# ATHENA hybrid tracker

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ATHENA Tracking WG

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ATHENA tracking and vertex detector

- Silicon and gaseous hybrid tracker
  - MAPS near the interaction point complemented by MPGDs at larger radii
  - Full coverage of the available space allows for tracking acceptance of $-3.8 < \eta < 3.75$
  - Low material budget tracking with sufficient redundancy over a large lever arm
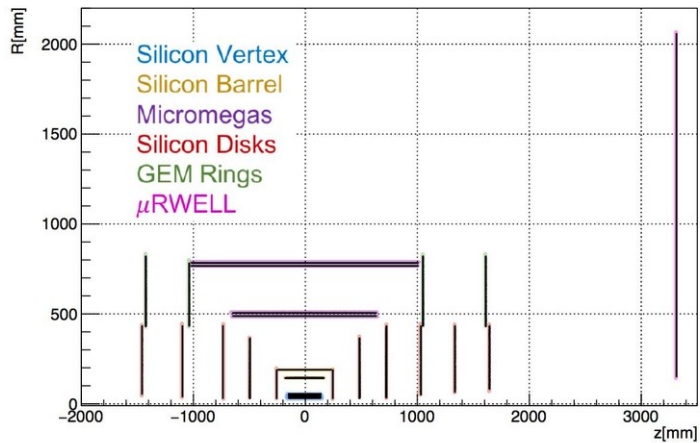
Tracking material surfaces as a function of z
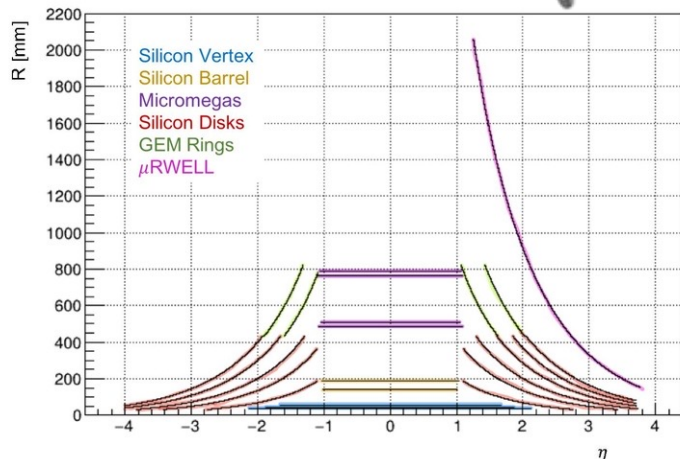
Tracking material surfaces as a function of pseudorapidity
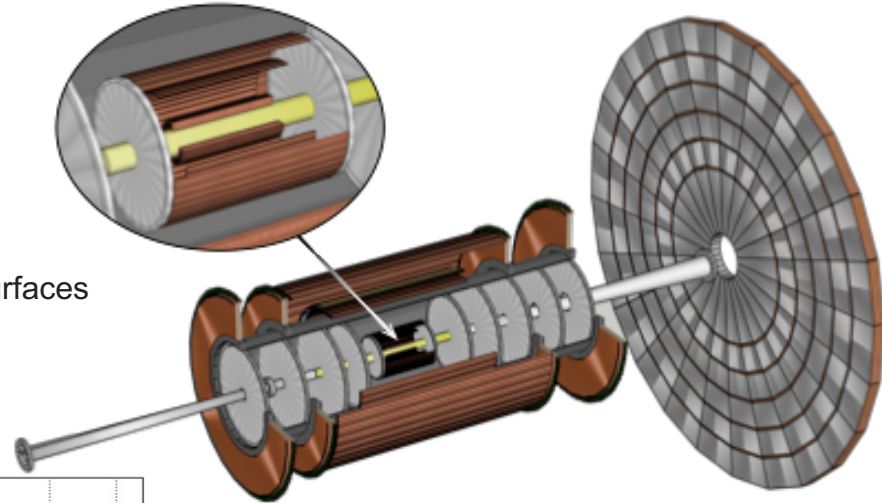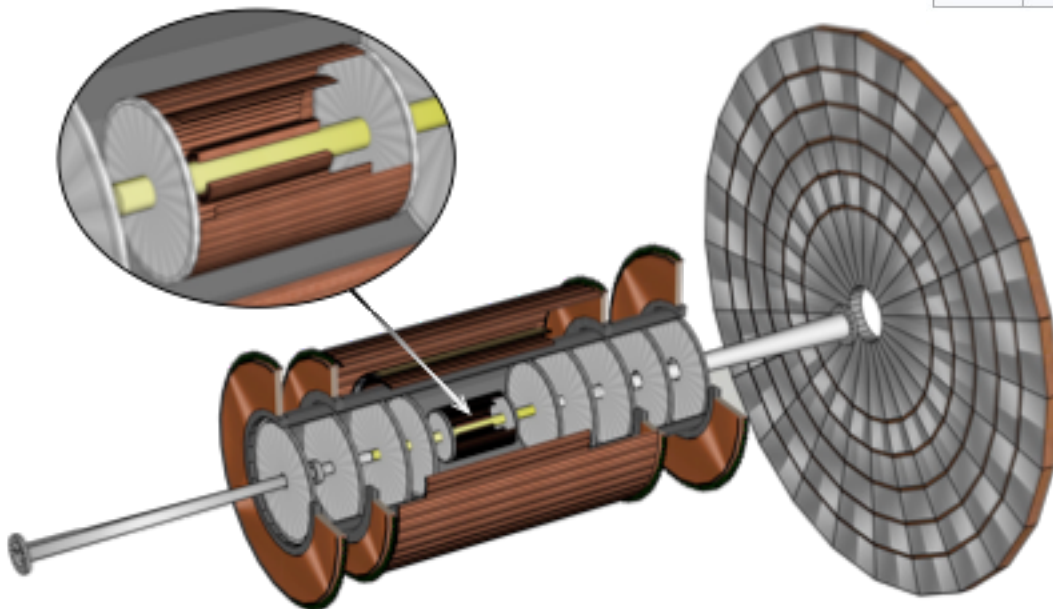
ATHENA Canyonlands v1.2

- Barrel
  - Three MAPS layers for vertexing
    - Wafer-scale sensors, thin and bent around the beam pipe
  - Two MAPS layers for sagitta measurements
  - 2+2 MM layers for tracking

Silicon Tracker (3 Vertex + 2 Barrel Layers)

R (cm)	Length (cm)	Resolution	Active Area Material (X/X0 %)
3.3	28.0	10 um pixel pitch	0.05
4.35	28.0	10 um pixel pitch	0.05
5.4	28.0	10 um pixel pitch	0.05
13.34	34.34	10 um pixel pitch	0.55
17.96	46.68	10 um pixel pitch	0.55

Micromegas Barrel (4 barrel layers)

R (cm)	Length (cm)	Resolution	Active Area Material (X/X0 %)
47.72	127.47	150 um (r-phi) x 150 um (z)	0.4
49.57	127.47	150 um (r-phi) x 150 um (z)	0.4
75.61	201.98	150 um (r-phi) x 150 um (z)	0.4
77.46	201.98	150 um (r-phi) x 150 um (z)	0.4

ATHENA Canyonlands v1.2

- Forward region

  - Six MAPS disks that extend until z = 165 cm for max lever arm

  - Two GEM rings to extend the acceptance and provide additional hit points for track reconstruction in 1.1 < eta < 2.0

  - uRWell layer behind the dRICH to help with PID and to improve the momentum resolution in the forward direction
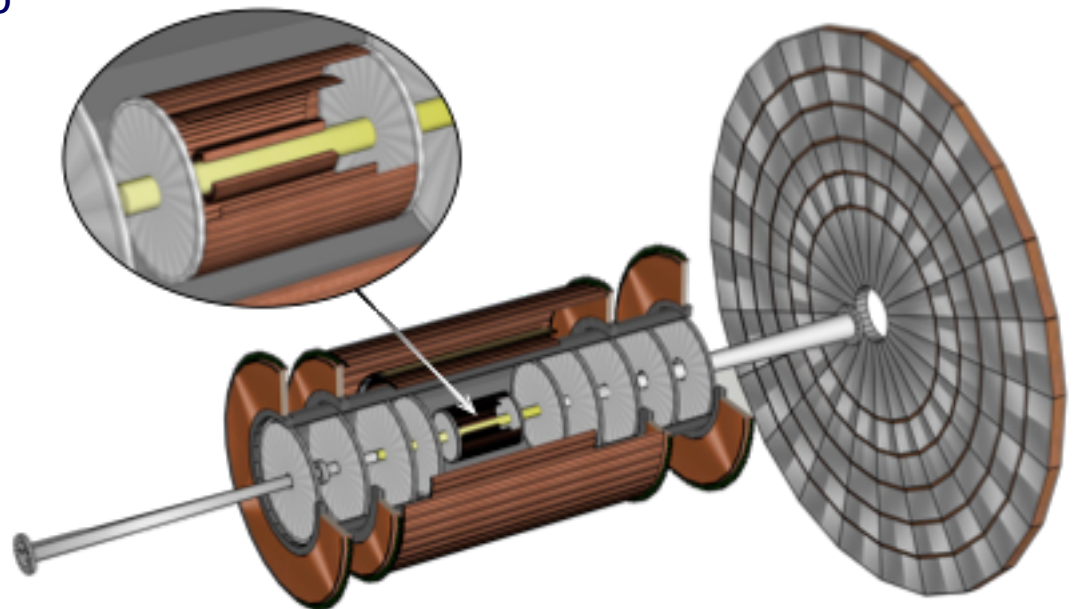
Silicon Disks

Inner R (cm)	Outer R (cm)	Z Position (cm)	Resolution	Active Area Material (X/X0 %)
3.18	18.62	25.0	10 um pixel pitch	0.24
3.18	36.50	49.0	10 um pixel pitch	0.24
3.47	43.23	73.0	10 um pixel pitch	0.24
5.08	43.23	103.65	10 um pixel pitch	0.24
6.58	43.23	134.33	10 um pixel pitch	0.24
8.16	43.23	165.0	10 um pixel pitch	0.24

Silicon Disk Support Material

Material	Thickness (cm)	Geometry
Al	0.2	cone from (z [cm], rho [cm]) = (16.8, 12.58) to (58.42, 43.23) and cylinder from (58.42, 43.23) to (165, 43.23)

MPGD Trackers

Inner R (cm)	Outer R (cm)	Z Position (cm)	Resolution	Active Area Material (X/X0 %)
44.68	76.91	105.76	250 um (r) x 50 um (r-phi)	0.4
44.68	76.91	161.74	250 um (r) x 50 um (r-phi)	0.4
19.34	195.5	332.0	250 um (r) x 50 um (r-phi)	0.4

ATHENA Canyonlands v1.2

- Backward region

  - Five MAPS disks that extend until z = -145 cm for max lever arm

  - Two GEM rings to extend the acceptance and provide additional hit points for track reconstruction in -1.1 < eta < -2.0

Silicon Disks

| Inner R (cm)	Outer R (cm)	Z Position (cm)	Resolution	Active Area Material (X/X0 %)
3.18	18.62	-25.0	10 um pixel pitch	0.24
3.18	36.50	-49.0	10 um pixel pitch	0.24
3.18	43.23	-73.0	10 um pixel pitch	0.24
3.95	43.23	-109.0	10 um pixel pitch	0.24
5.26	43.23	-145.0	10 um pixel pitch	0.24

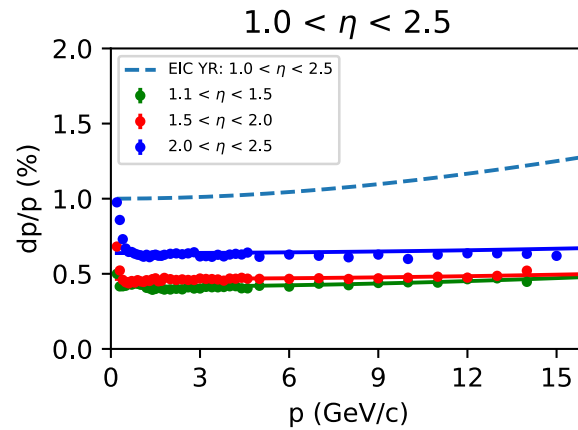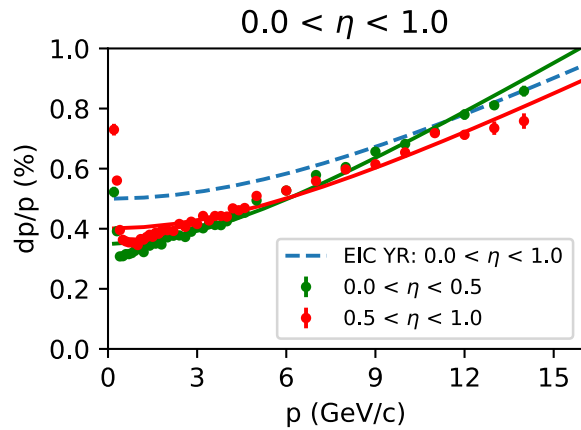**Silicon Disk Support Material**

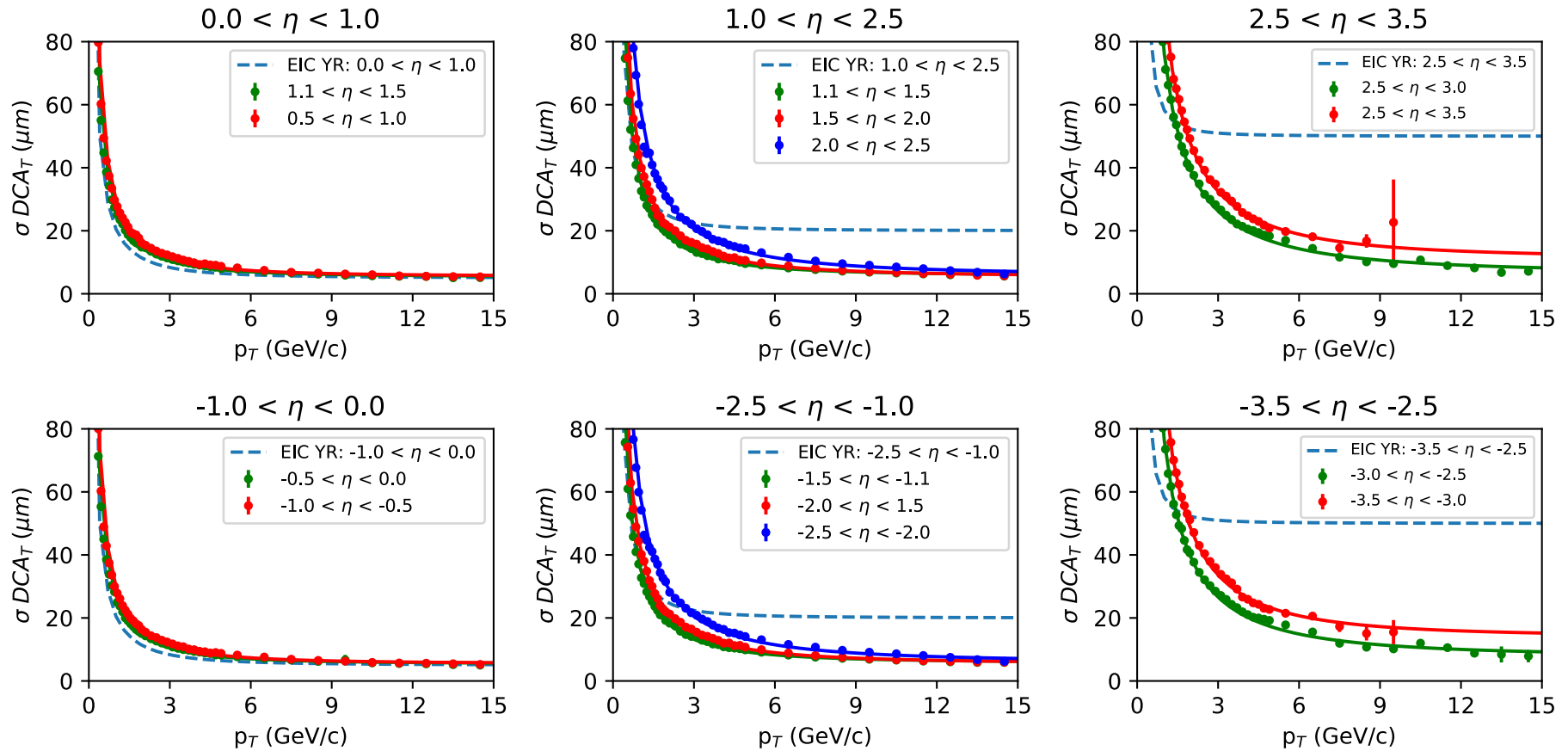| Material	Thickness (cm)	Geometry
Al	0.2	cone from (z [cm], rho [cm]) = (-16.8, 12.58) to (-58.42, 43.23) and cylinder from (-58.42, 43.23) to (-145, 43.23)

MPGD Trackers

Inner R (cm)	Outer R (cm)	Z Position (cm)	Resolution	Active Area Material (X/X0 %)
44.68	76.91	-103.0	250 um (r) x 50 um (r-phi)	0.4
44.68	76.91	-141.74	250 um (r) x 50 um (r-phi)	0.4
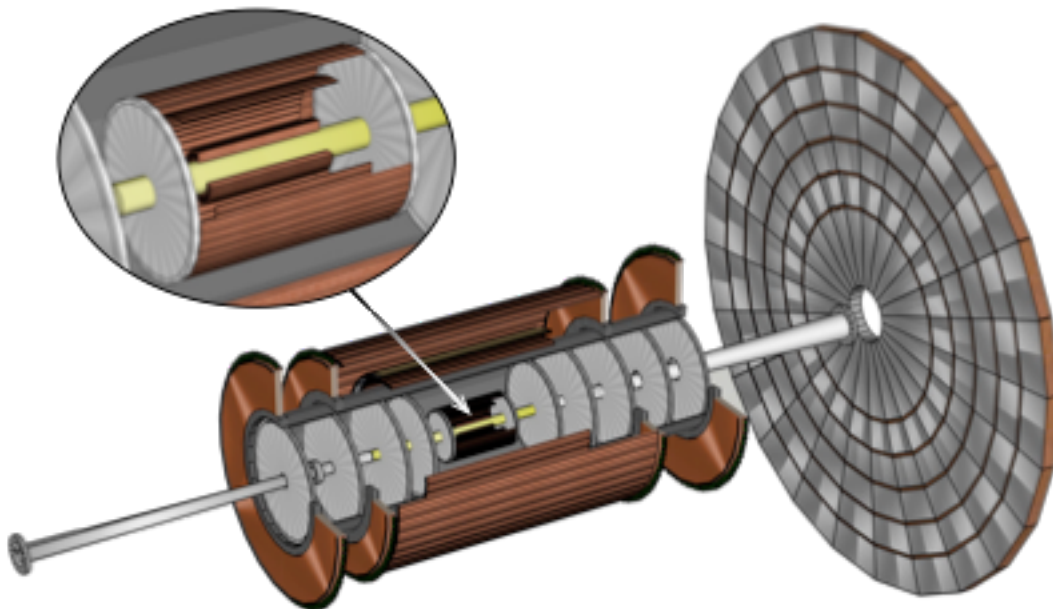
Performance against physics requirements
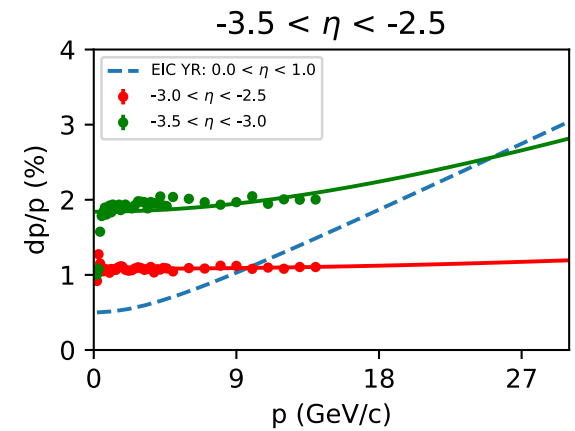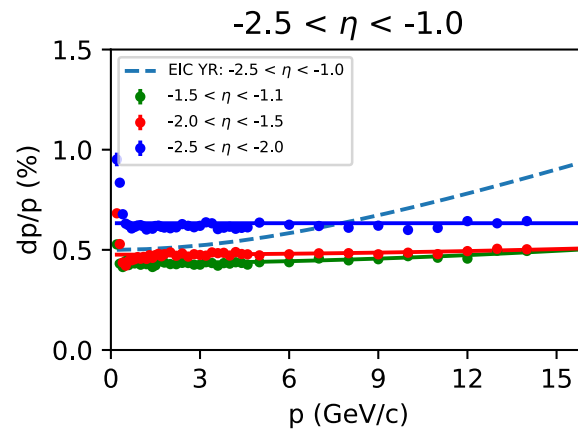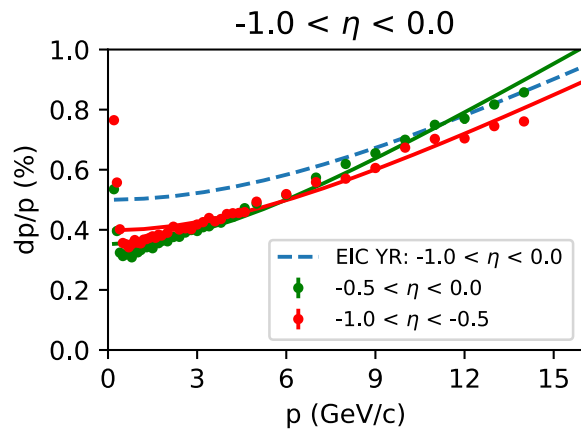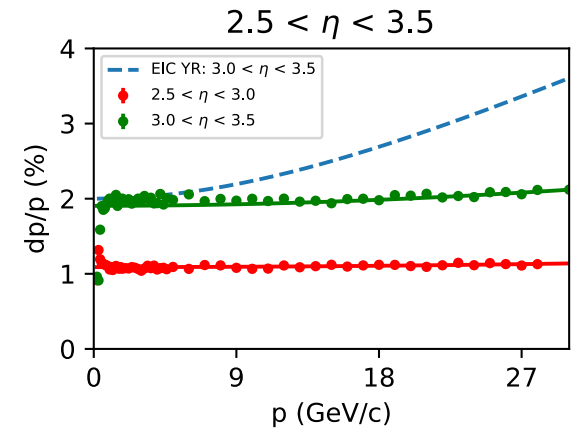
Performance against physics requirements

Next tasks for the tracking WG

- Topics on which work should continue
  - AC-LGAD Barrel TOF impact on tracking in ATHENA framework → *update today*
  - Status of mini-TPC material and tracking in ATHENA framework
  - ACTS progress → *update today*
    - Realistic track seeding
    - Track fitting
  - Detector R&D progress
    - Including refining the description in simulations

- Meeting logistics
  - Tuesdays 12-1 pm ET, by-weekly

DIS 2022 abstracts

- https://indico.cern.ch/event/1072533/

- 2 – 6 May, Spain

- Abstract deadline **Sunday 13 Feb 2022, 23:59 (Central European Time)**

- Abstract submission to be coordinated by WG coordinators
  - Please let us know if you plan to submit an abstract

- So far, we have received one abstract on the silicon vertex and tracking detector
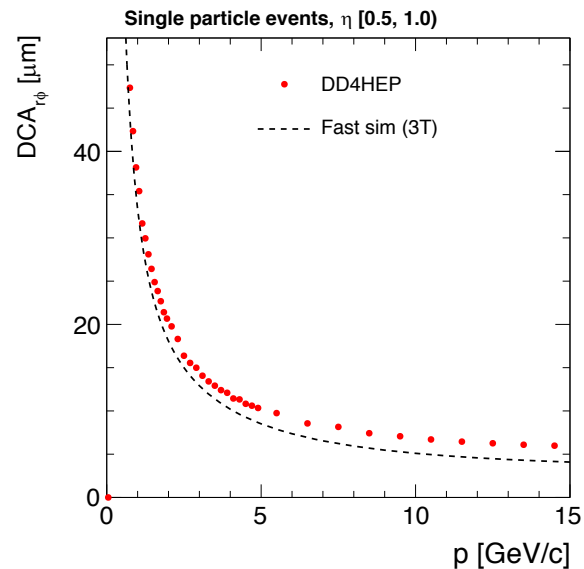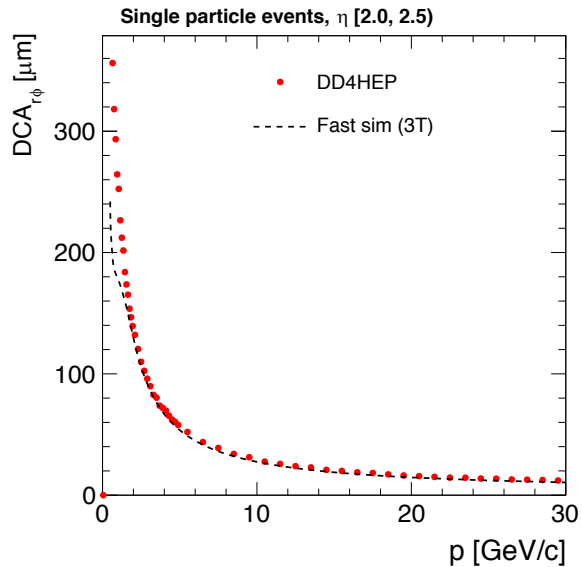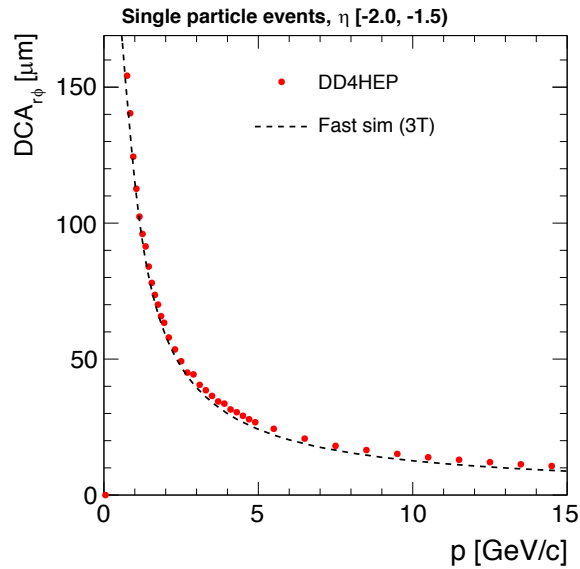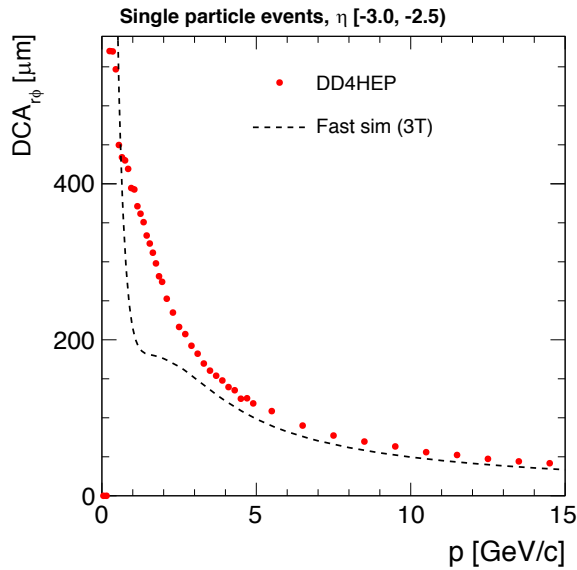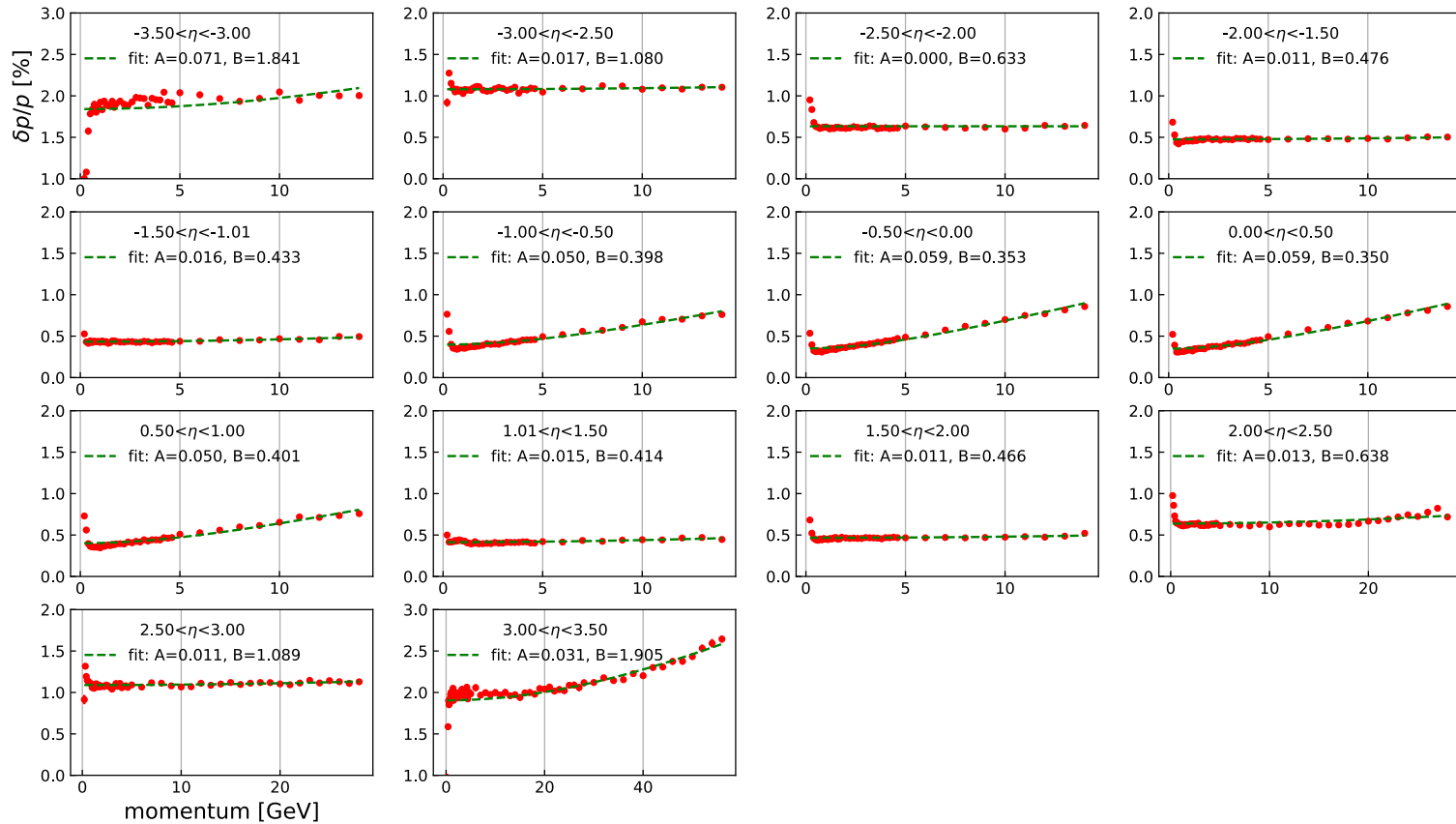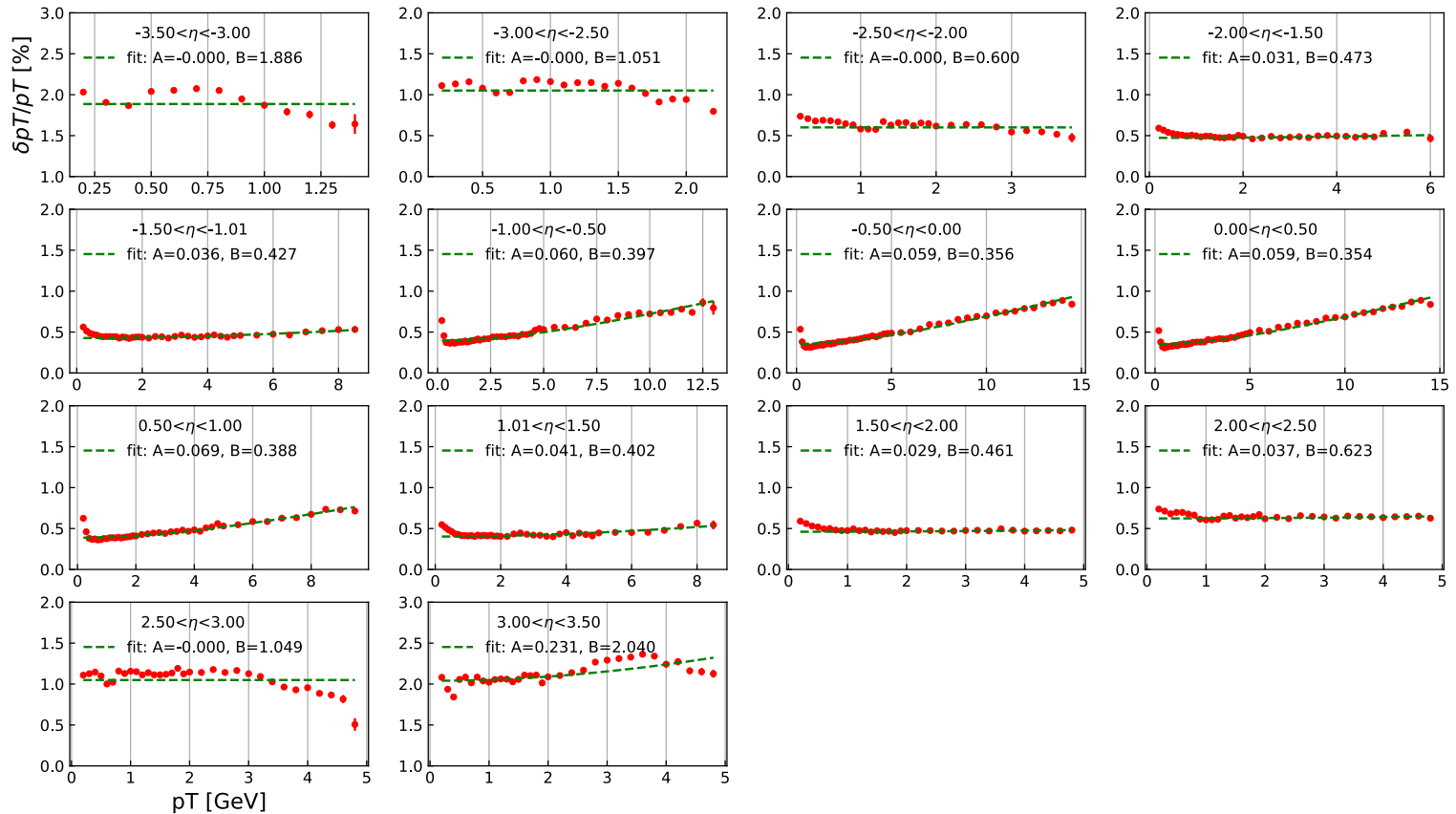
Backup

Simulation validation – dp/p
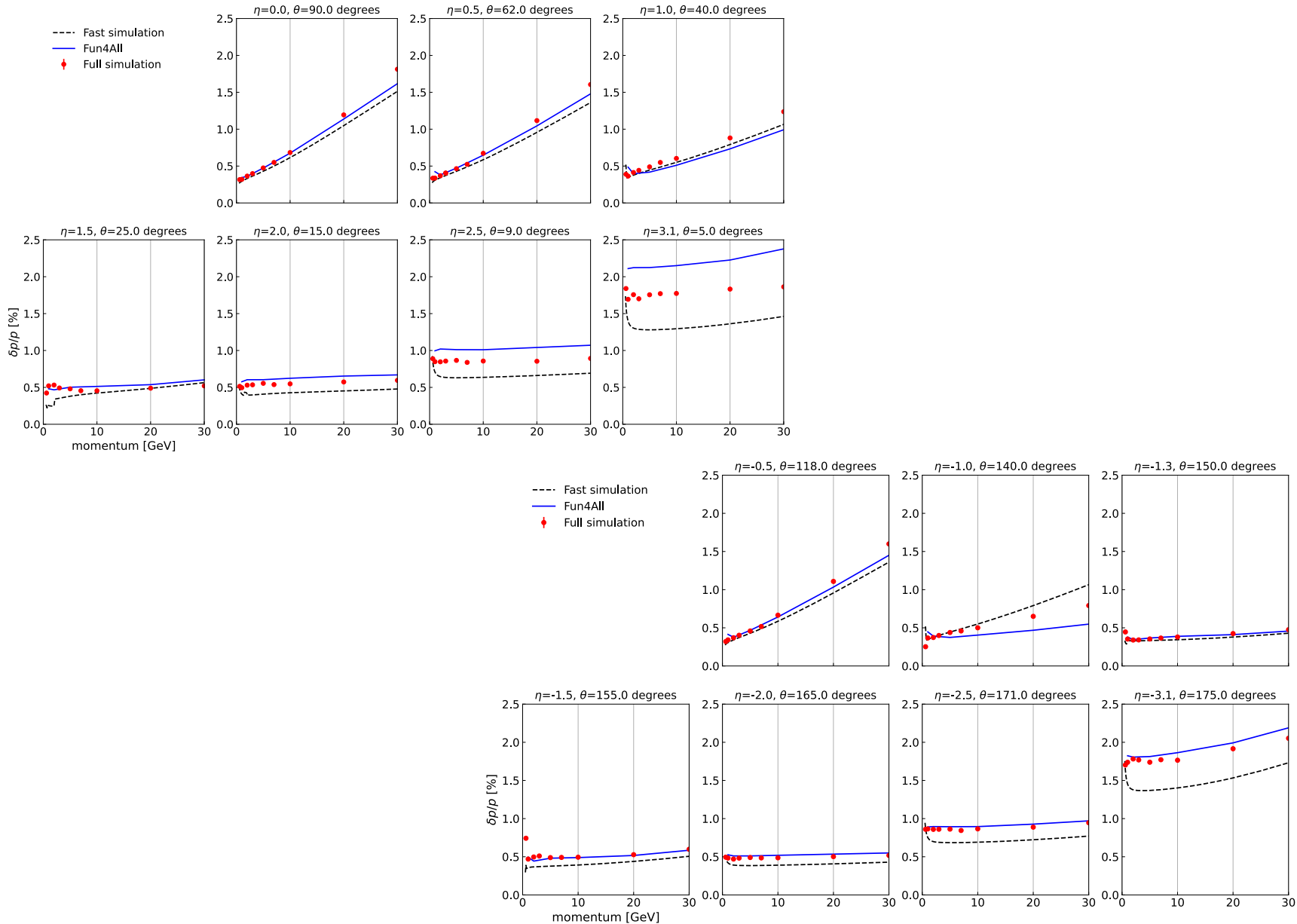
Simulation validation - DCA

Tracking performance – dp/p

Tracking performance – dp_T/p_T

Tracking performance – DCA