DCH studies with FastSim

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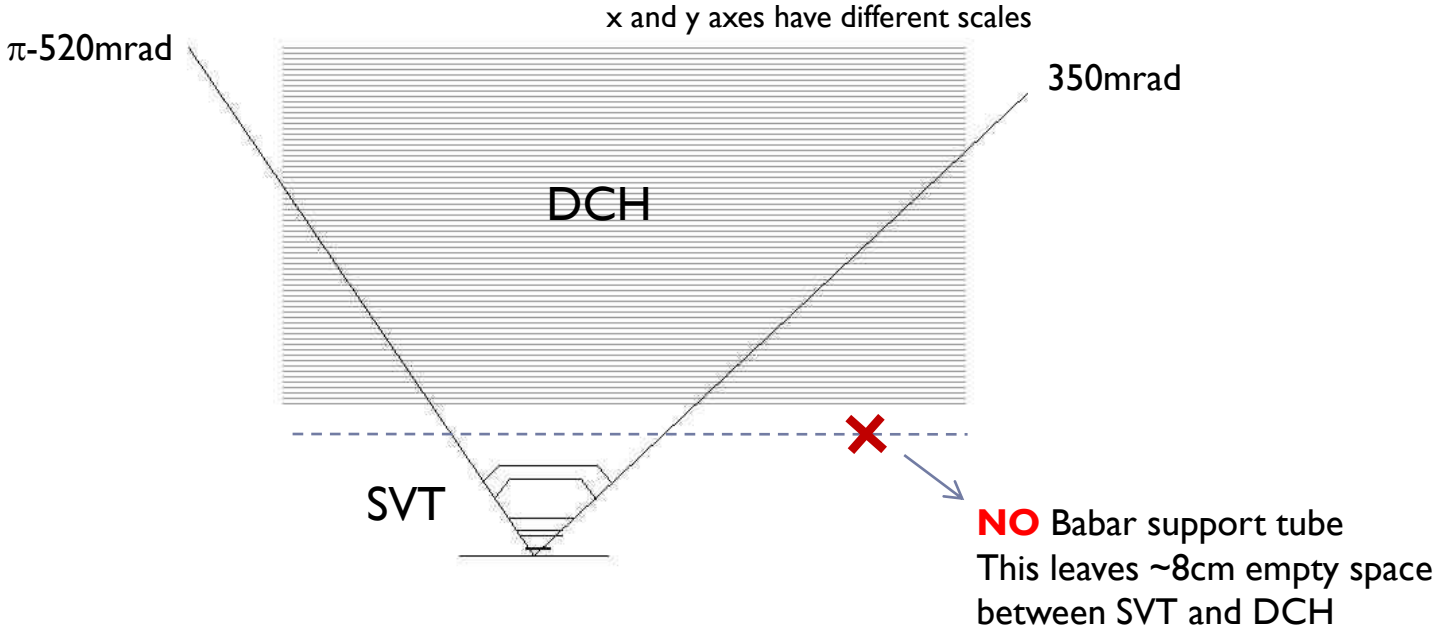
Configurations

- Start with the current configuration in FastSim (default config. in the following)
- DCH
  - 10 SuperLayers (4 cell layers per SL)
  - inner wall: 23.6cm
  - Axial/Stero+/Stereo- geometry
  - spatial reso: 125μm
- SVT: Babar + L0

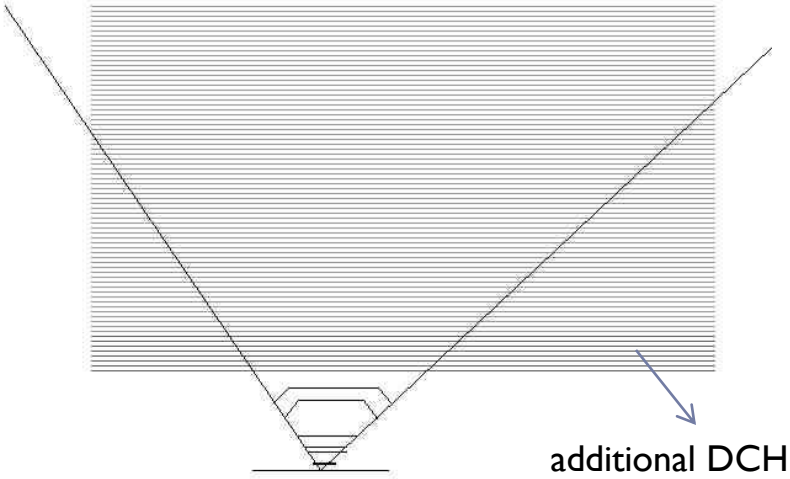


'Exercise' configurations

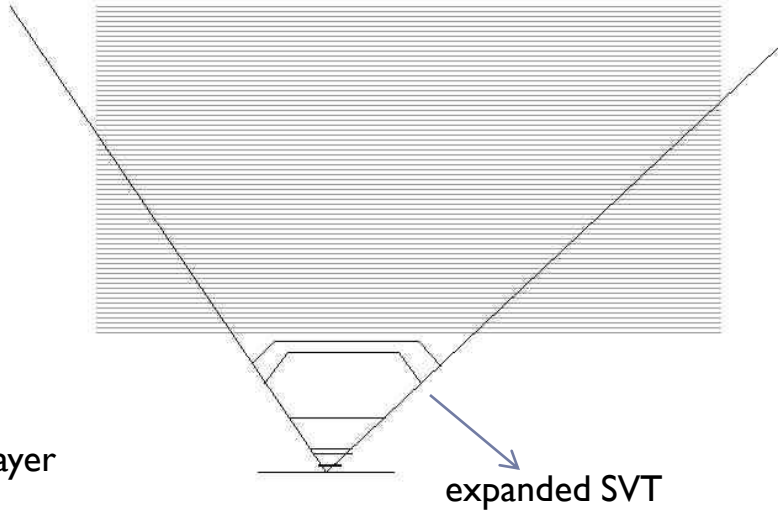
- DCH:
  - 10 SuperLayers (Babar) **+ inner SuperLayer** (4 cell layers per SL)
  - inner wall: 23.6cm → **17cm**
  - Axial/Stereo+/Stereo- geometry
  - spatial reso: 125μm
- SVT: Babar + L0

- DCH: Babar
  - 10 SL (4 cell layers per SL)
  - inner wall: 23.6cm; spatial reso: 125μm
- SVT: Babar+L0 with
  - L3: 5.92cm→**9.4cm**
  - L4:12.22cm→**20.6cm**
  - L5:14.22cm→**22.6cm**
  - spatial reso. unchanged
  - silicon thickness unchanged

"DCH small inner radius"



"SVT large outer radius"



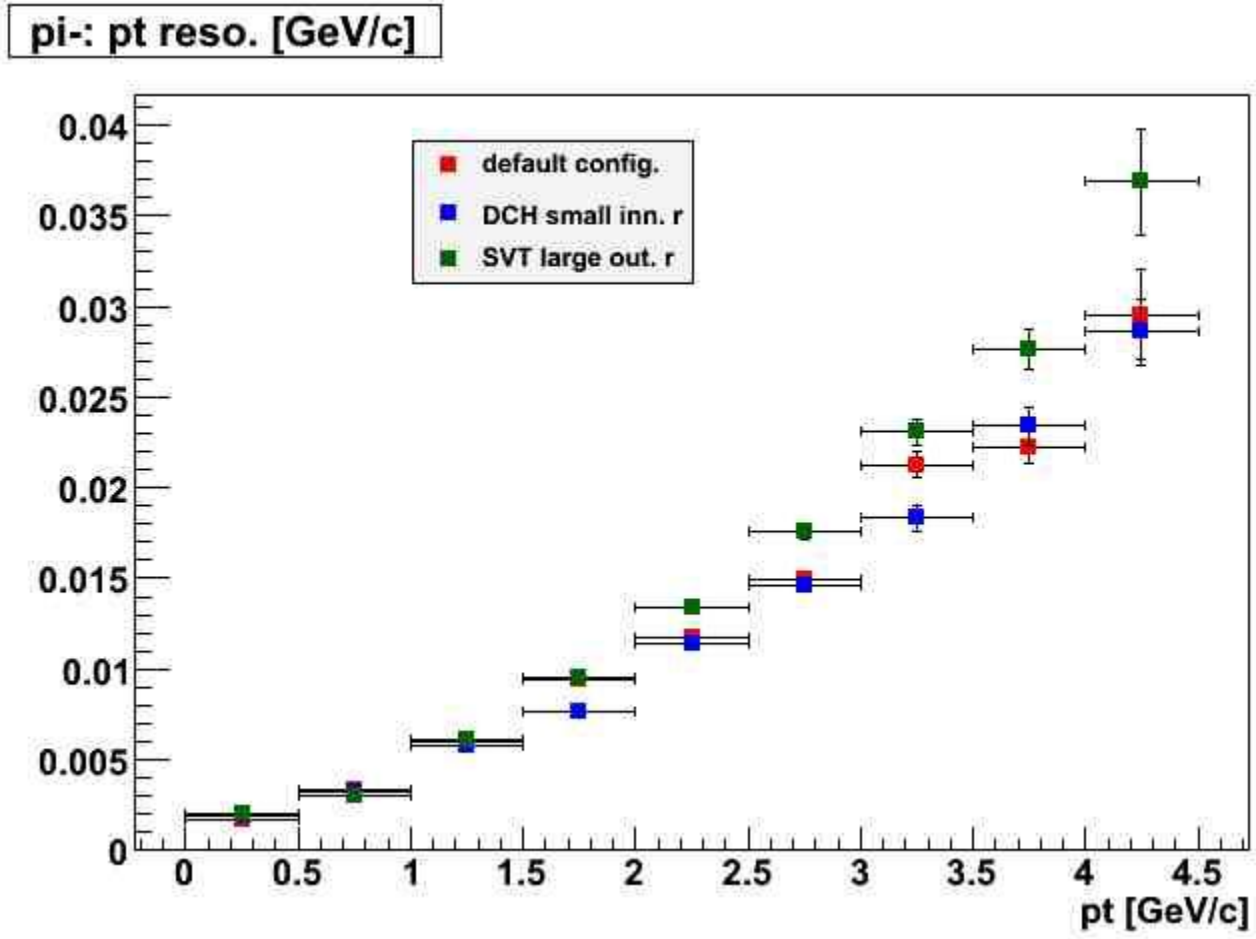
Performance studies with different DCH+SVT configurations

results in following slides are preliminary

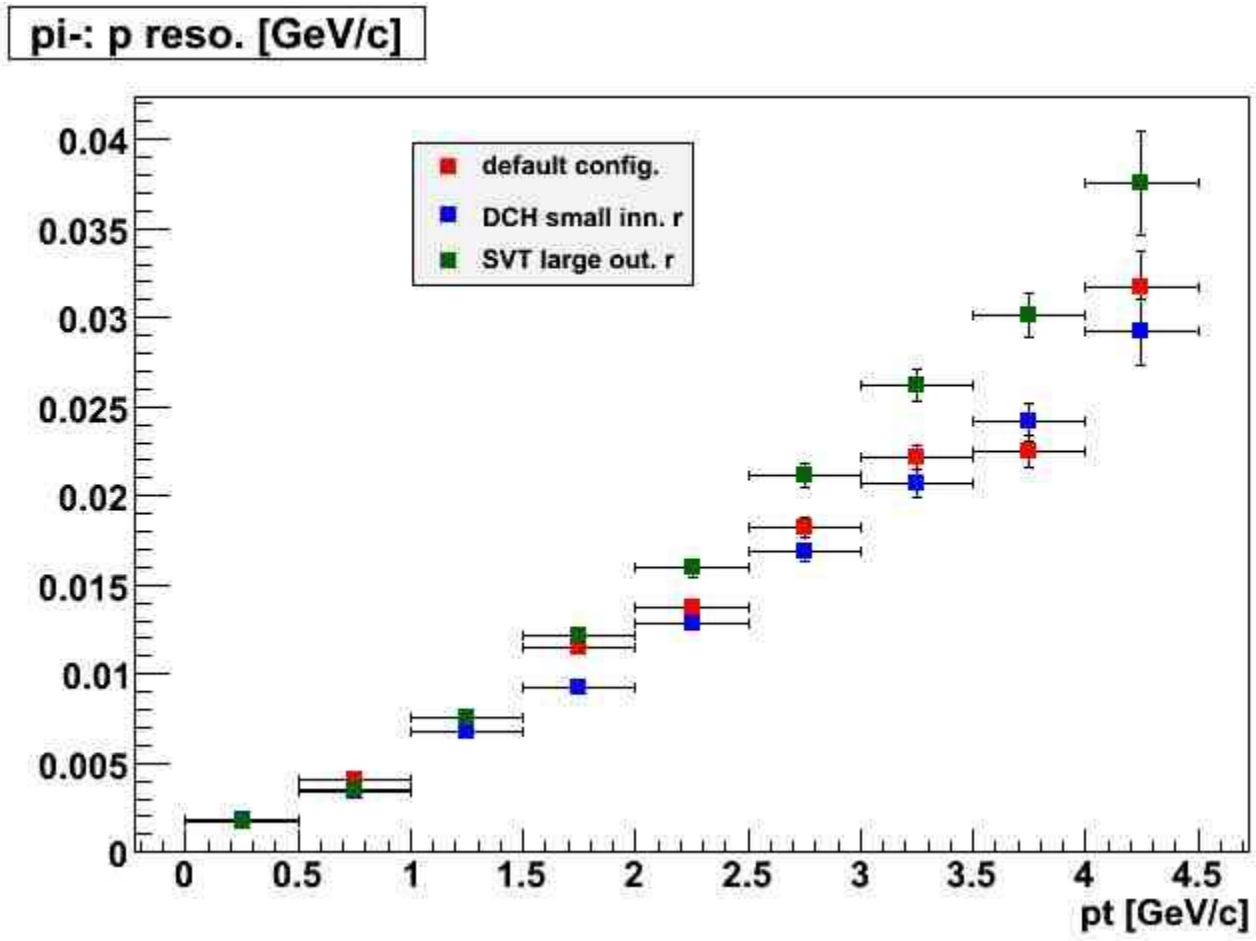
Single particles

- single charged particles events: e, μ, π, K, protons with
  - p in [0.05,4.5] GeV/c
  - cosTheta in [-1,1]
  - Phi in [0,2π]
- pt, p, theta and phi resolutions in bins of pt

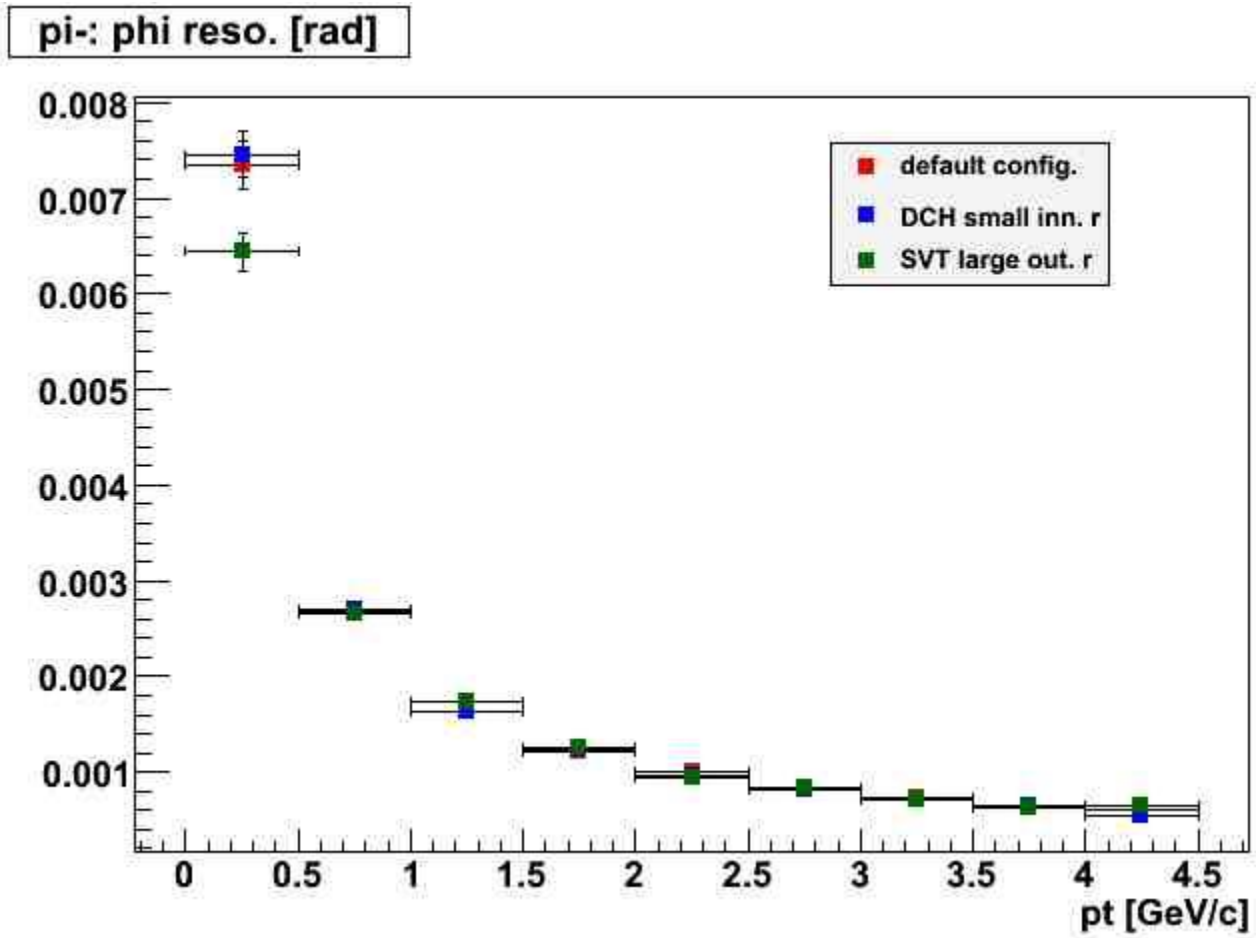
pt reso. vs. pt of pions



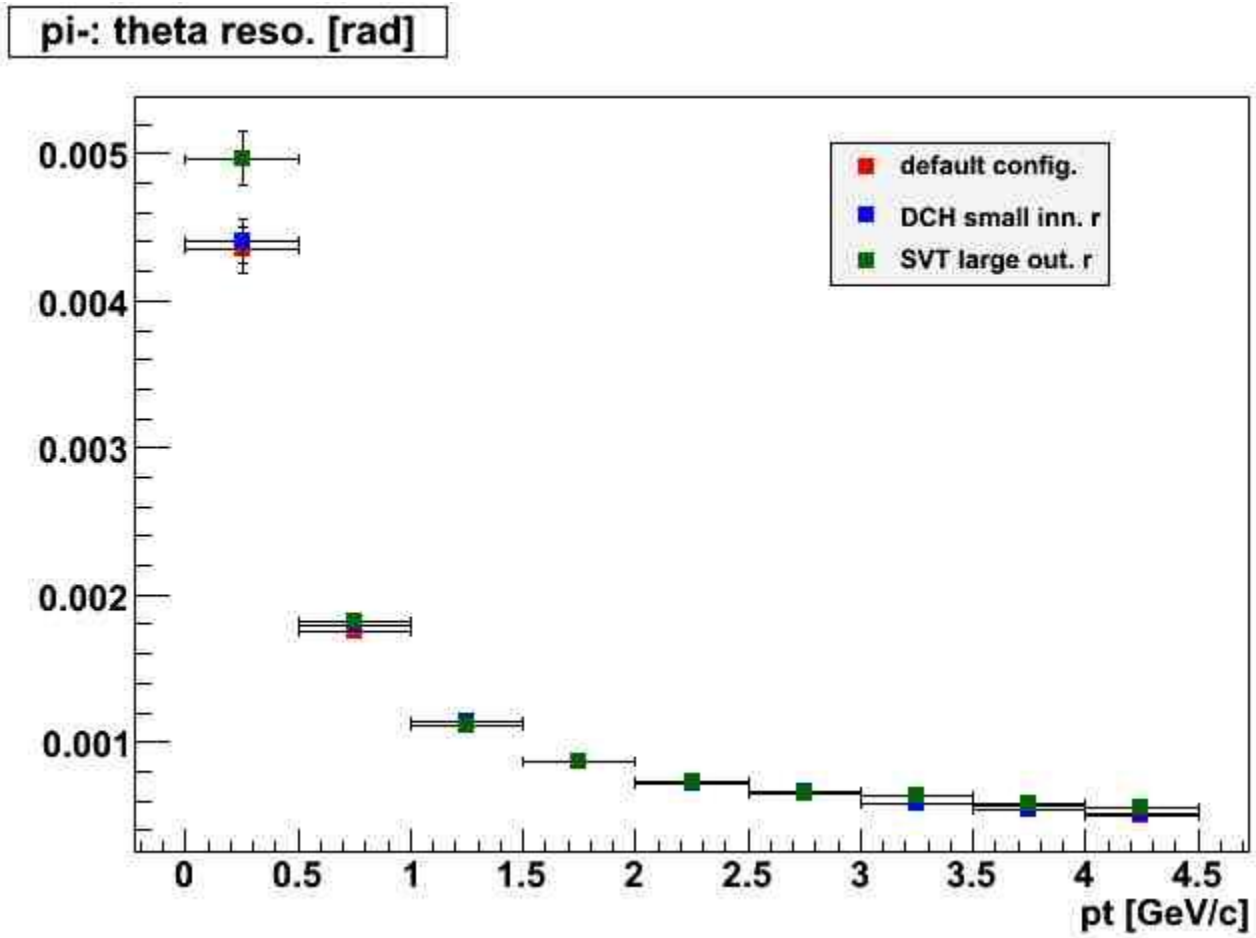
p reso. vs. pt of pions



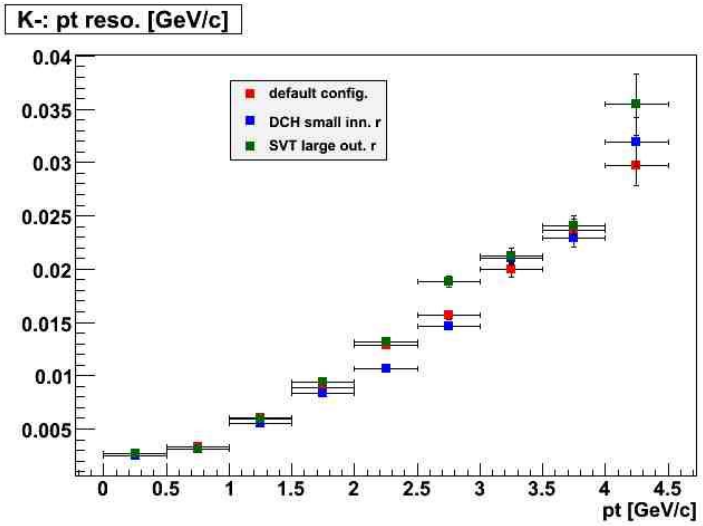
phi reso. vs. pt of pions

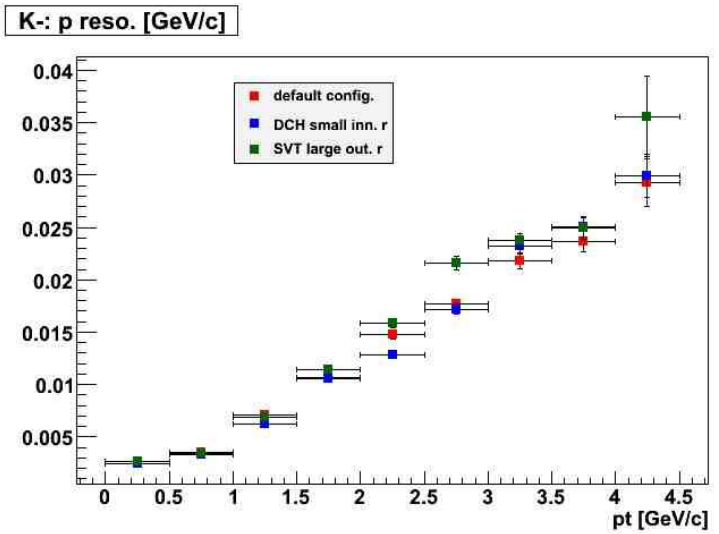


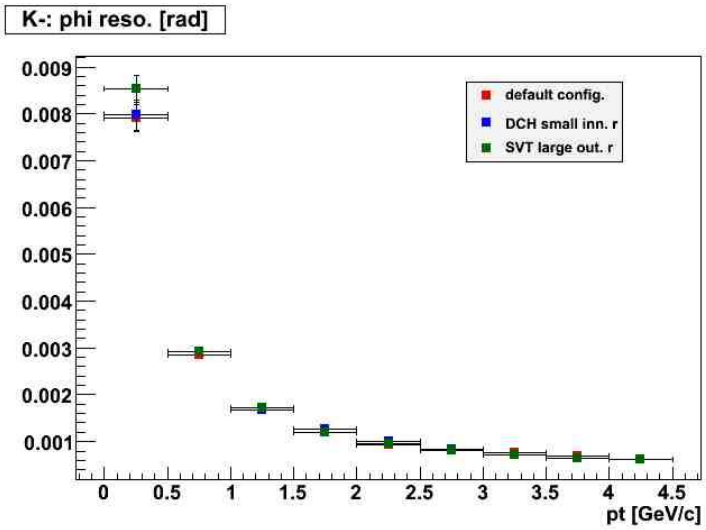
theta reso. vs. pt of pions

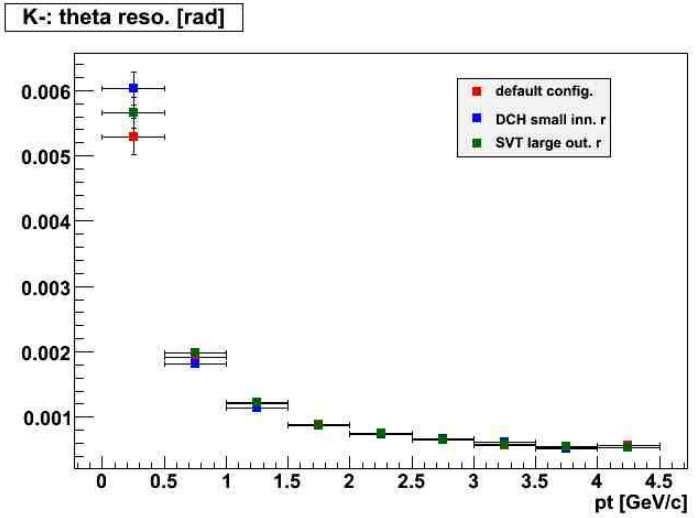


kaons

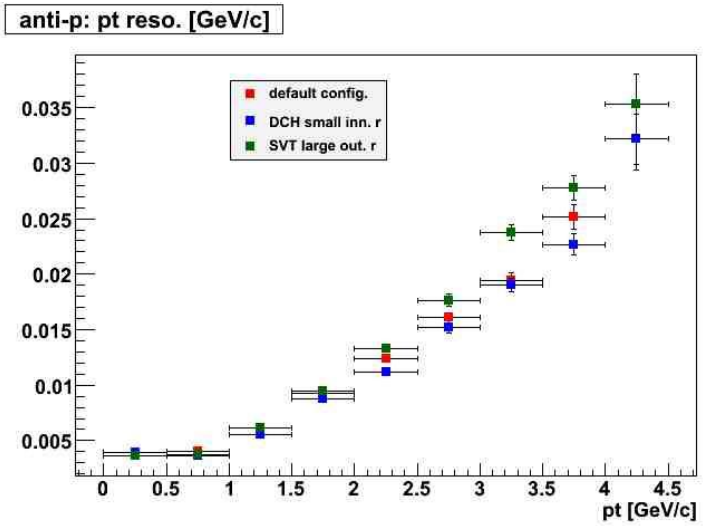

K-: pt reso. [GeV/c]
default config.
DCH small inn. r
SVT large out. r
pt [GeV/c]

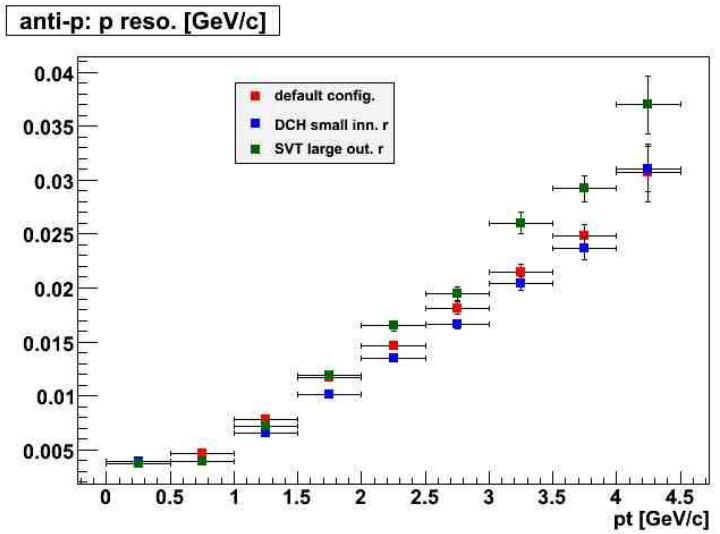

K-: p reso. [GeV/c]
default config.
DCH small inn. r
SVT large out. r
pt [GeV/c]

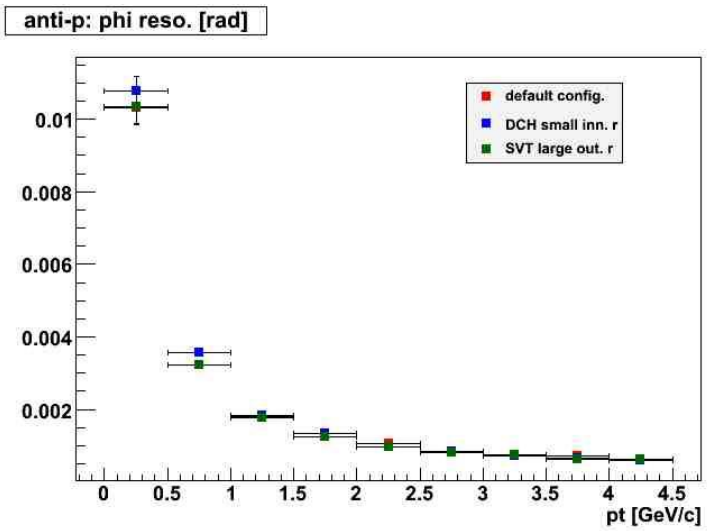

K-: phi reso. [rad]
default config.
DCH small inn. r
SVT large out. r
pt [GeV/c]

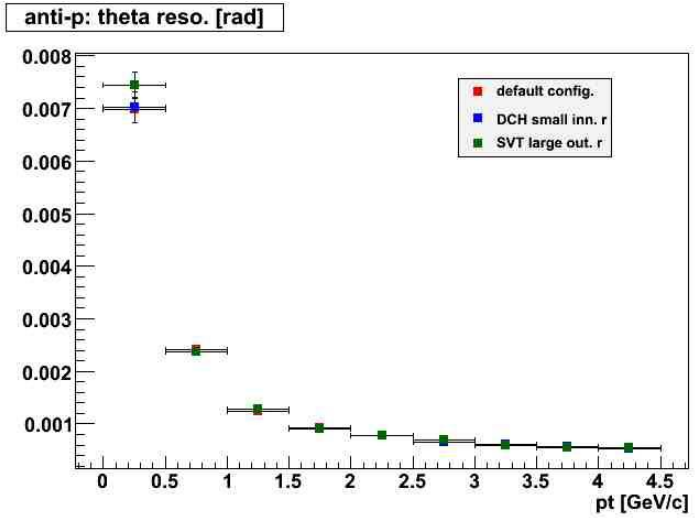

K-: theta reso. [rad]
default config.
DCH small inn. r
SVT large out. r
pt [GeV/c]

protons


anti-p: pt reso. [GeV/c]
default config.
DCH small inn. r
SVT large out. r
pt [GeV/c]


anti-p: p reso. [GeV/c]
default config.
DCH small inn. r
SVT large out. r
pt [GeV/c]

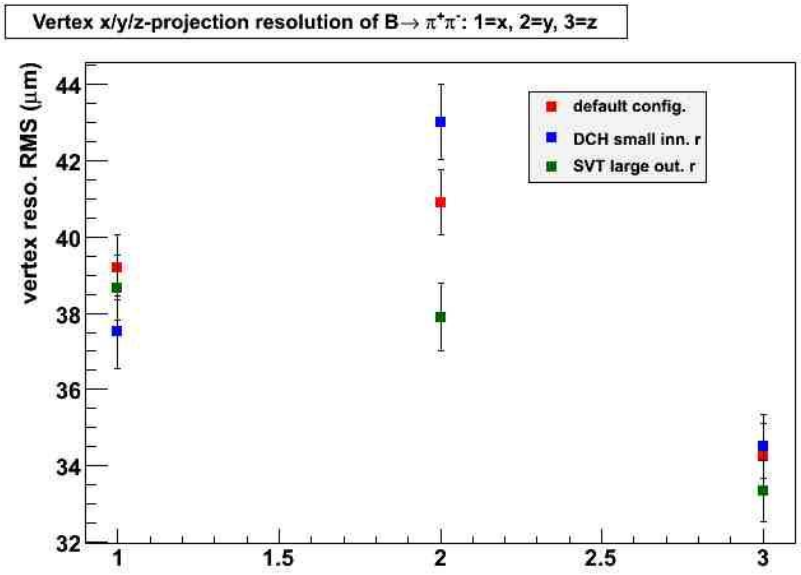

anti-p: phi reso. [rad]
default config.
DCH small inn. r
SVT large out. r
pt [GeV/c]

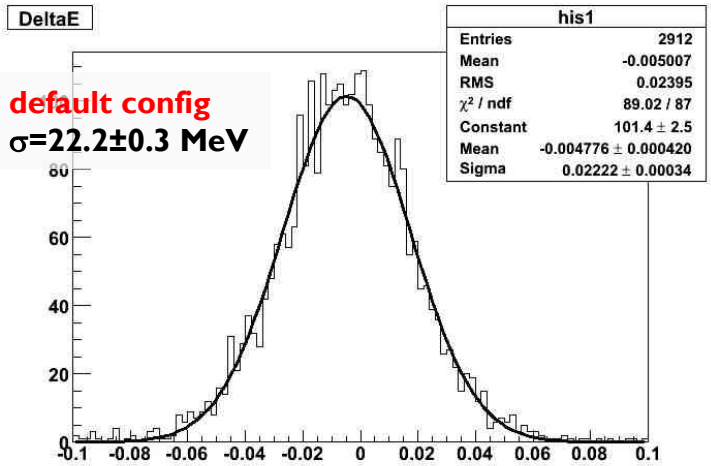

anti-p: theta reso. [rad]
default config.
DCH small inn. r
SVT large out. r
pt [GeV/c]

B reconstruction

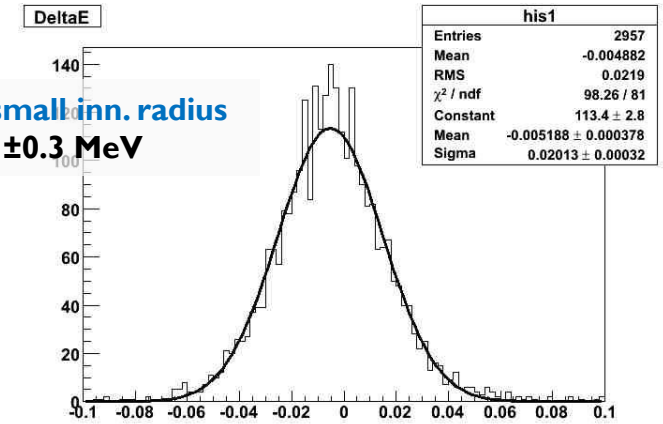
- Check how the configurations affect B reconstruction
- Consider 2 decay trees:
  - $B^0 \rightarrow \pi^+\pi^-$
  - $B \rightarrow D^{*+}K^-$, $D^{*+} \rightarrow D^0\pi^+$, $D^0 \rightarrow K^-\pi^+$ (D^0 mass constrained)
- Compare vertex resolutions and ΔE
- Note: the PmcMergeHits module was disabled in this tests because it requires some tuning. Therefore I expect that while the relative comparison of ΔE resolutions is meaningful, the absolute values are slightly underestimated

B reconstruction: $B \rightarrow \pi^+\pi^-$

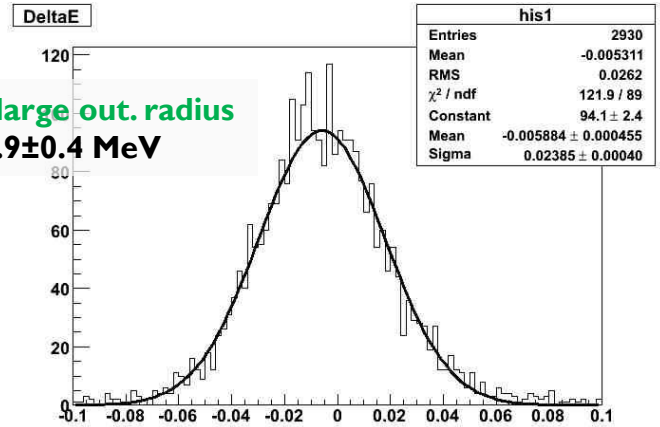




default config
σ=22.2±0.3 MeV

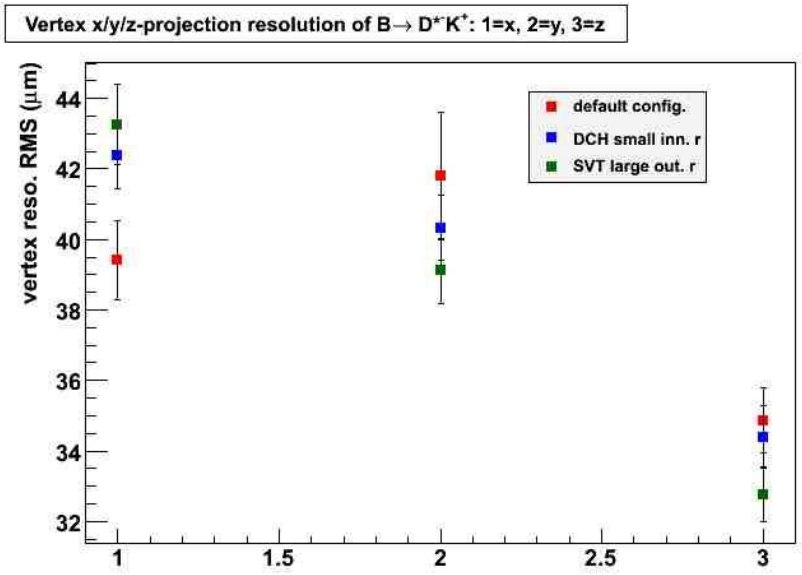


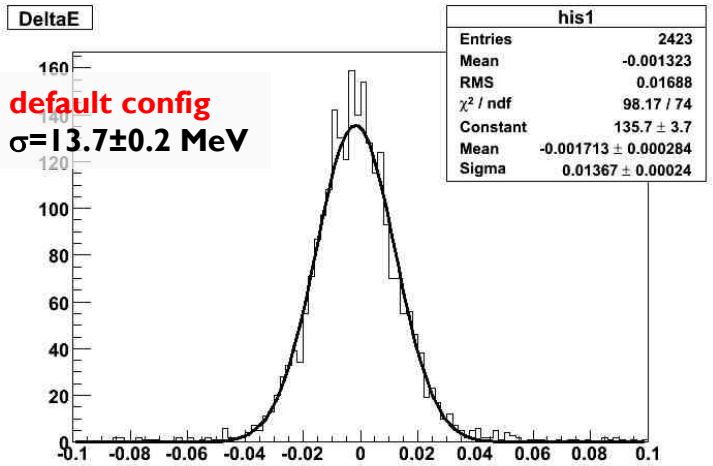
DCH small inn. radius
σ=20.1±0.3 MeV



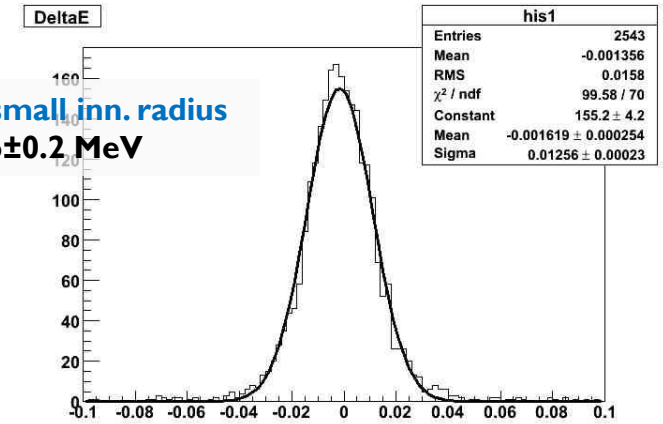
SVT large out. radius
σ=23.9±0.4 MeV

B reconstruction: B→D*⁻K⁺

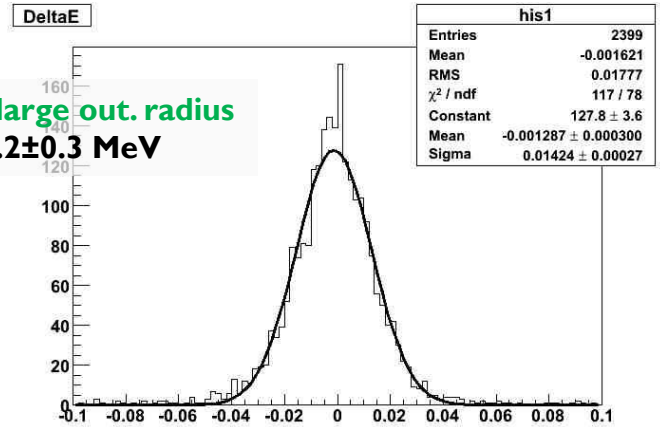




default config
σ=13.7±0.2 MeV



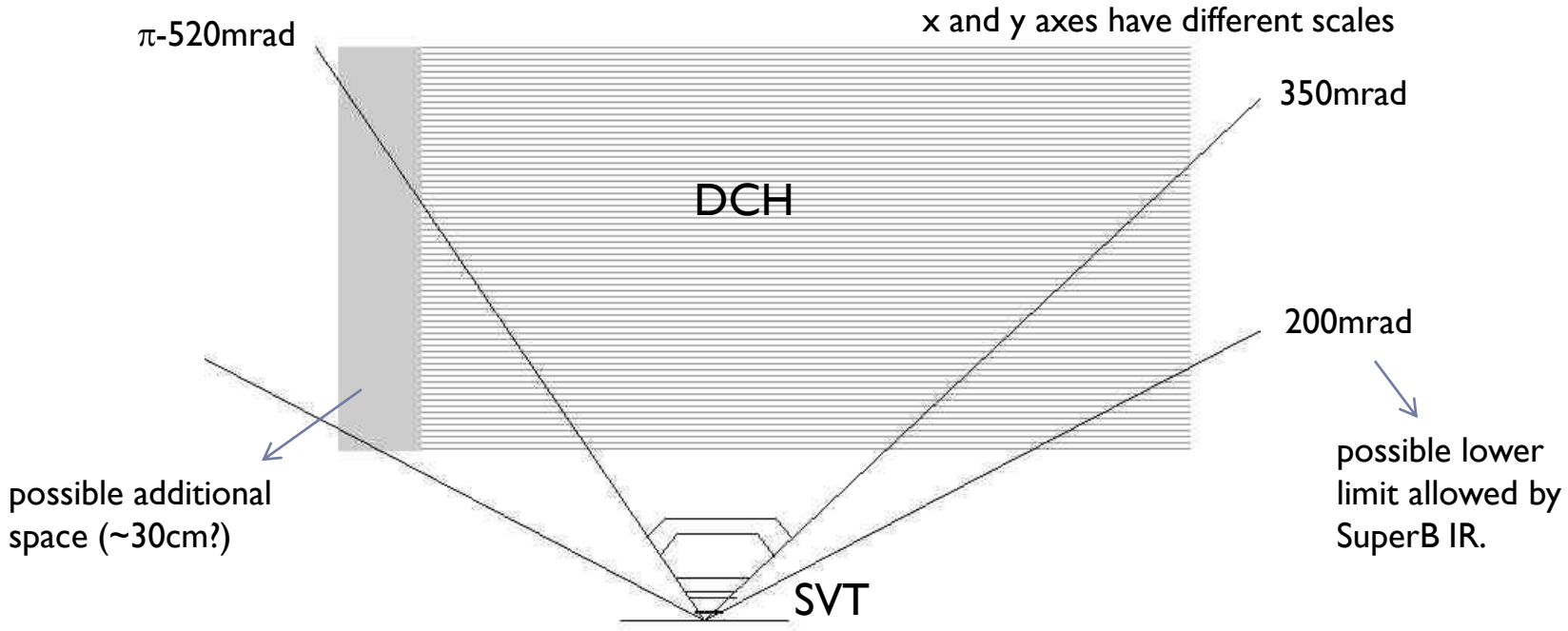
DCH small inn. radius
σ=12.6±0.2 MeV



SVT large out. radius
σ=14.2±0.3 MeV

Other configurations to explore

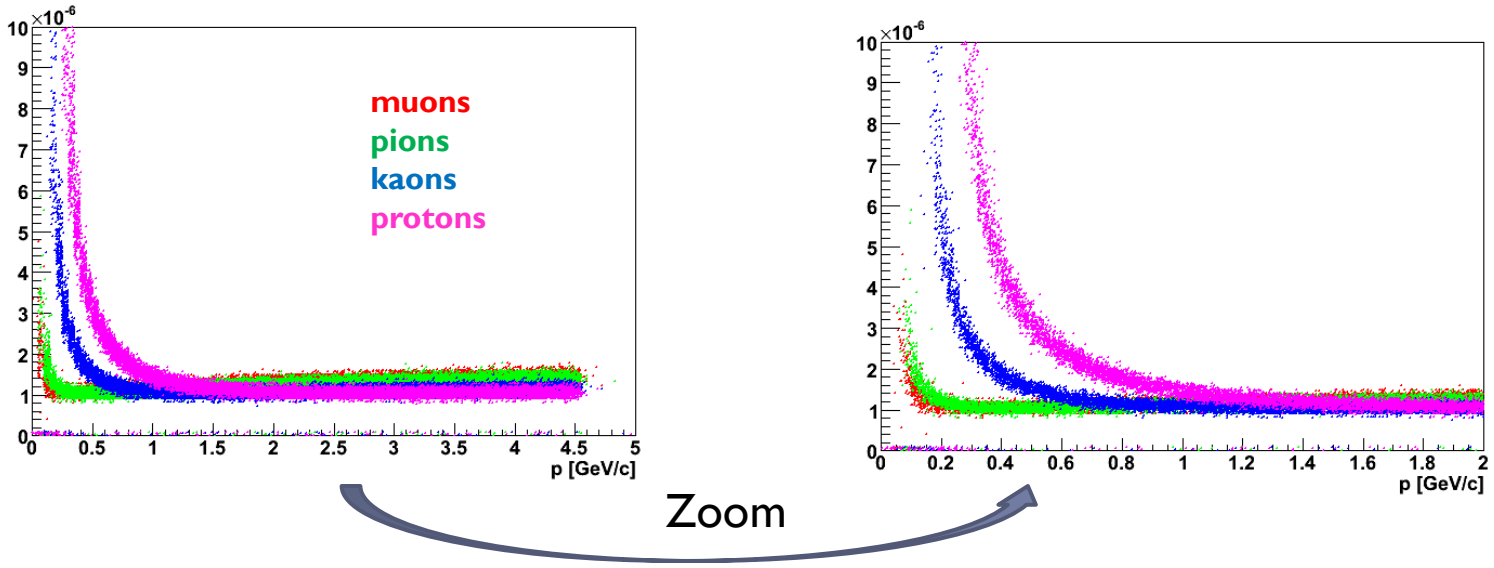
- There are other configurations to explore:
  - Change of DCH length (backward and forward)
  - Scan values of DCH inner radius till the vertex resolution worsens significantly
  - Explore the 200mrad scenario (see picture below)
  - Study/optimize internal DCH design (but formally this is not under DGWG's jurisdiction)



dE/dx measurement in FastSim

- Needed to build 'realistic' PID selectors required for optimization studies
- Presentation in Warwick: http://agenda.infn.it/getFile.py/access?contribId=58&sessionId=36&resId=0&materialId=slides&confId=1118
- Plan to commit dE/dx in May

Example of measured dE/dx vs. p in DCH (80:20 He-Ibu) for different particles



Summary and plans

Summary

- Tools to study the performance of different DCH configurations have been setup
- Development of dE/dx measurement in FastSim in progress

Short term plans

- Commit 1st version of dE/dx measurement in FastSim before next general meeting in Perugia
- Continue studying tracking performance of DCH configurations
  - Check prel. results shown today
  - Explore smaller DCH inner radii
  - Start studying the impact of changing the DCH length (backward and forward)
  - Explore the possibility of extending the ang. coverage to 200mrad
  - Possibly evaluate the impact on Breco (work in progress in FastSim/DGWG to setup the Brecoil-machinery)

possible for meeting in Perugia