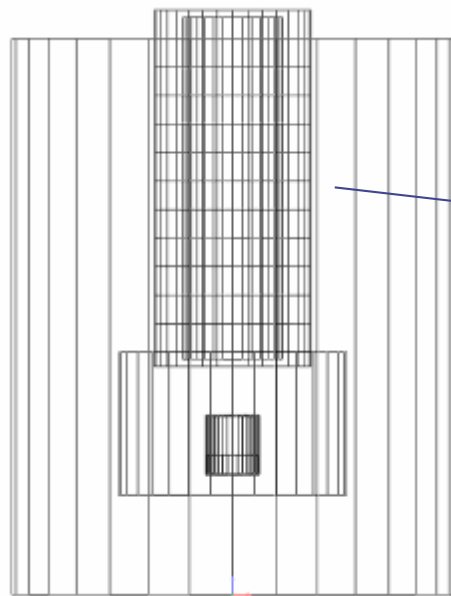# Building a geometry with SimpleGeo

Chris Theis

What we would like to build...
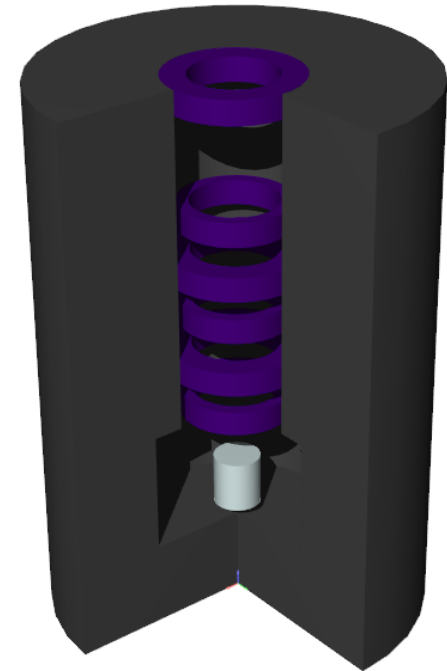
Collimators

Source

Irradiator with a lead container,
a radioactive source including
its encapsulation and some collimators

Creating an additional material

We need to create Cesium, which is not included in the list of standard materials. Do not forget to specify the physical property of the material with the created numerical ID in the input file for FLUKA!

1. Select "Edit" in the the "Materials" menu.
2. Press "New" in the material property dialog
3. Enter Cesium & set the color properties
4. A material with ID 26 will be created.
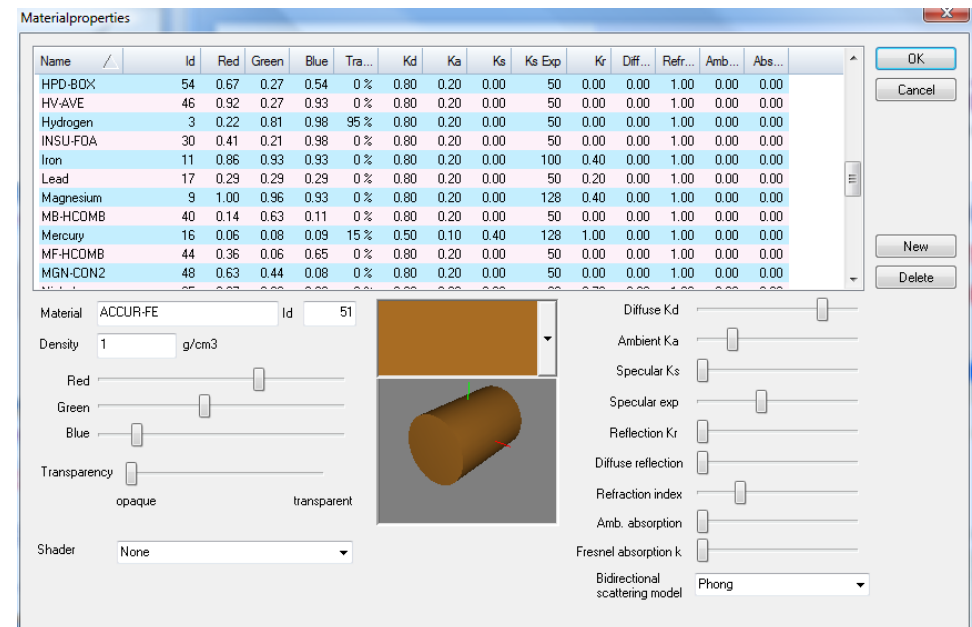
This material database will be stored in the same directory as your geometry. They must be kept in one place!

More on materials...

- In FLUKA Materials are assigned by a numerical ID

- The physical parameters must be specified in the input file

- If the standard materials are overwritten in an imported input the material name in SimpleGeo and the one in FLUKA will NOT match, because SimpleGeo uses the standard materials of FLUKA2005.6.

This causes no problem because in the exported FLUKA input the assignment is based on the numerical ID! However, it is strongly discouraged to overwrite standard material numbers to avoid confusion!!
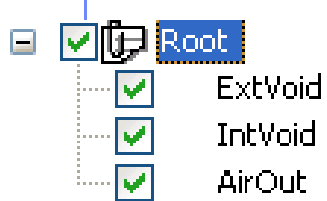
External & internal void

Bodies

- External void -> Cylinder: X = 0, Y = 0, Z = -200, R = 400, H = 600
  Name = ExtVoid
- Internal void -> Cylinder: X = 0, Y = 0, Z = -150, R = 250, H = 400
  Name = IntVoid
- AirOut   -> Cylinder: X = 0, Y = 0, Z = -100, R = 200, H = 300
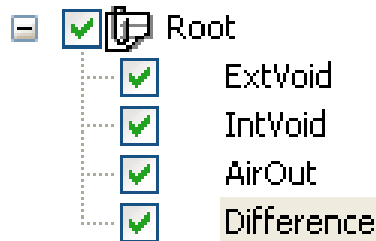 Name = AirOut

Regions

- External void: Type   = Difference (ExtVoid – IntVoid),
  Name = RExtVoid
  Material = Blackhole

Creating a region

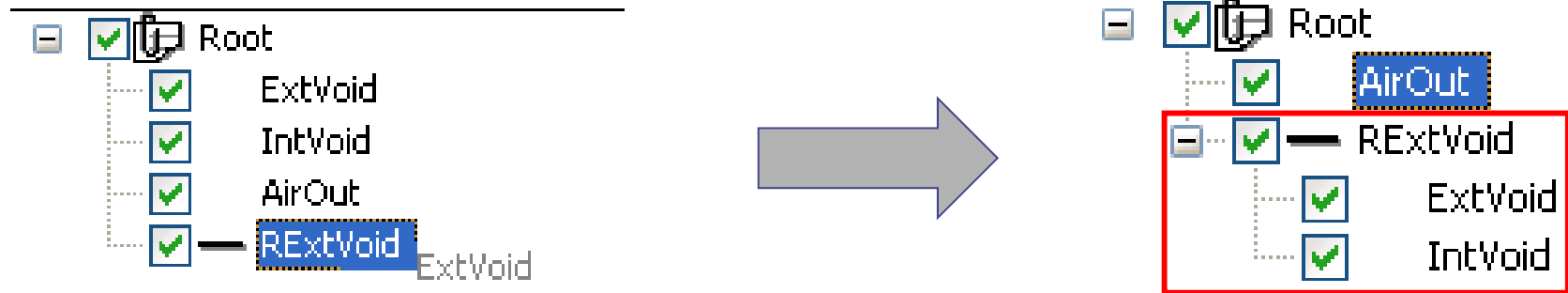*Add difference*

Change the name

Existing bodies in the CSG tree

Root
- ExtVoid
- IntVoid
- AirOut

Root
- ExtVoid
- IntVoid
- AirOut
- Difference

General	
Name	RExtVoid
Type	**Difference**
Comment	**no comment**
Importance	**default**
Position	
X-Rel.	0.00
Y-Rel.	0.00
Z-Rel.	0.00
Rot. X	0.00
Rot. Y	0.00
Rot. Z	0.00
Viz Attributes	
Contours	**Yes**
Contour color	**Black**
Contour style	**Solid**
Contour width	**Normal**
X-Ray mode	**Off**
Edge-Ray mode	**Off**

Hint: Edit fields for numerical parameters like position, size, radius etc. can evaluate mathematical expressions! For example one can enter "305 +(25*3)" which will evaluate to 380.

Creating a region

Drag "ExtVoid" and drop it over "RExtVoid".
Do the same with "IntVoid".

The difference of ExtVoid – IntVoid has been finished.

(The first body in a difference is always the one which is subtracted from)

Material assignments

- **Regions consisting of 1 body only:**
  Select the material in the property view

- **Regions made up of boolean operations:**

  Select the **top-most node of the region** (a boolean operator) and select the material in the property view

Creating a region with references

Regions

- Internal void: Type = Difference (IntVoid – AirOut),
  Name = RIntVoid
  Material = Air

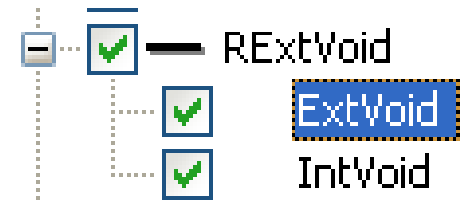One of these bodies exists and is already used in another region description!

Reference nodes

They share the geometry, position, orientation etc. but <u>NOT</u> the material!
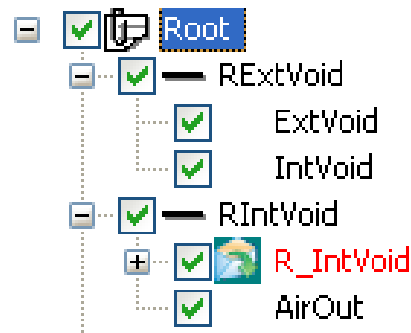
Creating a region with references

1. Create a difference with the name RIntVoid

2. Select the body IntVoid in the region RExtVoid.

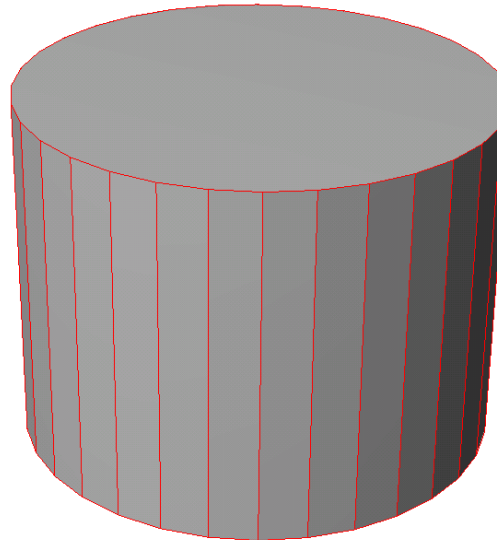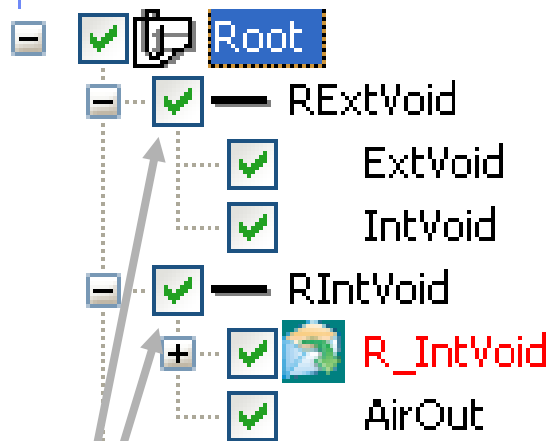3. Press the Shift key and drag IntVoid and drop it over RIntVoid while holding Shift pressed!

4. Also drag and drop the body AirOut over RIntVoid

5. Finally you'll have

References are marked by the envelope icon and automatically have a R_ prefix

Visibility

Hint: Selected (sub)regions are always shown with red contours

Now turn off the visibility be clicking on the checkbox of the upper-most node

Create the next bodies/regions

Bodies

- Lead container -> Cylinder: X = 0, Y = 0, Z = 0, R = 18, H = 45
  Name = LeadCon

- Air inside 1 -> Cylinder: X = 0, Y = 0, Z = 16, R = 5.5, H = 31
  Name = AirIn1

- Air inside 2 -> Cylinder: X = 0, Y = 0, Z = 7, R = 8, H = 10
  Name = AirIn2

Regions

- Lead container: Type = Difference (LeadCon – AirIn1 – AirIn2),
  Name = LeadCol
  Material = Lead

Creating another region with references

Regions

- Air outside: Type = Difference (AirOut – LeadCon – AirIn1)
  Name = ROuterAir
  Material = Air

All of these bodies exist and are already used in other region descriptions!
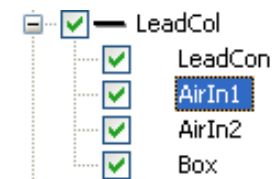
We need reference nodes again
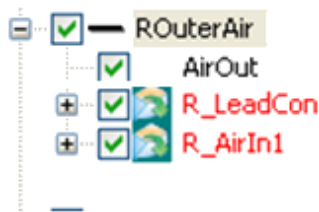
Creating a region with references

1. Create a difference with the name ROuterAir

2. Drag and drop the body AirOut, which becomes the first child node

3. Select the body AirIn1 in the region LeadCol.

4. Press the Shift key and drag AirIn1 and drop it over ROuterAir while holding Shift pressed!

5. Repeat step 4 with LeadCon

6. Finally you'll have
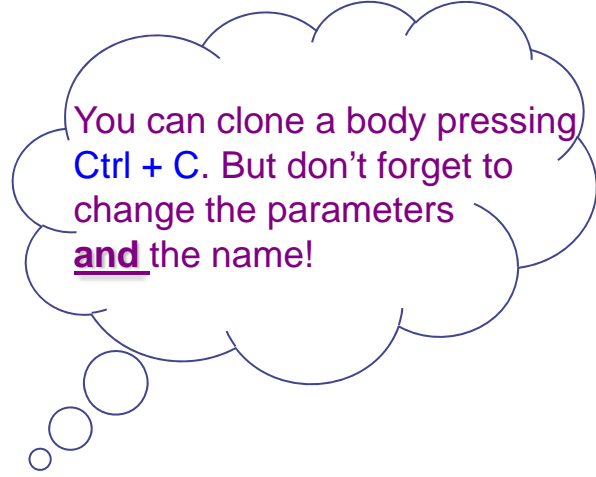

7. Turn off the visibility of ROuterAir

Creating further bodies/regions

Bodies

- Air inside 3 -> Cylinder: X = 0, Y = 0, Z = 16.5, R = 3.5, H = 30
  Name = AirIn3

- Collimator 1 -> Cylinder: X = 0, Y = 0, Z = 17, R = 4.5, H = 2
  Name = Coll1

- Collimator 2 -> Cylinder: X = 0, Y = 0, Z = 21, R = 5.5, H = 2
  Name = Coll2

- Collimator 3 -> Cylinder: X = 0, Y = 0, Z = 25, R = 4.5, H = 2
  Name = Coll3

- Collimator 4 -> Cylinder: X = 0, Y = 0, Z = 29, R = 5.5, H = 2
  Name = Coll4

- Collimator 5 -> Cylinder: X = 0, Y = 0, Z = 33, R = 4.5, H = 2
  Name = Coll5

- Collimator 6 -> Cylinder: X = 0, Y = 0, Z = 43, R = 5.5, H = 2
  Name = Coll6

You can clone a body pressing Ctrl + C. But don't forget to change the parameters **and** the name!
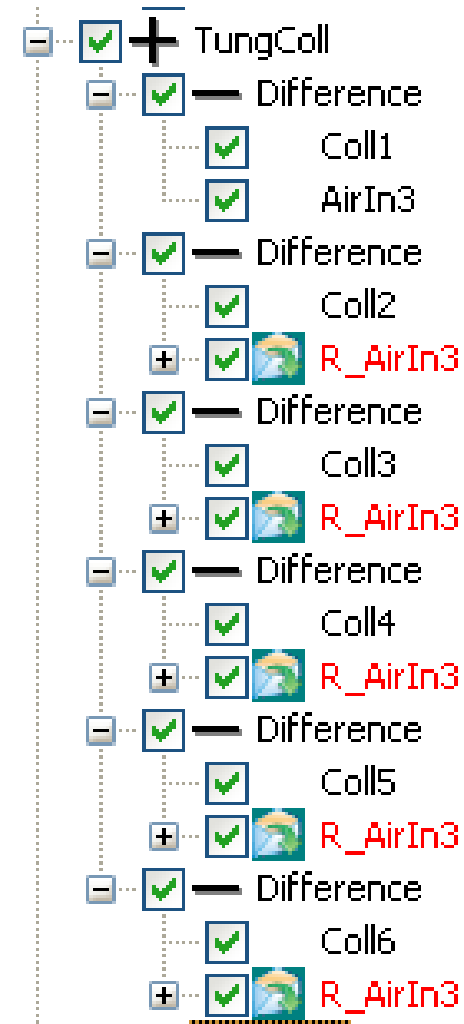
Creating further bodies/regions

Regions

- Tungsten collimator: Type = Union
  (Coll1 – AirIn3) | (Coll2 – AirIn3) | (Coll3 – AirIn3) |
  (Coll4 – AirIn3) | (Coll5 – AirIn3) | (Coll 6 - AirIn3)

  Name = TungColl
  Material = Tungsten

Don't forget to use references for already existing bodies! You can clone existing bodies and references by dragging and dropping them while holding the Ctrl key.

TungColl
- Difference
  - Coll1
  - AirIn3
- Difference
  - Coll2
  - R_AirIn3
- Difference
  - Coll3
  - R_AirIn3
- Difference
  - Coll4
  - R_AirIn3
- Difference
  - Coll5
  - R_AirIn3
- Difference
  - Coll6
  - R_AirIn3

Creating further bodies/regions

Bodies
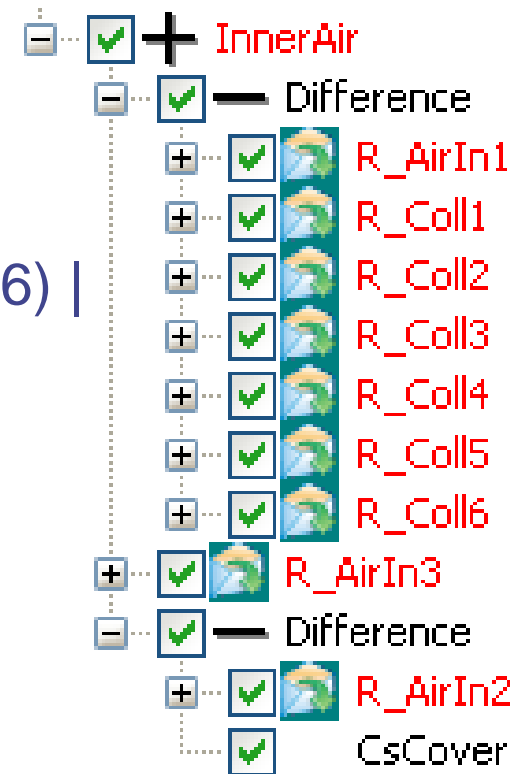
- Cs source cover -> Cylinder: X = 0, Y = 0, Z = 8.4, R = 1.9, H = 4.2
  Name = CsCover

Regions

- Air inside: Type   = Union
  (AirIn1 – Coll1 – Coll2 – Coll3 – Coll4 – Coll5 – Coll6) |
  (AirIn3) |
  (AirIn2 – CsCover)

  Name = InnerAir
  Material = Air

Creating further bodies/regions

Bodies

- Cs source inside -> Cylinder: X = 0, Y = 0, Z = 8.5, R = 1.8, H = 4.0

  Name = CsInner

- Al separator plane -> Plane: X = 0, Y = 0, Z = 9.8

  Name = CsAlSep

Regions

- Source: Type   = Difference (CsInner - CsAlSep)

  Name = Source

  Material = Cesium

- Source cover: Type   = Difference (CsCover - CsInner)

  Name = SourceCov

  Material = Iron

- Al part of the source: Type   = Intersection (CsInner x CsAlSep)

 Name = AlSrcPart

  Material = Aluminum

Export to FLUKA

SimpleGeo supports the following formats for exporting to FLUKA

- Old syntax with numbers
- New syntax with names and without parentheses
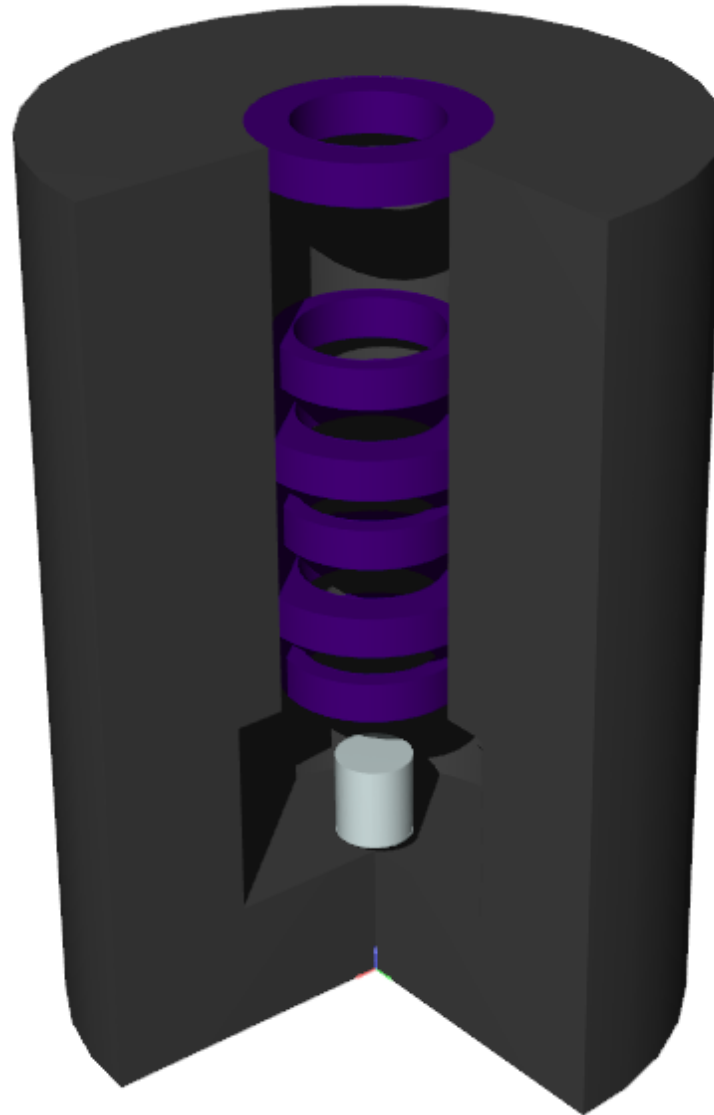- New syntax with names and with parentheses

In the export dialog you can select the respective format from the drop-down list at the bottom of the dialog.
In this case select the option
FLUKA input new syntax (*.new.inp)
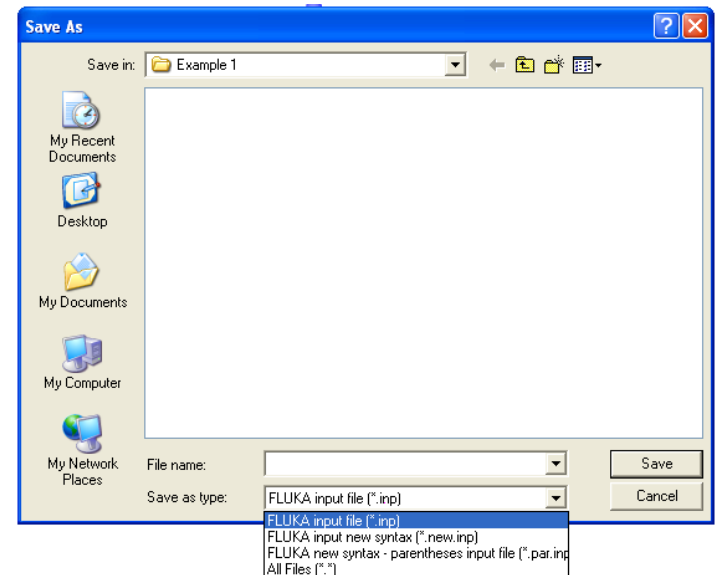
In the end...

Final version of the geometry with one part removed

You can find more examples in the gallery on the website

Website: www.cern.ch/theis/simplegeo