microdosimetry

Extended example located in \$G4INSTALL/examples/extended/medical/dna Contact : Sébastien Incerti (incerti@cenbg.in2p3.fr), Vladimir Ivantchenko, Mathieu Karamitros

Overview

The microdosimetry example illustrates the possibility to **combine discrete and condensed history processes in Geant4 at different geometrical scales and in selected regions in a unique Geant4 application**, thanks to the common software design adopted by the electromagnetic physics working groups of the Geant4 collaboration.

It simulates the track of a 50 MeV He+ ion and a 20 keV He2+ ion in liquid water. **Geant4 standard EM models** are used in the World volume while **Geant4-DNA models** are used in a Target volume, declared as a Region.

See details about the Geant4-DNA project at <u>http://geant4-dna.org</u>.

Description

The geometry is a 1 mm side cube (World) made of liquid water containing a smaller cubic Target volume of liquid water, with a thickness of 50 microns.

The proton beam is shot from the world in direction of the Target, both made of G4_WATER material.

The **DetectorConstruction** class explains how to define both volumes as regions.

The **PhysicsList** class explains how to activate Geant4 electromagnetic standard processes and models in the World region and Geant4-DNA processes and models in the Target region.

The **SteppingAction** class explains how to extract information on the transport and store it into a ntuple, defined in the **RunAction** class.

How to run the example

The example can be compiled with cmake and make. It uses multithreading mode by default.

In interactive mode, run:

./microdosimetry -mt 4 -root myRootFile.mac

The macro microdosimetry.in is executed by default.

To get visualization:

./microdosimetry -gui

(OGL is used by default)

or you may use your own visualization driver, for instance:

./microdosimetry -vis "DAWNFILE"

The geometry will be printed into a file.



Results and future developments

The output results consists in ROOT files (<u>http://root.cern.ch</u>), containing an ntuple with:

- the type of particle at each simulation step
- the type of process at each step
- the track position at each step (PreStep point, in nanometers)
- the energy deposit at each step (in eV)
- the step length (in nanometer)
- the kinetic energy loss along the step (in eV)
- the current Event ID

These files are merged and analyzed using the provided ROOT macro file plot.C. Type 'root plot.C' after the run is terminated. This macro gives the following graphical output:

The numbering scheme of processes is described in the SteppingAction class.

References

Refer to Geant4-DNA publications (http://geant4-dna.org) and in particular to :

 Combination of electromagnetic Physics processes for microdosimetry in liquid water with the Geant4 Monte Carlo simulation toolkit, V.N. Ivanchenko, S. Incerti, Z. Francis, H.N. Tran, M. Karamitros, M.A. Bernal, C. Champion and P. Guèye, Nucl. Instrum. and Meth. B 273 (2012) 95-97 (link)

Note that any report or published results obtained using the Geant4-DNA software shall cite the following Geant4-DNA collaboration publication: Med. Phys. 37 (2010) 4692-4708