Hands on "DICOM", "Magnetic Field" and "Parallel World"

create "medical" folder under /home/work
> cd ~/work
> mkdir medical

Hands on DICOM
The base directory of this hands on is /home/g4user/work/medical/dicom
You need to change the command path in following slides if you want to try in other directory.

1. install DCMTK
　　　download source code(dcmtk-3.6.7.tar.gz) and place in /home/g4user/work/medical/dicom

```
> cd ~/work/medical
> mkdir dicom
> cd dicom
> tar zxvf dcmtk-3.6.7.tar.gz
> mkdir dcmtk-3.6.7-build
> mkdir dcmtk-3.6.7-install
> cd dcmtk-3.6.7-build
> cmake -DCMAKE_INSTALL_PREFIX=../dcmtk-3.6.7-install -DBUILD_SHARED_LIBS=ON ../dcmtk-3.6.7
> make
> make install
```

Don't use copy and paste this line

Hands on DICOM
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  2. prepare DICOM example in Geant4

        > source /opt/geant4/11.1.2/bin/geant4.sh
        > export DCMTK_BASE_DIR=/home/g4user/work/medical/dicom/dcmtk-3.6.7-install

        > cd ~/work/medical/dicom
        > cp -r /opt/geant4/src/geant4-v11.1.2/examples/extended/medical/DICOM .

  edit DICOM/dicomReader/CMakeLists.txt
   add following line at the end of file
  target_link_libraries(dicomReader /home/g4user/work/medical/dicom/dcmtk-3.6.7-install/lib/libdcmrt.so)

Hands on DICOM
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3. compile DICOM example in Geant4

```
> mkdir DICOM-build
> mkdir DICOM-install
> cd DICOM-build
> cmake -DCMAKE_INSTALL_PREFIX=../DICOM-install -DDICOM_USE_DCMTK=ON -DDCMTK_DIR=/home/g4user/work/medical/dicom/dcmtk-3.6.7-install ../DICOM
> make
> make install
```

Don't use copy and paste this line

Hands on DICOM

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4. prepare tutorial source
    download source code (Galet_DICOM.tgz) and place in /home/g4user/work/medical/dicom

```
> cd ~/work/medical/dicom
> tar zxvf Galet_DICOM.tgz
>
> mkdir Galet-v11-MedEx-Galet-v11-MedEx-Ver000-build
> mkdir Galet-v11-MedEx-Galet-v11-MedEx-Ver000-install
> cd Galet-v11-MedEx-Galet-v11-MedEx-Ver000-build
> cmake -DCMAKE_INSTALL_PREFIX=../Galet-v11-MedEx-Galet-v11-MedEx-Ver000-install -DDICOM_DIR=/home/g4user/work/medical/dicom/DICOM-install/lib/Geant4-11.1.2 -DDCMTK_DIR=/home/g4user/work/medical/dicom/dcmtk-3.6.7-install ../Galet-v11-MedEx-Galet-v11-MedEx-Ver000
> make
> make install
```

Don't use copy and paste this line

add LD_LIBRARY_PATH
> export LD_LIBRARY_PATH=${LD_LIBRARY_PATH}:${DCMTK_BASE_DIR}/lib
> export LD_LIBRARY_PATH=${LD_LIBRARY_PATH}:/home/g4user/work/medical/dicom/DICOM-install/lib

Hands on DICOM
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  5. prepare run


```
> cd ~/work/medical/dicom/Galet-v11-MedEx-Galet-v11-MedEx-Ver000-install
> mkdir run
> cd ~/work/medical/dicom/Galet-v11-MedEx-Galet-v11-MedEx-Ver000-install/run
> cp ~/work/medical/dicom/Galet-v11-MedEx-Galet-v11-MedEx-Ver000/*mac .
> cp ~/work/medical/dicom/DICOM/ColourMap.dat .
> cp ~/work/medical/dicom/DICOM/*dcm .
> cp ~/work/medical/dicom/DICOM/Data.dat.new Data.dat
```

Hands on DICOM
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6. hands on

compile
> cd /home/g4user/work/medical/dicom/Galet-v11-MedEx-Galet-v11-MedEx-Ver000-build
> make
> make install

move to run directory
> cd ~/work/medical/dicom/Galet-v11-MedEx-Galet-v11-MedEx-Ver000-install/run

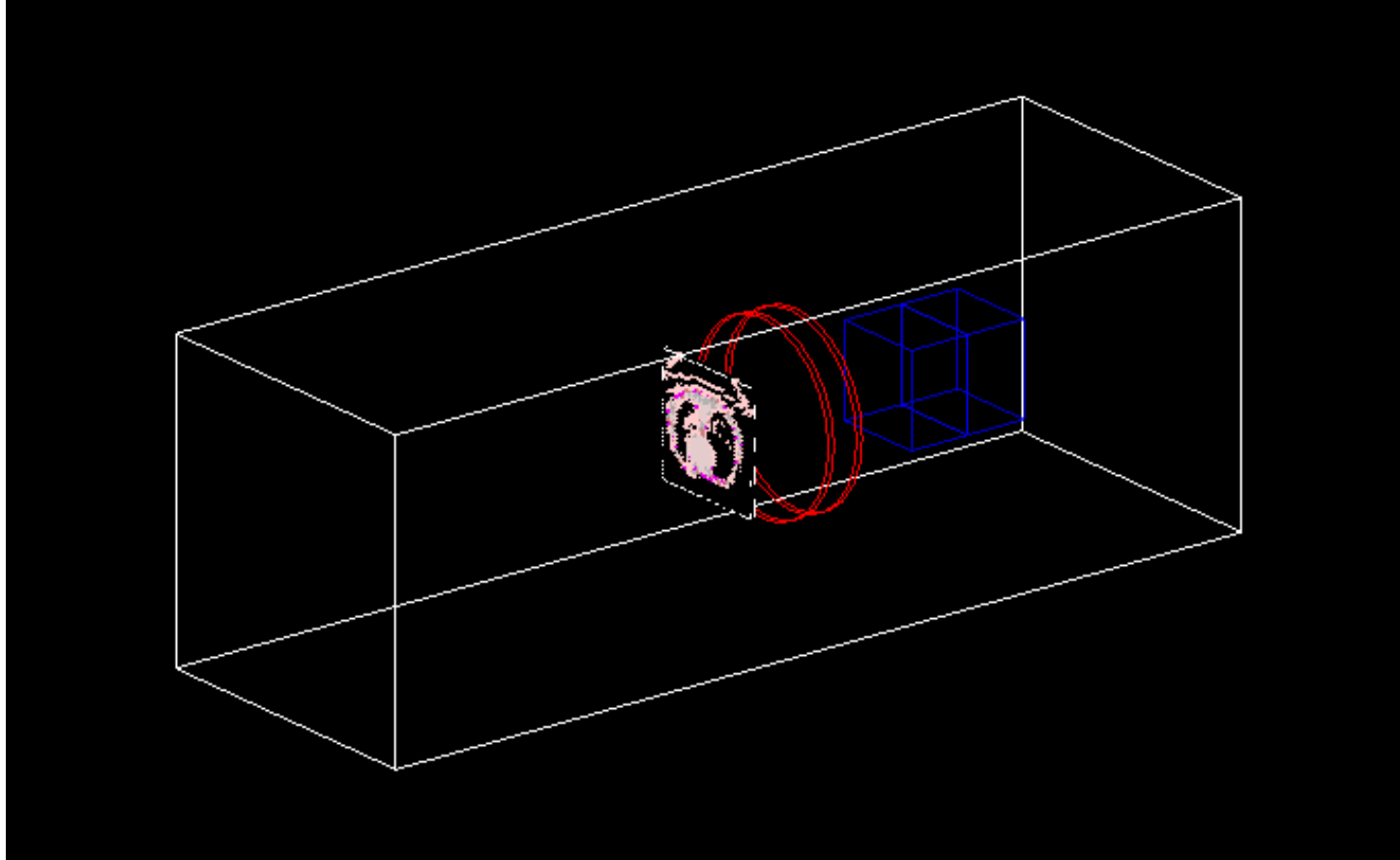run
> ../bin/Galet
or
> ../bin/Galet -m run0.mac

a. Move the target where you want
b. Shoot the proton bean from the direction(ex. Gantry=270, 45, 180) by moving and rotate the target

Hands on DICOM
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Hands on DICOM
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DetectorConstruction.cxx   ~L163

```
//  DICOM
//
GaletDICOM *dicom = new GaletDICOM("GaletDICOMLV");
G4LogicalVolume* dicomLV = dicom->ConstructPhantom();
G4ThreeVector dicom_position(0,0,0.*mm);
G4RotationMatrix* dicom_rot=new G4RotationMatrix();
dicom_rot->rotateX(0.0*degree);
dicom_rot->rotateY(0.0*degree);
dicom_rot->rotateZ(0.0*degree);
new G4PVPlacement(dicom_rot, dicom_position, dicomLV, "dicomPV",
                    worldLV, false,  0, fCheckOverlaps);
```

```
G4ThreeVector dicom_position(0,0,0.*mm);
dicom_rot->rotateX(0.0*degree);
dicom_rot->rotateY(0.0*degree);
```
➡
```
G4ThreeVector dicom_position(0,0,-100.*mm);
dicom_rot->rotateX(45.0*degree);
dicom_rot->rotateY(90.0*degree);
```

Hands on DICOM
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compile
> cd /home/g4user/work/medical/dicom/Galet-v11-MedEx-Galet-v11-MedEx-Ver000-build
> make
> make install

move to run directory
> cd ~/work/medical/dicom/Galet-v11-MedEx-Galet-v11-MedEx-Ver000-install/run

I suggest changing the grid mesh size of DICOM image
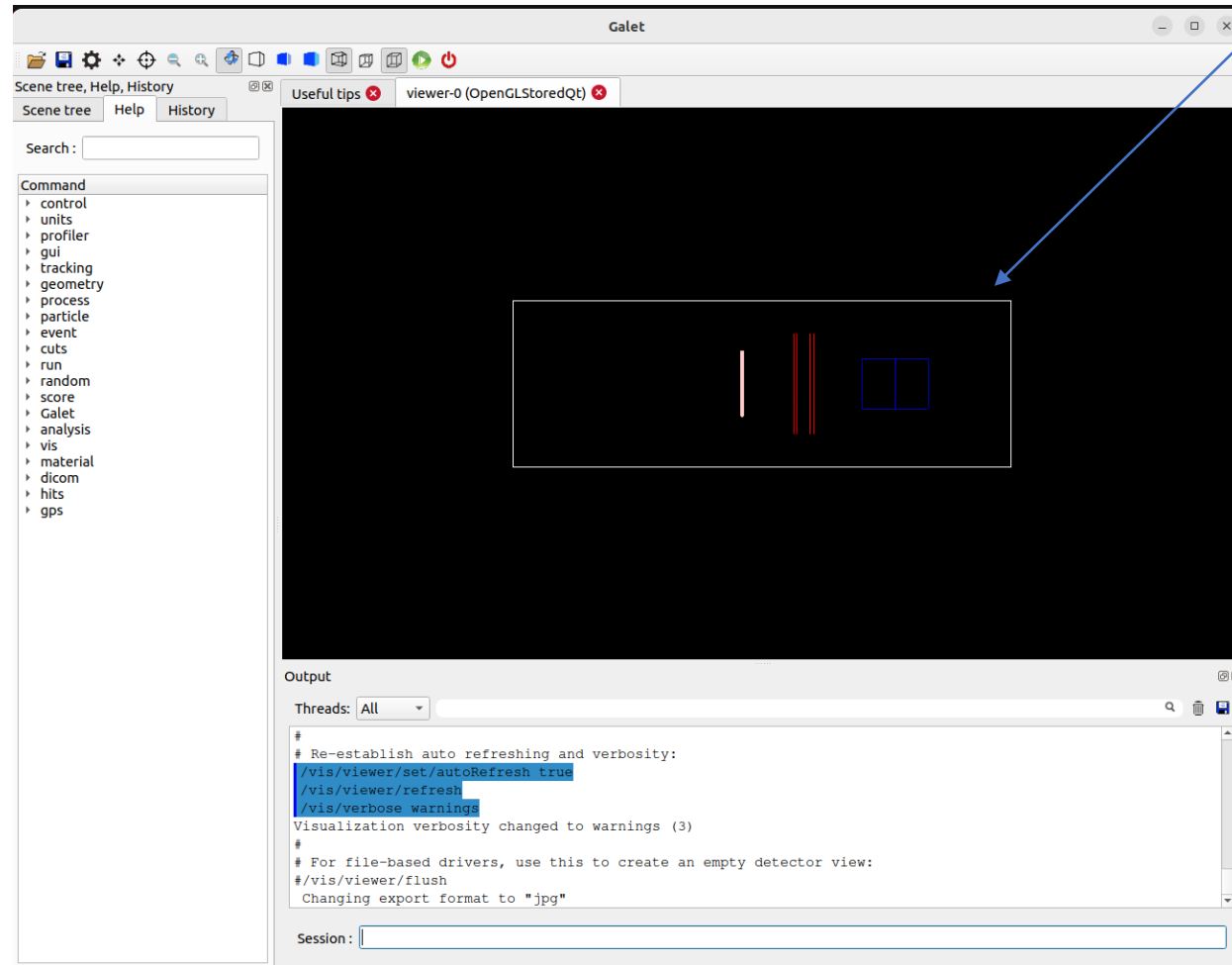Data.dat L1
:COMPRESSION 2   ⟶   :COMPRESSION 4

Hands on DICOM

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check the geometry
> ../bin/Galet

drag and move

Hands on DICOM
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```
        edit run0.mac
                /run/beamOn 1                          /run/beamOn 1000

        run
        > ../bin/Galet -m run0.mac


                                        no viewer, shoot 1000 protons
```

Hands on DICOM
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check the result
> root -l Galet.root
root [0] Galet->Draw("x:y","","colz")
or
root [0] Galet->Draw("x:y:z")