A Universal Class in Geant4 For The Patient Geometry Model Construction from DICOM files

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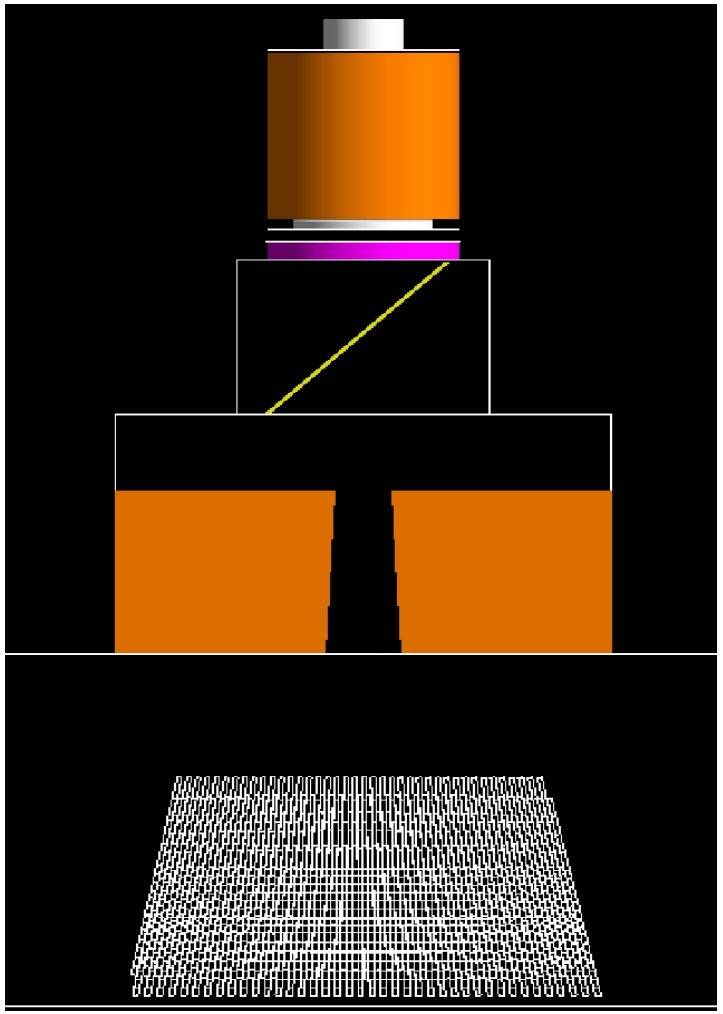
INTRODUCTION

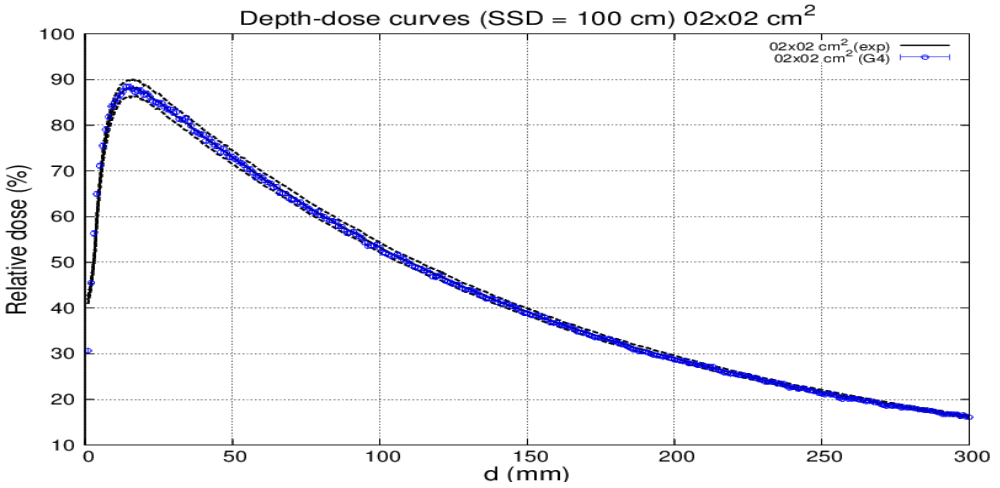
- **PhD Thesis:Assess potential inaccuracies on the dose calculated with commercial Treatment Planning Systems (TPS) under extreme density variations, using Monte Carlo calculations as benchmark.**

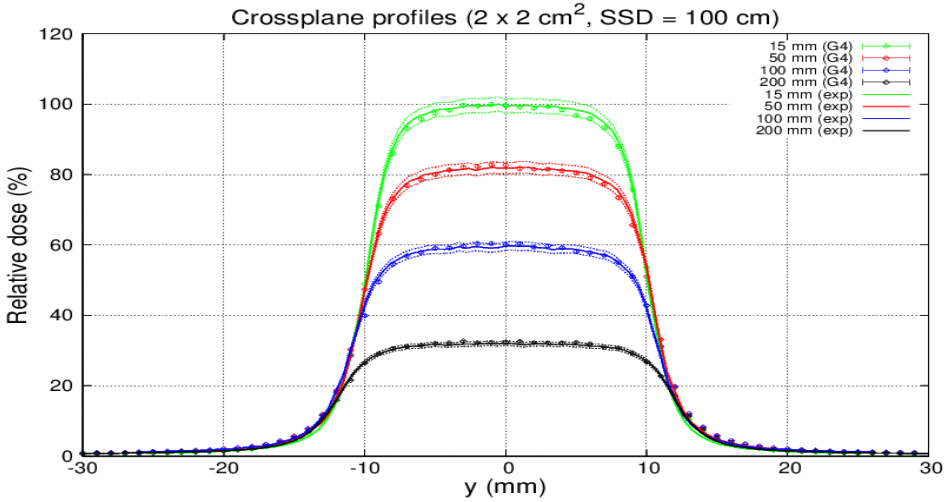
- **This talk: Implementation in the clinical routine of a tool which can establish the patient anatomy in the Geant4 simulation.**

ITEMS OF THE SIMULATION



M. A. Cortés-Giraldo, PhD Thesis.
Universidad de Sevilla, 2011





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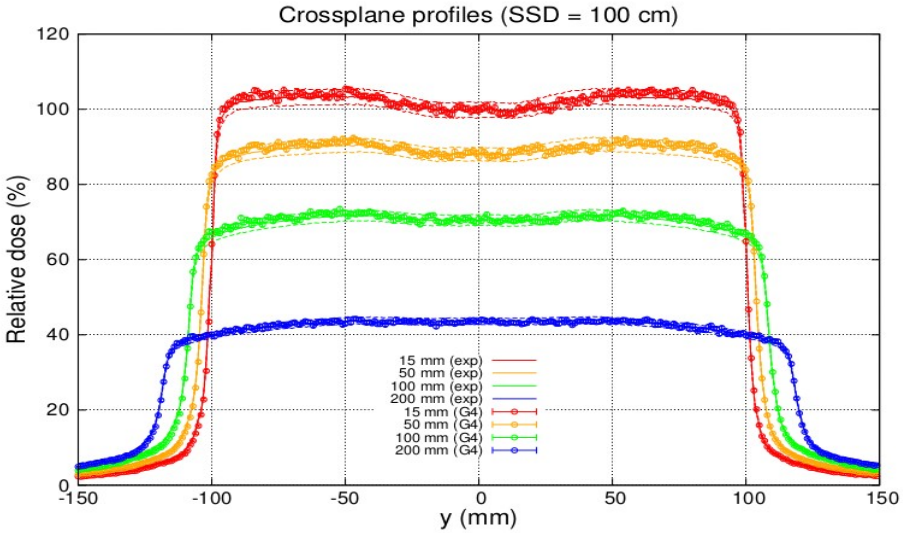

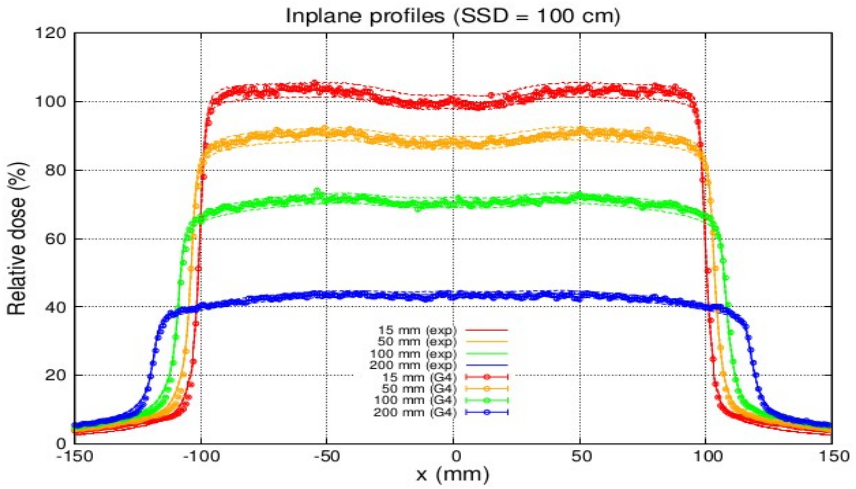

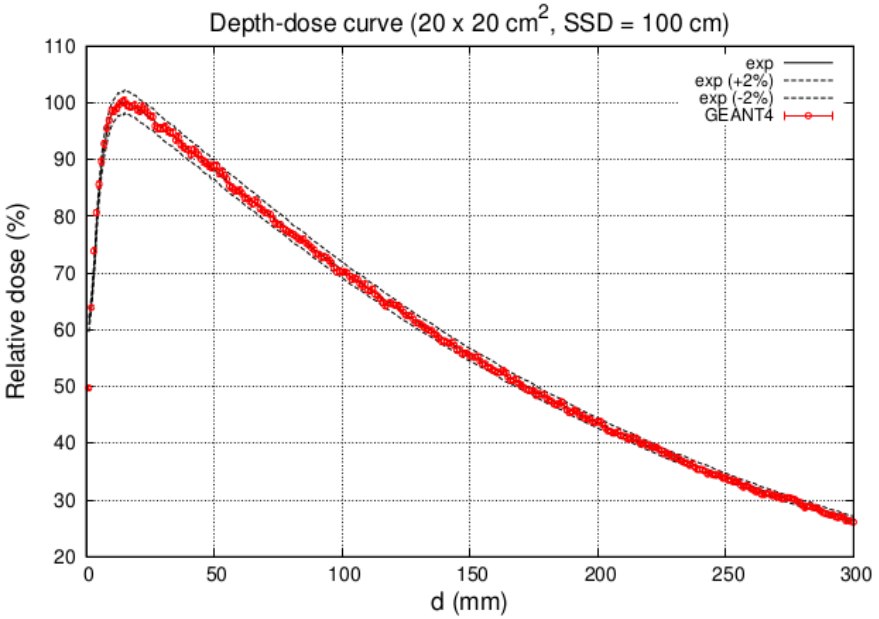

Beam Parameters:

- *6.2 MeV
- *FWHM(E) = 14%
- *FWHM(r)=1.5 mm

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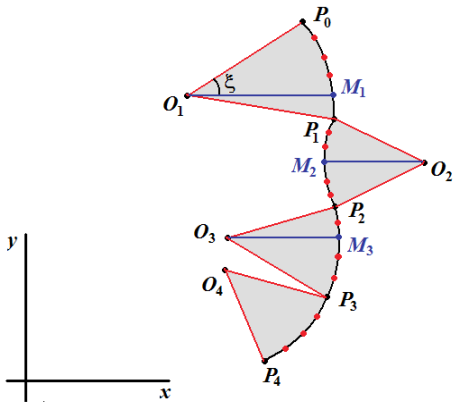

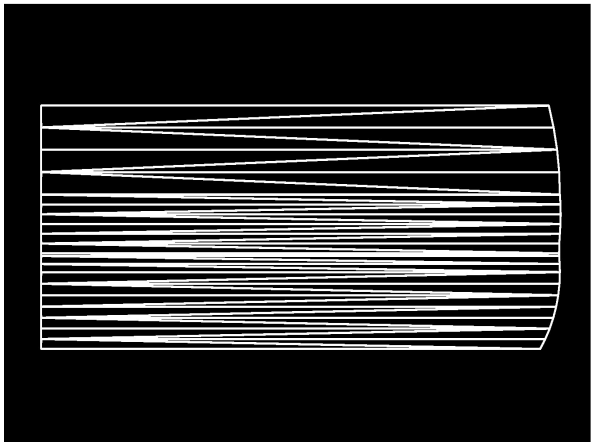

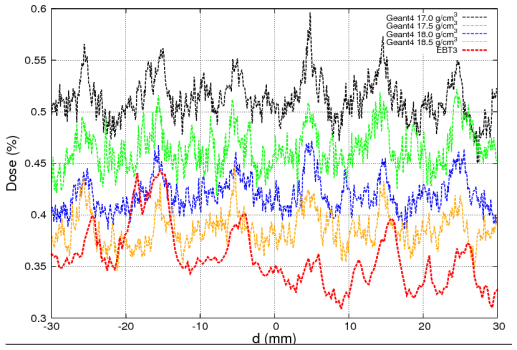

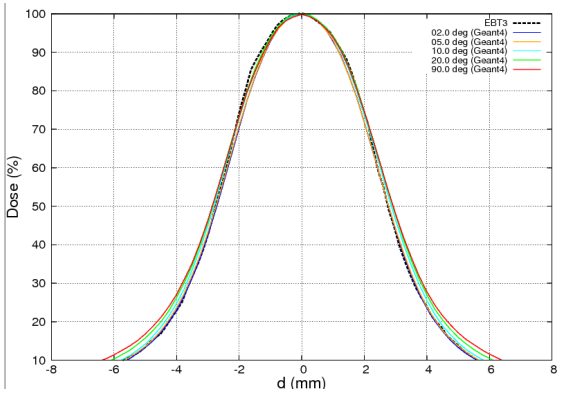

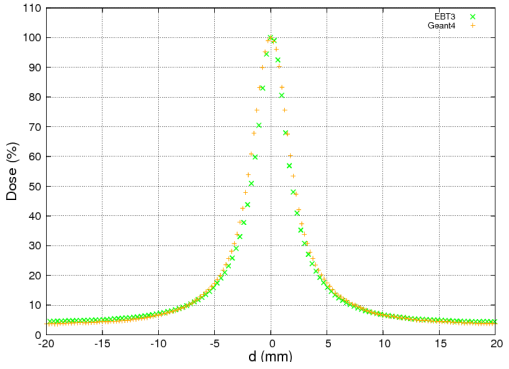

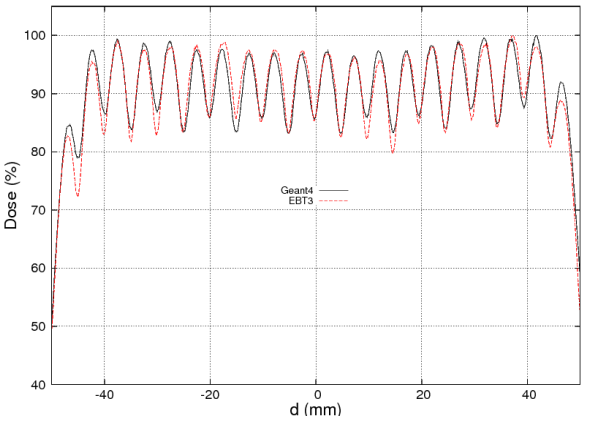

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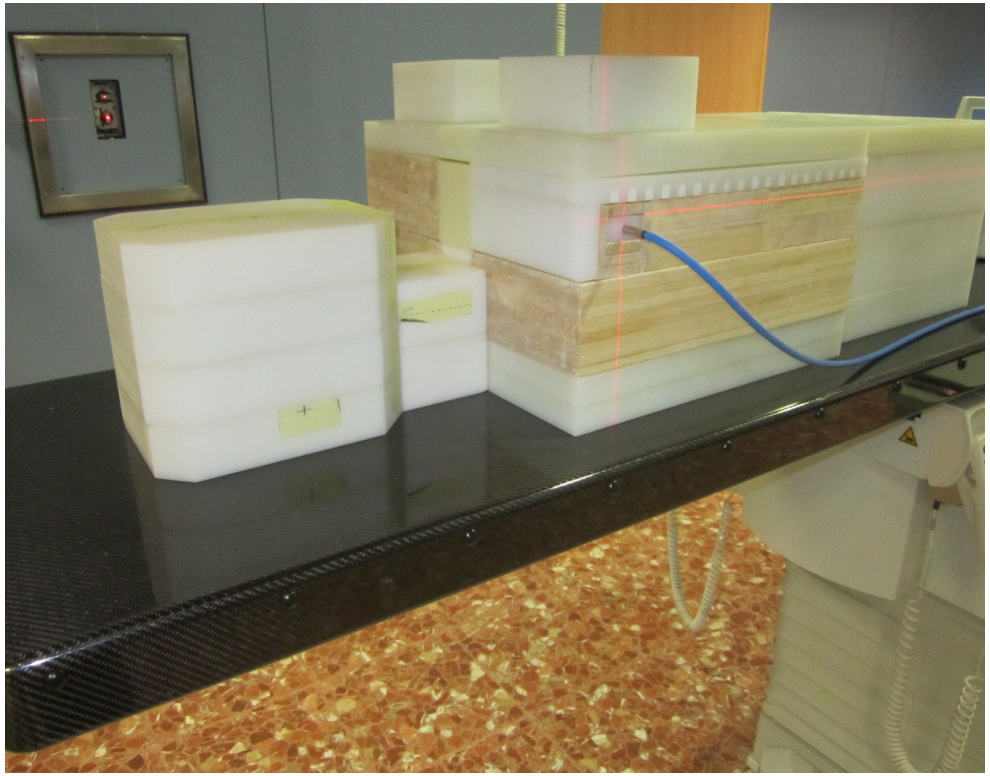
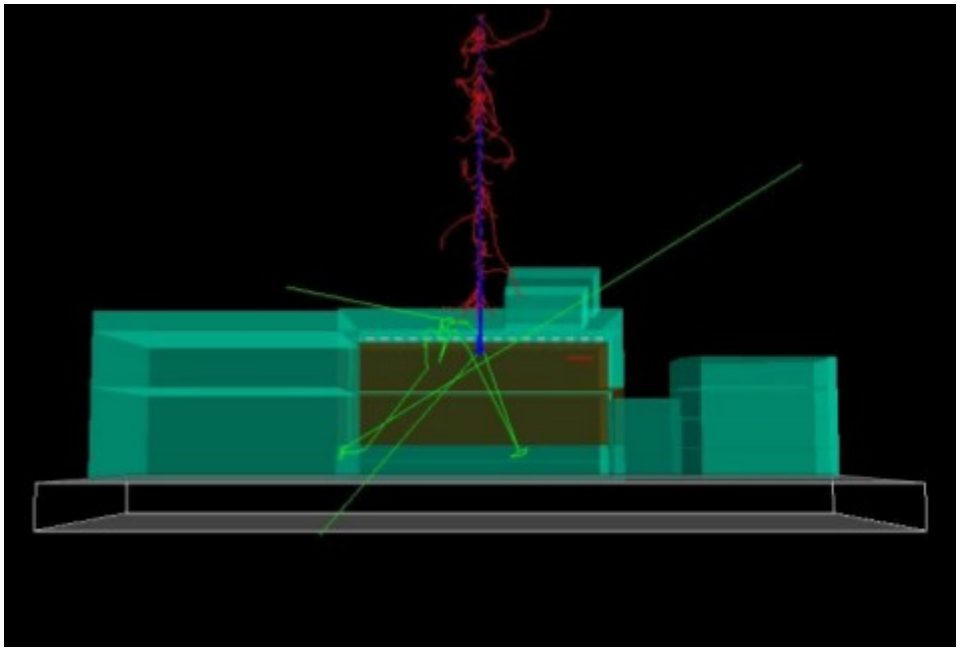


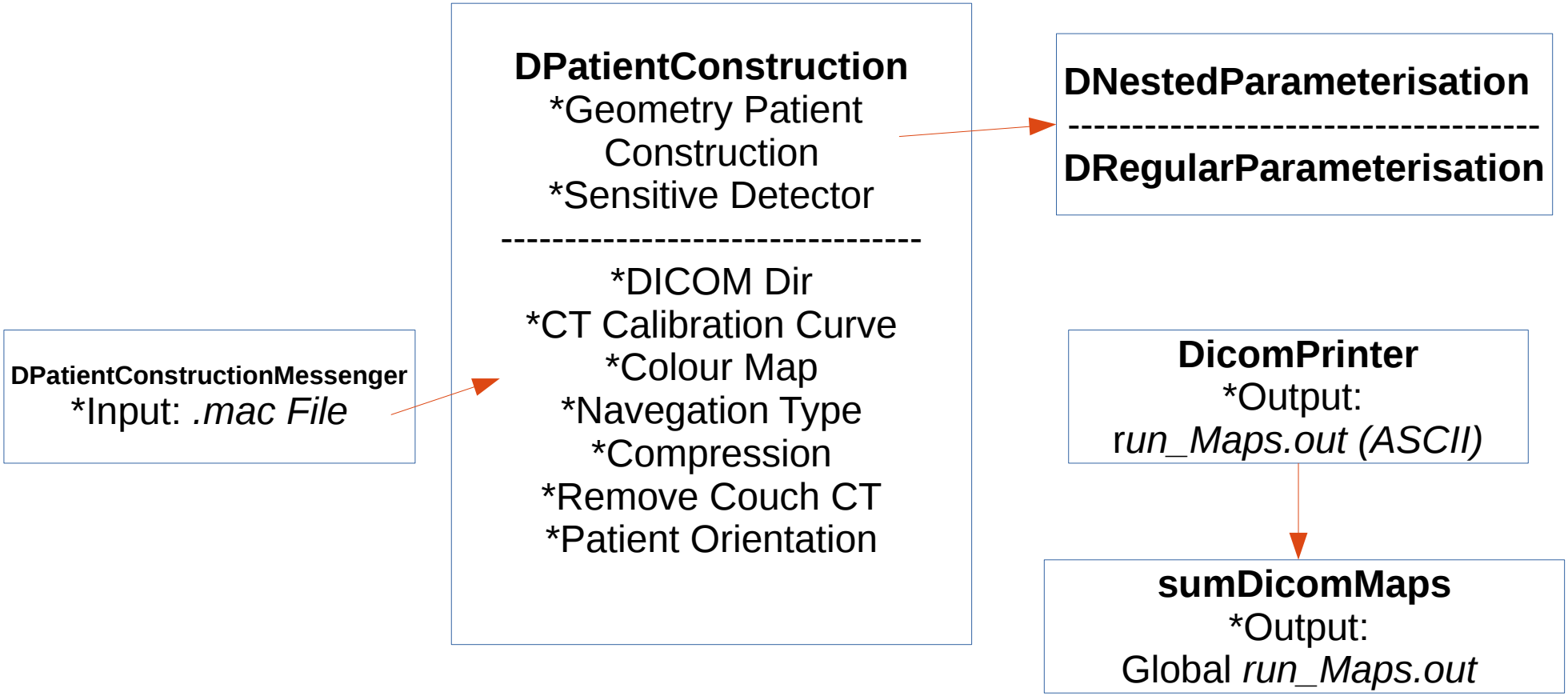


DEVELOPMENT OF THE CODE

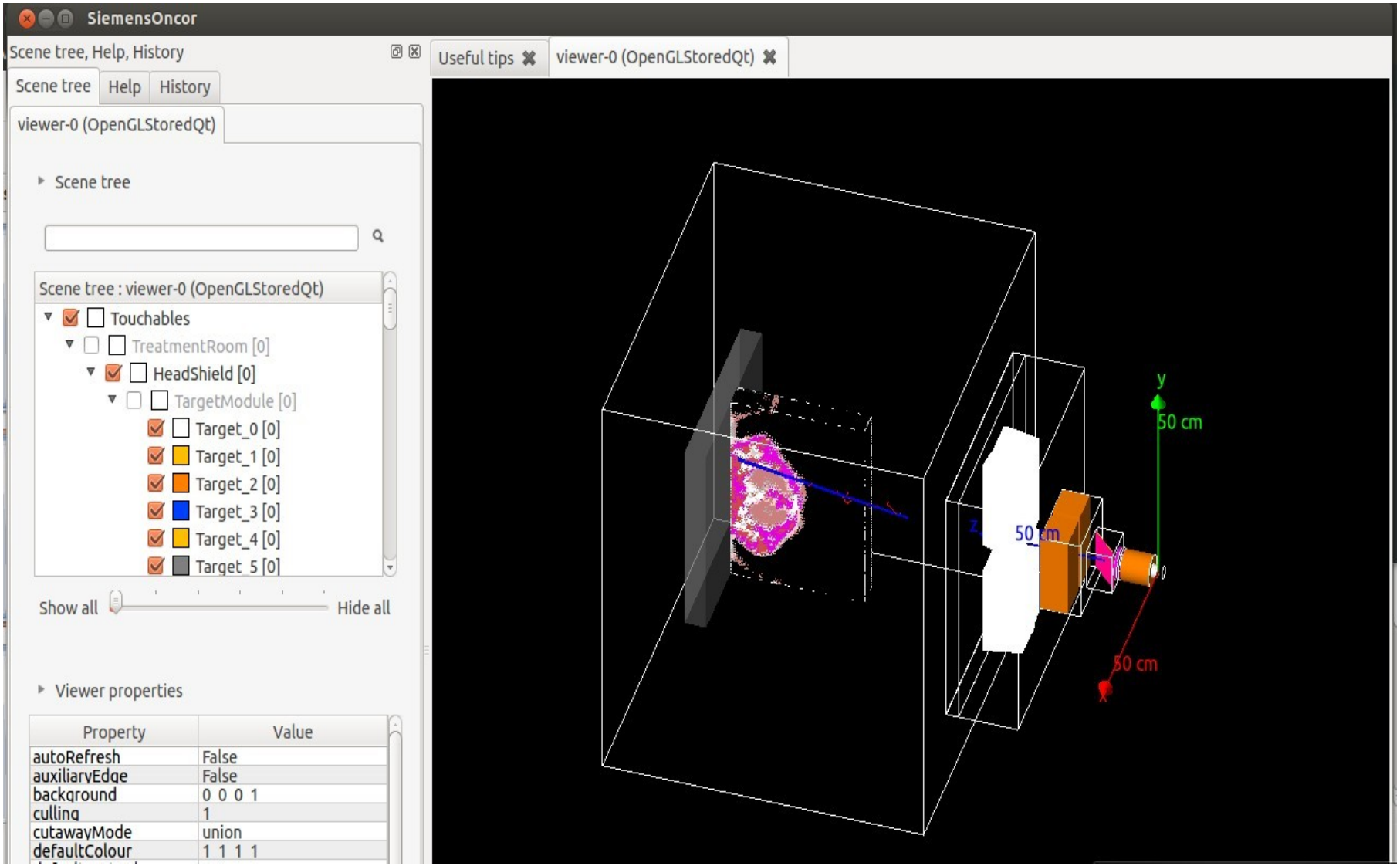
- **Reading Dicom Files using dcmtk libraries. Allows users any format.**
- **Tested in different Treatment Planning Systems (TPS):**
  - Phillips Pinnacle.
  - Varian Eclipse.
  - Elekta Oncentra.
- **Graphical representation using Qt.**
- **Output file with voxel dose information.**
- **Our point of depature is the DICOM example present at the Geant4 distribution (/examples/extended/medical/DICOM).**
- **The new classes are fully portable and were included into our existing Siemens Oncor Code.**

DEVELOPMENT OF THE CODE

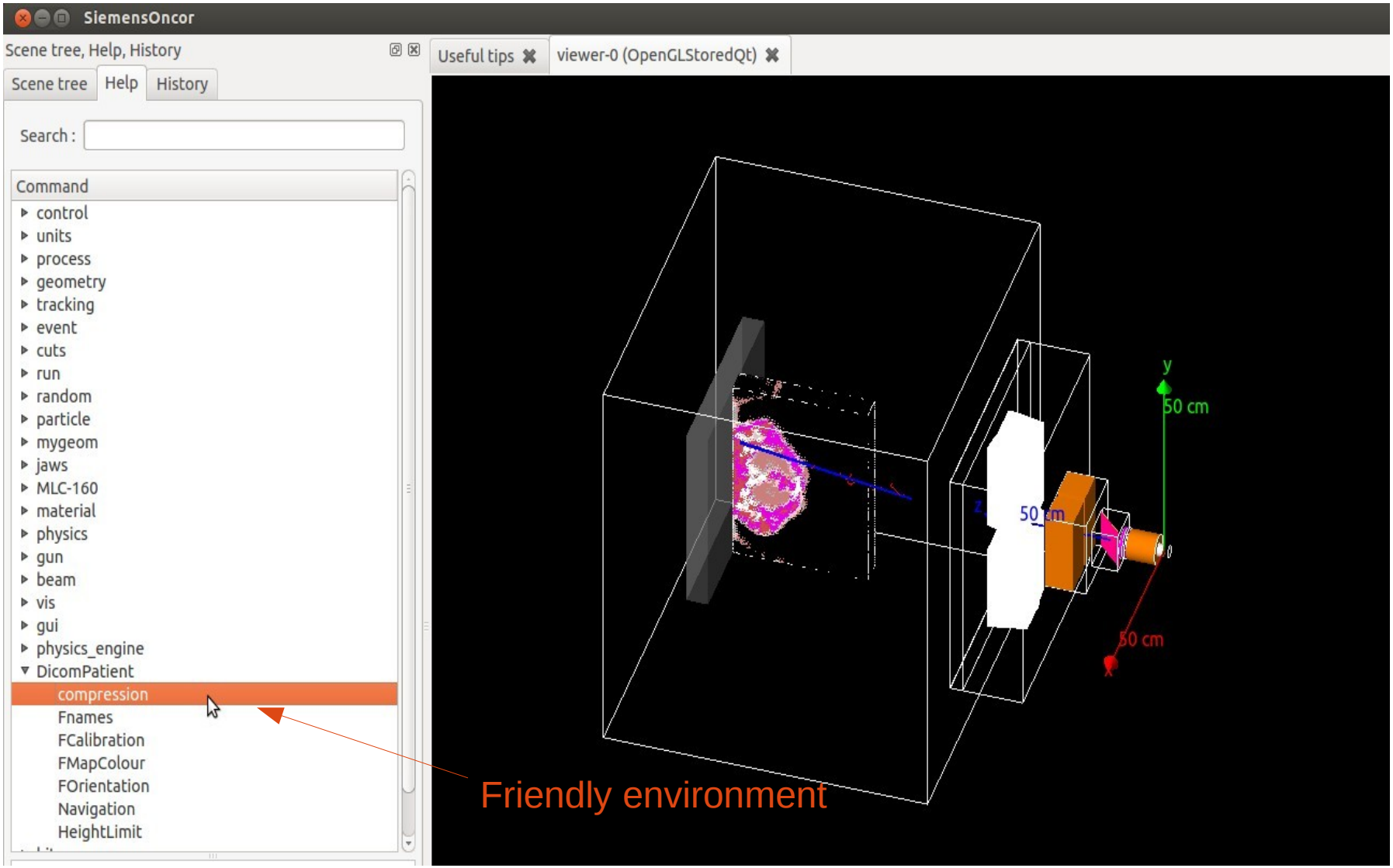
Class for the construction of the Geant4 patient geometry model.



RESULTS


SiemensOncor
Scene tree, Help, History
Scene tree
Help
History
viewer-0 (OpenGLStoredQt)
Scene tree
Scene tree : viewer-0 (OpenGLStoredQt)
Touchables
TreatmentRoom [0]
HeadShield [0]
TargetModule [0]
Target_0 [0]
Target_1 [0]
Target_2 [0]
Target_3 [0]
Target_4 [0]
Target_5 [0]
Show all
Hide all
Viewer properties
Property
Value
autoRefresh
False
auxiliaryEdge
False
background
0 0 0 1
culling
1
cutawayMode
union
defaultColour
1 1 1 1
Useful tips
viewer-0 (OpenGLStoredQt)
y
50 cm
50 cm
50 cm

RESULTS


SiemensOncor
Scene tree, Help, History
Scene tree
Help
History
Search :
Command
control
units
process
geometry
tracking
event
cuts
run
random
particle
mygeom
jaws
MLC-160
material
physics
gun
beam
vis
gui
physics_engine
DicomPatient
compression
Fnames
FCalibration
FMapColour
FOrientation
Navigation
HeightLimit
Useful tips
viewer-0 (OpenGLStoredQt)
y
50 cm
50 cm
50 cm
Friendly environment

RESULTS

- **ASCII Output adaptable to 3ddose format.**
- **Spatial information of the Dicom Images.**
- **Voxel dose information.**

runMaps_0.out

```
# nEvt = 10
# nMaps = 1
# Xm: -239.872 mm
# XM: 239.872 mm
# Ym: -187.4 mm
# YM: 187.4 mm
# Zm: -2.5 mm
# ZM: 57.5 mm
# NVx: 64
# NVy: 50
# NVz: 4
# ----------
# runHitMapID = 0
# fullName = DicomPatientSD/DoseDeposit
# no. entries = 13
      31  9.787816e-21  9.932424e-42
      95  1.398666e-20  2.163766e-41
      96  1.050991e-21  1.104582e-42
     159  1.443788e-20   2.37487e-41
     223  1.079465e-20  1.223171e-41
     287  9.369552e-21  8.909562e-42
     351  1.113869e-20  1.326666e-41
     415  1.025828e-20  1.164763e-41
     478  3.521463e-22   1.24007e-43
     479  6.795425e-21  5.643649e-42
     541  1.587607e-22  2.520496e-44
     542  3.320417e-22  1.102517e-43
     543  1.565976e-21  9.059952e-43
```

CONCLUSIONS

- **We have created a tool for the implementation of the patient geometry in the Geant4 simulation.**
- **Inputs exported from various TPS were read succesfully. Universality achieved.**
- **Parameters of the geometry can be controlled by the user thanks to the UI commands.**
- **Classes are fully adaptable to any Geant4 User Applications (provided that Detector Construction class is modified accordingly).**
- **Important tool developed for our dosimetric studies in patient which are ready to share.**