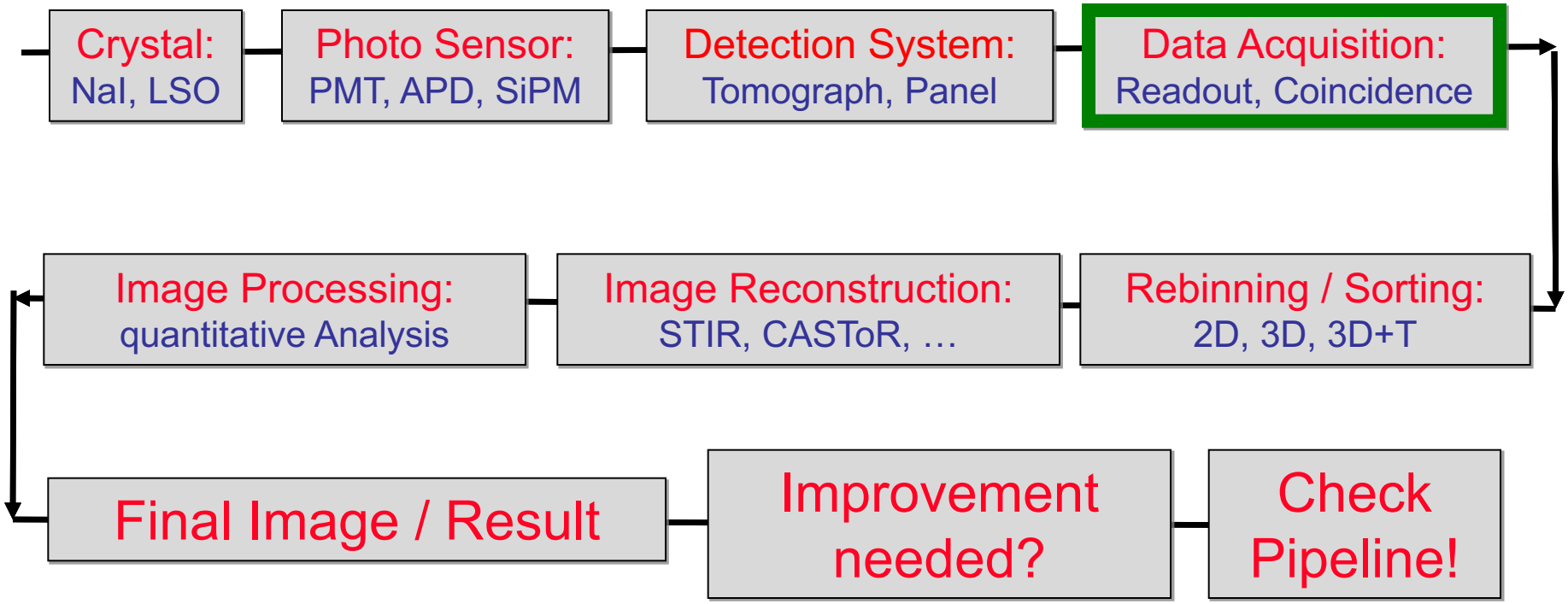
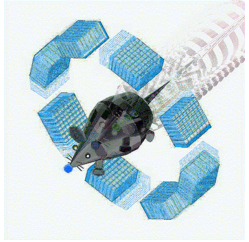
EduGATE → follows the basic Idea of a *Development / Processing* Pipeline ...

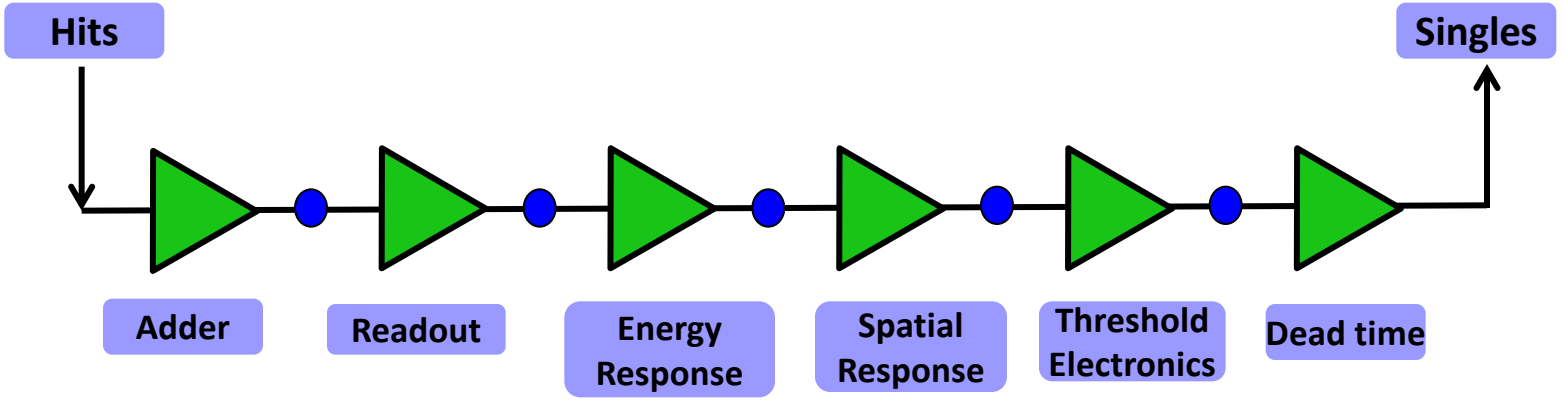
Experiment ⟷ **Simulation**





Signal Processing Pipeline:

Sensitive Detectors / Digitizer

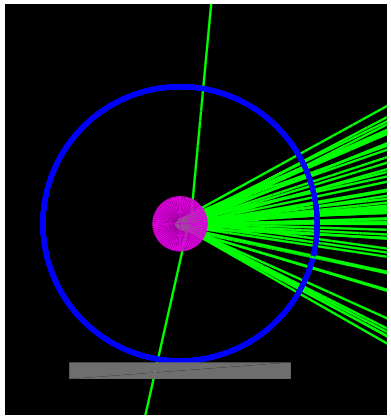


- Pre-programmed components
  - Sensitive detectors
  - Trajectory analyser
- Digitizer
  - Linear signal processing chain
  - Modular: set-up via scripting

```
/gate/digitizer/modules/insert blurring
/gate/digitizer/blurring/setResolution 0.15

/gate/digitizer/modules/insert spblurring
/gate/digitizer/spblurring/setResolution 0.15

/gate/digitizer/modules/insert readout

/gate/digitizer/modules/insert thresholder
/gate/digitizer/thresholder/setThreshold 50. keV
```

Basic GATE Macro → Phantom and Source

```
# PHANTOM V OLUME

# Create the attenuating volume/phantom

/gate/world/daughters/name Phantom
/gate/world/daughters/insert cylinder
/gate/Phantom/geometry/setRmax 50.0  mm
/gate/Phantom/geometry/setRmin 49.0  mm
/gate/Phantom/geometry/setHeight 20. cm
/gate/Phantom/placement/setTranslation
                                    0. 0. 0. cm
/gate/Phantom/setMaterial Water
/gate/Phantom/vis/setColor blue
#/gate/Phantom/vis/forceWireframe
/gate/Phantom/vis/forceSolid

/gate/Phantom/attachPhantomSD
```



```
# SOURCE Volume

# Add an extra object for source volume
/
gate/world/daughters/name source_vol
/gate/world/daughters/insert cylinder
/gate/source_vol/geometry/setRmax 2.  cm
/gate/source_vol/geometry/setRmin 0. cm
/gate/source_vol/geometry/setHeight 8. cm
/gate/source_vol/placement/setTranslation
                                    0. 0. 0. cm
/gate/source_vol/setMaterial Water
/gate/source_vol/vis/setColor magenta
/gate/source_vol/vis/forceWireframe
#/gate/source_vol/vis/forceSolid

/gate/source_vol/attachPhantomSD
```

file: Gamma_Camera.txt
with start-settings

→ large number of combinations

ViewPointThetaPhi: 0 90; 90 0; -90 0; 89 90;

VisuOnOff: novisu; visu;

Src_Act: 20 Bq; 50 Bq; 100 Bq; 1000 Bq; 10000 Bq; 0.1 MBq; 0.5

CameraType: camera_Tc; camera_I_131;

x_pos: 20.0; 15.0; 10.0;

CollMat: Lead; Vacuum; Air; Copper; Iron; Tungsten; Plexiglass;

CrysMat: NaI; BGO; LSO; GSO; PWO; LuAP; YAP; CZT;

PhanMat: Plexiglass; Water; Air; Vacuum; Lead; PVC; Copper;….;

PhanRmax: 50 mm; 52 ; 54 ;

PhanRmin: 49 mm; 49.99 mm; 49.9 mm; 49.5 mm;

SrcVolMat: Plexiglass; Air; Water; Vacuum; PVC;

SrcType: src_gamma_3_lim_ang; src_gamma_lim_ang;

Src_E: 140; 80; 364; 511; 1000; 2284;

E_blur: 0.1; 0.0; 0.05; 0;0.15; 0.20; 0.25;

SP_blur: 2.0; 0.5; 1.0; 1.5; 2.5; 3.0; 4.0; 5.0;

E_low: 5; 50; 100;

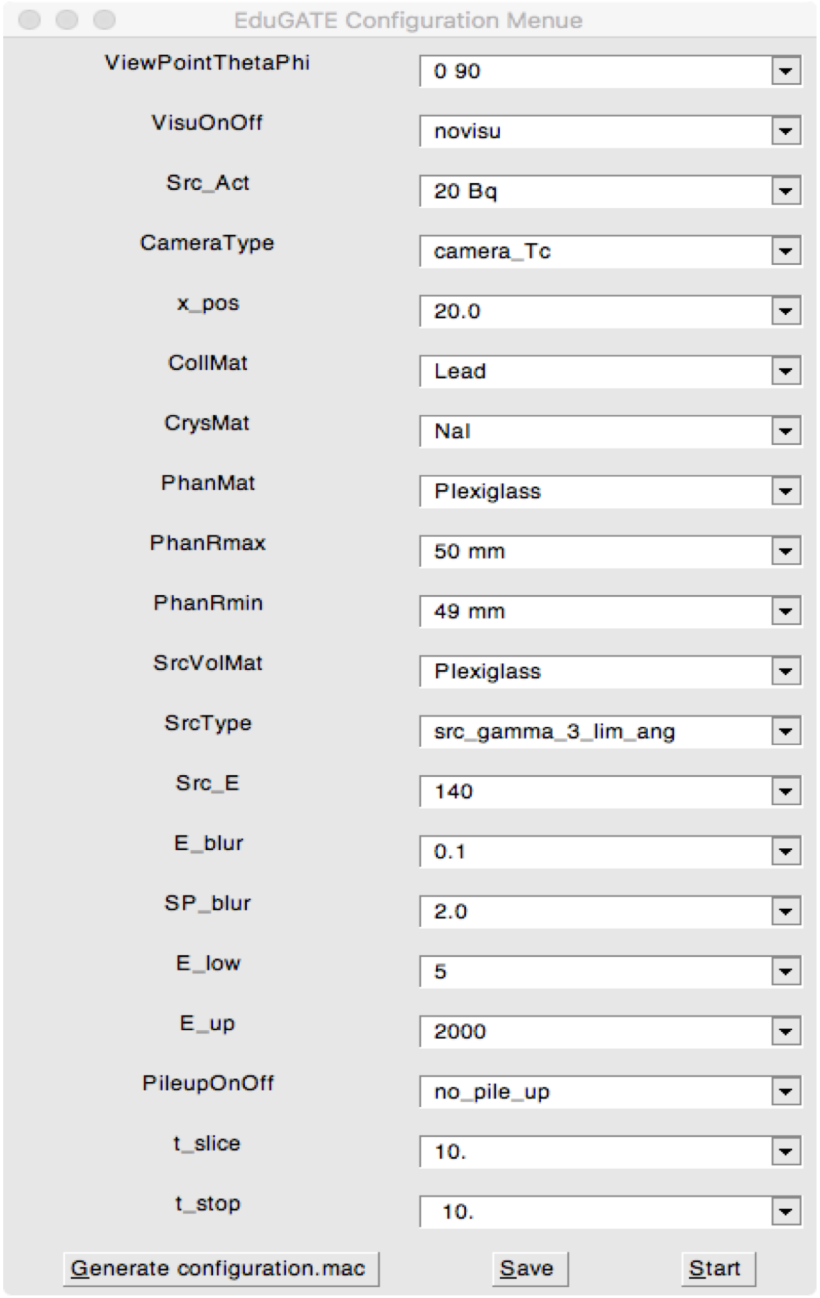
E_up: 2000; 100;

PileupOnOff: no_pile_up; pile_up;

t_slice: 10.; 1.0; 0.1; 0.01; 0.001; 0.0001;

t_stop: 10.; 1.0; 0.1; 0.01; 0.001; 0.0001;

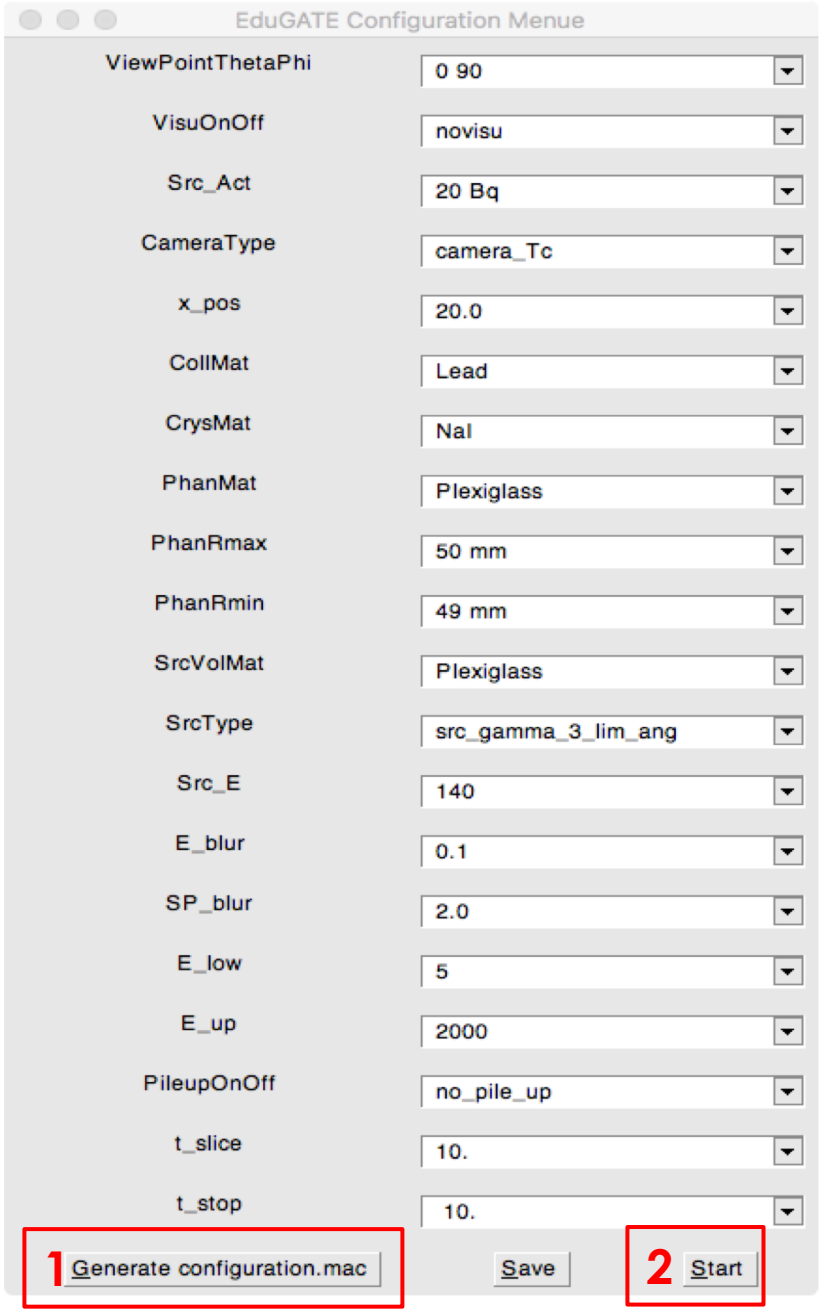
default selections



file: configuration.mac

← generated based on selections

```
/control/alias ViewPointThetaPhi  0 90
/control/alias VisuOnOff  novisu
/control/alias Src_Act  10000 Bq
/control/alias CameraType  camera_Tc
/control/alias x_pos  20.0
/control/alias CollMat  Lead
/control/alias CrysMat  NaI
/control/alias PhanMat  Plexiglass
/control/alias PhanRmax  50 mm
/control/alias PhanRmin  49 mm
/control/alias SrcVolMat  Plexiglass
/control/alias SrcType  src_electron_lim_ang
/control/alias Src_E  140
/control/alias E_blur  0.1
/control/alias SP_blur  2.0
/control/alias E_low  5
/control/alias E_up  2000
/control/alias PileupOnOff  no_pile_up
/control/alias t_slice  10.
/control/alias t_stop   10.
```



Hints for bookkeeping

construct Root-file-name from specific parameters:

GC_camera_Tc_Lead_NaI_Plexiglass_Plexiglass_src_gamma_3_lim_ang_140_1000Bq_ no_pile_up_0.1_2.0_5_2000_1.0_10..root

/control/alias RootFileName GC_{CamType}_{CollMat}_{CrysMat}_{PhanMat}_{SrcVolMat}_{SrcType}_{Src_E}_{Src_Act}

_{PileupOnOff}_{E_blur}_{SP_blur}_{E_low}_{E_up}_{t_slice}_{t_stop}

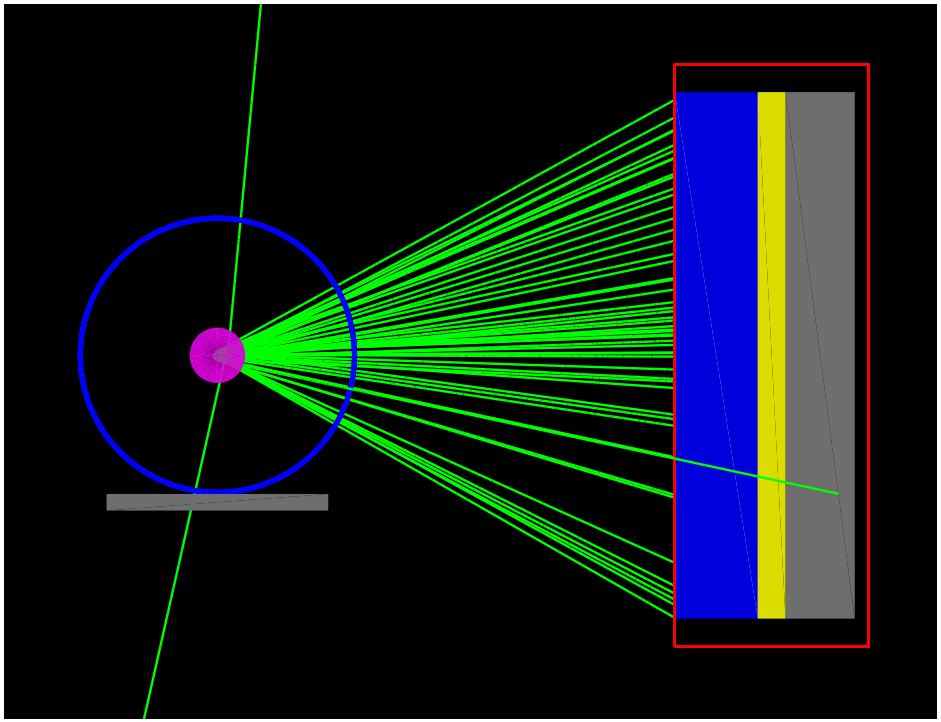
GC → Gamma_Camera:

(Correspondence - slected items)

CamType	camera_Tc
SrcType	sources_gamma_3
CollMat	Lead
CrysMat	NaI
Src_E	140 keV
Src_A	0.1MBq
E_blur	0.0
SP_blur	2.0 mm
E_low	5 keV
E_up	2000 keV
t_slice	1.0 sec → **# runs**
t_sop	10 sec →simulation time

Basic EduGATE Examples

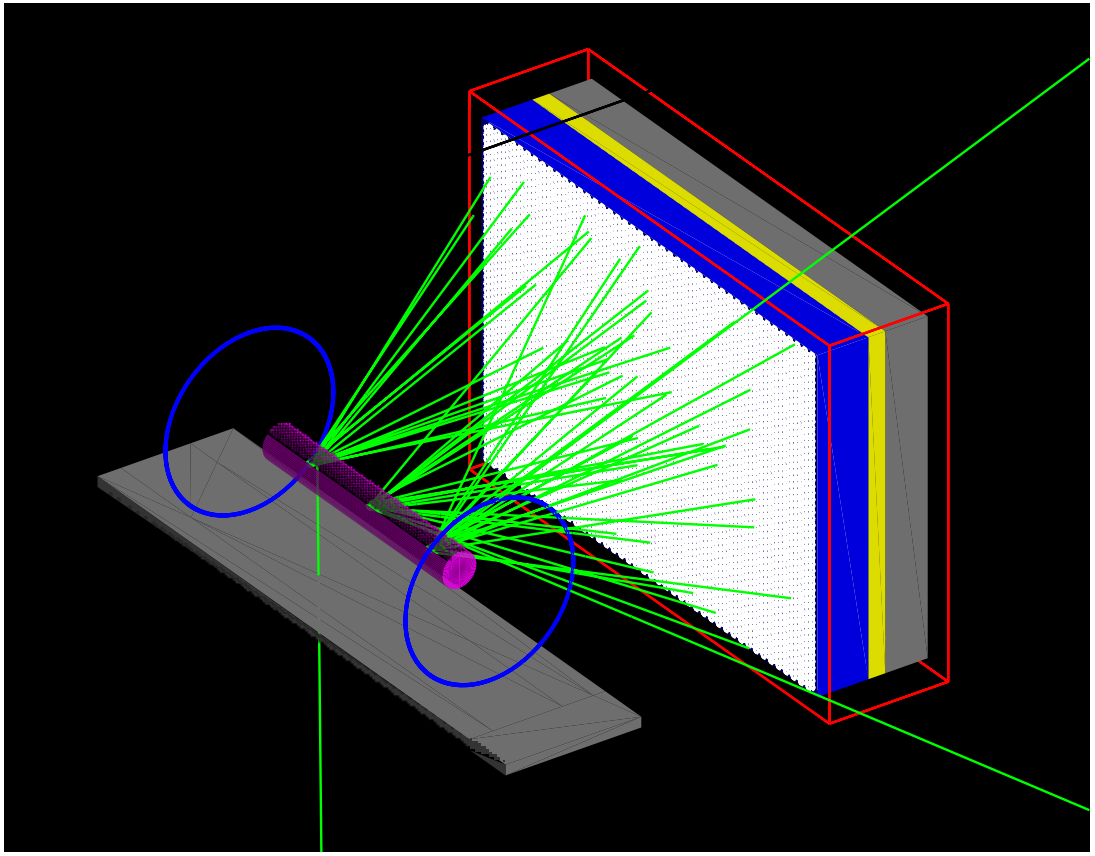
Planar Gamma Camera System



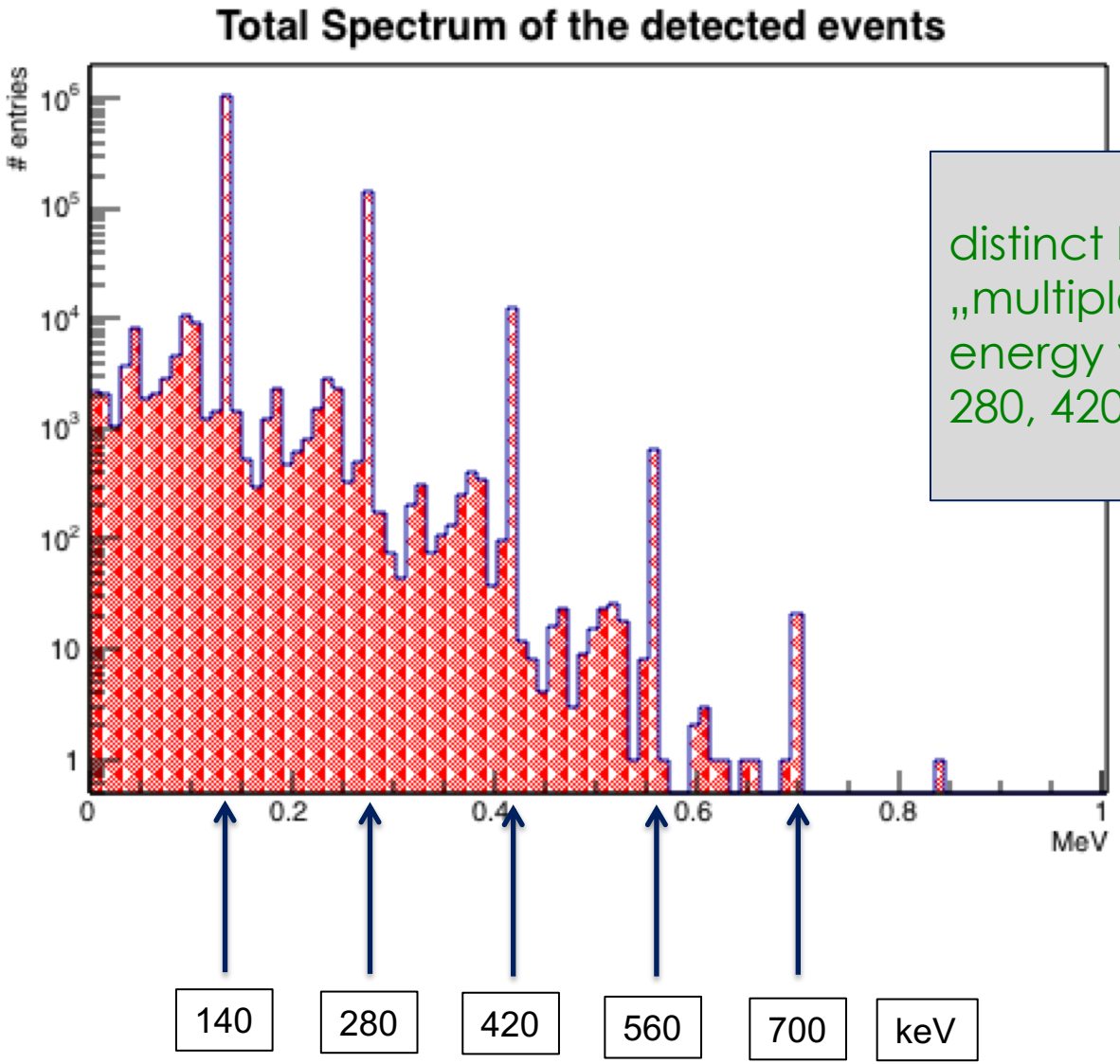
- Left : Magenta: cylindrical Phantom & Source, Blue: hollow cylinder serving as attenuating material of various types,
- Right: Head – Blue: Collimator – Yellow: Crystal, Grey: Back-compartment, Table
- Green: Gamma-rays

Basic EduGATE Examples

Planar Gamma Camera System



Perspective View – Facing the Front: Magenta: cylindrical Phantom & Source,
Blue: hollow cylinder serving as attenuating material of various types,
White: Camera-Head, Green: Gamma-rays



Effect of Pulse Pile-up

distinct lines show „multiples“ of basic energy value 140 keV → 280, 420, 560 700, 840 keV

GC_src_gamma_3_lim_ang_Lead_NaI_140_**100 MBq_pile_up**_0.0_2.0_5_2000_0.1_1.0.root
additional line for the DIGITIZER:
/gate/digitizer/Singles/insert pileup
/gate/digitizer/Singles/pileup/setDepth 1
/gate/digitizer/Singles/pileup/setPileup 100 ns

no energy blurring

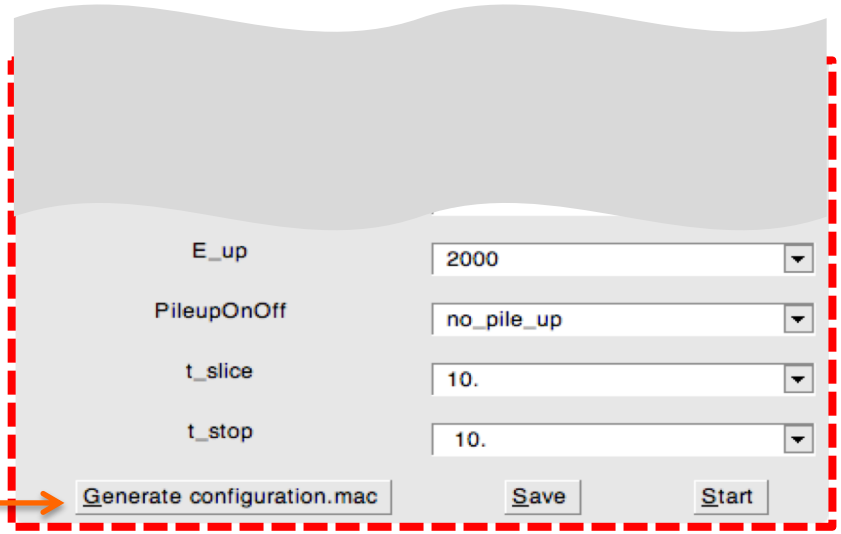
Demo-1(Gamma Camera)

- How to start??
- → use basic scripts to setup environment:

source config_starter_80_mac.csh

```
#!/bin/csh
# file config_starter80.csh  (also available for GATE 7.2)

setenv CURPATH $cwd

cd /Applications/root_v6.08.06/bin
source thisroot.csh

cd /Applications/geant4.10.03.p01-install/bin
source geant4.csh

setenv PATH /Applications/gate_v8.0-install/bin:$PATH

cd $CURPATH
```

```
# select configuration:

root -l 'GenerateGateConfiguration.C( "Gamma_Camera.txt" )'
```




```
# start GATE:

Gate Gamma_Camera.mac | & tee Gamma_Camera.log

echo Time is: `date` | & tee -a Gamma_Camera.log

# start Analysis:

root -l Gamma_Camera.C      → Select RootFile …
```

```
##### Number of emitted particles      : 300438
##### Number of detected events        :   1428
##### Primary events                   :   1185
##### Scatter in the phantom           :     42
##### Scatter in the table             :      0
##### Scatter in the collimator        :      7
##### Scatter in the crystal           :    168
##### Scatter in the backcompartment   :     25
```

Contact

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