Confronting FFT noise model and lower RC performance on HATs

Neutrino meeting
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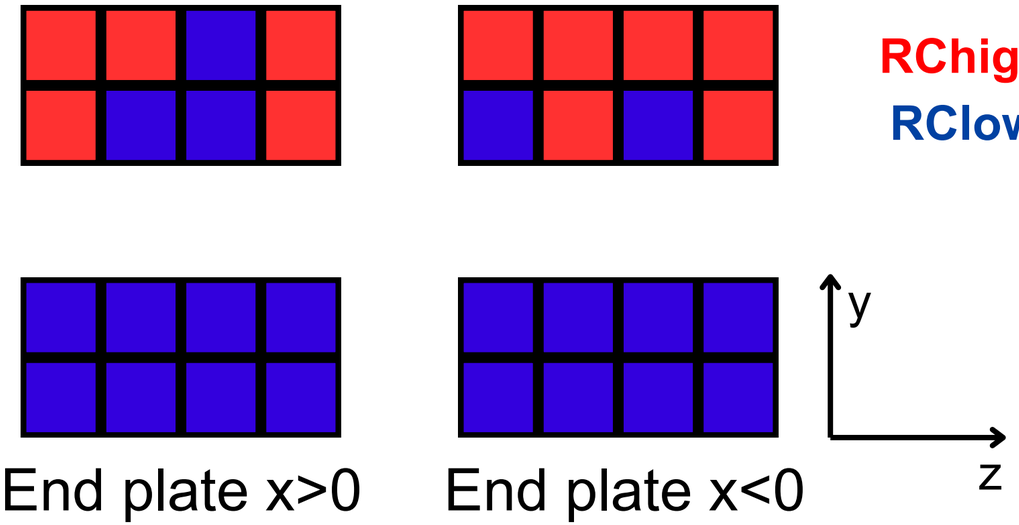
Using or not using lower RC - Dilemma

We know RC is not uniform inside each ERAM, but in the simulation we conveyed on classifying ERAMs into 2 RC values to use

- tHAT
- bHAT



The values of RC we currently use:

RChigh=158 RClow=112

Based on:
1) Test bench measurements in CERN
2) Posterior analysis in Saclay

Let's propose to reduce RC values

RChigh=120 RClow=90

Based on:
1) Saclay's RC (experiment) ≠ detResponseSim RC (effective parameter)
2) Providing good agreement Q1/Q0 with cosmics

Using or not using lower RC - How to proceed?

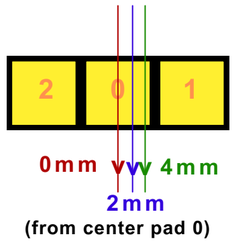
Let’s confront (14.32):

1) Old noise with current RC
2) FFT noise with current RC
3) FFT noise with lower RC

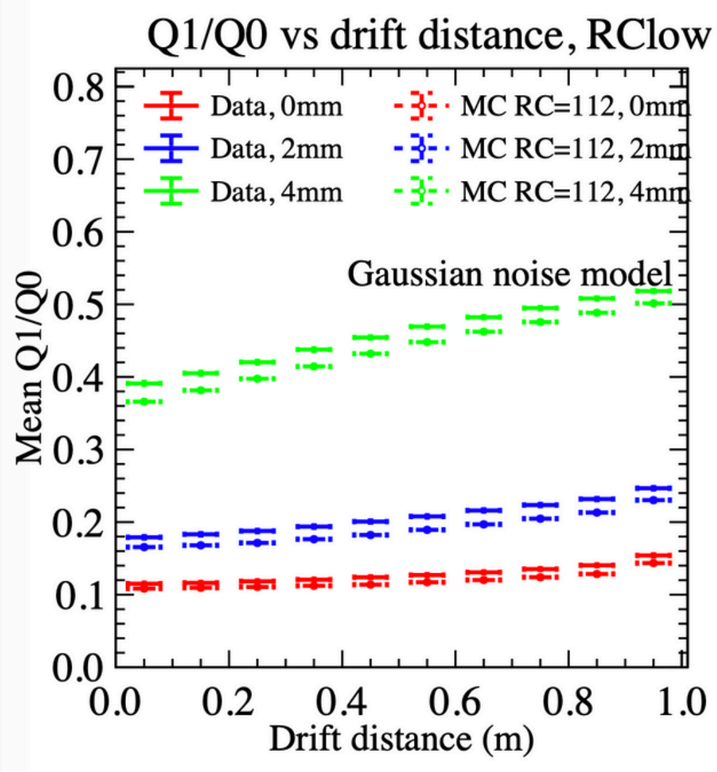
By checking:

- Q1/Q0 and T1-T0
- Spatial Resolution (SR)
- dEdx

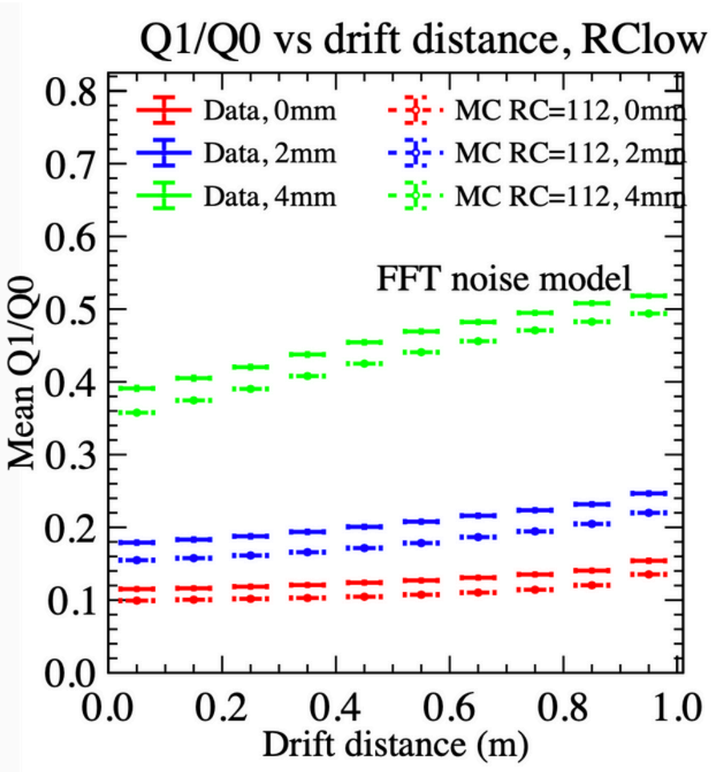
Q1/Q0 vs drift distance



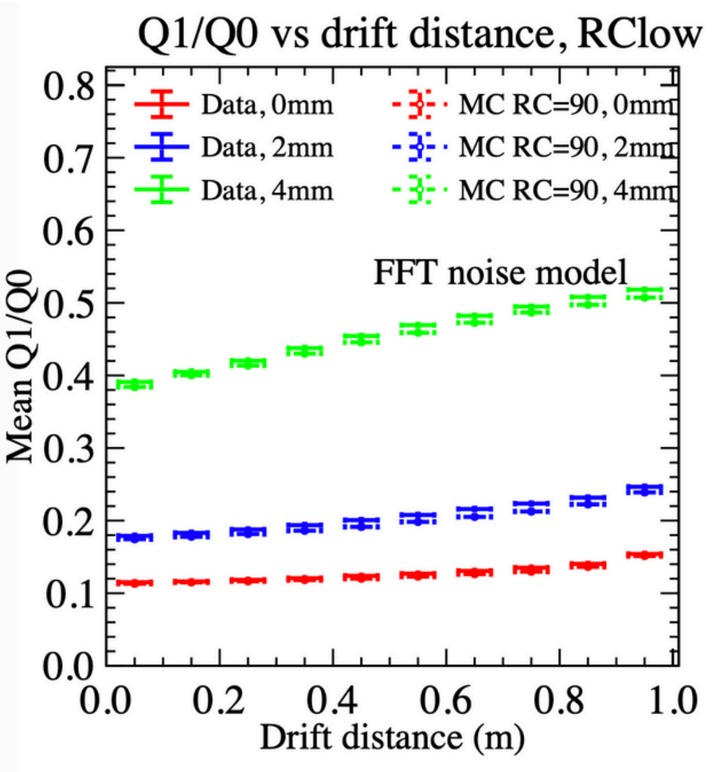
1) Old noise with current RC



2) FFT noise with current RC



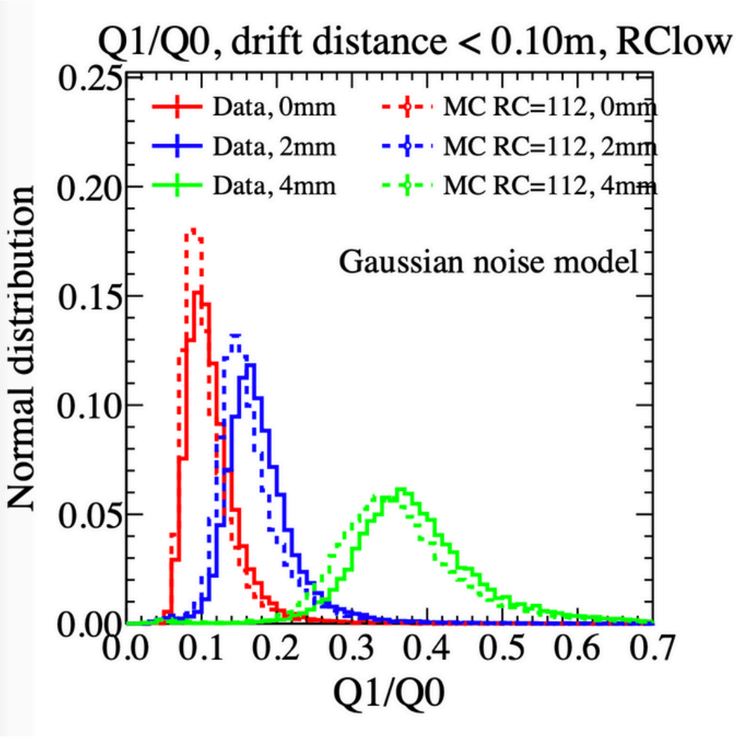
3) FFT noise with lower RC



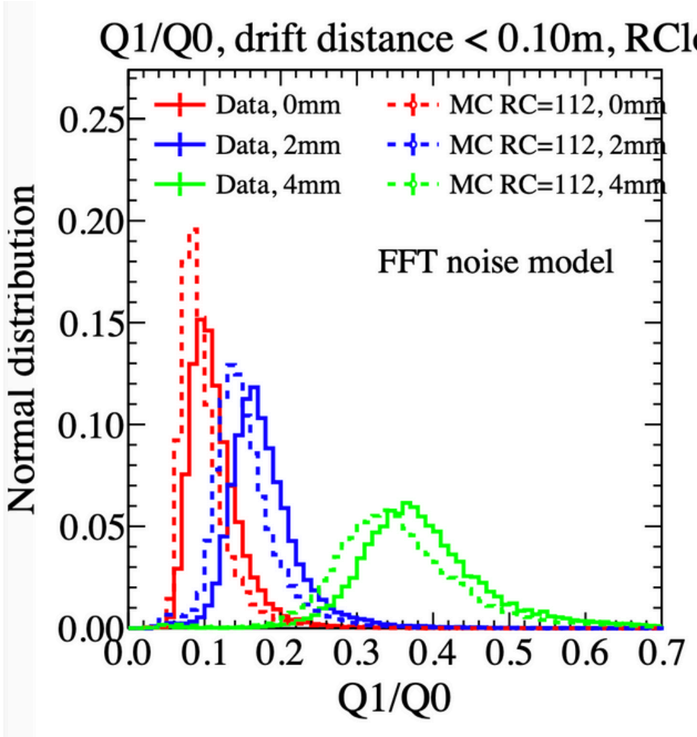
- Vertical tracks for 0mm, 2mm and 4mm from the leading pad
- MC underestimates Q1/Q0
- Lowering RC in FFT provides a very good match
- Same observations with RChigh

Q1/Q0 normal distributions for drift<0.10m

1) Old noise with current RC



2) FFT noise with current RC



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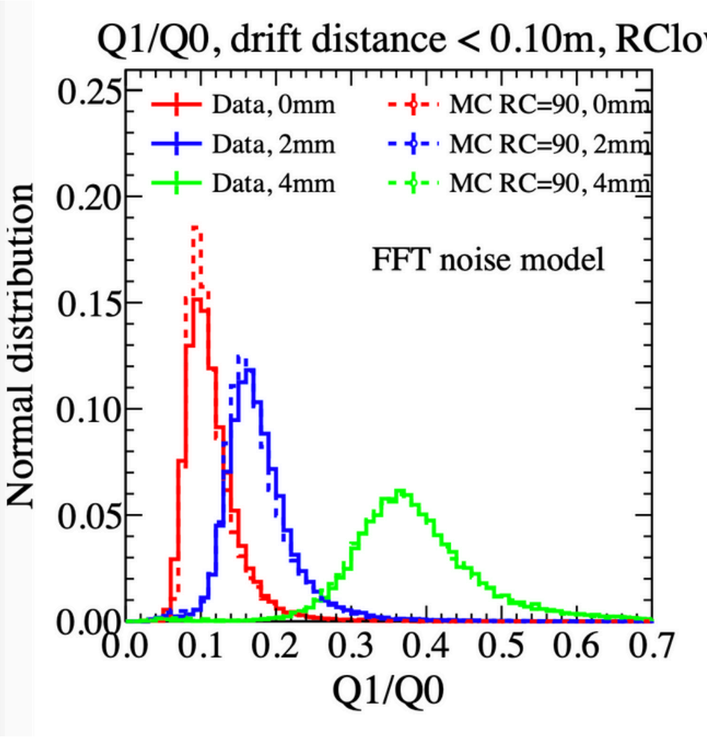

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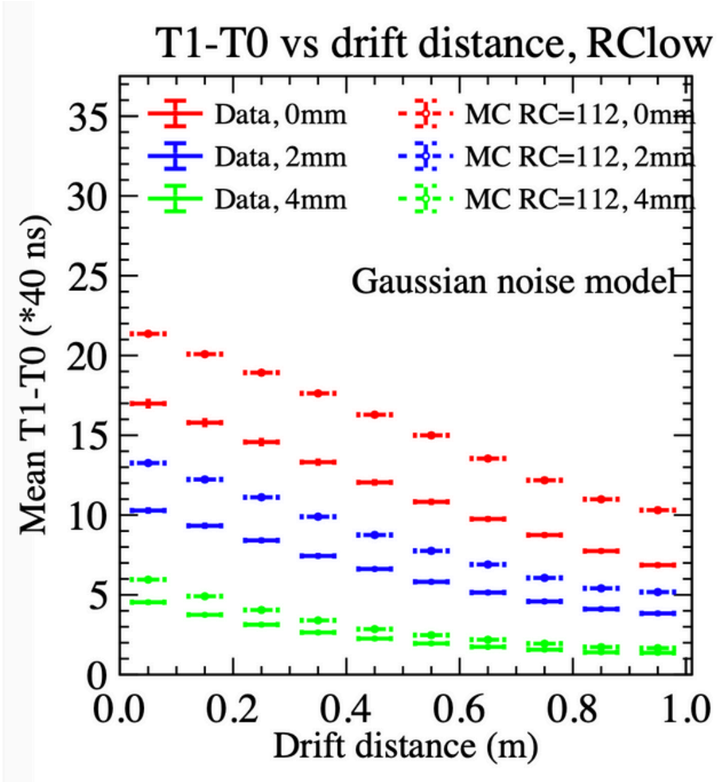
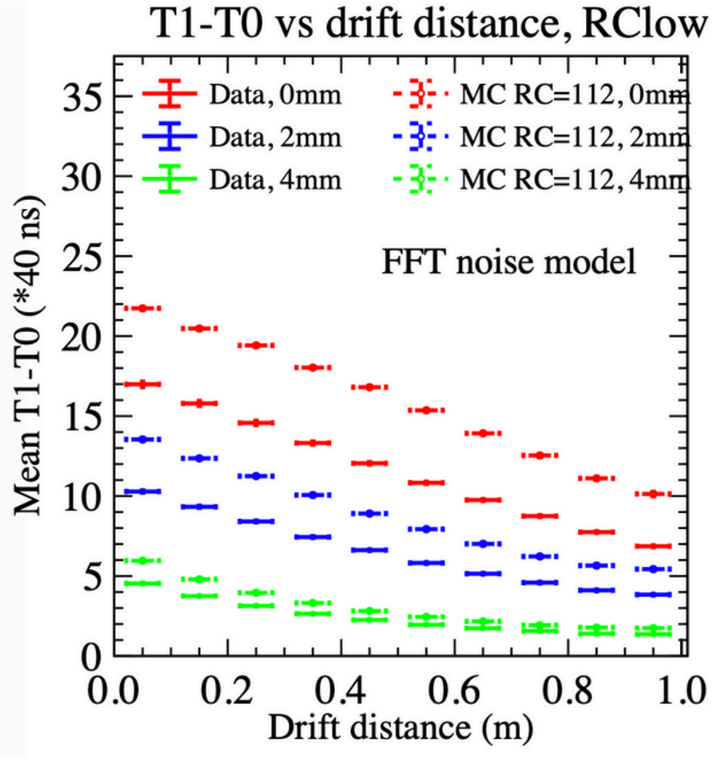
T1-T0 vs drift distance

1) Old noise with current RC



2) FFT noise with current RC



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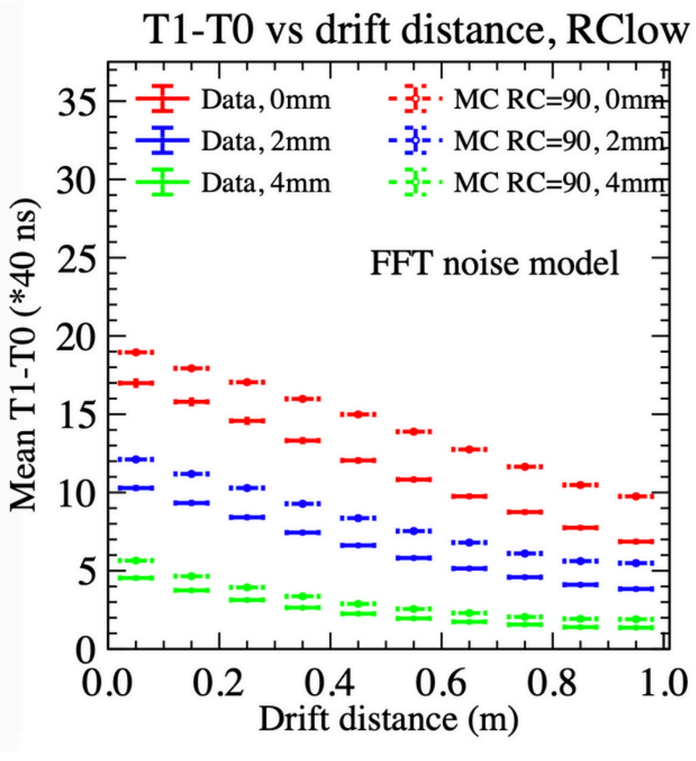

- Vertical tracks for 0mm, 2mm and 4mm from the leading pad
- MC overestimates T1-T0
- We do not know why the gap MC to data....
- Same observations with RChigh

T1-T0 normal distributions for drift<0.10m

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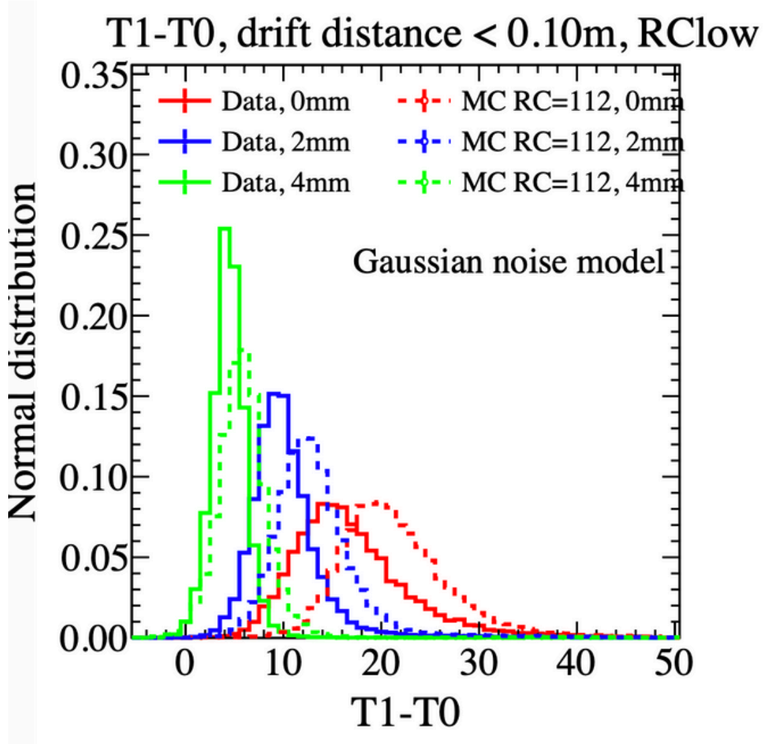
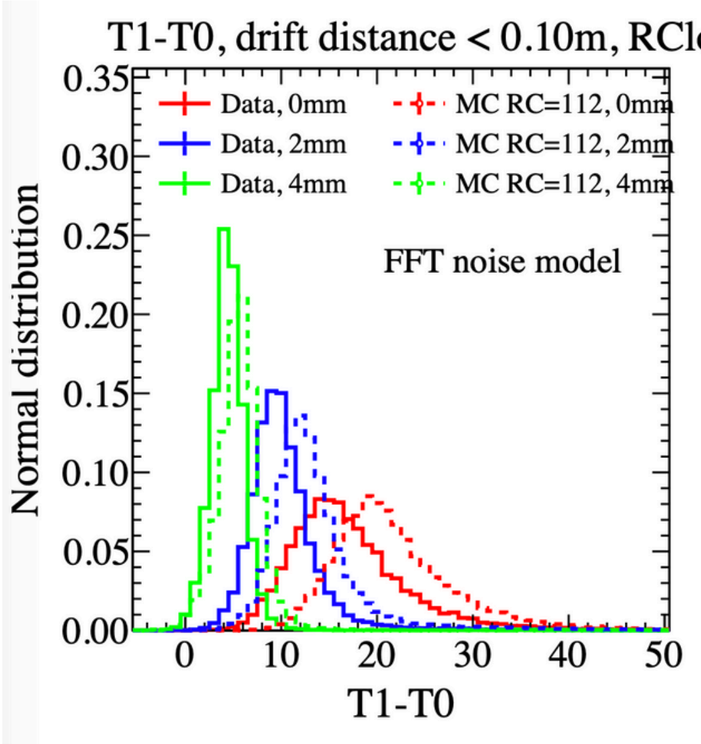


2) FFT noise with current RC



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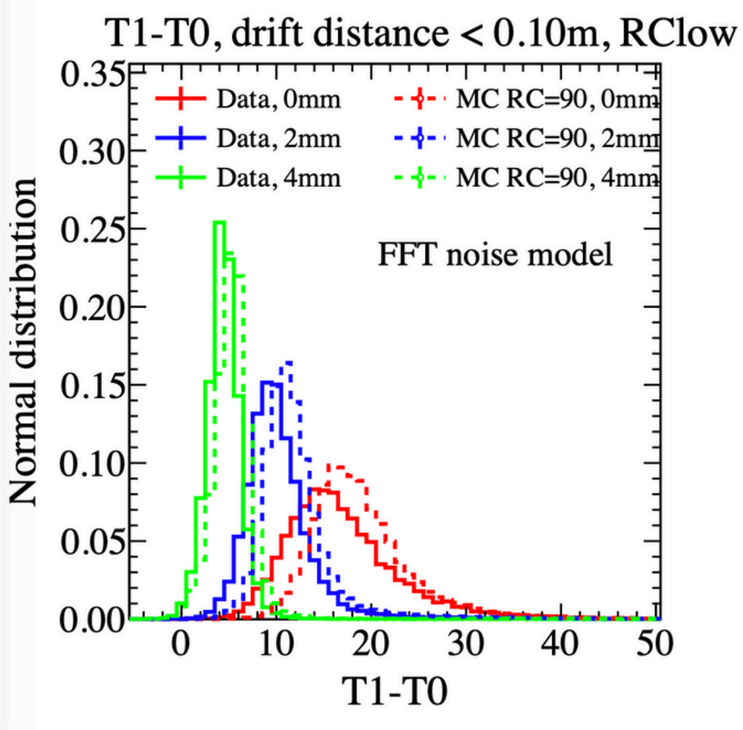


- Vertical tracks for 0mm, 2mm and 4mm from the leading pad
- MC overestimates T1-T0
- We do not know why the gap MC to data.... But not so bad!
- Same observations with RChigh

Spatial Resolution (SR)

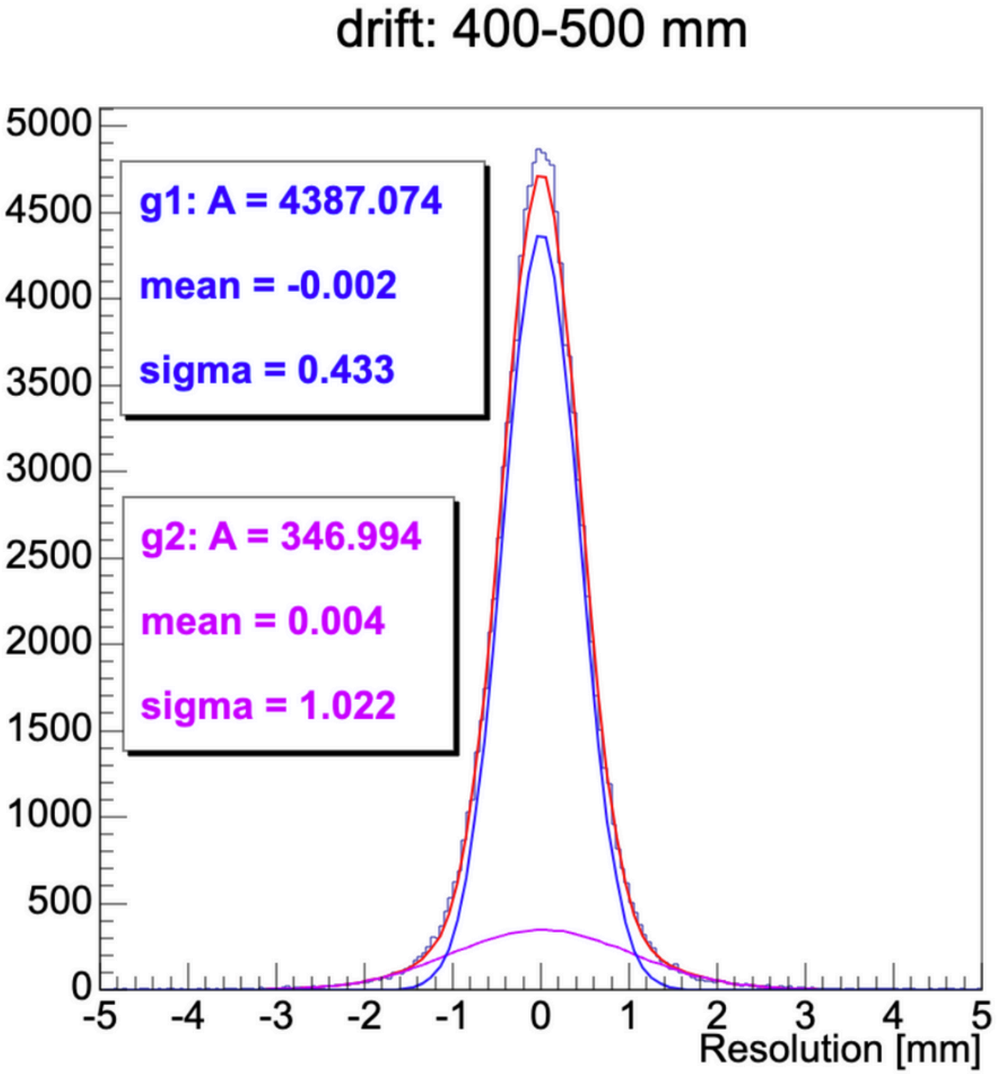
- Typically we have this kind of plots with the bulk of the distribution centered around zero and some long tails
- In the past we were trying to fit only the bulk with a gaussian limited between +/- 1 or +/- 0.7
- We decided to implement a double gaussian to fit both, the bulk and the tails
- Need to decide how to quote the spatial resolution…

$$SR = \sigma_1$$

Sigma bulk gaussian

$$SR = \frac{A_1\sigma_1 + A_2\sigma_2}{A1 + A2}$$

Accounting for sigma of both gaussians



Resolution = |fitted position - cluster position|

circle fit algorithm

logQ method

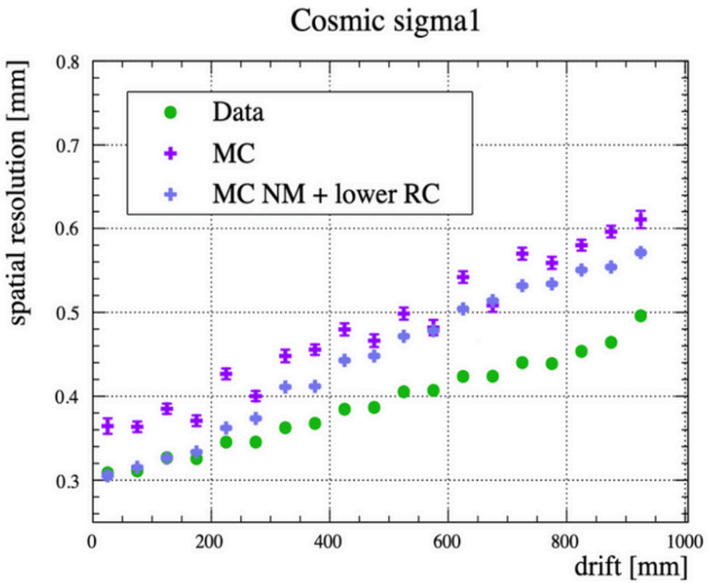
Spatial Resolution vs drift

Cosmics:

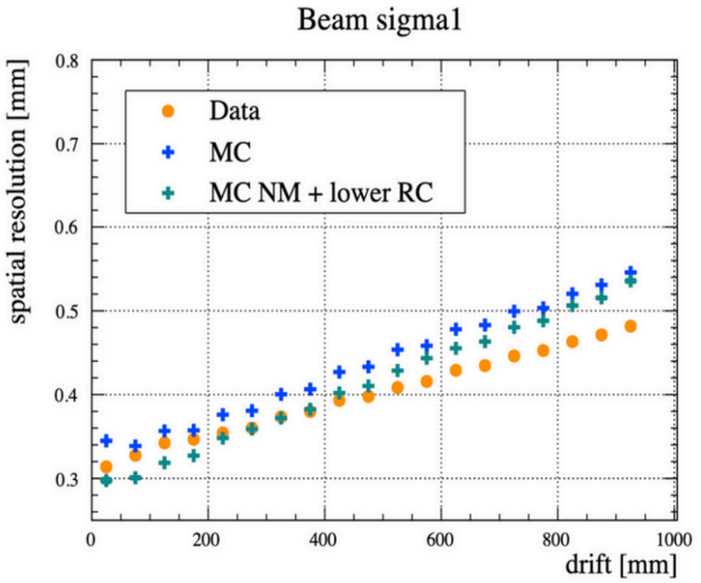
- FFT model (MC NM) at lower RC performs best at low drift distance

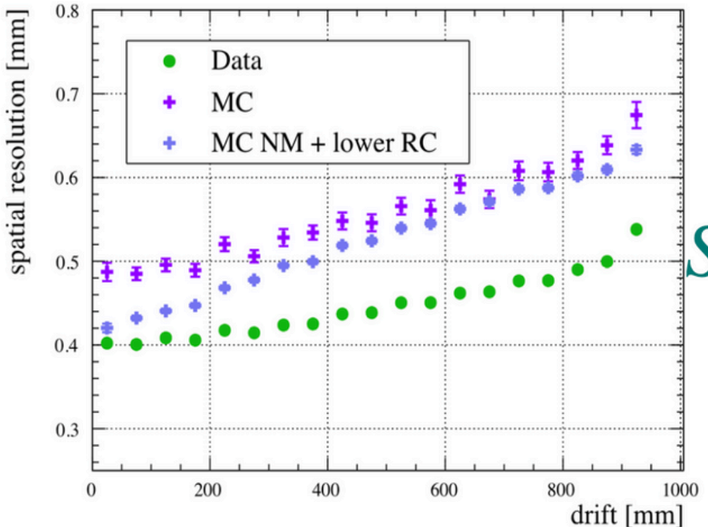
Beam:

- Match better the data than cosmics + old noise and FFT at lower RC converge at high drift distance

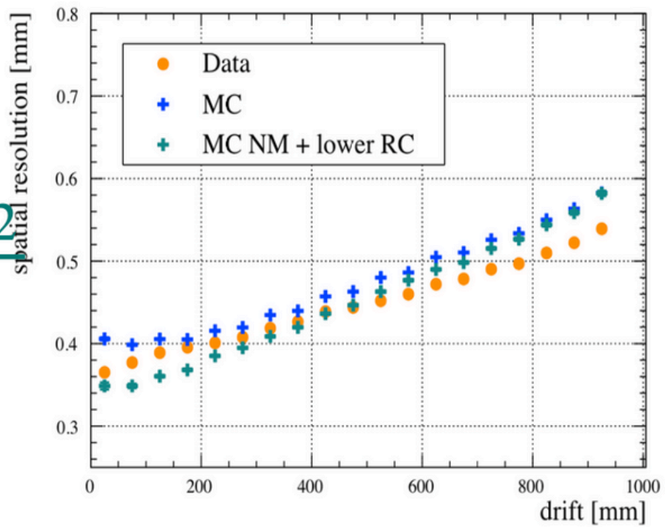


$$SR = \sigma_1$$



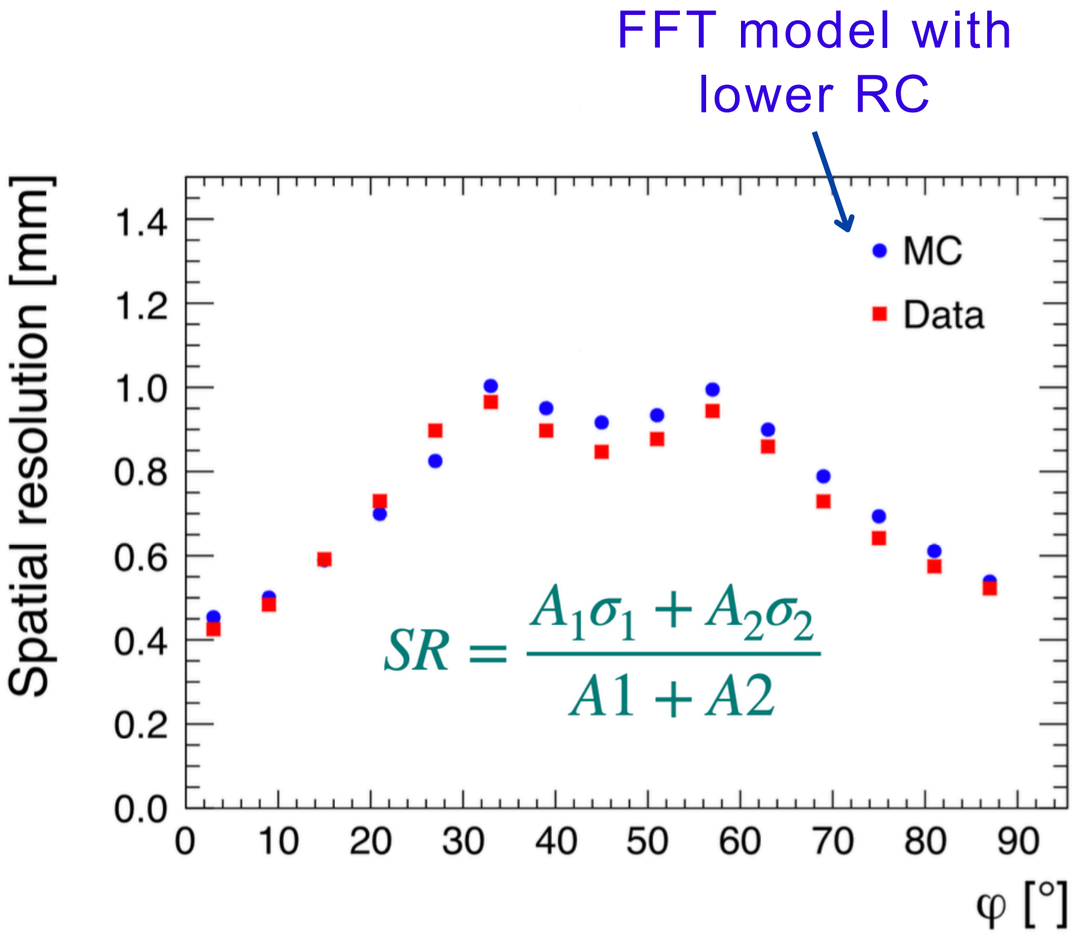


$$SR = \frac{A_1\sigma_1 + A_2\sigma_2}{A1 + A2}$$



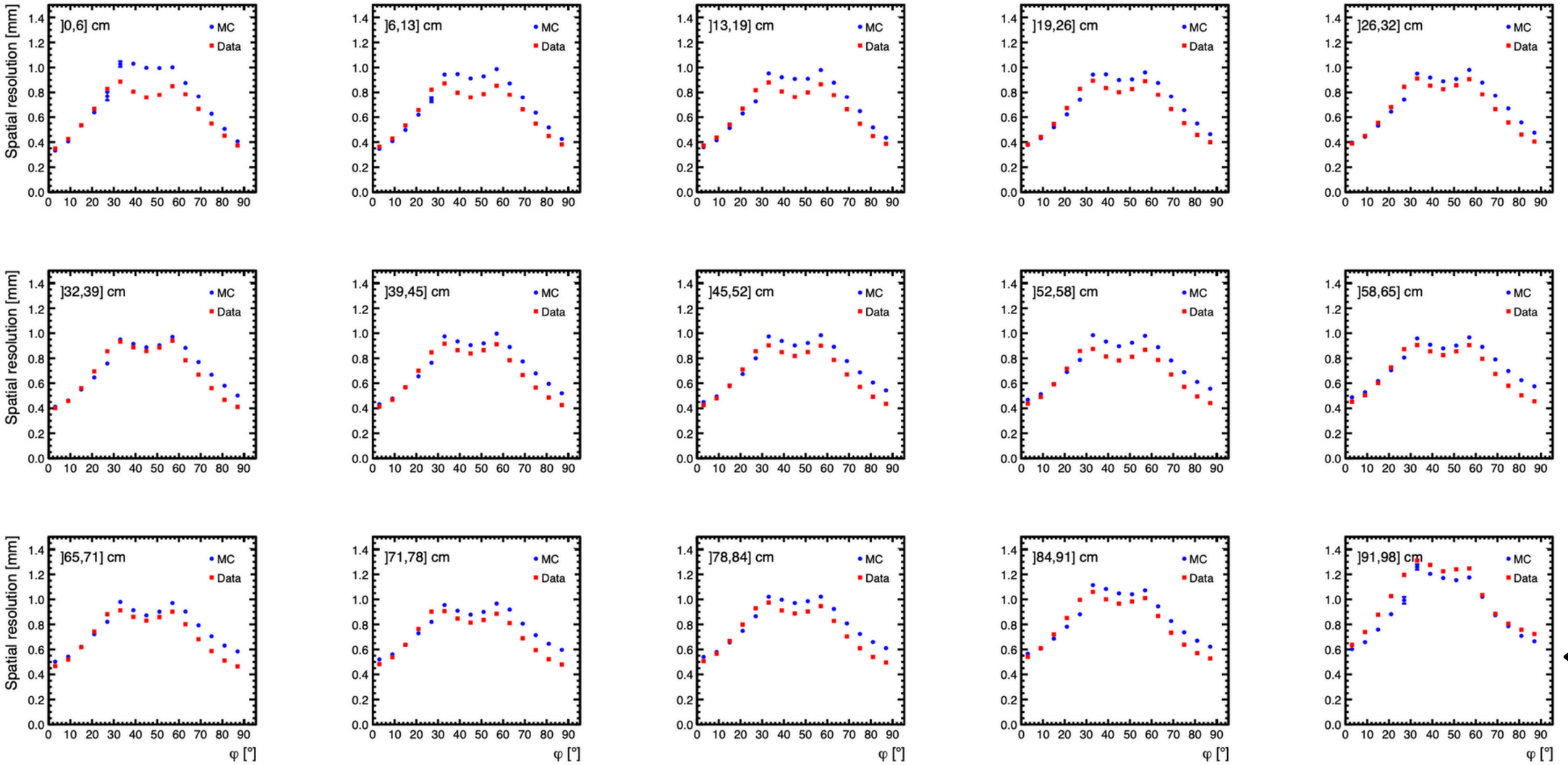
Spatial Resolution vs angle

- New values of RC
- Integrated over the whole drift distance
- Good agreement between data and MC



Spatial Resolution vs angle for different drifts

Low drift →

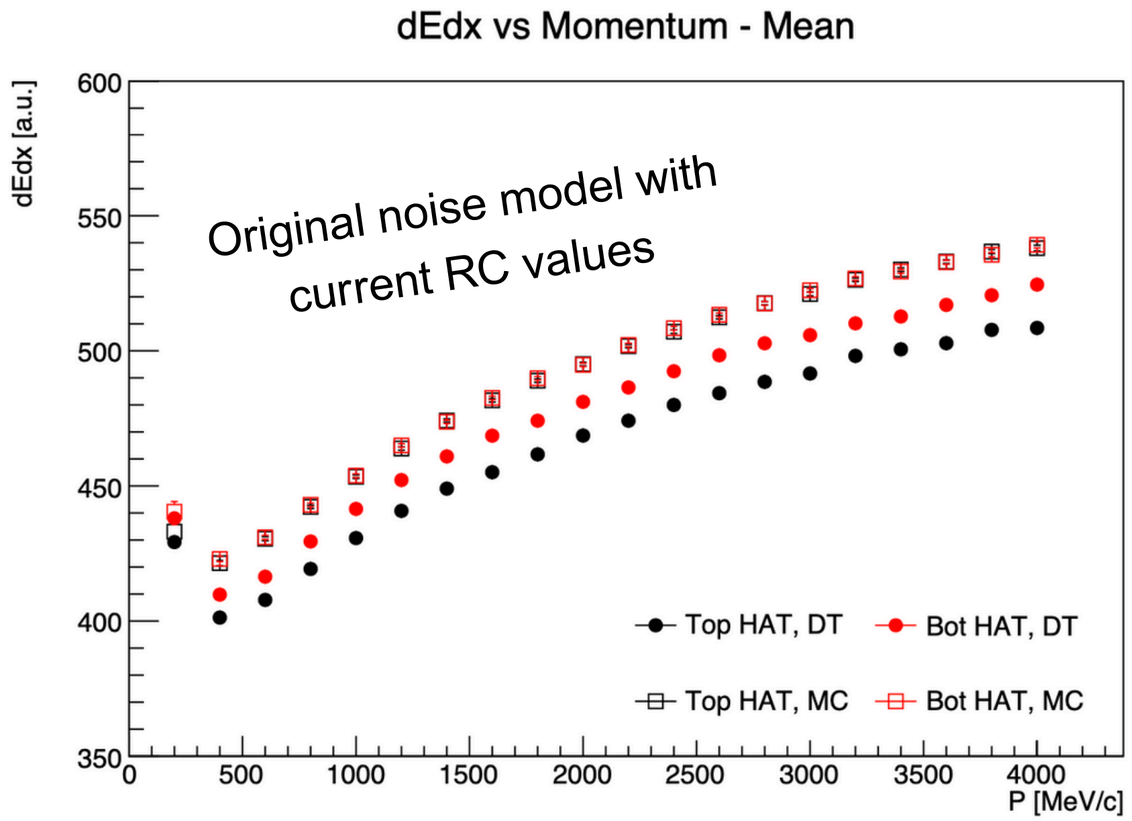


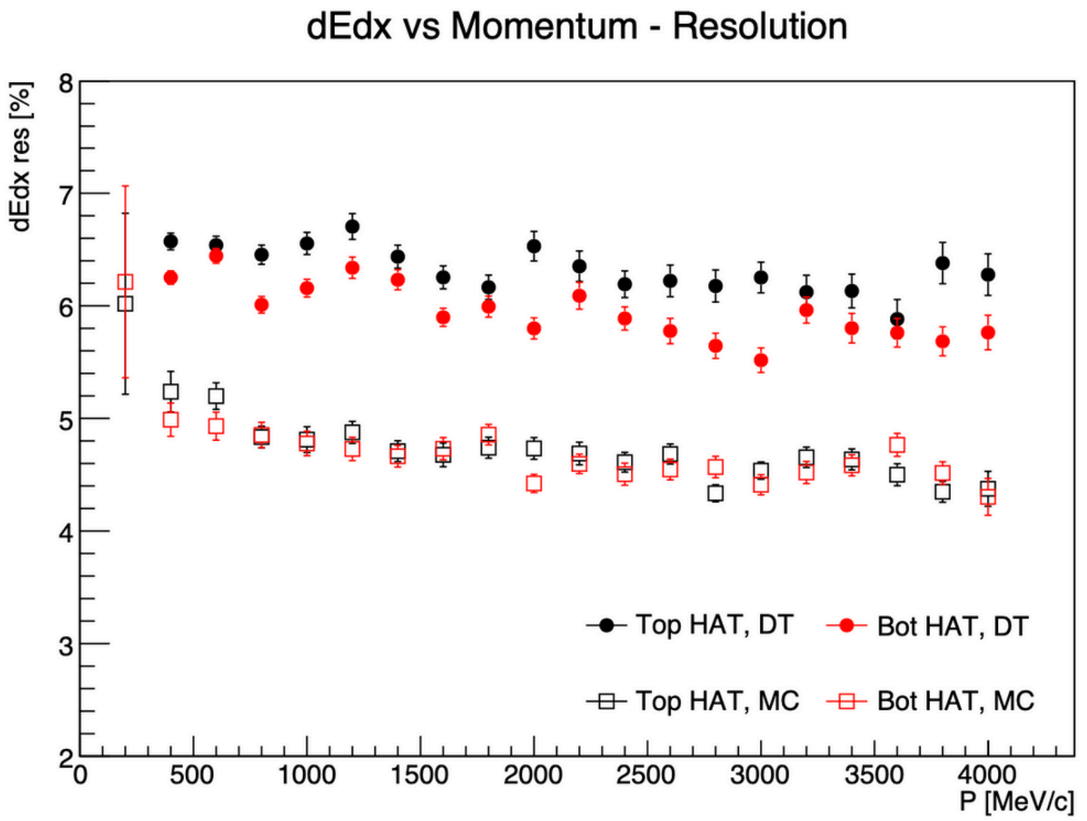
← High drift

$$SR = \frac{A_1\sigma_1 + A_2\sigma_2}{A1 + A2}$$

Each graph is for a different section of drift distance

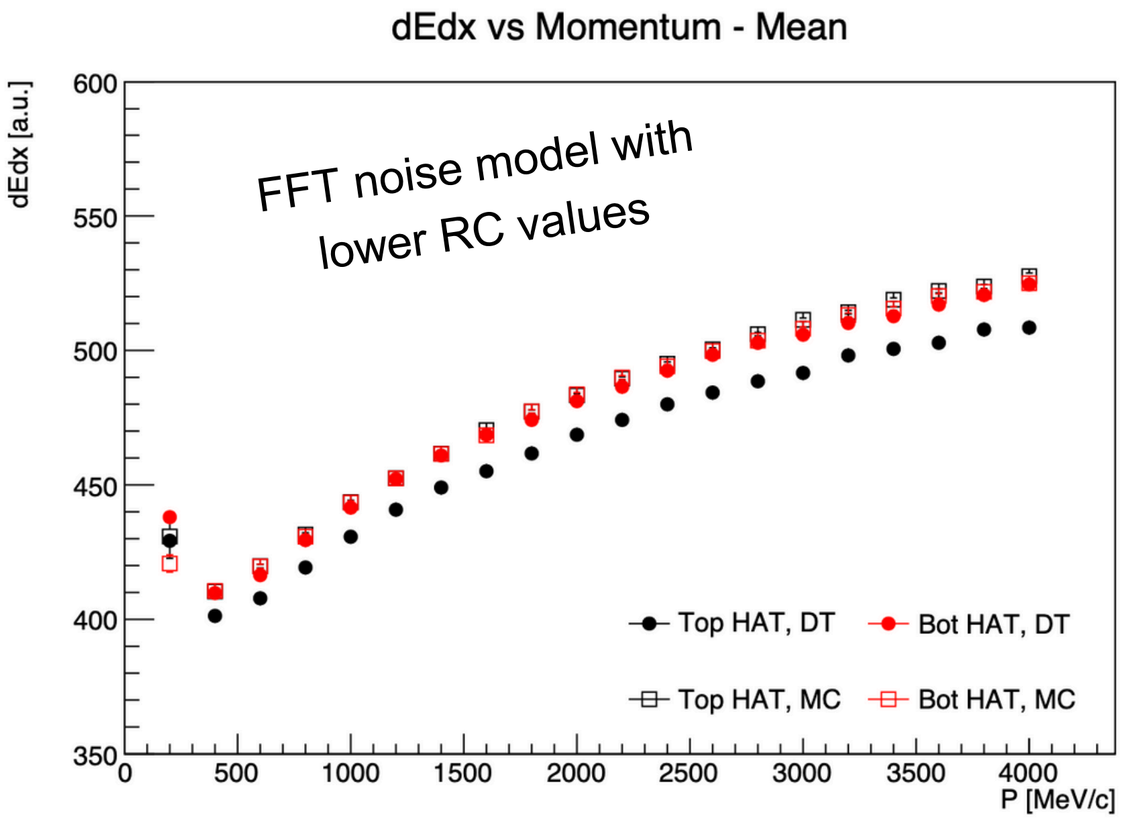
dEdx vs p (mean and resolution)

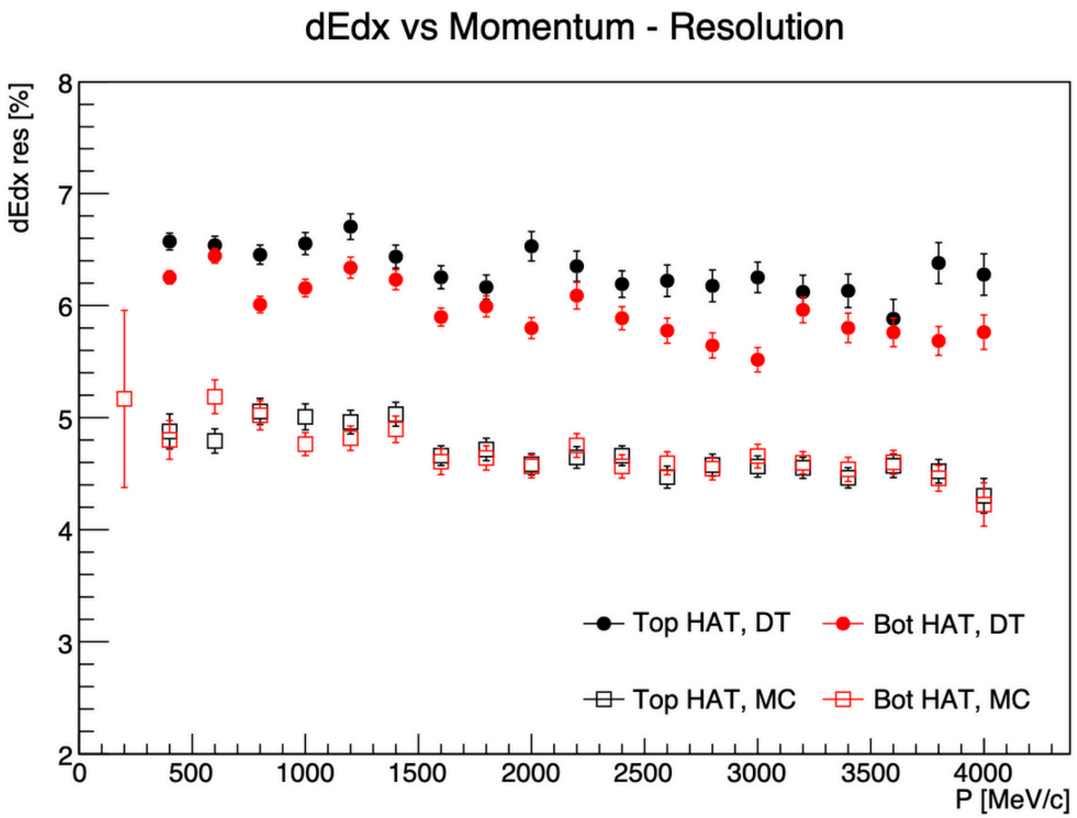




- Only horizontal tracks are considered (no cosmics)
- MC overestimates the mean and underestimates the resolution of dEdx

dEdx vs p (mean and resolution)





- No differences between top and bottom HAT for dEdx
- Slightly lower mean values
- No difference for the resolution

Summary

The values of RC we currently use:
RChigh=158 RClow=112

→ Using the FFT noise model →

Let's propose to reduce RC values
RChigh=120 RClow=90

- Variables analysed with new noise model and lower FFT:
  a. Q1/Q0 vs drift: improves agreement with cosmics
  b. T1-T0 vs drift: MC overestimates, but very similar normal distributions compared to data!
  c. Spatial resolution:
     i. vs drift: slight improvement for cosmics only
     ii. vs angle: very good agreement with data
  d. dEdx: slightly improves mean, but no considerable effects on resolution

To discuss...

1) Cons of lowering RC values?
2) More variables to cross check effects?
3) Conclusions for HATPC group meeting?