Physics impact of the PID

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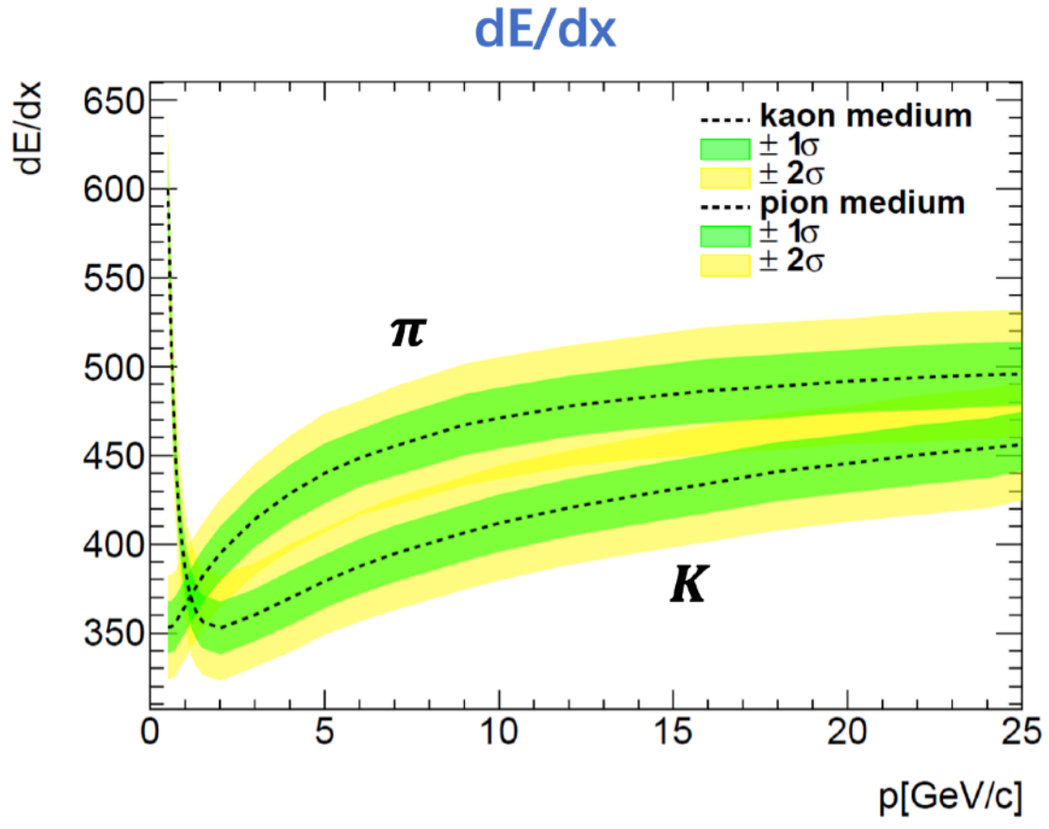
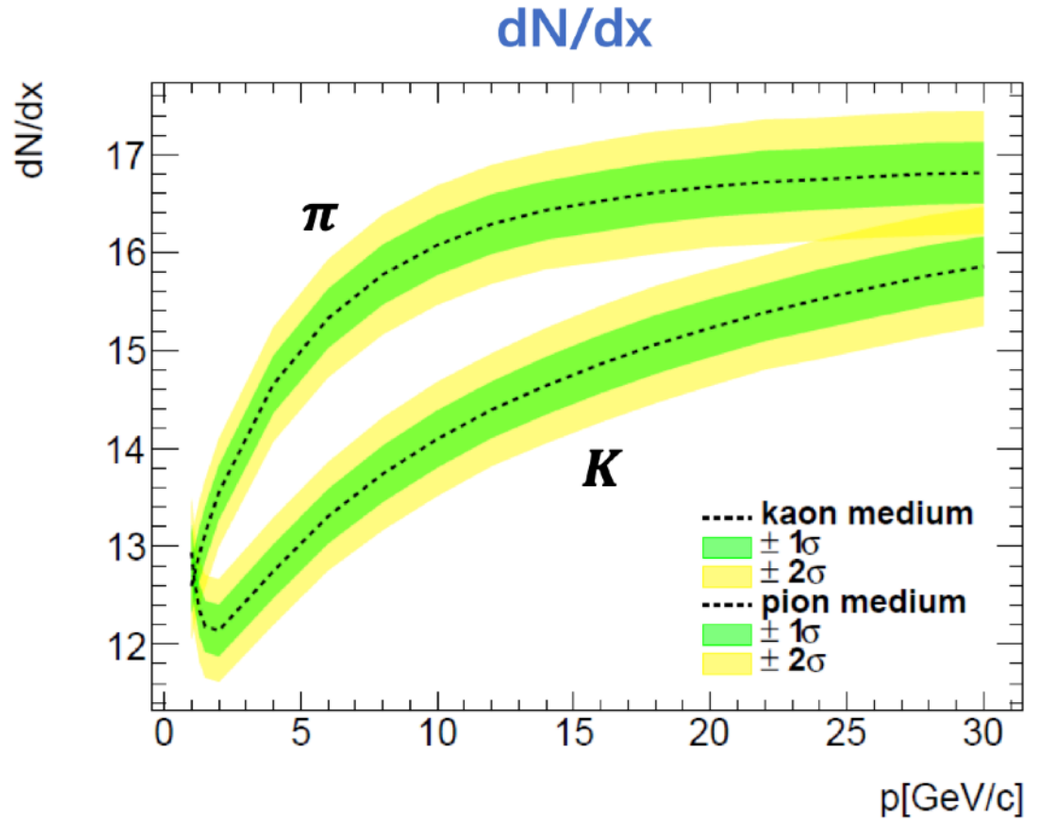
Motivations

- Studies of flavour physics heavily rely on the identification of species of particle
- PID with drift chamber is a key feature of CEPC 4th conceptual detector
- Target: assist the draft chamber team to optimise the design of drift chamber from physics point of view

DC K/pi separation power (truth)

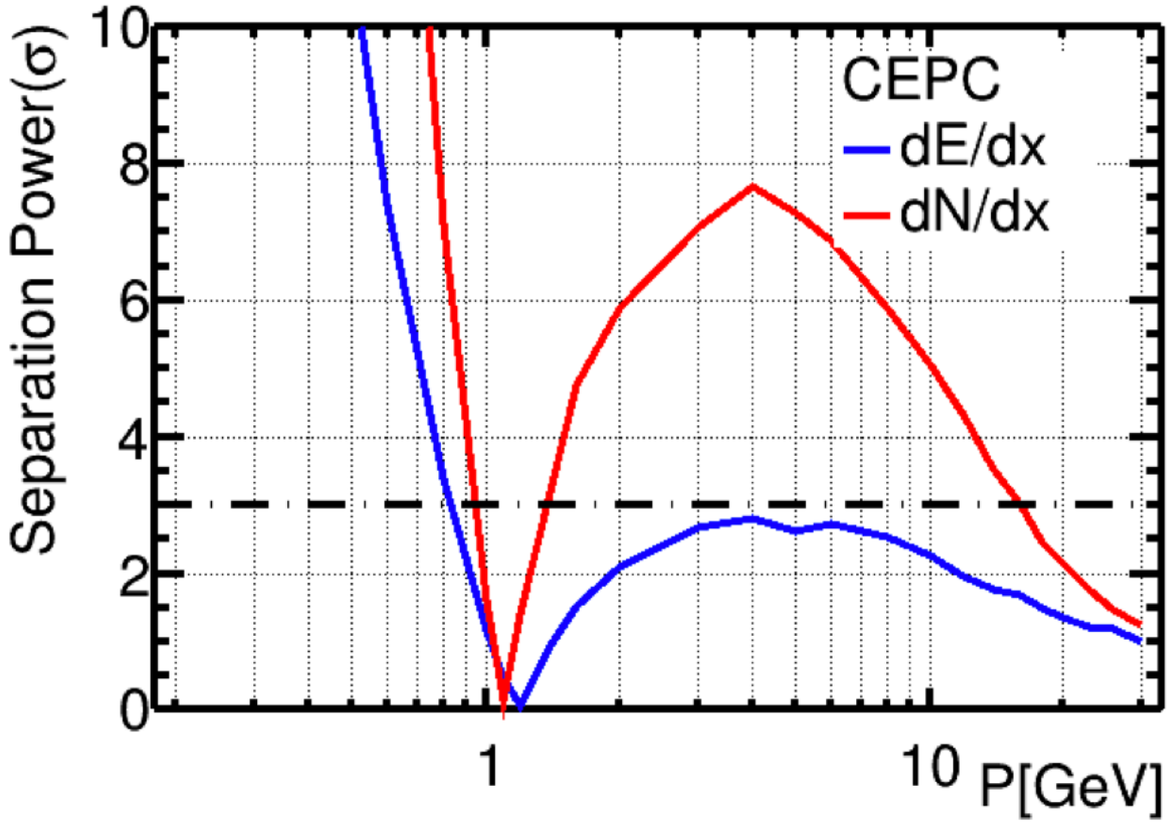
- Studies by Guang Zhao, etc.
- Comparison between drift chamber energy loss measurement and the cluster counting technique (MC truth):





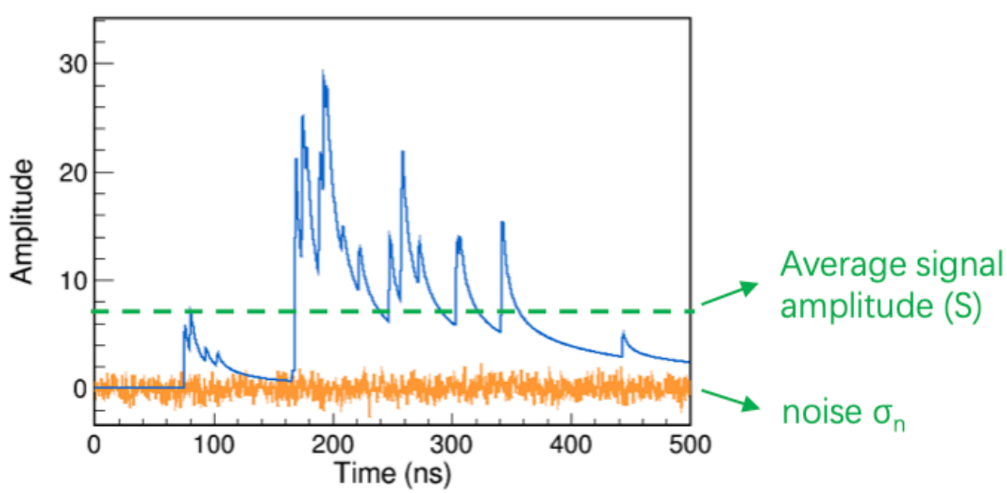
DC K/pi separation power (truth)

- Comparison between dE/dx and dN/dx
- Consider only dN/dx in the following studies



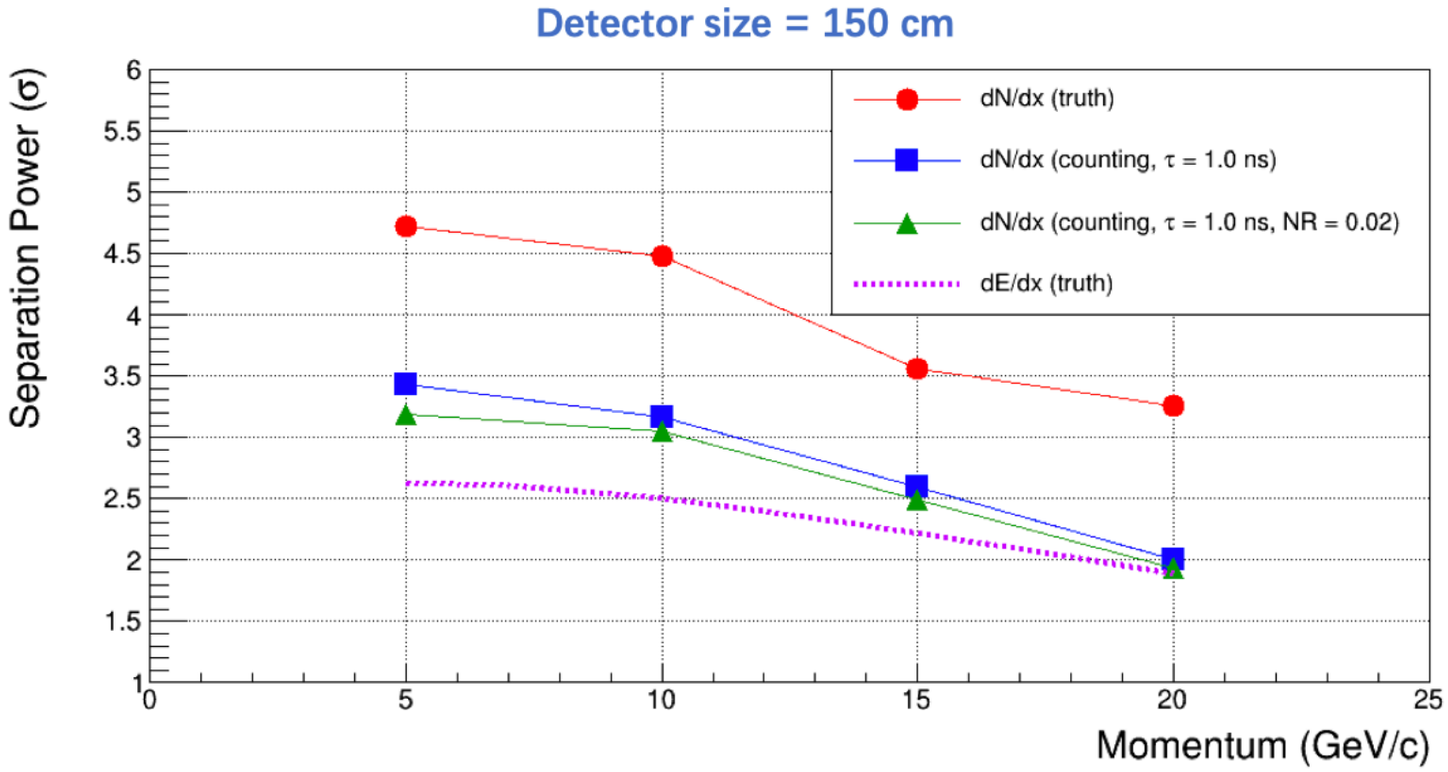
Assumptions on electronics

- Response after preamplifier would be ‘smeared’
  - Assumption 1: Time constants (τ) = 1.0 ns
- Noise would affect the performance
  - Assumption 2: Noise Ratio (Standard deviation of noises divided by Average signal amplitude σ_n/S) = 0.02



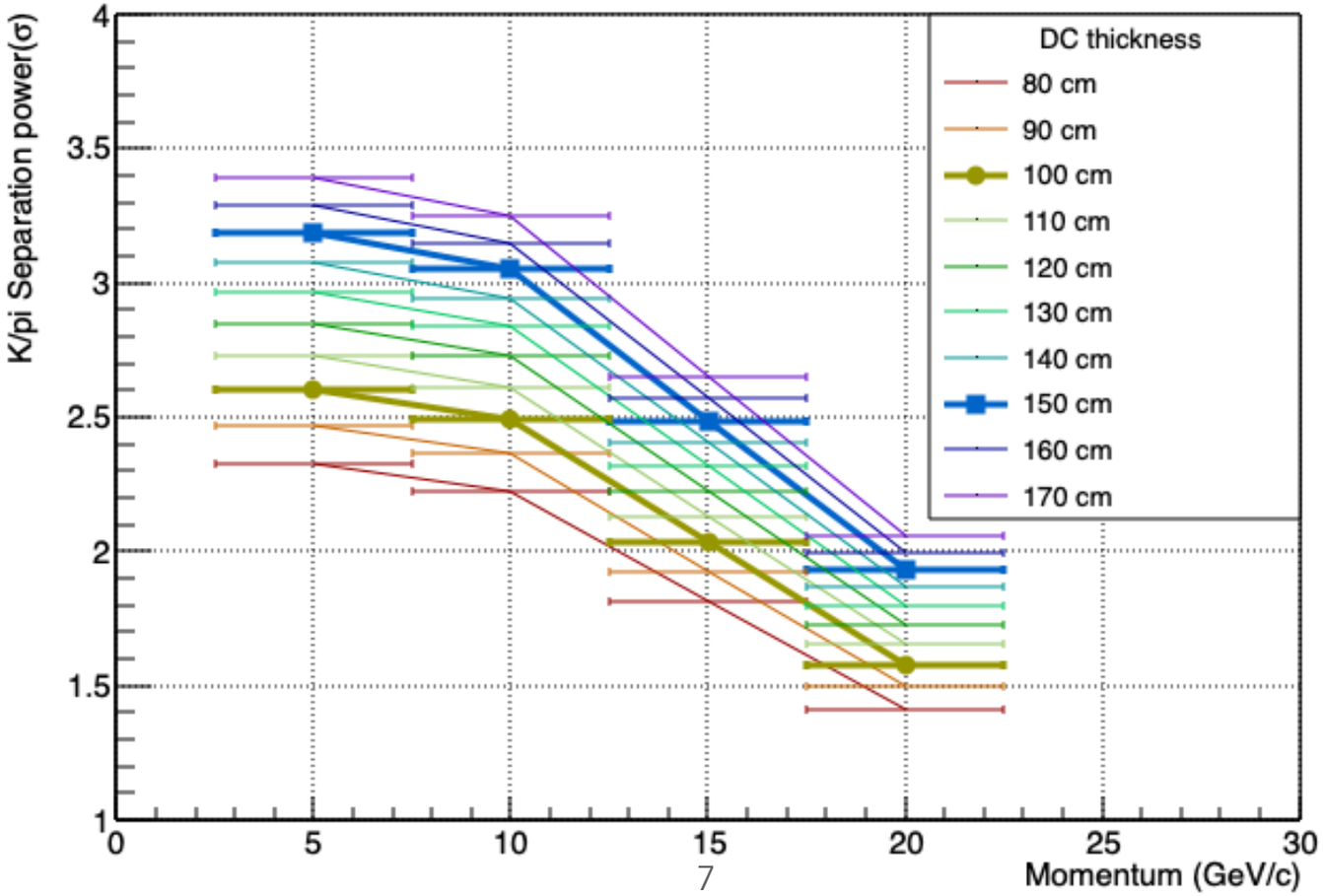
K/pi separation power (150 cm)

- With larger Time Constants (τ) or Noise Ratio (σ_n/S), the K/pi separation performance would be worse



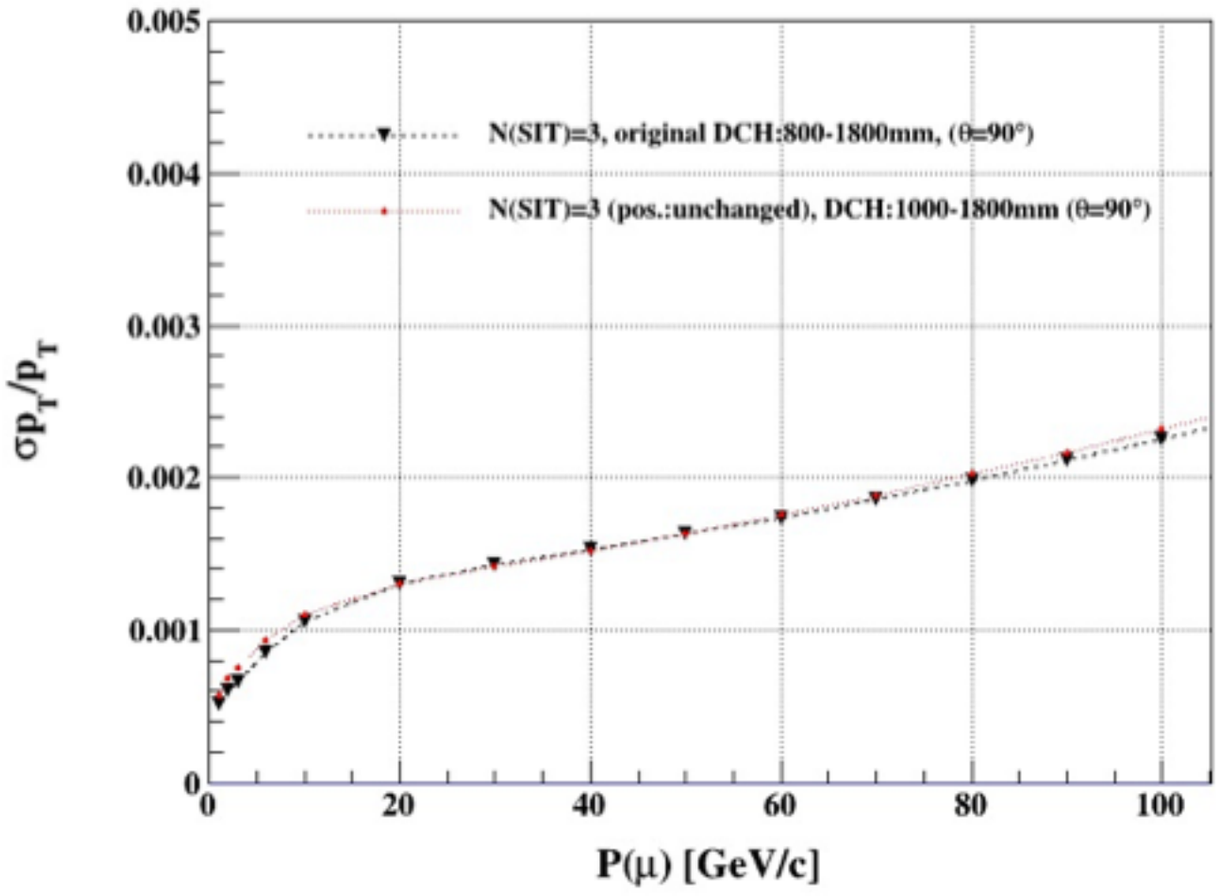
K/pi separation power vs. DC thickness

- K/pi separation power could be scaled with DC thickness
- 150 cm and 100 cm are highlighted



Momentum resolution

- Multiple studies show that transverse momentum have resolution better than 0.2% for p<60 GeV/c
- Flavour physics largely studies at 91 GeV collision energy
- In the following study, we consider a worst case
- Assumption 3: momentum measurement resolution: 0.2%
- This could be modelled more precisely in the future

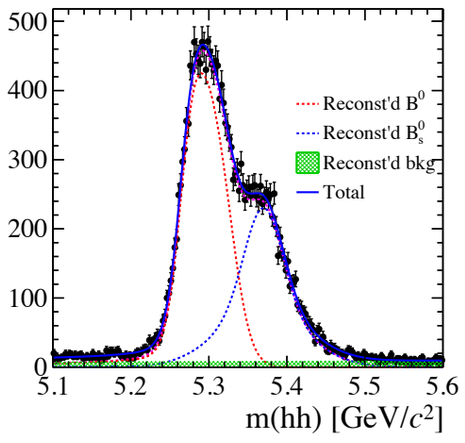


Impact on Physics: $B_{(s)}^0$ -> hh

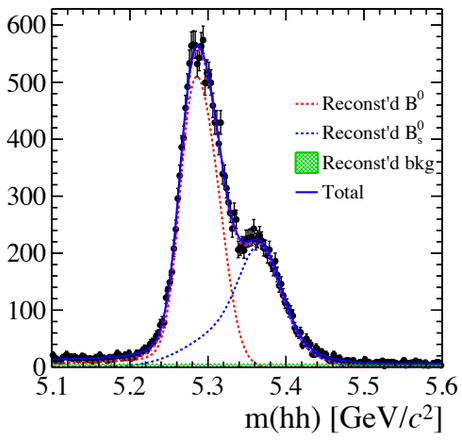
- $B_{(s)}^0$ -> hh events obtained with fast simulation
  - h = K or pi
  - Radiative decay allowed
  - No backgrounds simulated
  - Within mass window [5.1, 5.6] GeV/c^2:
    B->hh: 17132, B_s->hh: 5340
- $B_{(s)}^0$ masses are reconstructed at different DC thickness

Fits vs. DC thickness

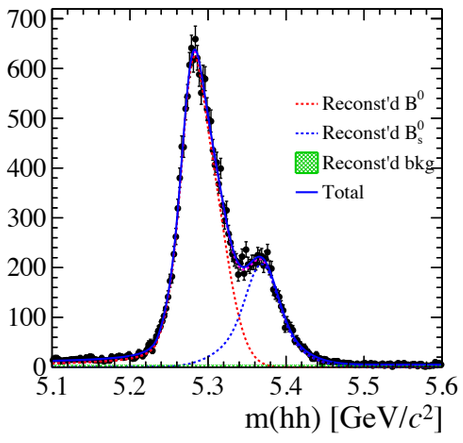
- 20cm



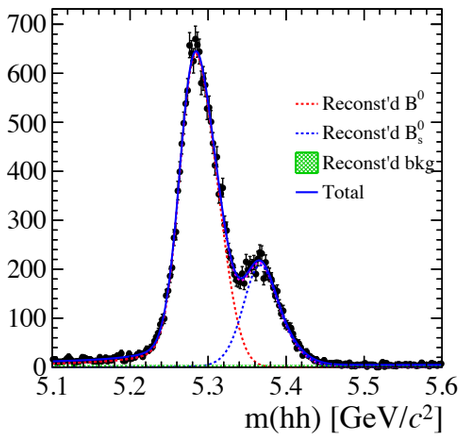
40cm



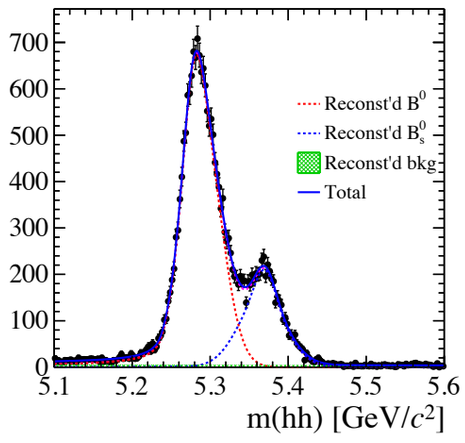
60cm



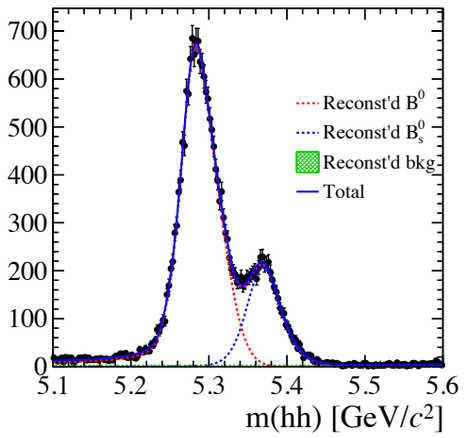
80cm



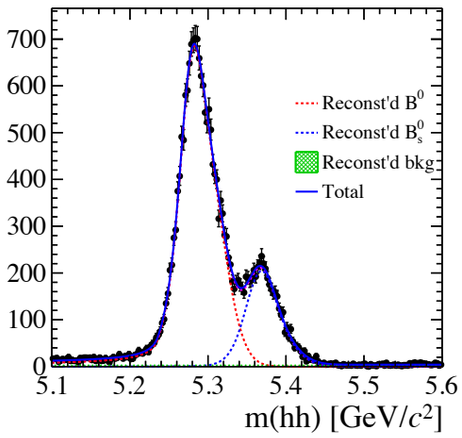
100cm



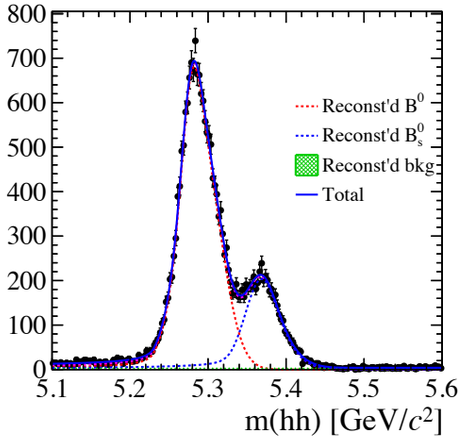
- 110cm



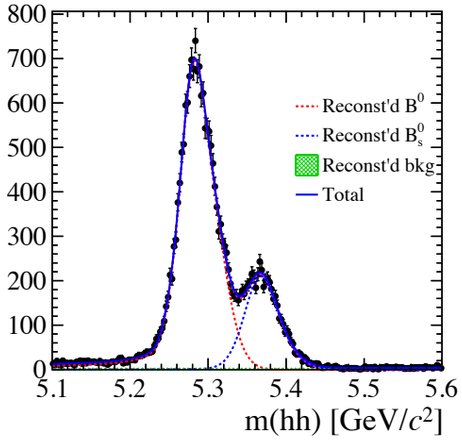
120cm



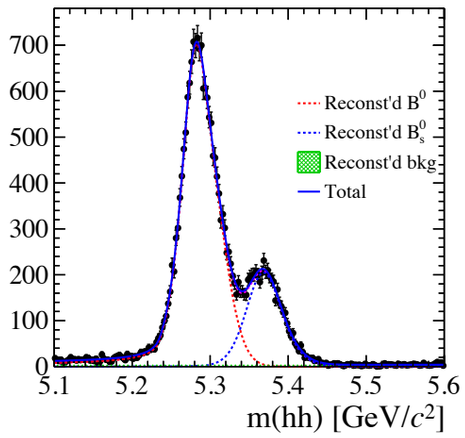
130cm



140cm

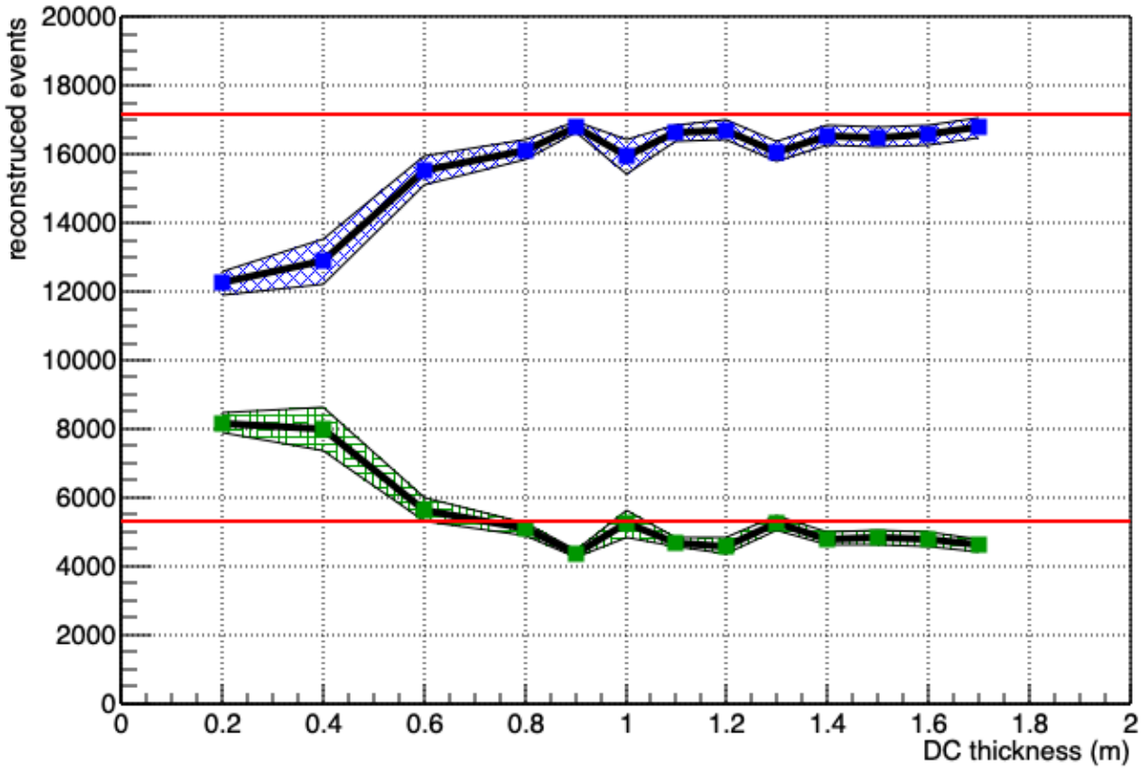


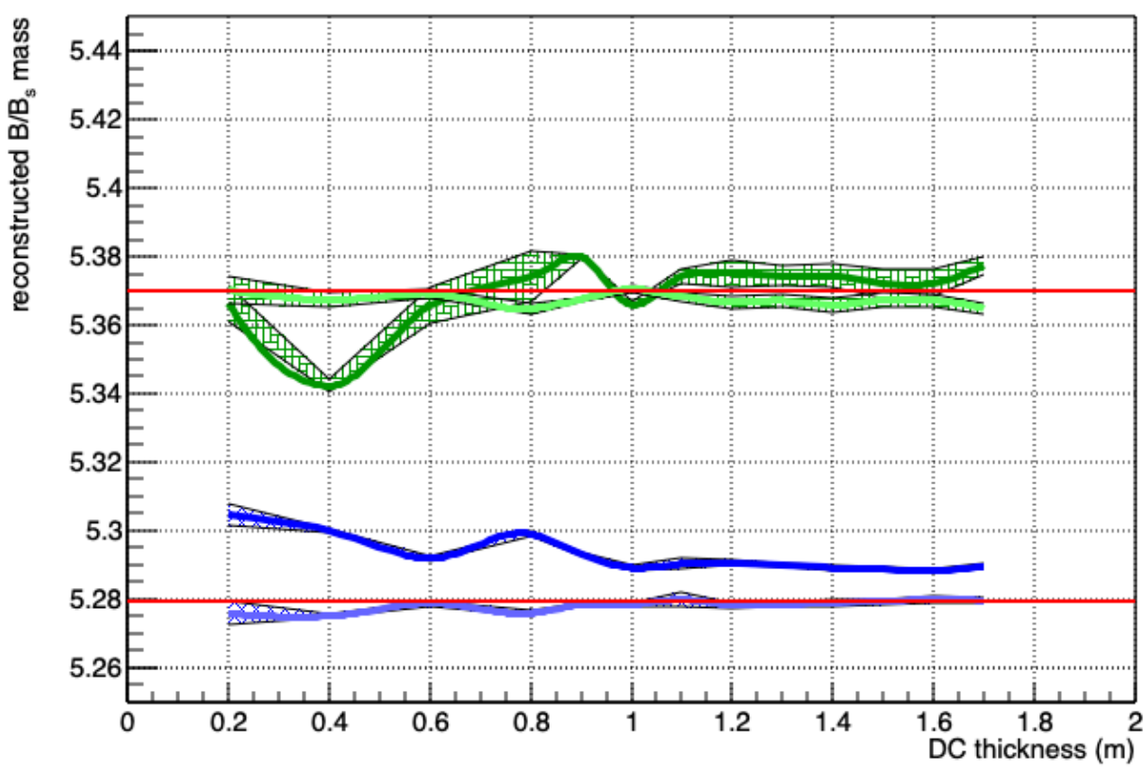
150cm



Fit parameters vs. DC thickness

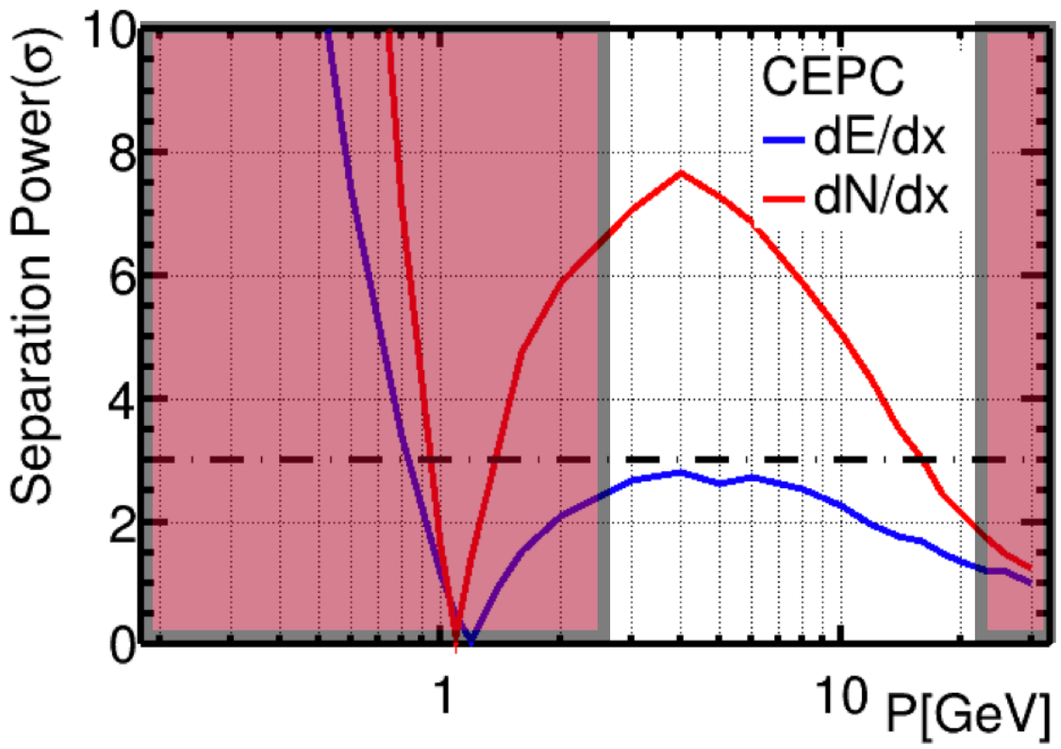
- Reconstructed event yield and central values of B/Bs mass vs. DC thickness
- Thickness > 1 meter can provide stable performance





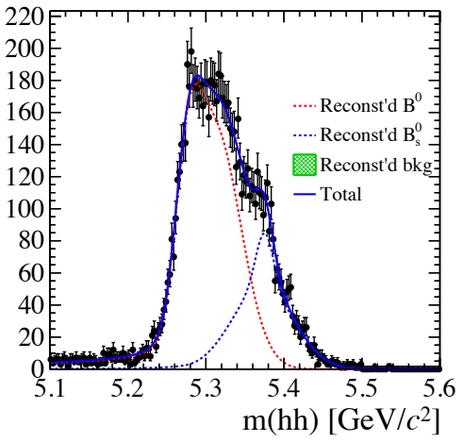
Momentum selection

- TOF will benefit low p region, but not considered in this study
  - In the future, we will combine TOF information
- Remove the regions with worse DC K/pi separation power

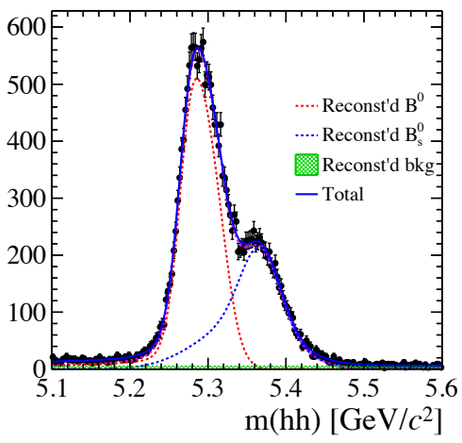


Fits vs. DC thickness

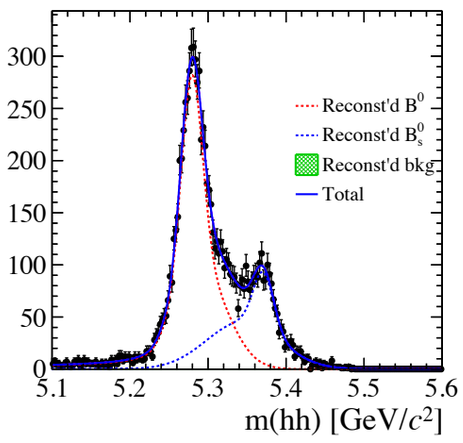
- 20cm



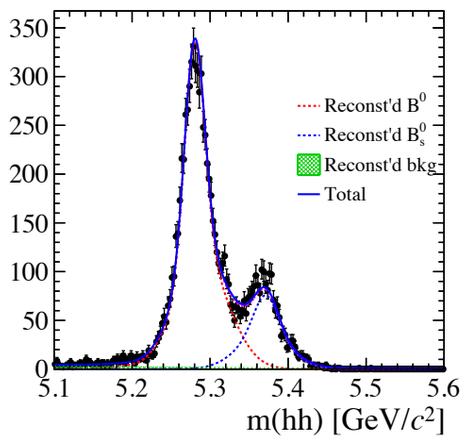
40cm



60cm



80cm



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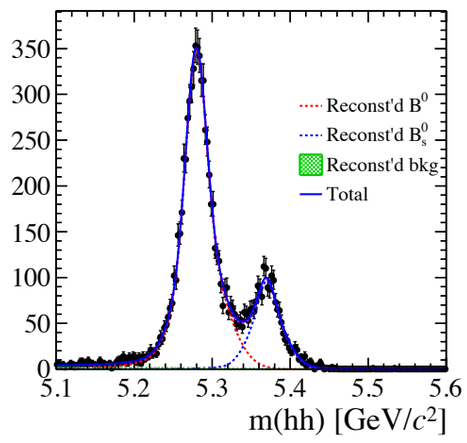
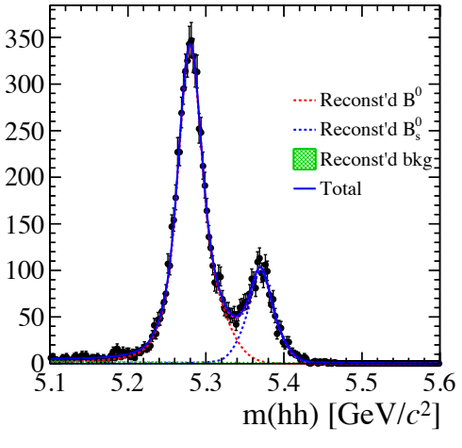
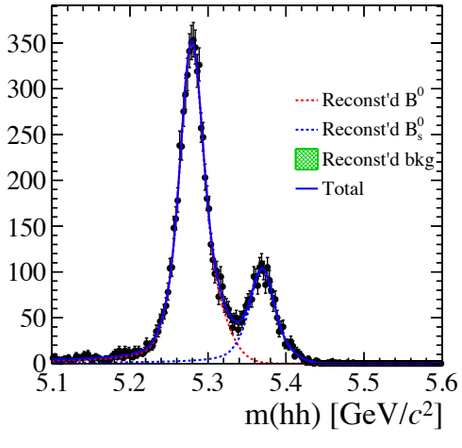


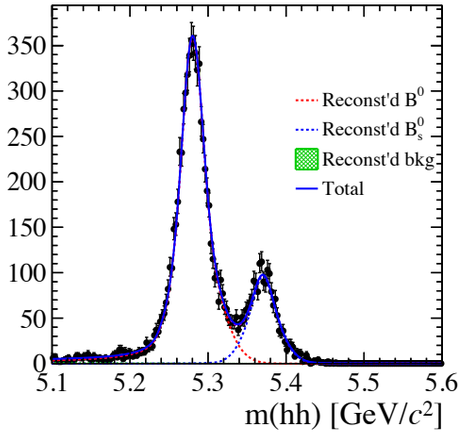
- 110cm



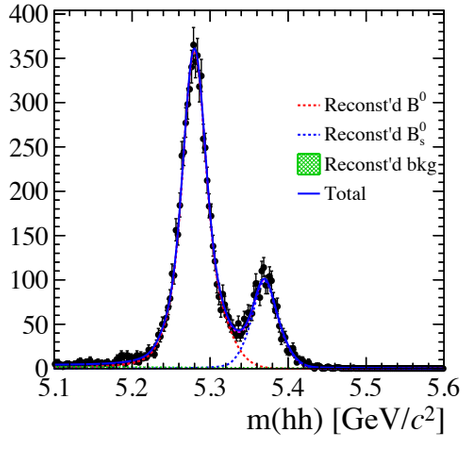
120cm



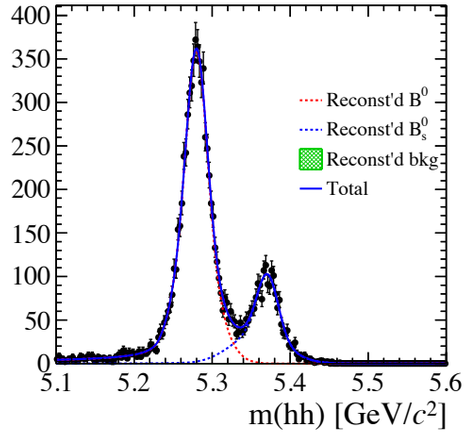
130cm



140cm



150cm



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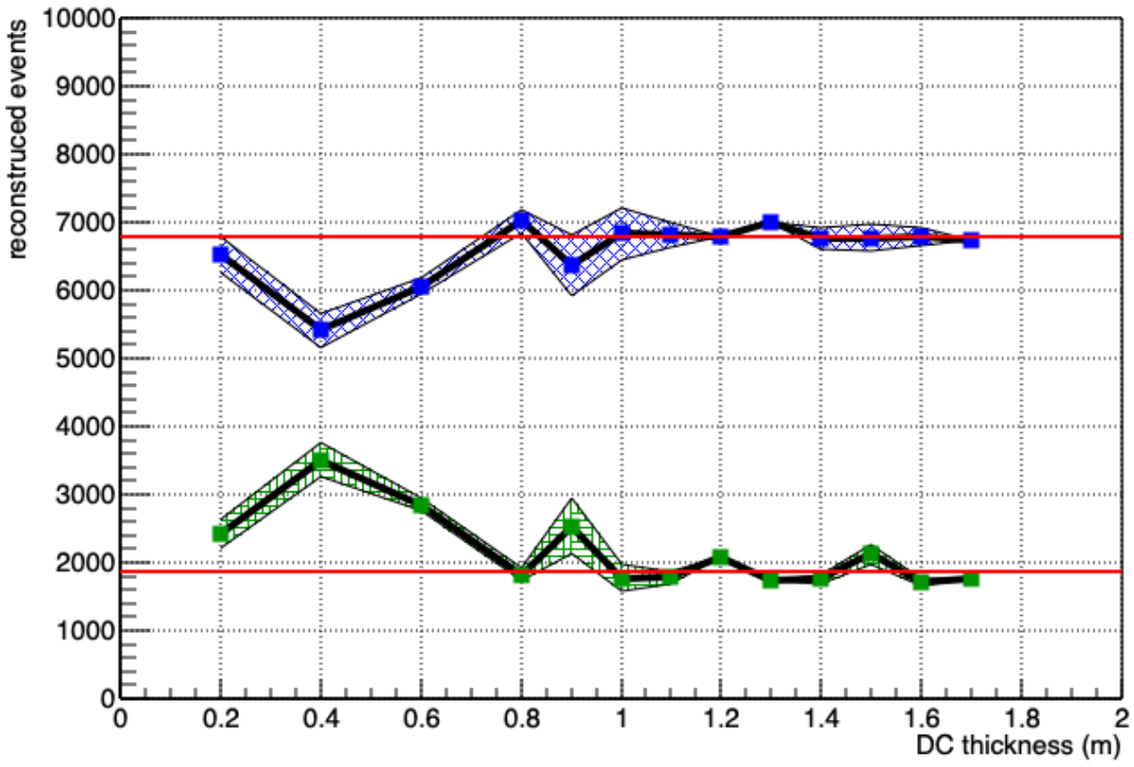

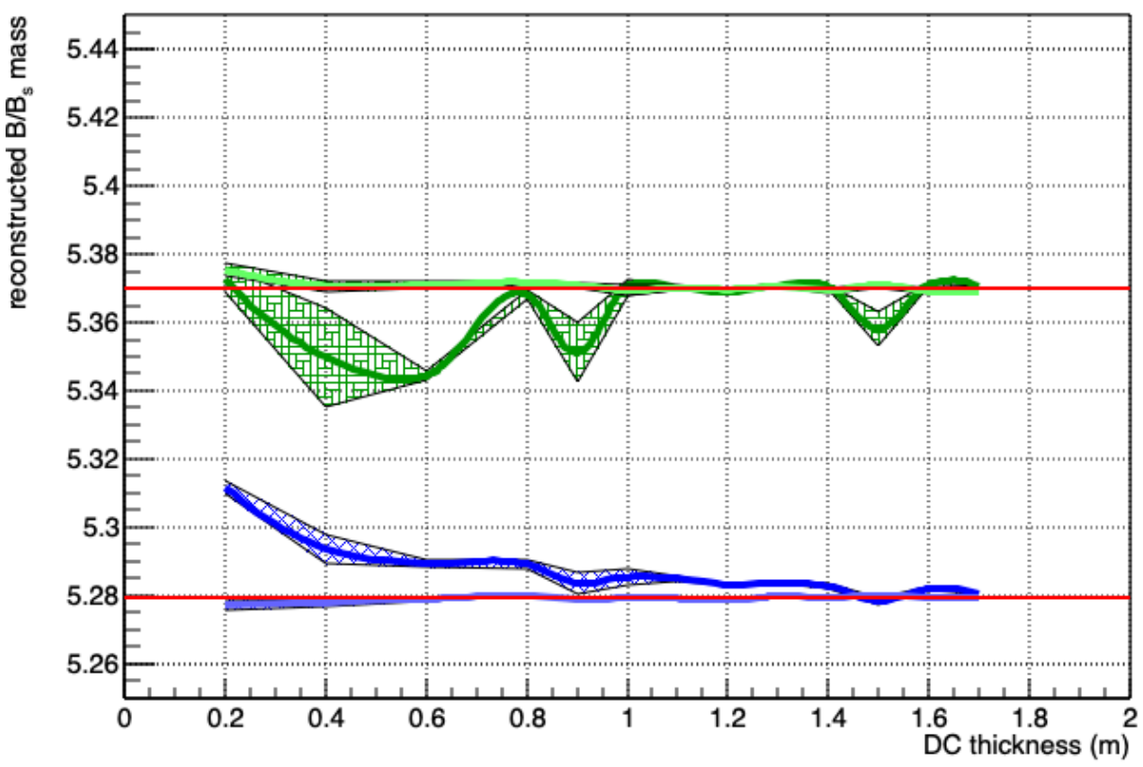

Summaries

- $B_{(s)}^{0}$ -> hh studied with fast simulation
- $B_{(s)}^{0}$ reconstructed with variant DC thickness
- Under the assumptions mentioned earlier, performance is quite stable with DC thickness larger than 1 m
- To do's:
  - Model momentum resolution more precisely
  - Extend studies to other channels