A Tool to Convert CAD Models for Importation into Geant4

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Problem:
How can a detector design in a CAD program be transferred into a Geant4 simulation?

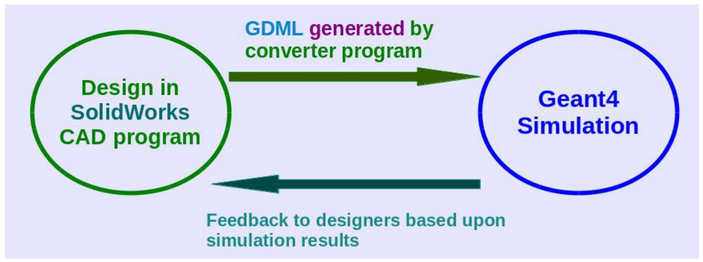
Solution:
Automated conversion of the CAD design into GDML for importation into Geant4

SW2GDML is a software tool called that reads a detector design in SolidWorks via the SolidWorks native application programming interface and then outputs Geometry Description Markup Language (GDML), the native Geant4 language for importing and exporting geometry.

SW2GDML reliably and efficiently converts a CAD design for automated importation into Geant4, thus eliminating laborious and error-prone manual development of geometry models in Geant4.

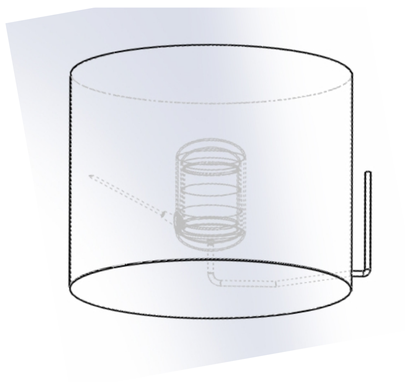
SW2GDML is about 3000 lines of C++ code developed with Microsoft Visual Studio.

Iterative Design Process

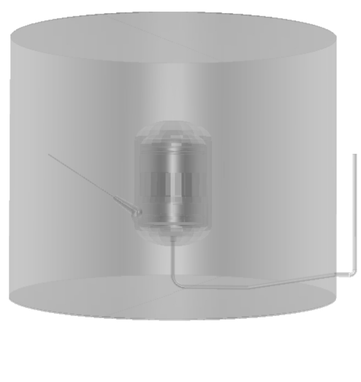


Automated conversion from SolidWorks to Geant4

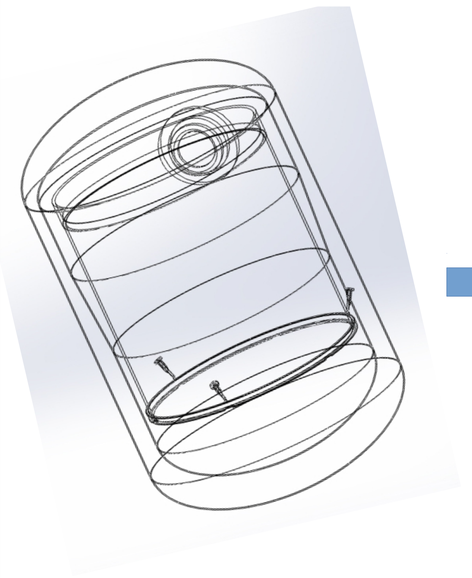
Simplified LZ model in SolidWorks



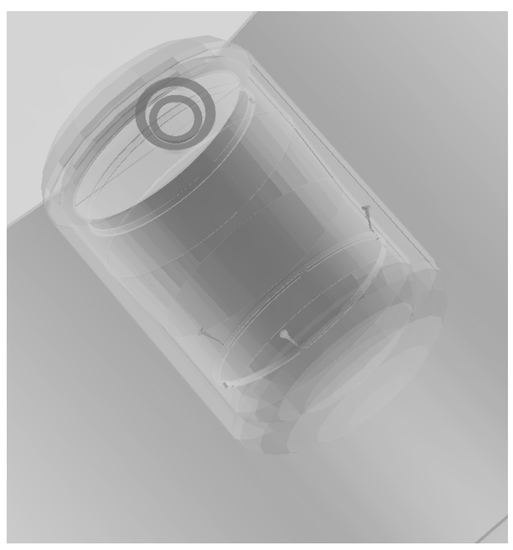
Converted model in Geant4



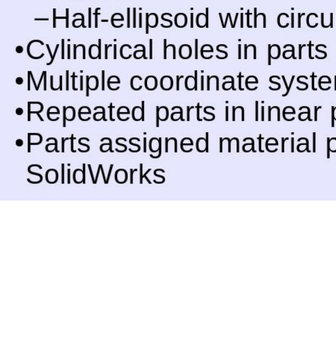
Simplified LZ inner tank in SolidWorks



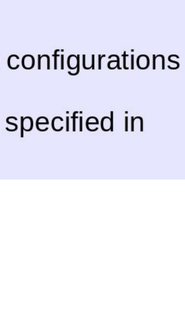
Converted inner tank in Geant4



Outer detector tank in SolidWorks



Converted tank in Geant4

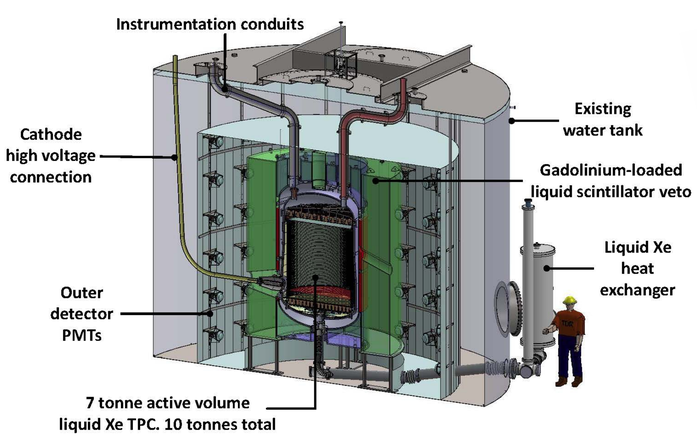


The LUX-ZEPLIN Dark Matter Experiment is building a detector holding 7 tonnes of liquid xenon that will be installed at the Sanford Underground Research Facility in the former Homestake gold mine in Lead, South Dakota.

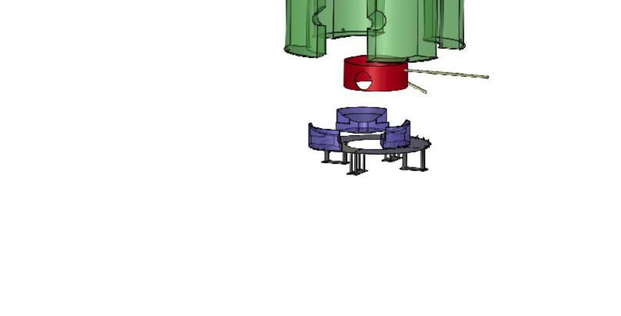
The detector is being designed with the SolidWorks computer-aided design program, developed by Dassault Systèmes SOLIDWORKS Corporation in Waltham, MA.

The figures below show an overview of the design of the LZ detector.

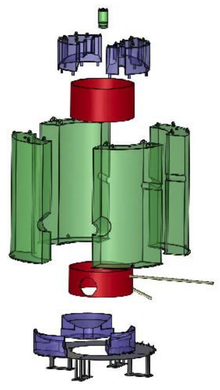
LZ Detector Overview



Previous design version of LZ detector, showing outer detector photo multiplier tubes



Outer detector liquid scintillator tanks (green)



Abbreviated sample GDML produced by SW2GDML:

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 rmax2="0.0746125" deltaphi="TWOPI"/>
 <cone name="cone2" z="0.6" rmin1="0.83095" rmin2="0.78895" rmax1="0.83895"
 rmax2="0.79695" deltaphi="TWOPI"/>
 <torus name="torus1" rtor="0.119" rmin="0" rmax="0.054" startphi="0" deltaphi="1.5708"/>
 <torus name="torus2" rtor="0.275" rmin="0" rmax="0.054" startphi="0" deltaphi="1.5708"/>
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 <ellipsoid name="s-revolve2" ax="0.91395" by="0.91395" cz="0.460418" zcut1="0"/>
 <ellipsoid name="s-revolve3" ax="0.78895" by="0.78895" cz="0.401699" zcut1="0"/>
 <ellipsoid name="s-revolve4" ax="0.83095" by="0.83095" cz="0.273815" zcut1="0"/>
 <tube name="disk1" rmin="0" rmax="3.81476" deltaphi="6.28319" z="0.0005"/>
 <tube name="disk2" rmin="0" rmax="3.81476" deltaphi="6.28319" z="0.0005"/>
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 <tube name="disk5" rmin="0" rmax="0.729" deltaphi="6.28319" z="0.0005"/>
 <tube name="cylinder1" z="5.96274" rmin="3.81" rmax="3.81476" deltaphi="6.28319"/>
 <tube name="cylinder2" z="0.0484212" rmin="0.12675" rmax="0.127" deltaphi="6.28319"/>
 <tube name="cylinder3" z="0.0589099" rmin="0.20285" rmax="0.2699" deltaphi="6.28319"/>
 <tube name="cylinder4" z="2.03636" rmin="0.91395" rmax="0.92195" deltaphi="6.28319"/>
 <tube name="cylinder5" z="0.506499" rmin="0.83095" rmax="0.83895" deltaphi="6.28319"/>
 ...
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  <first ref="torus1"/>
  <second ref="cylinder16"/>
  <position name="pos1" x="-0.171" y="0.119" z="0"/>
  <rotation name="rot1" x="0" y="1.5708" z="0"/>
 </subtraction>
</solids>
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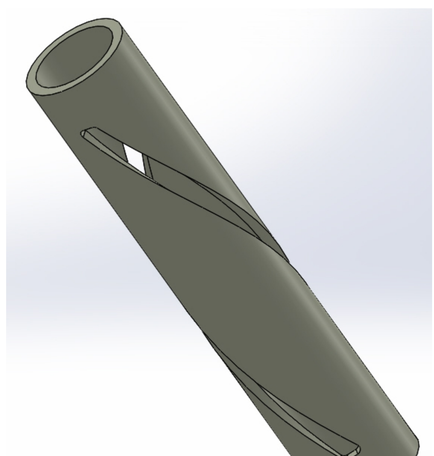

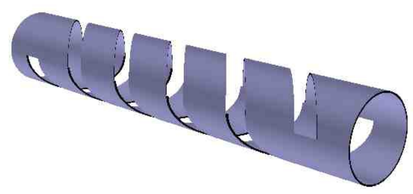

- Shapes:
  - Cylinder (full and partial)
  - Cone
  - Disk (full and partial)
  - Board
  - Torus
  - Half-ellipsoid with circular face
- Cylindrical holes in parts
- Multiple coordinate systems in simple configurations
- Repeated parts in linear patterns
- Parts assigned material properties as specified in SolidWorks