

Geometry Persistency

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Outline

- Text files (ASCII)
- Geometry Description Markup Language (GDML)
- Exchanging geometries with ROOT
- Importing geometries from CAD

ASCII Text Models

ASCII File Format

- Well defined syntax for identifying the different geometrical entities:
 - materials, solids, volumes and volume attributes
- Dedicated manual:
 - https://geant4.cern.ch/collaboration/working_groups/geometry/docs/textgeom/textgeom.pdf ([link](#))
- Example of use of ASCII text model:
 - [extended/persistence/P03](#)

ASCII File Format - Example

g4geom_simple.txt

```
// Define a parameter for later  
// use  
:P POSZ 5.
```

```
// Define materials  
:ELEM Hydrogen H 1. 1.  
:ELEM Oxygen O 8 16.  
:ELEM Nitrogen N 7 14.  
:MIXT Air 1.214E-03 2  
      Nitrogen    0.75  
      Oxygen      0.25
```

```
// Define rotation matrix  
:ROTM R00 90. 0. 90. 90. 0. 0.  
// unit matrix
```

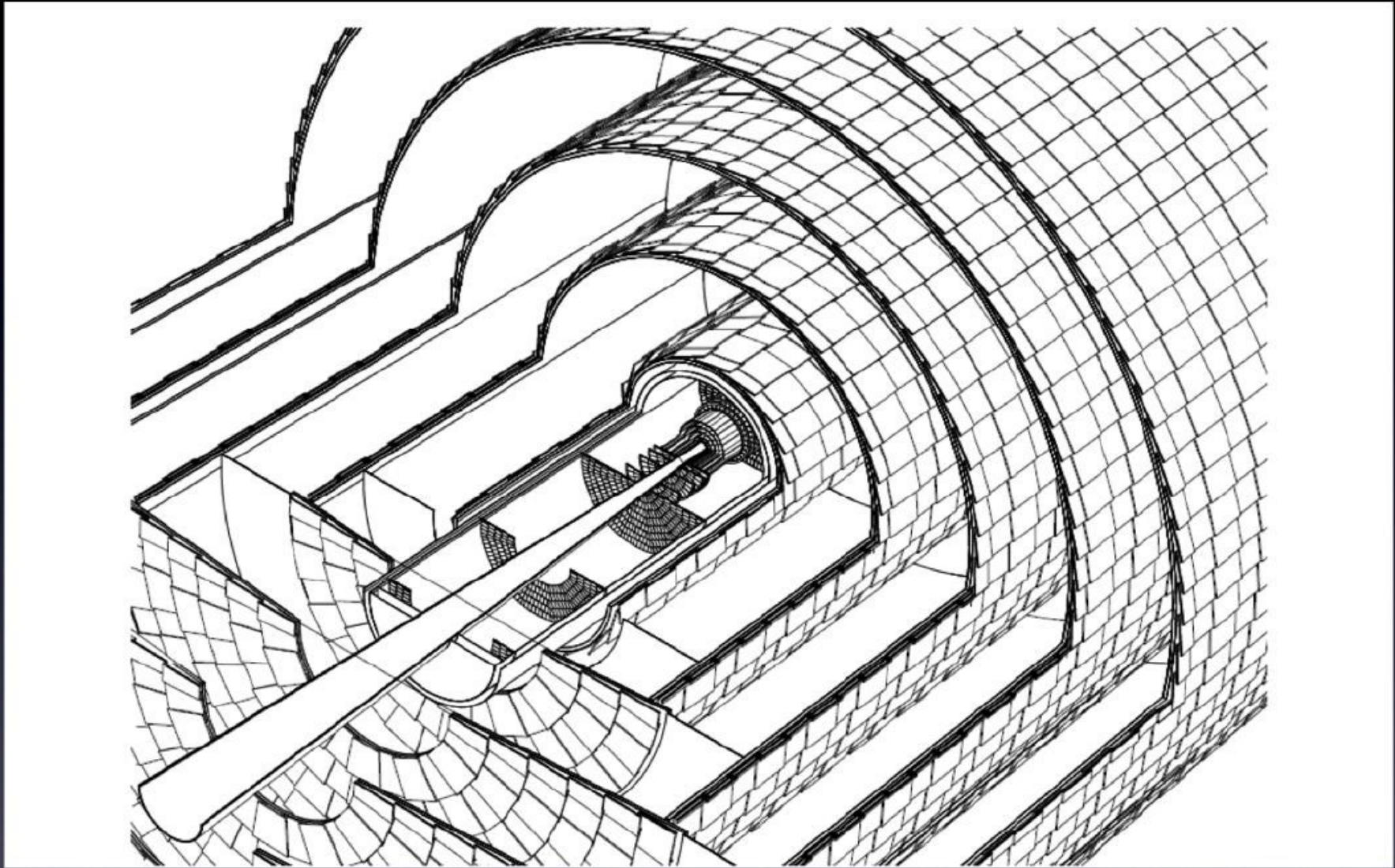
```
// Define volumes and place them  
:VOLUME world BOX 30. 30. 30. Air
```

```
:VOLUME "my tube" TUBS 0. 10. 20.  
0. 360. G4_WATER  
:PLACE "my tube" 1 world R00 0.  
0. $POSZ
```

```
:VOLUME sphere ORB 5. G4_AIR  
:PLACE sphere 1 "my tube" R00 0.  
1. 10.
```

GDML

Defining Geometry in GDML



Silicon Pixel & Microstrip Tracker for Collider Detector
Norman Graf, LCDD Collaboration, SLAC

GDML Format

- An XML-based language designed as an application-independent persistent format for describing geometries of detectors
 - Allows to define hierarchy of volumes, their materials and solids
- As pure XML, GDML can be used universally
 - Not just for Geant4
 - Can be used for interchanging geometries among different applications, used also to translate CAD geometries to Geant4
- XML is simple
 - Rigid set of rules, self-describing data validated against schema
- XML is extensible
 - Easy to add custom features, data type

GDML Format - Example

```
<box name="worldBox" x="1" y="1" z="1" unit="m" />
<box name="boxA" x="10" y="10" z="10" unit="cm" />

<position name="pos1" x="25.0" y="50.0" z="75.0" unit="cm" />
<rotation name="rotZ" z="30.0" unit="deg" />

<volume name="World">
  <material ref="Air" />
  <solid ref="WorldBox" />
  <physvol >
    <volumeref ref="boxA" />
    <positionref ref="pos1" />
    <rotationref ref="rot1" />
  </physvol >
</volume >
```

- Examples of use of GDML with Geant4:
 - [extended/persistency/gdml](#)

Geant4 <-> GDML

- **G4GDMLParser** class provides import/export of GDML files into/from Geant4

- Import:

```
#include "G4GDMLParser.hh"

G4GDMLParser* parser;
parser.Read("geometryFile.gdml");
G4VPhysicalVolume* world = parser.GetWorldVolume();
```

- Export

```
G4VPhysicalVolume* worldPV = ...;    // Get world
physical volume
G4GDMLParser* parser;
parser.Write("geometryFile.gdml", worldPV);
```

ROOT <-> GDML

- ROOT geometry model can also import/export GDML

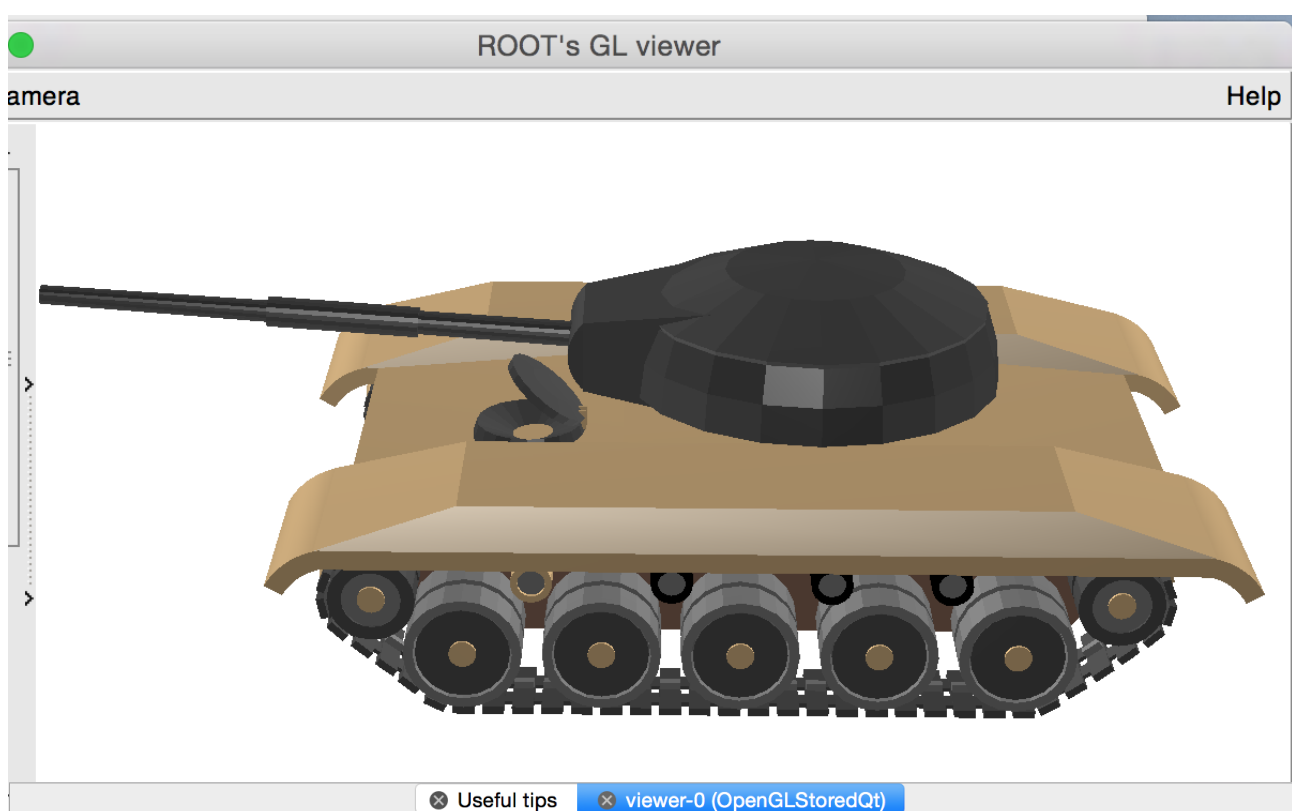
- Import:

```
root[0] TGeoManager::Import("geometryFile.gdml");
```

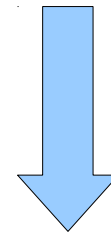
- Export

```
root[0] gGeoManager->Export("geometryFile.gdml");
```

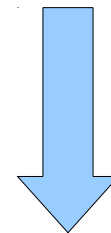
- GDML can be used to exchange geometry between ROOT and Geant4
 - The converted geometry may be incomplete if the source geometry is using solids not supported in the destination geometry model
 - ROOT geometry allows overlapping volumes, **not allowed** in Geant4



root/tutorials/geom/tank.C

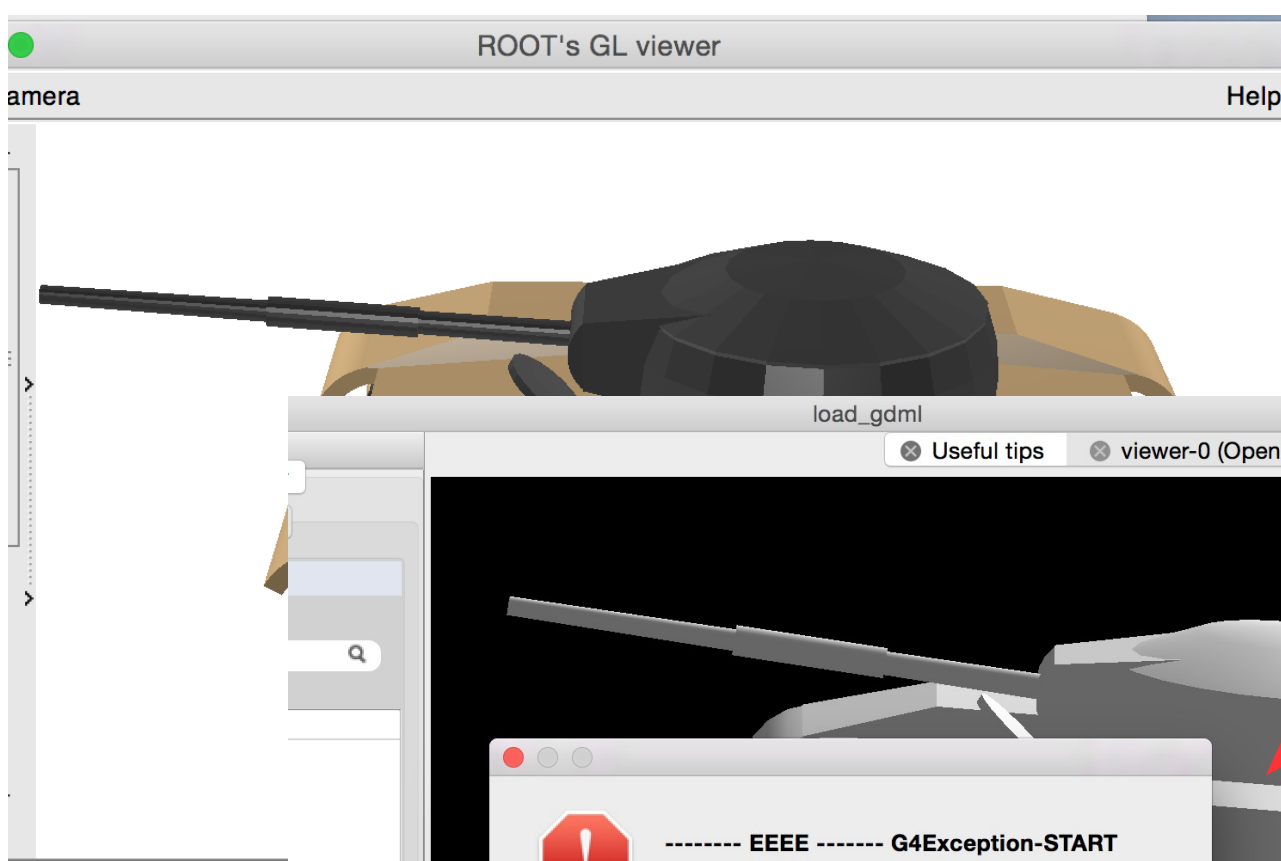


tank.gdml



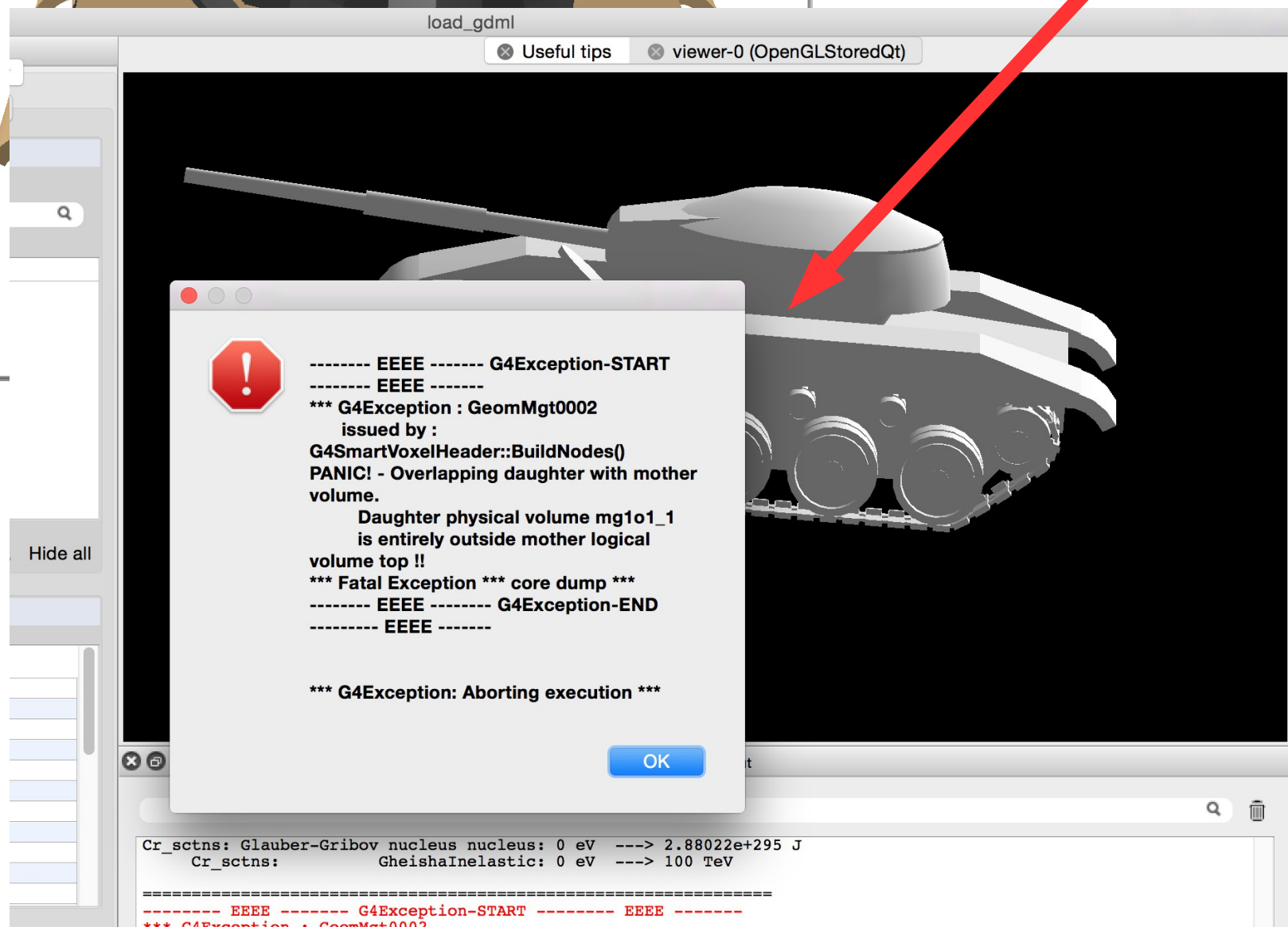
geant4/examples/extended
/persistency/gdml/G01

./load_gdml



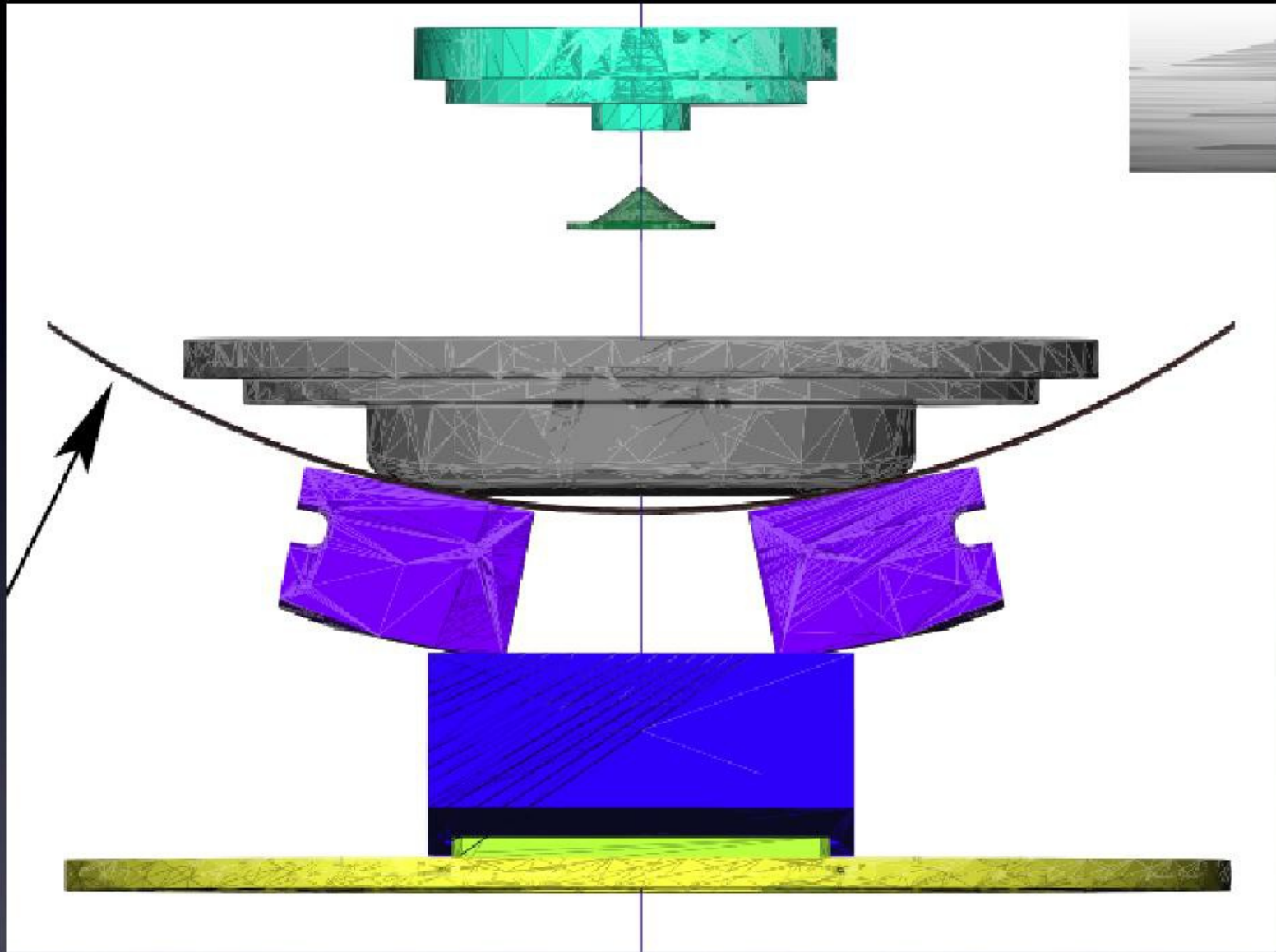
But !

/run/beamOn 1



CAD

Importing Geometry from CAD



Varian TrueBeam Linac, M. Constantin et. al, Stanford University

Importing CAD Geometries

- CAD geometries: 3D engineering drawings
- No unique file format, but most CAD programs support STEP output format
- Current solutions of converting STEP to Geant4
 - **ST-Viewer**: <http://www.steptools.com/>
 - **FastRad**: <http://www.fastrad.net/>
 - Not free, not perfect, but still helpful

Importing CAD Geometries (2)

- **Cadmesh:** <https://github.com/christopherpoole/cadmesh>

- Alternative solution to go from CAD to STL (Stereo Litography) or PLY (Polygon File Format) to [G4TessellatedSolid](#)
- Use of cadmesh classes in Geant4 application for reading STL or PLY files (from CAD) and generating G4TessellatedSolid objects in memory

