TPC for ILD

DD4HEP

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HELMHOLTZ ASSOCIATION

DESY

Introduction

- Mismatches found in the ILD TPC DD4HEP model and were discussed previously in this meeting
- Action to take was decided
- Changes shown in the following slides

Cathode

- Bug fixed to include cathode
- Before: Cathode → 55 um thick Kapton and on each side 2.5 um Cu (total cathode thickness 60 um)

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+ Material scan between: x_0 = ( 100.00, 100.00, -10.00) [cm] and x_1 = ( 100.00, 100.00,  10.00) [cm] :
+-----------------------------------------------------------------------------------------------------------------------------------------------------------------------
|     \   Material          Atomic                    Radiation   Interaction                 Path   Integrated  Integrated    Material
| Num. \  Name          Number/Z   Mass/A  Density     Length      Length     Thickness     Length      X0         Lambda      Endpoint
| Layer \                         [g/mole]  [g/cm3]    [cm]        [cm]         [cm]        [cm]       [cm]        [cm]     (     cm,     cm,     cm)
+-----------------------------------------------------------------------------------------------------------------------------------------------------------------------
|     1 TDR_gas              17   38.746   0.0017  11539.6342  69059.7950      9.997       10.00     0.000866    0.000145  (   0.00,   0.00,  10.00)
|     2 G4_Cu                29   63.546   8.9600      1.4352     15.5141      0.000       10.00     0.001041    0.000161  (   0.00,   0.00,  10.00)
|     3 G4_KAPTON             6   12.701   1.4200     28.5903     24.8436      0.003       10.00     0.001137    0.000272  (   0.00,   0.00,  10.00)
|     4 G4_KAPTON             6   12.701   1.4200     28.5903     24.8436      0.003       10.00     0.001233    0.000382  (   0.00,   0.00,  10.00)
|     5 G4_Cu                29   63.546   8.9600      1.4352     15.5141      0.000       10.00     0.001407    0.000398  (   0.00,   0.00,  10.00)
|     6 TDR_gas              17   38.746   0.0017  11539.6342  69059.7950      9.997       20.00     0.002273    0.000543  (   0.00,   0.00,  20.00)
+-----------------------------------------------------------------------------------------------------------------------------------------------------------------------
|     0 Average Material     14   29.709   0.0023   8797.3841  36823.5062     20.000       20.00     0.002273    0.000543  (   0.00,   0.00,  20.00)
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```

- Now: Cathode → 92 um thick Kapton and on each side 4 um Cu (total cathode thickness 100 um)

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+ Material scan between: x_0 = ( 100.00, 100.00, -10.00) [cm] and x_1 = ( 100.00, 100.00,  10.00) [cm] :
+-----------------------------------------------------------------------------------------------------------------------------------------------------------------------
|     \   Material          Atomic                    Radiation   Interaction                 Path   Integrated  Integrated    Material
| Num. \  Name          Number/Z   Mass/A  Density     Length      Length     Thickness     Length      X0         Lambda      Endpoint
| Layer \                         [g/mole]  [g/cm3]    [cm]        [cm]         [cm]        [cm]       [cm]        [cm]     (     cm,     cm,     cm)
+-----------------------------------------------------------------------------------------------------------------------------------------------------------------------
|     1 TDR_gas              17   38.746   0.0017  11539.6342  69059.7950      9.995       10.00     0.000866    0.000145  (   0.00,   0.00,  10.00)
|     2 G4_Cu                29   63.546   8.9600      1.4352     15.5141      0.000       10.00     0.001145    0.000171  (   0.00,   0.00,  10.00)
|     3 G4_KAPTON             6   12.701   1.4200     28.5903     24.8436      0.005       10.00     0.001306    0.000356  (   0.00,   0.00,  10.00)
|     4 G4_KAPTON             6   12.701   1.4200     28.5903     24.8436      0.005       10.00     0.001467    0.000541  (   0.00,   0.00,  10.00)
|     5 G4_Cu                29   63.546   8.9600      1.4352     15.5141      0.000       10.00     0.001745    0.000567  (   0.00,   0.00,  10.00)
|     6 TDR_gas              17   38.746   0.0017  11539.6342  69059.7950      9.995       20.00     0.002612    0.000711  (   0.00,   0.00,  20.00)
+-----------------------------------------------------------------------------------------------------------------------------------------------------------------------
|     0 Average Material     12   26.954   0.0027   7658.4155  28115.8466     20.000       20.00     0.002612    0.000711  (   0.00,   0.00,  20.00)
+-----------------------------------------------------------------------------------------------------------------------------------------------------------------------
```

Field cage

- Thickness of all materials in outer field cage wall multiplied by x3
- Thickness of air slightly decreased to keep total thickness unchanged
- Additional point: Cu and Al switched for both walls. Now Al faces towards the TPC sensitive volume while Cu faces outsides

Before

```
TPC10: Add Material to Outer Wall: dr =  0.07 mm. Material = G4_Cu X0 = 1.43516  0.00487749% X0
TPC10: Add Material to Outer Wall: dr =  0.05 mm. Material = G4_KAPTON X0 = 28.5903  0.000174884% X0
TPC10: Add Material to Outer Wall: dr =   0.3 mm. Material = g10 X0 = 16.1529  0.00185725% X0
TPC10: Add Material to Outer Wall: dr =  59.22 mm. Material = G4_AIR X0 = 30280.2  0.000195574% X0
TPC10: Add Material to Outer Wall: dr =   0.3 mm. Material = g10 X0 = 16.1529  0.00185725% X0
TPC10: Add Material to Outer Wall: dr =  0.05 mm. Material = G4_KAPTON X0 = 28.5903  0.000174884% X0
TPC10: Add Material to Outer Wall: dr =  0.01 mm. Material = G4_Al X0 = 8.8789  0.000112627% X0
TPC10: Outer wall material corresponds to 0.9% of a radiation length.
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Now

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TPC10: Add Material to Outer Wall: dr =  0.03 mm. Material = G4_Al X0 = 8.8789  0.00033788% X0
TPC10: Add Material to Outer Wall: dr =  0.15 mm. Material = G4_KAPTON X0 = 28.5903  0.000524653% X0
TPC10: Add Material to Outer Wall: dr =   0.9 mm. Material = g10 X0 = 16.1529  0.00557174% X0
TPC10: Add Material to Outer Wall: dr =  57.66 mm. Material = G4_AIR X0 = 30280.2  0.000190422% X0
TPC10: Add Material to Outer Wall: dr =   0.9 mm. Material = g10 X0 = 16.1529  0.00557174% X0
TPC10: Add Material to Outer Wall: dr =  0.15 mm. Material = G4_KAPTON X0 = 28.5903  0.000524653% X0
TPC10: Add Material to Outer Wall: dr =  0.21 mm. Material = G4_Cu X0 = 1.43516  0.0146325% X0
TPC10: Outer wall material corresponds to 2.7% of a radiation length.
```

Summary & Plans

- Changes applied for both large and small ILD model

- Gas? Move to T2K?
- Change would mean:
  - minor changes on interaction on particle with gas
  - Point resolution effects. To be updated? (will update the slides with current input to the code)

- Additional points?

Back-Up