LESSON 3 - A SIMPLE SOURCE, TOTAL INTERNAL REFLECTION, SPHERICAL GEOMETRY

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HOMEWORK 2 REVIEW

- world volume 是 geant4 中最基本的一个volume，所有其它的volume都在它里面，所以world volume一定比任何volume大。 你可以定义一个长达100km world volume。
- 对于我们做X-ray的来说，请务必把所有的world volume 材料定义成 vaccum。

- mother volume， 指某几何体以这个mother volume 为参照物放置。比如 “我在李老师身旁1m放个苹果”， 那么此时李老师就是 mother volume, 苹果是 daughter volume. （汉语里会讲父XX， 子XX， 英语里一开始也是 son volume, 我估计是美帝的政治正确所以讲 mother volume 和 daughter volume 括弧笑）

- envelope volume是B1例子里自己定义的。没有普遍性。B1例子是模拟生物体的，所以evnelope被定义为一个充满水的box，模拟生物体环境。
- envolope 显示蓝色的问题 >_>
  - 每次显示可视化的时候会启动一个叫vis.mac的文件
  - 在这个vis.mac文件中有一行命令：/vis/geometry/set/colour Envelope 0 0 0 1 .3 就让叫Envelope的几何体全部画成蓝色
  - 要不让它显示蓝色，你可以删掉这行，也可以把envelope 改个名。

- 玻璃定义有两种。二者等价。
- 陈酊存找到了一个内置的玻璃定义

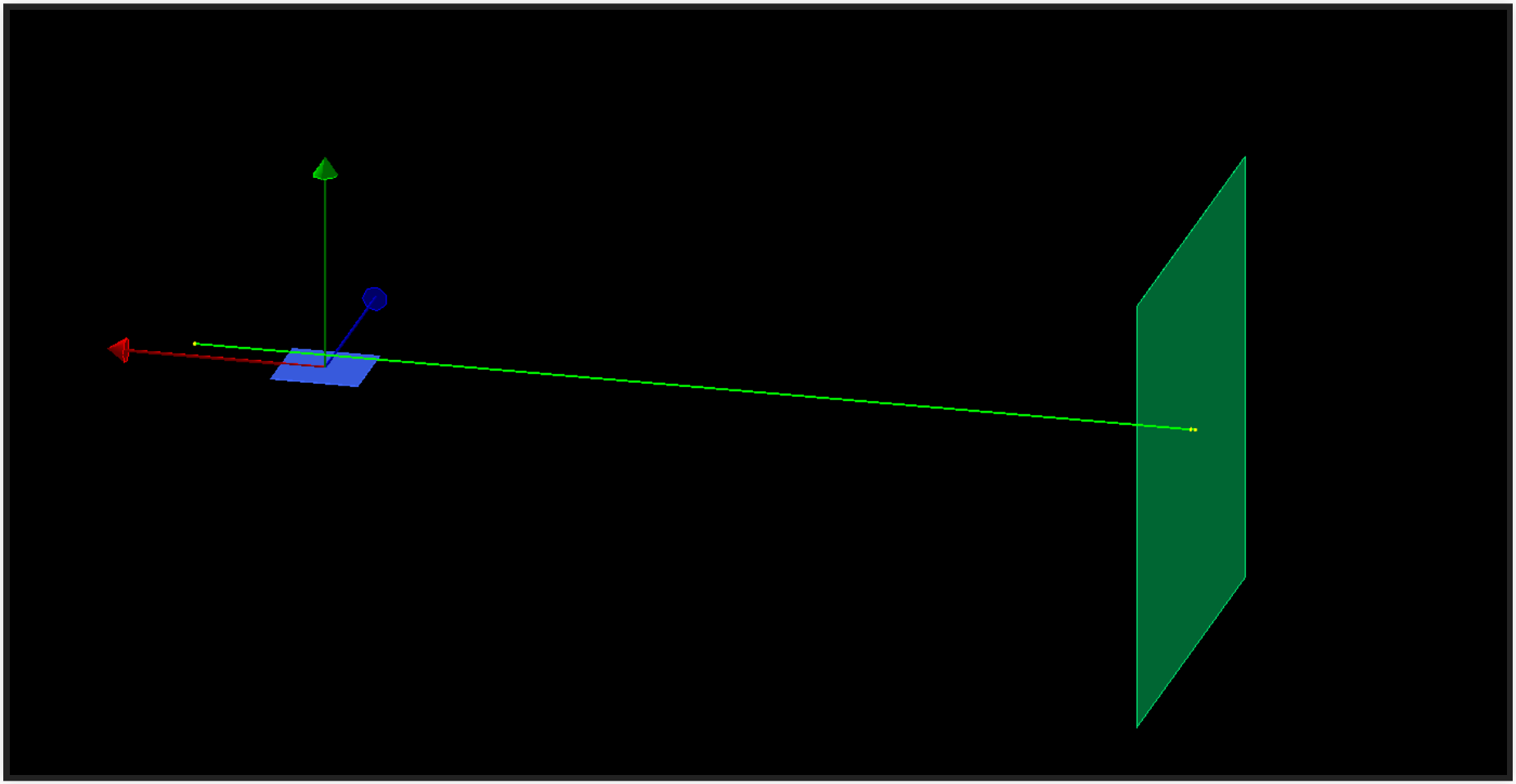
```
G4Material* SiO2 = nist->FindOrBuildMaterial
("G4_SILICON_DIOXIDE");
```

- 另一种方法是基本的定义，首先定义一个叫Si的元素，然后定义一个叫O的元素，再定义一个叫SiO2的分子，里面有一个Si和一个O。

```
G4Element* elSi = new G4Element(
    "Silicon","Si",14,28.085*g/mole);
G4Element* elO = new G4Element(
    "Oxygen","O",8,16.00*g/mole);
G4int ncomponents = 2;
G4double density = 2.200*g/cm3;
G4Material* SiO2 = new G4Material(
    "SiO2",2.200*g/cm3,ncomponents);
G4int natoms;
SiO2->AddElement(elSi,natoms = 1);
SiO2->AddElement(elO,natoms=2);
```

CREATE A SIMPLE SOURCE BY GENERAL PARTICLE SOURCE(GPS)

GPS is a tool for building complicated sources.



- Create a file named test.mac in the building directory
- Write the following code

```
/run/verbose 1
/tracking/storeTrajectory 1
/gps/particle gamma
/gps/pos/type Plane
/gps/pos/shape Square
/gps/pos/rot1 0. 0. 1.
/gps/pos/rot2 0. 1. 0.
/gps/pos/halfx 1. cm
/gps/pos/halfy 1. cm
/gps/pos/centre 3. 0.3 0. m
/gps/ang/type beam1d  # beam1d is a parallel light.
/gps/ene/type Mono
```

- Then run it in command window with the following command

```
/control/execute test.mac
```

CHANGE THE DIRECTION OF THE BEAM

- There are two ways to make the beam focused on a single point.
- Use /gps/ang/type focused.

```
/gps/ang/type focused
/gps/ang/focuspoint 0. 0. 0.
```

- Use angular rotation to rotate it to a single point. Below is the default rotation. The first line means x axis is (1,0,0). The second line means y axis is at (0,1,0). You can calculate the rotation angle you want.

```
/gps/ang/rot1 1. 0. 0.
/gps/ang/rot2 0. 1. 0.
```

X-RAY TOTAL INTERNAL REFLECTION

- There's no total internal reflection physics in Geant4
- A Netherland company wrote an X-ray package called xrtg for Geant4-9. I have been altered it to make it fit Geant4-10.
- When using this package, you have to first contain the xray reflectivity in the build directory. You can get data from https://henke.lbl.gov/optical_constants/getdb2.html

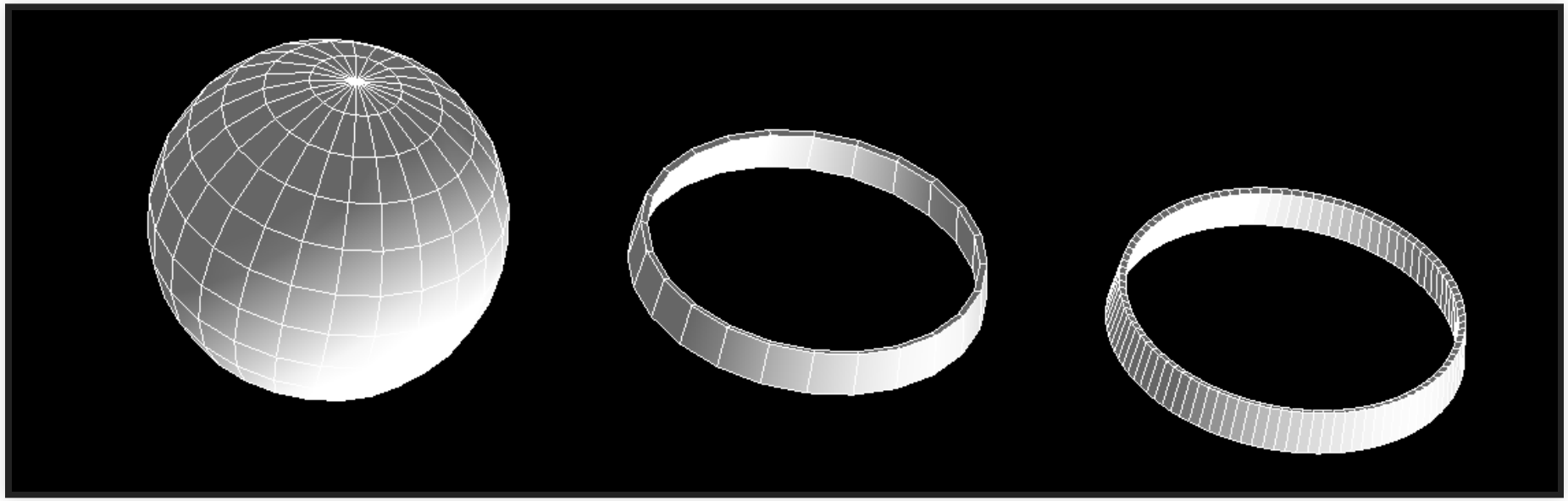
- First include header in DetectorConstruction.cc

```
#include "G4LogicalSkinSurface.hh"
#include "G4XraySpecularReflectingSurface.hh"
```

- Then define the Xray skin surface.

```
new G4LogicalSkinSurface("TargetIrSurface",
 LayerLogical,xray_surface_property);
```

SPHERICAL GEOMETRY



- First include header

```
#include "G4Sphere.hh"
```

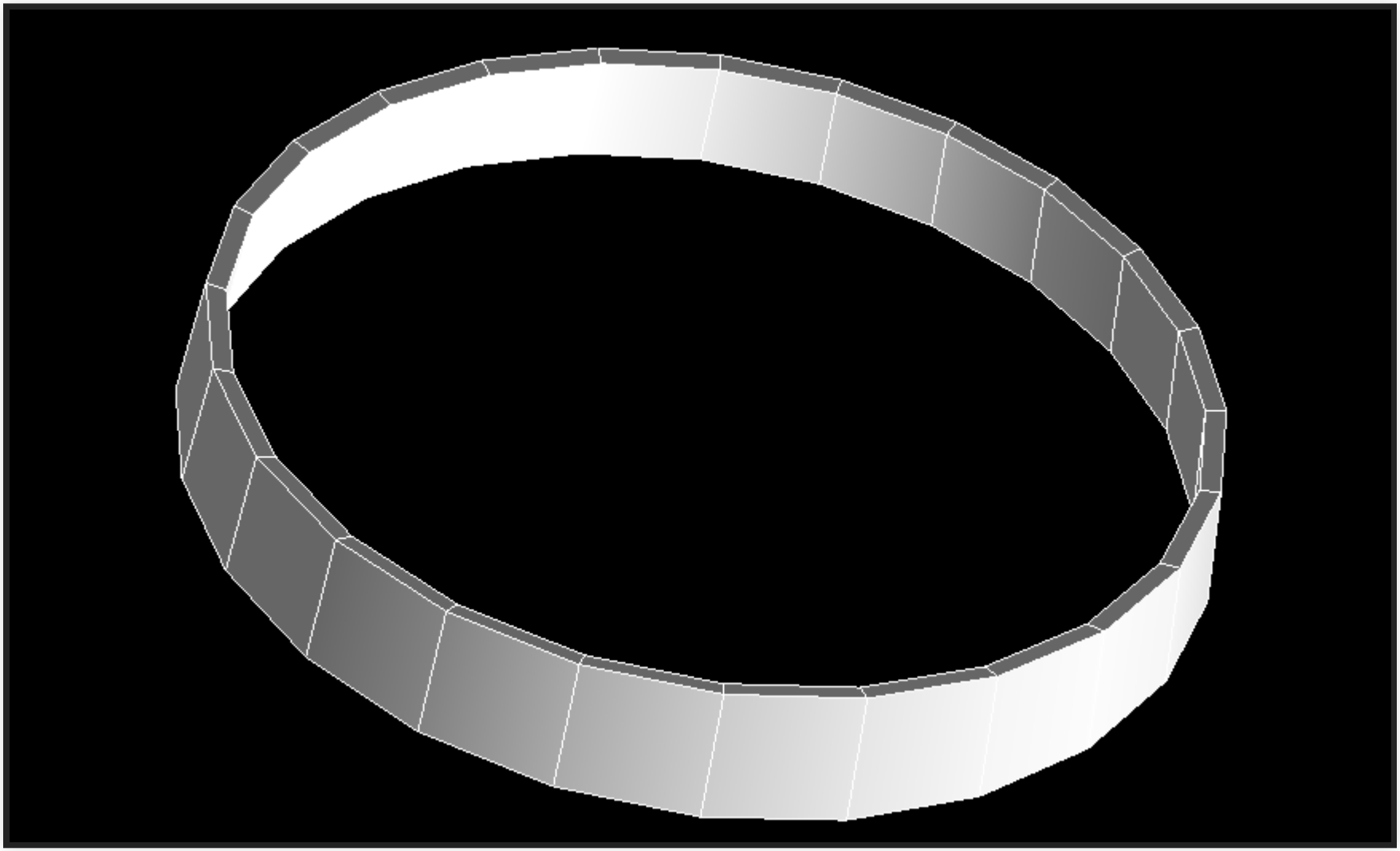
- To define a sphere, run the following code

```
  G4double rmin = 720.* mm;
  G4double rmax = 750. * mm;
  G4double Sphere1SPhi = 0.;
  // start phi angle, phi ranges [0,2*pi]
  G4double Sphere1DPhi = 2.* pi ;
  // delta phi angle
  G4double Sphere1STheta = 0.;
  // start theta angle, theta ranges [0,pi]
  G4double Sphere1DTheta = pi ;
  // delta theta angle
  G4VSolid* SphereSolid1 = new G4Sphere("SphereSolid",
                    rmin,rmax,Sphere1SPhi,Sphere1DPhi,
```

- Draw a ring

```
G4double Sphere2SPhi = 0.;
G4double Sphere2DPhi = 2.* pi ;
G4double Sphere2STheta = 6*pi/12;
G4double Sphere2DTheta = pi/12 ;
G4VSolid* SphereSolid2 = new G4Sphere("SphereSolid",
              rmin,rmax,Sphere2SPhi,Sphere2DPhi,
              Sphere2STheta,Sphere2DTheta);
G4LogicalVolume* SphereLogical2 =
              new G4LogicalVolume(SphereSolid2,Al,
              "SphereLogical");
new G4PVPlacement(0,G4ThreeVector(200.*cm,0.*cm,0.*cm),
              "SpherePhysical",SphereLogical2,
```

- In Geant4, you would find that, actually, a sphere is made of several boxes. For example, the ring we made just now is made up of 24 boxes, each boxes has $\Delta\Phi = 15^\circ$.



- To make it smoother, we can use 100 boxes to make a ring.

```
G4int i;
G4int part = 100;
G4double Sphere3SPhi = 0.;
G4double Sphere3DPhi = 2.* pi /part;
G4double Sphere3STheta = 6*pi/12;
G4double Sphere3DTheta = pi/12 ;
G4VSolid* SphereSolid3[part];
G4LogicalVolume* SphereLogical3[part];

for (i=0;i<part;i++){
    Sphere3SPhi = i*Sphere3DPhi;
    SphereSolid3[i] = new G4Sphere("SphereSolid",
```

HOME WORK 3

- 在share/examples/advanced/xray_telescope 基础上改。
- 如作业2第二题，制造一个微孔。微孔所有部件都在一个半径为 $750\,\mathrm{mm}$ 的球体上，要求使用G4Sphere命令建立所有几何体。
- 微孔长 $1.06\,\mathrm{mm}$, 外周 $26\,\mu\mathrm{m}$, 内周$20\,\mu\mathrm{m}$， 铱膜厚 $20\,\mathrm{nm}$.
- 设置一个光源，入射角极小，使之发生全反射。