

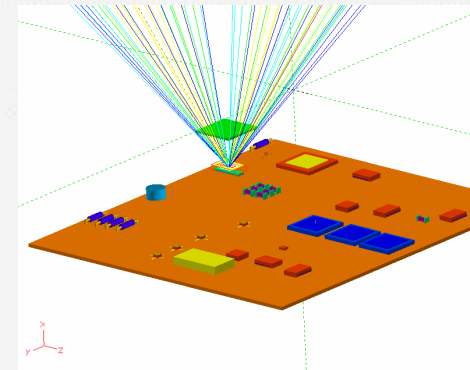


FASTRAD V3

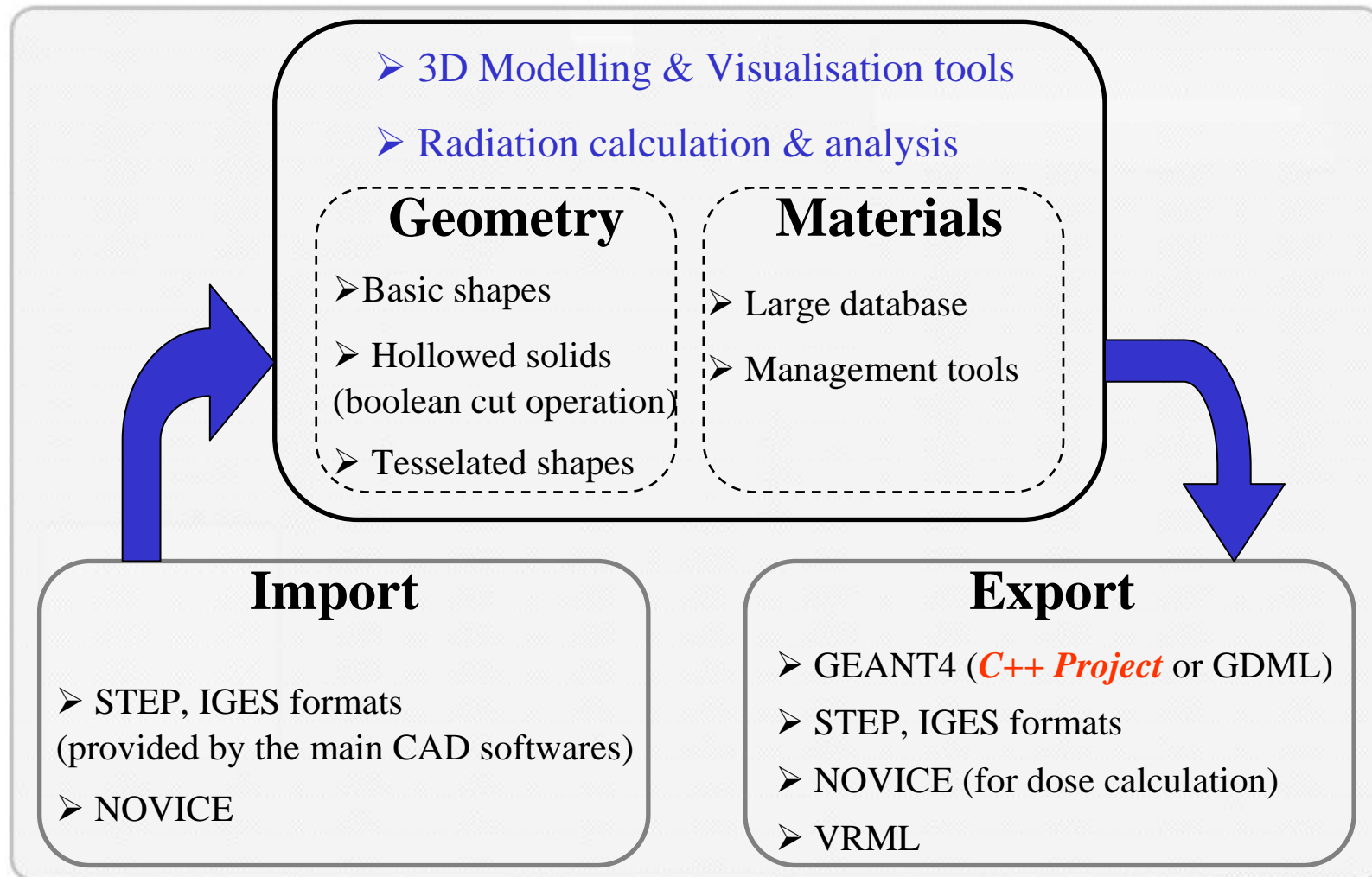
Ecole Geant4 Presentation
June 8th, 2007

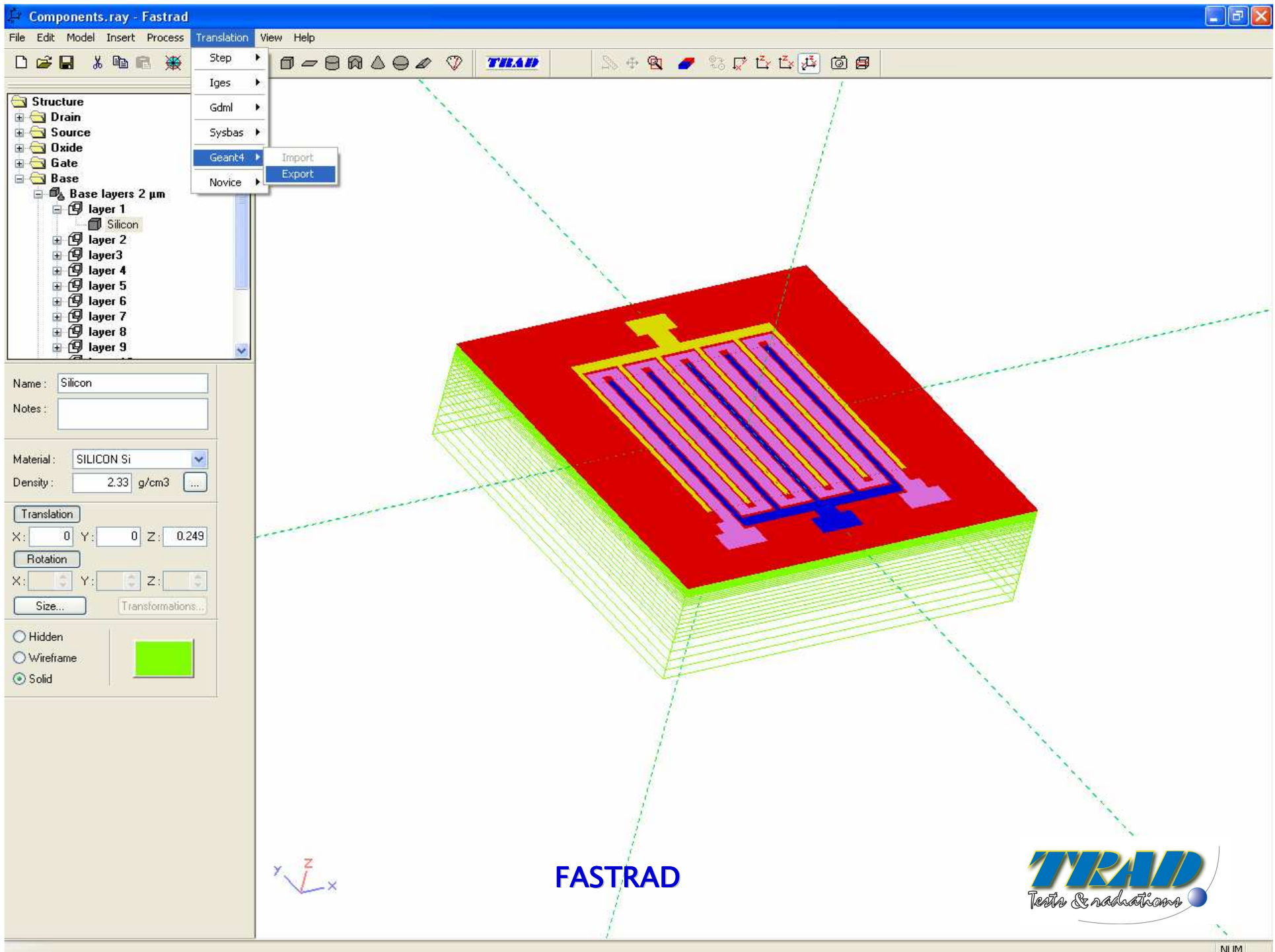
Main Functionalities

- Radiation CAD (Computer-Aided Design) Tool
 - 3D Geometry (simple shapes), materials, sensitive detectors
 - Design assistance tools.
 - Import 3D models : STEP, IGES
- Sector Analysis Tools
 - Ray-tracing on complex shapes
 - Post processing
- CAD Interface for others softwares
 - NOVICE import/export (EMPC)
 - **GEANT4 export (CERN)**



FASTRAD Application





Geant4 interface

Creation of Geant4 type files based on geometrical models designed with FASTRAD.

Interface provides several important tools :

- 16 different Physical Processes
- Detailed source definition
- 3 calculation methods
- Creation of macro files allowing an easier and more efficient use of Geant4

Geant4 interface – Main Dialog Box (1/7)

Contains the elements to choose the physical models and the type of particles.

It gives also access to two other dialog boxes of the interface :

- GPS Dialog Box (source definition)
- Histogram Dialog Box

Geant4 interface – Main Dialog Box (2/7)

Translation for GEANT 4

Project name:

Particule type:

Ion:

Number of beams:

Scenario (Physical processes):

☒ Electromagnetic ☒ WithNeutron ☒ WithMuon

Construction of particles' source:

☒ Parameters of histogramming :

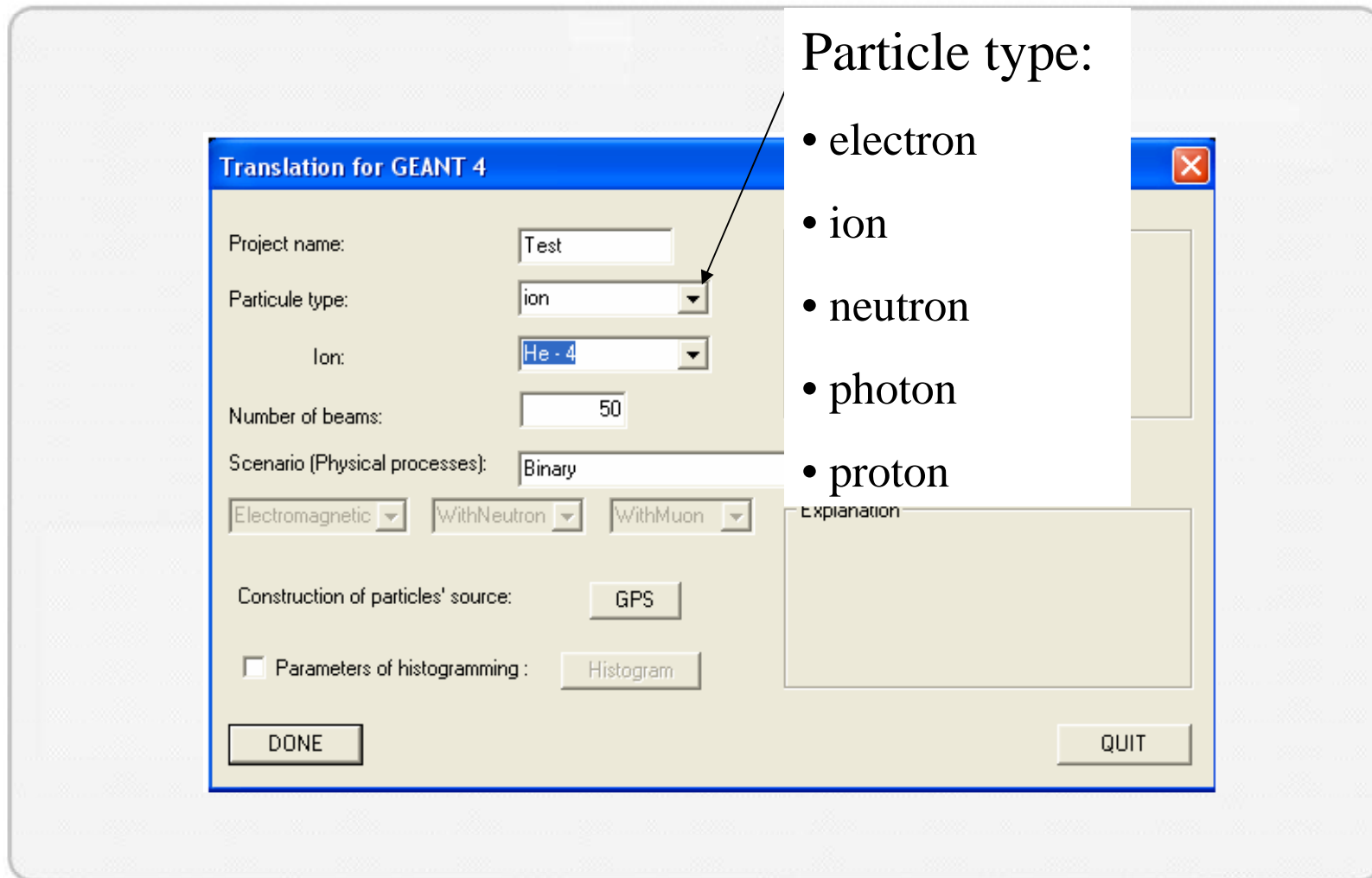
Scenario description

Binary scenario:

- Standard EM Physics
- Standard Hadron EM Physics
- Binary Hadron Inelastic Physics
- Muon Physics

Explanation

Geant4 interface – Main Dialog Box (3/7)



Geant4 interface – Main Dialog Box (4/7)

Translation for GEANT 4

Project name: Test

Particle type: ion

Ion: He - 4

Number of beams: 50

Scenario (Physical processes): Binary

Electromagnetic WithNeutron WithMuon

Construction of particles' source: GPS

☐ Parameters of histogramming : Histogram

DONE QUIT

Scenario
Binary sce
Standard
Standard
Standard
Binary Hadron Inelastic Physics
Muon Physics

For ions, list of every stable ions by element and isotope

Geant4 interface – Main Dialog Box (5/7)

Translation for GEANT 4

Project name:

Particule type:

Ion:

Number of beams:

Scenario (Physical processes):

Construction of particles' source:

☐ Parameters of histogramming :

Physical process:

- standard or low energy EM
- classic or binary
- Mars5GeV scenarios
- 8 others scenarios : combination of standard or low energy EM with or without neutrons and with or without muons

Geant4 interface – Main Dialog Box (6/7)

Translation for GEANT 4

Project name: Test

Particle type: ion

Ion: He - 4

Number of beams: 50

Scenario (Physical processes): Binary

Electromagnetic WithNeutron WithMuon

Construction of particles' source: GPS

☐ Parameters of histogramming : Histogram

DONE

Scenario description

Binary scenario:

- Standard EM Physics
- Standard Hadron EM Physics
- Binary Hadron Inelastic Physics
- Muon Physics

Explanation

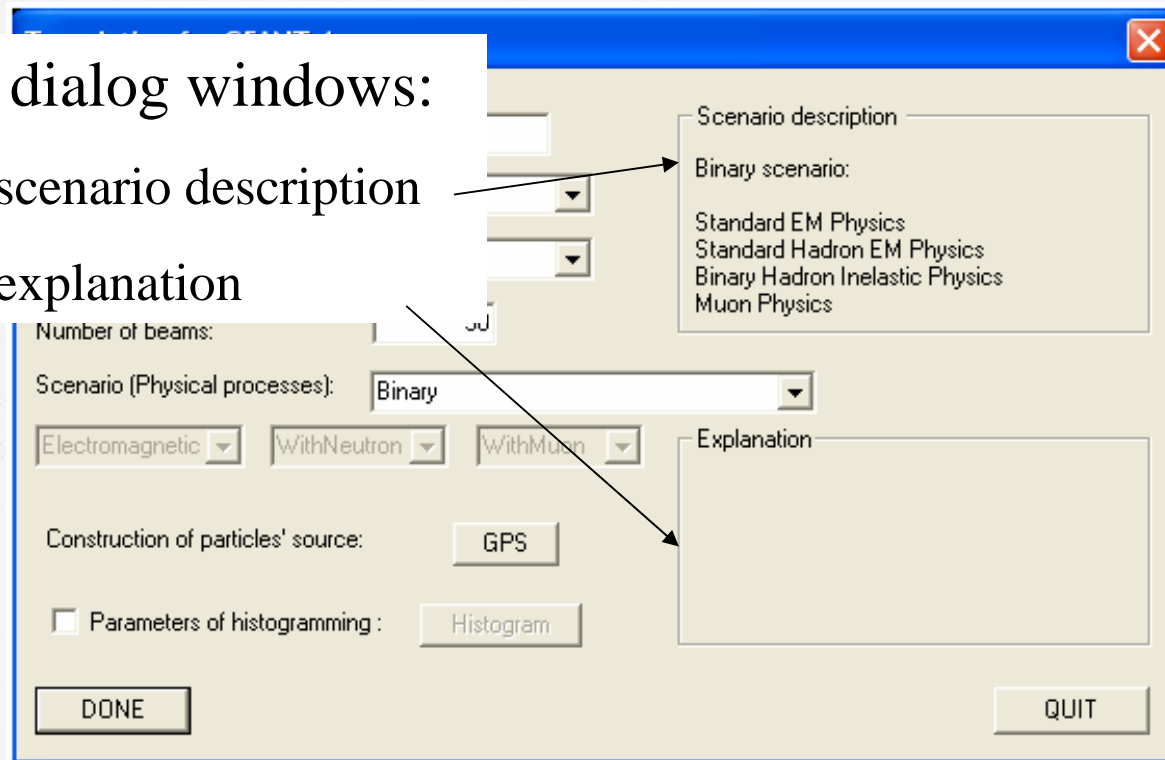
Calling buttons for 2 others dialog boxes:

- GPS (source definition)
- Histogramming

Geant4 interface – Main Dialog Box (7/7)

2 dialog windows:

- scenario description
- explanation



Geant4 interface – GPS Dialog Box (1/5)

Allows the configuration of the GPS that describes the incident particles source:

- Geometry
- Position
- Incident energy distribution
- Directional distribution

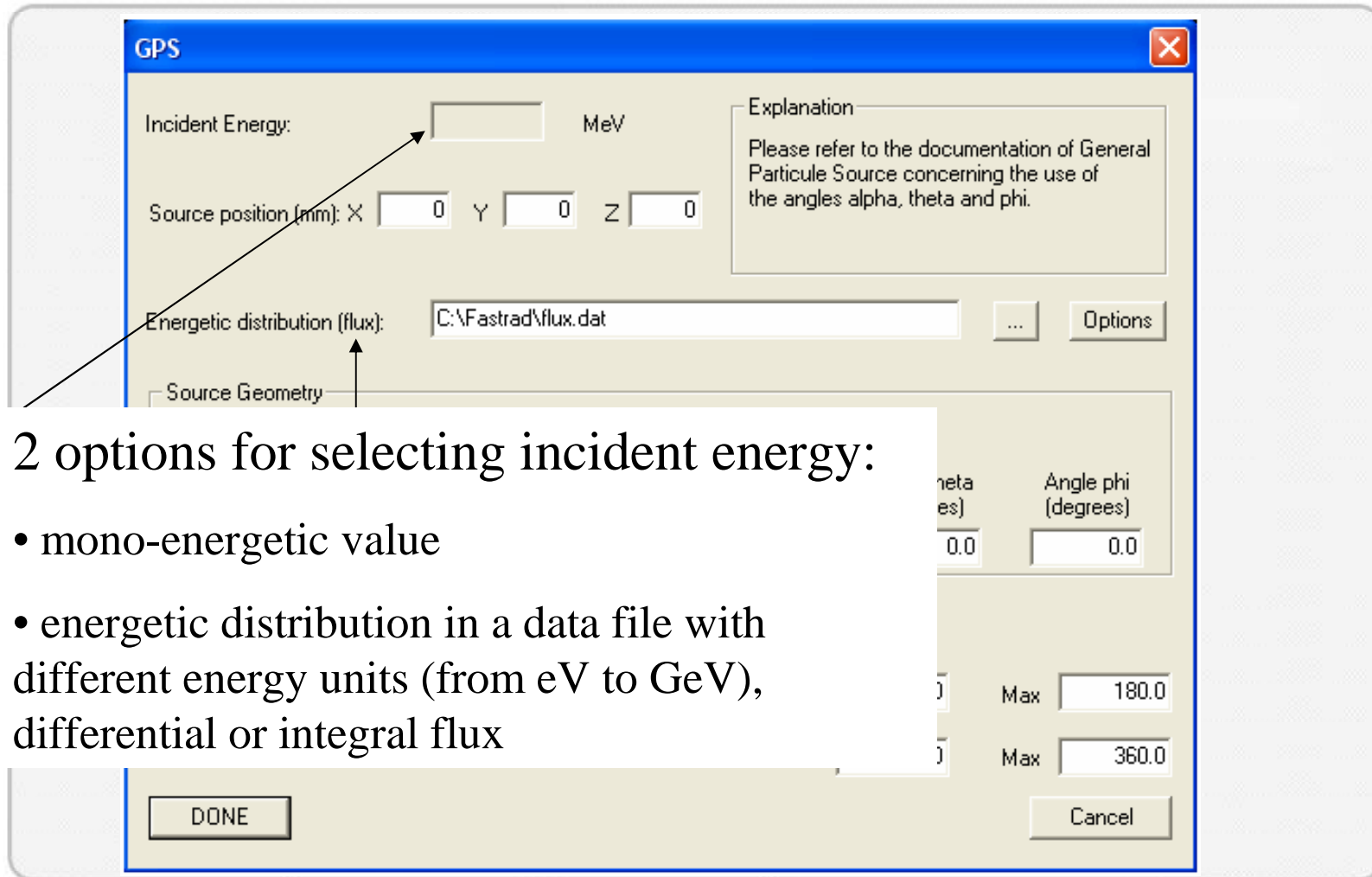
Geant4 interface – GPS Dialog Box (2/5)

The screenshot shows the 'GPS' dialog box with the following settings:

- Incident Energy:** [] MeV
- Source position (mm):** X [0] Y [0] Z [0]
- Energetic distribution (flux):** C:\Fastrad\flux.dat [...] [Options]
- Source Geometry:**
 - Type: [Volume] Shape: [Parallelepiped]
 - Half-length in the x-direction (mm): [10.0]
 - Half-length in the y-direction (mm): [10.0]
 - Half-length in the z-direction (mm): [10.0]
 - Angle alpha (degrees): [0.0]
 - Angle theta (degrees): [0.0]
 - Angle phi (degrees): [0.0]
- Initial direction:** X [0] Y [0] Z [1]
- Angular distribution:** [Isotropic]
 - Theta: Min [0.0] Max [180.0]
 - Phi: Min [0.0] Max [360.0]
- Buttons:** [DONE] [Cancel]

Explanation:
Please refer to the documentation of General Particle Source concerning the use of the angles alpha, theta and phi.

Geant4 interface – GPS Dialog Box (3/5)



2 options for selecting incident energy:

- mono-energetic value
- energetic distribution in a data file with different energy units (from eV to GeV), differential or integral flux

Geant4 interface – GPS Dialog Box (4/5)

Source geometry:

- type : point, beam, plane, surface and volume
- shape depends on type. The most current are :
circle, rectangle, square, annulus, ellipse ...
- parameters : half-lengths, radius and angles corresponding to type and shape

Source Geometry

Type: Shape:

Half-length in the x-direction (mm)	Half-length in the y-direction (mm)	Half-length in the z-direction (mm)	Angle alpha (degrees)	Angle theta (degrees)	Angle phi (degrees)
<input type="text" value="10.0"/>	<input type="text" value="10.0"/>	<input type="text" value="10.0"/>	<input type="text" value="0.0"/>	<input type="text" value="0.0"/>	<input type="text" value="0.0"/>

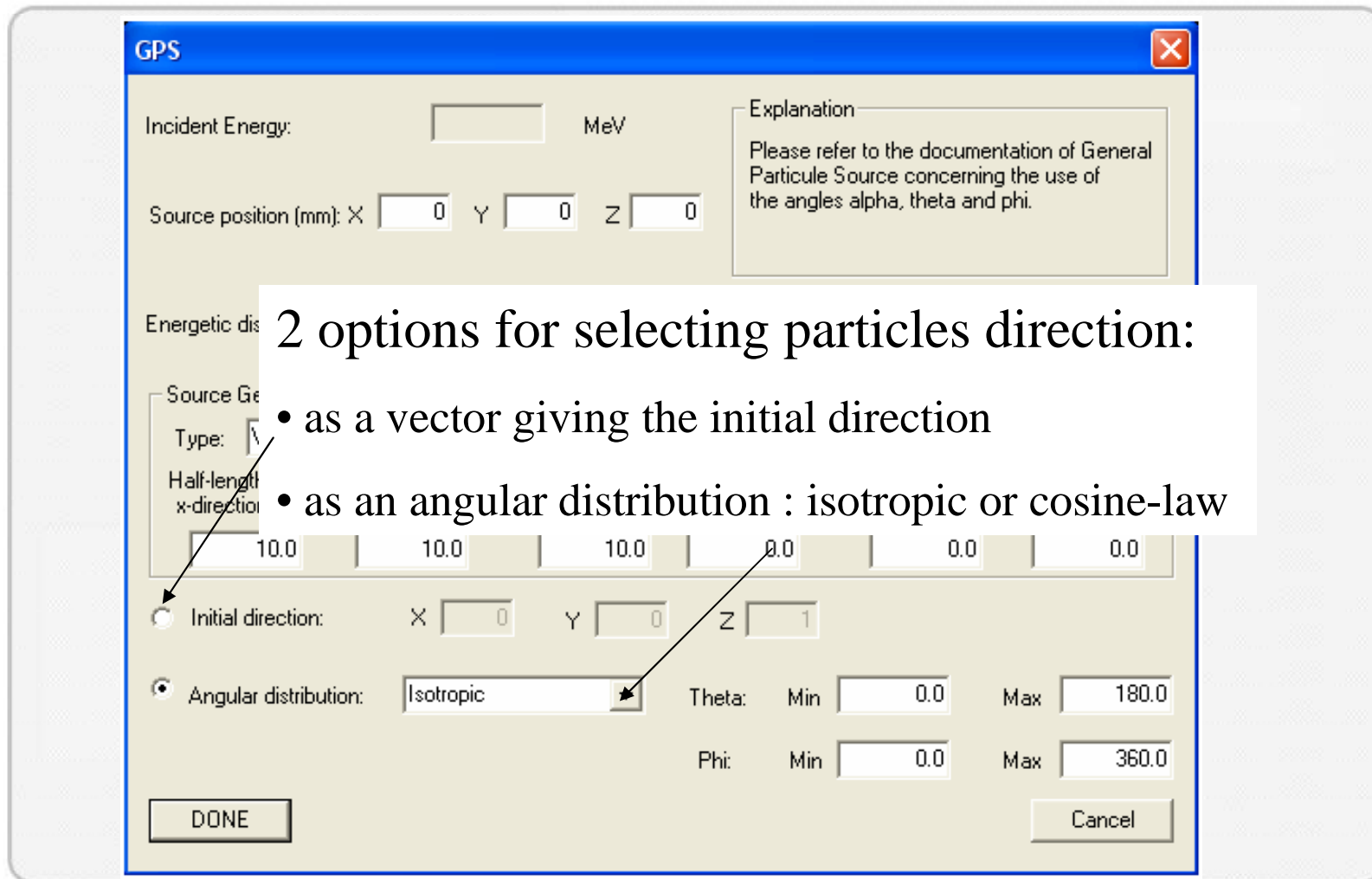
☐ Initial direction: X Y Z

☒ Angular distribution:

Theta: Min Max

Phi: Min Max

Geant4 interface – GPS Dialog Box (5/5)

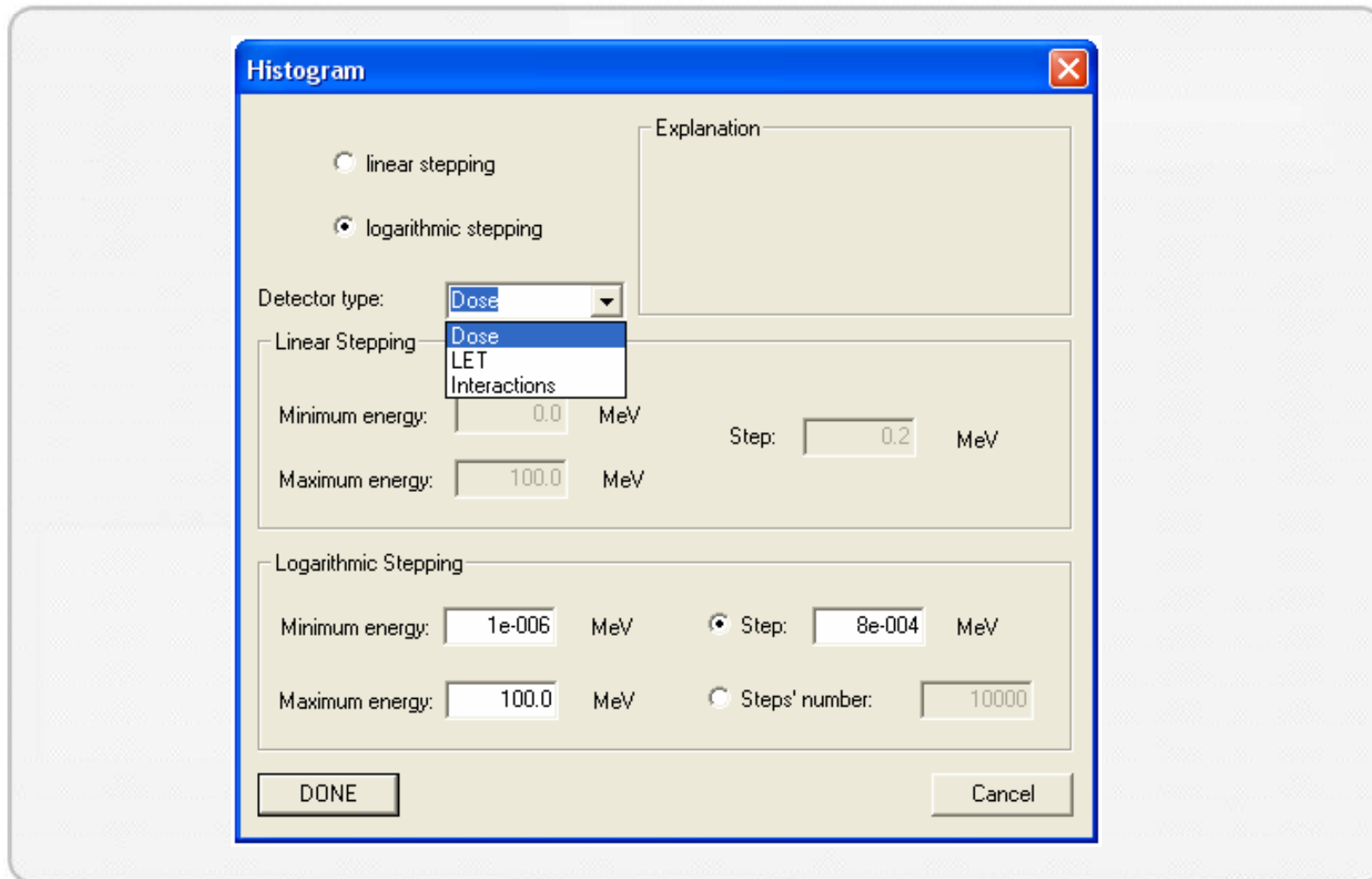


Geant4 interface – Histogram Dialog Box (1/5)

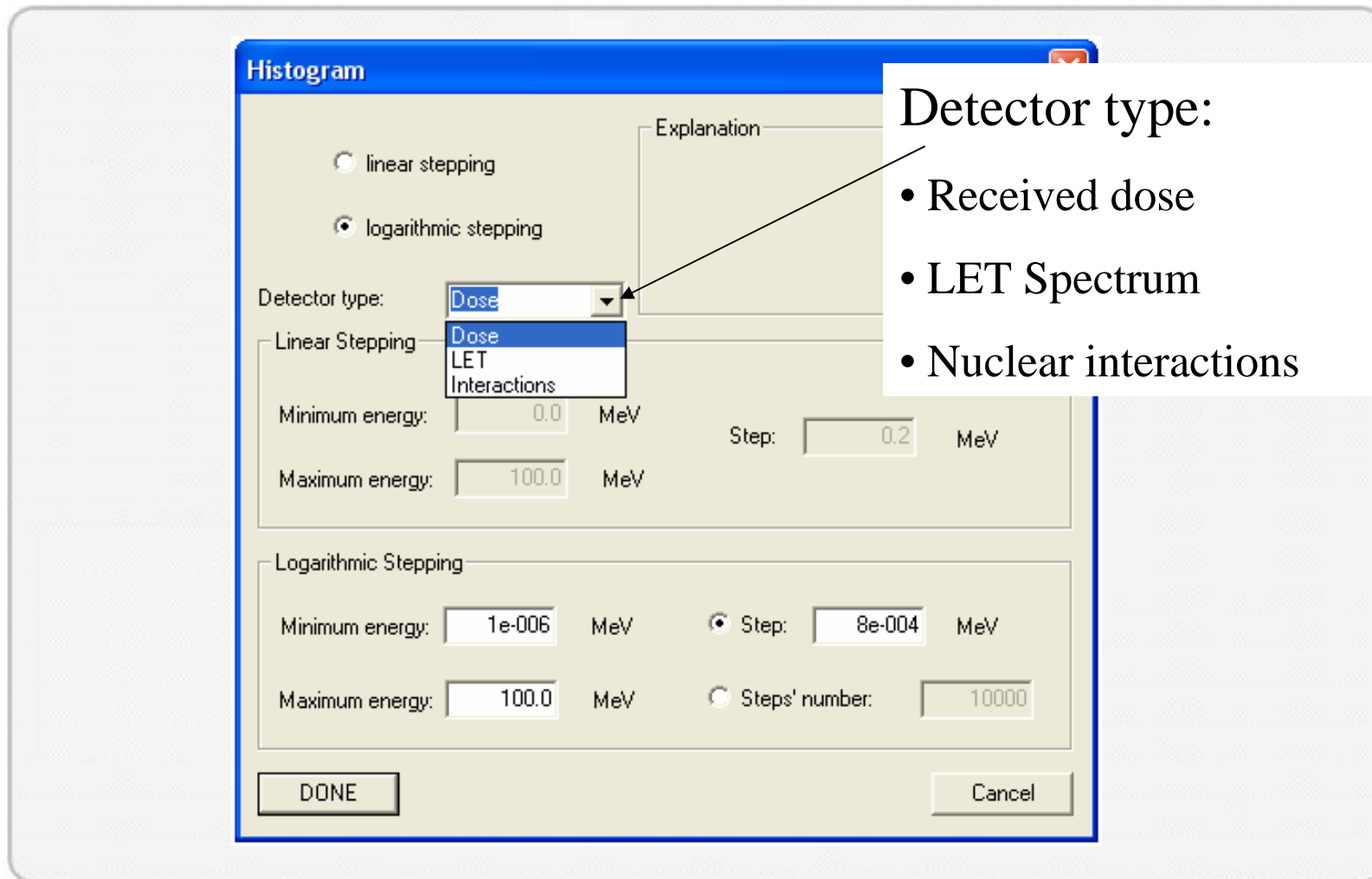
Gives the choice between three different types of post processing for a selected detector:

- Received Dose calculation
- LET (Linear Energy Transfert) Spectrum
- Nuclear Interactions i.e. information about particles hitting the detector

Geant4 interface – Histogram Dialog Box (2/5)



Geant4 interface – Histogram Dialog Box (3/5)



Geant4 interface – Histogram Dialog Box (4/5)

Scale choice:

- linear
- logarithmic

Histogram

☐ linear stepping

☒ logarithmic stepping

Detector type: **Dose**

Linear Stepping

Minimum energy: 0.0 MeV

Maximum energy: 100.0 MeV

Step: 0.2 MeV

Logarithmic Stepping

Minimum energy: 1e-006 MeV

Maximum energy: 100.0 MeV

Step: 8e-004 MeV

Steps' number: 10000

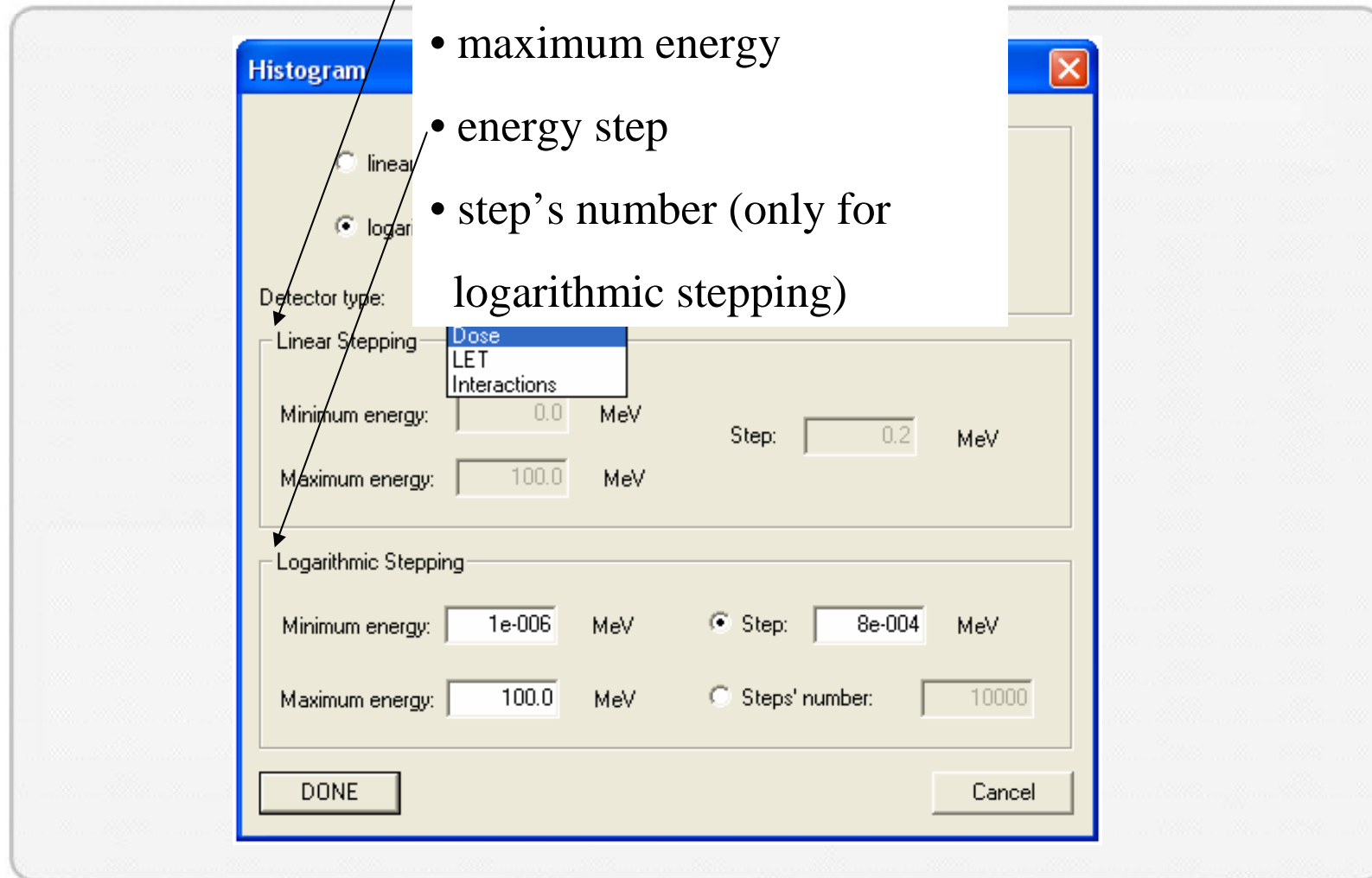
DONE **Cancel**

Geant4 interface

Parameters for stepping:

- minimum energy
- maximum energy
- energy step
- step's number (only for logarithmic stepping)

log Box (5/5)



Geant4 interface

Translation for GEANT 4

Project name:

Particule type:

Ion:

Number of beams:

Scenario (Physical processes):

Construction of particles' source:

☐ Parameters of histogramming :

Scenario description:

Binary scenario:

- Standard EM Physics
- Standard Hadron EM Physics
- Binary Hadron Inelastic Physics
- Muon Physics

Explanation:

DONE **QUIT**

Geant4 Files

FASTRAD provides ready to compile Geant4 files:

- Headers files (.hh)
- Source files (.cc)
- Main file
- Macro files, allowing changes without rebuilding Geant4 executable thanks to Geant4 Messengers:
 - o Detector type
 - o GPS variables (particles type, source modification)
 - o Number of beams
 - o Visualisation definition (choice of visual display, creation of visualisation, visualisation's option)

Macro Files Example (1/2)

```
#####  
#* Visu.mac  
#* Visualisation macro for project:  
#* (Geant4 compatible)  
#*  
#*  
#* Neither the authors of this software system, nor their employing  
#* institutes, nor the agencies providing financial support for this  
#* work make any representation or warranty, express or implied,  
#* regarding this software system or assume any liability for its  
#* use.  
#*  
#*  
#* Creation: 31/01/2007 by FASTRAD ((C) TRAD 2007)  
#* Last Modified:  
#####  
#  
# Macro file for the initialization phase of "Visu.mac"  
# when running in interactive mode  
#  
/control/verbose 2  
/run/verbose 2  
#  
/geom/detector Dose  
/gps/particle e-  
/gps/pos/type Point  
/gps/pos/centre 0.000 0.000 100.000 mm  
/gps/direction 0.000 0.000 1.000  
/gps/ene/mono 1.000 MeV
```

Macro Files Example (2/2)

```
#
# create empty scene
#
/vis/scene/create
#
# Create a scene handler for a specific graphics system
# (Edit the next line(s) to choose another graphic system)
#
#/vis/open DAWNFILE
#/vis/open OGLIX
#/vis/open OGLSX
#/vis/open OGLIXm
/vis/open OGLSXm
#/vis/open HepRepXML
#/vis/open VRML1
#/vis/open VRML2
#
# draw scene
#
#/vis/viewer/set/style surface
/vis/viewer/set/style wireframe
/vis/viewer/set/viewpointThetaPhi 90. 180. deg
/vis/viewer/zoom 1.
/vis/viewer/flush
#
# for drawing the tracks
# (if too many tracks cause core dump => storeTrajectory 0)
#
/tracking/storeTrajectory 1
/vis/scene/endOfEventAction accumulate

/tracking/verbose 0

/run/beamOn 50
```


Post processing : Histogram

3 different types of post processing :

- Received dose by primary particles and secondary electrons and gammas + sampling of deposited energy
- Sampling of LET spectrum for primaries
- Sampling of incident energy for primaries and secondaries on the detector + details for each hitting particle : # event, particle type, incident energy, deposited energy, momentum and origin volume (only for secondaries)

Conclusion

- The interface FASTRAD/Geant4 is an efficient tool to provide ready to compile Geant4 project from a CAD tool.
- Possible improvements :
 - calculation on multiple detectors
 - binding GDML/Geant4
- Contacts for further information:
 - <http://www.trad.fr> (company website)
 - Fastrad@trad.fr (software team)
 - Pierre.Pourrouquet@trad.fr (personal e-mail)