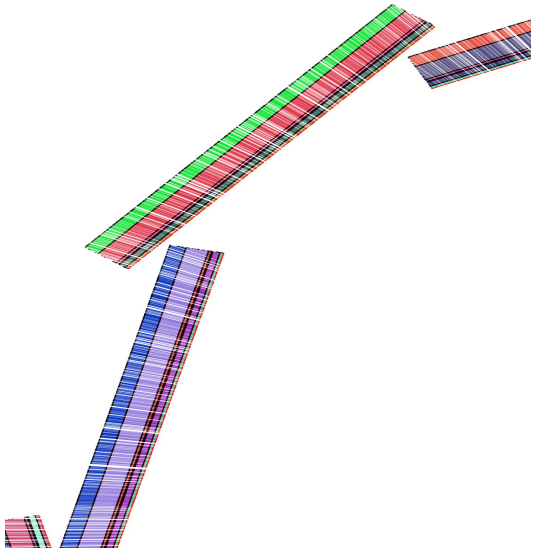
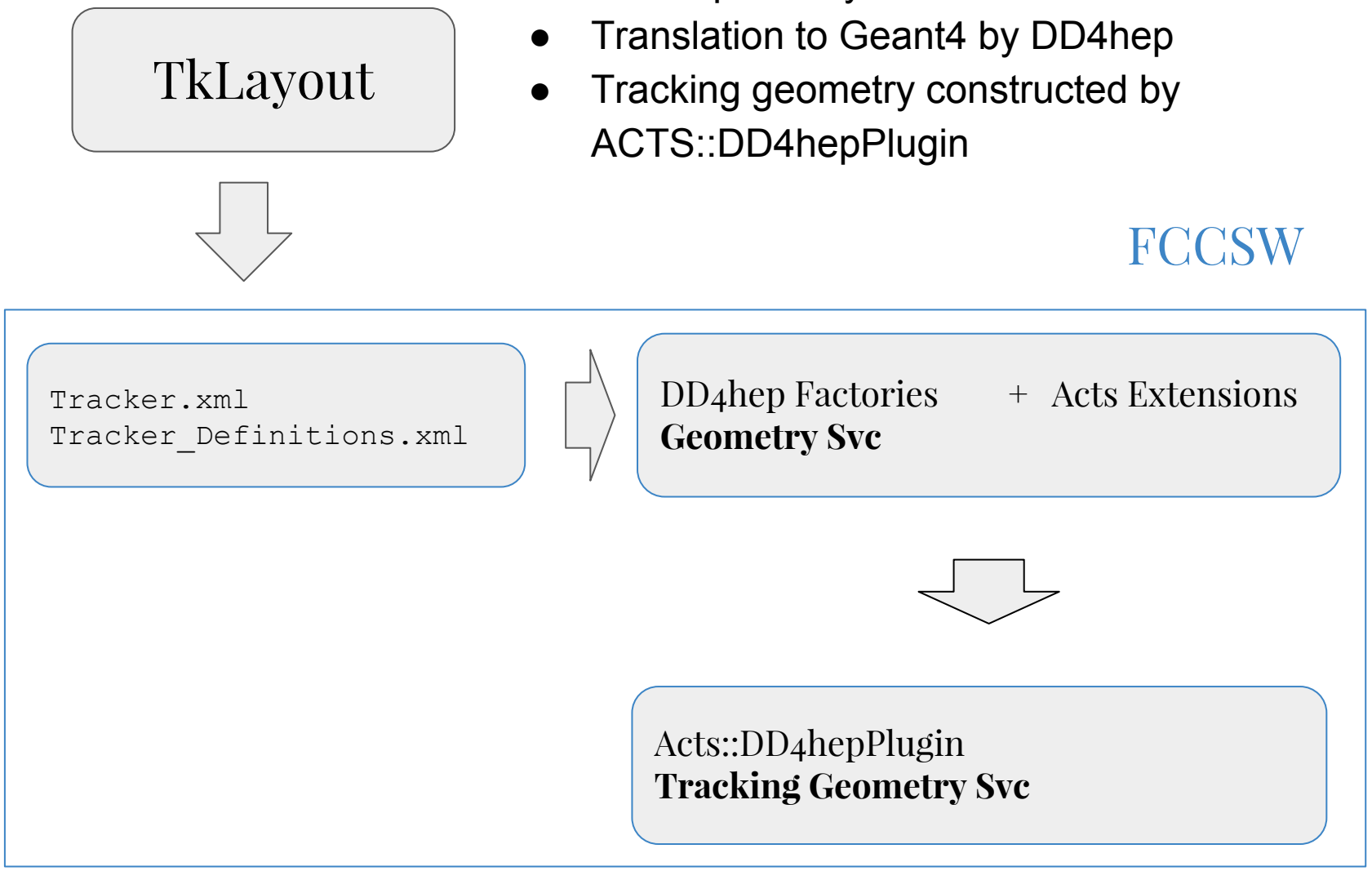
Tracker geometry validation and full simulation

FCC hadron detector meeting
Valentin Volkl, 05.04.2017



Geometry Workflow

- DD4hep compact file generated by tkLayout
- DD4hep geometry constructed from this config by DD4hep factory
- Translation to Geant4 by DD4hep
- Tracking geometry constructed by ACTS::DD4hepPlugin



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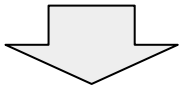
FCCSW

`Tracker.xml`
`Tracker_Definitions.xml`

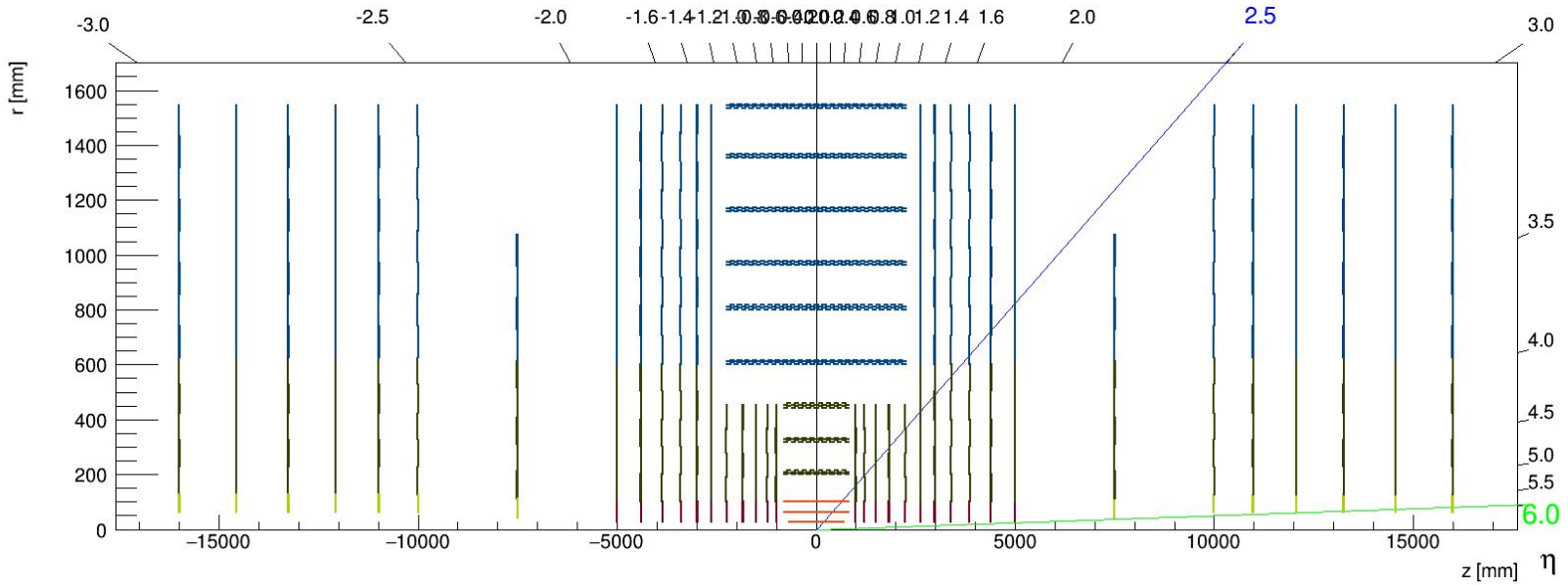
DD4hep Factories + Acts Extensions
Geometry Svc



Acts::DD4hepPlu
Tracking Geometry Svc

- Integration test of FCC geometry added to ACTS- Test-Framework

DD4hep Full Simulation Geometry: **FCC hh Option 3 v2**



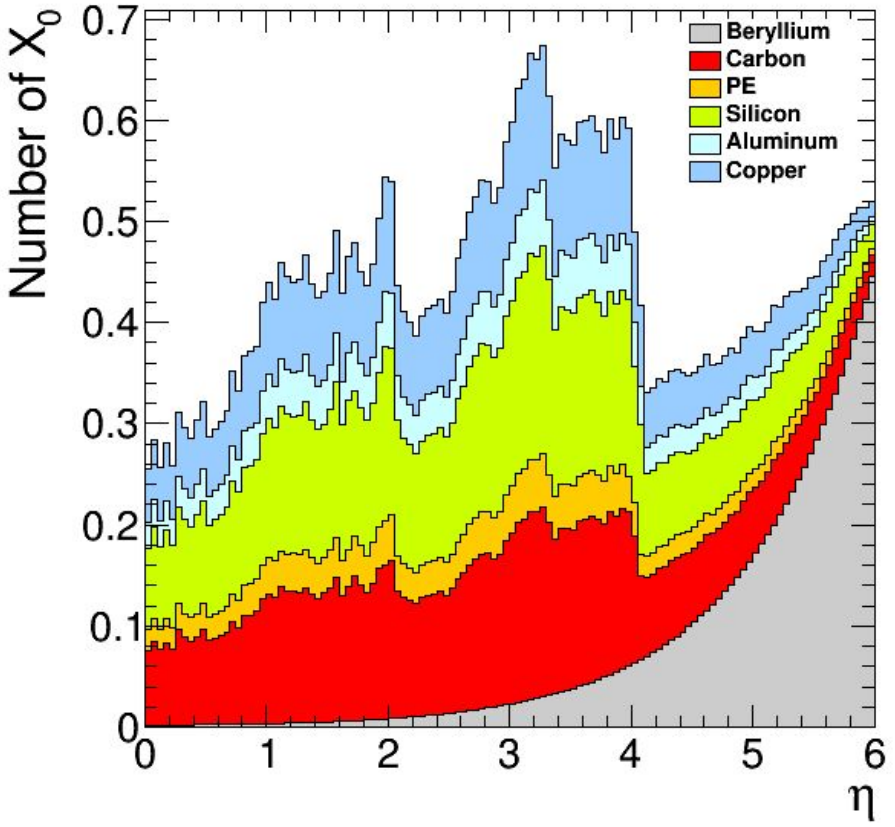
http://fcc-tklayout.web.cern.ch/fcc-tklayout/FCChh_Option3.v02/index.html

Z.Drasal

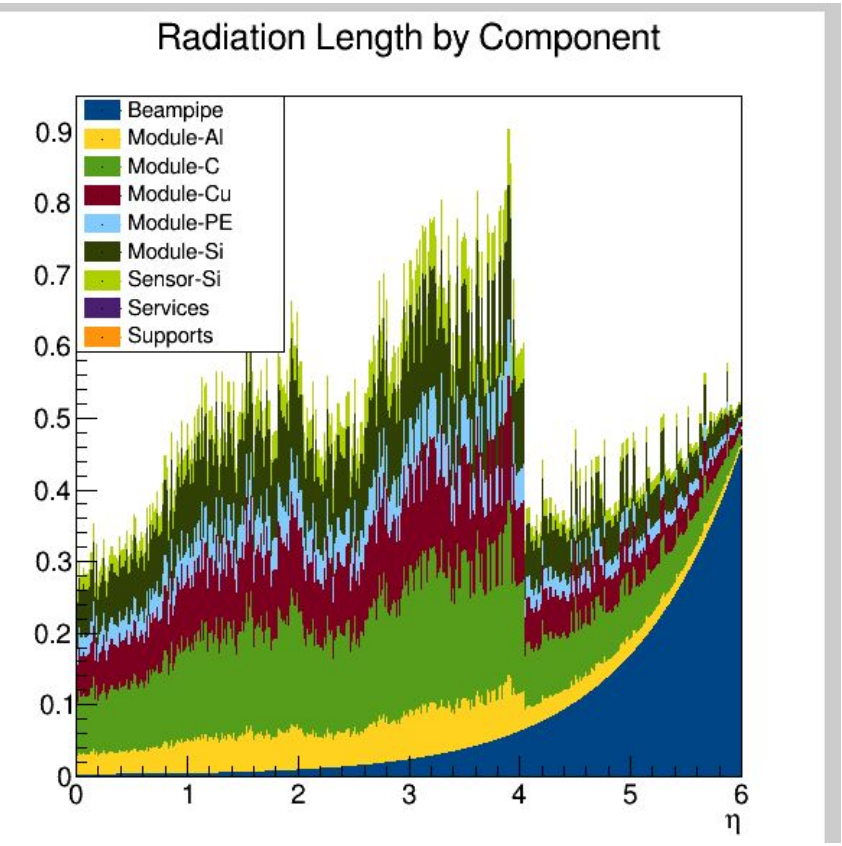
DD4hep Full Simulation Geometry - Material Budget

- No services and support structures
- Phi-averaged - for specific directions it can be up to 20% larger due to overlaps
- Small differences in material descriptions (Radiation lengths of C, PE differ slightly) between DD4hep and TkLayout are being investigated

DD4hep



Compare with: TkLayout



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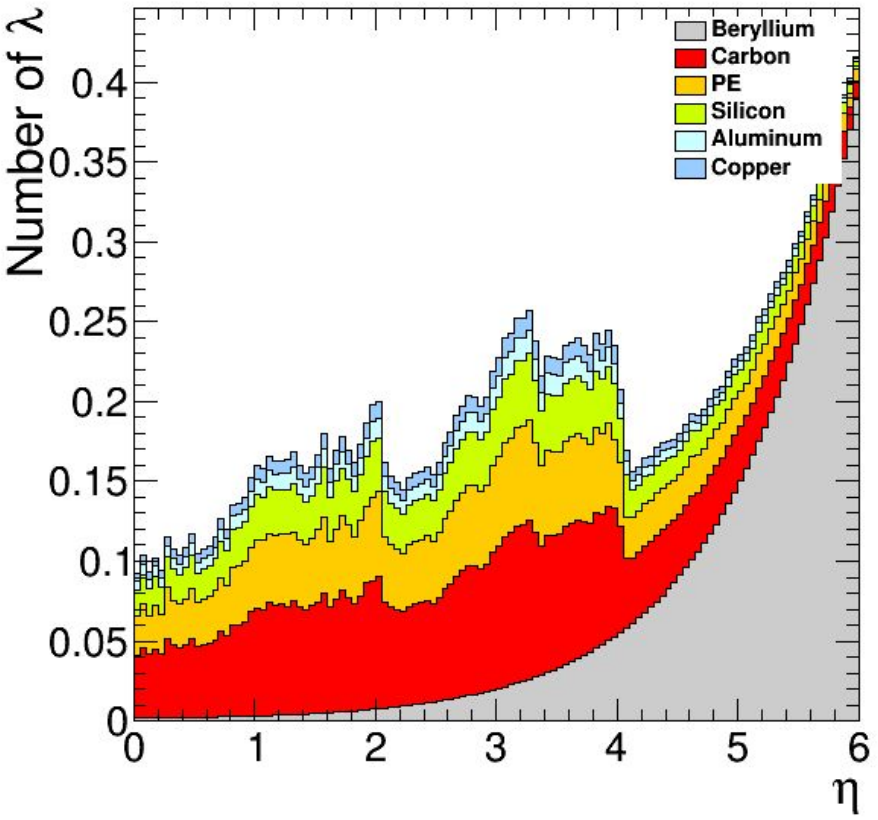
DD4hep



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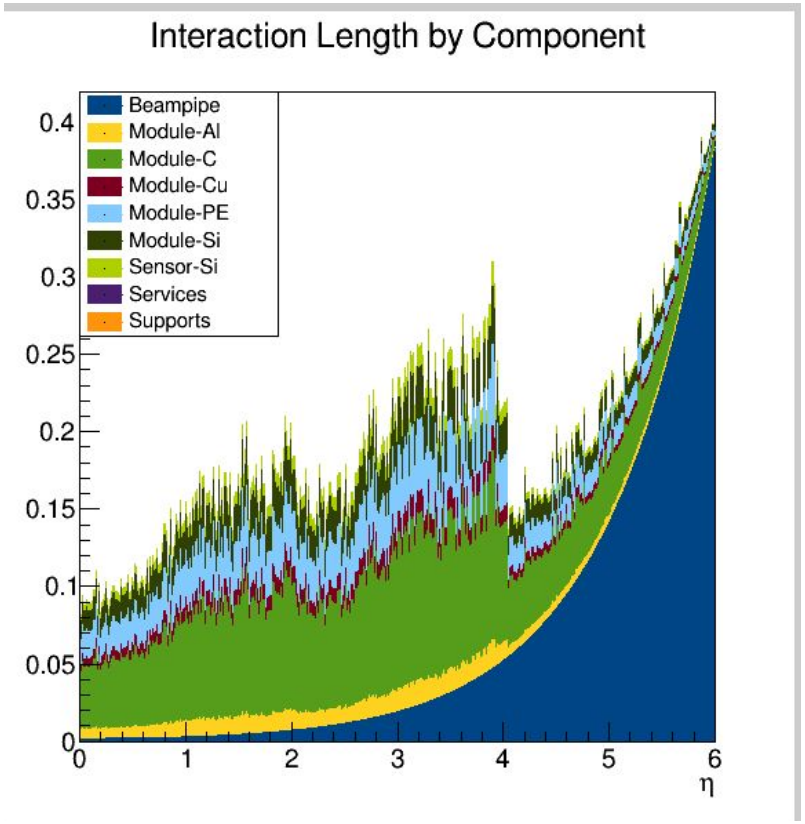
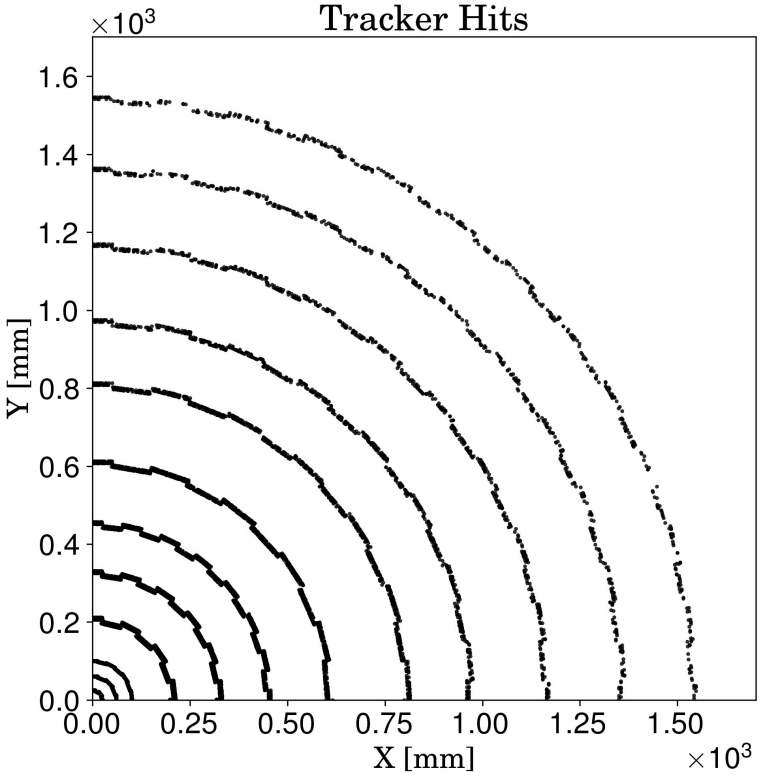
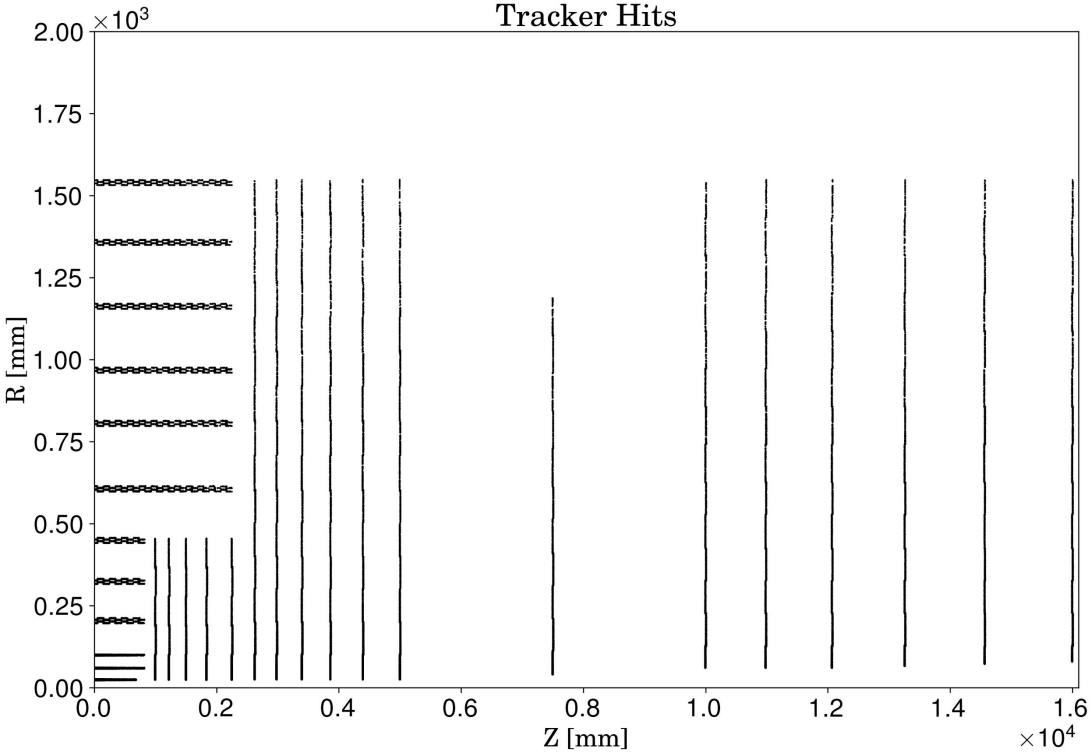


DD4hep Full Simulation Geometry - Geantino Scan



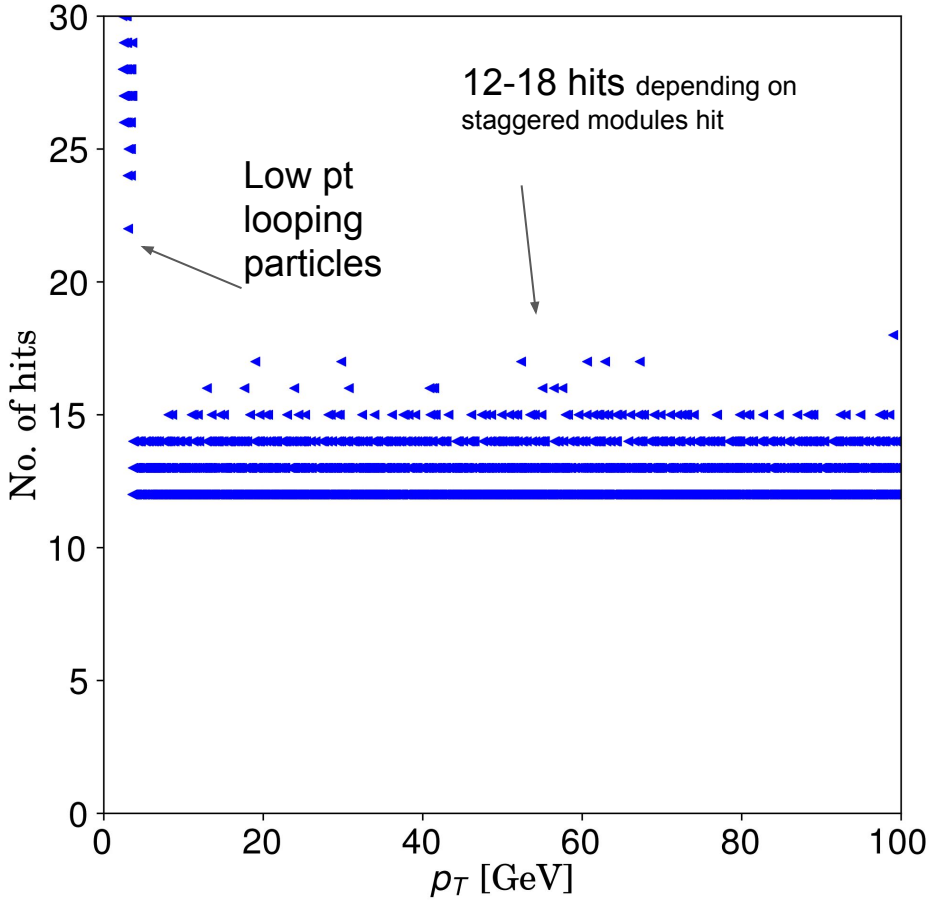


- Check ‘by Eye’ indicates all hits are in the proper positions
- Overlap-free (according to TGeo and Geant geometry tools)

Full Sim Results: Number of hits per single particle event

- Charged Geantinos

η = 0.001
1 GeV < |*p*| < 100 GeV
500 events



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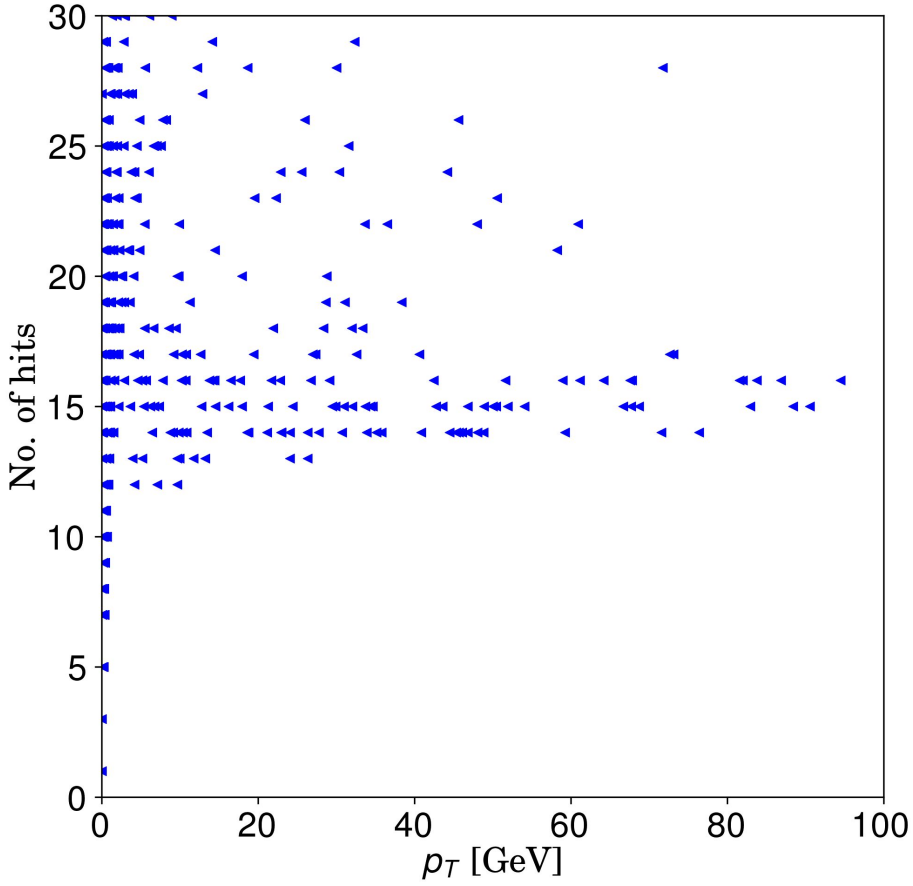
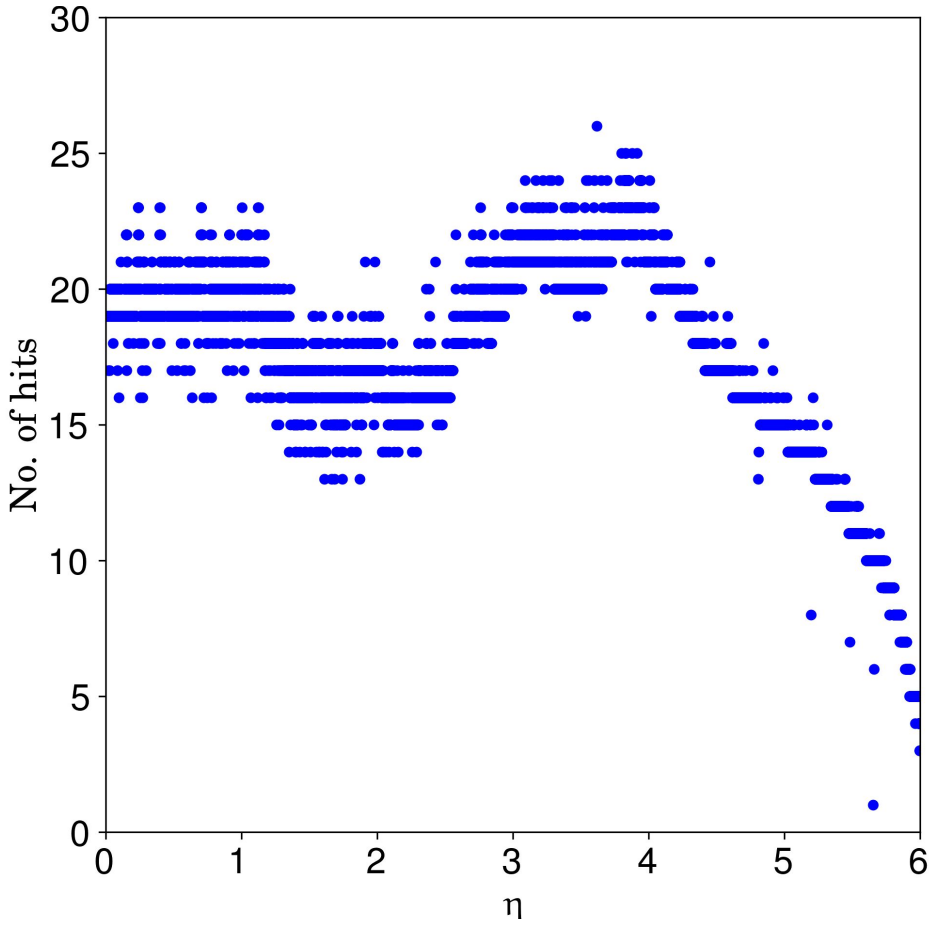


Full Sim Results: Number of hits per single particle event

- Charged Geantinos

$0 < \eta < 6$
$|p|$ = 100 GeV
500 events



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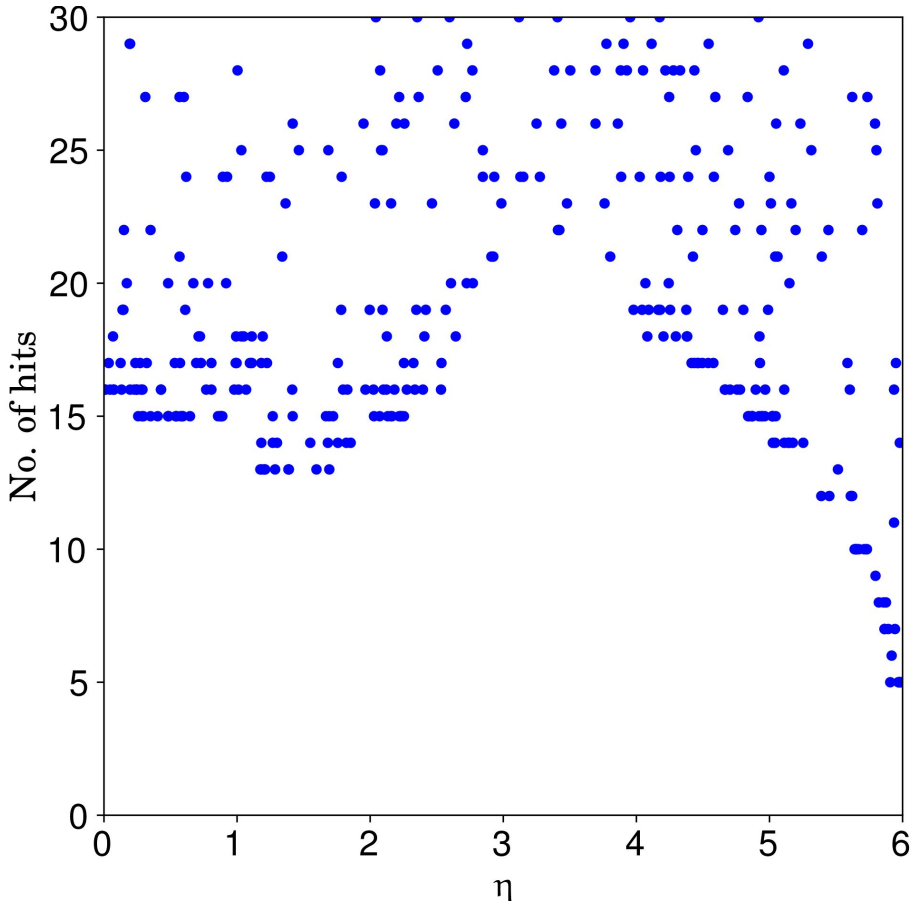


How-to study a new Detector Layout? A demonstrator

1. Create a new TkLayout config, p. ex. **FCChh_OptionX.cfg**

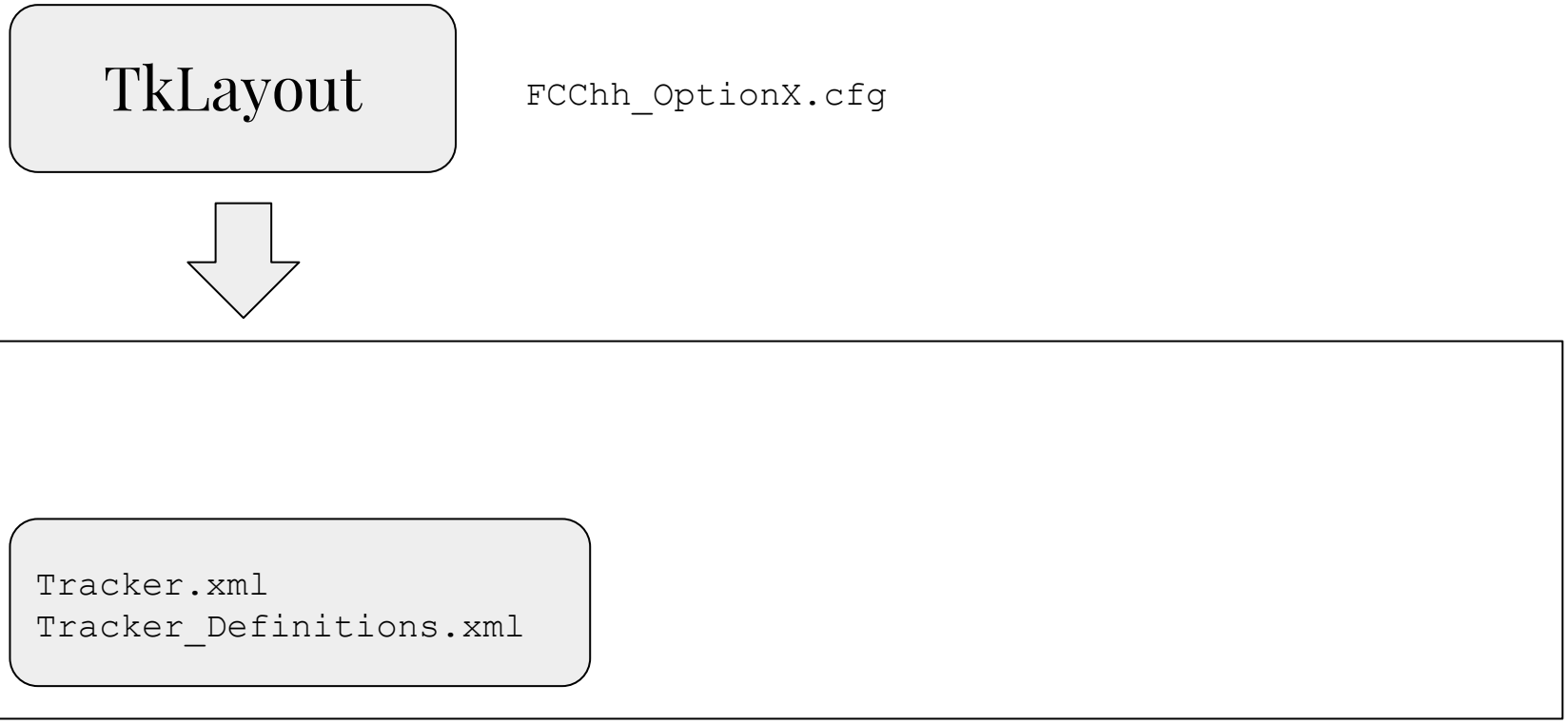
TkLayout

```
~/tklayout/run/results (devLite *)$ colordiff FCChh_Option3.cfg FCChh_OptionX.cfg  -C 3
*** FCChh_Option3.cfg   2017-04-04 17:10:28.582960316 +0200
--- FCChh_OptionX.cfg   2017-04-04 17:09:33.534772757 +0200
***************
*** 206,212 ****
      Barrel BRL {
        @include Strip_Outer_module.cfg
        @include Strip_material.cfg
!       numLayers 6
        outerZ 2250
        startZMode modulecenter
        innerRadius 600
--- 206,212 ----
      Barrel BRL {
        @include Strip_Outer_module.cfg
        @include Strip_material.cfg
!       numLayers 9
        outerZ 2250
```

How-to study a new Detector Layout? A demonstrator

1. Create a new TkLayout config, p. ex. **FCChh_OptionX.cfg**
2. Run TkLayout with the FCCSW extractor to create the compact files used in FCCSW

```
tklayout FCChh_OptionX.cfg -e FCC
```



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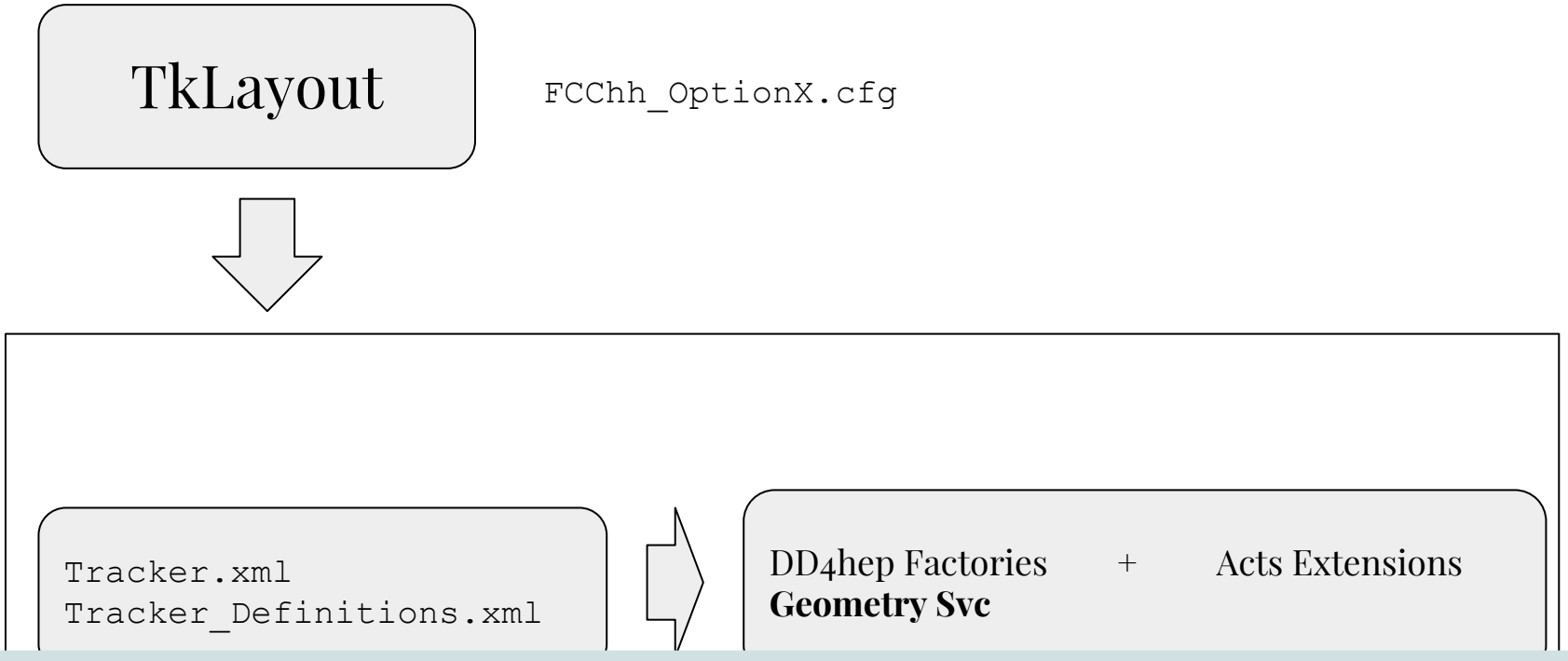
```

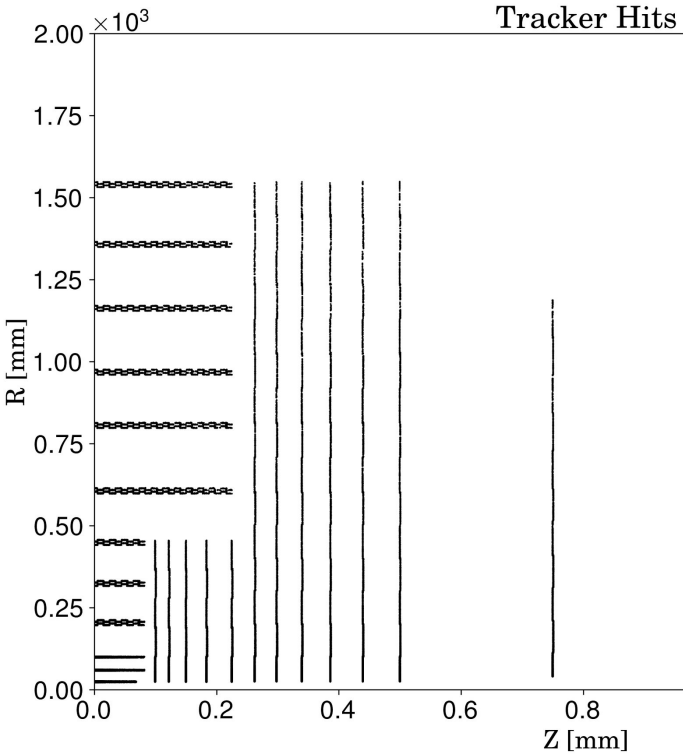
3. Copy compact files to FCCSW (even better, make a PR to share them)
4. Run simulations!



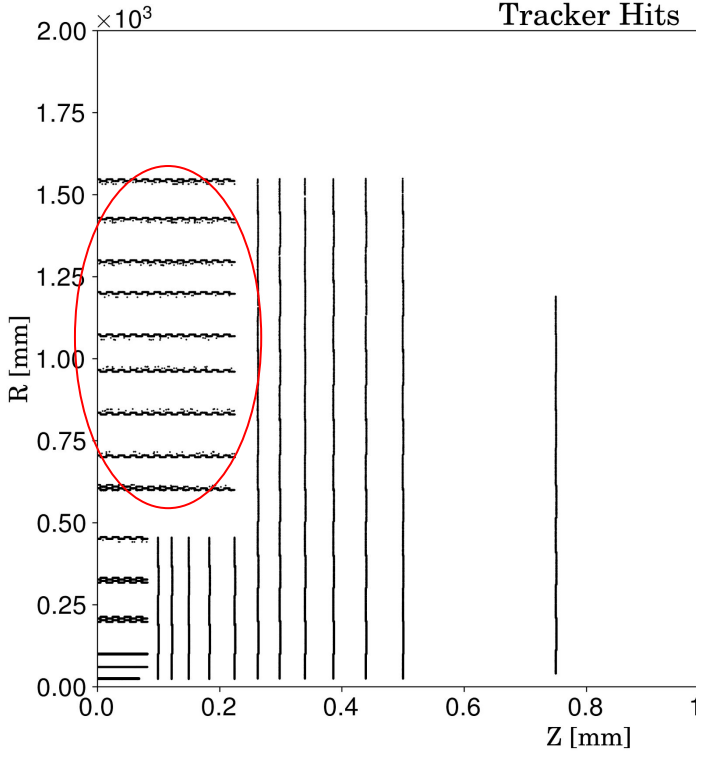

```
<layer id="8" radius="1424.085*mm" rmin="1414.435*mm" rmax="1434.649*mm" bigDelta="5.000*mm" phi0="1.570796*rad">
    <rods repeat="88" smallDelta="2.500*mm" rPhiOverlap="0.500*mm" nRPhiSegments="2" zOverlap="0.500*mm" nModules="47">
        <rodOdd id="1">
```

How-to study a new Detector Layout? A demonstrator

FCC hh Option 3 v2



FCC hh Option X - an example of a new layout



Conclusion

- Detector Geometry and workflow well established
  - validation of tracker model implementation (material scans)
  - first full simulation results using tracker model in FCCSW
  - straight forward to test new / modified tracker designs

- Track Reconstruction effort on-going
  - Integration of ACTS into FCCSW
  - Some issues with the translation of simulation geometry to tracking geometry
  - conclusion of this imminent