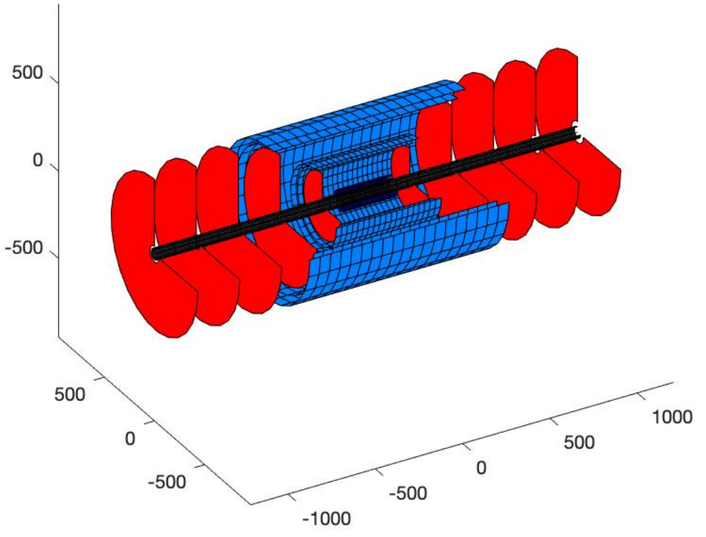
A look at new baseline(s) from Fast Simulations

- Aim to use the space available in ATHENA productively,
- Last week's discussion on baseline 2 seemed to emphasize the "convenience" of cylindrical silicon disk arrays over a projective geometry (for reasons I do not fully subscribe to),
- Choice of disk radii seemed unresolved and/or cost- rather than performance-driven (to me),

- One way to look at the all-silicon and hybrid concepts is that they are essentially the same up to an outer silicon barrel radius and an outer silicon disk radius,
- In what follows for the hybrid concept(s), I chose the outer silicon barrel radius to be the ~22cm radius of the sagitta layers in the all-silicon design for the hybrid geometry; it otherwise has an outer radius of ~78cm with gaseous detector resolutions of $150\mu m/\sqrt{12}$ and $X/X_0 = 0.4\%$ for each of the four layers and the lengths are so as to maintain projectivity,
- I chose the outer disk radius to be the ~18cm radius of the smallest-|z| disks and the ~36cm radius of the next-to-smallest-|z| disks; the gas-tech disks are chosen to complement the silicon at outer radii so as to maintain projectivity and have resolutions of $150\mu m/\sqrt{12}$ and $X/X_0 = 0.4\%$,



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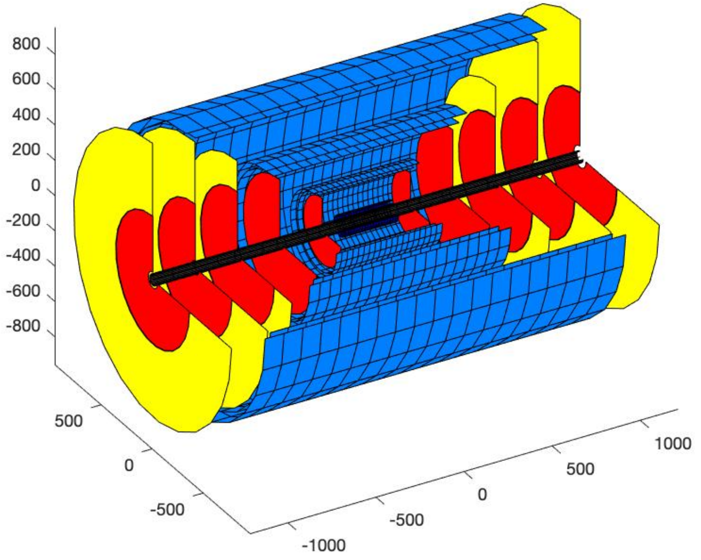

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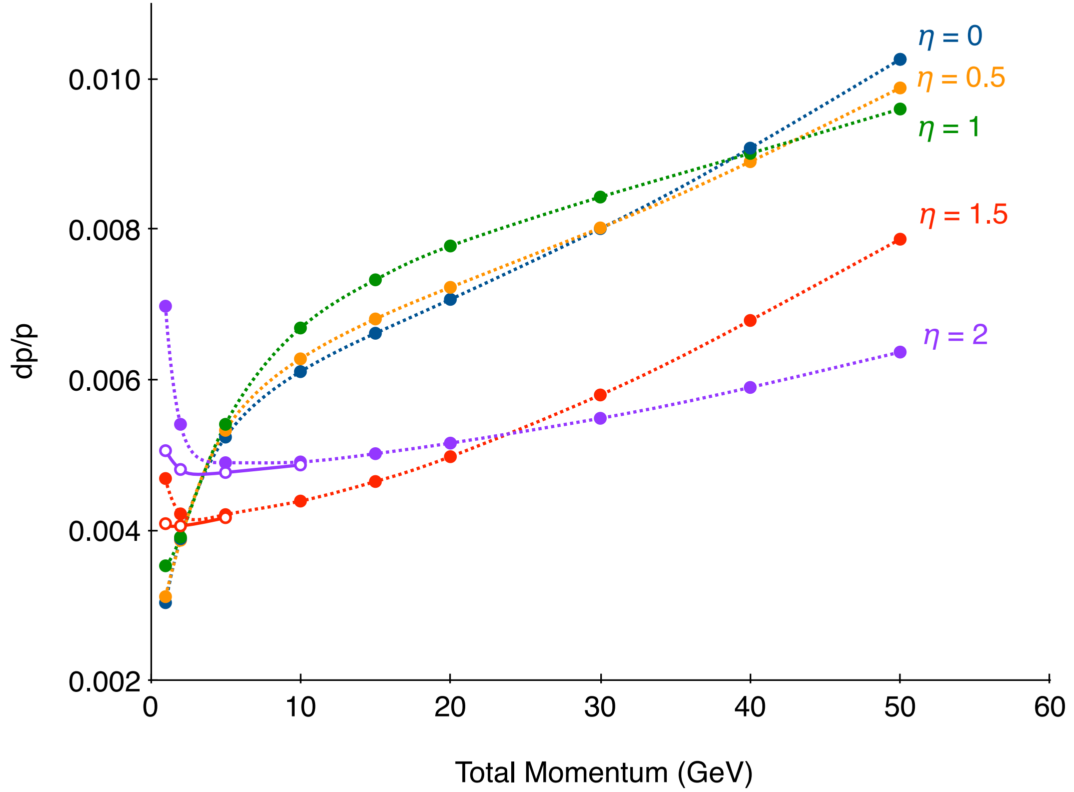

dp/p
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Total Momentum (GeV)
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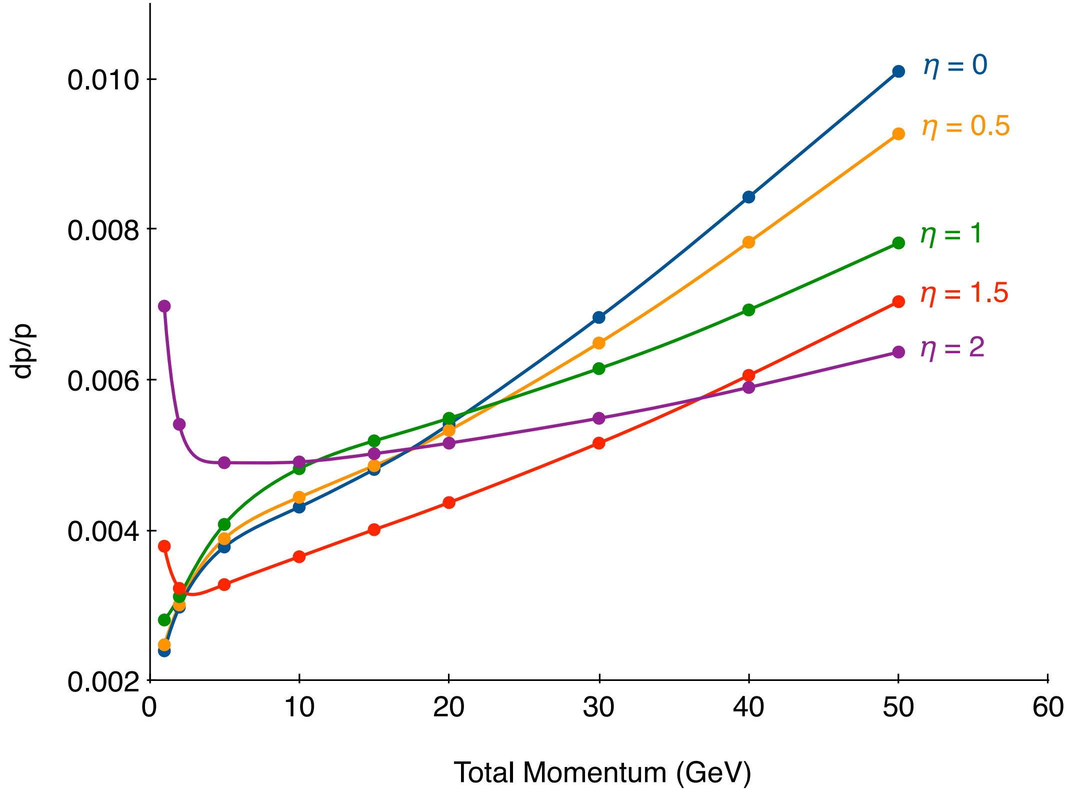
$\eta = 0.5$
$\eta = 1$
$\eta = 1.5$
$\eta = 2$



dp/p
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Total Momentum (GeV)
$\eta = 0$
$\eta = 0.5$
$\eta = 1$
$\eta = 1.5$
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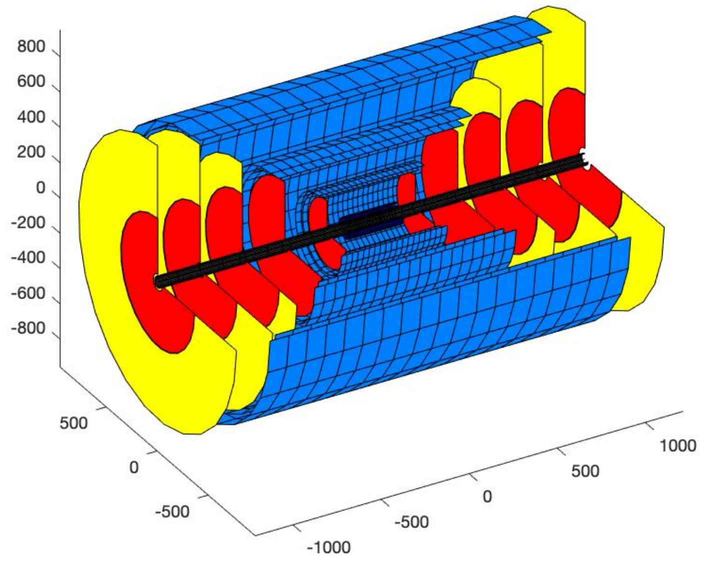
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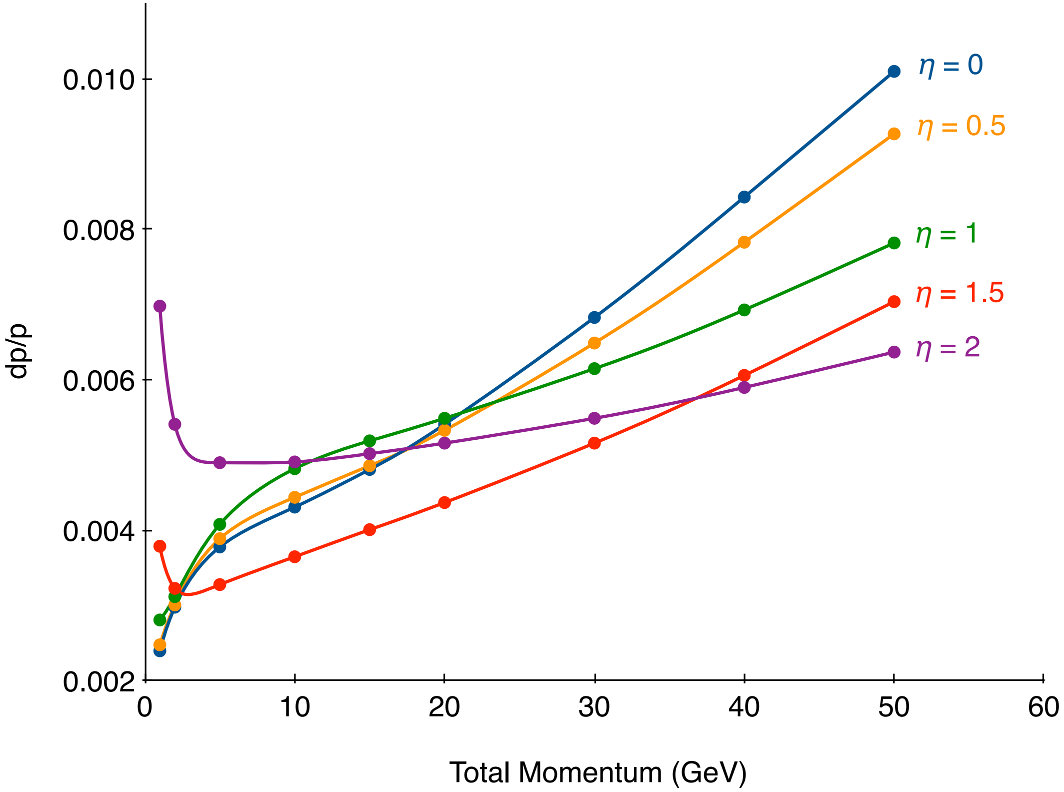
dp/p
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Total Momentum (GeV)
$\eta = 0$
$\eta = 0.5$
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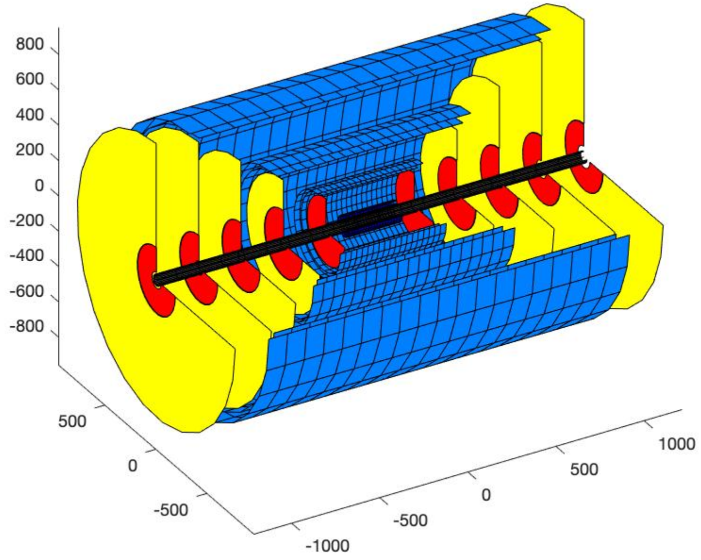
$\eta = 1.5$
$\eta = 2$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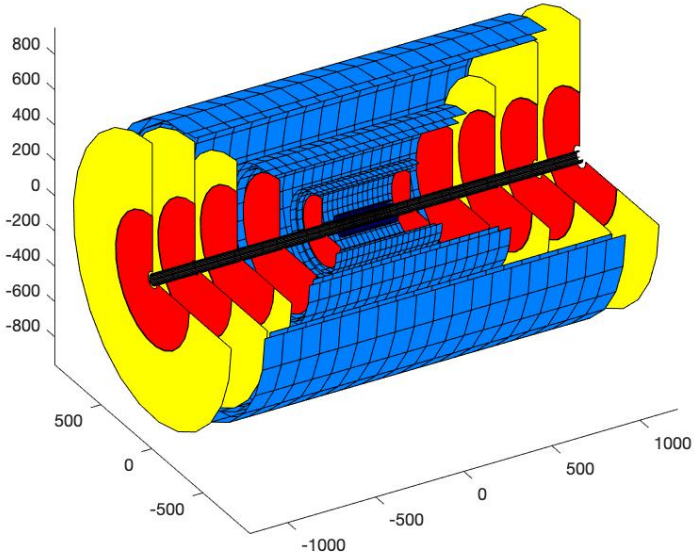
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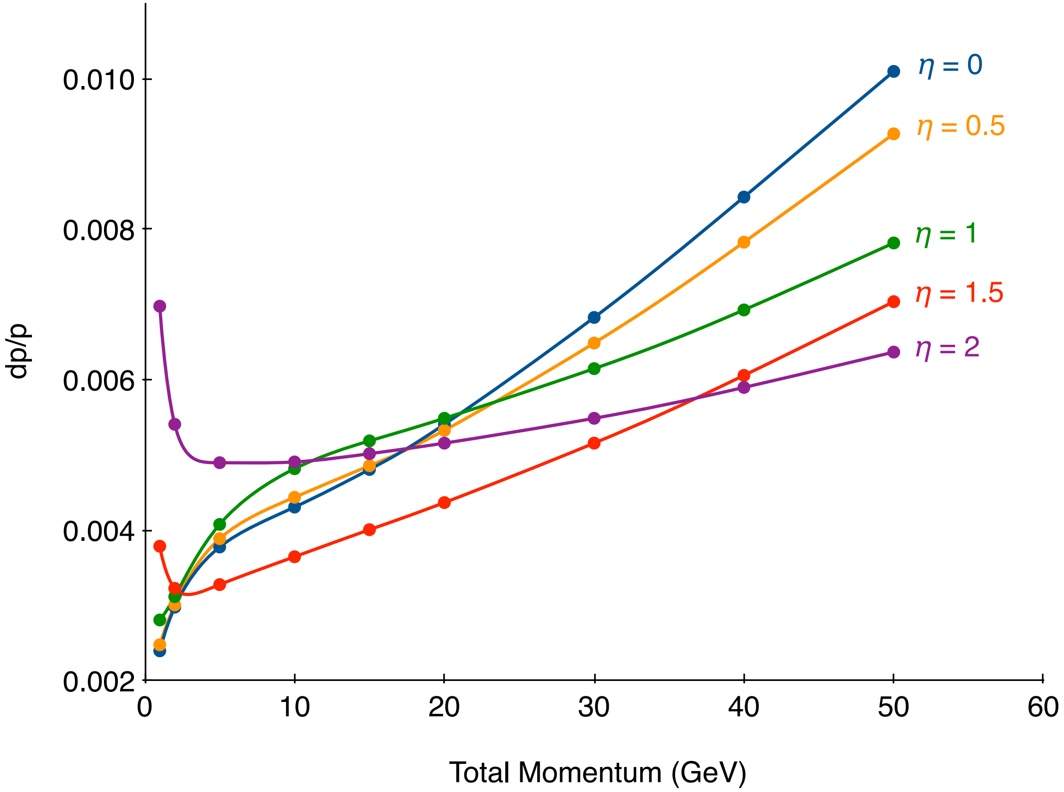
dp/p
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0.006
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0.002
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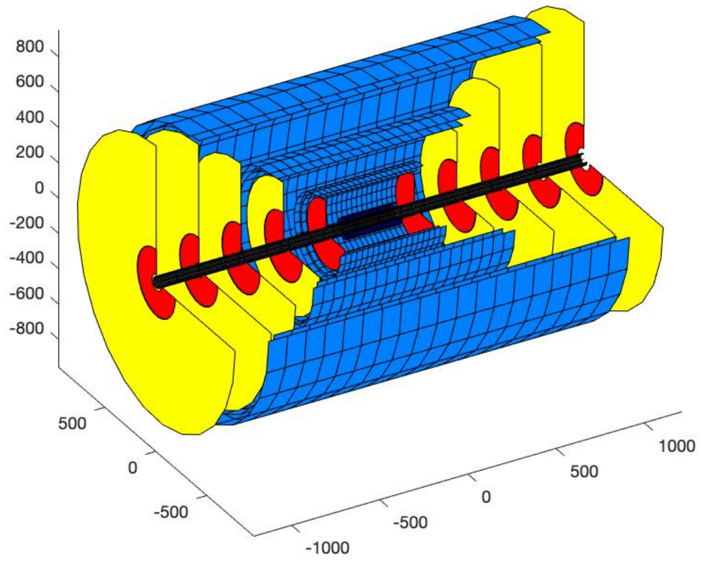
Total Momentum (GeV)
η = 0
η = 0.5
η = 1
η = 1.5
η = 2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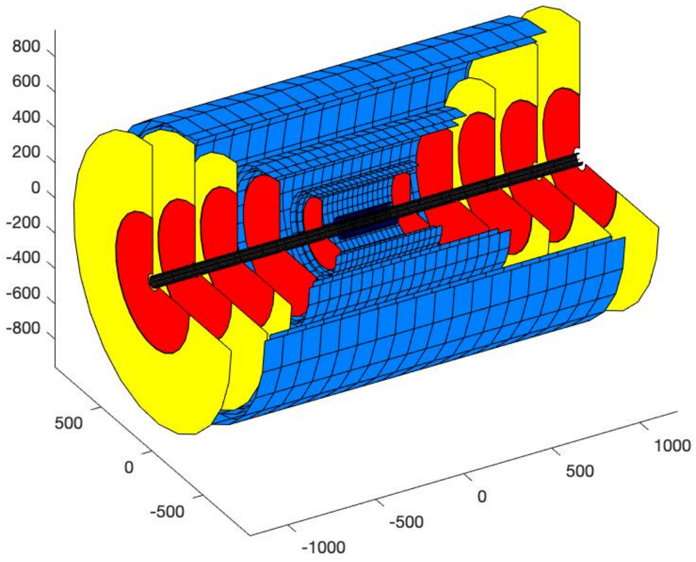
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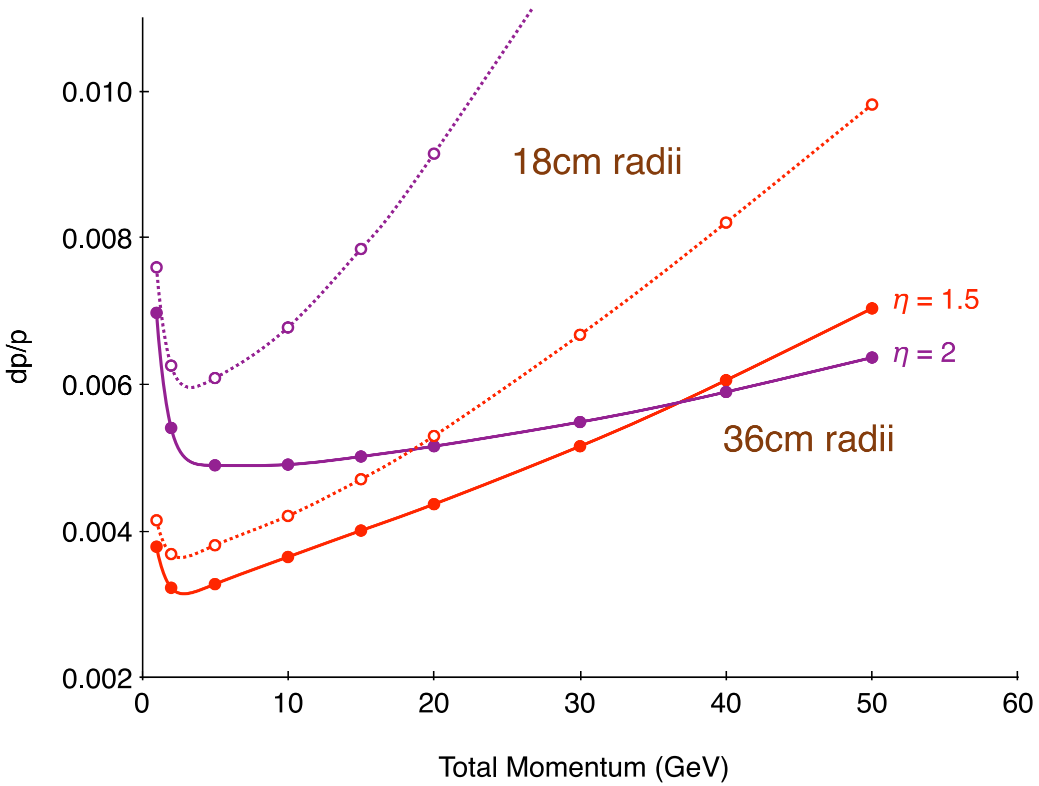
dp/p
0.010
0.008
0.006
0.004
0.002
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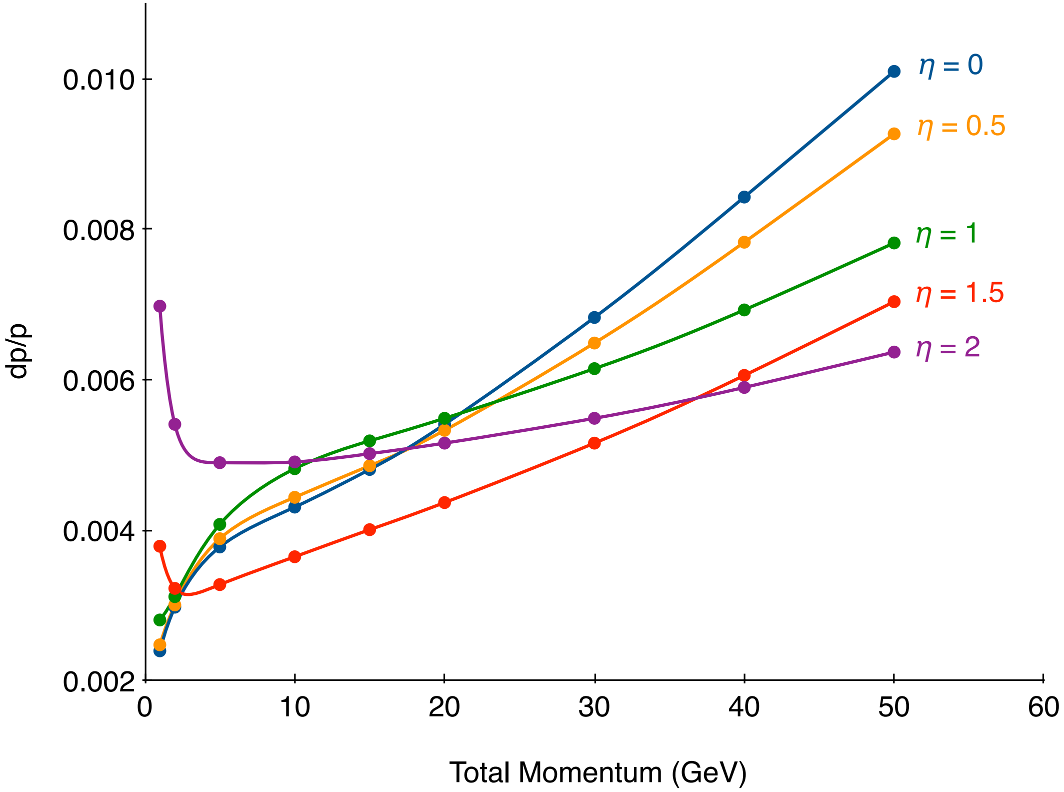
Total Momentum (GeV)
18cm radii
36cm radii
$\eta = 1.5$
$\eta = 2$


dp/p
0.010
0.008
0.006
0.004
0.002
0
10
20
30
40
50
60
Total Momentum (GeV)
$\eta = 0$
$\eta = 0.5$
$\eta = 1$
$\eta = 1.5$
$\eta = 2$

Conclusion and closing comments

- ATHENA space is sufficient to productively consider a hybrid tracking concept (no surprise at all),
- A substantial reduction of the (up to) ~43cm outer radii of the forward and backward disks compared to the all-silicon design will lead to a considerable performance hit at intermediate to large $|\eta|$, the region where most of the (SI-)DIS struck quarks hadronize (no real surprise either, recall TPC+Si versus all-Si),
- Some of this can be recovered by better resolution in the gaseous disks (< 150μm/√12) and/or extending the tracker in abs(z); e.g. 50μm/√12 with r = 18cm gives 5.9 (9.9)% dp/p at p = 10 (50) GeV

- The outer radius of the gaseous technology in the hybrid concept appears to me to be chosen by available space rather than performance or cost considerations; I thus think that there would be the possibility to reduce this outer radius e.g. to accommodate time-of-flight or other functionality (whether that is a good idea, or not, is a separate matter not considered here),
- Vertex performance should be anticipated to be similar; single-track DCAs are identical to within ~12% in r.ϕ (all-silicon typically being better) and ~4% in z in these concepts (with equal configurations of the silicon vertex barrels and smallest-$|z|$ silicon disk*),
- The transition between the outer silicon disk radius and the inner gas-tech disks will obviously need some form of mechanical support and services; I studied performance with an additional (inactive) cylinder with X/X_0 = 2% (chosen from silicon services) and find a ~20% relative hit in dp/p for η = 1.5 up to ~5 GeV,
- I have not explicitly studied angular resolutions into the dRICH,
- I have not explicitly studied extending the tracker in $|z|$ (for the concepts presented here).

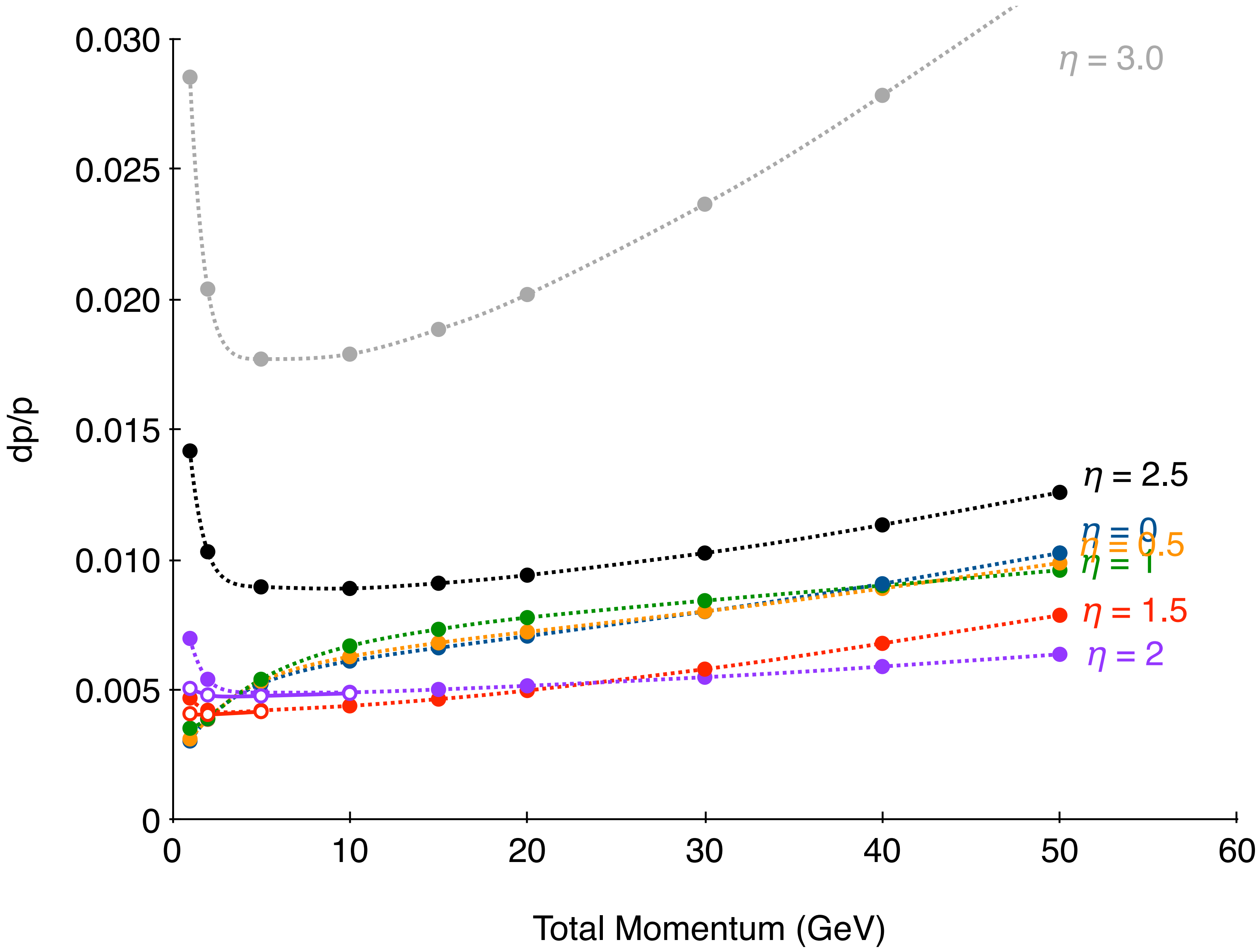
Backup

A few useful numbers

- The outer radius of the hybrid concept(s) considered here is ~78 cm,
- The outer radii of the silicon disks in the hybrid concept(s) considered here are ~18 and ~36 cm,

- A pseudo-rapidity of 1.5 corresponds to a radius r = 56cm at z = 1.21m,
- A pseudo-rapidity of 2.0 corresponds to a radius r = 33cm at z = 1.21m,
- A pseudo-rapidity of 2.5 corresponds to a radius r = 20cm at z = 1.21m,

- Hence, pseudo-rapidities of 1.5 and 2.0 are most relevant for the studies discussed here.


0.030
0.025
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0.015
0.010
0.005
0
dp/p
0
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50
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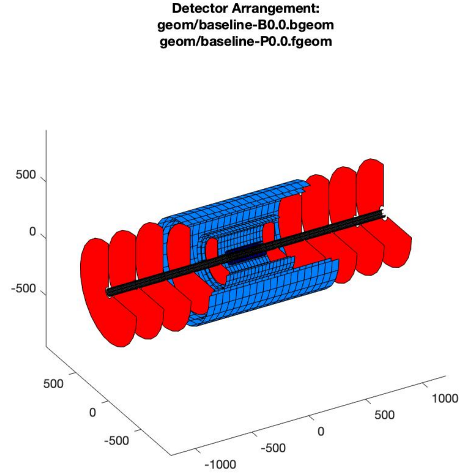
η = 2.5
η = 0
η = 0.5
η = 1
η = 1.5
η = 2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