DCH and SVT studies with FastSim

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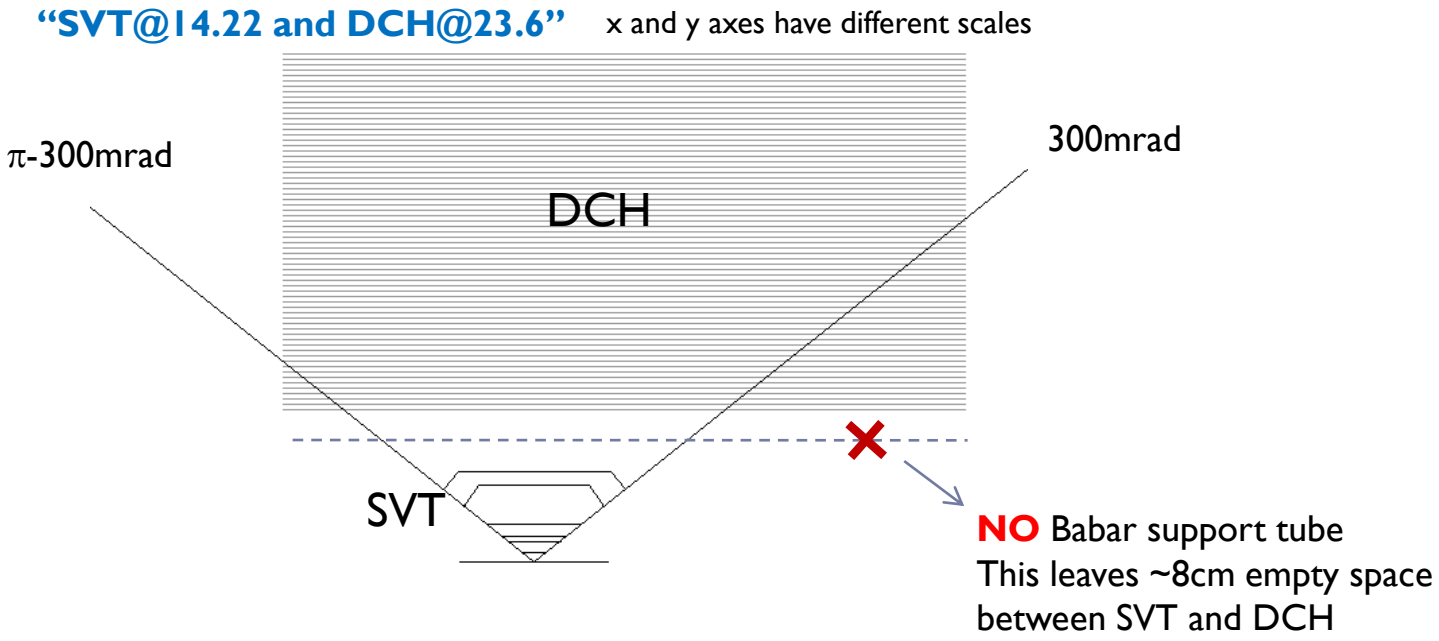
17 June 2009

Configurations I

- 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: nominal baseline. BaBar SVT + L0. Angular coverage 300mrad fwd and bwd

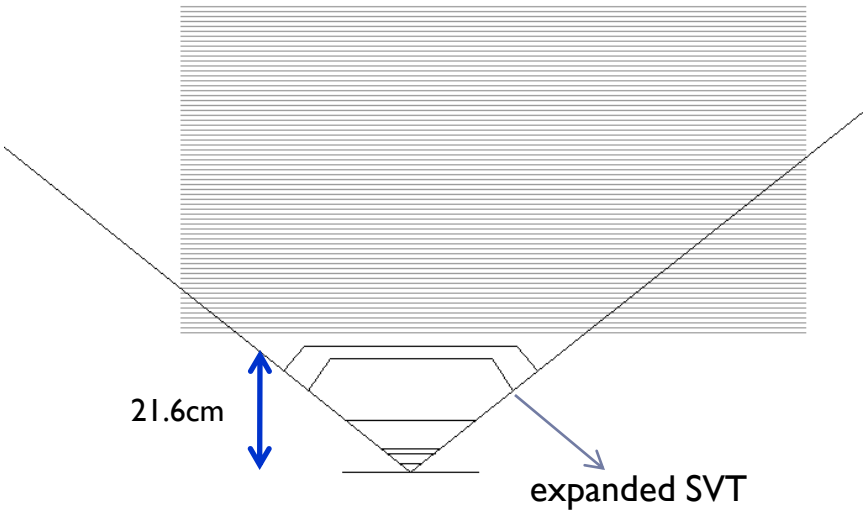


Configurations II

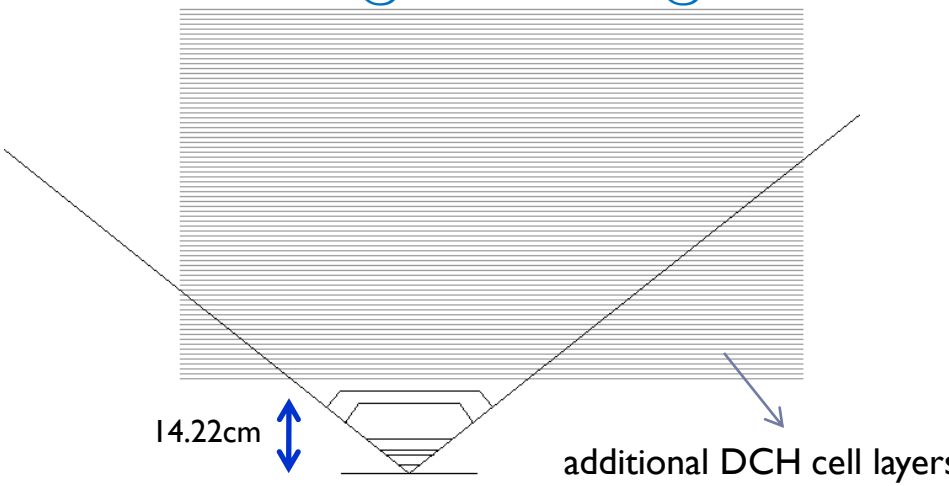
- DCH: Babar
  - 10 SuperLayers (BaBar)
  - inner wall: 23.6cm; spatial reso: 125μm
- SVT: nominal baseline with
  - L3: 5.92cm→**9.0cm**
  - L4:12.22cm→**19.6cm**
  - L5:14.22cm→**21.6cm**

- DCH:
  - 10 SuperLayers (Babar) **+ 4 cell layers**
  - inner wall: 23.6cm → **16.22cm**
  - Axial/Stereo+/Stereo- geometry
  - spatial reso: 125μm
- SVT: nominal baseline

"SVT@21.6 and DCH@23.6"



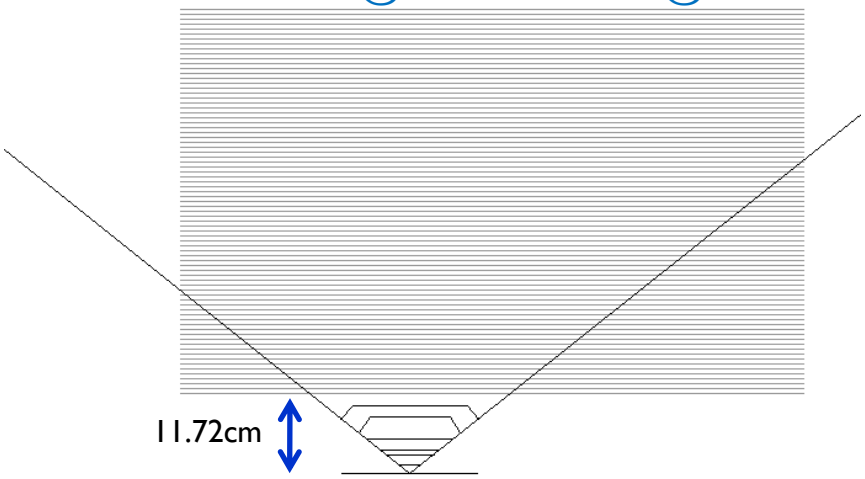
"SVT@14.22 and DCH@16.22"



Configurations III

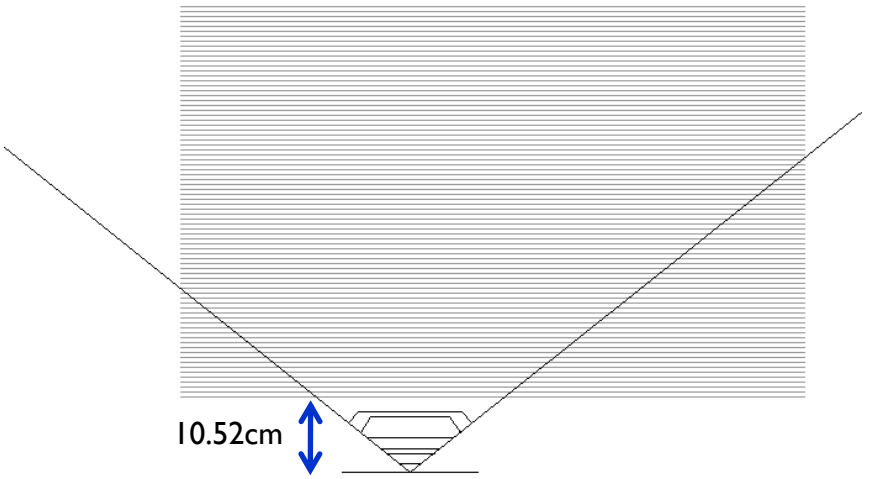
- DCH:
  - 10 SuperLayers (Babar) **+ 6 cell layers**
  - inner wall: 23.6cm → **13.72cm**
  - Axial/Stereo+/Stereo- geometry
  - spatial reso: 125μm
- SVT: nominal baseline with
  - L3: 5.92cm
  - L4:12.22cm→**9.72cm**
  - L5:14.22cm→**11.72cm**

"SVT@11.72 and DCH@13.72"



- DCH: Babar
  - 10 SuperLayers (Babar) **+ 7 cell layers**
  - inner wall: 23.6cm → **12.52cm**
  - Axial/Stereo+/Stereo- geometry
  - spatial reso: 125μm
- SVT: nominal baseline with
  - L3: 5.92cm
  - L4:12.22cm→**9.52cm**
  - L5:14.22cm→**10.52cm**

"SVT@10.52 and DCH@12.52"

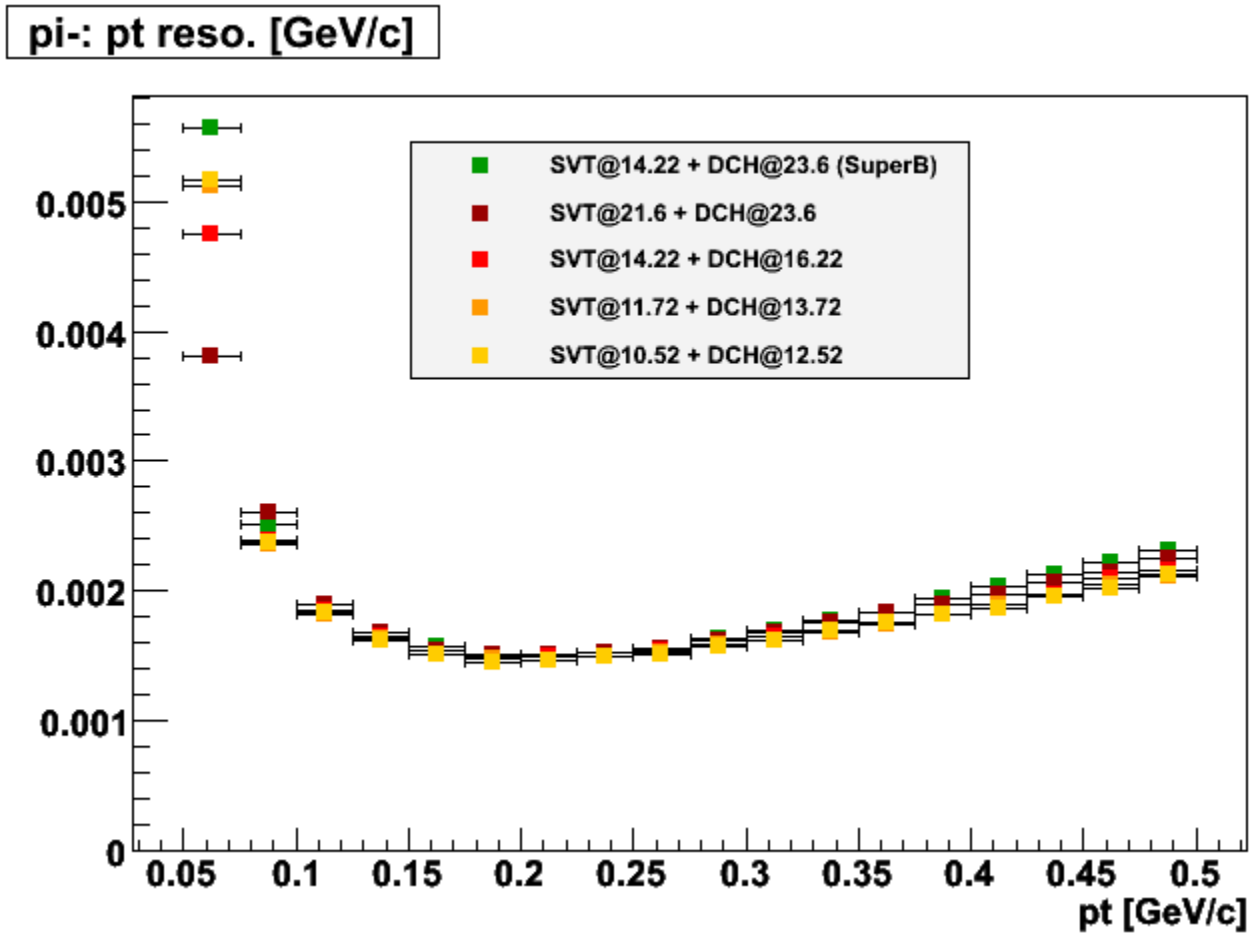


Single particles

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

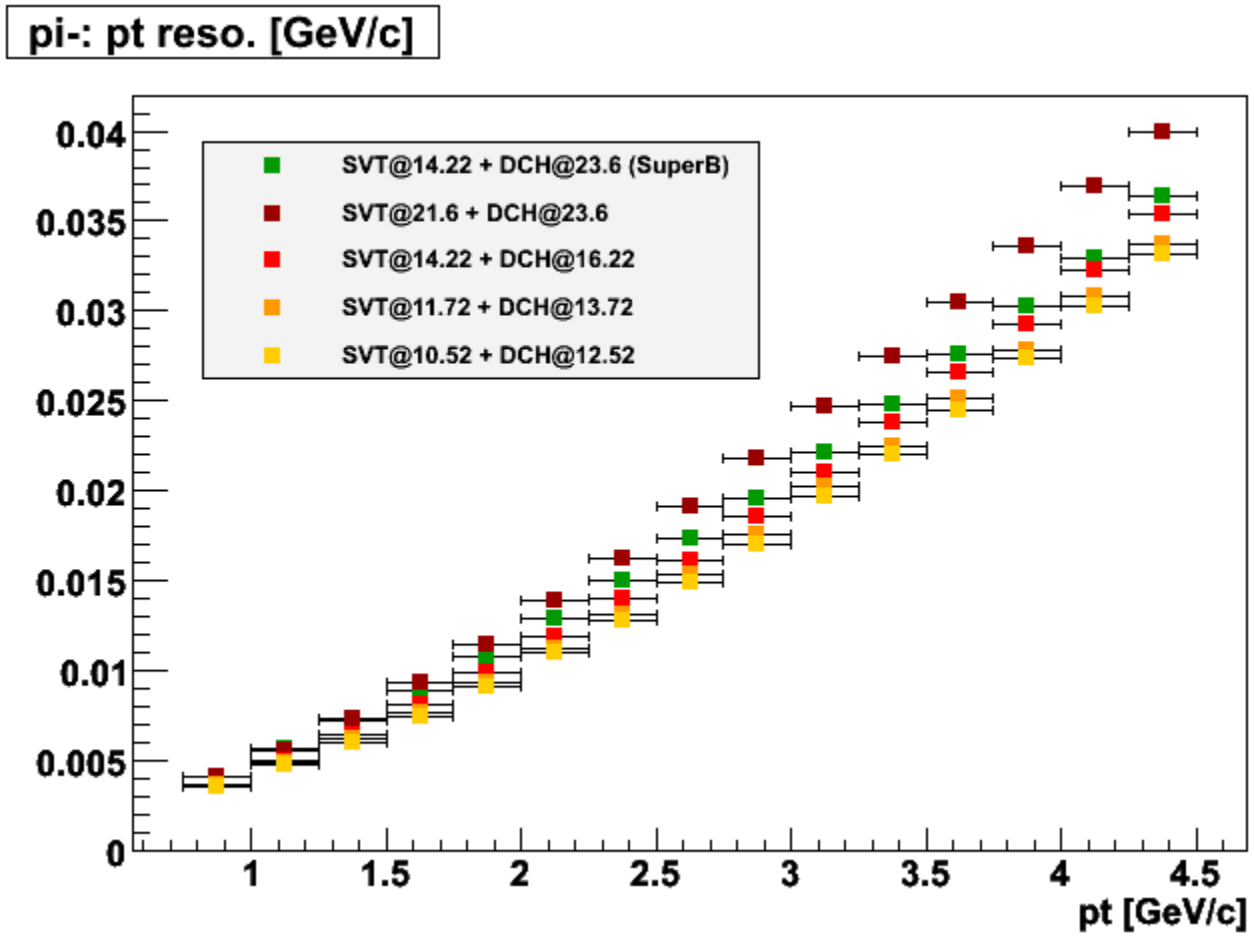
Note:
I didn't focus on the track reco. efficiencies. Some problems observed in previous revisions of V0.0.9. Code has evolved quite recently. See Dave's talk later in this session

pt resolution vs. pt



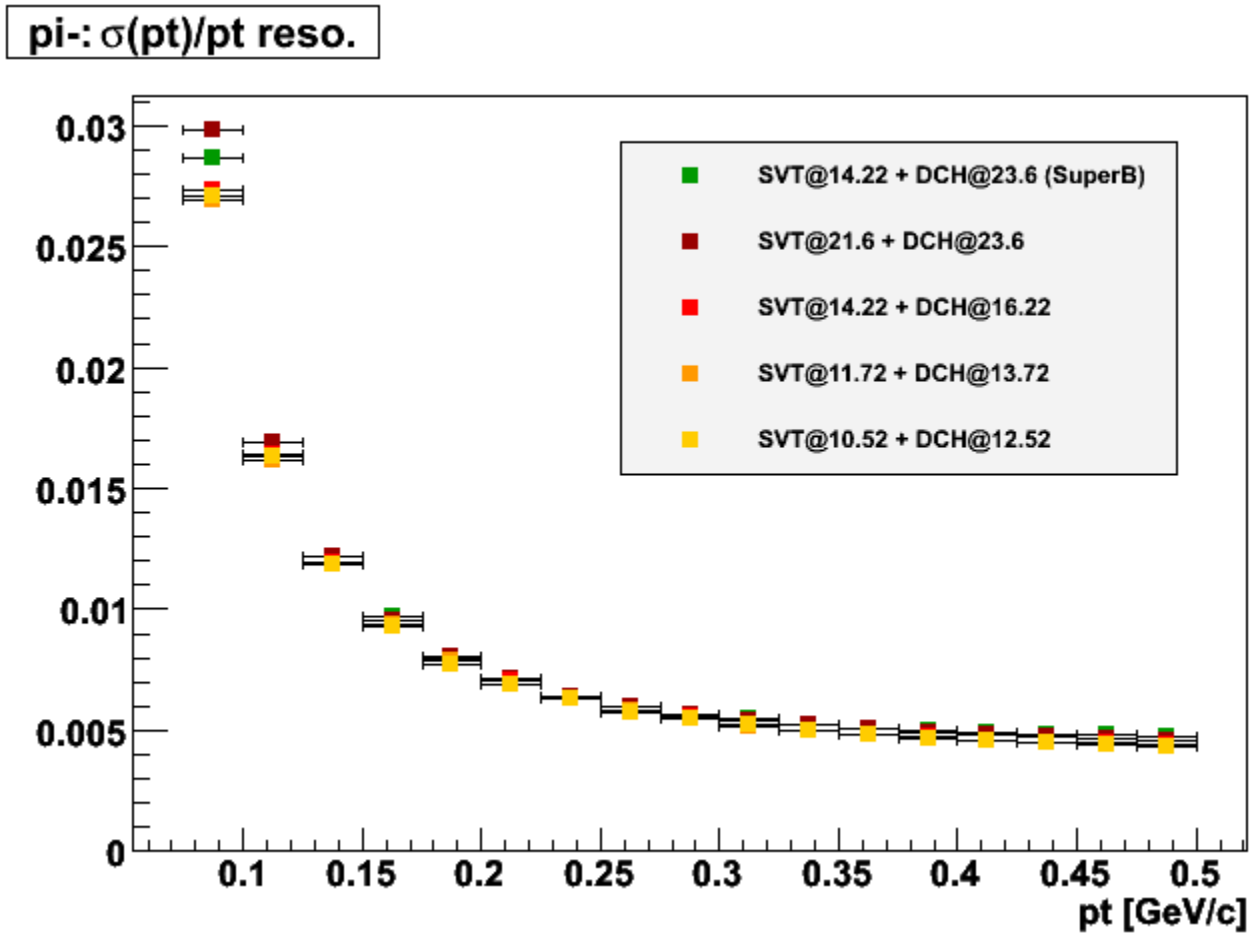
- configurations with smaller DCH radii give a slightly better pt measurement at pt in [~0.1-0.5]GeV/c

pt resolution vs. pt

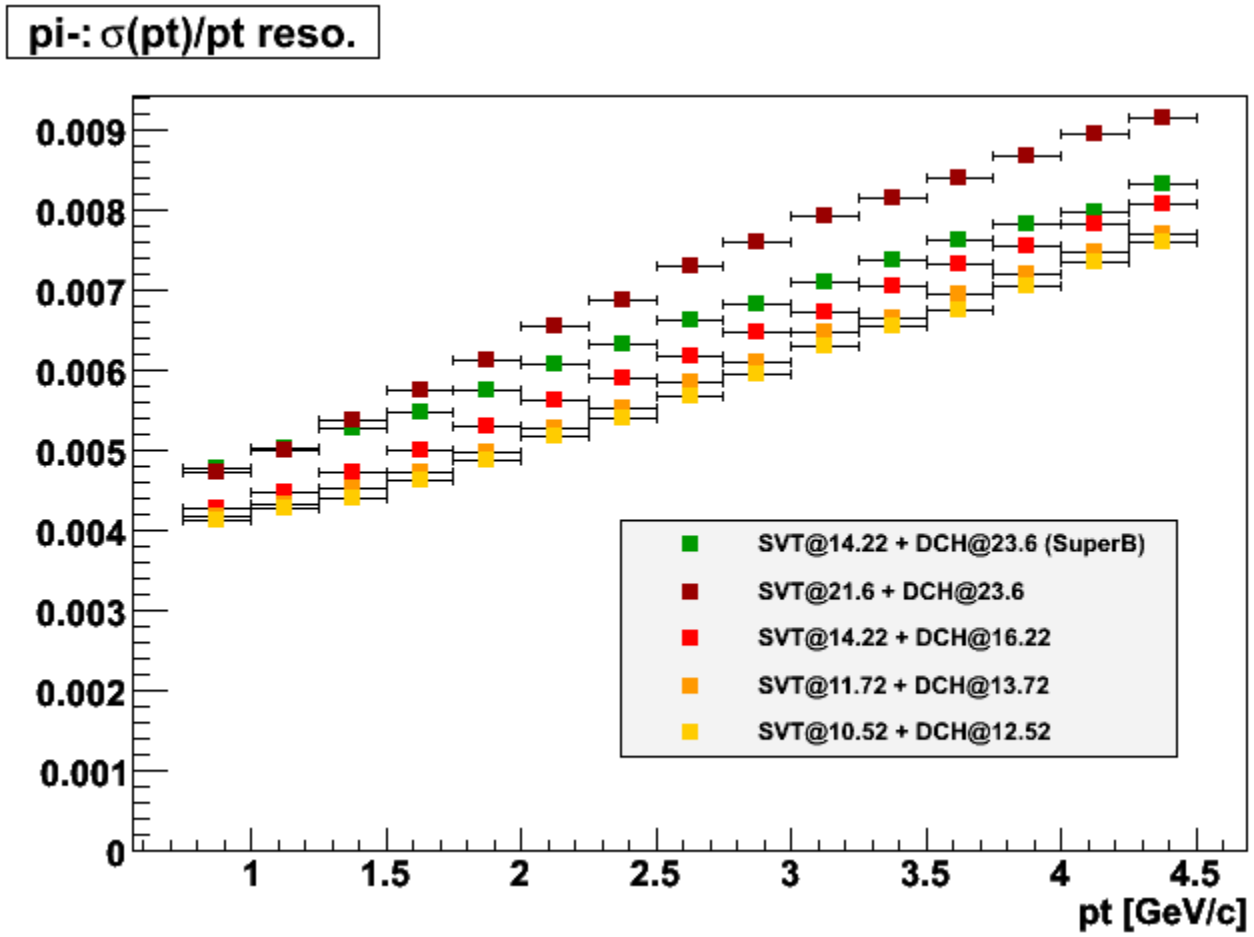


- the difference is larger at higher pt

σ(pt)/pt vs. pt

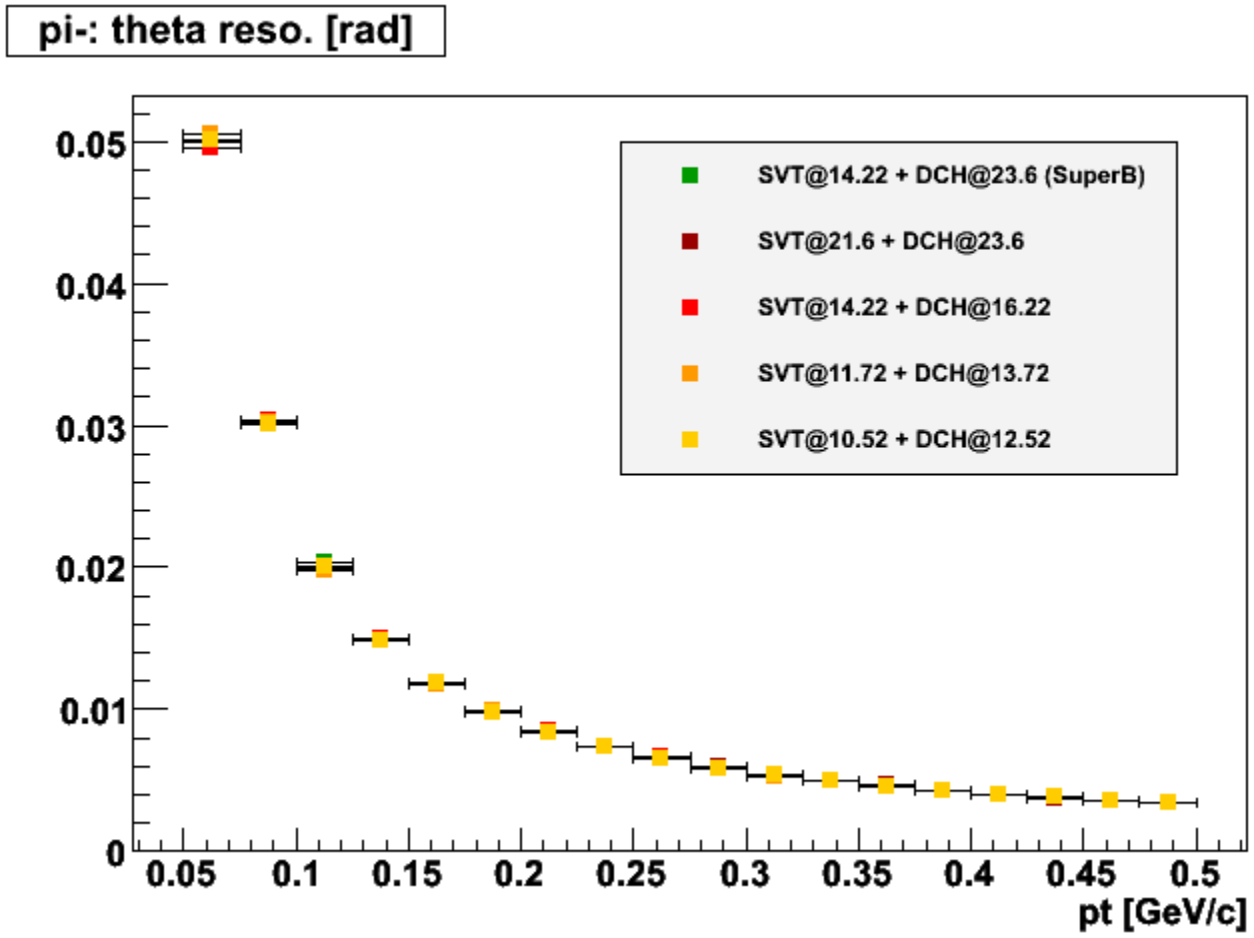

pi-: σ(pt)/pt reso.
SVT@14.22 + DCH@23.6 (SuperB)
SVT@21.6 + DCH@23.6
SVT@14.22 + DCH@16.22
SVT@11.72 + DCH@13.72
SVT@10.52 + DCH@12.52
0.03
0.025
0.02
0.015
0.01
0.005
0
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
pt [GeV/c]

σ(pt)/pt vs. pt

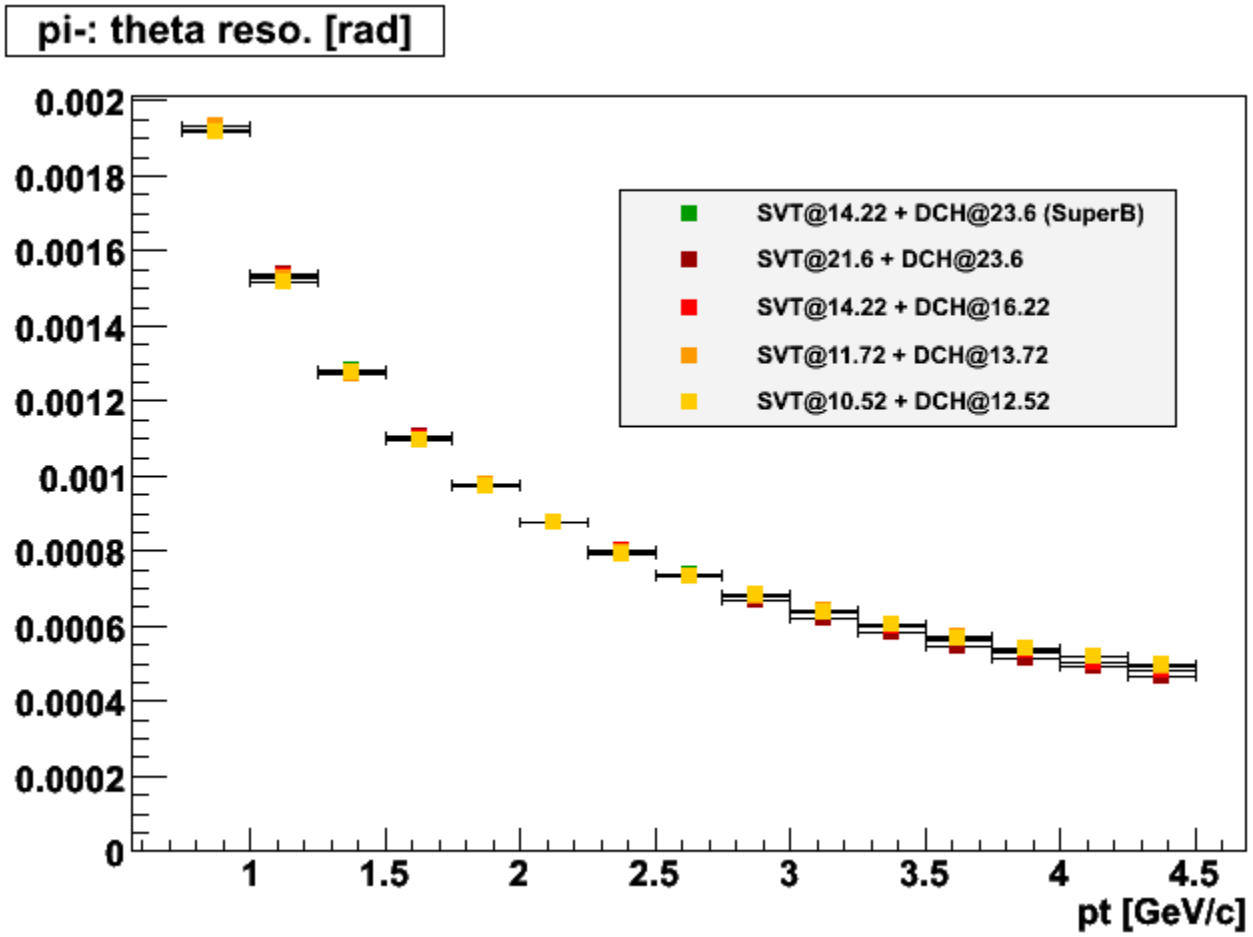


- The configuration with the SVT extended to a radius of 21.6cm give a worse pt measuremnt

polar angle vs. pt

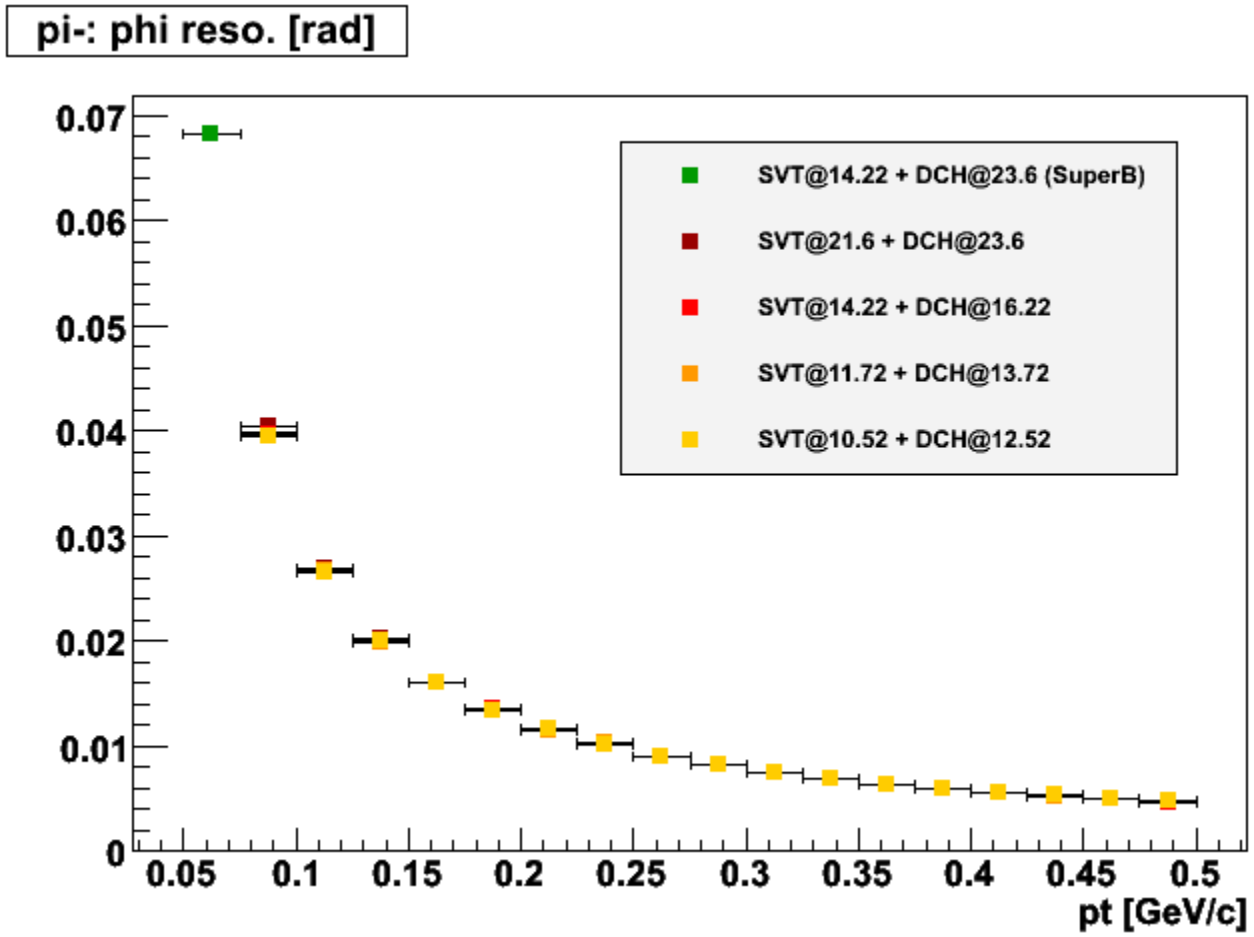


polar angle vs. pt

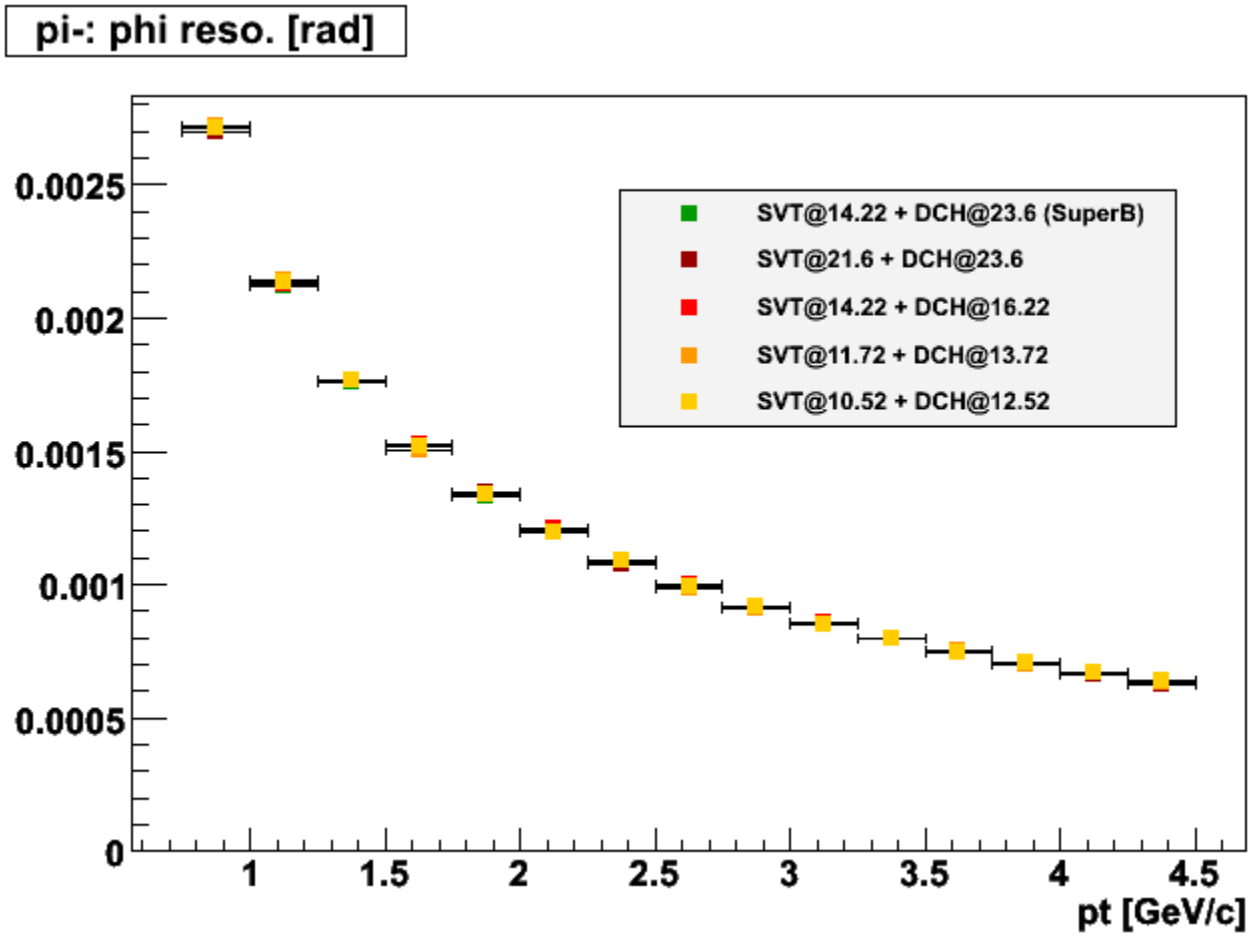


- In general no significant difference in the measurement of θ

Phi angle vs. pt



Phi angle vs. pt



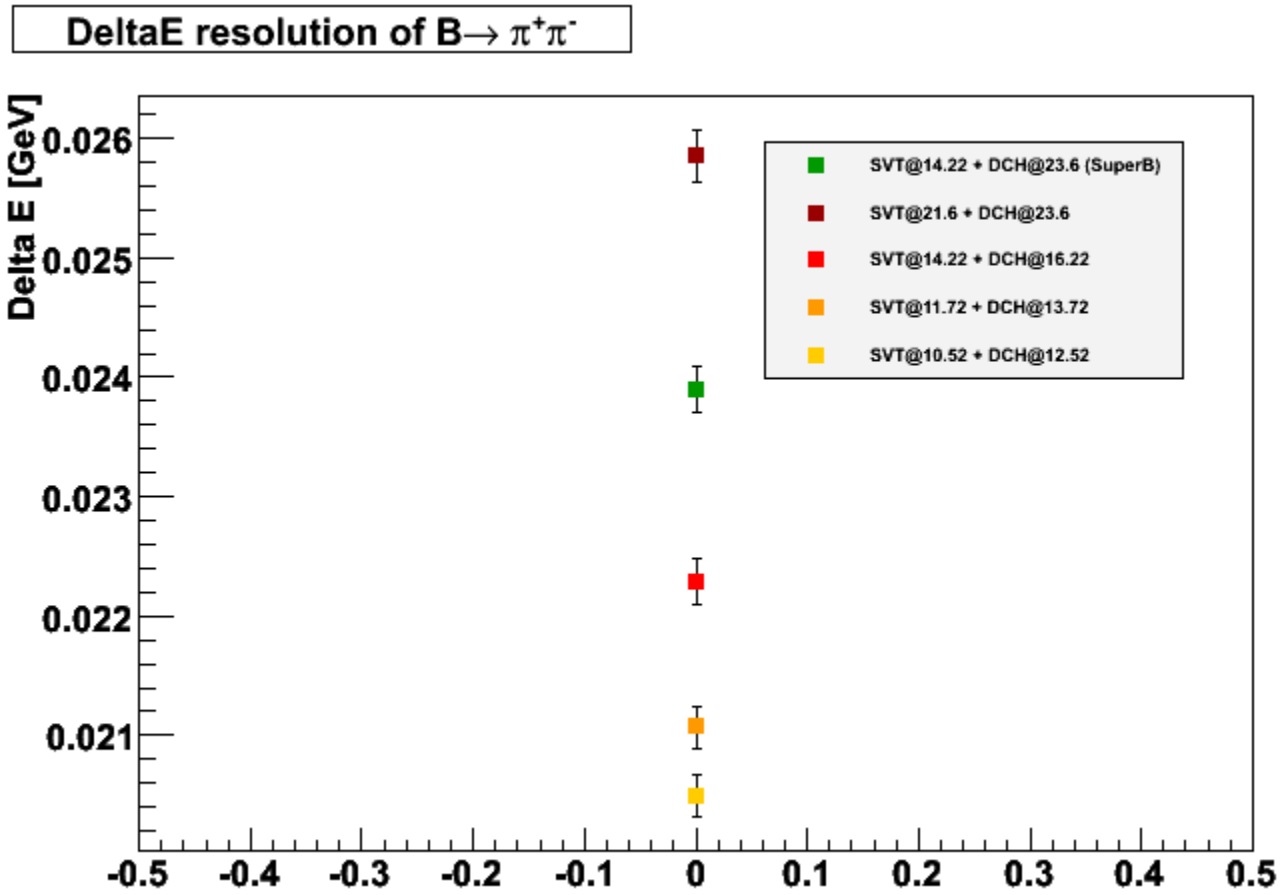
- In general no significant difference in the measurement of ϕ

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, ΔE and efficiency

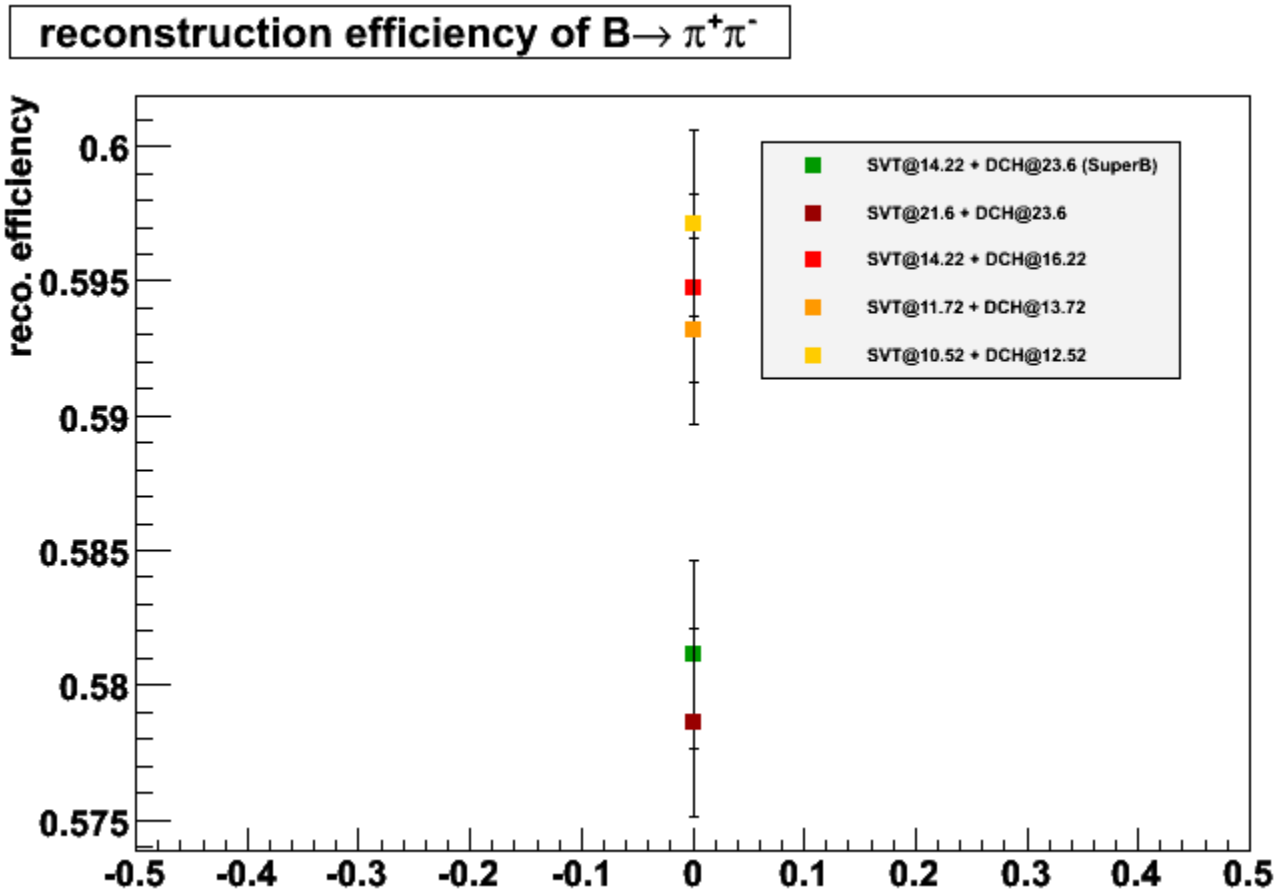
- Note: the PmcMergeHits module was disabled in this tests. Therefore while the relative comparison of ΔE resolutions is probably meaningful, the absolute values are a little underestimated

$B \rightarrow \pi^+\pi^-$: ΔE resolution



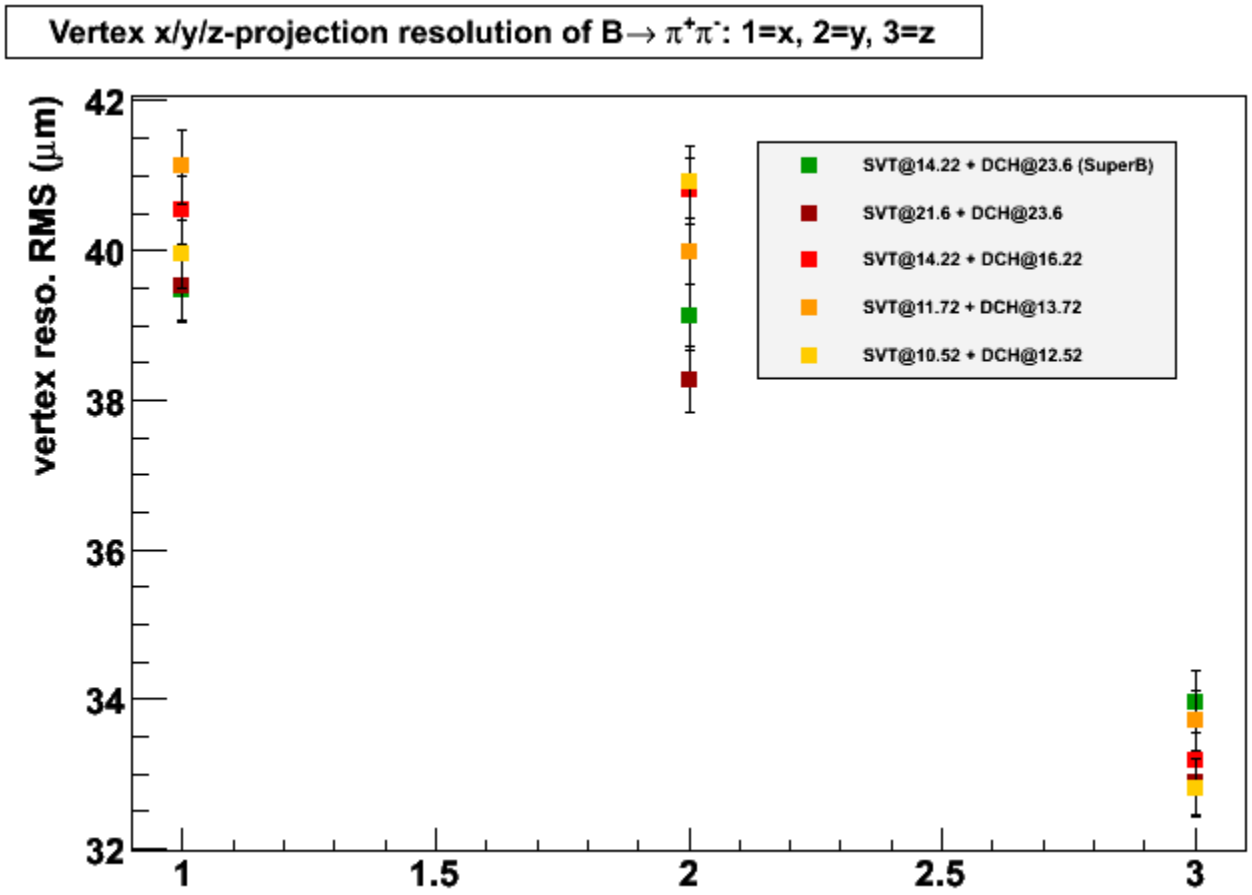
- Consistently with the results showed for the single tracks, the kinematic quantities of the composite particles have a better resolutions when the number of DCH layers increases

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



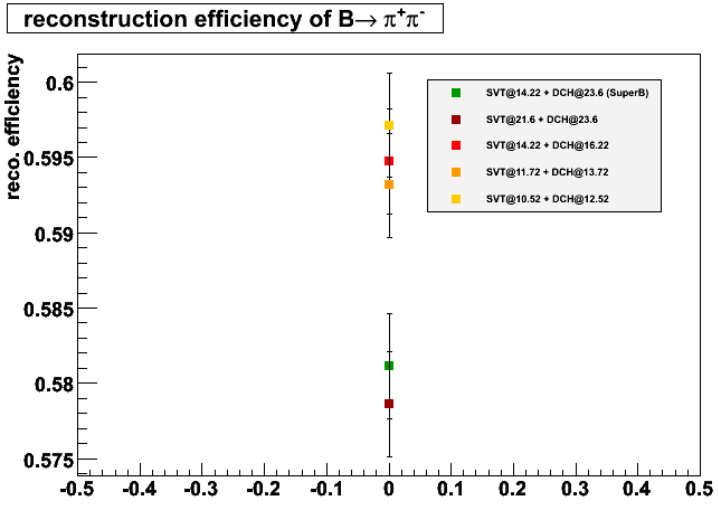
- There's a ~2% (absolute) efficiency gain when the first DCH layers are closer to the IP

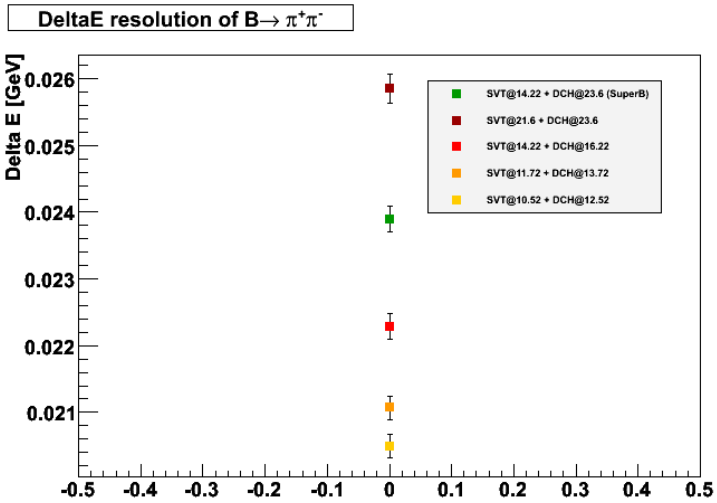
$B \rightarrow \pi^+\pi^-$: vertex resolution

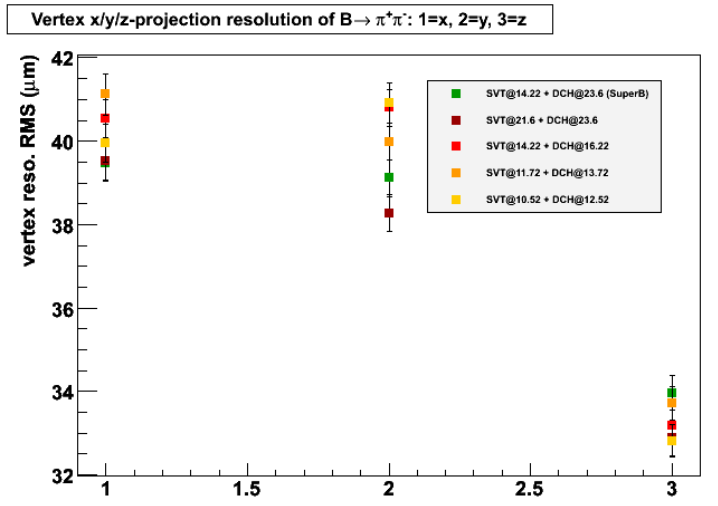


- No significant difference in the vertex resolution

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

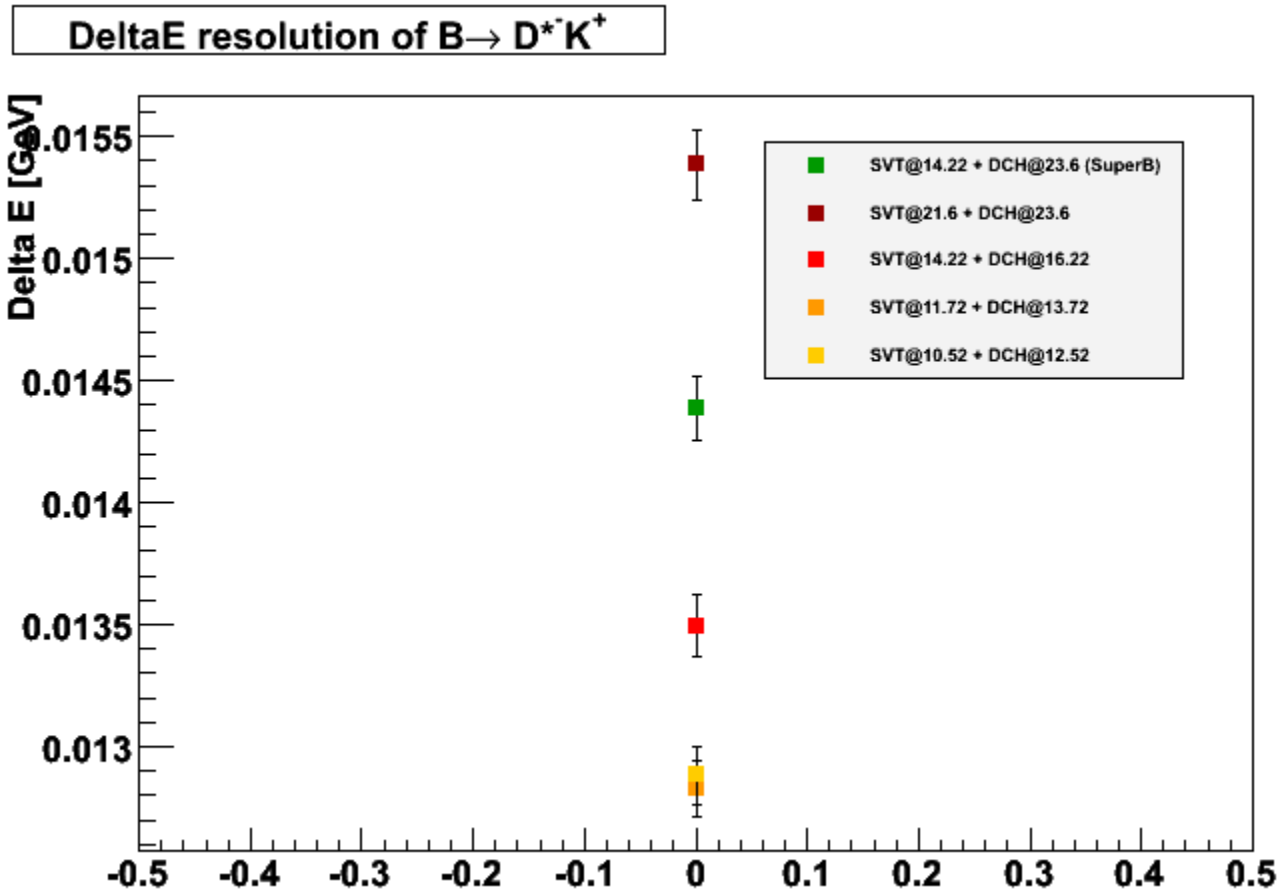






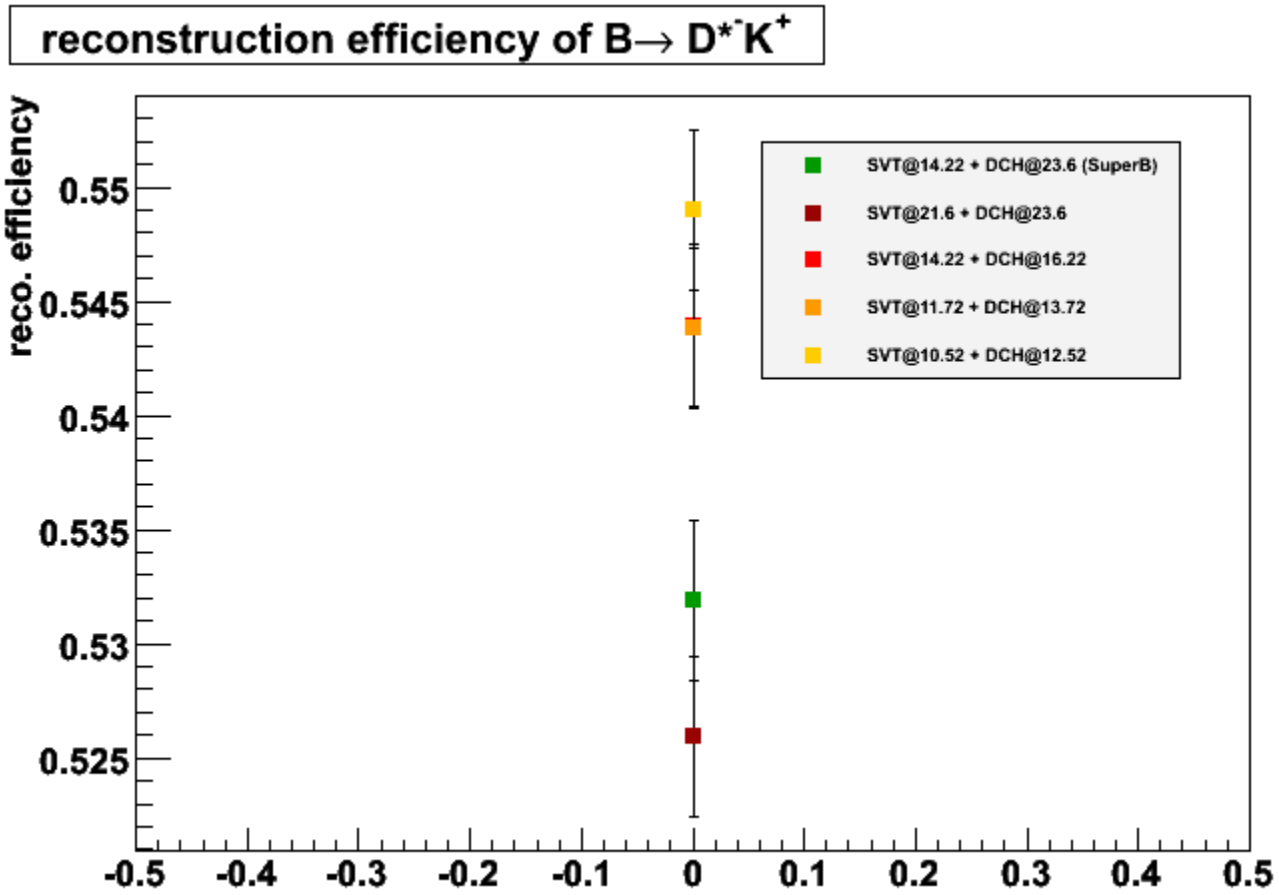
- best performance with small DCH inner radius:
  - ΔE resolution improves up to 25%
  - ~2% (absolute) reco. efficiency increase
  - vertex resolution variation negligible

$B \rightarrow D^{*-}K^{+}$: ΔE resolution



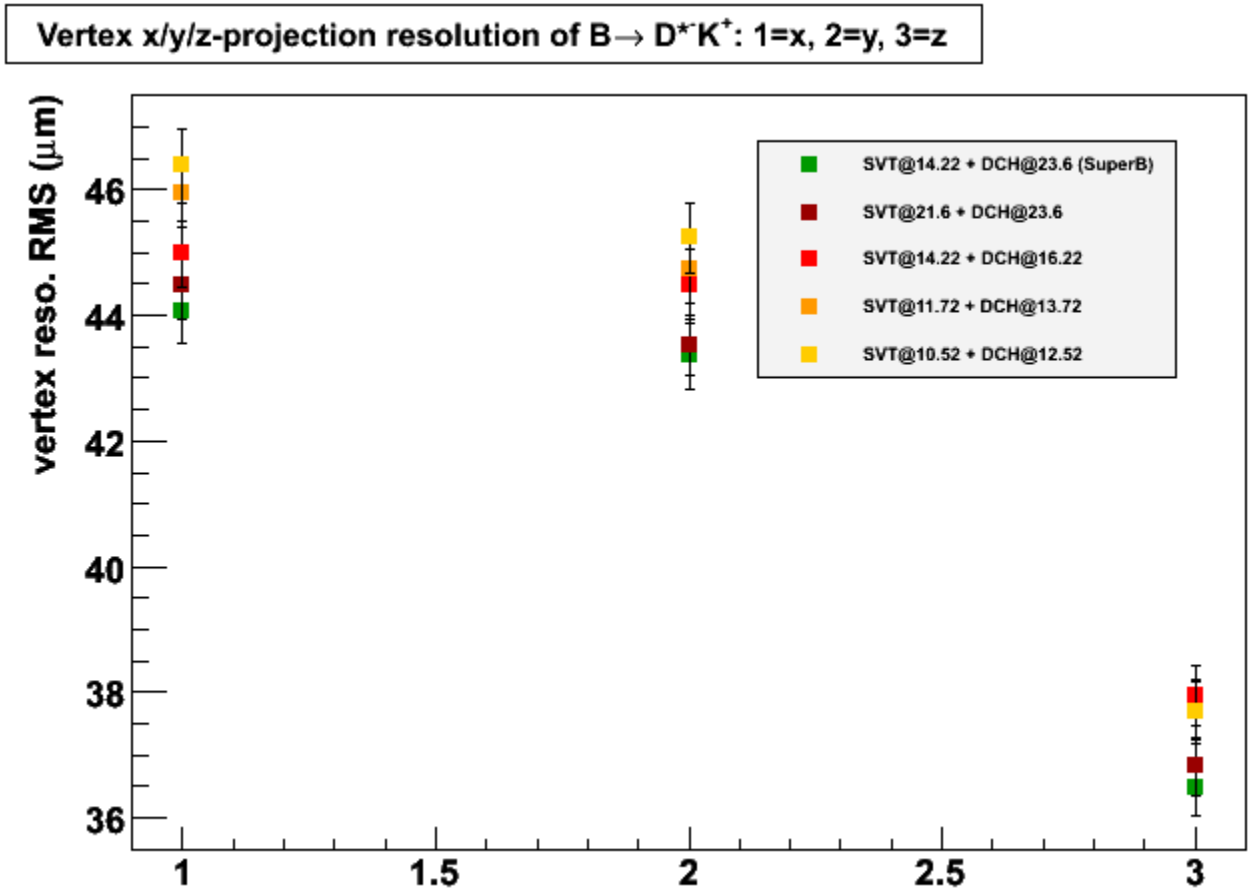
- Trend similar to what observed in $B \rightarrow \pi\pi$

B→D*⁻K⁺ : reconstruction efficiency



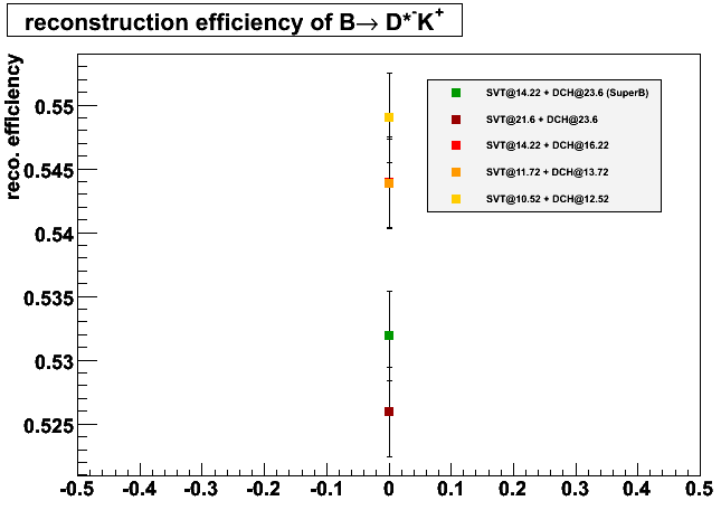
- Trend similar to what observed in B→ππ

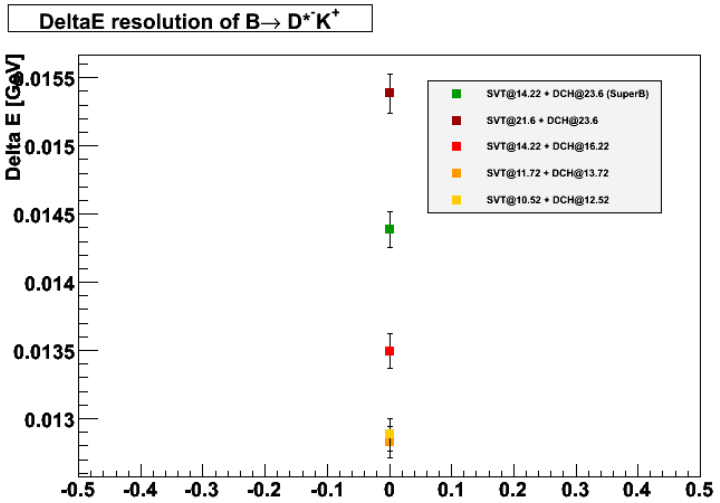
B→D*⁻K⁺ : vertex resolution

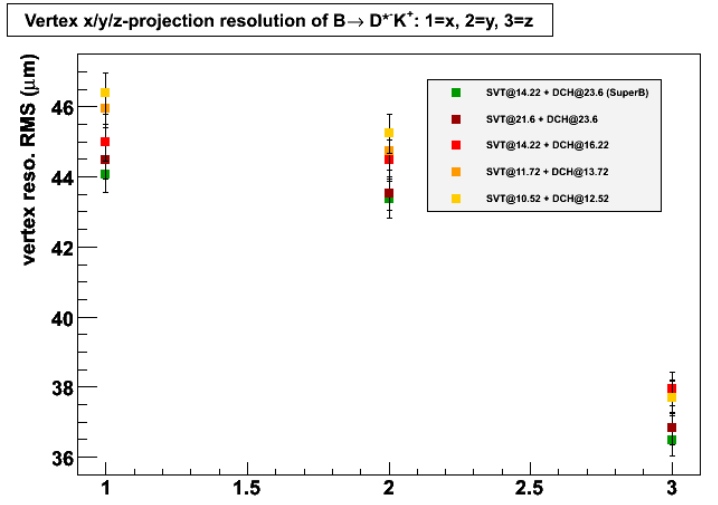


- Trend similar to what observed in B→ππ

B→D*⁻K⁺ : summary





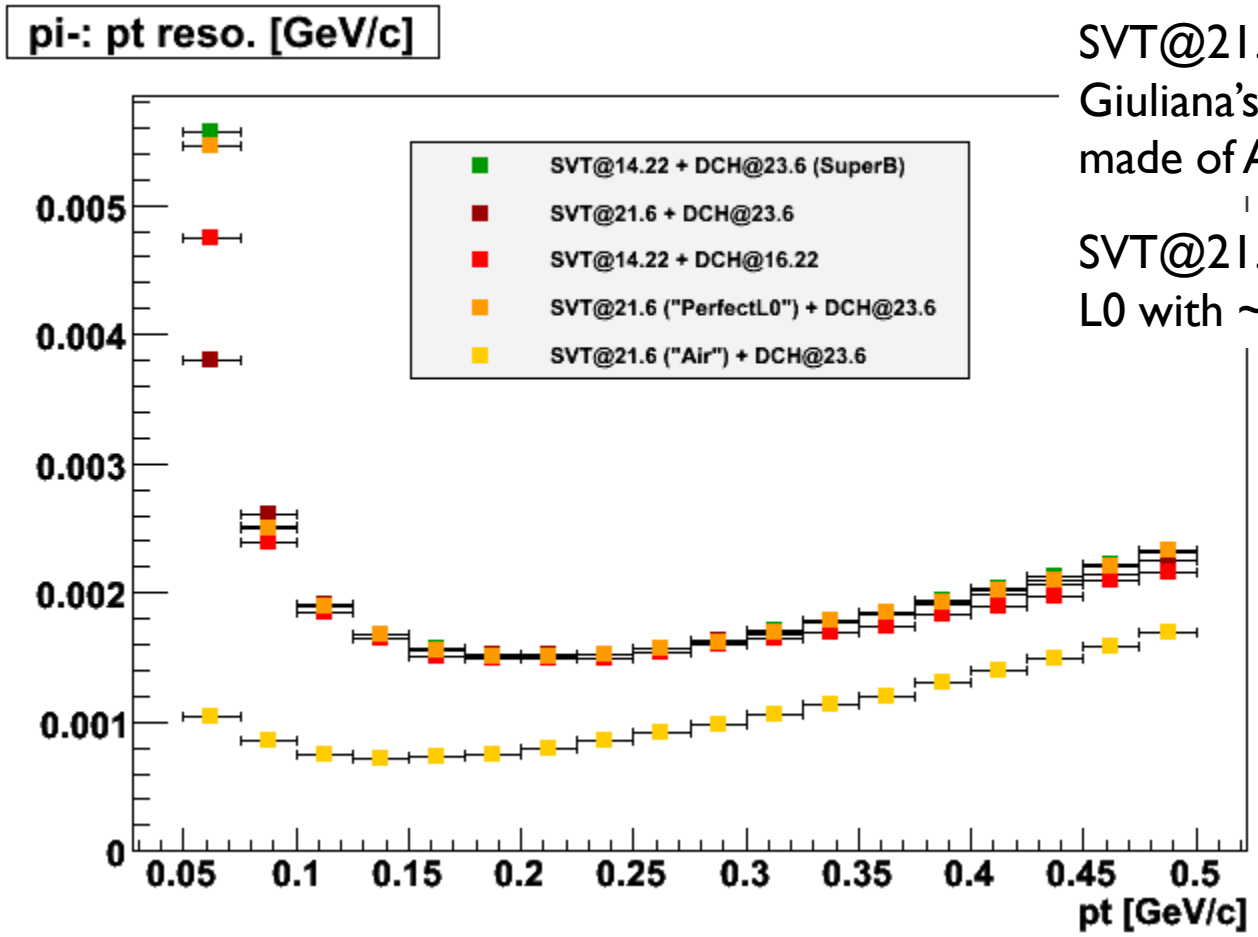


- best performance with small DCH inner radius:
  - ΔE resolution improves up to 20%
  - ~2% (absolute) reco. efficiency increase
  - vertex resolution variation negligible

Conclusions

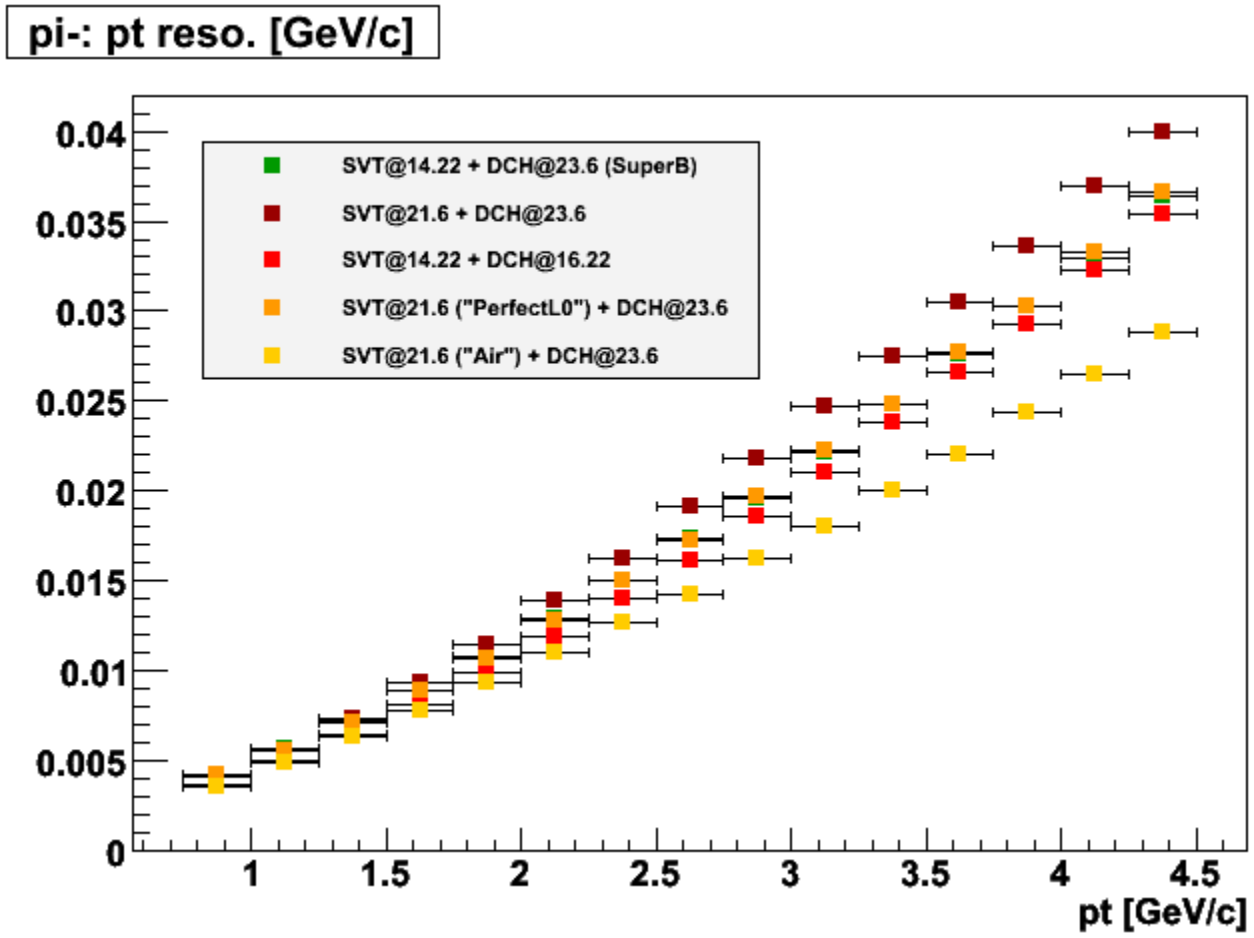
- Configurations with smaller SVT and DCH radii give better performance. ..
- But other factors play a role in these studies:
  - (machine) backgrounds
  - pattern recognition (not included in FastSim, though some effects can be 'parameterized')
- We need to know the bkg rates

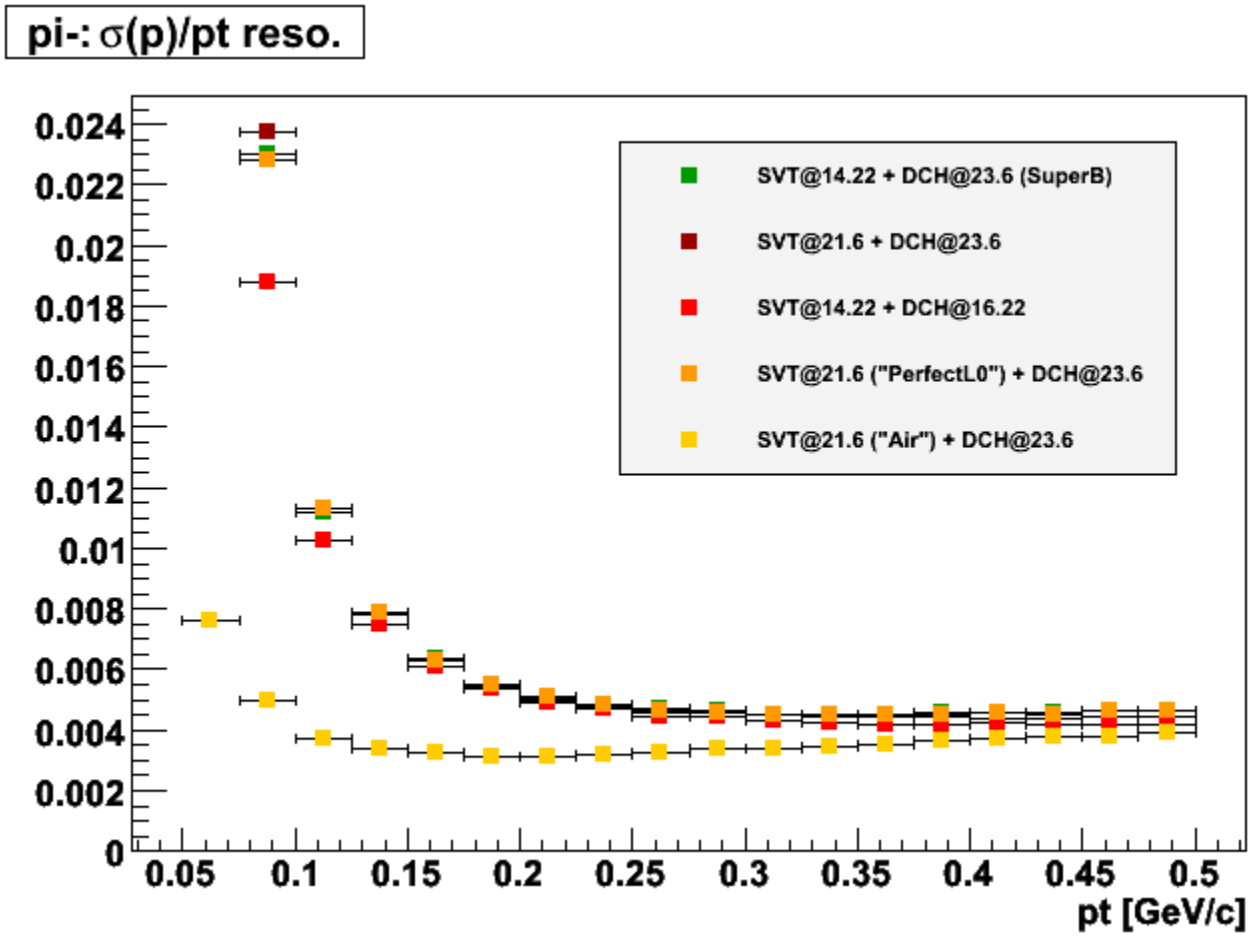
BACKUP

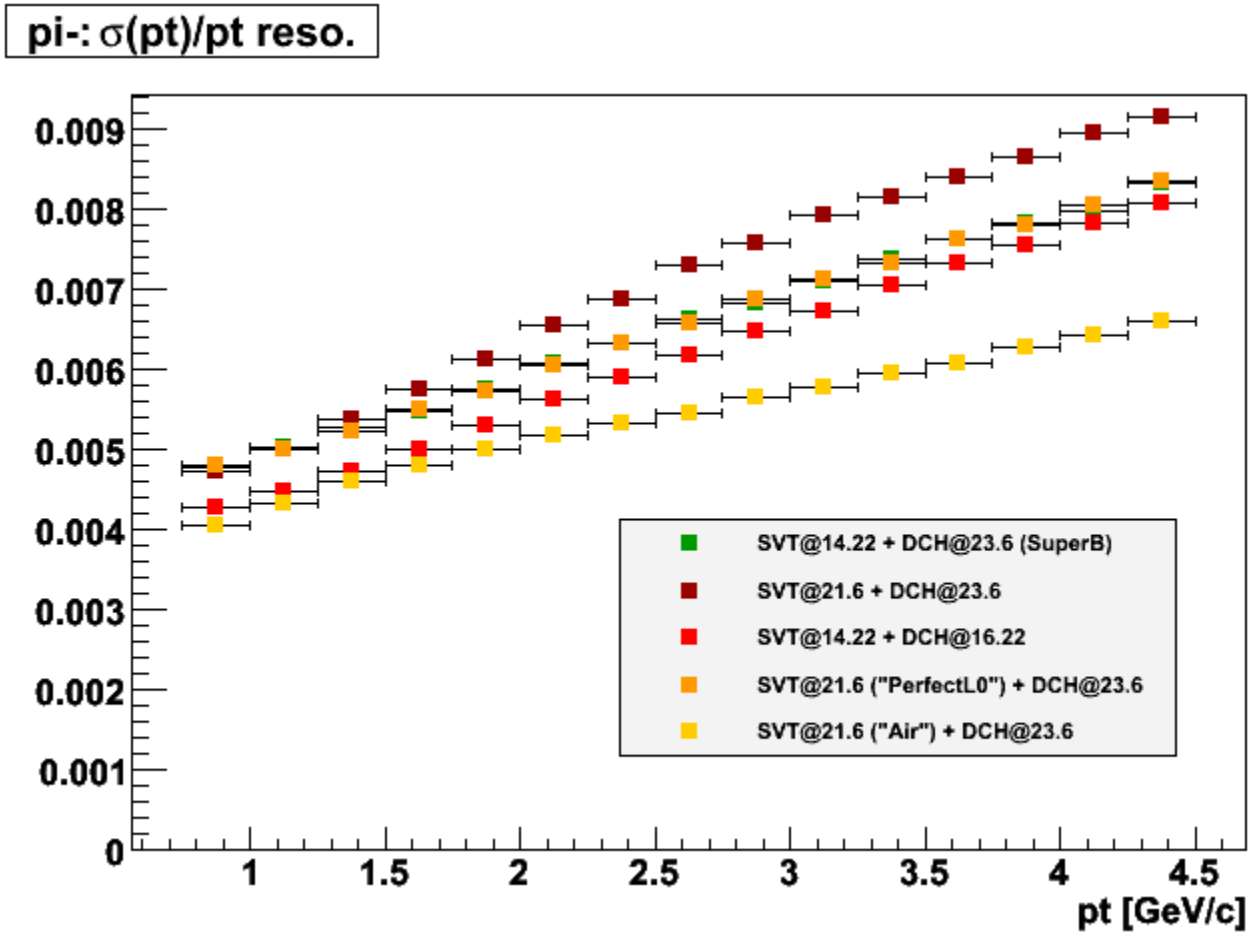


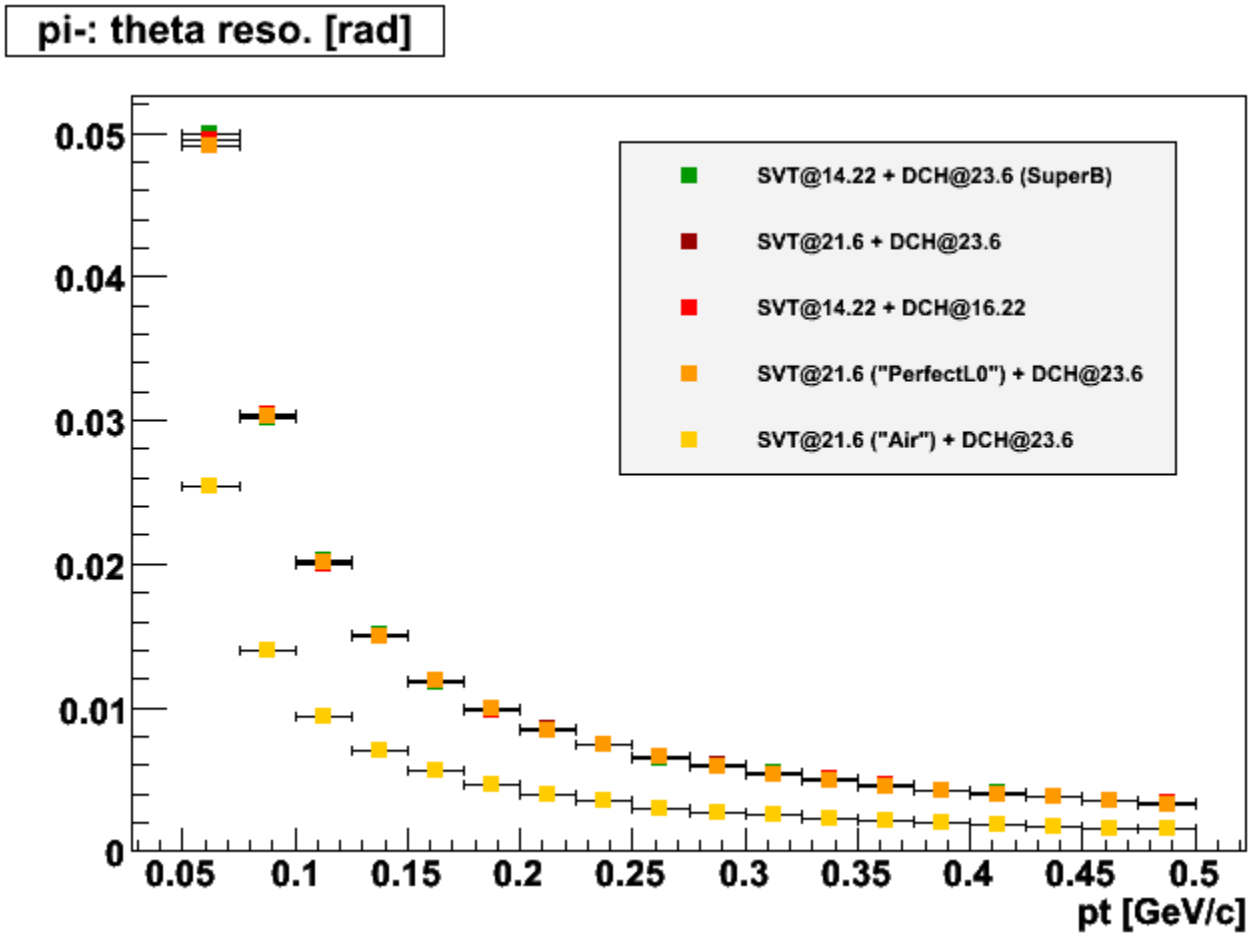
SVT@21.6("Air"): Giuliana's dream SVT made of Air

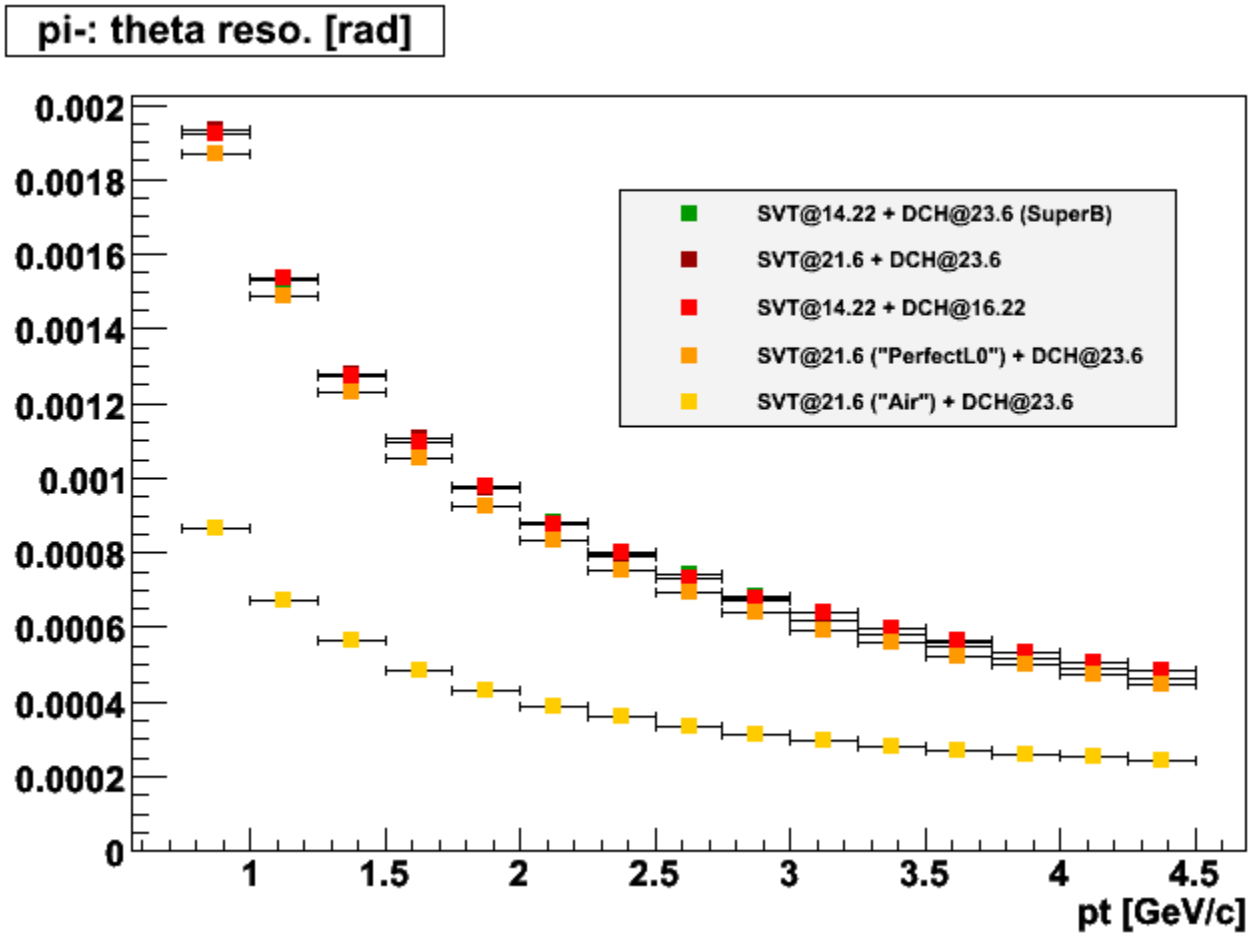
SVT@21.6("PerfectL0"): L0 with ~perfect spat. reso.

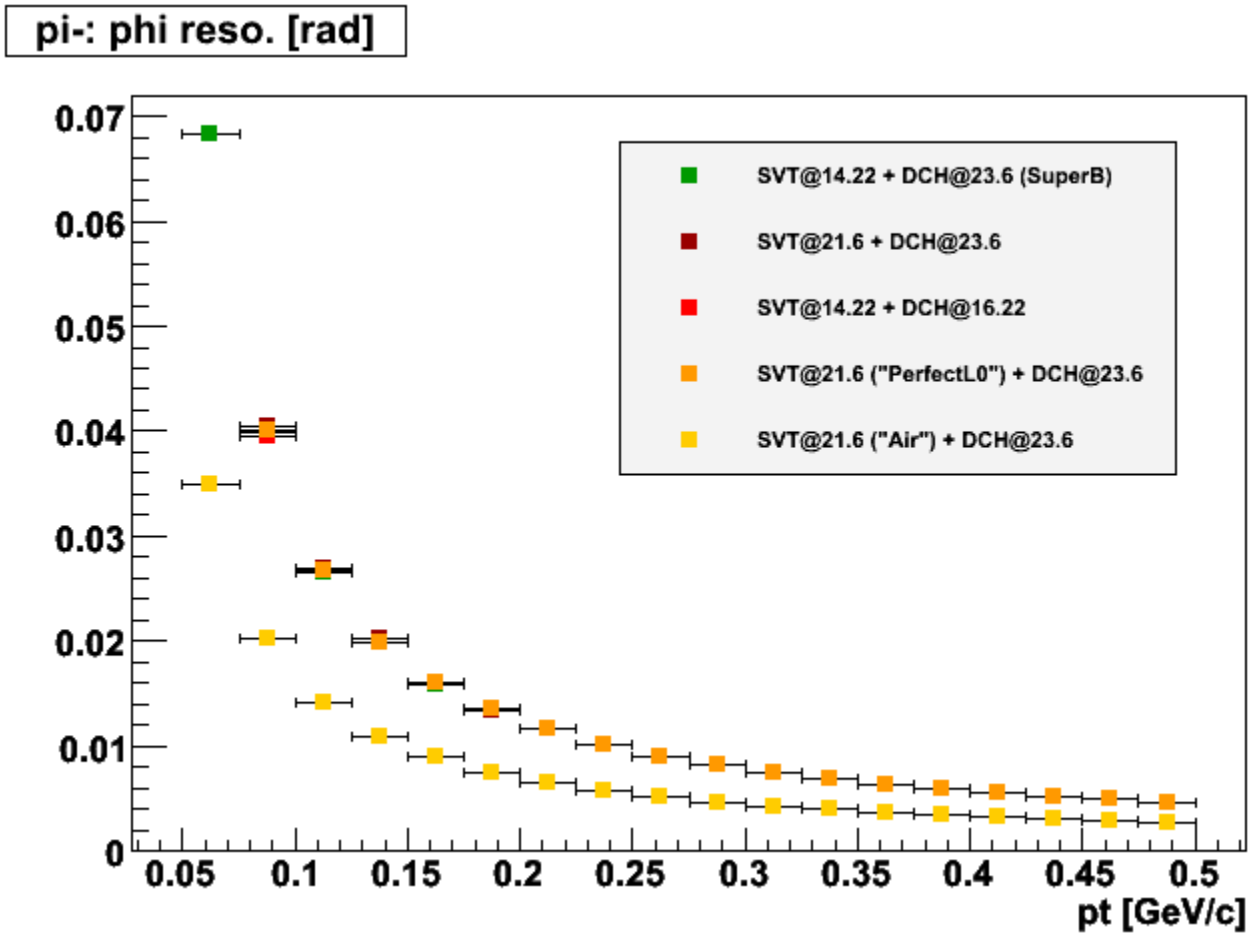

pi-: pt reso. [GeV/c]
SVT@14.22 + DCH@23.6 (SuperB)
SVT@21.6 + DCH@23.6
SVT@14.22 + DCH@16.22
SVT@21.6 ("PerfectL0") + DCH@23.6
SVT@21.6 ("Air") + DCH@23.6
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
1
1.5
2
2.5
3
3.5
4
4.5
pt [GeV/c]

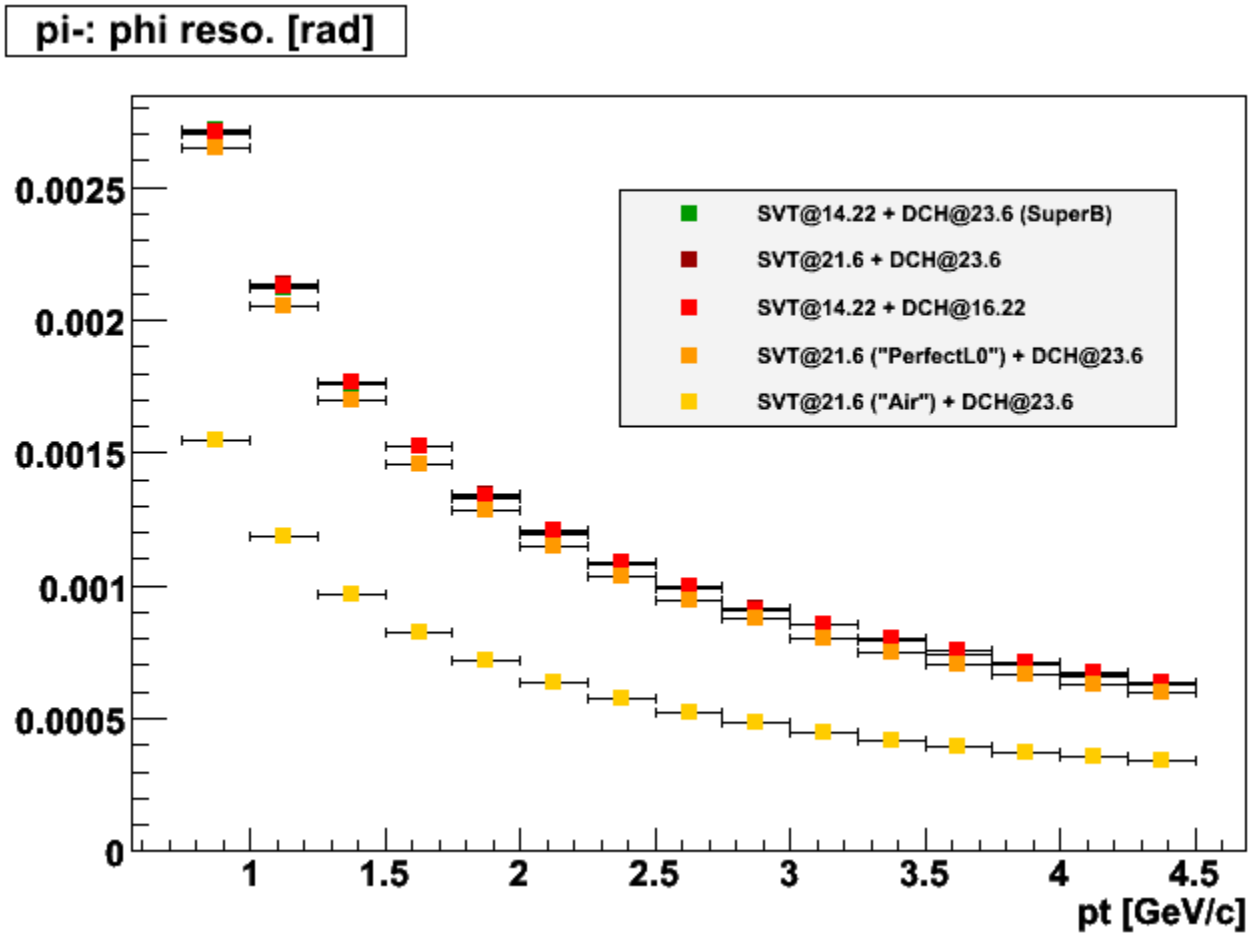

pi-: σ(p)/pt reso.
0.024
0.022
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
pt [GeV/c]
SVT@14.22 + DCH@23.6 (SuperB)
SVT@21.6 + DCH@23.6
SVT@14.22 + DCH@16.22
SVT@21.6 ("PerfectL0") + DCH@23.6
SVT@21.6 ("Air") + DCH@23.6


pi-: σ(pt)/pt reso.
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
1
1.5
2
2.5
3
3.5
4
4.5
pt [GeV/c]
SVT@14.22 + DCH@23.6 (SuperB)
SVT@21.6 + DCH@23.6
SVT@14.22 + DCH@16.22
SVT@21.6 ("PerfectL0") + DCH@23.6
SVT@21.6 ("Air") + DCH@23.6


pi-: theta reso. [rad]
0.05
0.04
0.03
0.02
0.01
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
pt [GeV/c]
SVT@14.22 + DCH@23.6 (SuperB)
SVT@21.6 + DCH@23.6
SVT@14.22 + DCH@16.22
SVT@21.6 ("PerfectL0") + DCH@23.6
SVT@21.6 ("Air") + DCH@23.6


pi-: theta reso. [rad]
0.002
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
1
1.5
2
2.5
3
3.5
4
4.5
pt [GeV/c]
SVT@14.22 + DCH@23.6 (SuperB)
SVT@21.6 + DCH@23.6
SVT@14.22 + DCH@16.22
SVT@21.6 ("PerfectL0") + DCH@23.6
SVT@21.6 ("Air") + DCH@23.6


pi-: phi reso. [rad]
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
pt [GeV/c]
SVT@14.22 + DCH@23.6 (SuperB)
SVT@21.6 + DCH@23.6
SVT@14.22 + DCH@16.22
SVT@21.6 ("PerfectL0") + DCH@23.6
SVT@21.6 ("Air") + DCH@23.6


pi-: phi reso. [rad]
0.0025
0.002
0.0015
0.001
0.0005
0
1
1.5
2
2.5
3
3.5
4
4.5
pt [GeV/c]
SVT@14.22 + DCH@23.6 (SuperB)
SVT@21.6 + DCH@23.6
SVT@14.22 + DCH@16.22
SVT@21.6 ("PerfectL0") + DCH@23.6
SVT@21.6 ("Air") + DCH@23.6