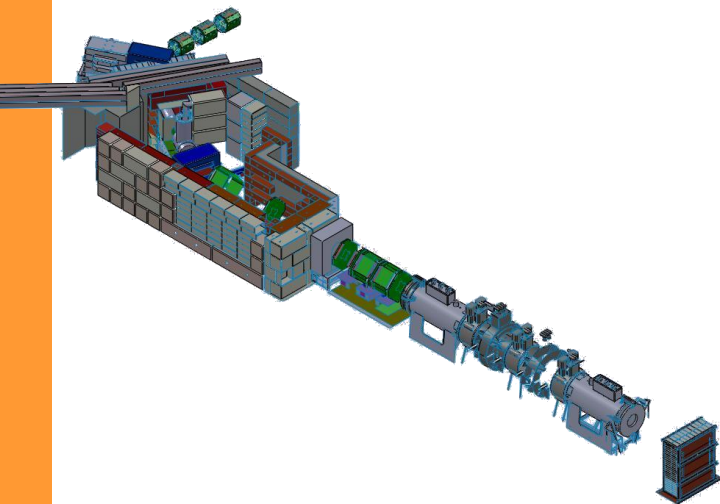


# Active CAD Geometry Handling System Update

This presentation shall describe;

- Work over the last 3 months
  - Ongoing work
  - Plans for the future



# CAD Import is now in MAUS

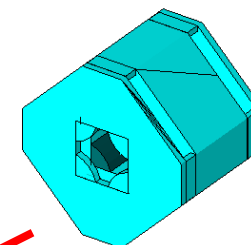
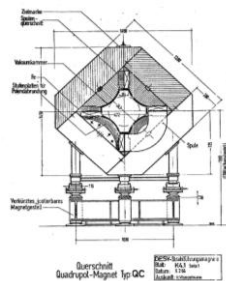
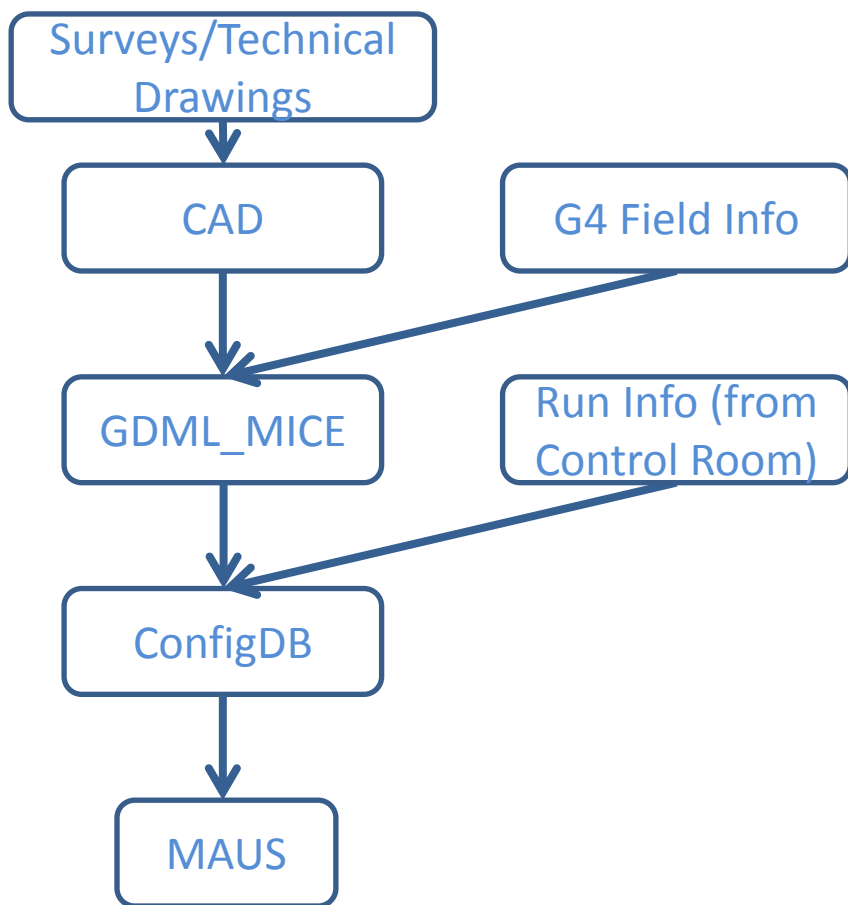
After the last collaboration meeting the CAD Import was merged with the trunk and release in MAUS

Big Thanks to Chris R for working on the merge!

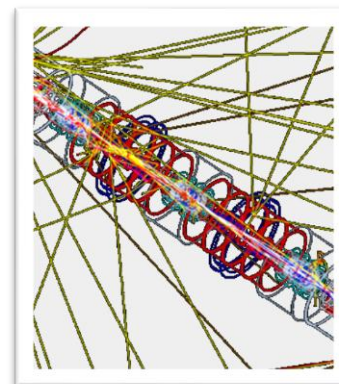


# The Designed System

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



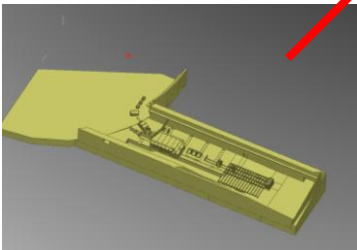
Above: Technical Drawing of Quad  
 Right: CAD Drawing of Quad  
 Below: G4MICE Simulation Example



# Current Work

Current Work is on,

- Field Information (G4 Field) has been added to GDML
  - About to be tested
- Detector Internal Geometries being added to GDML (Tracker)
- First draft of the entire hall's CAD model being made (Jason Tarrant)



# Current Work

- To add the field and detector information we needed to,
- Extend the GDML schema to include MICE specific Information (Can be found in 'GDML\_MICE.xsd' in MAUS)

```

<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
<!--+++++BASE TYPES+++++-->
  <xs:complexType name="G4MagnetType">
    <xs:attribute name="Name"/>
    <xs:attribute name="Type"/>
    <xs:attribute name="File_Location"/>
  </xs:complexType>
  <xs:complexType name="TOFType">
    <xs:attribute name="TOF"/>
  </xs:complexType>
  <xs:complexType name="KLType">
    <xs:attribute name="KL"/>
  </xs:complexType>
  <xs:complexType name="CherenkovType">
    <xs:attribute name="Cherenkov"/>
  </xs:complexType>
  <xs:complexType name="runMagnetType">
    <xs:attribute name="name" use="required" type="xs:NCName"/>
    <xs:attribute name="polarity" use="required" type="xs:NCName"/>
    <xs:attribute name="setCurrent" use="required" type="xs:decimal"/>
  </xs:complexType>
  <xs:complexType name="PositionType">
    <xs:attribute name="x" use="required" type="xs:double"/>
    <xs:attribute name="y" use="required" type="xs:double"/>
    <xs:attribute name="z" use="required" type="xs:double"/>
  </xs:complexType>
  <xs:complexType name="LengthType">
    <xs:attribute name="value" type="xs:double"/>
    <xs:attribute name="units" use="optional"/>
  </xs:complexType>
  <xs:complexType name="MausFileReferenceType">
    <xs:sequence>
      <xs:element name="Position" type="PositionType"/>
      <xs:element name="Rotation" type="PositionType"/>
    </xs:sequence>
    <xs:attribute name="name" type="xs:anyURI" use="required"/>
  </xs:complexType>
  <xs:complexType name="MAUS_ROOT_DIR_Type">
    <xs:attribute name="location" default="/home"/>
  </xs:complexType>
  <xs:complexType name="G4StepMaxType">
    <xs:attribute name="Value" use="required"/>
  </xs:complexType>
  <xs:complexType name="NameType">
    <xs:attribute name="name" use="required"/>
  </xs:complexType>

```



# Current Work

- To add the field and detector information we needed to,
- Change the XSLT script to account for the new changes  
(Can be found in 'GDML2G4MICE.xml' in MAUS)

```

<?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:if test="structure/volume/materialref/@ref = 'Vacuum'">AIR</xsl:if>
  PropertyDouble G4StepMax
  <xsl:value-of select="MICE_Information/Other_Information/G4StepMax/@Value" />
  mm
  </title>
</head>
- <body>
- <xsl:for-each select="structure/volume/physvol">
  Module
  <xsl:value-of select="ancestor::gdml/MICE_Information/Other_Information/GDML_Files/@location" />
  /
  <xsl:value-of select="substring-before(file/@name, '.')" />
  .dat { Position
  <xsl:value-of select="position/@x" />
  <xsl:text />
  <xsl:value-of select="position/@y" />
  <xsl:text />
  <xsl:value-of select="position/@z" />
  mm Rotation
  <xsl:if test="rotationref/@ref = 'identity'">0.0 0.0 0.0 deg</xsl:if>
  }

```



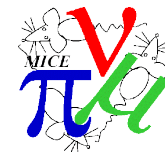
# Current Work

These changes allow us to write MICE specific information in GDML which can stand alone, in its own file, or can be added to the geometry information which is genuine GDML.

```

<?xml version="1.0" ?>
- <gdml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="file:something">
- <MICE_Information>
  <Configuration_Information />
- <G4Field_Information>
  - <Dipole>
    <Volume name="None" />
    <FieldType name="MagneticFieldMap" />
    <FieldMapMode name="Read" />
    <FileType name="g4bl3dGrid" />
    <FileName name="{MAUS_ROOT_DIR}/FILES/Models/Modules/BeamLine/B1_6inch.table" />
    <Symmetry name="Dipole" />
  </Dipole>
  - <Quadrupole>
    <Volume name="None" />
    <FieldType name="Multipole" />
    <Dimensions height="0.5" width="0.5" length="2.0" units="m" />
    <FieldStrength Value="1" units="T/M" />
    <Pole Value="2" />
    <MaxEndPole Value="4" />
    <EndFieldType name="Tanh" />
    <EndLength Value="0.12528" units="m" />
    <CentreLength Value="0.330899" units="m" />
  </Quadrupole>
  - <Solenoid>
    <Volume name="None" />
    <FieldType name="Solenoid" />
    <FileName name="{MAUS_ROOT_DIR}/tmp/coupling.fld" />
    <CurrentDensity Value="1" />
    <Length Value="250" />
    <Thickness Value="116" />
    <InnerRadius Value="725" />
    <ScaleFactor name="-96.21" />
  </Solenoid>
  <G4Magnet_info File_Location="/home/QCFieldMap.txt" Name="Quad 1 to 3" Type="QC" />
</G4Field_Information>

```



# Current Work

```

- <Detector_Information>
  <TOF />
  <KL />
  <Cherenkov />
- <Tracker>
  - <Tracker ID_Number="1">
    <Tracker Number="1" />
    <Position x="1" y="1" z="1" />
    <Rotation alpha="1" beta="1" gamma="1" />
    <Length />
    <Thickness thickness="1" />
    <Material name="1" />
    <Invisible True="1" />
  </Tracker>
  - <Station ID_Number="2">
    <Tracker Number="2" />
    <Position x="2" y="2" z="2" />
    <Rotation alpha="2" beta="2" gamma="2" />
    <Length />
    <Thickness thickness="2" />
    <Station Number="2" />
    <Material name="2" />
    <OpticsMaterialLength />
  </Station>
</Tracker>
</Detector_Information>
- <Other_Information>
  <GDML_Files location="/home" />
  <G4StepMax Value="0.0" />
</Other_Information>
</MICE_Information>
</gdml>

```

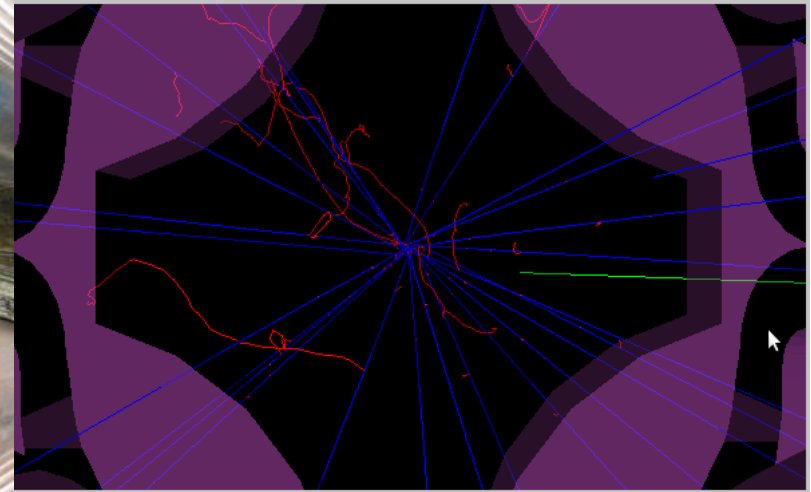




# Future Work

- Once Jason Tarrant's CAD is complete upload it to database (first official geometry)
  - Finalise details of management (Fastrad translation and internal detector geometries)
    - 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!
- I currently have a CAD of the EMR and will be starting tests with this geometry.

# Any Questions?



If you have CADs which you wish to simulate please email me the .stp or .step files and I can return MICE Modules which you can use in MAUS.

## Thank You for Listening

Matthew.Littlefield@brunel.ac.uk



**Brunel**  
UNIVERSITY

```
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 -218.8885 -93.8940 124.7836
PropertyHep3Vector Vector7 -219.6500 -61.8703 109.3414
PropertyHep3Vector Vector8 -211.6265 -62.4295 123.4829
PropertyHep3Vector Vector9 -242.4697 -19.8242 69.1215
PropertyHep3Vector Vector10 -252.1166 -58.8120 52.1187
PropertyHep3Vector Vector11 -257.2766 -28.6124 43.8242
PropertyHep3Vector Vector12 -259.4254 -4.4629 39.2369
PropertyHep3Vector Vector13 -239.8388 -33.7846 75.1684
PropertyHep3Vector Vector14 -283.7828 -59.5343 137.4484
PropertyHep3Vector Vector15 -198.9713 -89.5396 145.7879
PropertyHep3Vector Vector16 -196.4189 -52.5819 158.2864
PropertyHep3Vector Vector17 -178.7701 -63.2373 181.3927
PropertyHep3Vector Vector18 -188.8163 -79.8831 165.8961
PropertyHep3Vector Vector19 -198.2712 -42.8461 161.1219
PropertyHep3Vector Vector20 -185.6786 -28.6449 169.2164
PropertyHep3Vector Vector21 -182.9540 -13.2917 174.8184
PropertyHep3Vector Vector22 -171.8628 -43.8820 193.5669
PropertyHep3Vector Vector23 -167.7651 -19.9907 200.7891
```



```

<?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:desc>
  </xd:doc>
  <xsl:output method="text"/>
  <xsl:template match="gdm1">
    <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
        }
        </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.gdm1"/>
    <position name="posRef_1" x="0.0000" y="0.0000" z="0.0000"/>
    <rotationref ref="identity"/>
  </physvol>

  <physvol>
    <file name="Step_1.gdm1"/>
    <position name="posRef_2" x="0.0000" y="0.0000" z="0.0000"/>
    <rotationref ref="identity"/>
  </physvol>

  <physvol>
    <file name="Step_2.gdm1"/>
    <position name="posRef_3" x="-0.0000" y="-0.0000" z="-1207.5000"/>
    <rotationref ref="identity"/>
  </physvol>
  
```

```

Configuration Structure_224400784
{
  Dimensions 15000.0 10000.0 50000.0 mm
  PropertyString Material Vacuum
  PropertyDouble G4StepMax 5.0 mm

  Module Step_0.gdm1
  {
    Position 0.0000 0.0000 0.0000 mm
    Rotation 0.0 0.0 0.0 degree
  }

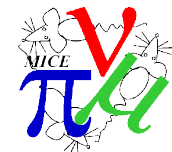
  Module Step_1.gdm1
  {
    Position 0.0000 0.0000 0.0000 mm
    Rotation 0.0 0.0 0.0 degree
  }

  Module Step_2.gdm1
  {
    Position -0.0000 -0.0000 -1207.5000 mm
    Rotation 0.0 0.0 0.0 degree
  }

  Module Step_3.gdm1
  {
    Position 0.0000 0.0000 0.0000 mm
    Rotation 0.0 0.0 0.0 degree
  }

  Module Step_4.gdm1
  {
    Position 0.0000 0.0000 0.0000 mm
    Rotation 0.0 0.0 0.0 degree
  }

  Module Step_5.gdm1
  {
    Position -0.0000 -0.0000 757.5000 mm
    Rotation 0.0 0.0 0.0 degree
  }
}
  
```



```

<?xml version="1.0" ?>
<gdml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="file:
- <MICE_Information>
  <Configuration_Information />
- <G4Field_Information>
  - <Dipole>
    <Volume name="None" />
    <FieldType name="MagneticFieldMap" />
    <FieldMapMode name="Read" />
    <FileType name="g4bl3dGrid" />
    <FileName name="{MAUS_ROOT_DIR}/FILES/Models/Modules/BeamLine/B1_6inch.table" />
    <Symmetry name="Dipole" />
  </Dipole>
- <Quadrupole>
  <Volume name="None" />
  <FieldType name="Multipole" />
  <Dimensions height="0.5" width="0.5" length="2.0" units="m" />
  <FieldStrength Value="1" units="T/M" />
  <Pole Value="2" />
  <MaxEndPole Value="4" />
  <EndFieldType name="Tanh" />
  <EndLength Value="0.12528" units="m" />
  <CentreLength Value="0.330899" units="m" />
</Quadrupole>
- <Solenoid>
  <Volume name="None" />
  <FieldType name="Solenoid" />
  <FileName name="{MAUS_ROOT_DIR}/tmp/coupling.fld" />
  <CurrentDensity Value="1" />
  <Length Value="250" />
  <Thickness Value="116" />
  <InnerRadius Value="725" />
  <ScaleFactor name="-96.21" />
</Solenoid>
  <G4Magnet_info File_Location="/home/QCFieldMap.txt" Name="Quad 1 to 3" Type="QC" />
</G4Field_Information>

```

```

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
}

```

