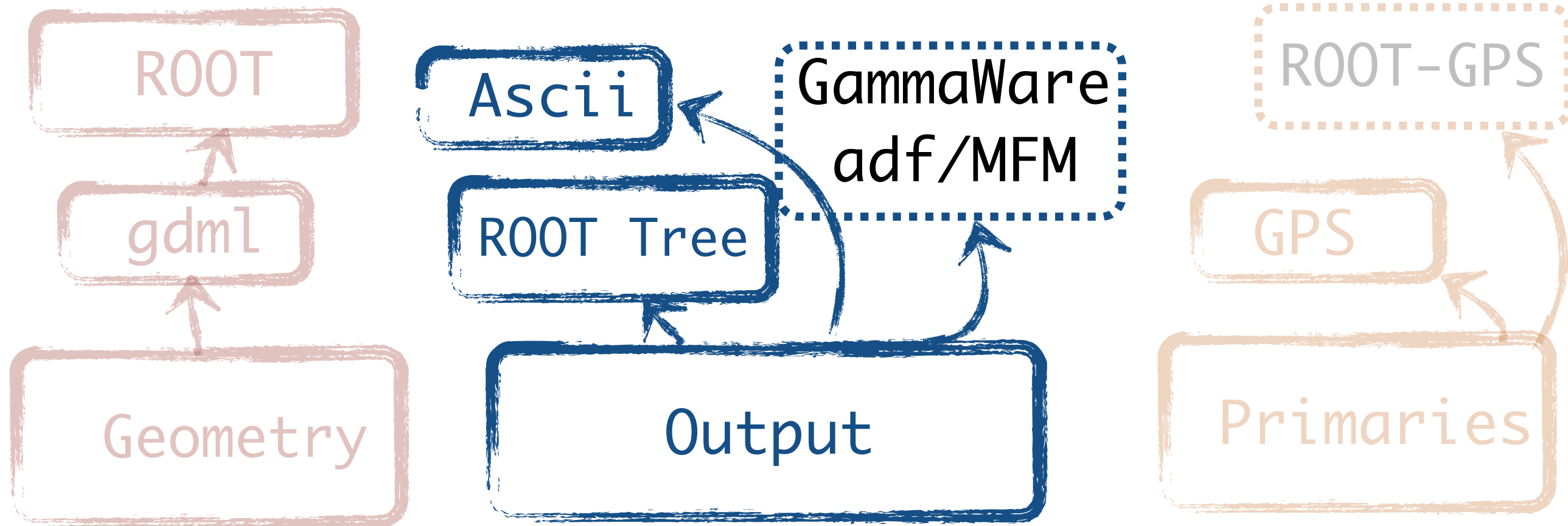
General structure of SToGS package



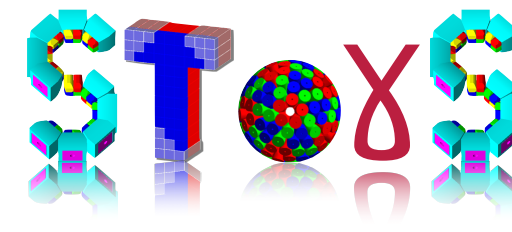
Geant4 ↔ USER

Configuration

General structure of SToGS package



Geant4 ↔ USER

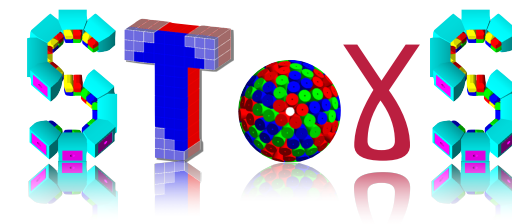


Configuration

Input file `SToGS_Source.conf`

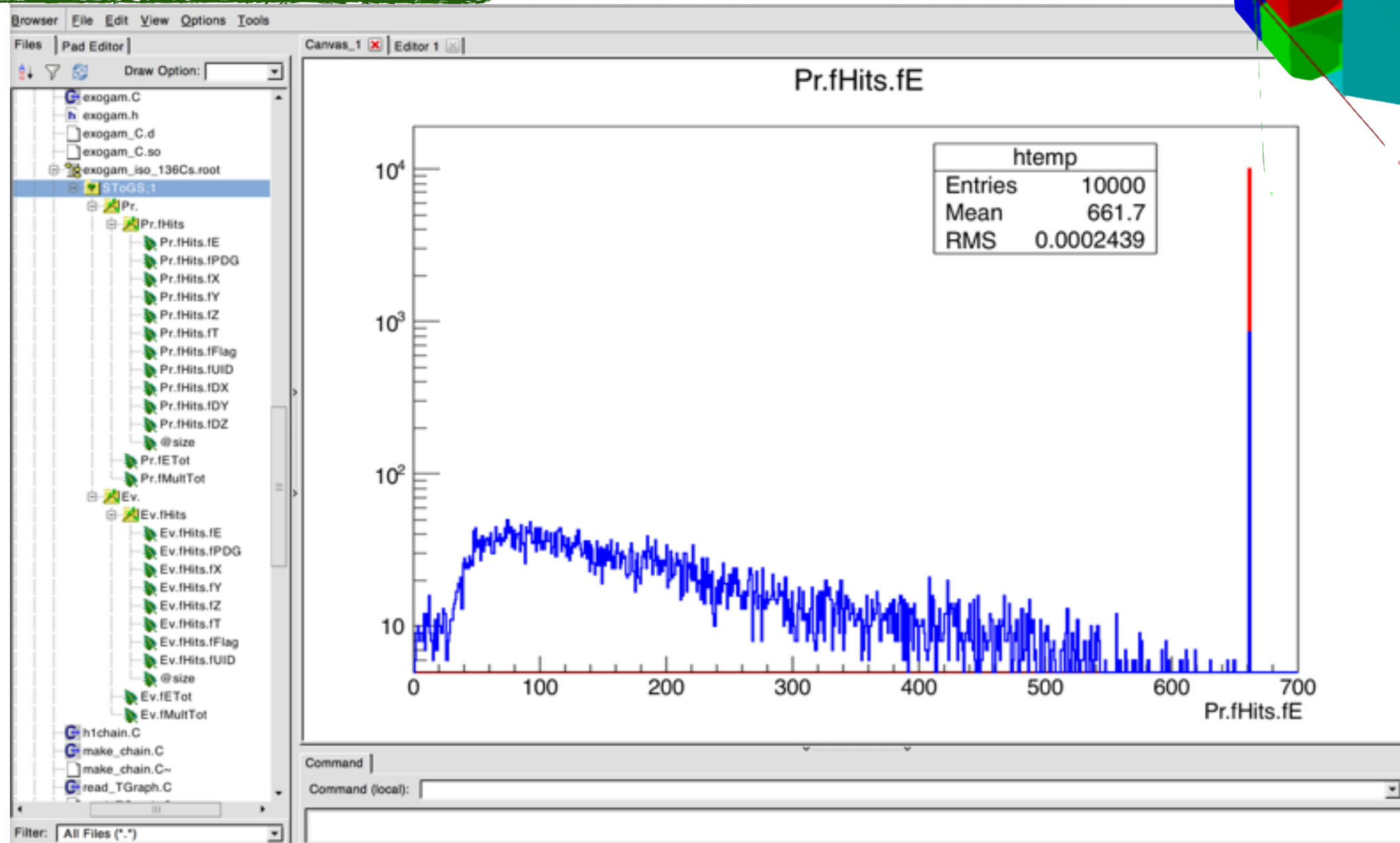
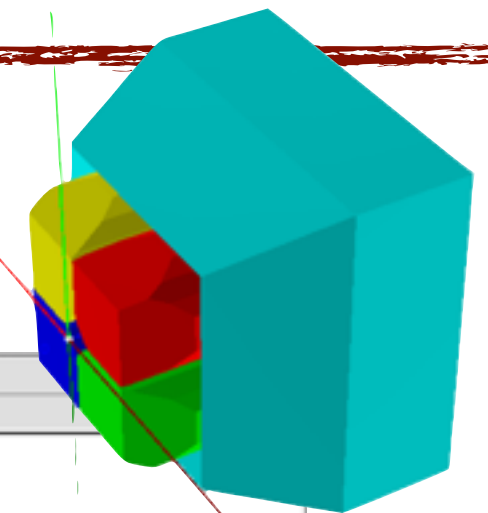
```
SToGS_Source.conf — SToGSDefault (git: master)
3 #
4 # The UserActionInitialization (which deals without outputs and the generator [thread local objects])
5 #
6 #actions: printout run;event;track;step
7 #actions: ascii setup/SToGS_ascii_actions.conf
8 actions: stogstree setup/SToGS_tree_actions.conf
9 #
10 # Detector geometry
11 #
12 #setup: factory DetectorFactory/Generics/TwoShells$toto
13 #setup: factory DetectorFactory/Scintillators/ParisPW_2
14 setup: factory DetectorFactory/SemiConductors/Ge/EXOCLOVER_A-bare
15 #setup: factory DetectorFactory/Arrays/AGATA_180
16 #
17 # The Physics list
18 #
19 physics: stogs_m general0;emstandard_opt0;
20 #physics: stogs_m general0;emstandard_opt0;Optical;
21 #physics: stogs_m general0;emstandard_opt0;ParisHadron0
22 #
23 # generator
24 #
25 generator: GPS G4Macros/GPS_Cs137.mac
26 #
27 # In case of MT, allows the user to specify the number of threads
28 #
29 nbthread: 2
30 #
```

Line: 6:2 Apache Tab Size: 4



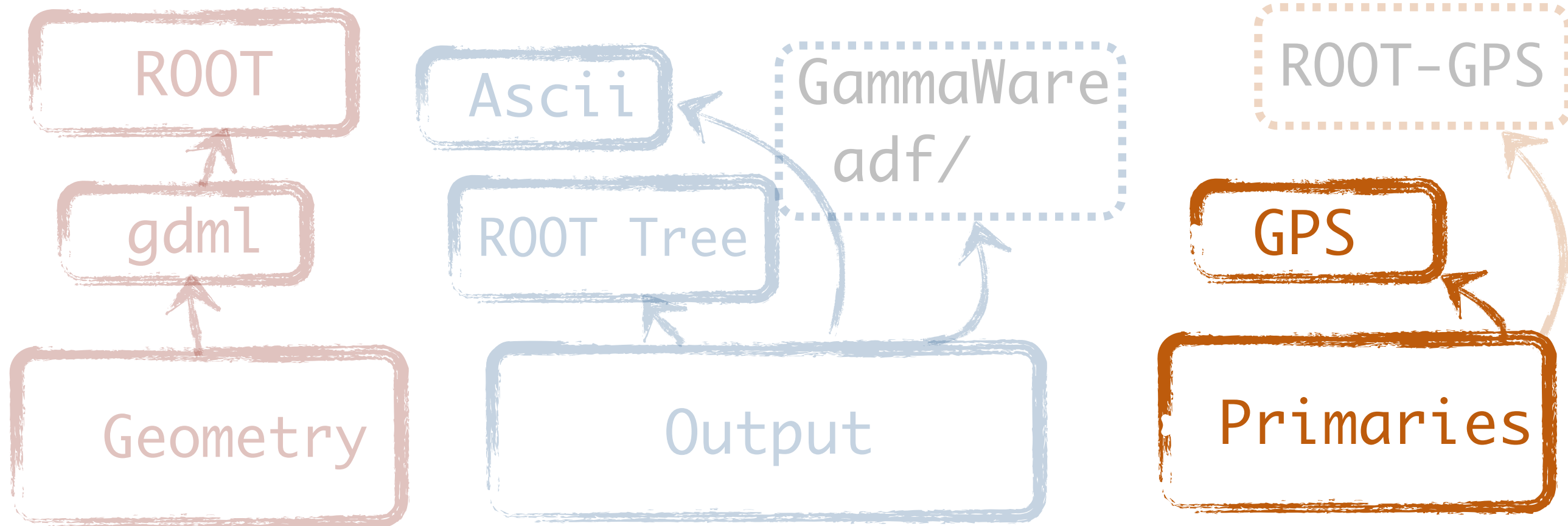
Configuration

Output root file

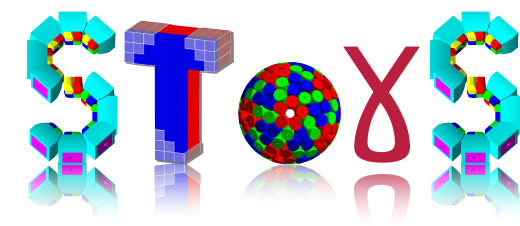


Configuration

General structure of SToGS package

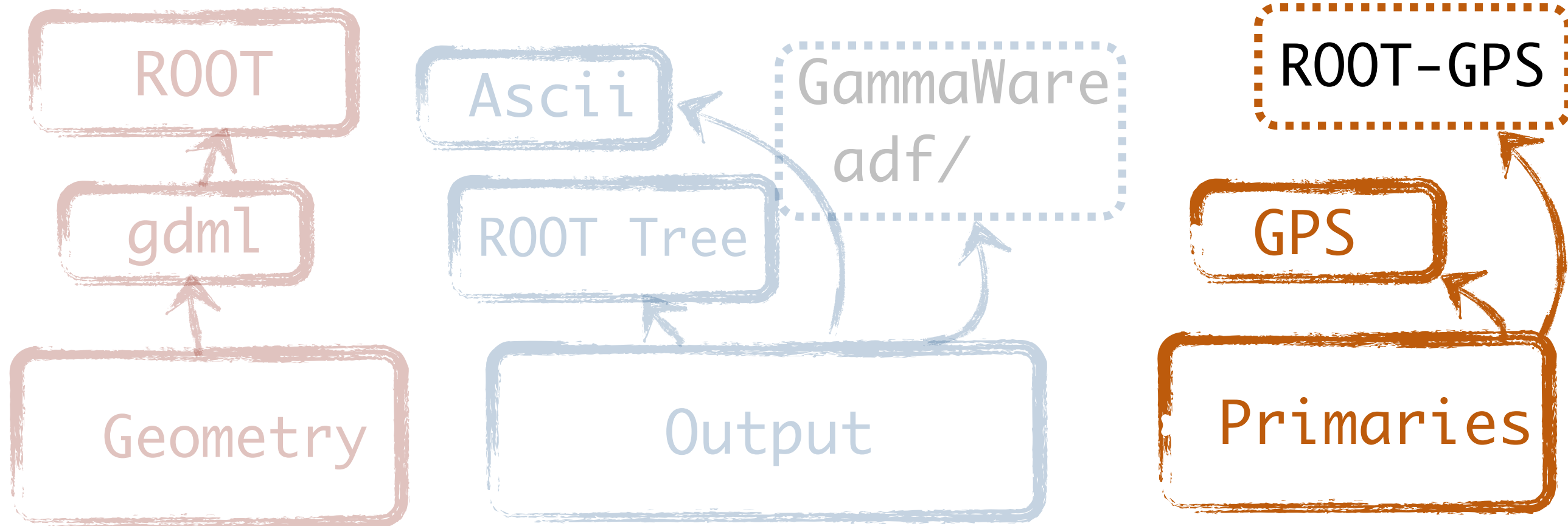


Geant4 ↔ USER



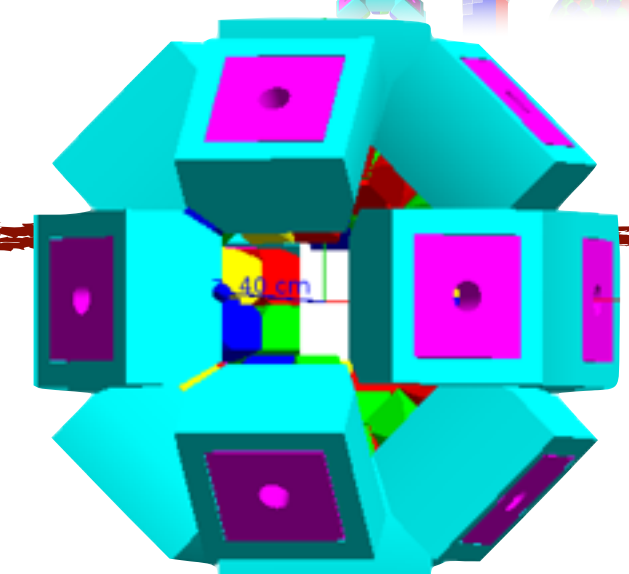
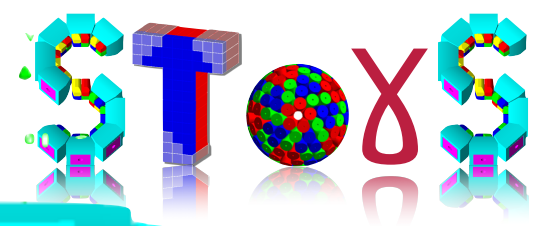
Configuration

General structure of SToGS package

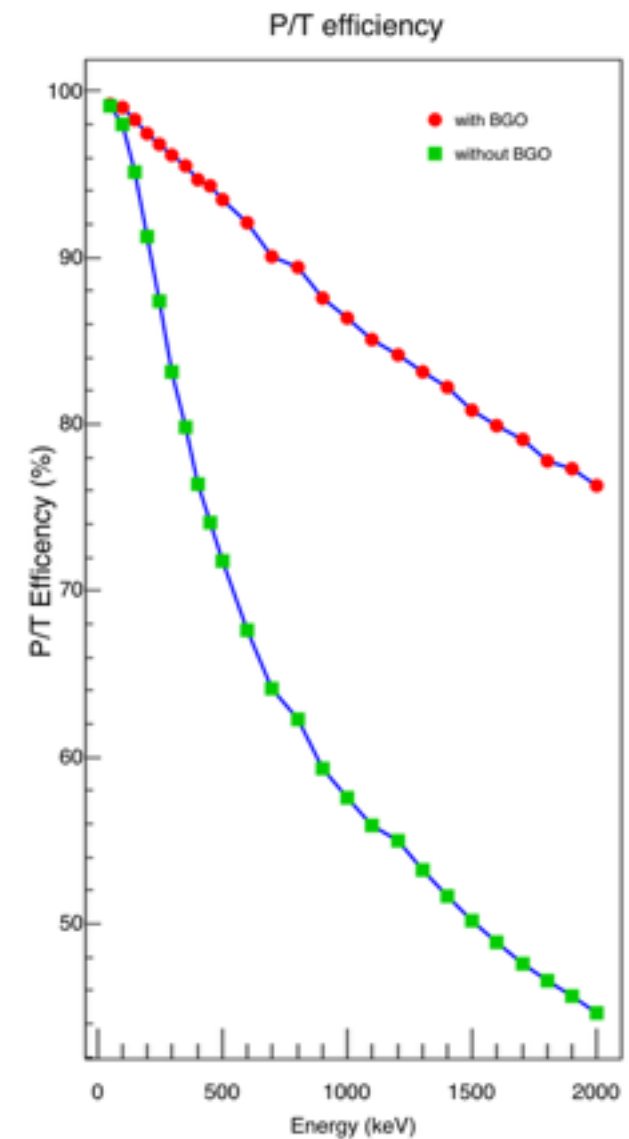
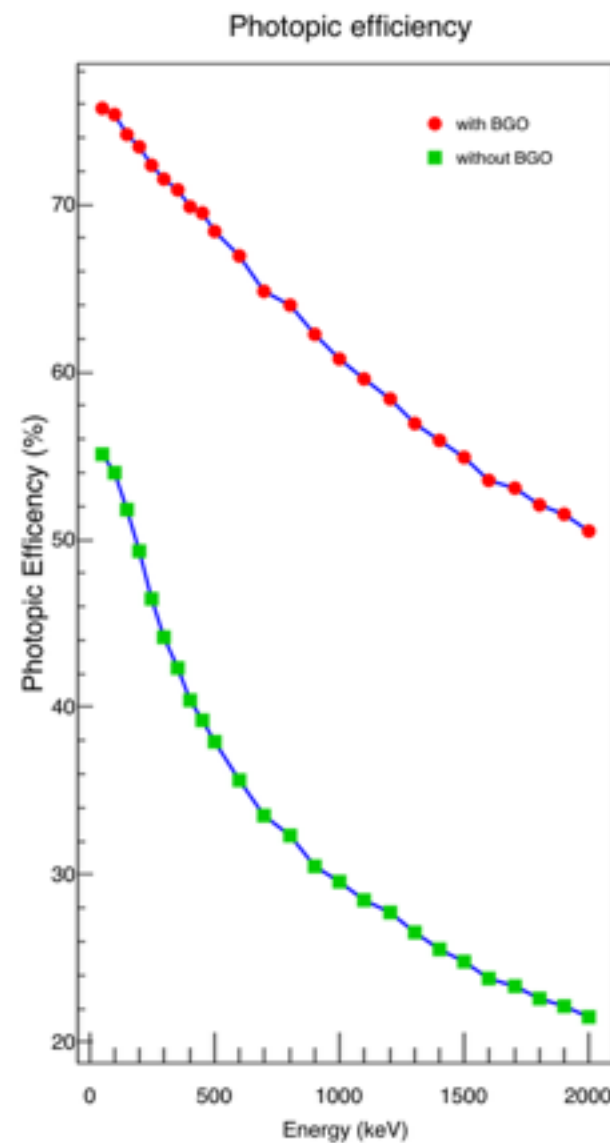
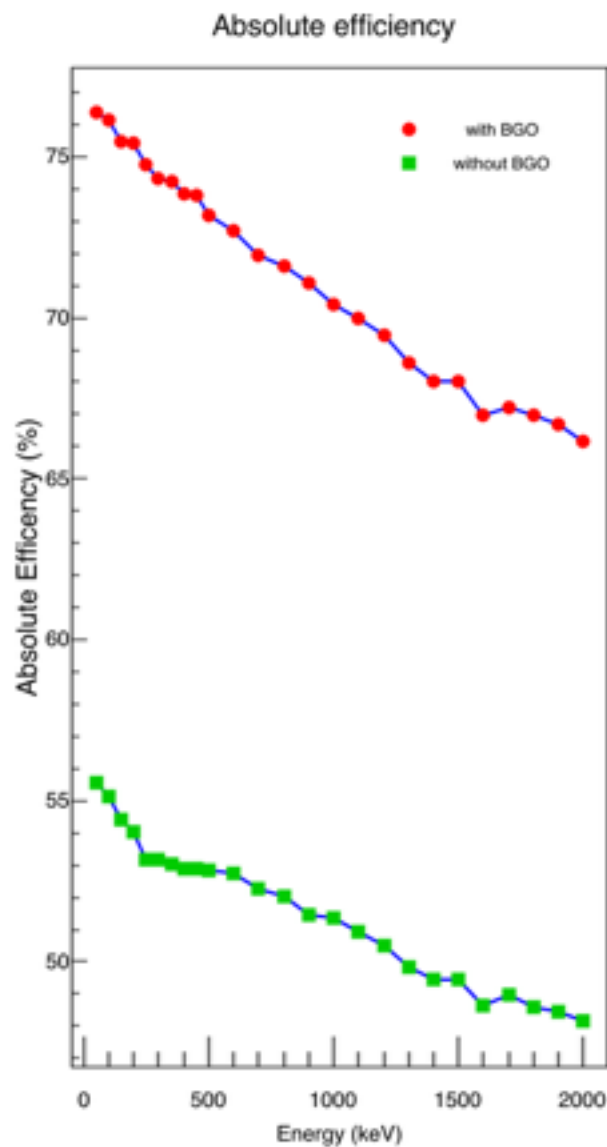


Geant4 ↔ USER

Results

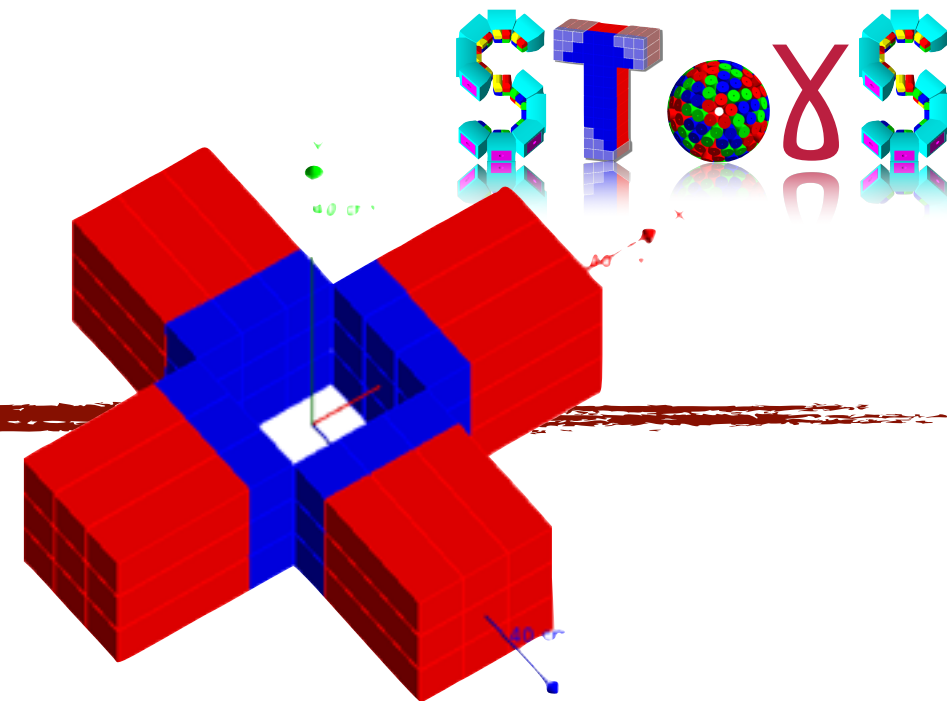


EXOGAM detector ^{137}Cs source
 $d = 11.35$ cm from the center



Results

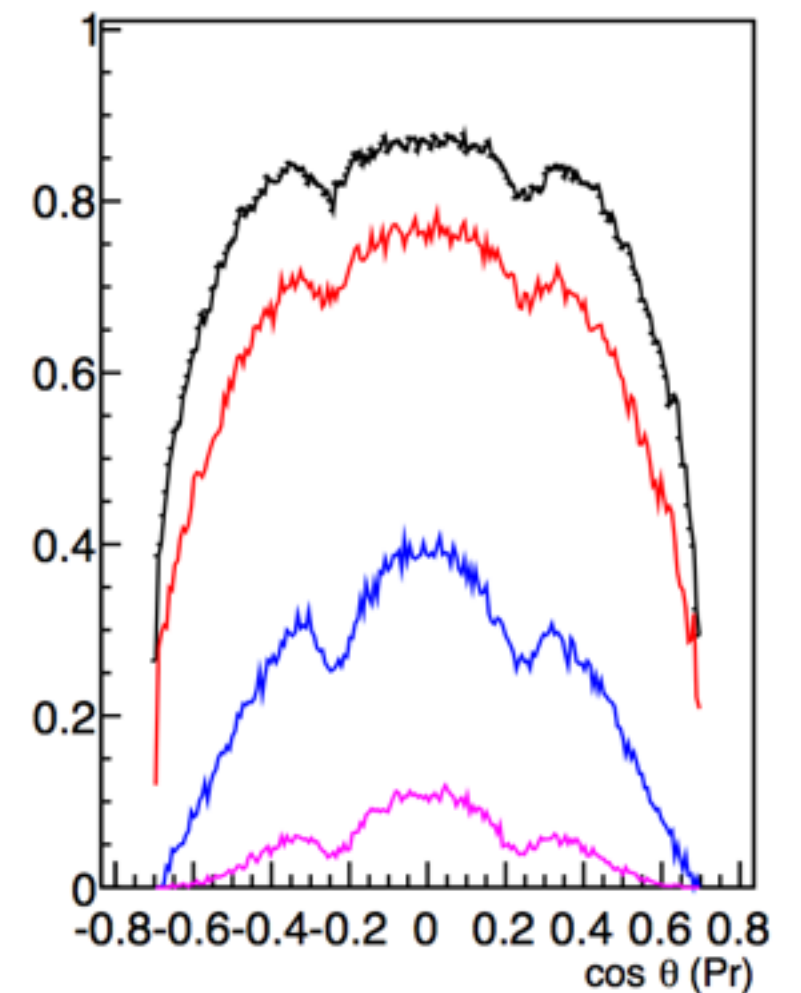
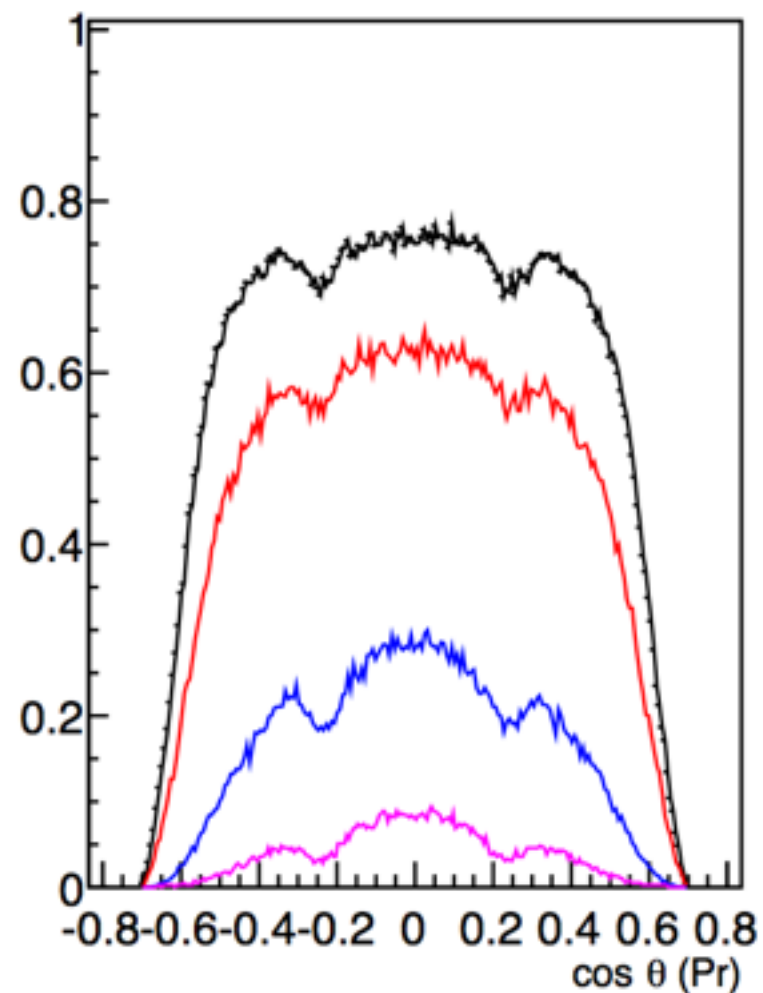
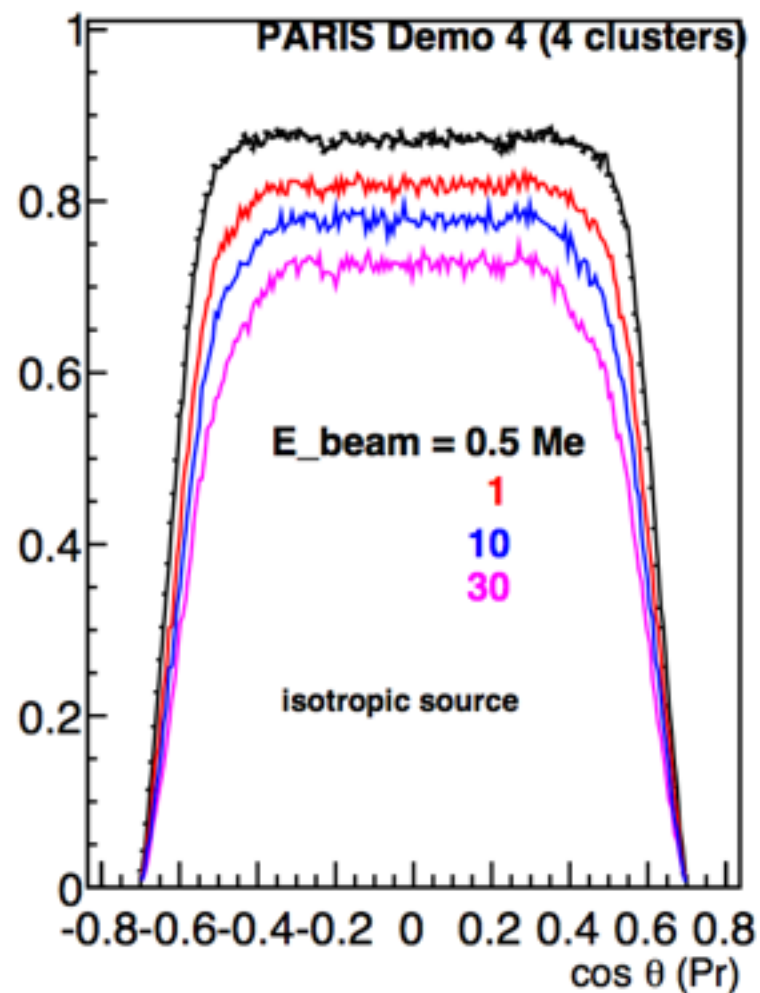
PARIS Demonstrator 4 clusters at 90°
 $d = 7.7701$ cm from the center



Total/Sent (absolute efficiency)

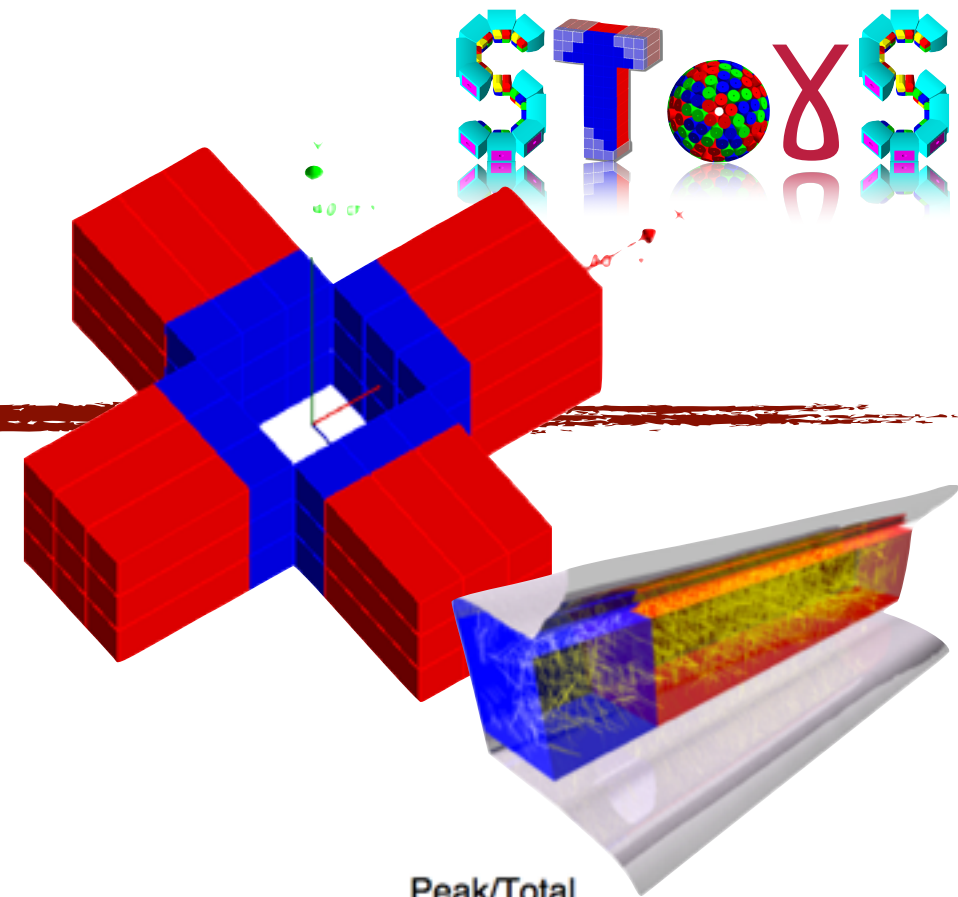
Peak/Sent (photopic efficiency)

Peak/Total



Results

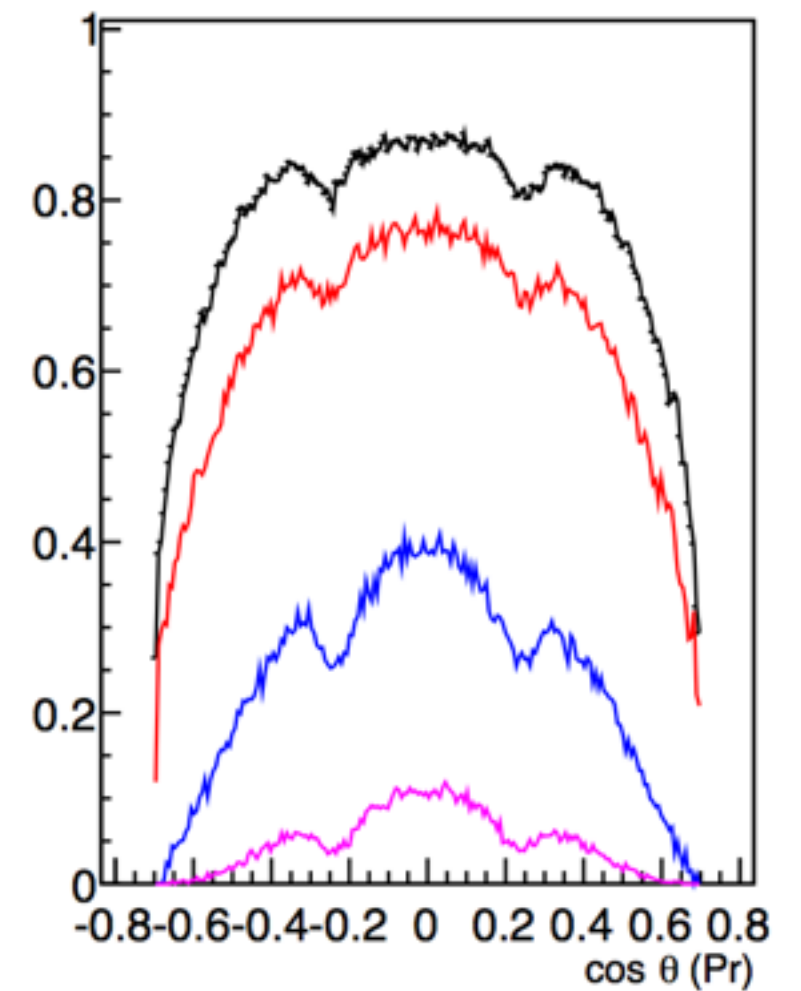
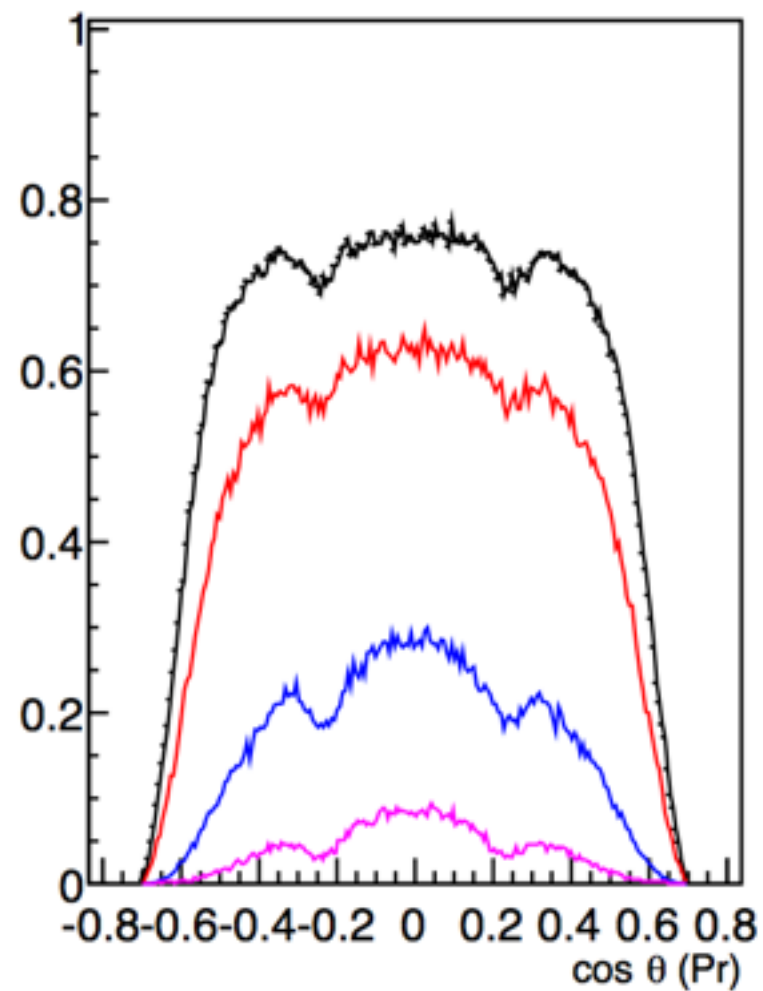
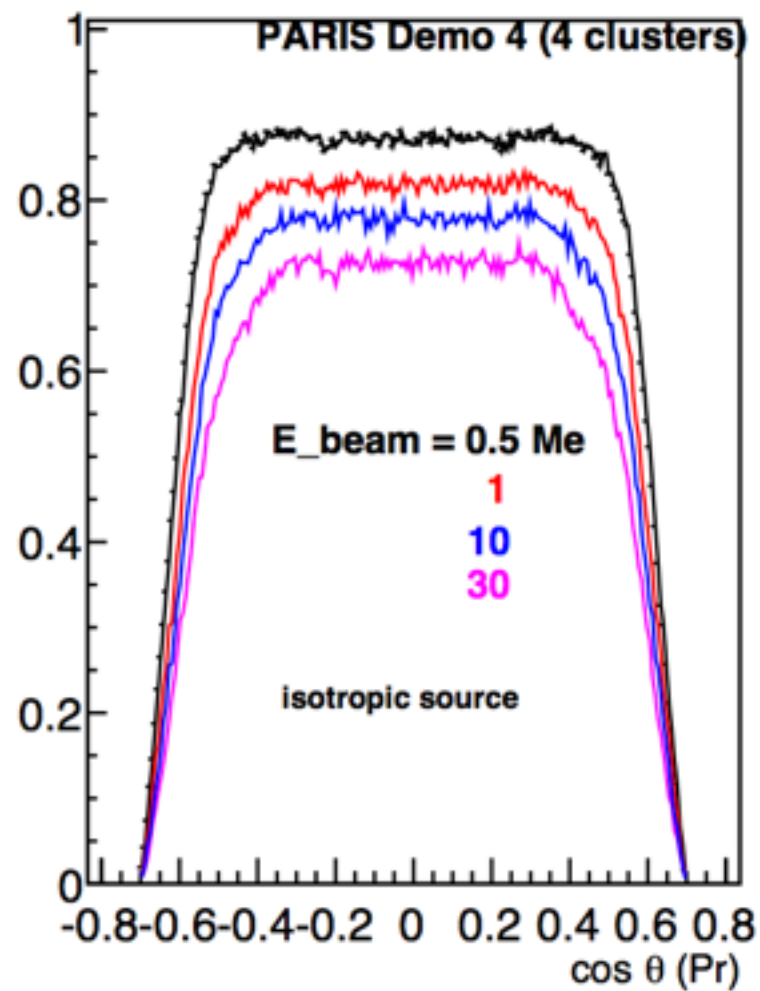
PARIS Demonstrator 4 clusters at 90°
 $d = 7.7701$ cm from the center



Total/Sent (absolute efficiency)

Peak/Sent (photopic efficiency)

Peak/Total



Conclusions

Documentation

User guide → In progress

Geometry

- ◆ based on facility to import-export set-up
- ◆ at the user level

More detectors to be added in the Factory

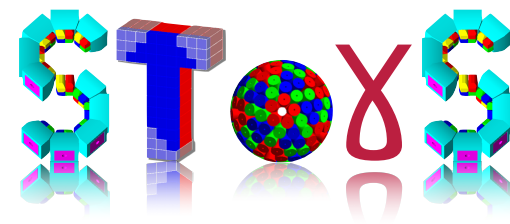
Physics

Output: plugging system i.e. ascii, root tree...

Input: ROOT tree interface (GPS like)

Nuclear reactions, exotic beam in Geant4

The
End



Configuration

Installation

```
git https://github.com/stezow/stogs
```

```
cmake
```

```
a version of Geant4 installed with the GDML module  
compiled
```

```
git clone https://github.com/stezow/stogs.git SToGS
```