Fast Tracking Simulations using LDT

Cheuk-Ping Wong
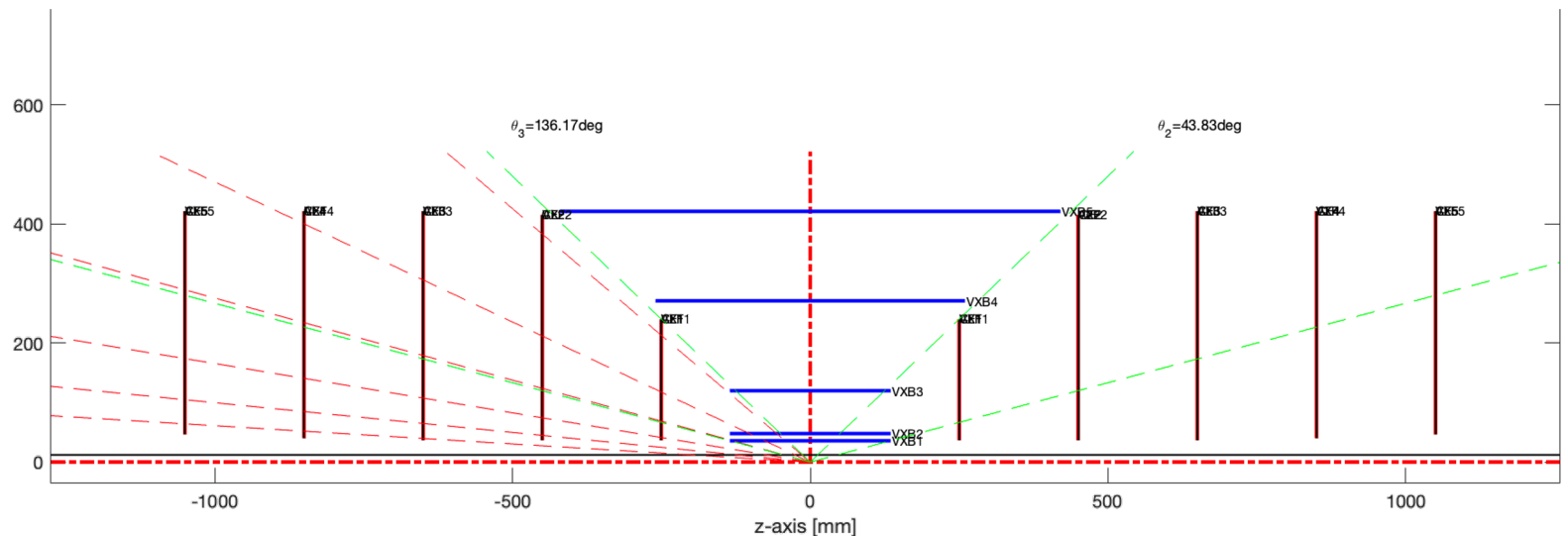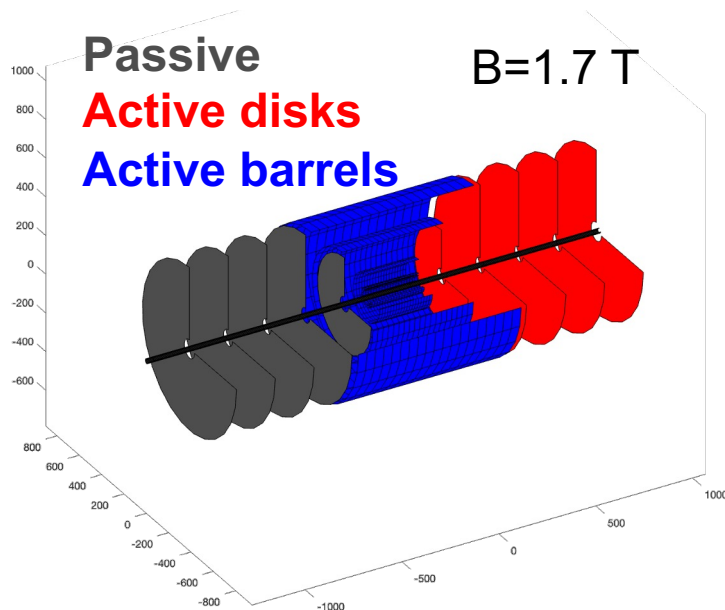
02-26-2024

Tracking Detector Setup in LDT

```
06 Number of layers            :    6
07 Description (optional)       : |Beamtube|------------Barrel Vertex Detector---------------|
08 Names of the layers (opt.)  :   XBT,      VXB1,      VXB2,      VXB3,      VXB4,      VXB5
09 Radii [mm]                  :   12,       36,        48,        120,       271,       421,
10 Upper limit in z [mm]       :   1800,     135,       135,       135,       260,       420,
11 Lower limit in z [mm]       :  -1800,    -135,      -135,      -135,      -260,      -420,
12 Efficiency RPhi             :   0,        0.95,      0.95,      0.95,      0.95,      0.95,
13 Efficiency 2nd coord. (eg. z):  -1
14 Stereo angle alpha [Rad]    :   pi/2
15 Thickness [rad. lengths]    :   0.0253, 0.000427, 0.000427, 0.000427, 0.000427, 0.000427,
```

Thickness=X/X_0 (using references from https://pdg.lbl.gov/2022/AtomicNuclearProperties)

Passive
Active disks
Active barrels

B=1.7 T

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Tracking Detector Setup in LDT

```
06 Number of layers        : 15
07 Description (optional)   : |───────forward vertex det (pixels)────────────────|──────service Al foil───────────────────────|─────────support CF─────────────────────────|
08 Names of the layers (opt.): VXF1,      VXF2,      VXF3,      VXF4,      VXF5,      AL1,       AL2,       AL3,       AL4,       AL5,       CF1,       CF2,       CF3,       CF4,       CF5,
09 z positions [mm]         : 250,       450,       650,       850,       1100,      250.3,     450.3,     650.3,     850.3,     1100.3,    250.6,     450.6,     650.6,     850.6,     1100.6,
10 Inner radius [mm]        : 36.7,      36.7,      36.7,      40.1,      46.4,      36.7,      36.7,      36.7,      40.1,      46.4,      36.7,      36.7,      36.7,      40.1,      46.4,
11 Outer radius [mm]        : 240,       415,       421.4,     421.4,     421.4,     240,       415,       421.4,     421.4,     421.4,     240,       415,       421.4,     421.4,     421.4,
12 Efficiency u             : 0.95,      0.95,      0.95,      0.95,      0.95,      0,         0,         0,         0,         0,         0,         0,         0,         0,         0,
13 Efficiency v             : −1
14 Angle 1st coord. (u) [Rad]: 0
15 Angle 2nd coord. (v) [Rad]: pi/2
16 Thickness [rad. lengths]  : 0.000427, 0.000427, 0.000427, 0.000427, 0.000427, 0.00169, 0.00169, 0.00169, 0.00169, 0.00169, 0.000562, 0.000562, 0.000562, 0.000562, 0.000562
```


Passive
Active disks
**Active barrels**
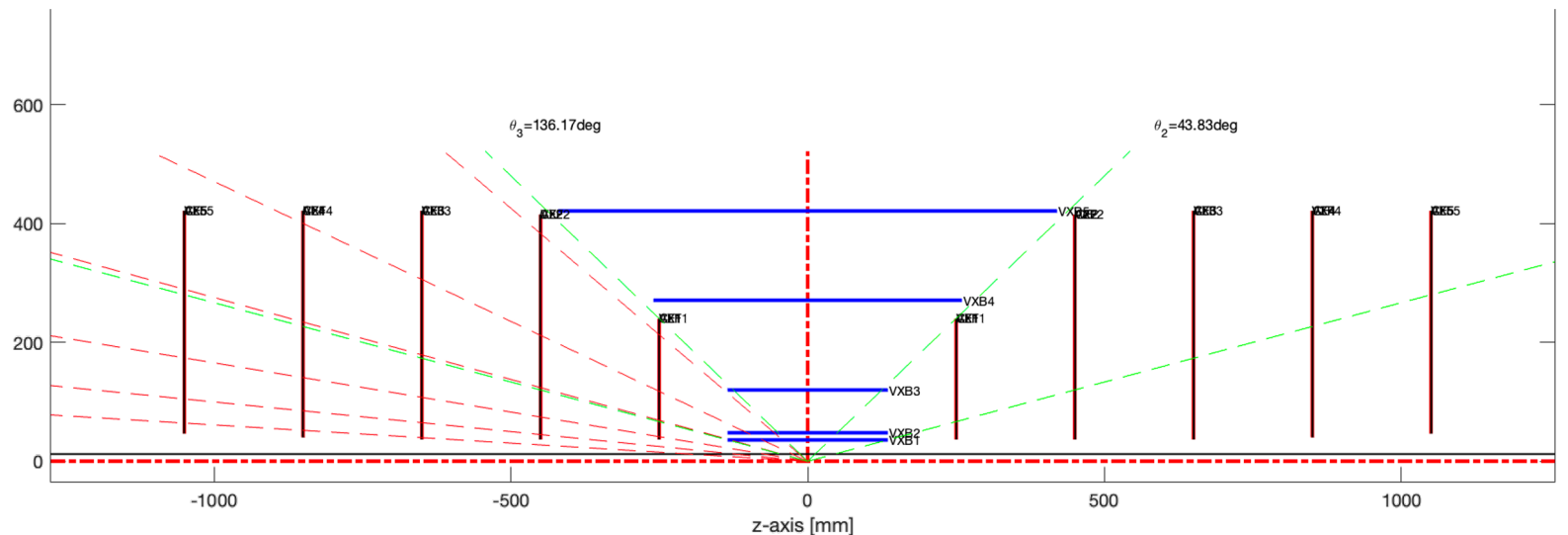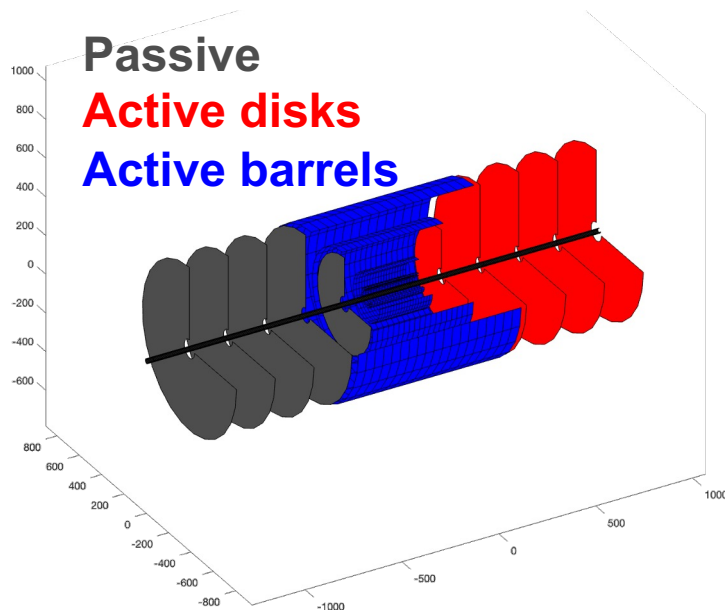
Comparing LDT and DD4hep Results

Cannot run LDT with track $\eta = -3, -3.5$
Going to try a slightly different η values
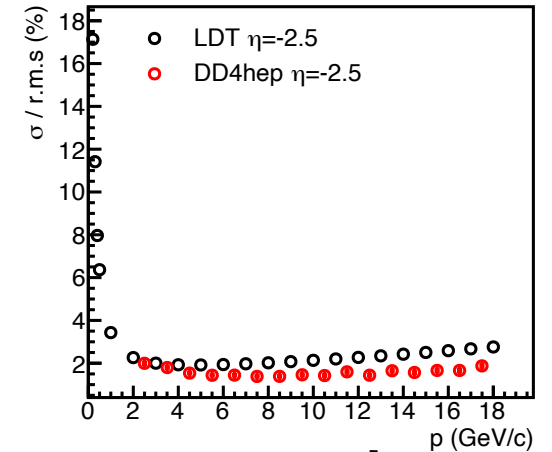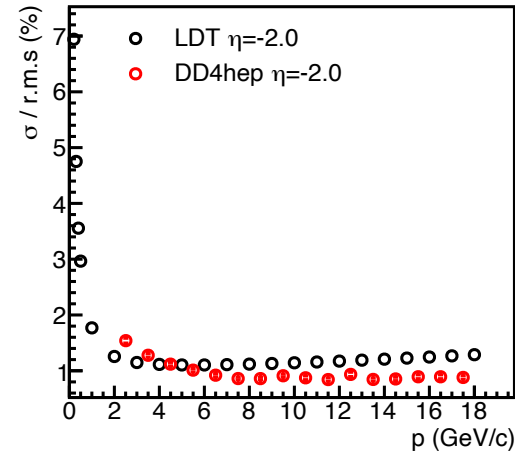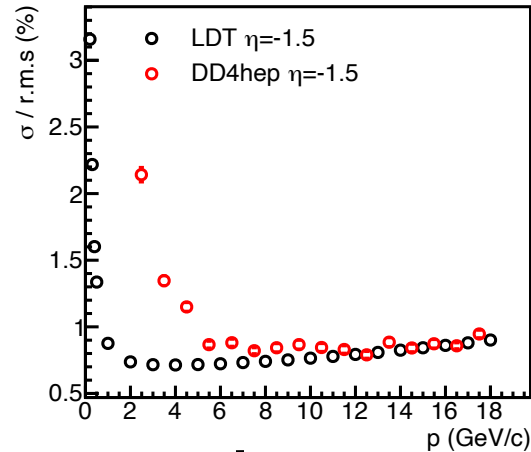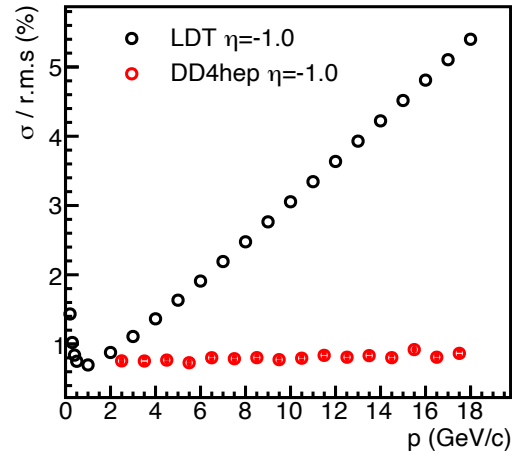
Particularly big discrepancy
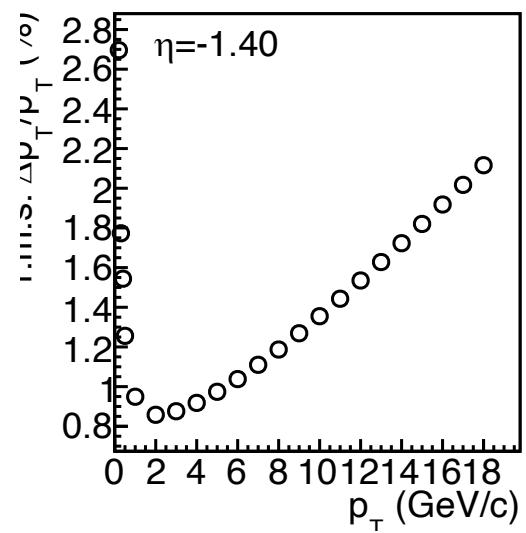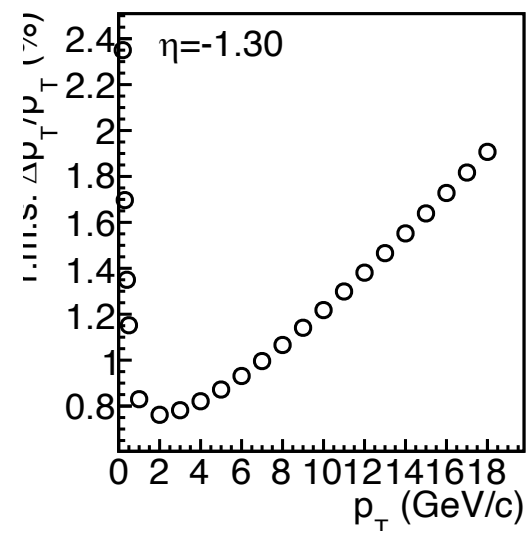
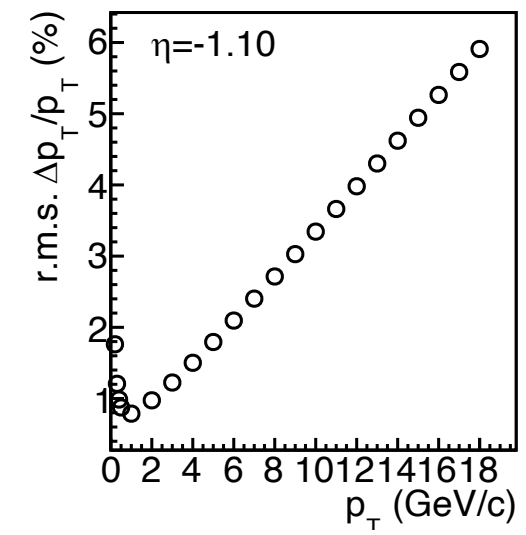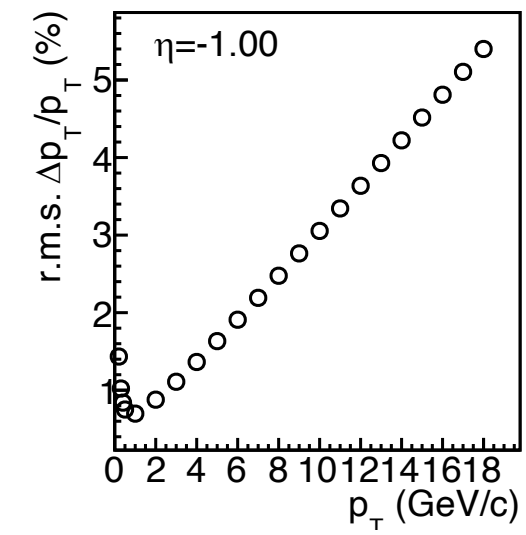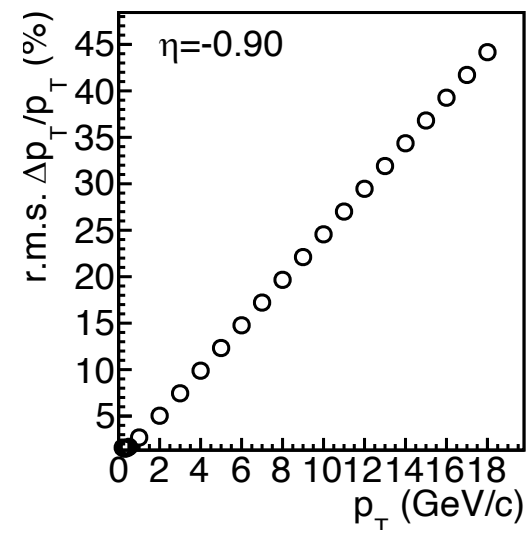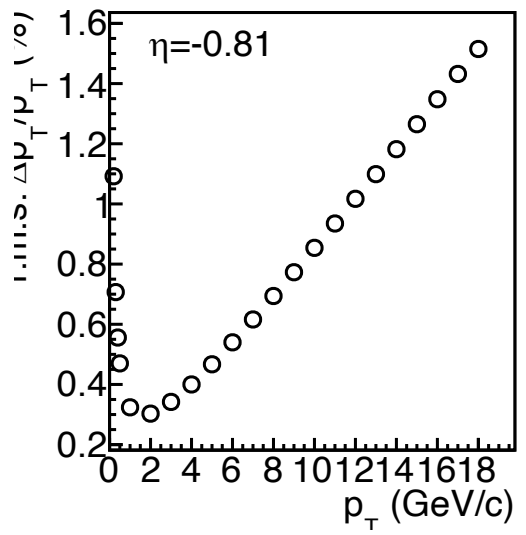- High momentum: LDT > DD4hep
  - Different definitions of pixel/resolutions?
- Low momentum: DD4hep > LDT
  - LDT underestimates multiple scattering
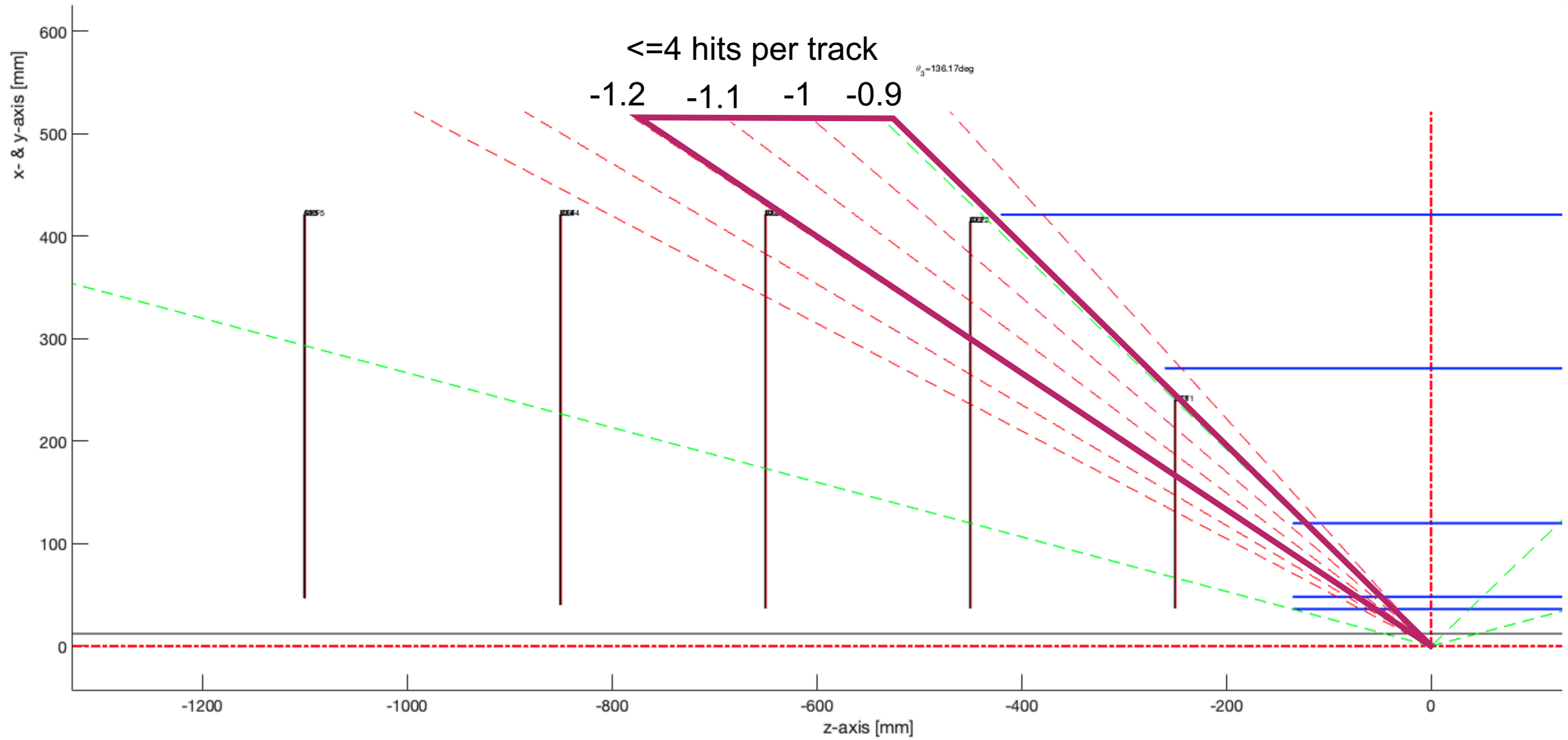 - The radiation lengths of the disks/layers are off

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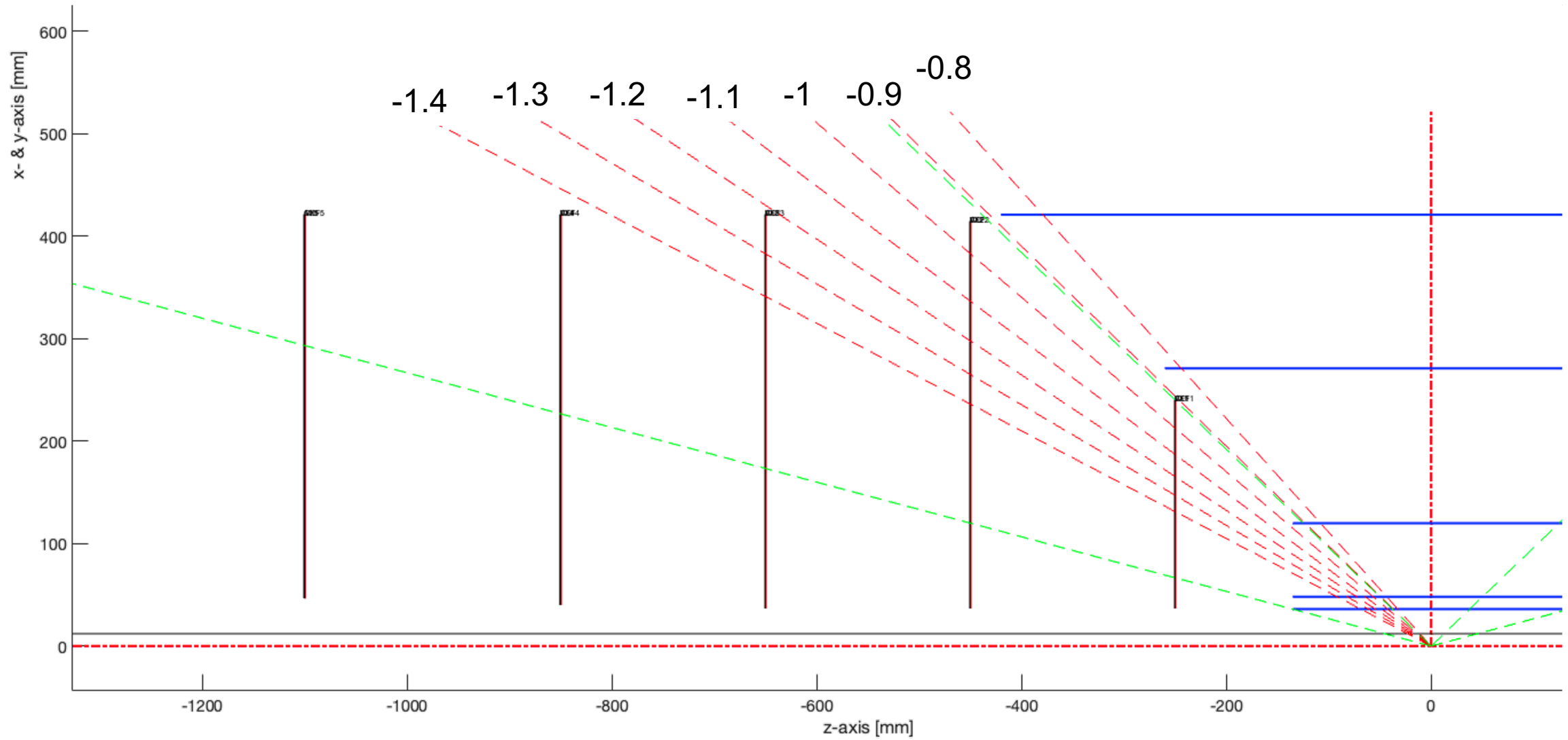
Test Around $\eta = 1$

Momentum Resolutions Around $\eta = 1$
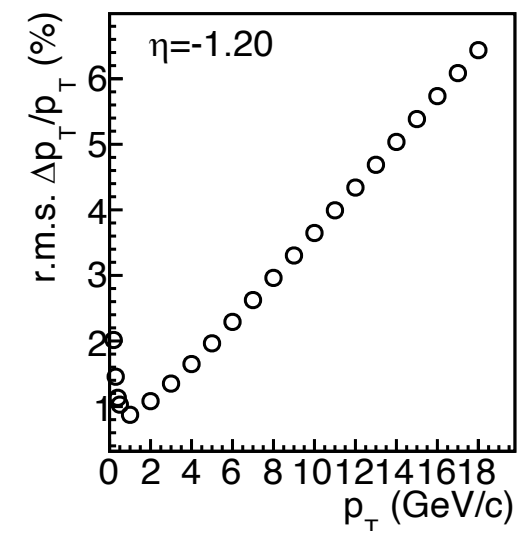
Test Around $\eta = 1$

Summary

- Initial detector setup in LDT based on ePIC craterlake tracking design
  - 5 disks, last disk at -110 cm
  - Symmetric detector setup
  - Added support/service parts on disks
  - Implemented material budget
- Momentum resolutions from LDT simulations
  - Need to examine the discrepancy between LDT and DD4hep
  - Resolution is particularly worse compared to DD4hep at the gap region between barrel vertex and disks

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