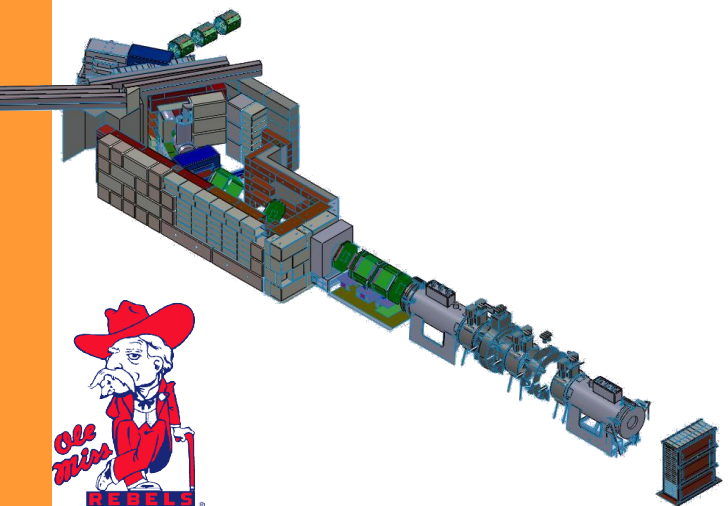
Active CAD Geometry Handling System

This presentation shall describe;

- The motivation to design a new system
- How the new system works and user interaction
- Current work/results
- Future work



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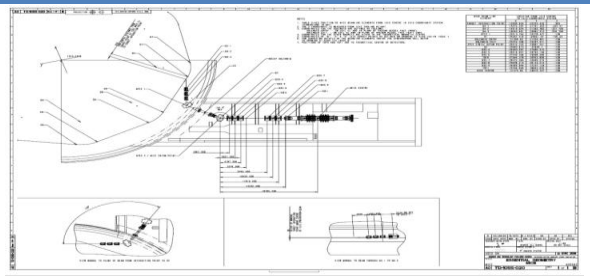
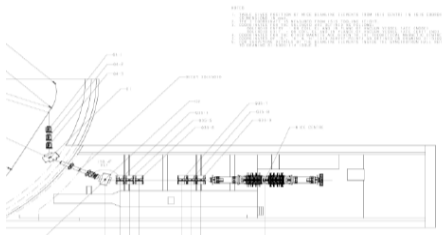
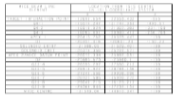


G4MICE





My Initial Task:

- Examine technical drawings and surveys
- Update G4MICE's geometry

Findings:

- Geometry was incorrect, so it became untrustworthy
- Many people wrote their own geometries

Changes needed:

- A new system?
- Trustworthy and more importantly correct geometries
- A management system which can control this information

So, an investigation into CAD translation was conducted. It found that we could translate CAD and utilise the Configuration Database (CDB) to store the information.

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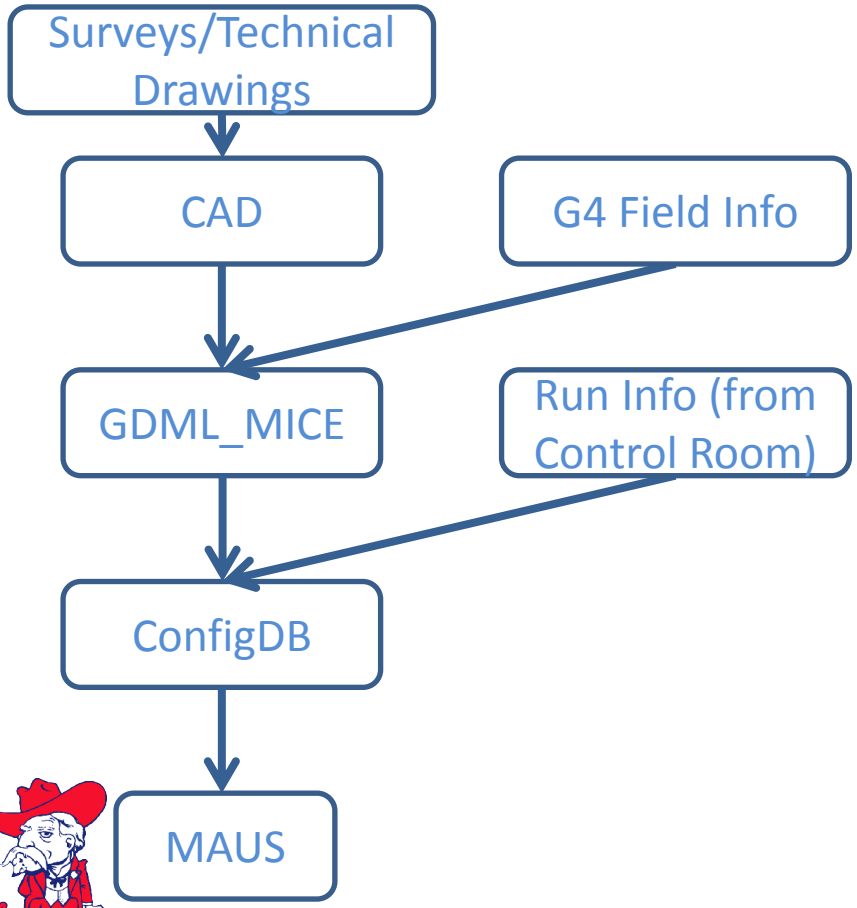
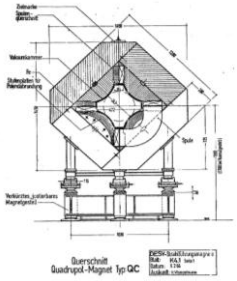
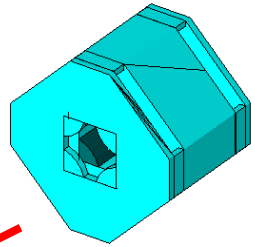
The Designed System

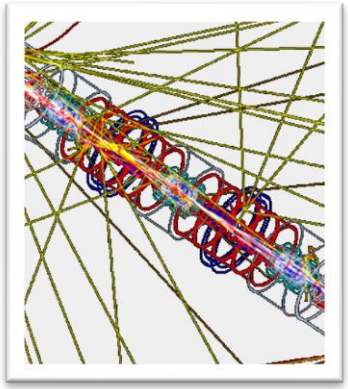
To use this transfer in an efficient manner a new geometry handling system was designed.





Above: Technical Drawing of Quad
Right: CAD Drawing of Quad
Below: G4MICE Simulation Example





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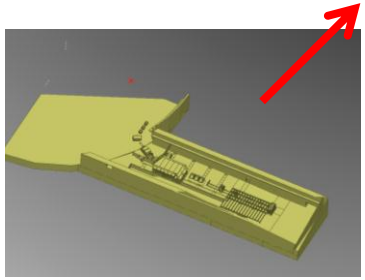
Current Status

The First Version of this system is now complete!

- The code for the system is finished

- Jason Tarrant is currently working on a new version of the CAD reasons are:
  - Actual CAD is far too large
  - It contains far too much detail
  - Includes many unnecessary parts



- Some initial simulations have been conducted

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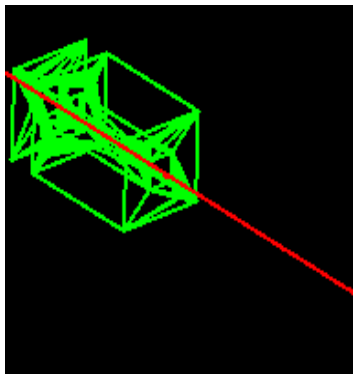
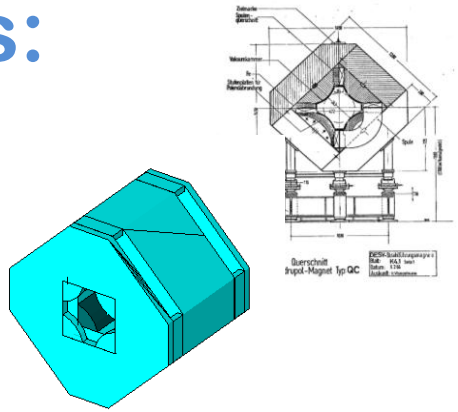
Current Simulations:
Test Quad

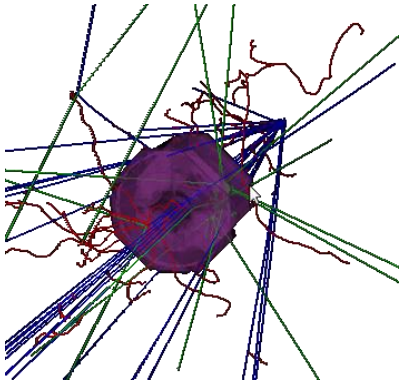


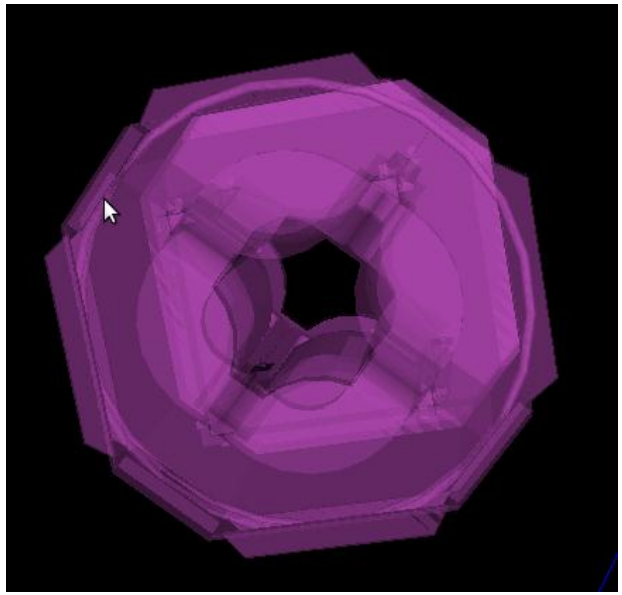
Left: G4MICE Quad

Right: CAD Quad

Below: CAD translated
MAUS Quad







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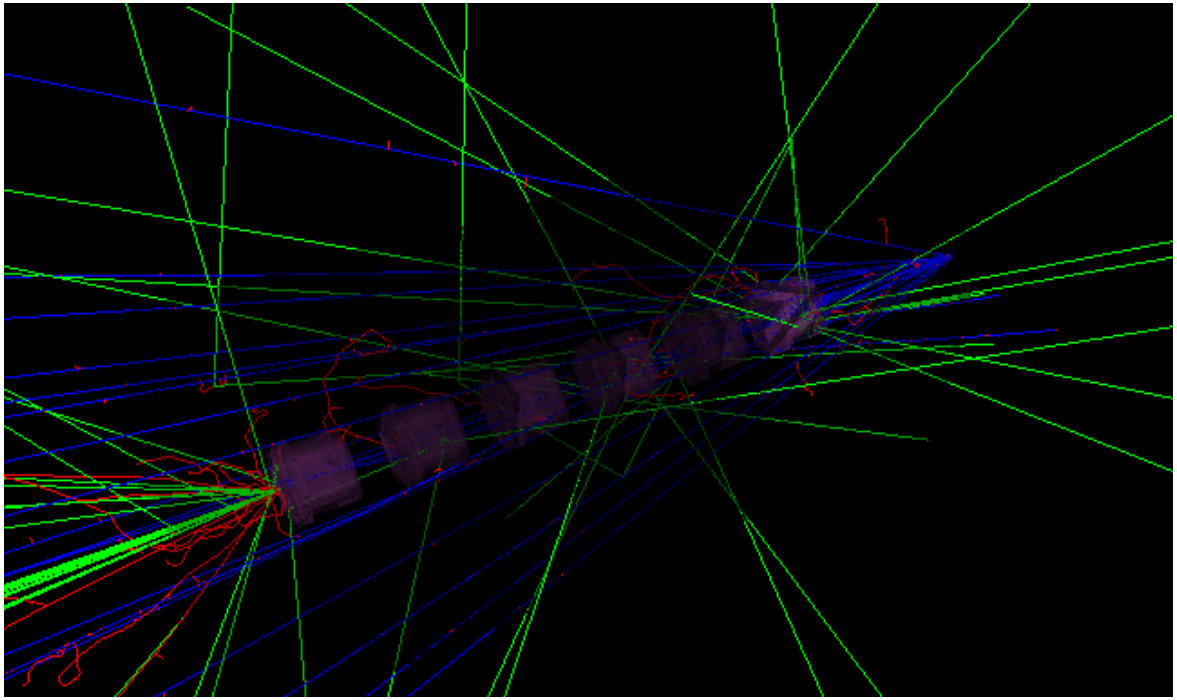
Current Simulations:
6 Quads (Step 1)



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User/Developer Interaction

Developers will:

1. Run CAD through FastRad
2. Run one executable upon the GDML files which will upload the geometry to the CDB

Users will be able to:

1. Download current geometry directly into MAUS or download a local copy
2. Download an old geometry directly into MAUS or download a local copy
3. Download geometry, from a particular run number, directly into MAUS or download a local copy

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Future Work

- Once Jason Tarrant's CAD is complete upload it to database (first official geometry
- Finalise details of management (Fastrad translation and internal detector geometries)
- Extend the code to include the merging of run data\field information (Provisions for this are already in the code, however the details of how the simulation will use this need to be finished)
- Write code which downloads the geometry directly to the simulation (doesn't download a local copy)
- Collect internal geometries from each detector group (Oleg from the tracker and Gene from the CKOV have already begun) and then extend the GDML_MICE schema
- As always TESTS! TESTS! TESTS!

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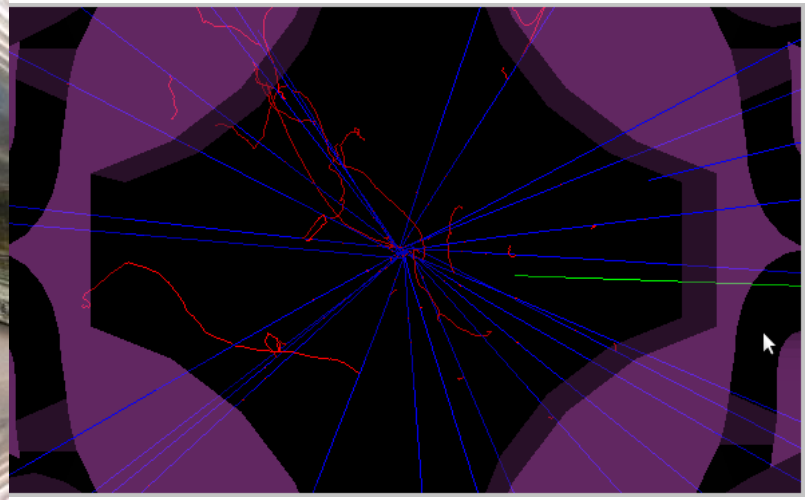
Any Questions?



Thank You for Listening

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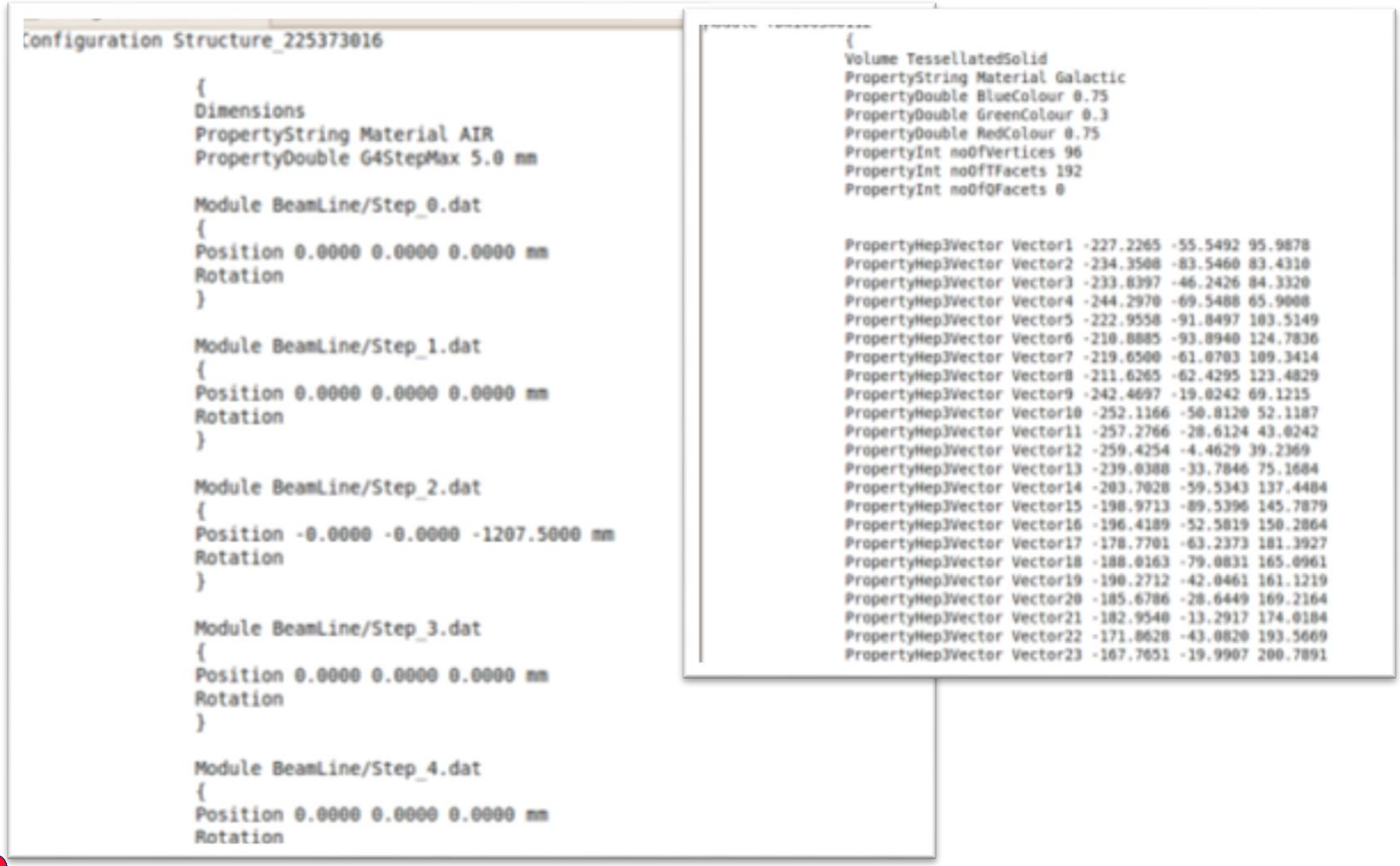

```
Configuration Structure_225373016

                {
                Dimensions
                PropertyString Material AIR
                PropertyDouble G4StepMax 5.0 mm

                Module BeamLine/Step_0.dat
                {
                Position 0.0000 0.0000 0.0000 mm
                Rotation
                }

                Module BeamLine/Step_1.dat
                {
                Position 0.0000 0.0000 0.0000 mm
                Rotation
                }

                Module BeamLine/Step_2.dat
                {
                Position -0.0000 -0.0000 -1207.5000 mm
                Rotation
                }

                Module BeamLine/Step_3.dat
                {
                Position 0.0000 0.0000 0.0000 mm
                Rotation
                }

                Module BeamLine/Step_4.dat
                {
                Position 0.0000 0.0000 0.0000 mm
                Rotation
```

```
                {
                Volume TessellatedSolid
                PropertyString Material Galactic
                PropertyDouble BlueColour 0.75
                PropertyDouble GreenColour 0.3
                PropertyDouble RedColour 0.75
                PropertyInt noOfVertices 96
                PropertyInt noOfTFacets 192
                PropertyInt noOfQFacets 0


                PropertyHep3Vector Vector1 -227.2265 -55.5492 95.9878
                PropertyHep3Vector Vector2 -234.3508 -83.5460 83.4310
                PropertyHep3Vector Vector3 -233.8397 -46.2426 84.3320
                PropertyHep3Vector Vector4 -244.2970 -69.5488 65.9008
                PropertyHep3Vector Vector5 -222.9558 -91.8497 103.5149
                PropertyHep3Vector Vector6 -210.8885 -93.8940 124.7836
                PropertyHep3Vector Vector7 -219.6500 -61.0703 109.3414
                PropertyHep3Vector Vector8 -211.6265 -62.4295 123.4829
                PropertyHep3Vector Vector9 -242.4697 -19.0242 69.1215
                PropertyHep3Vector Vector10 -252.1166 -50.8120 52.1187
                PropertyHep3Vector Vector11 -257.2766 -28.6124 43.0242
                PropertyHep3Vector Vector12 -259.4254 -4.4629 39.2369
                PropertyHep3Vector Vector13 -239.0388 -33.7846 75.1684
                PropertyHep3Vector Vector14 -203.7028 -59.5343 137.4484
                PropertyHep3Vector Vector15 -198.9713 -89.5396 145.7879
                PropertyHep3Vector Vector16 -196.4189 -52.5819 150.2864
                PropertyHep3Vector Vector17 -178.7701 -63.2373 181.3927
                PropertyHep3Vector Vector18 -188.0163 -79.0831 165.0961
                PropertyHep3Vector Vector19 -190.2712 -42.0461 161.1219
                PropertyHep3Vector Vector20 -185.6786 -28.6449 169.2164
                PropertyHep3Vector Vector21 -182.9540 -13.2917 174.0184
                PropertyHep3Vector Vector22 -171.8628 -43.0820 193.5669
                PropertyHep3Vector Vector23 -167.7651 -19.9907 200.7891
```

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```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:stylesheet xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
    xmlns:xd="http://www.oxygenxml.com/ns/doc/xsl" exclude-result-prefixes="xd" version="1.0">
    <xd:doc scope="stylesheet">
        <xd:desc>
            <xd:p><xd:b>Created on:</xd:b> Jan 10, 2011</xd:p>
            <xd:p><xd:b>Author:</xd:b> Matt</xd:p>
            <xd:p/>
        </xd:desc>
    </xd:doc>

    <xsl:output method="text"/>
    <xsl:template match="gdml">
        <html>
            <head>
                <title>Configuration <xsl:value-of select="structure/volume/@name"/>

                {
                Dimensions <xsl:if test="solids/sphere/@name, WorldSphereRef">15000.0 10000.0 50000.0 mm</xsl:if>
                PropertyString Material <xsl:value-of select="structure/volume/materialref/@ref"/>
                PropertyDouble G4StepMax 5.0 mm
                </title>
            </head>
            <body>
                <xsl:for-each select="structure/volume/physvol">
                Module <xsl:value-of select="file/@name"/>
                {
                Position <xsl:value-of select="position/@x"/><xsl:text> </xsl:text><xsl:value-of select="position/@y"/
><xsl:text> </xsl:text><xsl:value-of select="position/@z"/> mm
                Rotation <xsl:if test="rotationref/@ref, identity"> 0.0 0.0 0.0 degree</xsl:if>
                }
                </xsl:for-each>
                }
            </body>
        </html>
    </xsl:template>
</xsl:stylesheet>
```

```
<volume name="Structure_224400784">
    <materialref ref="Vacuum"/>
    <solidref ref="WorldSphereRef"/>

    <physvol>
        <file name="Step_0.gdml"/>
        <position name="posRef_1" x="0.0000" y="0.0000" z="0.0000"/>
    <rotationref ref="identity"/>
    </physvol>

    <physvol>

        <file name="Step_1.gdml"/>
        <position name="posRef_2" x="0.0000" y="0.0000" z="0.0000"/>
    <rotationref ref="identity"/>
    </physvol>
    <physvol>
        <file name="Step_2.gdml"/>
        <position name="posRef_3" x="-0.0000" y="-0.0000" z="-1207.5000"/>
    <rotationref ref="identity"/>
```

```
Configuration Structure_224400784

        {
        Dimensions 15000.0 10000.0 50000.0 mm
        PropertyString Material Vacuum
        PropertyDouble G4StepMax 5.0 mm

        Module Step_0.gdml
        {
        Position 0.0000 0.0000 0.0000 mm
        Rotation  0.0 0.0 0.0 degree
        }

        Module Step_1.gdml
        {
        Position 0.0000 0.0000 0.0000 mm
        Rotation  0.0 0.0 0.0 degree
        }

        Module Step_2.gdml
        {
        Position -0.0000 -0.0000 -1207.5000 mm
        Rotation  0.0 0.0 0.0 degree
        }

        Module Step_3.gdml
        {
        Position 0.0000 0.0000 0.0000 mm
        Rotation  0.0 0.0 0.0 degree
        }

        Module Step_4.gdml
        {
        Position 0.0000 0.0000 0.0000 mm
        Rotation  0.0 0.0 0.0 degree
        }

        Module Step_5.gdml
        {
        Position -0.0000 -0.0000 757.5000 mm
        Rotation  0.0 0.0 0.0 degree
        }
```

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```
                <rotationref ref="identity"/>
                </physvol>
                <physvol>
                        <file name="Step_3.gdml"/>
                        <position name="posRef_4" x="0.0000" y="0.0000" z="0.0000"/>
                <rotationref ref="identity"/>
                </physvol>
                <physvol>
                        <file name="Step_4.gdml"/>
                        <position name="posRef_5" x="0.0000" y="0.0000" z="0.0000"/>
                <rotationref ref="identity"/>
                </physvol>
                <physvol>
                        <file name="Step_5.gdml"/>
                        <position name="posRef_6" x="-0.0000" y="-0.0000" z="757.5000"/>
                <rotationref ref="identity"/>
                </physvol>
        </volume>
</structure>

<field>
        <Type name="quad"/>
        <Pole num="5"/>
        <MaxEndPole num="2"/>
        <Magnitude tesla="5"/>
        <Height mm="5"/>
        <Width mm="6"/>
        <Length mm="7"/>
        <EndLength mm="6"/>
        <EndFieldType name="Enge"/>
        <EffectiveWidth num="3"/>
        <Enge1 num="3"/>
        <Enge2 num="3"/>
        <Enge3 num="3"/>
        <Enge4 num="3"/>
</field>


<setup name="Default" version="1.0">
        <world ref="Structure_224400784"/>
</setup>
```

```
Module QuadTypeIV_Boolean
{
  Volume            Box
  Dimensions        1.5 1.5 1.046 m

  PropertyDouble    RedColour    0.0
  PropertyDouble    GreenColour  1.0
  PropertyDouble    BlueColour   1.0
  PropertyBool      Invisible    1
  PropertyString    Material     Galactic

//Field model
  Module QCField
  {
    Volume None
    Position 0.0 0.0 0.0 mm
  //Field model
    PropertyString FieldType          Multipole
    PropertyInt    Pole               2 //Quad field
    PropertyInt    MaxEndPole         6 //Simulate end field up to octupole order
    PropertyDouble Magnitude          -2.237294e-04     //normalised to Opera Field map
    PropertyDouble Height             0.54     m
    PropertyDouble Width              0.54     m
    PropertyDouble Length             5.633106e+02  mm
    PropertyDouble EndLength          1.772302e+02
    PropertyString EndFieldType       Enge
    PropertyDouble EffectiveWidth     1.538410e+01  mm
    PropertyDouble Enge1              1.075890e-01
    PropertyDouble Enge2              5.710438e-02
    PropertyDouble Enge3              2.734375e-06
    PropertyDouble Enge4              1.367187e-08
  }
```

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