χ^2 cut in track finding

- Multi-peak structure related to # of hits used in track finding/fitting
  - χ^2 of the hits at the outer barrel layers can be fairly big (if requiring χ^2<25, some tracks will contain < 5 hits for track finding/fitting)
  - Examples from 2 selected events (0-1: vertex layers , 3-4: middle layers, 6-7: outer layers)

```
parts_from_fit      DEBUG Hit @ 0 with chi2 2.01125e-07
parts_from_fit      DEBUG Hit @ 1 with chi2 0.00214357
parts_from_fit      DEBUG Hit @ 3 with chi2 1.29493
parts_from_fit      DEBUG Hit @ 4 with chi2 6.9389
parts_from_fit      DEBUG Hit @ 6 with chi2 121.331
parts_from_fit      DEBUG Hit @ 7 with chi2 148.643
```

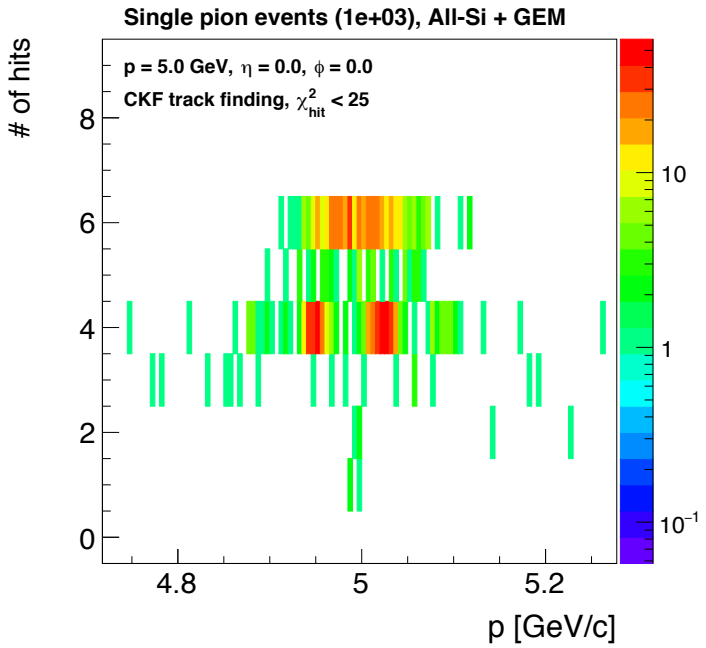
These two hits won't be used with χ^2 < 25

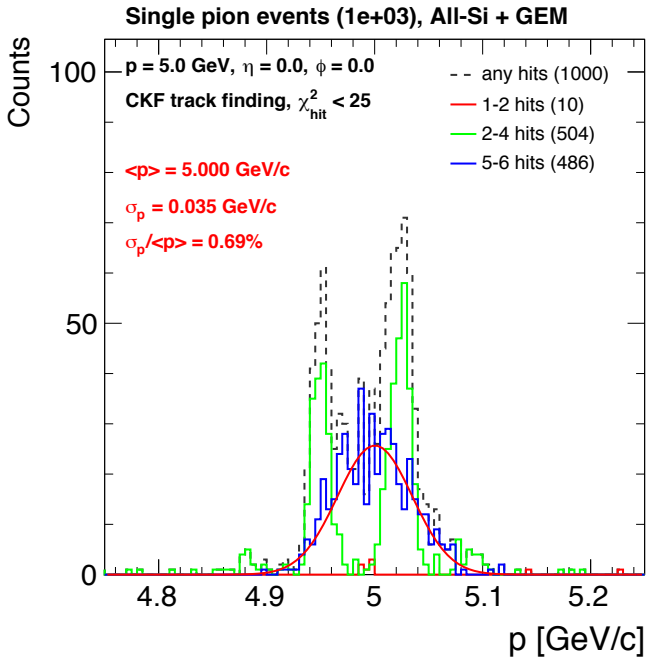
```
parts_from_fit      DEBUG Hit @ 0 with chi2 2.01125e-07
parts_from_fit      DEBUG Hit @ 1 with chi2 1.15074e-05
parts_from_fit      DEBUG Hit @ 3 with chi2 0.0121946
parts_from_fit      DEBUG Hit @ 4 with chi2 0.388696
parts_from_fit      DEBUG Hit @ 6 with chi2 69.3841
parts_from_fit      DEBUG Hit @ 7 with chi2 8.29462
```

This one hit won't be used with χ^2 < 25

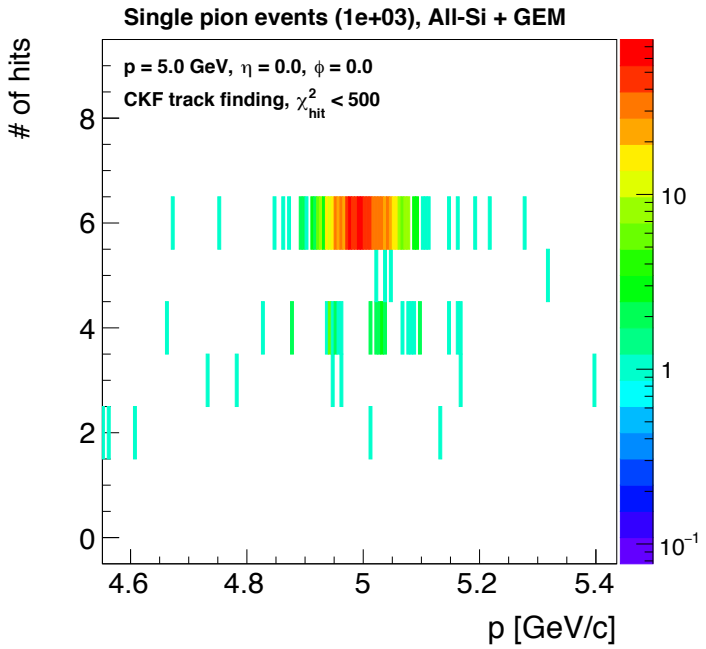
p distribution of tracks with different number of hits

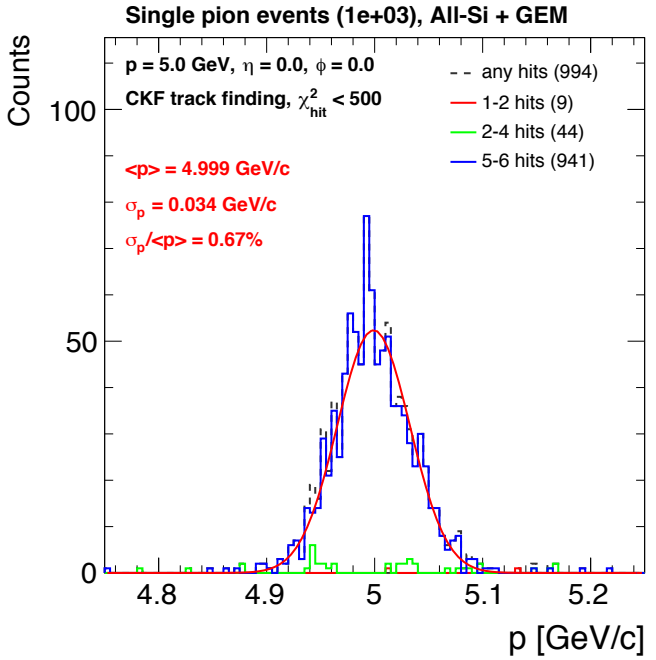
$\chi^2 < 25$, lots of tracks with only 4 hits





$\chi^2 < 500$, most of tracks with 6 hits

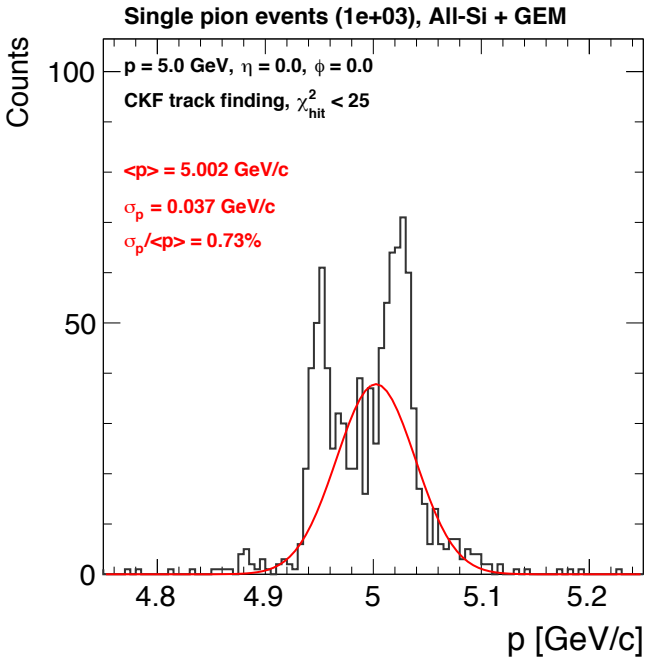




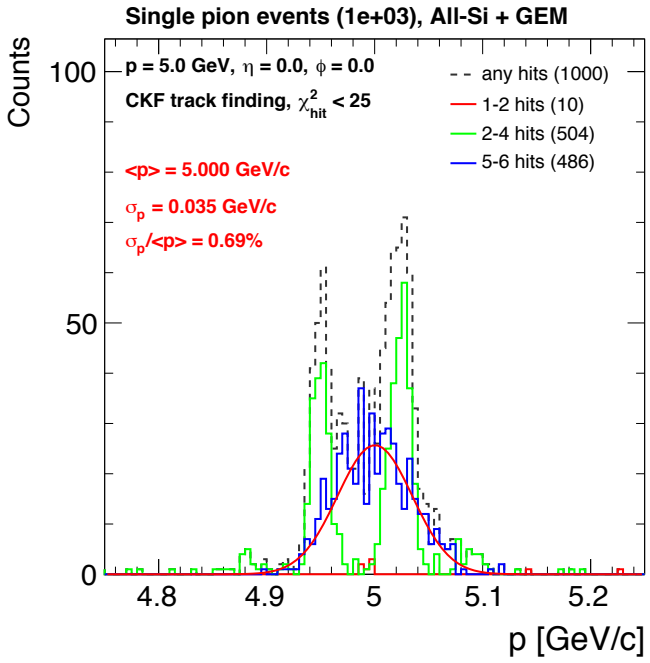
p = 5 GeV, η = 0

p resolution not changing significantly

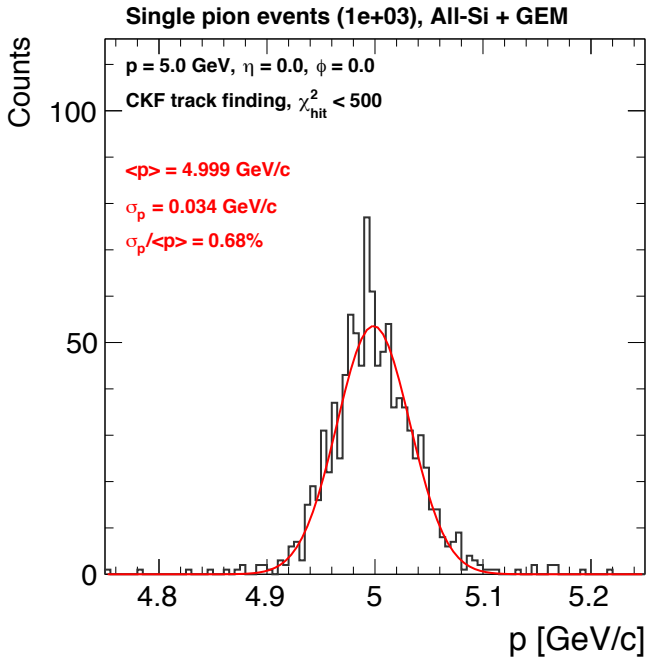
Small χ^2 cut (fit all tracks)



Small χ^2 cut (only fit tracks with 6 hits)



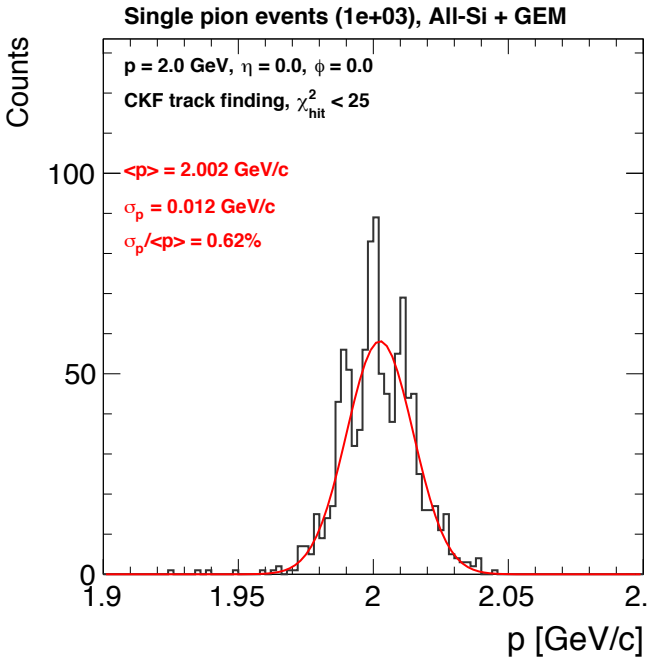
Large χ^2 cut (fit all tracks)



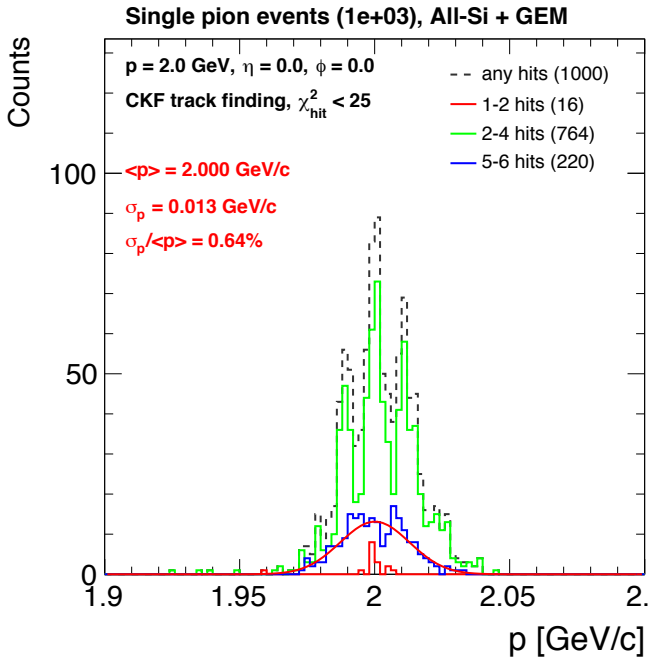
p = 2 GeV, η = 0

p resolution not changing significantly

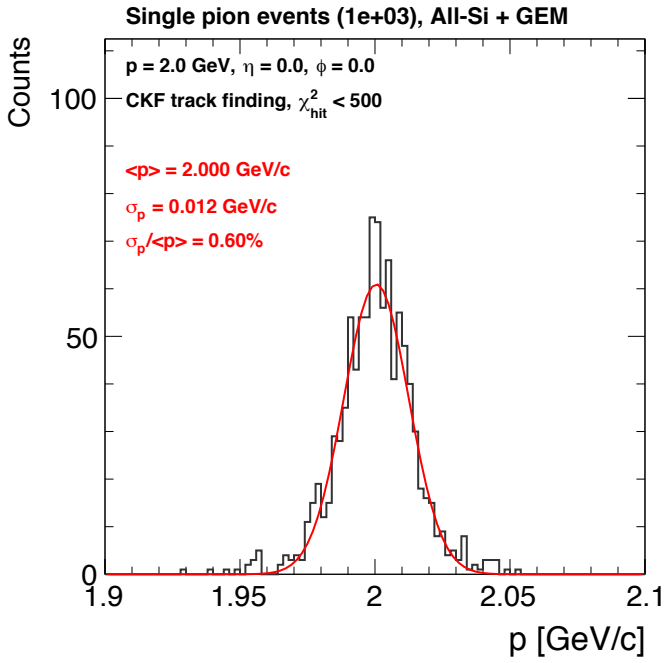
Small χ^2 cut (fit all tracks)



Small χ^2 cut (only fit tracks with 6 hits)



Large χ^2 cut (fit all tracks)

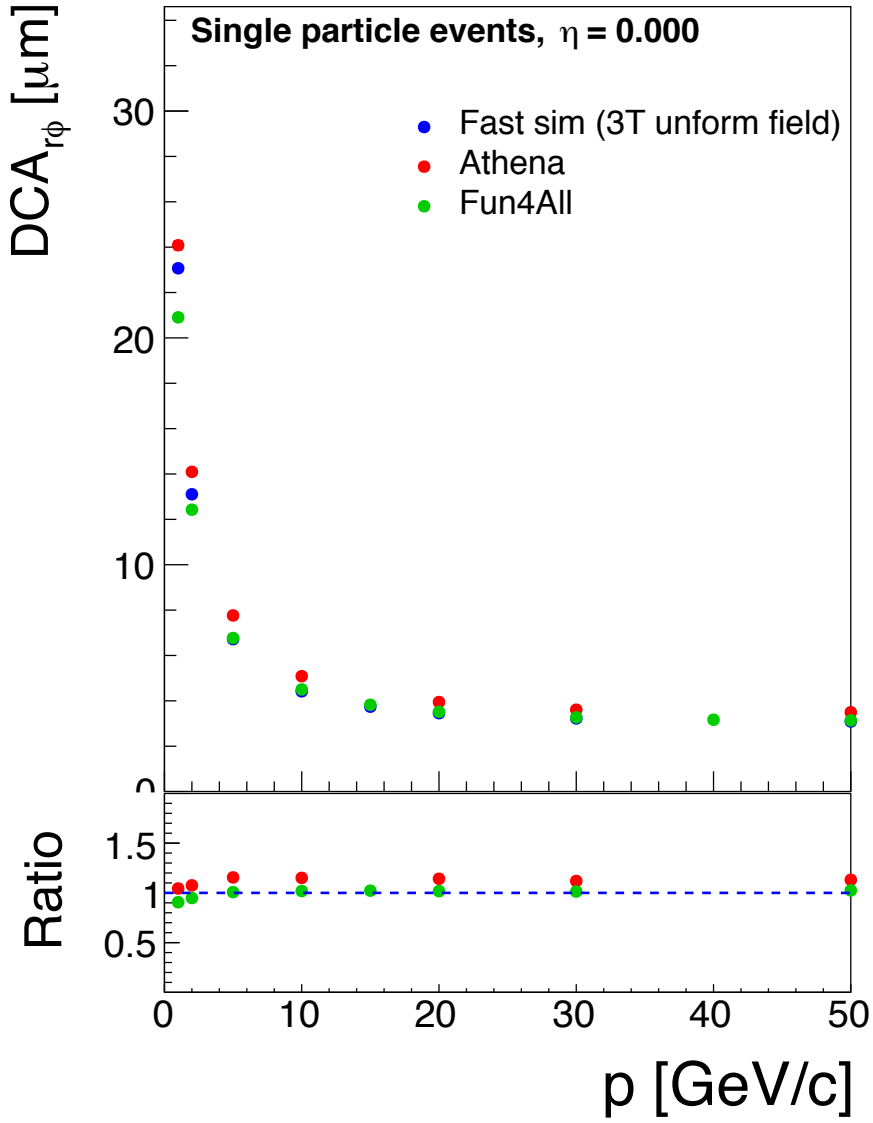


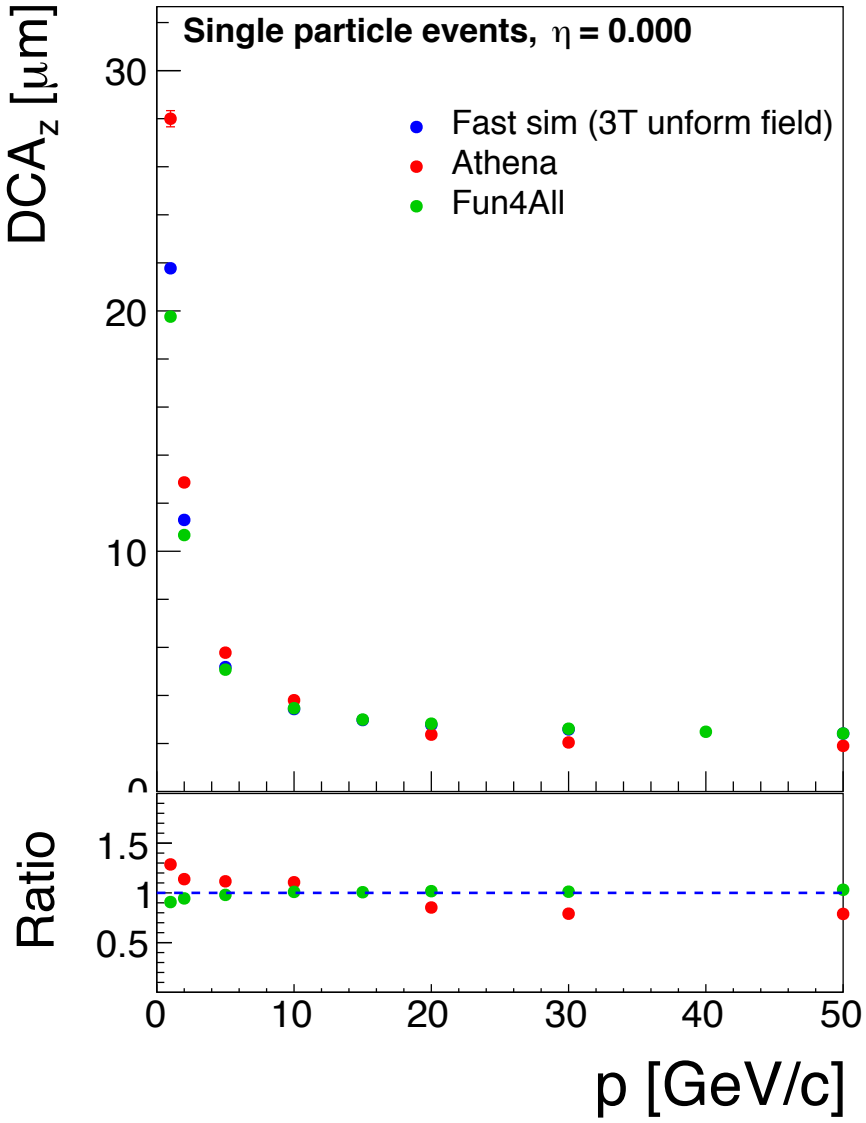
Material map update

- Why such big χ^2 at outer layers?
  - Related to the material map (material effect not included in KalmanFilter model and will lead to a under-estimated covariance matrix)
- Need new material map and it's already updated by Shujie
- It would be useful to save track quality related variables for future tracking performance studies

DCA comparison with the updated material map

- Better agreement with the updated material map





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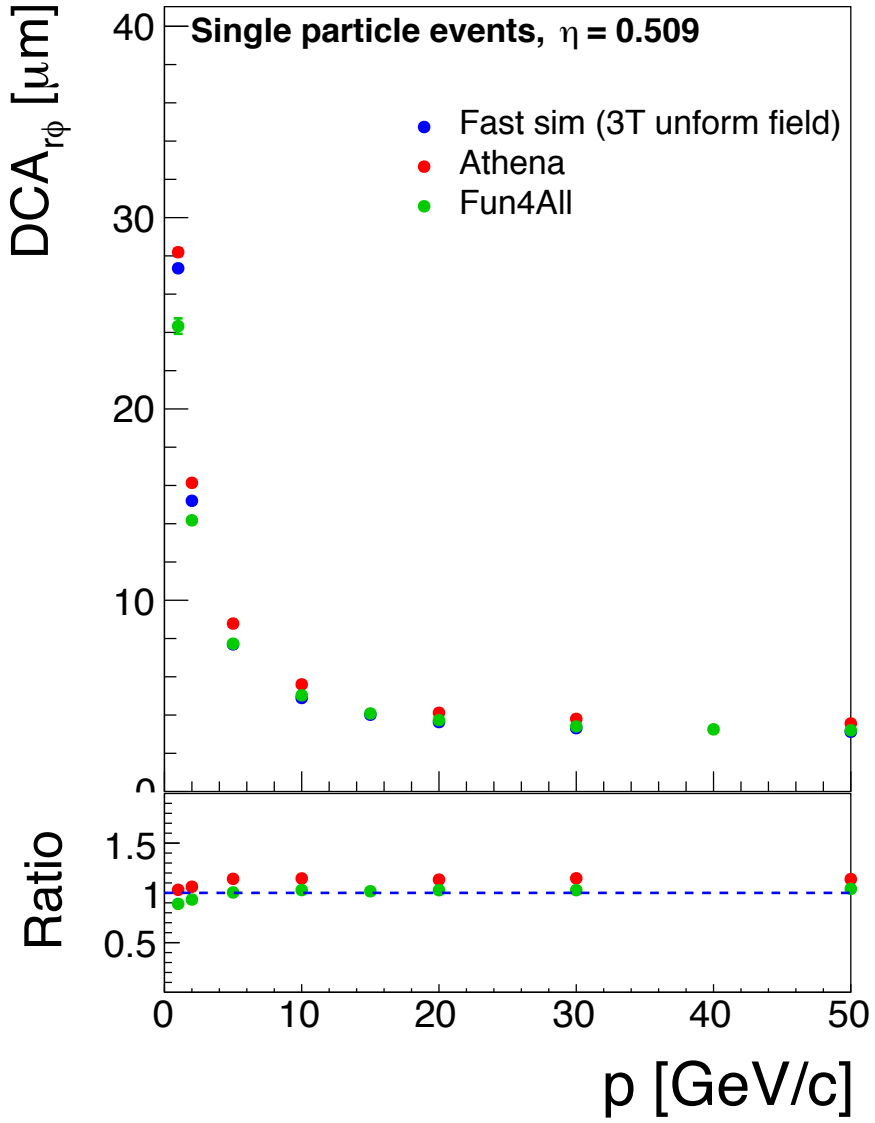

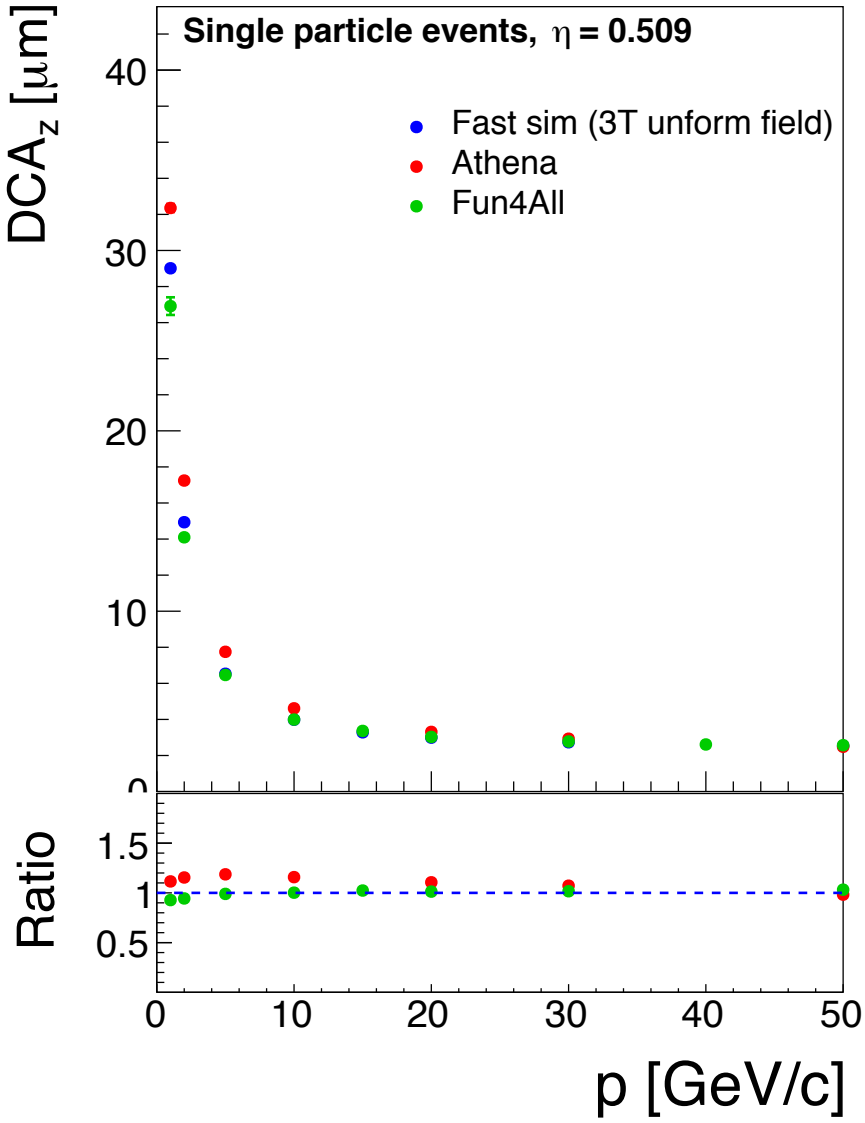

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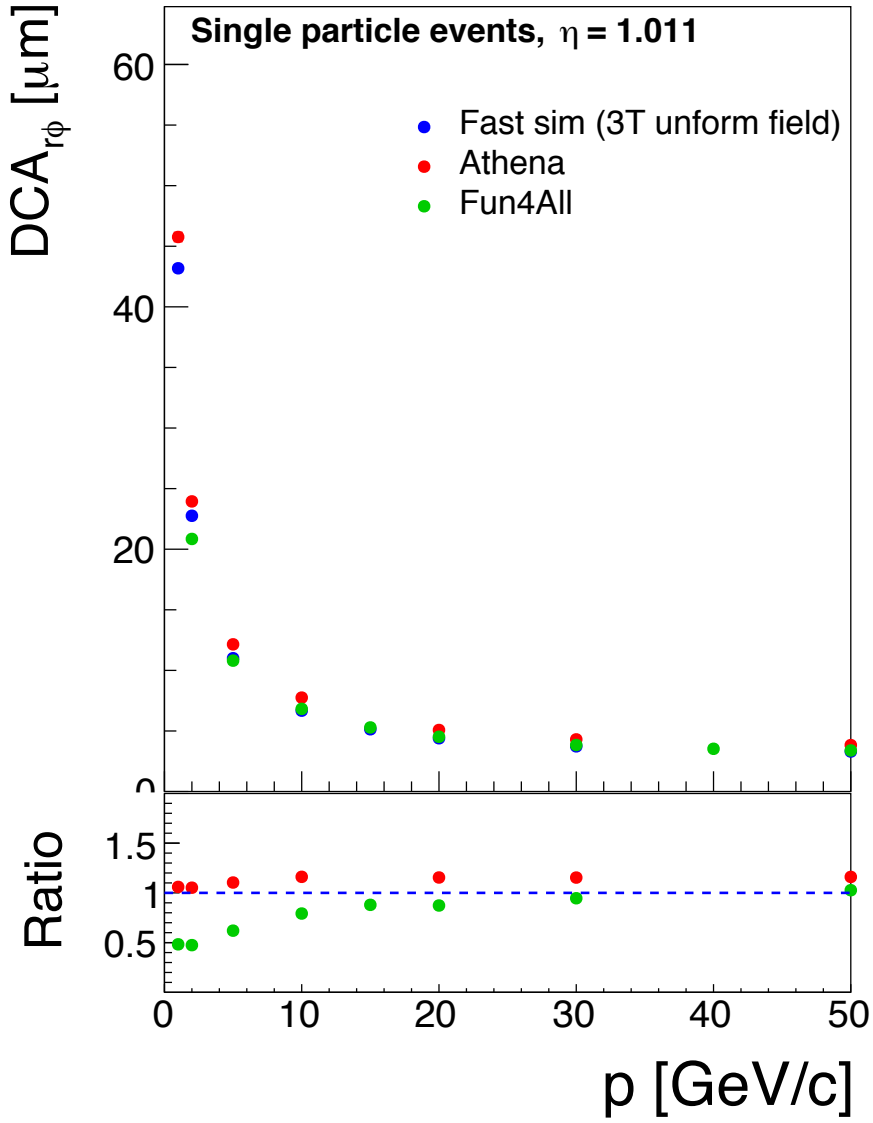

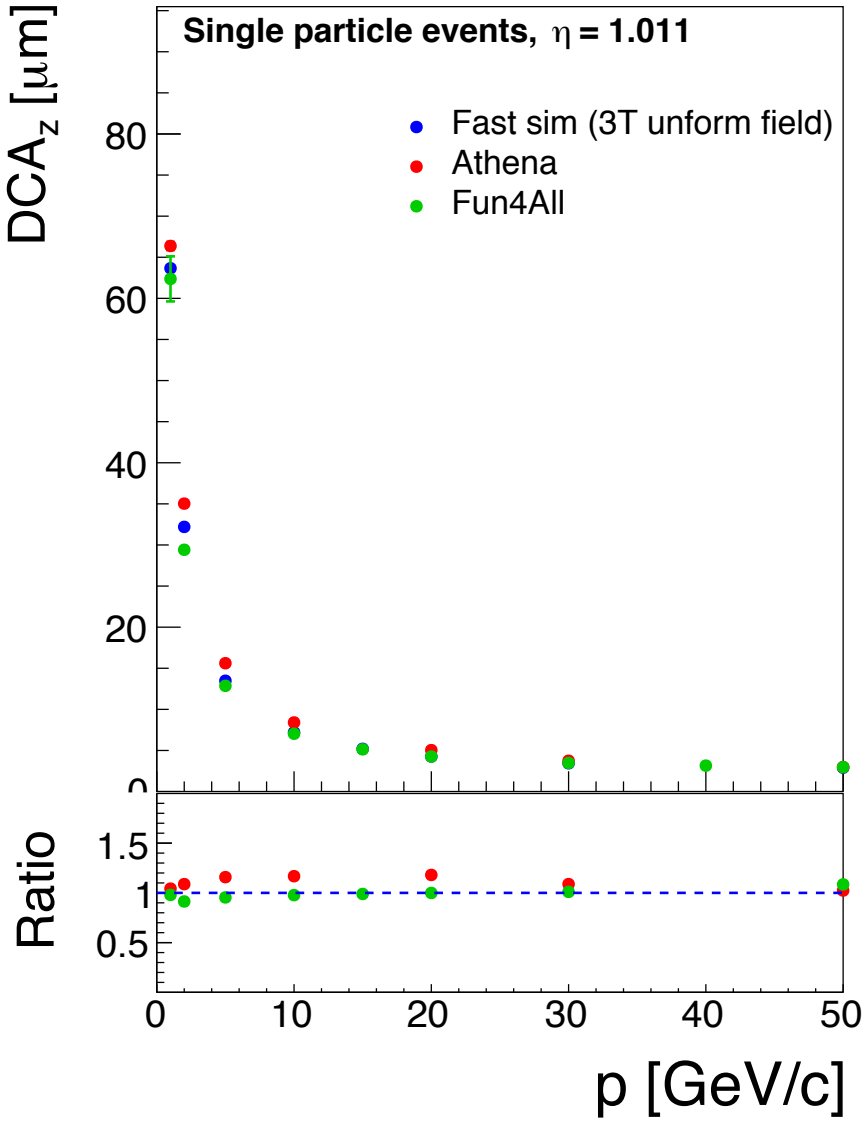

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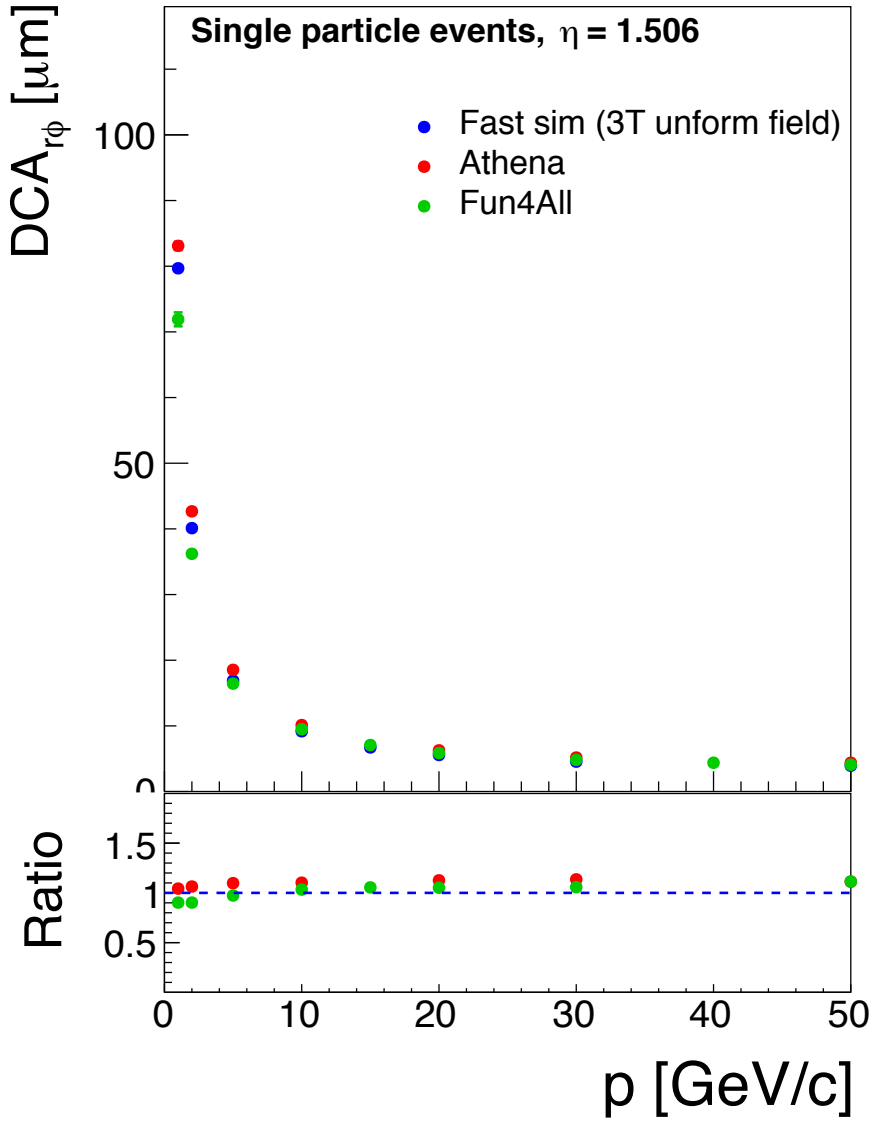

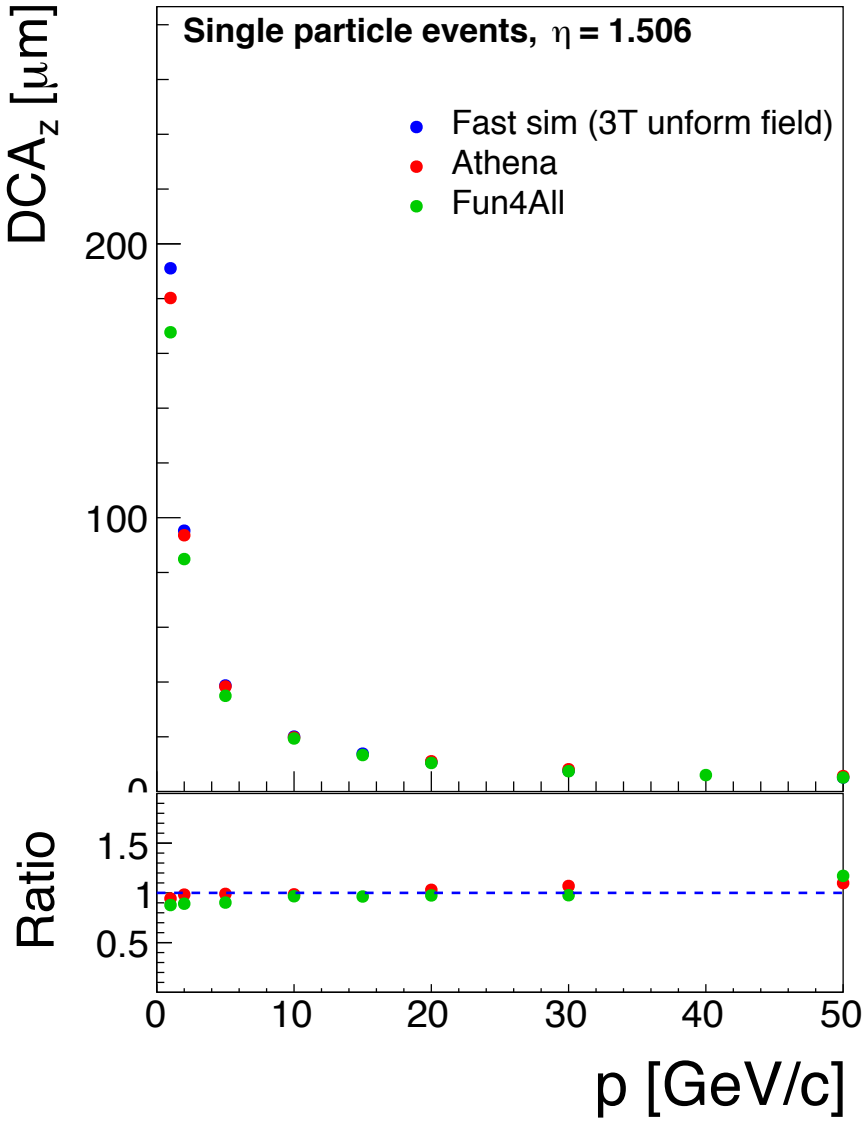

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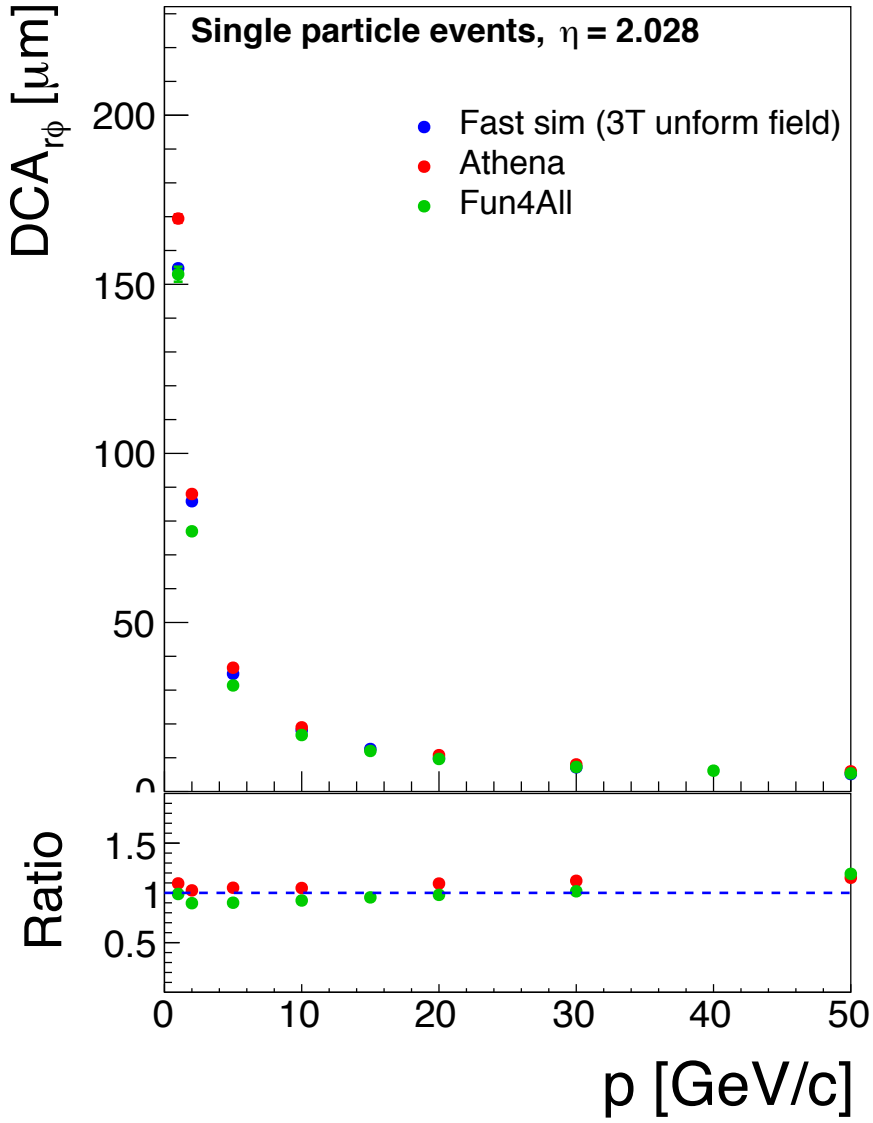
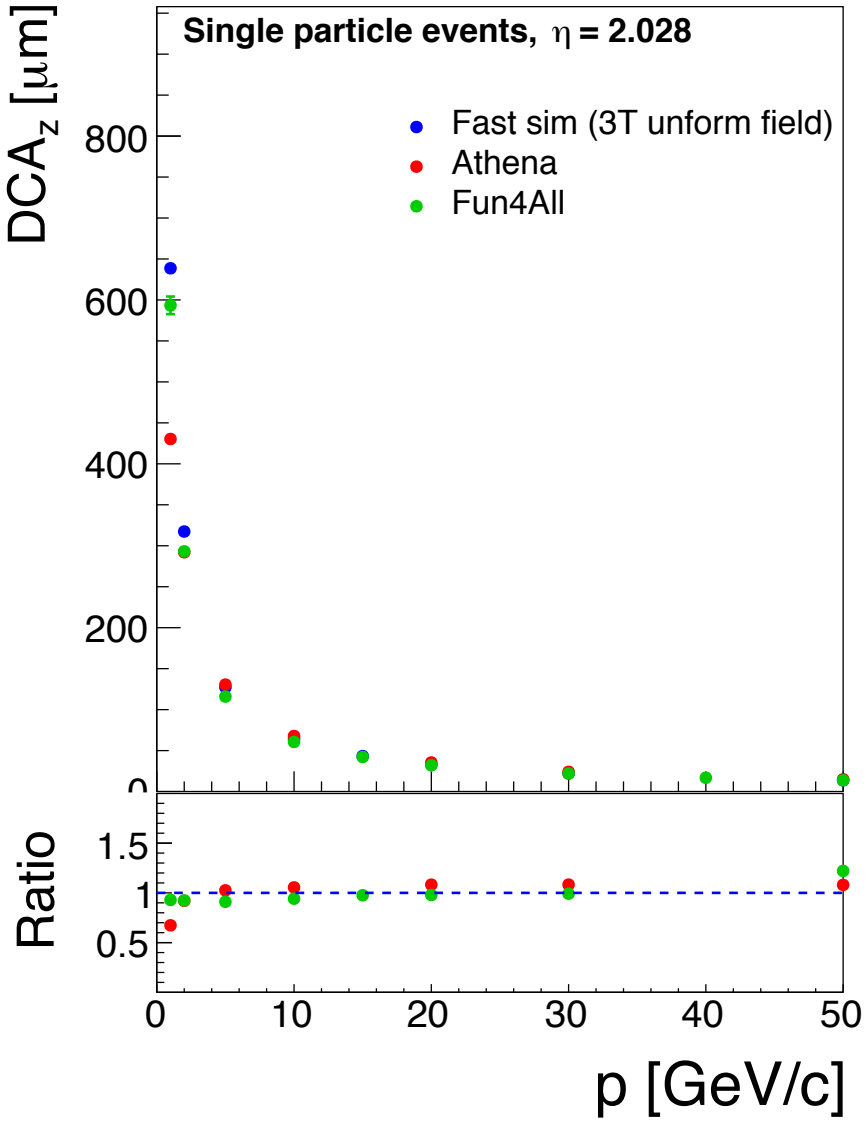
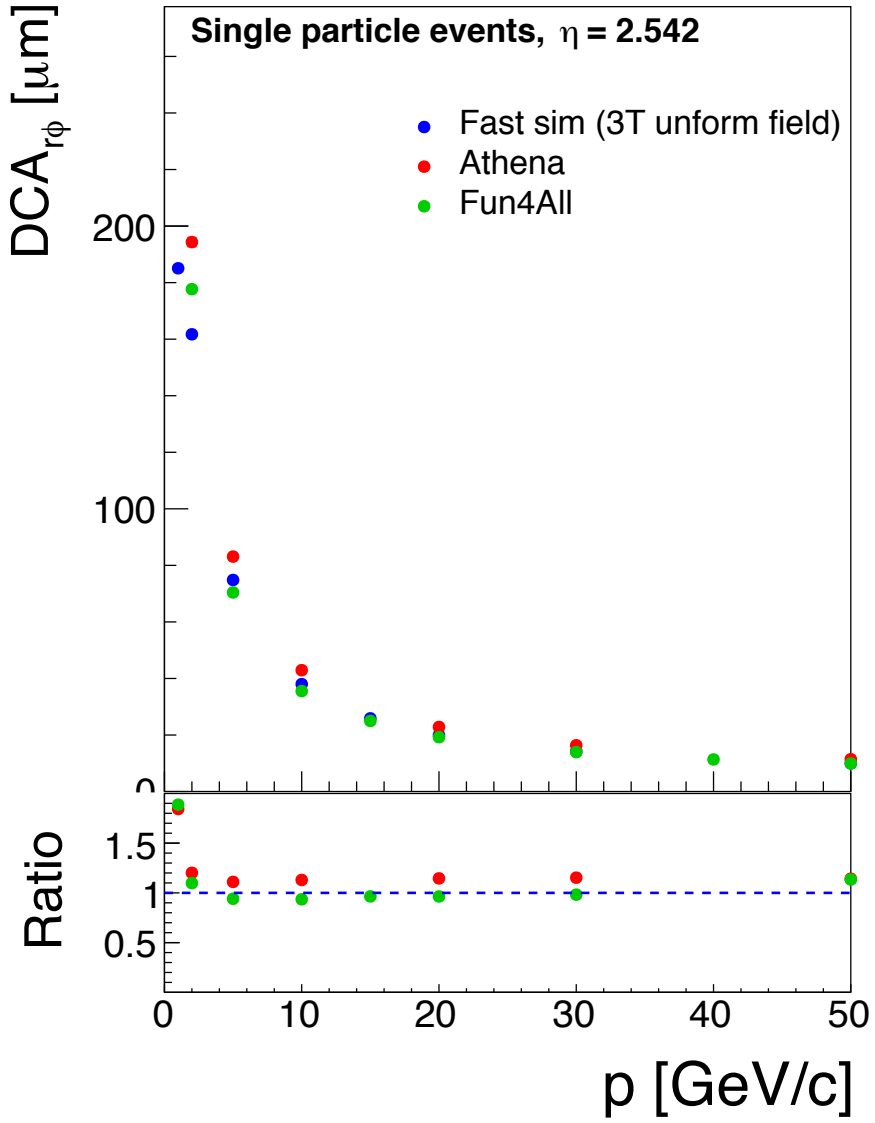
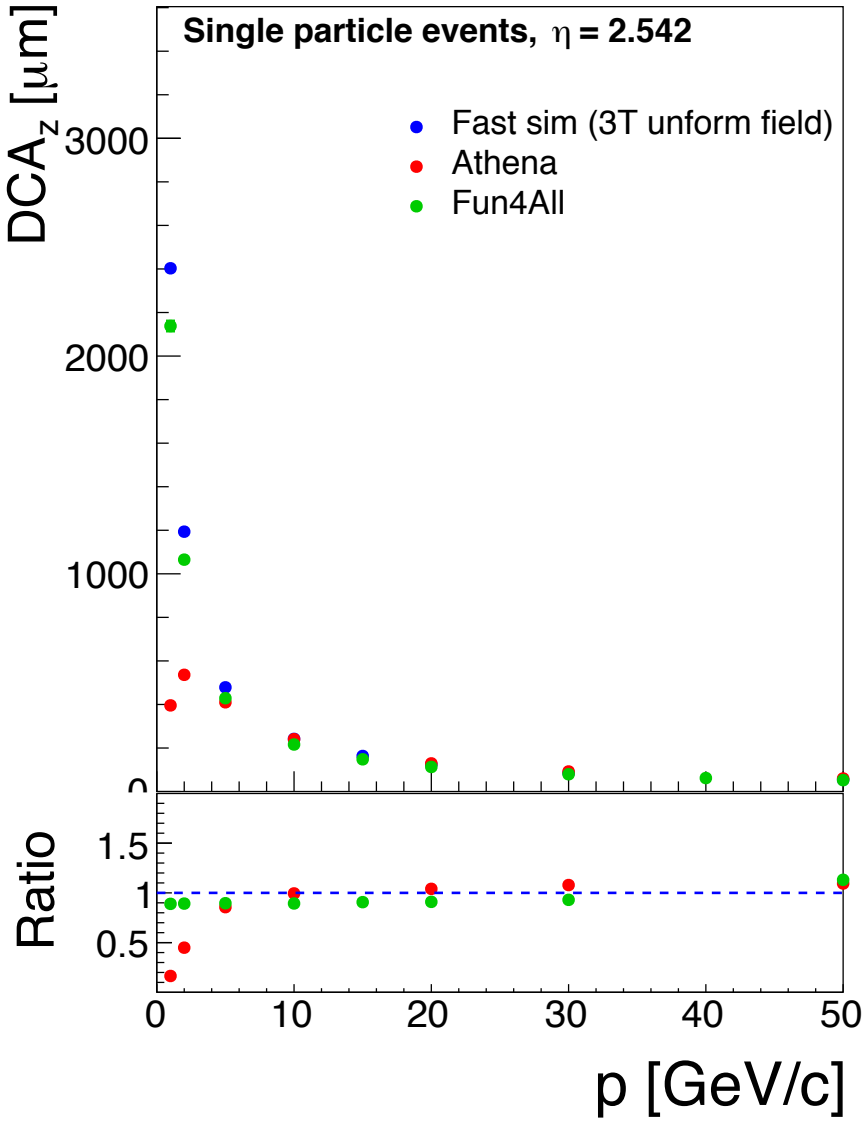




DCA comparison with the updated material map

- Small DCA_Z at low p with updated material map





DCA comparison with the updated material map

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