Topic: README - EduGATE - Coincidence Channel (Coin_Chan)

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General Remarks on the general setup of the "Coincidence Channel"

The setup is best understood looking at Figure 1:

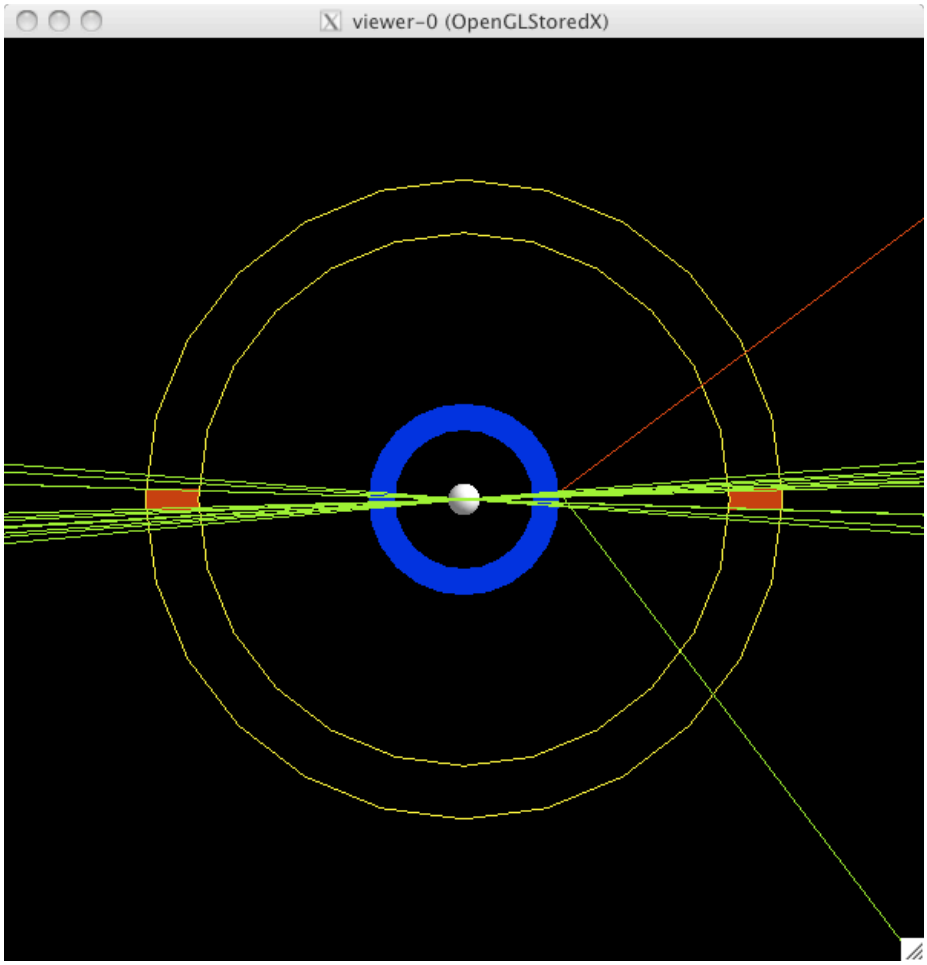

Fig. 1 a: General setup of the Coincidence Channel as seen from the front, i.e., looking with the z-axis. Please note, that the source volume is not visible as it is covered by the gamma rays in green.

The general setup of this "Coincidence Channel" is taken from the Cylindrical PET example, which comes with the GATE distribution, but has been simplified for the purpose of EduGATE.

For simplicity the type of source has been chosen as two gammas emitted back-to-back from an annihilation event. There is no explicit generation of a positron emitted from a nucleus and a subsequent annihilation with an electron. However, the interested user following the rules for GATE to define sources can easily introduce this.

The material of the volume surrounding the source(s) (named source_vol) can be selected in the configuration file. The same applies for the phantom (i.e attenuating volume) shown in blue. Here, also the thickness can/should be adjusted by varying the PhanRmax/PhanRmin in order to study the effect of attenuating or scattering material on gammas at different energies.

The Coincidence channel is the basic setup, consisting of two detector modules shown in red. The users, however, can extent this system by setting the number of detectors to a higher number like 8, 16, 32, or even 64, ending up with a fully equipped PET system (see also Fig. 1b). The material of the crystal used for detecting the gammas can be varied among various types.

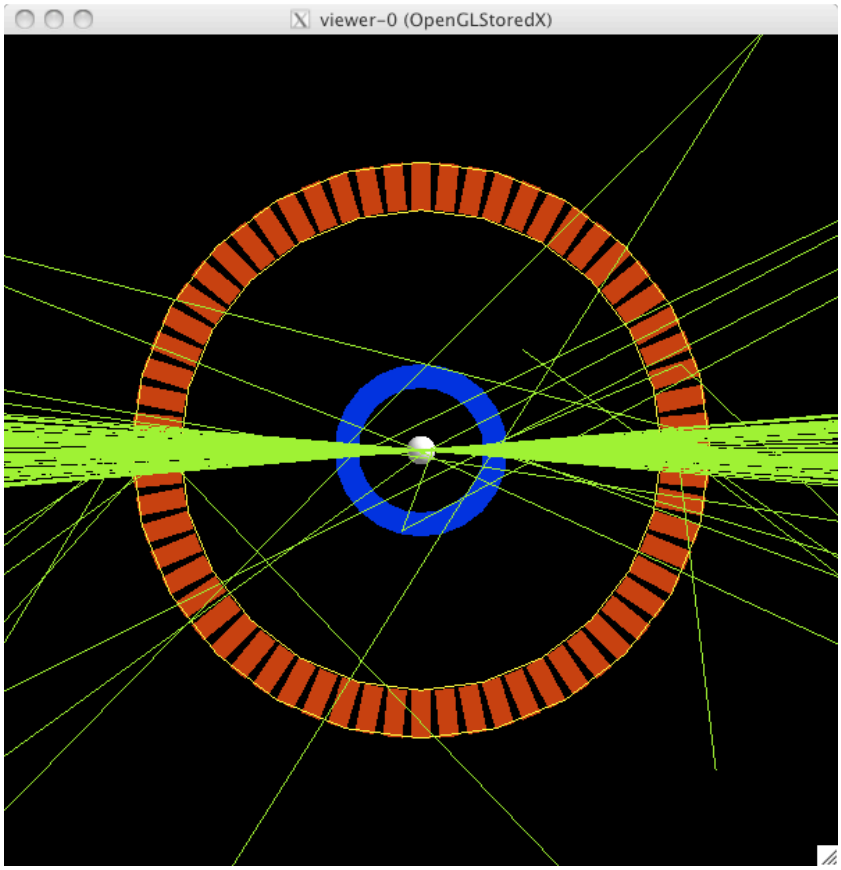

Fig. 1 b: Extended setup of the Coincidence Channel with 64 modules as seen from the front, i.e., looking with the z-axis. Scattered gammas now have the chance to be detected by the modules added to make up a full ring.

Specific Details:

0) Version GATE: gate_v6.1 / GEANT4: geant4-09-03-patch-02
GATE: gate_v6.0_p01 / GEANT4: geant4-09-02-patch-03
(two physics.com files are provided, one each version)

1) Files

config_starter.sh

(it looks like this:)

```
#!/bin/csh
# file config_starter.sh
source /Applications/gate_v6.1/env_gate.csh
root -l 'GenerateGateConfiguration.C( "Coin_chan.txt" )'
(select/modify your configuration interactively; a new configuration can be saved)
Gate Coin_Chan.mac
```

Coin_Chan.txt
(contains all options that can be set via 'GenerateGateConfiguration.C, see below under (2))

GenerateGateConfiguration.C
(see under “config_starter.sh”)

Main Macro
.../EduGate/Coin_Chan/Coin_Chan.mac
-- timing is specified here, using 'TimeSlice' to see progress of simulation
-- only ROOT-output is selected, carrying the number of detector modules and the material of the phantom in the "RootFileName"

central Macro to set up a specific configuration (via config_starter)
.../EduGate/Coin_Chan/configuration.mac

switching on/off visualization
.../EduGate/Coin_Chan/visu.mac
.../EduGate/Coin_Chan/novisu.mac

defining the phantom surrounding the source
.../EduGate/Coin_Chan/phantom.mac

define all physical processes
.../EduGate/Coin_Chan/physics.mac

define primary gamma source (type: backtoback)
.../EduGate/Coin_Chan/sources.mac

ROOT-based analysis Programm:
.../EduGate/Coin_Chan/Coin_Chan.C

2) Selecting a Configuration, Running Gate and perform an Analysis with Root:

to run the Coin_Chan example, simply type: *config_starter.sh*
and a window opens as shown in Figure 2.

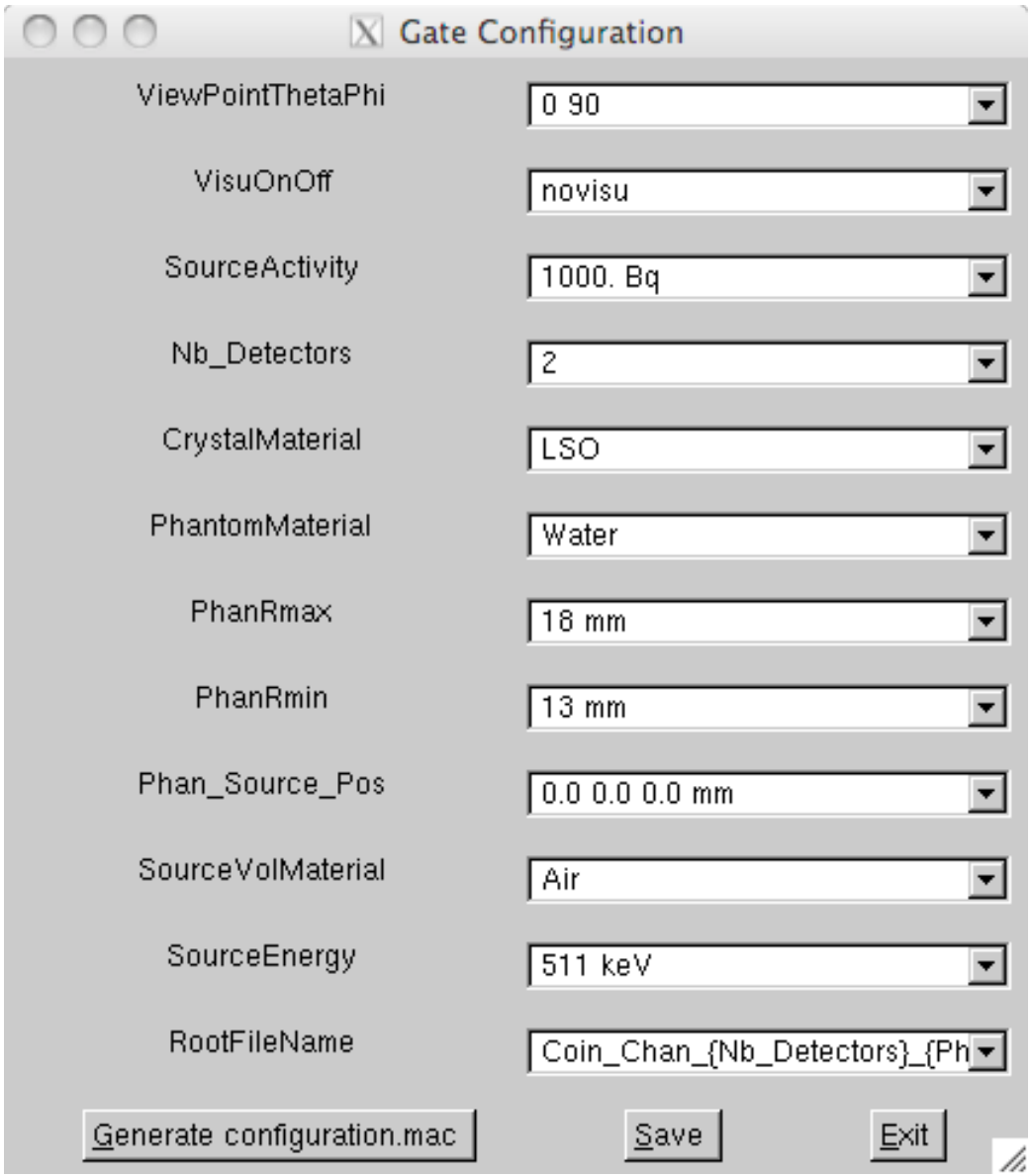

Fig. 2: Interactive selection of a configuration. Click the “Save”-button to store the current settings as default in file “Coin_Chan.txt” for the future. Click “Generate configuration.mac” to save the current setting in configuration.mac, which after clicking “Exit” will be used for the next run.

You should see lines like:

```
Processing GenerateGateConfiguration.C( "Coin_Chan.txt" )...
/control/alias ViewPointThetaPhi  0 90
/control/alias VisuOnOff  novisu
/control/alias SourceActivity  1000. Bq
/control/alias Nb_Detectors  2
/control/alias CrystalMaterial  LSO
/control/alias PhantomMaterial  Water
/control/alias PhanRmax  18 mm
/control/alias PhanRmin  13 mm
/control/alias Phan_Source_Pos  0.0 0.0 0.0 mm
/control/alias SourceVolMaterial  Air
/control/alias SourceEnergy  511 keV
/control/alias RootFileName  Coin_Chan_{Nb_Detectors}_{PhantomMaterial}
End of Configuration
```

This shows the contents of the file configuration.mac and is used in the Gate run started next.

A collection of possible parameters or options is stored in Coin_chan.txt. This file can be edited to include additional parameters that can be selected within the menu.

File: Coin_Chan.txt

```
ViewPointThetaPhi: 0 90; 90 0; 89 90; 30 30;
VisuOnOff: novisu; visu;
SourceActivity: 1000. Bq; 40. Bq; 100000. Bq;
Nb_Detectors: 2; 64;
CrystalMaterial: LSO; BGO; NaI;
PhantomMaterial: Water; Air; Vacuum; Lead; PVC; Plexiglass;
PhanRmax: 18 mm;
PhanRmin: 13 mm;
Phan_Source_Pos: 0.0 0.0 0.0 mm;
SourceVolMaterial: Water; Air; Vacuum; PVC; Plexiglass;
SourceEnergy: 511 keV; 100 keV;
RootFileName: Coin_Chan_{Nb_Detectors}_{PhantomMaterial};
```

GATE is started and a ROOT-file is created with a name specified in 'configuration.mac'

To run the ROOT-based analysis program, type: root -l Coin_Chan.C, which can also be directly started from config_starter.sh by adding this line to the script.

A window opens as shown in Fig. 3 and you can select a root file to be analyzed and a file with extension 'gif' is created, storing the displayed plot.

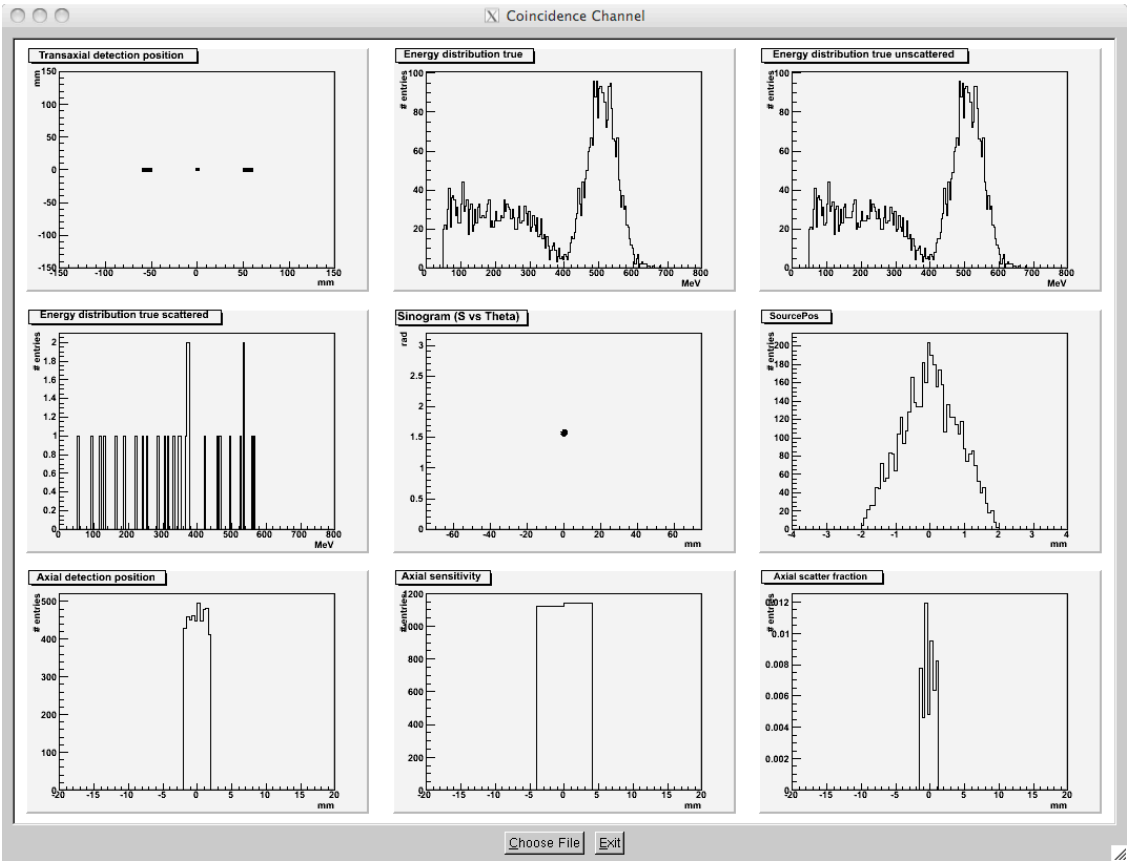

Fig. 3: Starting the root-analysis module (Coin_Chan.C) will show (after the selection of a root file) some plots previously defined in the module.

The output in the terminal window will also provide some statistics, as shown below:

```
##### Reading from file: Coin_Chan_2_Water

 ******************************************************************************
 *                                                                            *
 *  E d u G a t e  S i m u l a t i o n  A n a l y s i s                        *
 *  C o i n _ C h a n                                                         *
 *                                                                            *
 ******************************************************************************


 bytes read                      : 475208
 total coincidences              : 2284
 true unscattered coincidences   : 2266
 random coincidences             : 2
 scattered coincidences          : 16
 ratio scatter/true              : 0.0070609


 ******************************************************************************


Info in <TCanvas::Print>: GIF file Coin_Chan_2_Water.gif has been created
```