Brookhaven National Laboratory

U.S. DEPARTMENT OF ENERGY

Tracking Simulations for the EIC 2nd Detector

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06-24-2024

@BrookhavenLab

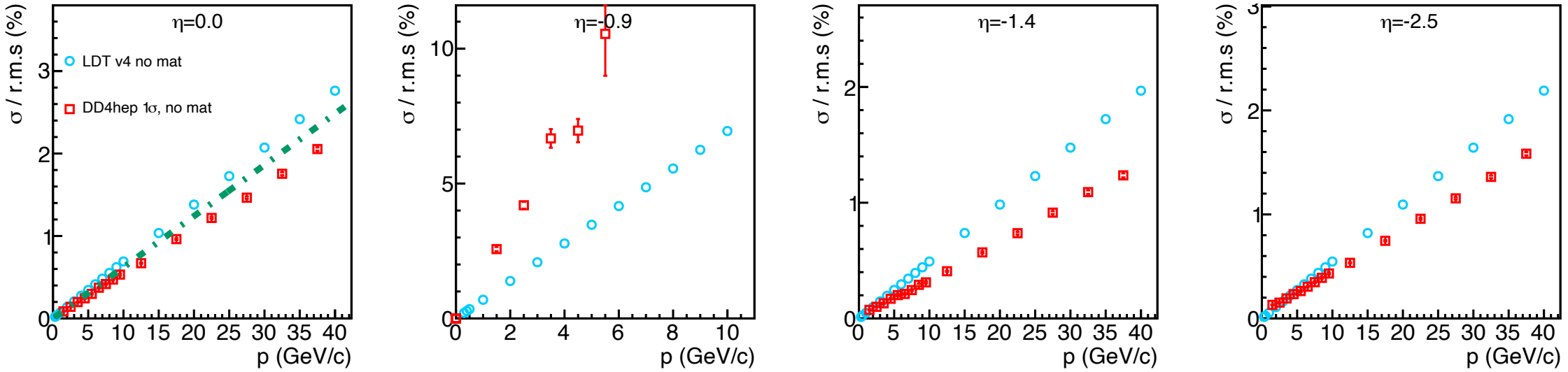
After Talking to Shujie

- LDT and DD4hep comprisons
  - Double check the comparison with multiple scattering turned off
  - Use a different branch for track information in DD4hep output
    ReconstructedChargedParticles → CentralCKFTrackParameters
  - Use charged pion instead of electron
  - Double check geometry in LDT setup (to-do)
  - Check discrepancy between the RMS and Gaussian 1σ of $\Delta p/p$ (to-do)

- She also gave me ideas on how to implement drift chamber in DD4hep

Momentum Resolution Comparison

- LDT: no material (X=0)
  - Barrel resolution: $dr\phi = 20/\sqrt{12}$ um, $dz = 20/\sqrt{12}$ um
  - Disk resolution: du=20 um, dv=20 um
- DD4hep: minimal materials of silicon layers/disks, vacuum beam pipe, turn off multiple scattering



Transverse Momentum Resolution Comparisons

- LDT: no material (X=0)
  - Barrel resolutions: $dr\phi = 20/\sqrt{12}$ um, $dz = 20/\sqrt{12}$ um
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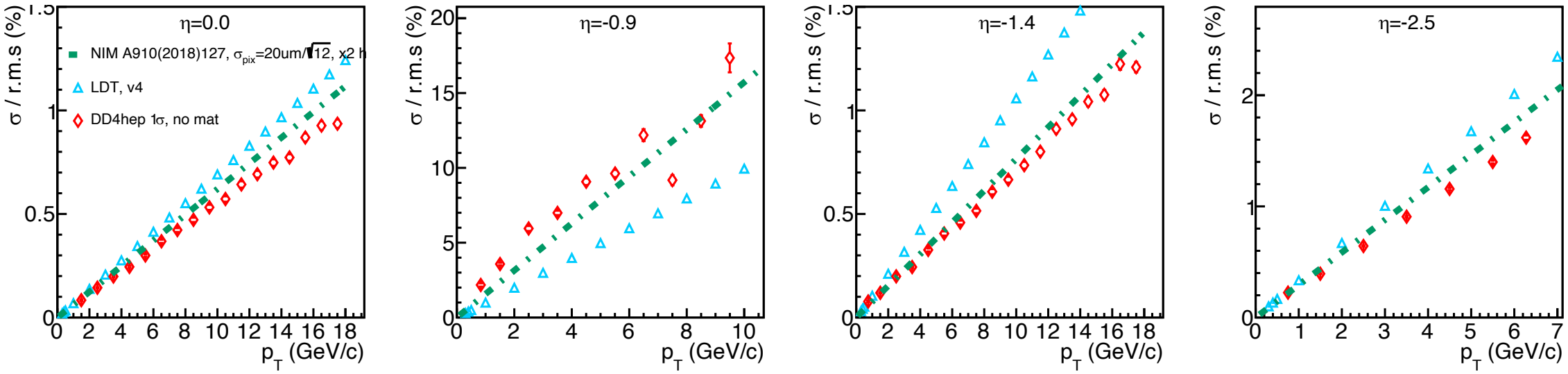
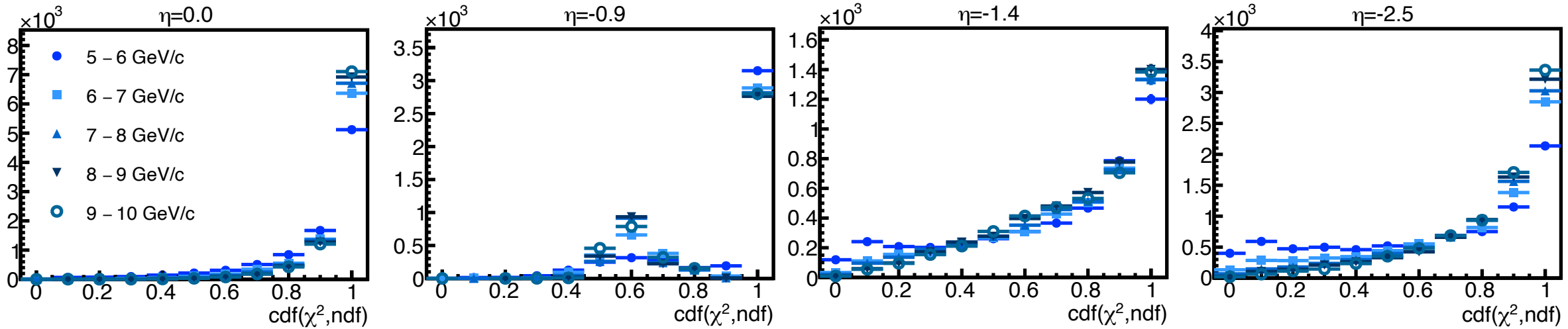


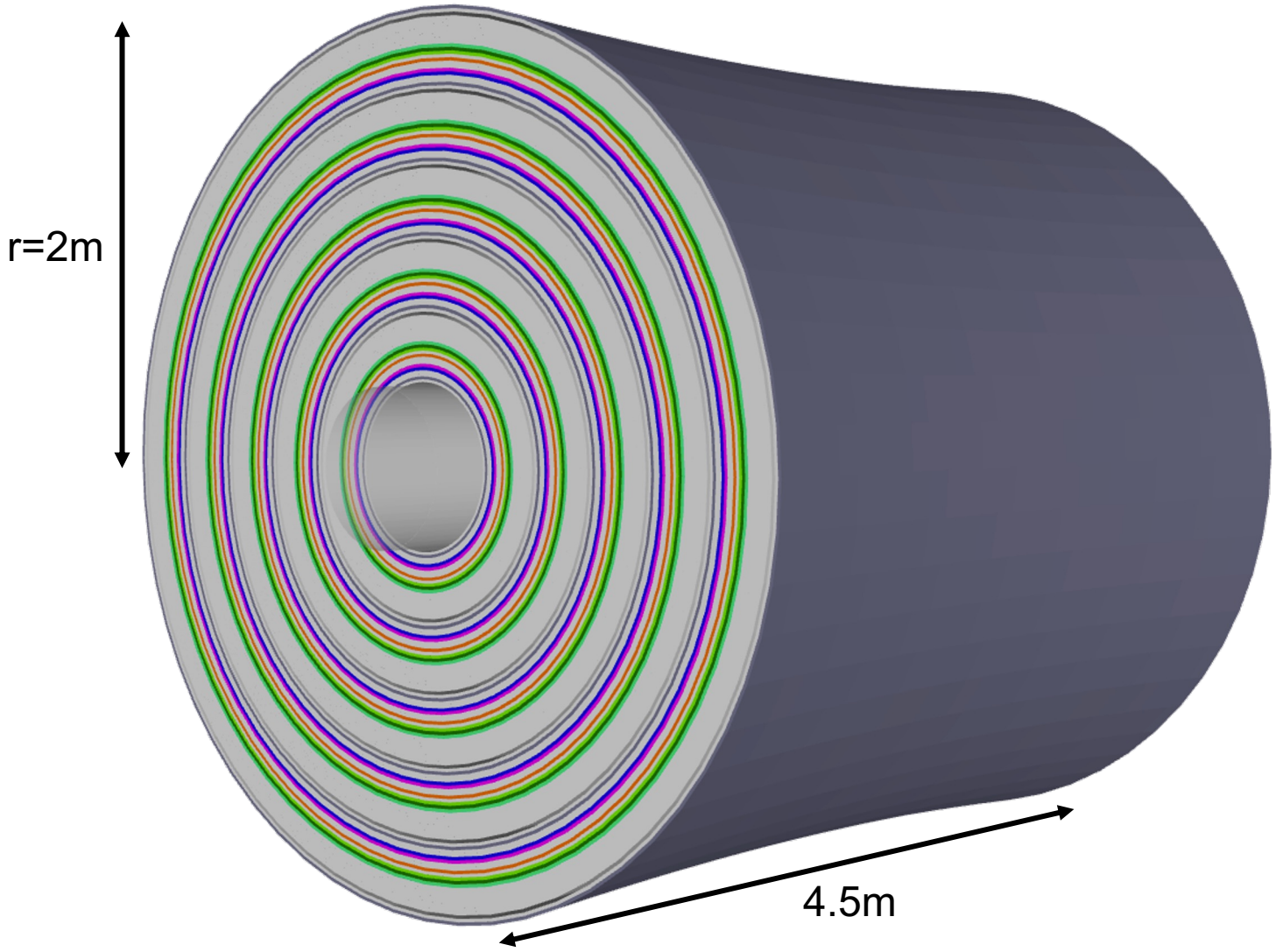
χ^2cdf from DD4hep + ACTS

Minimal materials of silicon layers/disks, vacuum beam pipe, turn off multiple scattering



Next: implement infinite pixel resolution

Drift Chamber Implementation in DD4hep



- IDEA drift chamber
- 112 layers
- Source codes:
  - https://github.com/key4hep/k4geo/blob/main/detector/tracker/DriftChamber_o1_v02.cpp
  - https://github.com/AIDASoft/DD4hep/blob/master/DDRec/include/DDRec/DCH_info.h
- XML:
  https://github.com/key4hep/k4geo/blob/main/FCCee/IDEA/compact/IDEA_o1_v03/DriftChamber_o1_v02.xml
- I am trying to figure out how to draw the wires only
- Include the drift chamber into ACTS

Summary

- Double check LDT and DD4hep comparisons with multiple scattering turned off
  - Still observe the discrepancy between LDT and DD4hep
  - To-do: (1) double check geometry in LDT setup (2) set infinite pixel size in the simulations
- χ^2 cdf from DD4hep + ACTS is still not flat after turning off multiple scattering and use different track branch
  - To-do: set infinite pixel size in the simulations
- Initial implementation of drift chamber in DD4hep
  - To-do: (1) draw wires only in event display (2) include drift chamber in ACTS

Back Up

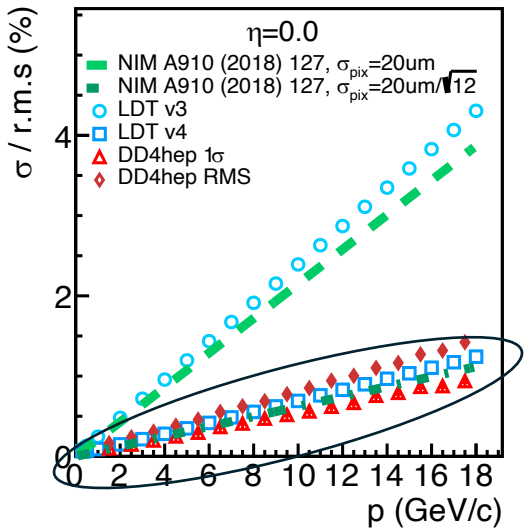
Momentum Resolutions

05-20-2024

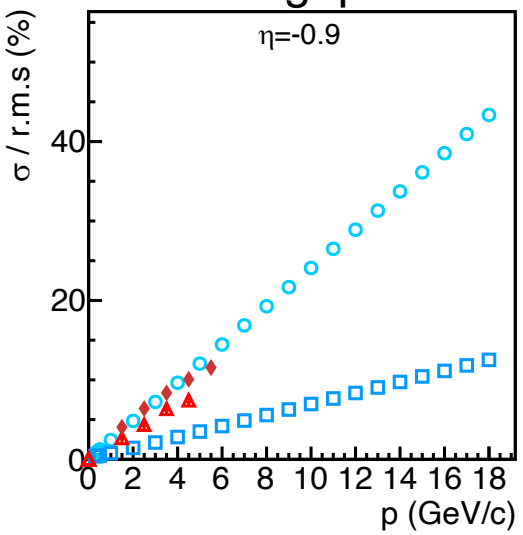
Same as last update with minimal materials

- $\mathbf{dr\phi = 20\ um}$, $\boldsymbol{dz = 20\ um}$, $du = 20$ um, $dv = 20$ um
- $\mathbf{dr\phi = 20/\sqrt{12}\ um}$, $\boldsymbol{dz = 20/\sqrt{12}\ um}$, $du = 20$ um, $dv = 20$ um

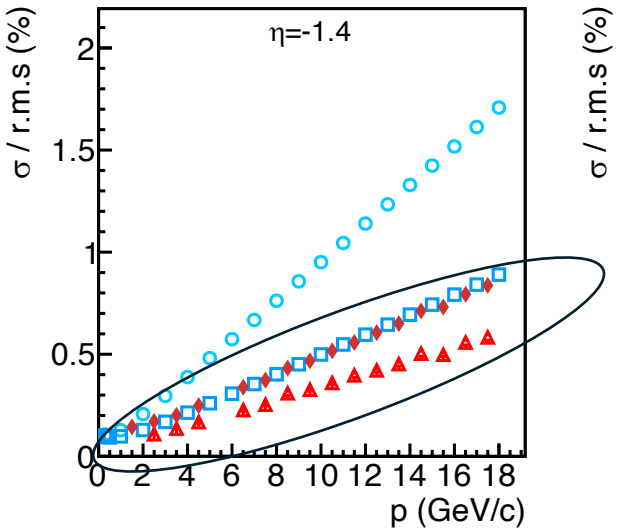
All barrel hits



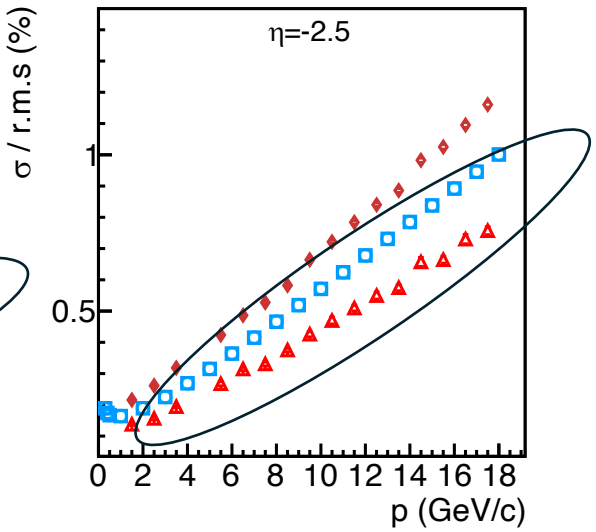
The gap



2 barrel + 3 disk hits



All disk hits



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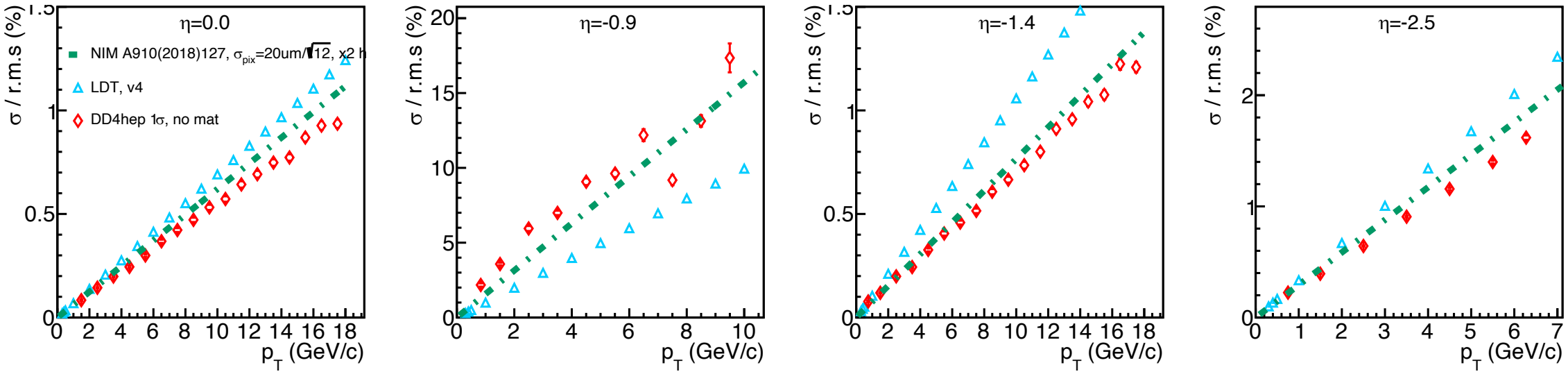

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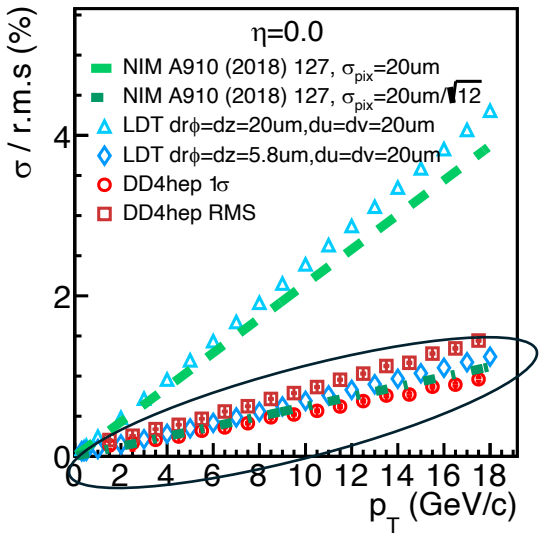
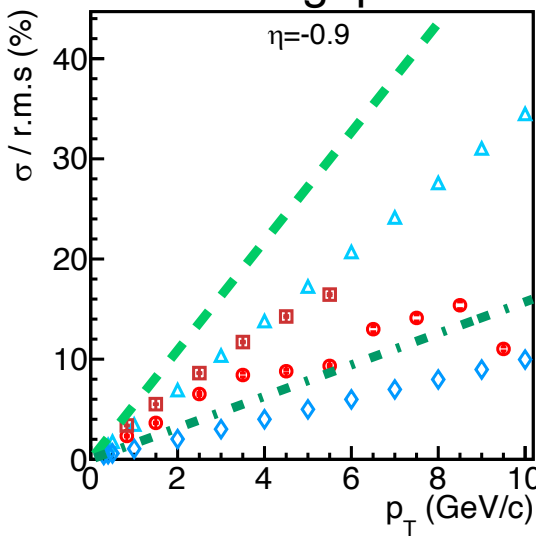
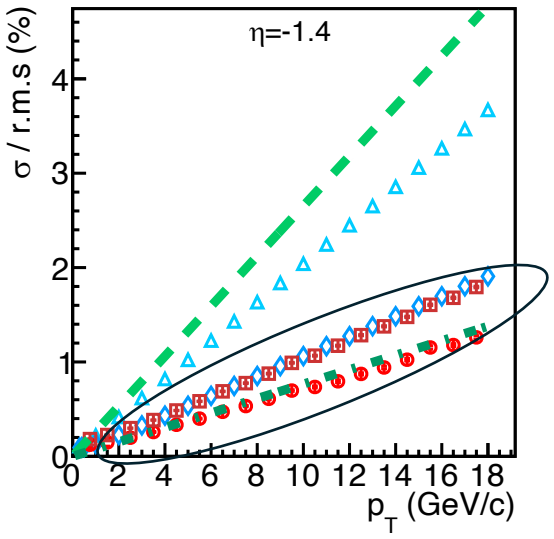
All barrel hits



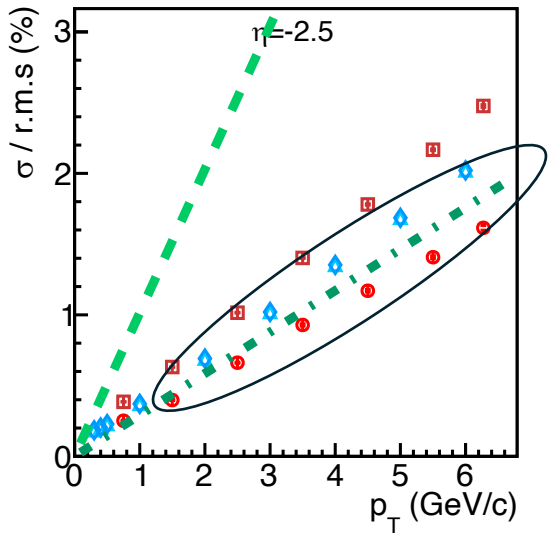
The gap



2 barrel + 3 disk hits



All disk hits



- The analytical calculation suggests that pixel errors are treated differently between barrel and backward trackers in LDT?
- Analytical calculation prefers the Gaussian σ resolution from DD4hep at $\eta = -0.9, -1.4, -2.5$