



# Implementation of a Drift Chamber in DD4hep

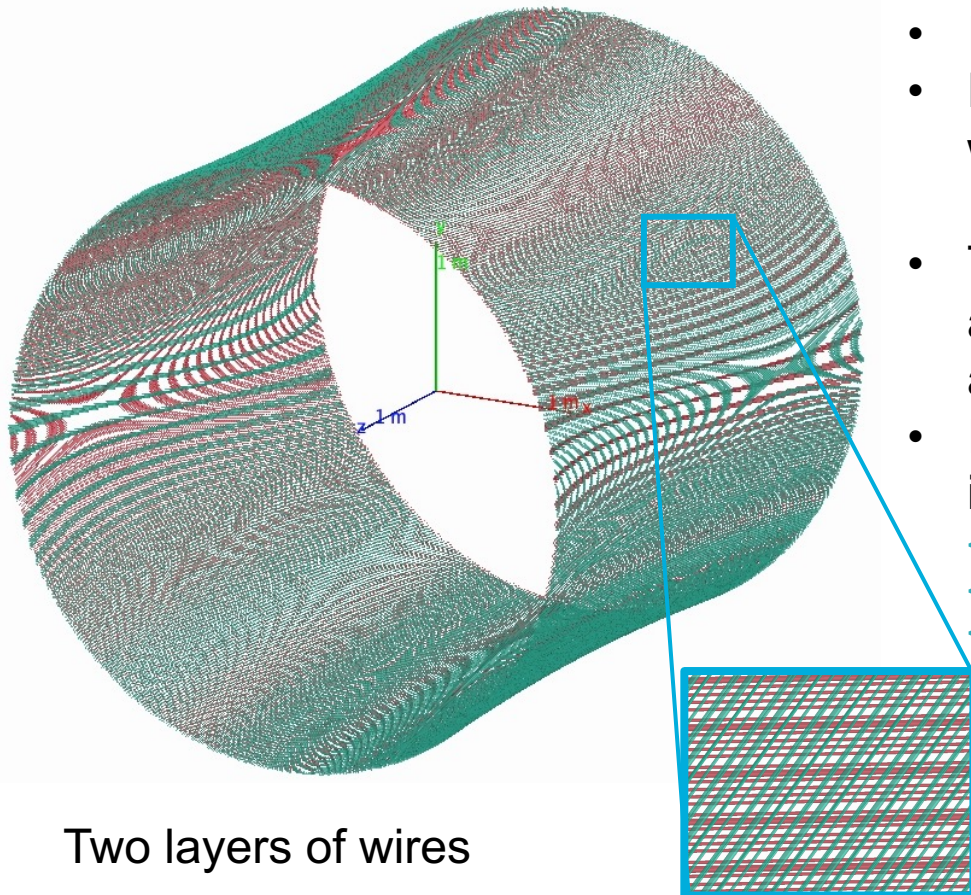
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07-05-2024



# IDEA Drift Chamber Implementation in DD4hep

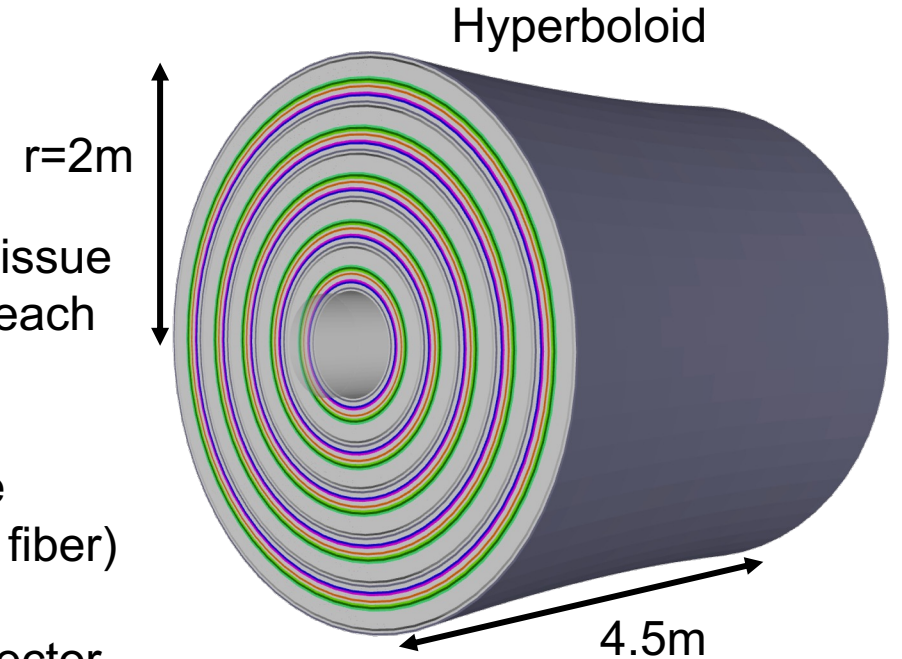
- Source codes:
  - [https://github.com/key4hep/k4geo/blob/main/detector/tracker/DriftChamber\\_o1\\_v02.cpp](https://github.com/key4hep/k4geo/blob/main/detector/tracker/DriftChamber_o1_v02.cpp)
  - [https://github.com/AIDASoft/DD4hep/blob/master/DDRRec/include/DDRRec/DCH\\_info.h](https://github.com/AIDASoft/DD4hep/blob/master/DDRRec/include/DDRRec/DCH_info.h)
- XML:  
[https://github.com/key4hep/k4geo/blob/main/FCCee/IDEA/compact/IDEA\\_o1\\_v03/DriftChamber\\_o1\\_v02.xml](https://github.com/key4hep/k4geo/blob/main/FCCee/IDEA/compact/IDEA_o1_v03/DriftChamber_o1_v02.xml)



- I fixed major overlapping issue
- Figured out how to draw each wires in event display
- The drift chamber include a cylinder vessel (carbon fiber) and endcaps
- Inside the vessel, the detector is separated by 112 layers of gas

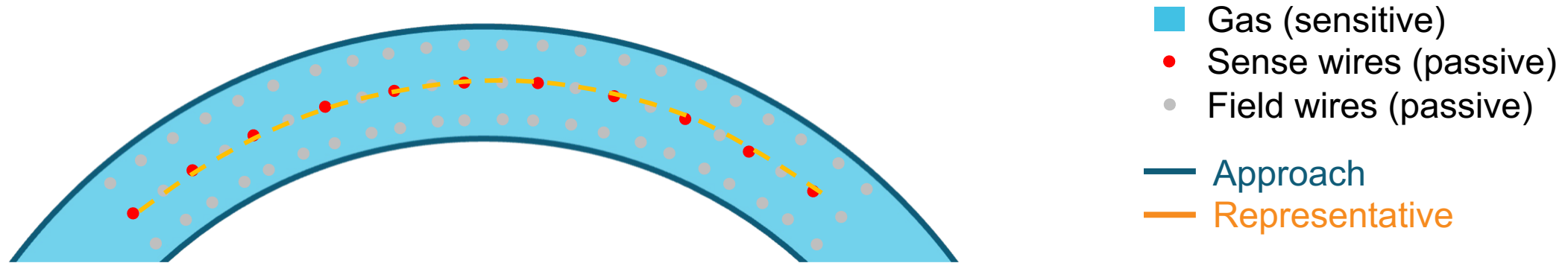
```
<fraction n="0.382635100446205" ref="He" />  
<fraction n="0.107061807167701" ref="H" />  
<fraction n="0.510303092386095" ref="C" />
```

- Within a layer of gas are the wires
- Sense wires:  $d=20.3\text{ }\mu\text{m}$ , tungsten coated by gold
- Field wires:  $d=40.3\text{ }\mu\text{m}$  /  $50.3\text{ }\mu\text{m}$ , aluminum coated by gold



# Drawing of a Single Layer

Trying to set each layer as approach, and set the sense wires to be representative



My branch: <https://github.com/eic/D2EIC/tree/19-implementation-of-a-drift-chamber>

Source code (DriftChamber.cpp)

Gas layer: <https://github.com/eic/D2EIC/blob/492c30d2122b0c60b9192185141fdd5925a9da2a/src/DriftChamber.cpp#L260>

Sense and field wires: <https://github.com/eic/D2EIC/blob/492c30d2122b0c60b9192185141fdd5925a9da2a/src/DriftChamber.cpp#L467C8-L467C42>

# Related files

compact/definitions.xml (<https://github.com/eic/D2EIC/blob/19-implementation-of-a-drift-chamber/compact/definitions.xml>)

```
<constant name="DCH_0_ID" value="87"/>
```

compact/tracking/definitions\_dch.xml

([https://github.com/eic/D2EIC/blob/492c30d2122b0c60b9192185141fdd5925a9da2a/compact/tracking/definitions\\_dch.xml#L111](https://github.com/eic/D2EIC/blob/492c30d2122b0c60b9192185141fdd5925a9da2a/compact/tracking/definitions_dch.xml#L111))

```
<detectors>
  <detector id="DCH_0_ID"
    name="DCHTrackerSubAssembly"
    type="DD4hep_SubdetectorAssembly"
    vis="TrackerSubAssemblyVis">
    <composite name="DCH"/>
  </detector>
</detectors>
```

compact/tracking/dch.xml (<https://github.com/eic/D2EIC/blob/492c30d2122b0c60b9192185141fdd5925a9da2a/compact/tracking/dch.xml#L83>)

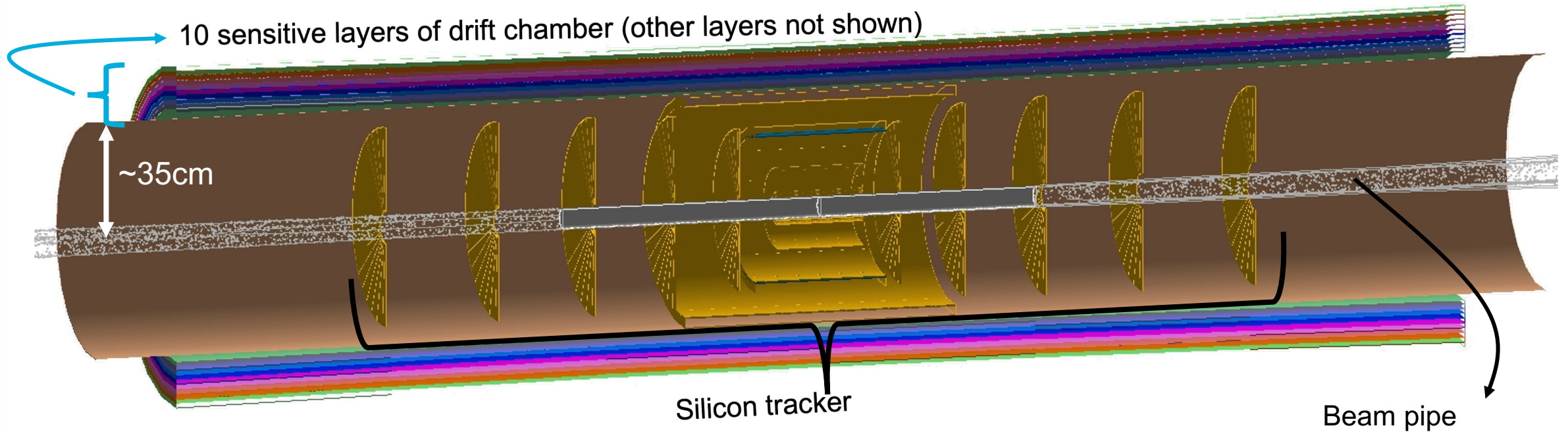
\* Reduce number of layers by changing "DCH\_nsuperlayers" and "DCH\_nlayersPerSuperlayer"

D2EIC/D2EIC\_dch\_only.xml

Beam pipe + drift chamber



# Integrated Tracking Design



The maximum radius of the silicon tracker is reduced to 30cm

# Generating Material Map

```
jug_xl> cwong1@eic0105:/gpfs/mnt/gpfs02/eic/pingwong/DD4hep/detectorXML/D2EIC/install/share/D2EIC/myMaterialMap$ ../../../../../../material_maps_new/run_matmap_py.sh 1 | tee log
```

```
.....  
-----  
mat:  
-----  
{'layer': 1, 'value': {'bounds': {'type': 'CylinderBounds', 'values': [13.500349999999997, 736.0, 3.141592653589793, 0.0, 0.0, 0.0]}, 'geo_id': 72057662757404672, 'material':  
{'binUtility': {'binningdata': [{'bins': 1, 'max': 3.1415927410125732, 'min': -3.1415927410125732, 'option': 'closed', 'type': 'equidistant', 'value': 'binPhi'}, {'bins': 1, 'max':  
736.0, 'min': -736.0, 'option': 'open', 'type': 'equidistant', 'value': 'binZ'}]}, 'mapMaterial': False, 'mappingType': 'Default', 'type': 'proto'}, 'transform': {'rotation': None,  
'translation': None}, 'type': 'CylinderSurface'}, 'volume': 1}  
-----  
mat:  
-----  
{'boundary': 1, 'value': {'bounds': {'type': 'RadialBounds', 'values': [0.0, 30.500699999999995, 3.141592653589793, 0.0]}, 'geo_id': 72339069014638592, 'material': {'binUtility':  
{'binningdata': [{'bins': 1, 'max': 3.1415927410125732, 'min': -3.1415927410125732, 'option': 'closed', 'type': 'equidistant', 'value': 'binPhi'}, {'bins': 1, 'max':  
30.500699999999995, 'min': 0.0, 'option': 'open', 'type': 'equidistant', 'value': 'binR'}]}, 'mapMaterial': False, 'mappingType': 'Default', 'type': 'proto'}, 'transform':  
{'rotation': None, 'translation': [0.0, 0.0, -737.0]}, 'type': 'DiscSurface'}, 'volume': 1}  
-----  
mat:  
-----  
{'boundary': 2, 'value': {'bounds': {'type': 'RadialBounds', 'values': [0.0, 30.500699999999995, 3.141592653589793, 0.0]}, 'geo_id': 72620543991349248, 'material': {'binUtility':  
{'binningdata': [{'bins': 1, 'max': 3.1415927410125732, 'min': -3.1415927410125732, 'option': 'closed', 'type': 'equidistant', 'value': 'binPhi'}, {'bins': 1, 'max':  
30.500699999999995, 'min': 0.0, 'option': 'open', 'type': 'equidistant', 'value': 'binR'}]}, 'mapMaterial': False, 'mappingType': 'Default', 'type': 'proto'}, 'transform':  
{'rotation': None, 'translation': [0.0, 0.0, 737.0]}, 'type': 'DiscSurface'}, 'volume': 1}  
-----  
mat:  
-----  
{'boundary': 3, 'value': {'bounds': {'type': 'CylinderBounds', 'values': [30.500699999999995, 737.0, 3.141592653589793, 0.0, 0.0, 0.0]}, 'geo_id': 72902018968059904, 'material':  
{'binUtility': {'binningdata': [{'bins': 1, 'max': 3.1415927410125732, 'min': -3.1415927410125732, 'option': 'closed', 'type': 'equidistant', 'value': 'binPhi'}, {'bins': 1, 'max':  
737.0, 'min': -737.0, 'option': 'open', 'type': 'equidistant', 'value': 'binZ'}]}, 'mapMaterial': False, 'mappingType': 'Default', 'type': 'proto'}, 'transform': {'rotation': None,  
'translation': None}, 'type': 'CylinderSurface'}, 'volume': 1}  
-----
```

```
Namespace(inputFile='config-map.json', outputFile='config-map_new.json')  
Volume ID      Name      Approaches  
1 acts_beampipe_central::Barrel 1, 2  
1 acts_beampipe_central::Barrel X  
Done! Updated config file at config-map_new.json
```

drift chamber doesn't show up

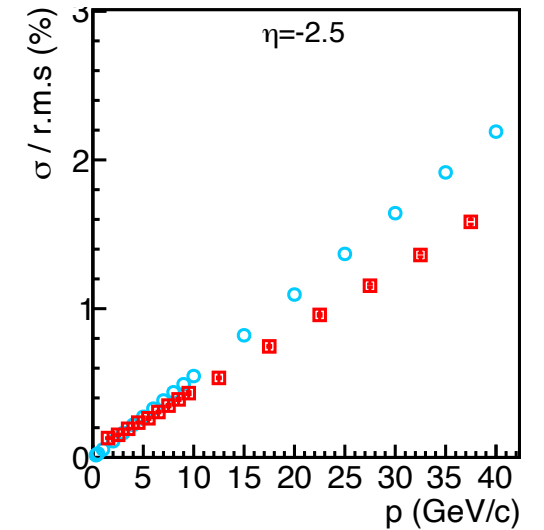
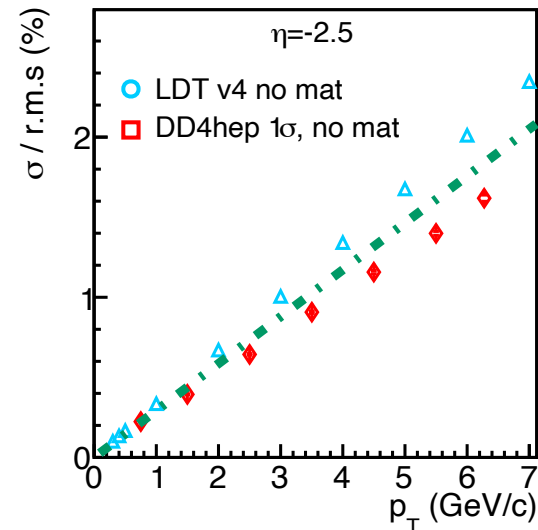
# Summary

- Finished initial drift chamber implementation in DD4hep
  - Fixed overlapping issue
- To-do: add the drift chamber in ACTS for track reconstruction  
Message Shujie for help

# LDT Silicon Disk Dimensions

Disk	Z (mm)		Inner r (mm)		Outer r (mm)	
	DD4hep	LTD	DD4hep	LTD	DD4hep	LTD
1	249.8	250	36.8	36.7	240	240
2	449.8	450	36.8	36.7	415	415
3	699.8	700	38.8	36.7	421.4	421.4
4	999.8	1000	40.1	40.1	421.4	421.4
5	1349.8	1350	46.4	46.4	421.4	421.4

- <math><0.1\%</math> difference in z position
- Cannot explain the resolution discrepancy in the backward region





# LDT Silicon Barrel Layer Dimensions

Barrel	Half length (mm)		Inner r (mm)		Outer r (mm)	
	DD4hep	LTD	DD4hep	LTD	DD4hep	LTD
1	135	135	35	35	37	n/a
2	135	135	47	47	49	n/a
3	135	135	119	119	121	n/a
4	<b>261</b>	<b>260</b>	<b>270.5</b>	<b>271</b>	301	n/a
5	420	420	<b>429</b>	<b>430</b>	460	n/a