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//
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// ********************************************************************
//
//         Filippo Ambroglini : filippo.ambroglini@pg.infn.it
//
//....oooOO0OOooo........oooOO0OOooo........oooOO0OOooo........oooOO0OOooo......
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#include "TrackerConstructionConfig4.hh"

#include "G4NistManager.hh"
#include "HEPDSWMaterial.hh"
#include "G4Box.hh"
#include "G4SubtractionSolid.hh"
#include "G4UnionSolid.hh"
#include "G4LogicalVolume.hh"
#include "G4PVPlacement.hh"
#include "G4PVReplica.hh"

#include "G4GeometryManager.hh"
#include "G4PhysicalVolumeStore.hh"
#include "G4LogicalVolumeStore.hh"
#include "G4SolidStore.hh"
#include "G4VisAttributes.hh"
#include "G4SDManager.hh"
#include "TrackerSD.hh"


#include "G4UImanager.hh"
#include "G4UnitsTable.hh"
#include "G4PhysicalConstants.hh"
#include "G4SystemOfUnits.hh"
#include <iomanip>

//....oooOO0OOooo........oooOO0OOooo........oooOO0OOooo........oooOO0OOooo......

TrackerConstructionConfig4::TrackerConstructionConfig4()
  :fSolidTracker(0),fSolidLayer(0),fSolidCFFrameHole(0),fSolidCFFrame(0),
   fSolidPoronFrameHole(0),fSolidPoronFrame(0),fSolidSiliconPlate(0),fSolidSilic
onSensor(0),
   fSolidLadderBox(0),fSolidLadder(0),fSolidKaptonS(0),fSolidKaptonK(0),fSolidHy
brid(0),
   fSolidHeatSink(0),fSolidRingK(0),fSolidRingS(0),
   fLogicTracker(0),fLogicLayer(0),fLogicCFFrame(0),fLogicPoronFrame(0),fLogicSi
liconPlateP(0),fLogicSiliconPlateM(0),
   fLogicSiliconSensor(0),fLogicLadderBox(0),fLogicLadder(0),fLogicKaptonS(0),fL
ogicKaptonK(0),
```

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   fLogicHybrid(0),fLogicHeatSink(0),fLogicRingK(0),fLogicRingS(0),
   fPhysiTracker(0),fPhysiLayer(0),fPhysiCFFrame(0),fPhysiPoronFrame(0),fPhysiLa
dderBox(0),
   fPhysiLadder(0),fPhysiRingK(0),fPhysiKaptonK(0),fPhysiHybridK(0),fPhysiSilico
nPlateP(0),
   fPhysiSiliconSensorP(0),fPhysiSiliconPlateM(0),fPhysiSiliconSensorM(0),fPhysi
KaptonS(0),
  fPhysiHybridS(0),fPhysiRingS(0),fPhysiHeatSink(0)
{
  pMaterial = new HEPDSWMaterial();
  fLayerNumber = 2;
  fLadderNumber = 3;

  fTracker_X = 267.3*mm;
  fTracker_Y = 305.5*mm;
  fTracker_Z = 20.0*mm;

  fLayer_X = 267.3*mm;
  fLayer_Y = 305.5*mm;
  fLayer_Z = 10.0*mm;

  fCFFrame_X = 267.3*mm;
  fCFFrame_Y = 305.5*mm;
  fCFFrame_Z = 10.0*mm;

  fCFMiddleFrameHole_X = 255.3*mm;
  fCFMiddleFrameHole_Y = 305.5*mm;
  fCFMiddleFrameHole_Z = 6.3*mm;

  fCFFrameHole1_X = 247.9*mm;
  fCFFrameHole1_Y = 60.5*mm;
  fCFFrameHole1_Z = 6.0*mm;

  fCFFrameHole2_X = 72.6*mm;
  fCFFrameHole2_Y = 215.0*mm;
  fCFFrameHole2_Z = 11.0*mm;

  fPoronFrame_X = 255.3*mm;
  fPoronFrame_Y = 299.5*mm;
  fPoronFrame_Z = 6.3*mm;

  fPoronMiddleFrameHole_X = 247.3*mm;
  fPoronMiddleFrameHole_Y = 299.5*mm;
  fPoronMiddleFrameHole_Z = 2.8*mm;

  fPoronFrameHole1_X = 247.9*mm;
  fPoronFrameHole1_Y = 66.5*mm;
  fPoronFrameHole1_Z = 7.0*mm;

  fPoronFrameHole2_X = 72.6*mm;
  fPoronFrameHole2_Y = 224.3*mm;
  fPoronFrameHole2_Z = 7.0*mm;

  fSiSens_X = 77.606*mm;
  fSiSens_Y = 109.65*mm;
  fSiSens_Z = 0.3*mm;

  fSiActiveSens_X = 71.606*mm;
  fSiActiveSens_Y = 105.85*mm;
  fSiActiveSens_Z = 0.3*mm;

  fLadderBox_X = 246.9*mm;
  fLadderBox_Y = 295.5*mm;
  fLadderBox_Z = 2.8*mm;

  fLadderBoxEnd_X = 246.9*mm;
  fLadderBoxEnd_Y = 60.5*mm;
  fLadderBoxEnd_Z = 4.41*mm;
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```
   fLadder_X = 82.3*mm;
   fLadder_Y = 295.5*mm;
   fLadder_Z = 2.8*mm;

   fLadderEnd_X = 82.3*mm;
   fLadderEnd_Y = 60.5*mm;
   fLadderEnd_Z = 4.41*mm;

   fKaptonS_X = 72.0*mm;
   fKaptonS_Y = 9.01*mm;
   fKaptonS_Z = 2.4*mm;

   fKaptonK_X = 68.7*mm;
   fKaptonK_Y = 222.69*mm;
   fKaptonK_Z = 0.1*mm;

   fHybrid_X = 76*mm;
   fHybrid_Y = 60*mm;
   fHybrid_Z = 0.5*mm;

   fHeatSink_X = 78.3*mm;
   fHeatSink_Y = 60*mm;
   fHeatSink_Z = 2.32*mm;

   fRingK_X = 82.3*mm;
   fRingK_Y = 295.5*mm;
   fRingK_Z = 2.8*mm;

   fRingKHole1_X = 78.3*mm;
   fRingKHole1_Y = 295.5*mm;
   fRingKHole1_Z = 2*mm;

   fRingKHole2_X = 72.6*mm;
   fRingKHole2_Y = 215*mm;
   fRingKHole2_Z = 2.9*mm;

   fRingKHole3_X = 72.6*mm;
   fRingKHole3_Y = 63.5*mm;
   fRingKHole3_Z = 2.9*mm;

   fRingS_X = 78*mm;
   fRingS_Y = 221*mm;
   fRingS_Z = 1*mm;

   fRingSHole_X = 72.6*mm;
   fRingSHole_Y = 215*mm;
   fRingSHole_Z = 1.5*mm;

   ComputeObjectsPositioning();

   siliconMaterial = "Silicon";
   cfiberMaterial  = "CarbonFiber";
   kaptonMaterial  = "Kapton";
   poronMaterial   = "Poron";

}

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TrackerConstructionConfig4::~TrackerConstructionConfig4()
{
  if (pMaterial) delete pMaterial;
}

void TrackerConstructionConfig4::ComputeObjectsPositioning(){

   transCFFrameHole0_Y =-6*mm;
   transCFFrameHole0_Z =-0.15*mm;
   transCFFrameHole1_Y =-(fCFFrame_Y/2.-fCFFrameHole1_Y/2.);
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```
   transCFFrameHole1_Z =-3*mm;
   transCFFrameHole2_X =82.5*mm;
   transCFFrameHole2_Y =fCFFrame_Y/2.-fCFFrameHole2_Y/2.-22*mm;
   transCFFrameHole3_X =0;
   transCFFrameHole3_Y =fCFFrame_Y/2.-fCFFrameHole2_Y/2.-22*mm;
   transCFFrameHole4_X =-82.5*mm;
   transCFFrameHole4_Y =fCFFrame_Y/2.-fCFFrameHole2_Y/2.-22*mm;
   transCFFrameHole5_X =82.5*mm;
   transCFFrameHole5_Y =fCFFrame_Y/2.-fCFFrameHole2_Y/2.-248*mm;
   transCFFrameHole6_X =0;
   transCFFrameHole6_Y =fCFFrame_Y/2.-fCFFrameHole2_Y/2.-248*mm;
   transCFFrameHole7_X =-82.5*mm;
   transCFFrameHole7_Y =fCFFrame_Y/2.-fCFFrameHole2_Y/2.-248*mm;

   transPoronFrameHole0_Y =-4*mm;
   transPoronFrameHole0_Z =-0.61*mm;
   transPoronFrameHole1_Y =-(fPoronFrame_Y/2.-fPoronFrameHole1_Y/2.);
   transPoronFrameHole2_X =82.5*mm;
   transPoronFrameHole2_Y =fPoronFrame_Y/2.-fPoronFrameHole2_Y/2.-6.7*mm;
   transPoronFrameHole3_X =0;
   transPoronFrameHole3_Y =fPoronFrame_Y/2.-fPoronFrameHole2_Y/2.-6.7*mm;
   transPoronFrameHole4_X =-82.5*mm;
   transPoronFrameHole4_Y =fPoronFrame_Y/2.-fPoronFrameHole2_Y/2.-6.7*mm;;

   transRingKHole1_Y = -9*mm;
   transRingKHole1_Z = fRingK_Z/2.-fRingKHole1_Z/2.-1*mm;
   transRingKHole2_Y = fRingK_Y/2.-fRingKHole2_Y/2.-12*mm;
   transRingKHole3_Y = fRingK_Y/2.-fRingKHole3_Y/2.-233*mm;
   transRingSHole_Y = fRingS_Y/2.-fRingSHole_Y/2.-3*mm;

   transLadderBox_Y = -(fLadderBox_Y/2.-fLadderBoxEnd_Y/2.);
   transLadderBox_Z = fLadderBox_Z/2.-fLadderBoxEnd_Z/2.;

   transLadder_Y = -(fLadder_Y/2.-fLadderEnd_Y/2.);
   transLadder_Z = fLadder_Z/2.-fLadderEnd_Z/2.;

   transKaptonS_Y = 0.1*mm;
   transKaptonS_Z = -0.1*mm;

   fPhysiTracker_X = 0;
   fPhysiTracker_Y = -23.55;
   fPhysiTracker_Z = 353.2*mm;

   fPhysiPoronFrame_X = 0;
   fPhysiPoronFrame_Y = -(fCFFrame_Y/2.-fPoronFrame_Y/2.);
   fPhysiPoronFrame_Z = -0.15*mm;

   fPhysiLadderBox_X = 0;
   fPhysiLadderBox_Y = -(fCFFrame_Y/2.-fLadderBox_Y/2.);
   fPhysiLadderBox_Z = -0.76*mm;

   fPhysiRingK_X = 0;
   fPhysiRingK_Y = 0;
   fPhysiRingK_Z = 0;

   fPhysiKaptonK_X = 0;
   fPhysiKaptonK_Y = fLadder_Y/2.-fKaptonK_Y/2.-12.71*mm;
   fPhysiKaptonK_Z = fLadder_Z/2.-fKaptonK_Z/2.-1.09*mm;

   fPhysiHybridK_X = 0;
   fPhysiHybridK_Y = -(fLadder_Y/2.-fHybrid_Y/2.);
   fPhysiHybridK_Z = 0.06*mm;

   fPhysiSiliconPlateP_X = 0;
   fPhysiSiliconPlateP_Y = fLadder_Y/2.-fSiSens_Y/2.-9.5*mm;
   fPhysiSiliconPlateP_Z = fLadder_Z/2.-fSiSens_Z/2.-1.24*mm;

   fPhysiSiliconSensorP_X = 0;
   fPhysiSiliconSensorP_Y = fSiSens_Y/2.-fSiActiveSens_Y/2.-3*mm;
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  fPhysiSiliconSensorP_Z = 0;

  fPhysiSiliconPlateM_X = 0;
  fPhysiSiliconPlateM_Y = fLadder_Y/2.-fSiSens_Y/2.-119.25*mm;
  fPhysiSiliconPlateM_Z = fLadder_Z/2.-fSiSens_Z/2.-1.24*mm;
  fPhysiSiliconSensorM_X = 0;
  fPhysiSiliconSensorM_Y = fSiSens_Y/2.-fSiActiveSens_Y/2.-0.8*mm;
  fPhysiSiliconSensorM_Z = 0;

  fPhysiKaptonS_X = 0;
  fPhysiKaptonS_Y = fLadder_Y/2.-fKaptonS_Y/2.-226.4*mm;
  fPhysiKaptonS_Z = fLadder_Z/2.-fKaptonS_Z/2.-1.61*mm;

  fPhysiHybridS_X = 0;
  fPhysiHybridS_Y = -(fLadder_Y/2.-fHybrid_Y/2.);
  fPhysiHybridS_Z = -2.76*mm;

  fPhysiRingS_X = 0;
  fPhysiRingS_Y = fLadder_Y/2.-fRingS_Y/2.-9*mm;
  fPhysiRingS_Z = fLadder_Z/2.-fRingS_Z/2.-1.8*mm;

  fPhysiHeatSink_X = 0;
  fPhysiHeatSink_Y = -(fLadder_Y/2.-fHeatSink_Y/2.);
  fPhysiHeatSink_Z = -1.35*mm;
}

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void TrackerConstructionConfig4::Builder(G4VPhysicalVolume* motherVolume)
{
  G4SDManager* SDman = G4SDManager::GetSDMpointer();
  G4String tkSDname = "/hepd/silicon";
  TrackerSD * tkSD = new TrackerSD(tkSDname);
  SDman->AddNewDetector(tkSD);

  pMaterial->DefineMaterials();
  G4Material* vacuum     = pMaterial->GetMaterial("Galactic");
  G4Material* poronMat   = pMaterial->GetMaterial(poronMaterial);
  G4Material* cfMat      = pMaterial->GetMaterial(cfiberMaterial);
  G4Material* kapMat     = pMaterial->GetMaterial(kaptonMaterial);
  G4Material* silMat     = pMaterial->GetMaterial(siliconMaterial);
  G4Material* fr4Mat     = pMaterial->GetMaterial("FR4");
  G4Material* copperMat = pMaterial->GetMaterial("Copper");

  G4RotationMatrix* myRot = new G4RotationMatrix;

  fSolidTracker = new G4Box("fSolidTracker",fTracker_X/2.,fTracker_Y/2.,fTracker_Z/
2.);
  fSolidLayer  = new G4Box("fSolidLayer",fLayer_X/2.,fLayer_Y/2.,fLayer_Z/2.);

  G4ThreeVector transCFFrameHole0(0,transCFFrameHole0_Y,transCFFrameHole0_Z);
  G4ThreeVector transCFFrameHole1(0,transCFFrameHole1_Y,transCFFrameHole1_Z);
  G4ThreeVector transCFFrameHole2(transCFFrameHole2_X,transCFFrameHole2_Y,0);
  G4ThreeVector transCFFrameHole3(transCFFrameHole3_X,transCFFrameHole3_Y,0);
  G4ThreeVector transCFFrameHole4(transCFFrameHole4_X,transCFFrameHole4_Y,0);
  G4ThreeVector transCFFrameHole5(transCFFrameHole5_X,transCFFrameHole5_Y,0);
  G4ThreeVector transCFFrameHole6(transCFFrameHole6_X,transCFFrameHole6_Y,0);
  G4ThreeVector transCFFrameHole7(transCFFrameHole7_X,transCFFrameHole7_Y,0);

  fSolidCFFrameHole = new G4Box("fSolidCFFrameHole",fCFFrameHole2_X/2.,fCFFrameHole
2_Y/2.,fCFFrameHole2_Z/2.);

  fSolidCFFrame = new G4SubtractionSolid("fSolidCFFrame",
                                   new G4SubtractionSolid("CFFrame7",
                                                    new G4Subtractio
nSolid("CFFrame6",
      new G4SubtractionSolid("CFFrame5",
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```
                                   new G4SubtractionSolid("CFFrame4",
                                                    new G4SubtractionSolid("CFFrame3",
                                                                     new G4Subtra
ctionSolid("CFFrame2",

  new G4SubtractionSolid("CFFrame1",

                              new G4Box("CFFrameBox",fCFFrame_X/2.,fCFFrame_Y/2.,fCF
Frame_Z/2.),

                              new G4Box("CFMiddleFrameHole",fCFMiddleFrameHole_X/2.,fC
FMiddleFrameHole_Y/2.,fCFMiddleFrameHole_Z/2.),

                              myRot,transCFFrameHole0),

    new G4Box("CFBottomFrameHole",fCFFrameHole1_X/2.,fCFFrameHole1_Y/2.,fCFFrameHol
e1_Z/2.),

    myRot,transCFFrameHole1),

                                                       fSolidCFFram
eHole,myRot,transCFFrameHole2),
                                                    fSolidCFFrameHole,myRot,transCFFram
eHole3),
                              fSolidCFFrameHole,myRot,transCFFrameHole4),
      fSolidCFFrameHole,myRot,transCFFrameHole5),                    fSolidCFFrameHol
e,myRot,transCFFrameHole6),
                                             fSolidCFFrameHole,myRot,transCFFrameHol
e7);

  G4ThreeVector transPoronFrameHole0(0,transPoronFrameHole0_Y,transPoronFrameHol
e0_Z);
  G4ThreeVector transPoronFrameHole1(0,transPoronFrameHole1_Y,0);
  G4ThreeVector transPoronFrameHole2(transPoronFrameHole2_X,transPoronFrameHole2
_Y,0);
  G4ThreeVector transPoronFrameHole3(transPoronFrameHole3_X,transPoronFrameHole3
_Y,0);
  G4ThreeVector transPoronFrameHole4(transPoronFrameHole4_X,transPoronFrameHole4
_Y,0);
  fSolidPoronFrameHole = new G4Box("fSolidPoronFrameHole",fPoronFrameHole2_X/2.,fPor
onFrameHole2_Y/2.,fPoronFrameHole2_Z/2.);

  fSolidPoronFrame = new G4SubtractionSolid("fSolidPoronFrame",
                                         new G4SubtractionSolid("PoronFrame4",
                                                          new G4Subtrac
tionSolid("PoronFrame3",

  new G4SubtractionSolid("PoronFrame2",

                              new G4SubtractionSolid("PoronFrame1",

                                                new G4Box("PoronFrameBox",fPoronF
rame_X/2.,fPoronFrame_Y/2.,fPoronFrame_Z/2.),

                                                new G4Box("PoronMiddleFrameHole",fP
oronMiddleFrameHole_X/2.,fPoronMiddleFrameHole_Y/2.,fPoronMiddleFrameHole_Z/2.),
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                                       myRot,transPoronFrameHole0),
                        new G4Box("PoronBottomFrameHole",fPoronFrameHole1_X/2.,fPo
ronFrameHole1_Y/2.,fPoronFrameHole1_Z/2.),
                        myRot,transPoronFrameHole1),
   fSolidPoronFrameHole,myRot,transPoronFrameHole2),
                                                       fSolidPoronFr
ameHole,myRot,transPoronFrameHole3),
                                   fSolidPoronFrameHole,myRot,transPoro
nFrameHole4);

   fSolidSiliconPlate   = new G4Box("fSolidSiliconPlate",fSiSens_X/2.,fSiSens_Y/2.,fSi
Sens_Z/2.);
   fSolidSiliconSensor  = new G4Box("fSolidSiliconSensor",fSiActiveSens_X/2.,fSiActive
Sens_Y/2.,fSiActiveSens_Z/2.);

   G4ThreeVector transLadderBox(0,transLadderBox_Y,transLadderBox_Z);
   fSolidLadderBox       = new G4UnionSolid("fSolidLadderBox",
                                   new G4Box("LadderBox",fLadderBox_X/2.,f
LadderBox_Y/2.,fLadderBox_Z/2.),
                                   new G4Box("LadderBoxEnd",fLadderBoxEnd_
X/2.,fLadderBoxEnd_Y/2.,fLadderBoxEnd_Z/2.),
                                   myRot,transLadderBox);
   G4ThreeVector transLadder(0,transLadder_Y,transLadder_Z);
   fSolidLadder         = new G4UnionSolid("fSolidLadder",
                                   new G4Box("Ladder",fLadder_X/2.,fLadder_
Y/2.,fLadder_Z/2.),
                                   new G4Box("LadderEnd",fLadderEnd_X/2.,fL
adderEnd_Y/2.,fLadderEnd_Z/2.),
                                   myRot,transLadder);

   G4ThreeVector transKaptonS(0,transKaptonS_Y,transKaptonS_Z);
   fSolidKaptonS         = new G4SubtractionSolid("fSolidKaptonS",
                                   new G4Box("fKaptonS1",fKaptonS_X/
2.,fKaptonS_Y/2.,fKaptonS_Z/2.),
                                   new G4Box("fKaptonS2",fKaptonS_X/
2.+3*mm,fKaptonS_Y/2.,fKaptonS_Z/2.),
                                   myRot,transKaptonS);

   fSolidKaptonK         = new G4Box("fSolidKaptonK",fKaptonK_X/2.,fKaptonK_Y/2.,fKa
ptonK_Z/2.);
   fSolidHybrid         = new G4Box("fSolidHybrid",fHybrid_X/2.,fHybrid_Y/2.,fHybrid
_Z/2.);
   fSolidHeatSink        = new G4Box("fSolidHeatSink",fHeatSink_X/2.,fHeatSink_Y/2.,f
HeatSink_Z/2.);

   G4ThreeVector transRingKHole1(0,transRingKHole1_Y,transRingKHole1_Z);
   G4ThreeVector transRingKHole2(0,transRingKHole2_Y,0);
   G4ThreeVector transRingKHole3(0,transRingKHole3_Y,0);

   fSolidRingK = new G4SubtractionSolid("fSolidRingK",
                                   new G4SubtractionSolid("RingKStep2",
                                                       new G4SubtractionS
olid("RingKStep1",
    new G4Box("RingKBlock",fRingK_X/2.,fRingK_Y/2.,fRingK_Z/2.),

    new G4Box("RingKHole1",fRingKHole1_X/2.,fRingKHole1_Y/2.,fRingKHole1_Z/2.),

    myRot,transRingKHole1),
                                                       new G4Box("RingKHol
e2",fRingKHole2_X/2.,fRingKHole2_Y/2.,fRingKHole2_Z/2.),
                                                       myRot,transRingKHo
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le2),
                        new G4Box("RingKHole3",fRingKHole3_X/2.,fR
ingKHole3_Y/2.,fRingKHole3_Z/2.),
                        myRot,transRingKHole3);

   G4ThreeVector transRingSHole(0,transRingSHole_Y,0);
   fSolidRingS = new G4SubtractionSolid("fSolidRingS",
                        new G4Box("RingSBlock",fRingS_X/2.,fRingS_
Y/2.,fRingS_Z/2.),
                        new G4Box("RingSHole",fRingSHole_X/2.,fRin
gSHole_Y/2.,fRingSHole_Z/2.),
                        myRot,transRingSHole);

   fLogicTracker        = new G4LogicalVolume(fSolidTracker,vacuum,"fLogicTracker");
   fLogicLayer          = new G4LogicalVolume(fSolidLayer,vacuum,"fLogicLayer");
   fLogicCFFrame        = new G4LogicalVolume(fSolidCFFrame,cfMat,"fLogicCFFrame");
   fLogicPoronFrame     = new G4LogicalVolume(fSolidPoronFrame,poronMat,"fLogicPoron
Frame");
   fLogicSiliconPlateP = new G4LogicalVolume(fSolidSiliconPlate,silMat,"fLogicSilico
nPlateP");
   fLogicSiliconPlateM = new G4LogicalVolume(fSolidSiliconPlate,silMat,"fLogicSilico
nPlateM");
   fLogicSiliconSensor = new G4LogicalVolume(fSolidSiliconSensor,silMat,"fLogicSilic
onSensor");
   fLogicLadderBox      = new G4LogicalVolume(fSolidLadderBox,vacuum,"fLogicLadderBox
");
   fLogicLadder         = new G4LogicalVolume(fSolidLadder,vacuum,"fLogicLadder");
   fLogicKaptonS        = new G4LogicalVolume(fSolidKaptonS,kapMat,"fLogicKaptonS");
   fLogicKaptonK        = new G4LogicalVolume(fSolidKaptonK,kapMat,"fLogicKaptonK");
   fLogicHybrid         = new G4LogicalVolume(fSolidHybrid,fr4Mat,"fLogicHybrid");
   fLogicHeatSink       = new G4LogicalVolume(fSolidHeatSink,copperMat,"fLogicHeatSin
k");
   fLogicRingK          = new G4LogicalVolume(fSolidRingK,cfMat,"fLogicRingK");
   fLogicRingS          = new G4LogicalVolume(fSolidRingS,cfMat,"fLogicRingS");

   fLogicSiliconSensor->SetSensitiveDetector(tkSD);


   G4RotationMatrix * rotTracker = new G4RotationMatrix;
   rotTracker->rotateZ(180*deg);
   rotTracker->rotateX(180*deg);

   fPhysiTracker = new G4PVPlacement(rotTracker,
                        G4ThreeVector(fPhysiTracker_X,fPhysiTracker_
Y,fPhysiTracker_Z),
                        "Tracker",
                        fLogicTracker,
                        motherVolume,
                        false,0,true);

   fPhysiLayer = new G4PVReplica("Layer",
                        fLogicLayer,
                        fPhysiTracker,
                        kZAxis,
                        fLayerNumber,
                        fLayer_Z);

   fPhysiCFFrame = new G4PVPlacement(0,
                        G4ThreeVector(0,0,0),
                        "CFFrame",
                        fLogicCFFrame,
                        fPhysiLayer,
                        false,0,true);


   fPhysiPoronFrame = new G4PVPlacement(0,
                        G4ThreeVector(fPhysiPoronFrame_X,fPhysiPo
ronFrame_Y,fPhysiPoronFrame_Z),
                        "PoronFrame",
```

```
                                    fLogicPoronFrame,
                                    fPhysiLayer,
                                    false,0,true);

   fPhysiLadderBox = new G4PVPlacement(0,
                                    G4ThreeVector(fPhysiLadderBox_X,fPhysiLadd
erBox_Y,fPhysiLadderBox_Z),
                                    "LadderBox",
                                    fLogicLadderBox,
                                    fPhysiLayer,
                                    false,0,true);

   fPhysiLadder = new G4PVReplica("Ladder",
                                    fLogicLadder,
                                    fPhysiLadderBox,
                                    kXAxis,
                                    fLadderNumber,
                                    fLadder_X);
   fPhysiRingK = new G4PVPlacement(0,
                                    G4ThreeVector(fPhysiRingK_X,fPhysiRingK_Y,fPhy
siRingK_Z),
                                    "RingK",
                                    fLogicRingK,
                                    fPhysiLadder,
                                    false,0,true);

   fPhysiKaptonK = new G4PVPlacement(0,
                                    G4ThreeVector(fPhysiKaptonK_X,fPhysiKaptonK_
Y,fPhysiKaptonK_Z),
                                    "KaptonK",
                                    fLogicKaptonK,
                                    fPhysiLadder,
                                    false,0,true);

   fPhysiHybridK = new G4PVPlacement(0,
                                    G4ThreeVector(fPhysiHybridK_X,fPhysiHybridK_
Y,fPhysiHybridK_Z),
                                    "HybridK",
                                    fLogicHybrid,
                                    fPhysiLadder,
                                    false,0,true);

   fPhysiSiliconPlateP = new G4PVPlacement(0,
                                    G4ThreeVector(fPhysiSiliconPlateP_X,fP
hysiSiliconPlateP_Y,fPhysiSiliconPlateP_Z),
                                    "SiliconPlateP",
                                    fLogicSiliconPlateP,
                                    fPhysiLadder,
                                    false,0,true);

   fPhysiSiliconSensorP = new G4PVPlacement(0,
                                    G4ThreeVector(fPhysiSiliconSensorP_X,
fPhysiSiliconSensorP_Y,fPhysiSiliconSensorP_Z),
                                    "SiliconSensorP",
                                    fLogicSiliconSensor,
                                    fPhysiSiliconPlateP,
                                    false,0,true);

   fPhysiSiliconPlateM = new G4PVPlacement(0,
                                    G4ThreeVector(fPhysiSiliconPlateM_X,fP
hysiSiliconPlateM_Y,fPhysiSiliconPlateM_Z),
                                    "SiliconPlateM",
                                    fLogicSiliconPlateM,
```

```
                                    fPhysiLadder,
                                    false,0,true);

   fPhysiSiliconSensorM = new G4PVPlacement(0,
                                    G4ThreeVector(fPhysiSiliconSensorM_X,
fPhysiSiliconSensorM_Y,fPhysiSiliconSensorM_Z),
                                    "SiliconSensorM",
                                    fLogicSiliconSensor,
                                    fPhysiSiliconPlateM,
                                    false,0,true);

   fPhysiKaptonS = new G4PVPlacement(0,
                                    G4ThreeVector(fPhysiKaptonS_X,fPhysiKaptonS_
Y,fPhysiKaptonS_Z),
                                    "KaptonS",
                                    fLogicKaptonS,
                                    fPhysiLadder,
                                    false,0,true);

   fPhysiHybridS = new G4PVPlacement(0,
                                    G4ThreeVector(fPhysiHybridS_X,fPhysiHybridS_
Y,fPhysiHybridS_Z),
                                    "HybridS",
                                    fLogicHybrid,
                                    fPhysiLadder,
                                    false,0,true);

   fPhysiHeatSink = new G4PVPlacement(0,
                                    G4ThreeVector(fPhysiHeatSink_X,fPhysiHeatSin
k_Y,fPhysiHeatSink_Z),
                                    "HeatSink",
                                    fLogicHeatSink,
                                    fPhysiLadder,
                                    false,0,true);

   fPhysiRingS = new G4PVPlacement(0,
                                    G4ThreeVector(fPhysiRingS_X,fPhysiRingS_Y,fPhy
siRingS_Z),
                                    "RingS",
                                    fLogicRingS,
                                    fPhysiLadder,
                                    false,0,true);

   //Visualization Attribute
   G4VisAttributes* attBlue = new G4VisAttributes(G4Colour::Blue());
   attBlue->SetVisibility(true);
   attBlue->SetForceAuxEdgeVisible(true);
   fLogicSiliconPlateP->SetVisAttributes(attBlue);
   fLogicSiliconPlateM->SetVisAttributes(attBlue);

   G4VisAttributes* attGray = new G4VisAttributes(G4Colour::Gray());
   attGray->SetVisibility(true);
   attGray->SetForceAuxEdgeVisible(true);
   fLogicSiliconSensor->SetVisAttributes(attGray);

   G4VisAttributes* attYellow = new G4VisAttributes(G4Colour::Yellow());
   attYellow->SetVisibility(true);
   attYellow->SetForceAuxEdgeVisible(true);
   fLogicPoronFrame->SetVisAttributes(attYellow);

   G4VisAttributes* attMagenta = new G4VisAttributes(G4Colour::Magenta());
   attMagenta->SetVisibility(true);
   attMagenta->SetForceAuxEdgeVisible(true);
   fLogicKaptonS->SetVisAttributes(attMagenta);
```

```
  fLogicKaptonK->SetVisAttributes(attMagenta);

  G4VisAttributes* attBrown = new G4VisAttributes(G4Colour::Brown());
  attBrown->SetVisibility(true);
  attBrown->SetForceAuxEdgeVisible(true);
  fLogicCFFrame->SetVisAttributes(attBrown);
  fLogicRingK->SetVisAttributes(attBrown);
  fLogicRingS->SetVisAttributes(attBrown);

  G4VisAttributes* attGreen = new G4VisAttributes(G4Colour::Green());
  attGreen->SetVisibility(true);
  attGreen->SetForceAuxEdgeVisible(true);
  fLogicHybrid->SetVisAttributes(attGreen);

  G4VisAttributes* attRed = new G4VisAttributes(G4Colour::Red());
  attRed->SetVisibility(true);
  attRed->SetForceAuxEdgeVisible(true);
  fLogicHybrid->SetVisAttributes(attRed);

  G4VisAttributes* attBlack = new G4VisAttributes(G4Colour::Black());
  attBlack->SetVisibility(true);
  attBlack->SetForceAuxEdgeVisible(true);
  fLogicHeatSink->SetVisAttributes(attBlack);

  G4VisAttributes * attInvisible = new G4VisAttributes();
  attInvisible->SetVisibility(false);
  attInvisible->SetForceAuxEdgeVisible(false);
  fLogicTracker->SetVisAttributes(attInvisible);
  fLogicLayer->SetVisAttributes(attInvisible);
  fLogicLadderBox->SetVisAttributes(attInvisible);
  fLogicLadder->SetVisAttributes(attInvisible);

}
```