Preliminary studies of the DCH configuration using TRACKERR

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Introduction – What we want to do

- We want to study how the design of the DCH (number and dimension of cells, gas, etc.) affects the quality of the track reconstruction
- We use TRACKERR, a program for calculating tracking errors embedded in the PravdaMC simul. package. It has been already used by A. Roodman and M. Allen to do similar studies for the CDR.
- We need to understand and validate the output of TRACKERR before using it to optimize the design of the detector.
- The purpose of this talk is to summarize what we've found so far and hopefully receive useful feedback

Changes in the Babar DCH configuration file

- The configuration of the Babar DCH used by TRACKERR is stored into an ASCII file whose latest 'official' version was written in June 1996.
- We have updated the flat file with a more accurate representation of the current Babar DCH to our knowledge. The main differences are
  - a ~20% increase of the overall gas+wires density (most significant change)
  - small translation of the DCH w.r.t. the rest of the detector
  - tiny variation of the stereo angles

How we have done this study

- We simulated and reconstructed 5000 B^0--> $\pi+\pi-$ events with different DCH configurations and we compared the distributions of ΔE

Babar DCH (Geant4)

Vs.

Babar DCH (TRACKERR)

Vs.

alternative DCH configs (TRACKERR)

B^0--> $\pi+\pi-$ ΔE comparison (I)

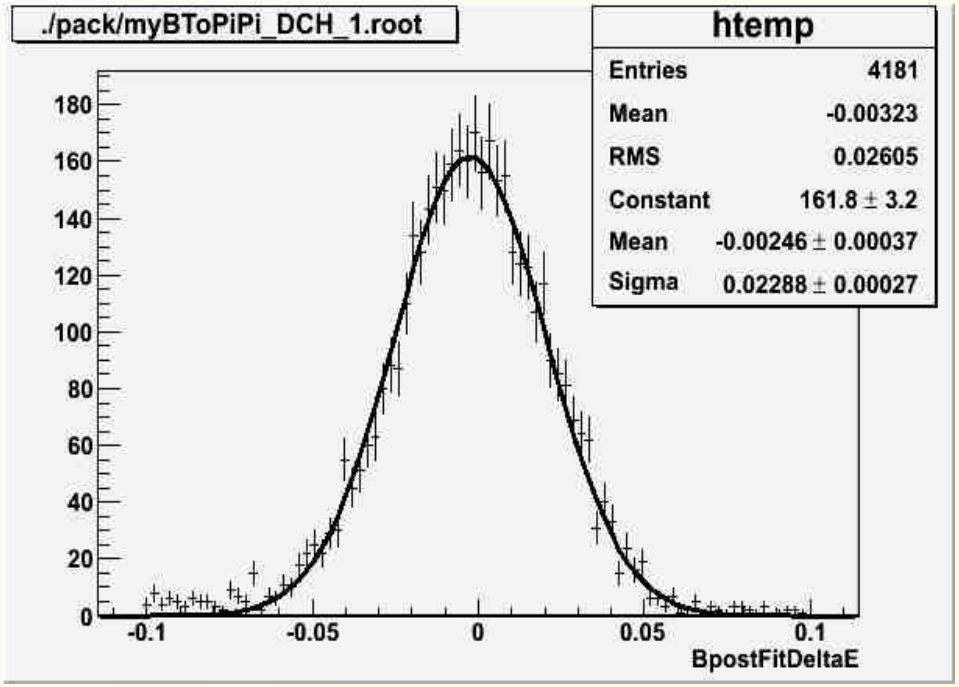
Babar DCH (TRACKERR)
10 Super Layers (SL)
4 layers in each SL
cell size: 1.2 x 1.2 cm^2
cell spat. res.: 140μm

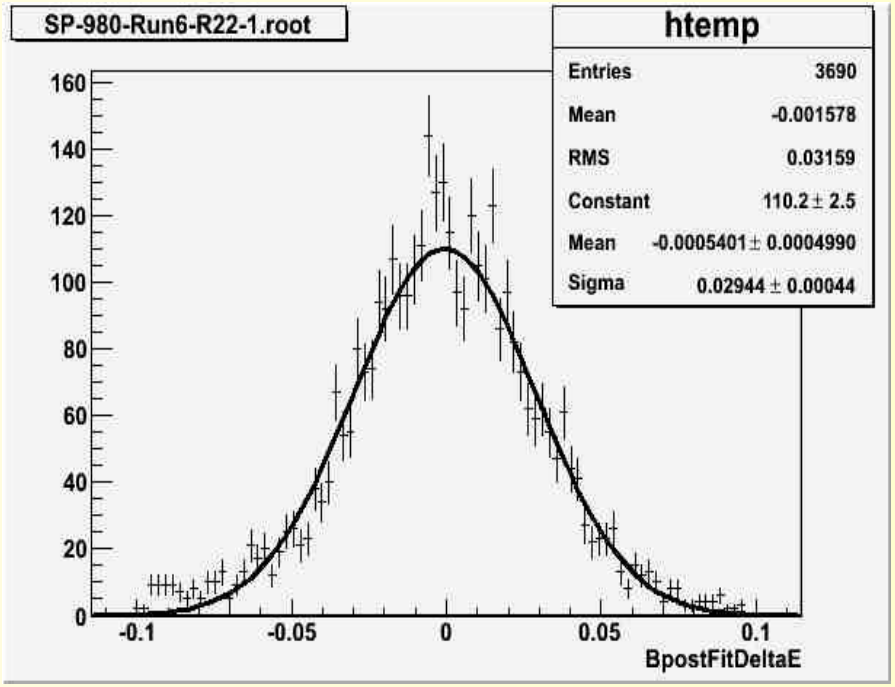
22.9±0.3 MeV

Vs.

Babar DCH (Geant4)
10 Super Layers (SL)
4 layers in each SL
cell size: 1.2 x 1.2 cm^2

29.4±0.4 MeV





We don't know yet where the difference in the resolutions comes from

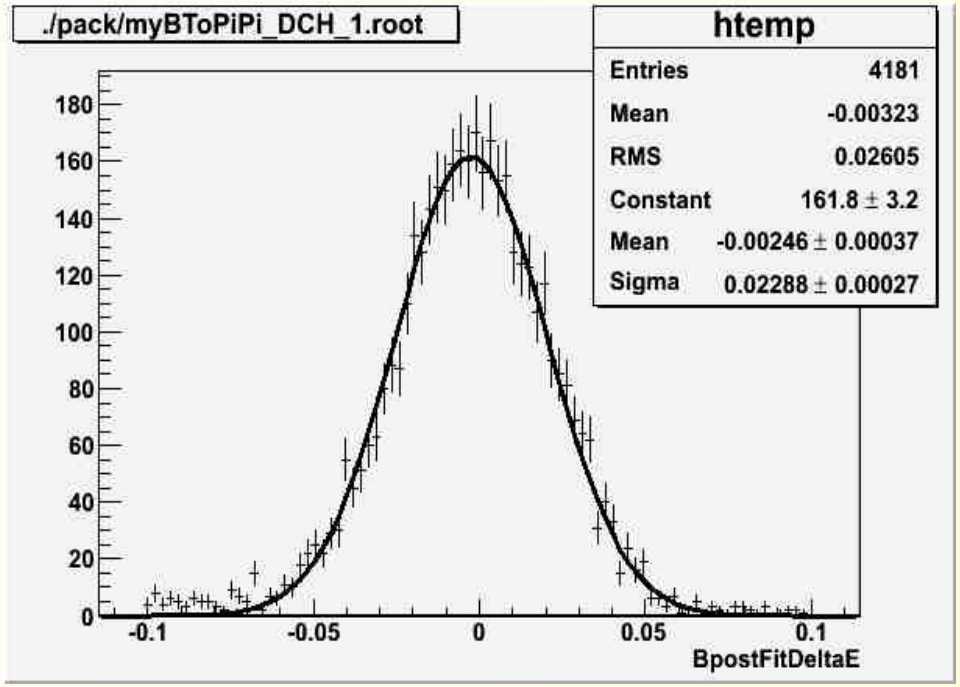
B^0--> $\pi^+\pi^-$ ΔE comparison (II)

Babar DCH (TRACKERR)
10 Super Layers (SL)
4 layers in each SL
cell size: 1.2 x 1.2 cm^2
cell spat. res.: 140μm

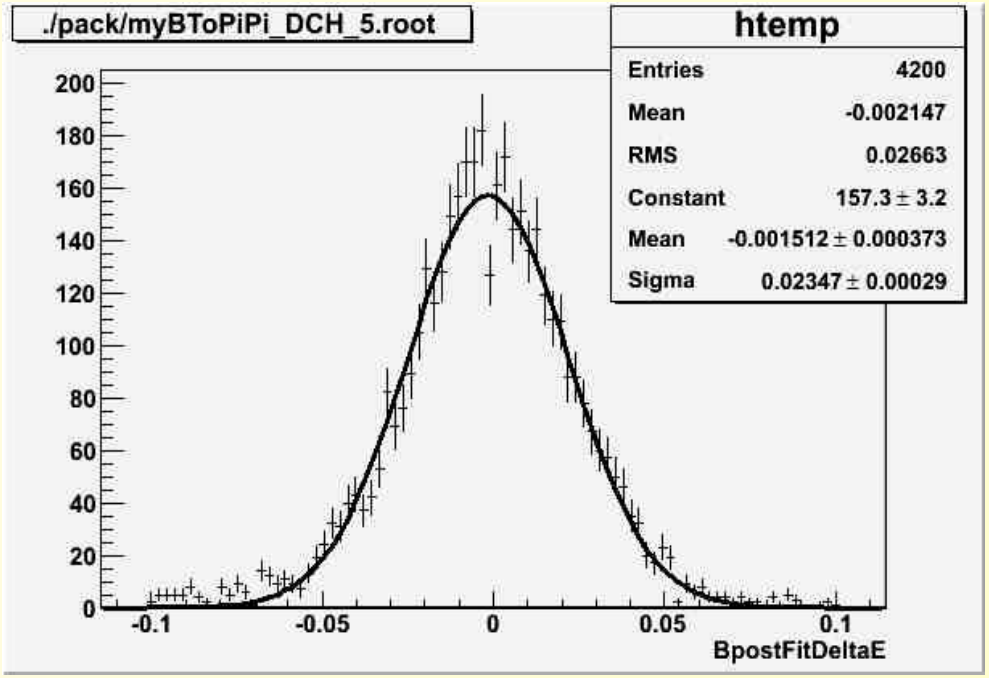
Vs.

new DCH (TRACKERR)
10 Super Layers (SL)
6 layers in each SL
cell size: 0.8 x 0.8 cm^2
cell spat. res.: 159μm

22.9±0.3 MeV



23.5±0.3 MeV



The patial resolutions of the cells were taken from CDR.

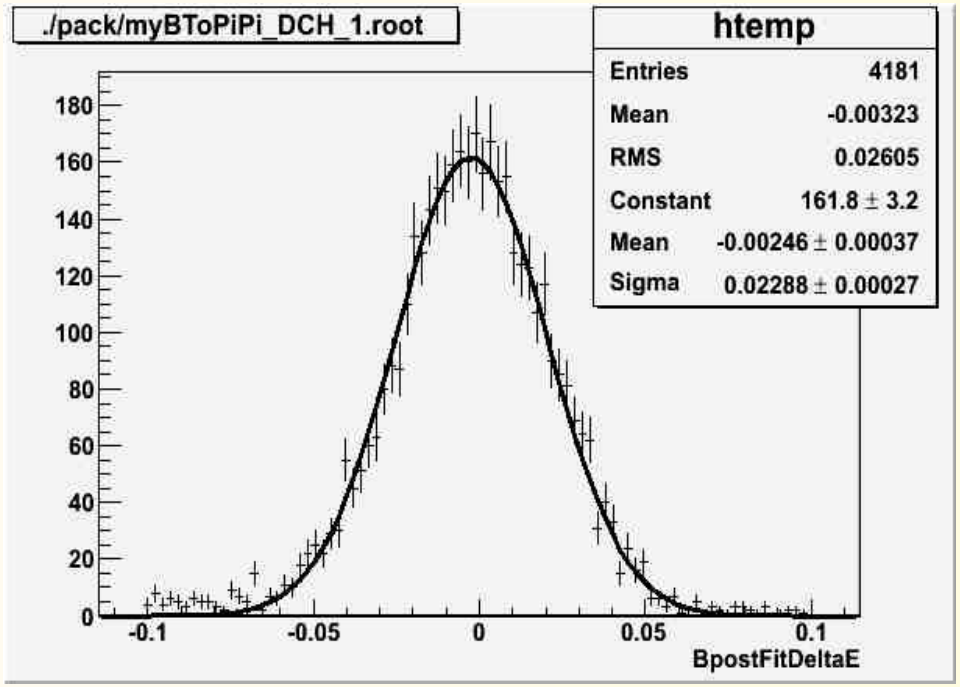
B^0--> $\pi^+\pi^-$ ΔE comparison (III)

Babar DCH (TRACKERR)
10 Super Layers (SL)
4 layers in each SL
cell size: 1.2 x 1.2 cm^2
cell spat. res.: 140μm

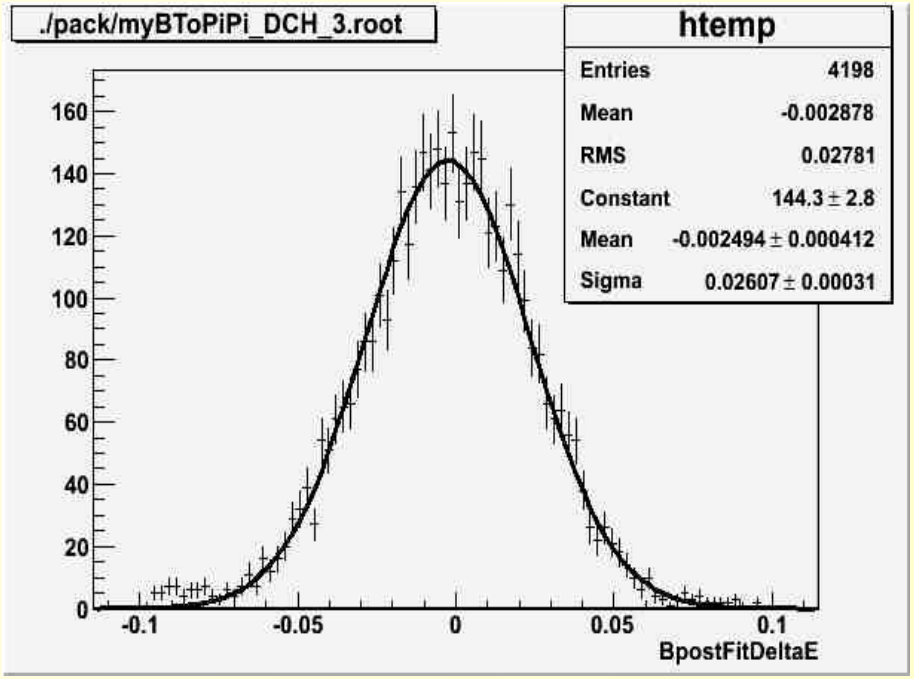
Vs.

new DCH (TRACKERR)
10 Super Layers (SL)
8 layers in each SL
cell size: 0.6 x 0.6 cm^2
cell spat. res.: 178μm

22.9±0.3 MeV



26.1±0.3 MeV



The patial resolutions of the cells were taken from CDR.

B^0--> $\pi^+\pi^-$ ΔE comparison (IV)

Babar DCH (TRACKERR)
10 Super Layers (SL)
4 layers in each SL
cell size: 1.2 x 1.2 cm^2
cell spat. res.: 140μm

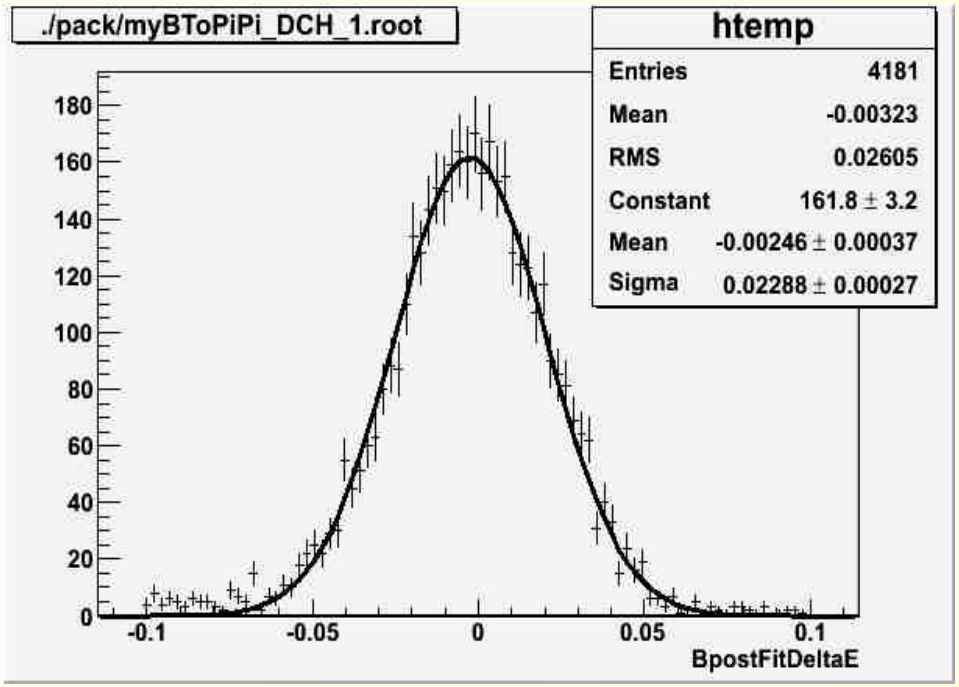
Vs.

new DCH (TRACKERR)
3+7 Super Layers (SL)

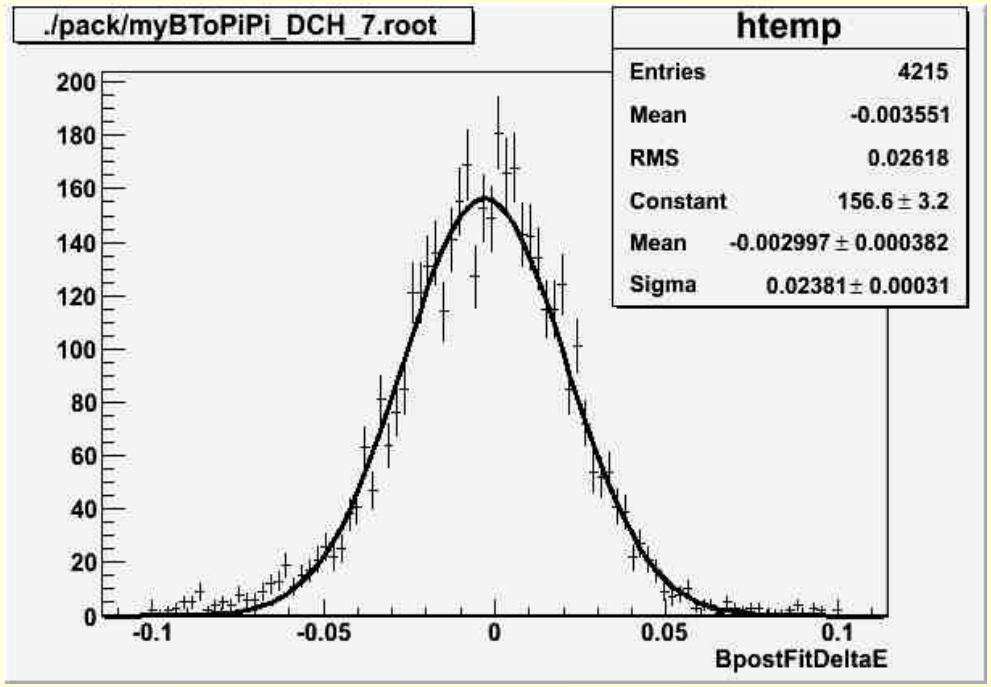
3 internal SL:
8 layers in each SL
cell size: 0.6 x 0.6 cm^2
cell spat. res.: 178μm

7 external SL:
4 layers in each SL
cell size: 1.2 x 1.2 cm^2
cell spat. res.: 140μm

22.9±0.3 MeV



23.8±0.3 MeV



The patial resolutions of the cells were taken from CDR.

B^0--> $\pi^+\pi^-$ ΔE comparison (V)

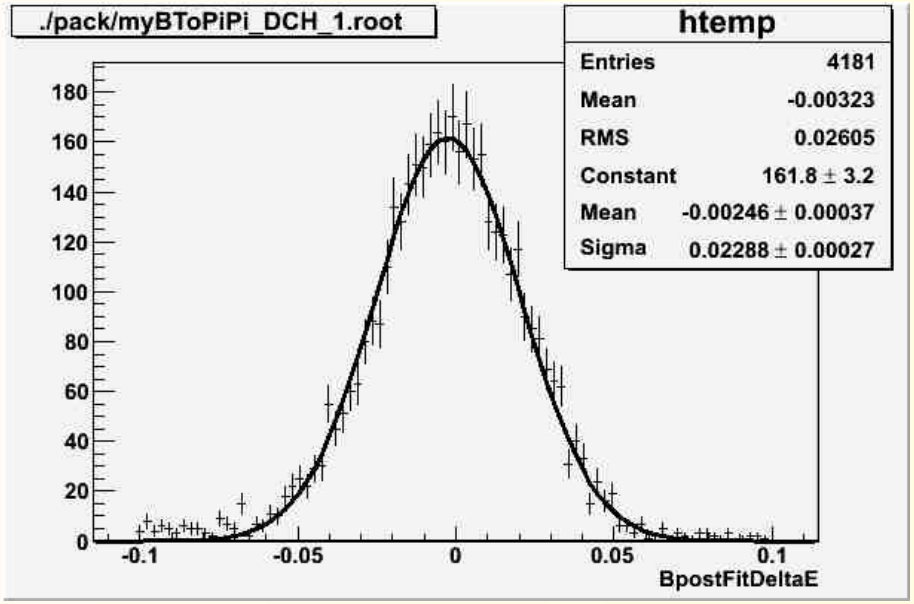
The previous plots are done with the ERRTRACK flag which is used in the default Babar configuration in PravdaMC. Using ERRSDC the resolution improves A LOT.
With ERRSDC the errors are perpendicular to the track and to the sense wire. ERRTRACK is supposed to do the same for null stereo angles.
Need to understand such a big difference.

Babar DCH (TRACKERR with ERRTRACK)
10 Super Layers (SL)
4 layers in each SL
cell size: 1.2 x 1.2 cm^2
cell spat. res.: 140µm

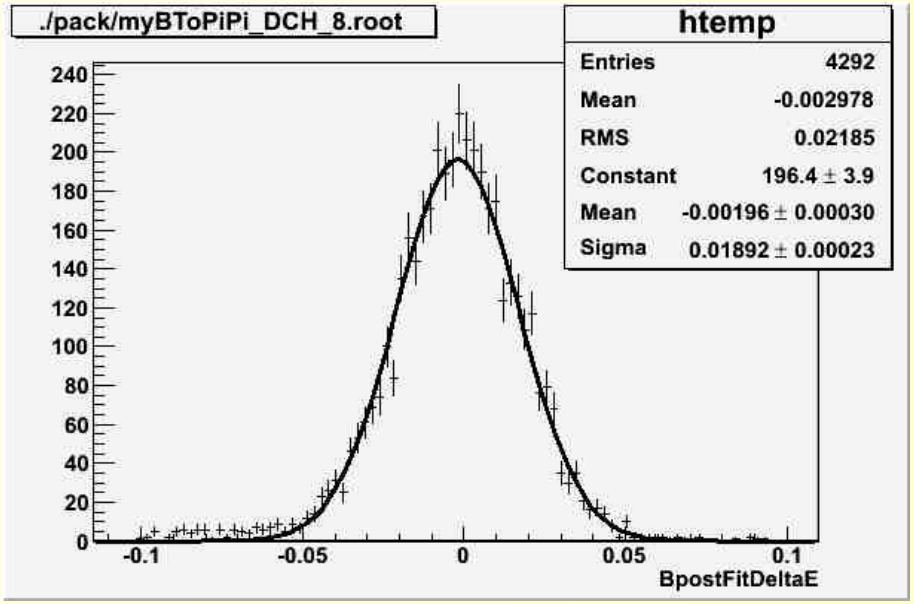
Vs.

Babar DCH (TRACKERR with ERRSDC)
10 Super Layers (SL)
4 layers in each SL
cell size: 1.2 x 1.2 cm^2
cell spat. res.: 140µm

22.9±0.3 MeV



18.9±0.2 MeV



Summary

- We have started evaluating the quality of the track reconstruction of the DCH as a function of the cell layout and material using TRACKERR
- First preliminary results seem to indicate that track errors of TRACKERR are significantly underestimated w.r.t. the full simulation (as also found in CDR)
- There are a few other things not fully understood which require ad hoc investigation
- We plan to do a set of tests to understand if TRACKERR can eventually be used reliably to for DCH optimization

To do list

- Investigate the difference between Geant4 and TRACKERR resolutions.
- Evaluate the spatial resolution of the cell vs. the cell geometry (the resolutions used for this exercise were taken from CDR)
- Repeat the study on other decay channels, e.g. to see the effect of multiple scattering on lower momentum tracks.