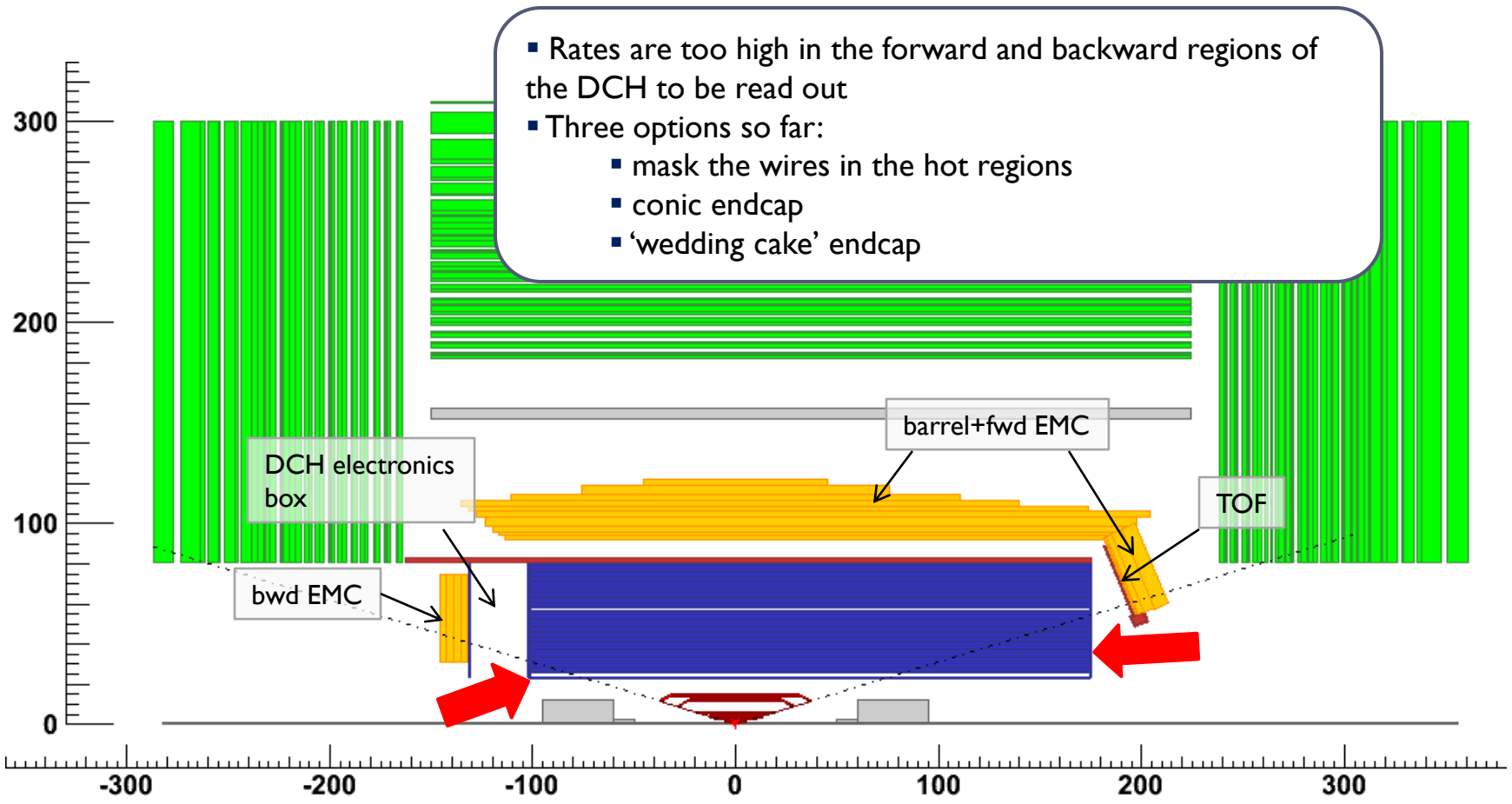
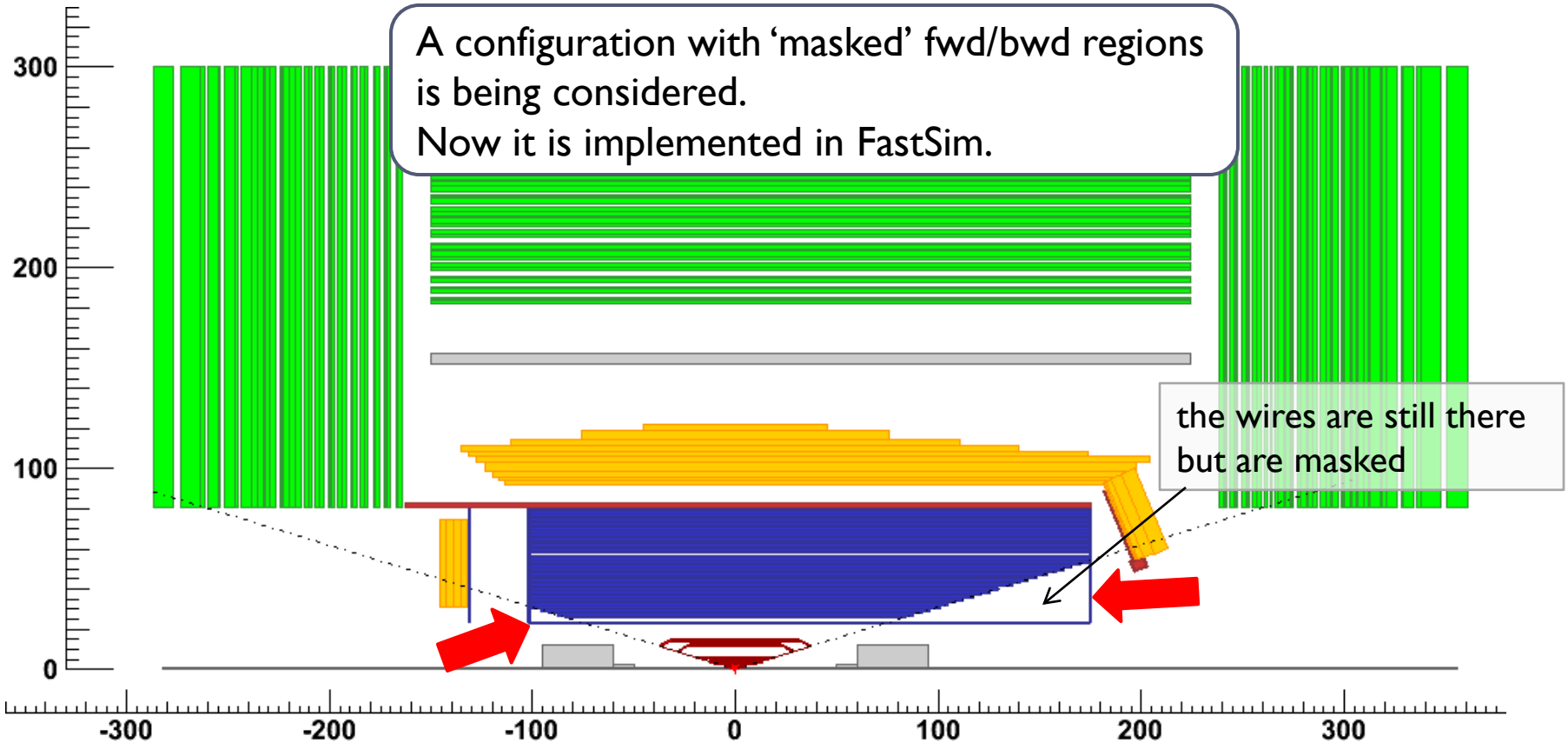
DCH configurations: some preliminary results and plans

M. Rama, DGWG meeting
17 November 2009

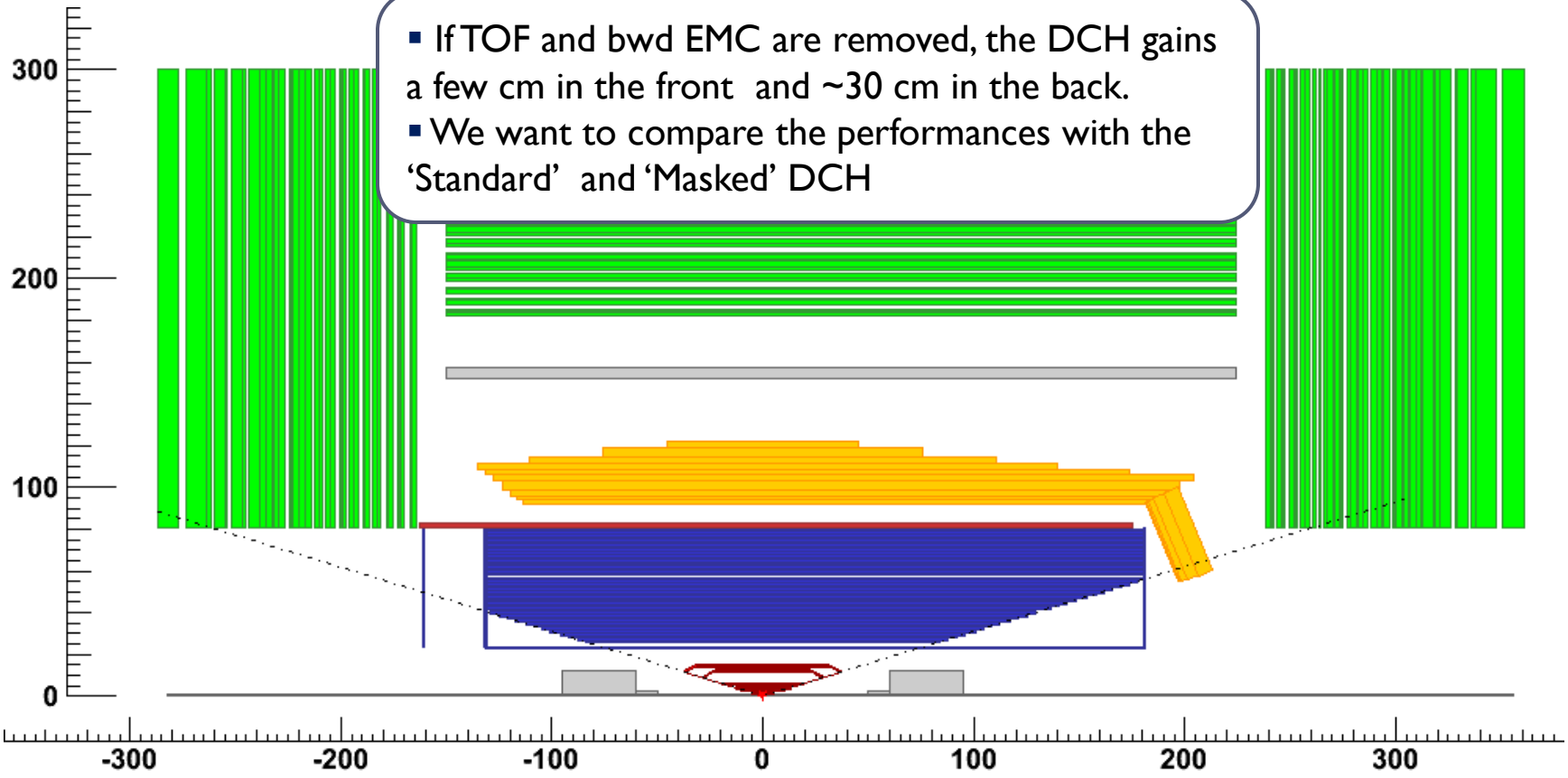
‘standard’ DCH configuration unmasked



standard DCH with fwd/bwd regions masked

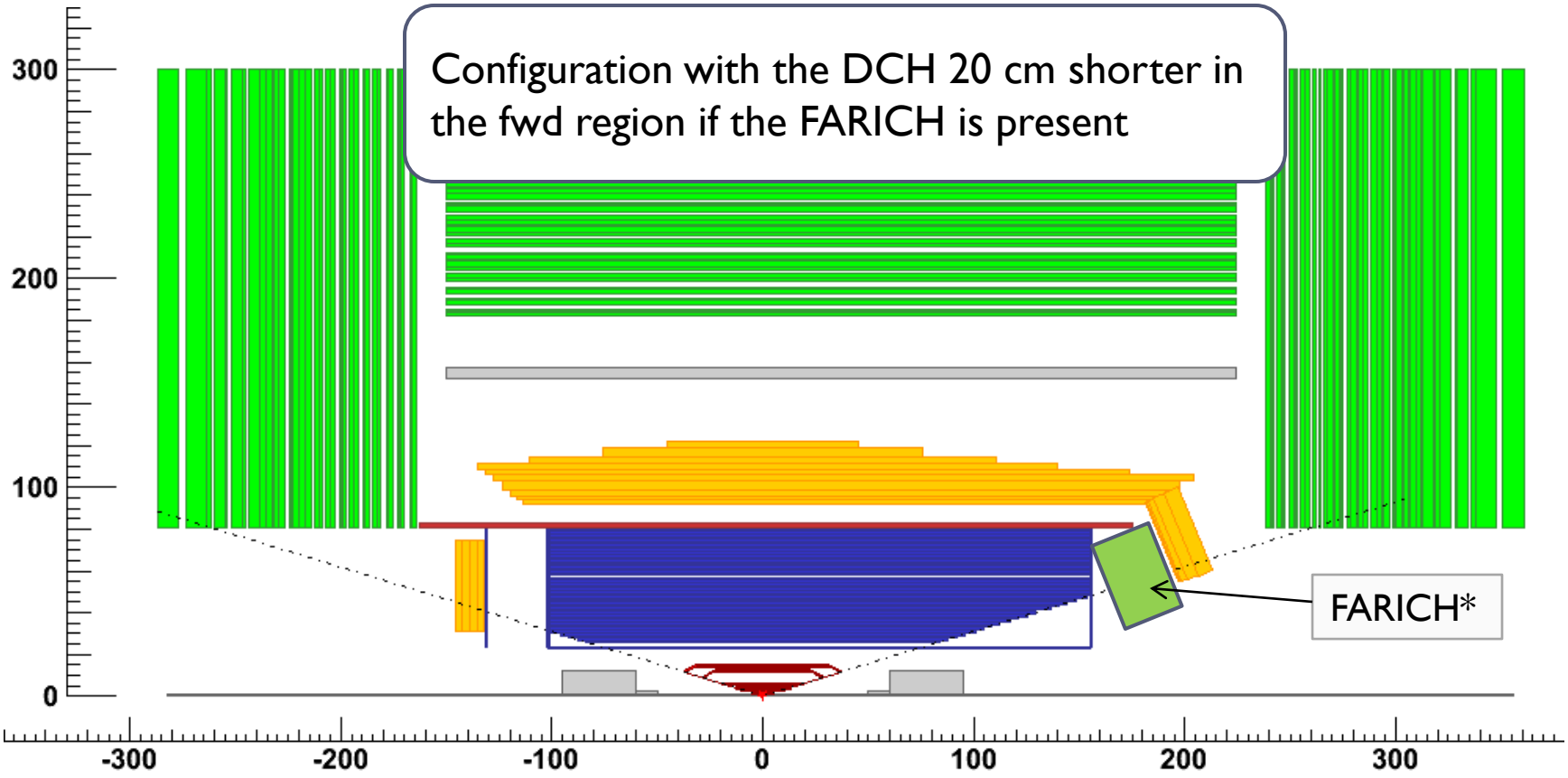


Long DCH



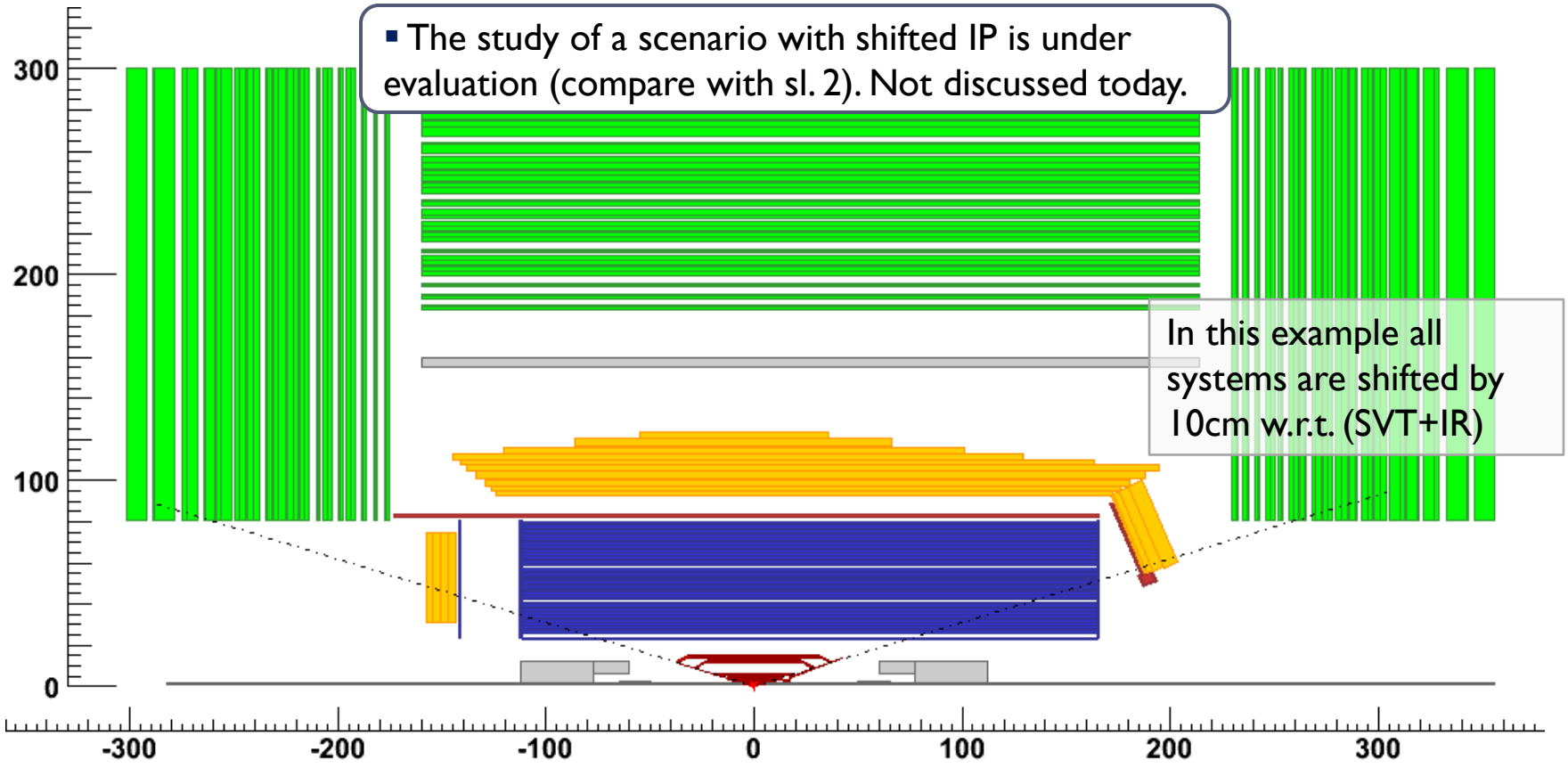
- If TOF and bwd EMC are removed, the DCH gains a few cm in the front and ~30 cm in the back.
- We want to compare the performances with the 'Standard' and 'Masked' DCH

DCH 20cm shorter to allocate the RICH



*see E.Kravchenko at the SLAC Oct09 SuperB meeting

shifted IP



- The study of a scenario with shifted IP is under evaluation (compare with sl. 2). Not discussed today.

In this example all systems are shifted by 10cm w.r.t. (SVT+IR)

Plan

4 configurations:

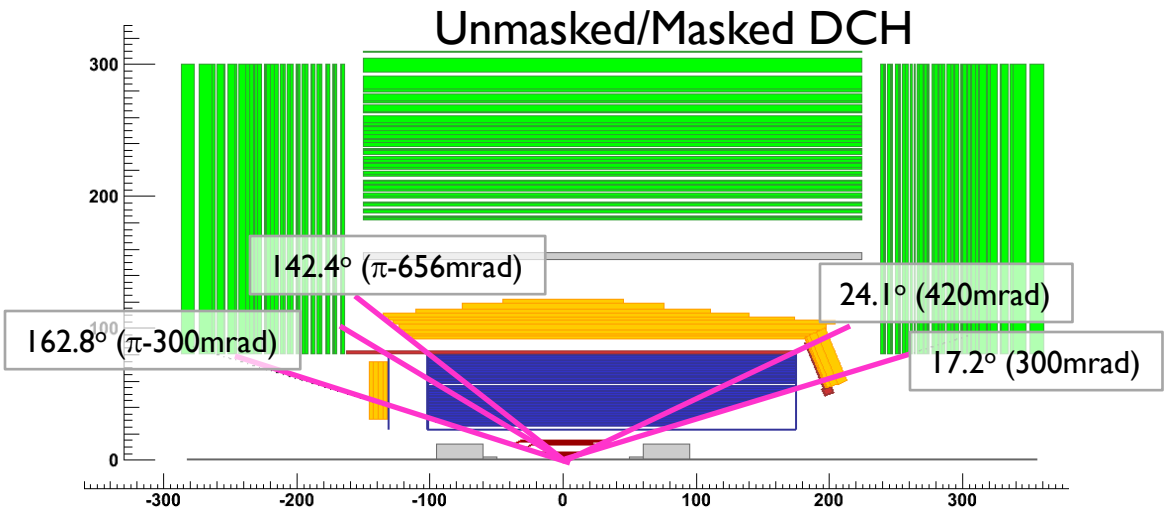
- Unmasked (sl. 2)
- Masked (sl. 3)
- Long (sl. 4)
- Short (sl. 5)
- shifted IP (sl. 6)

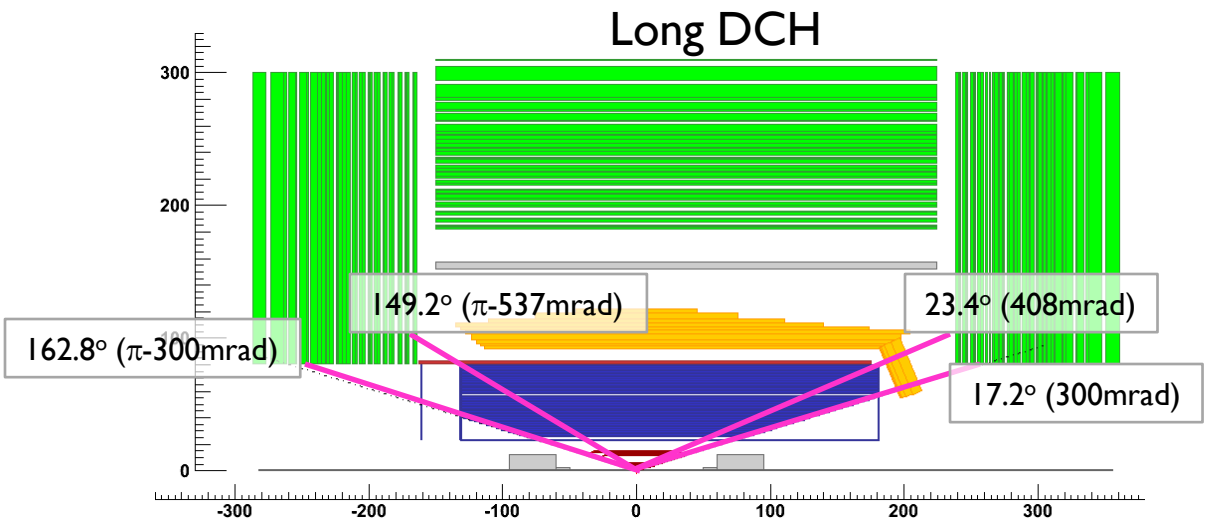
today

- Compare the 'Masked' DCH with the 'Long' and 'Short' cfg
  - track reconstruction
  - DCH dE/dx

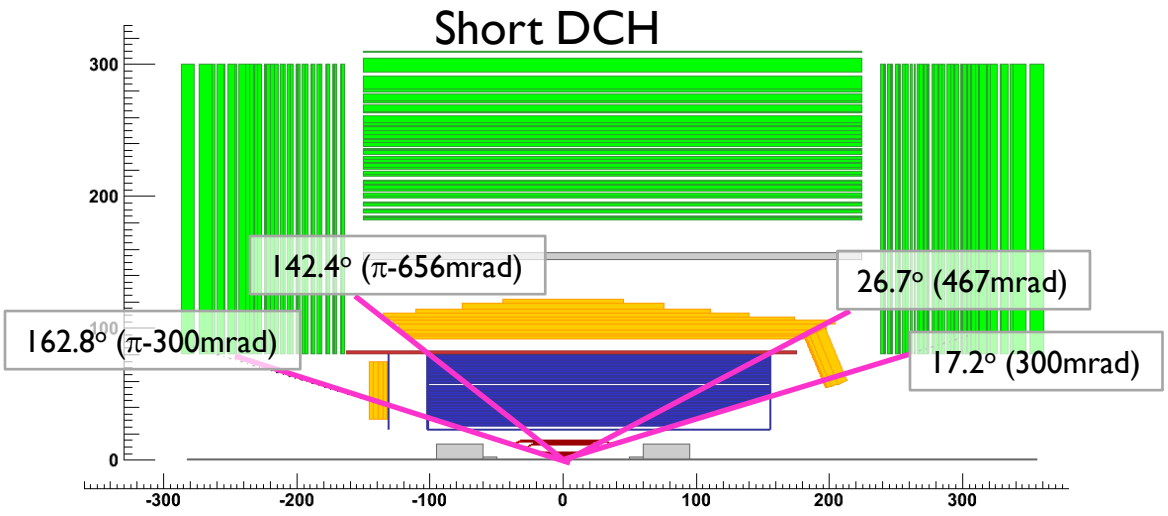
tested with:
- 10k $B^0 \to \pi^+\pi^-$ events
- 10k $B^0 \to D^*K$ events
- 50k single particles

Angles useful to interpret the patterns in next slides

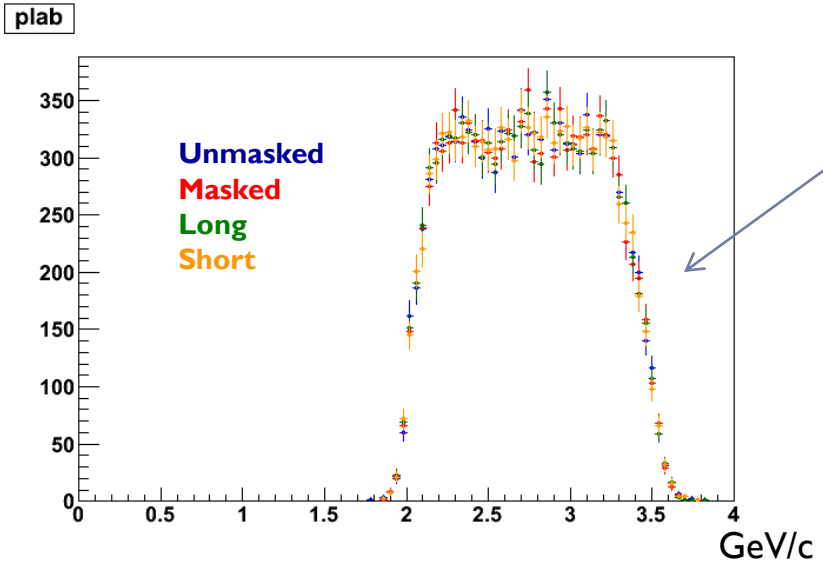




Angles (II)


Short DCH
142.4° (π-656mrad)
26.7° (467mrad)
162.8° (π-300mrad)
17.2° (300mrad)
300
200
100
0
-300
-200
-100
0
100
200
300

Reconstruction efficiency of $B \rightarrow \pi^+\pi^-$



high momentum range complementary to $B^0 \rightarrow D^{*-}K^+$, $D^{*-} \rightarrow D^0\pi^-$, $D^0 \rightarrow K\pi$

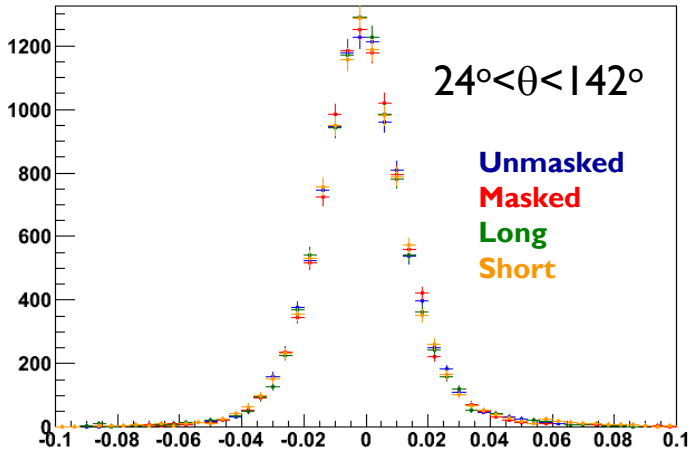
DCH configuration	eff. mc-truth
Unmasked	0.805 +/- 0.004
Masked	0.805 +/- 0.004
Long	0.806 +/- 0.004
Short	0.804 +/- 0.004

note: same run numbers (i.e. same generated events) for the 4 configurations

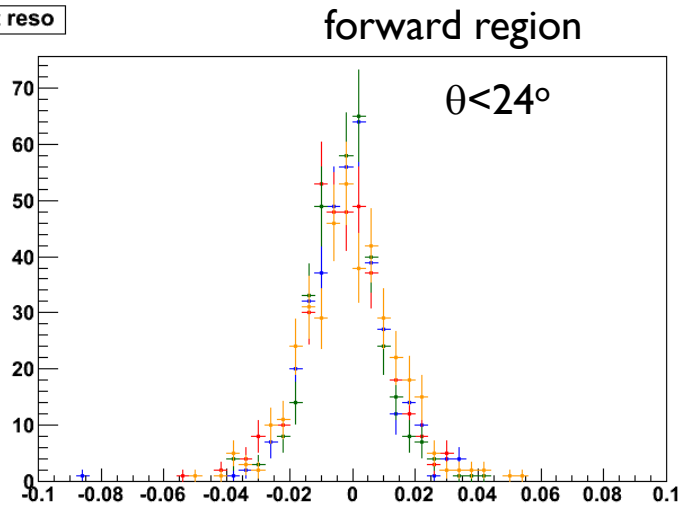
the $B^0 \rightarrow \pi^+\pi^-$ reconstruction efficiency is not affected

B→ππ: track momentum resolution

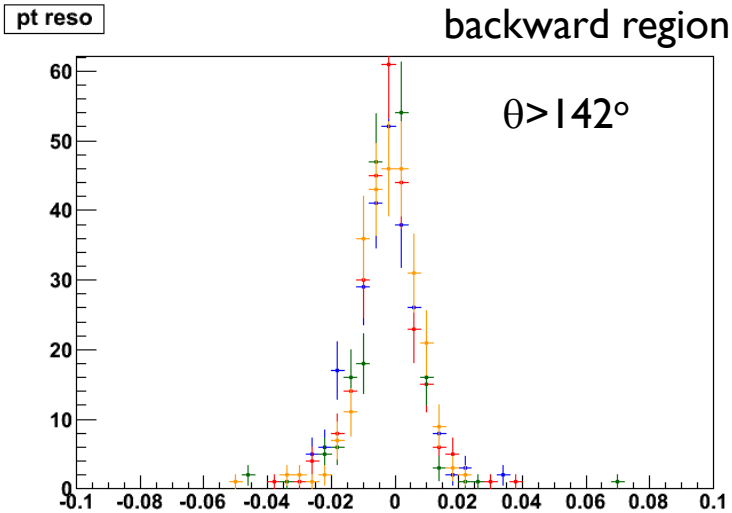
central region (common to 'Long' and 'Standard')



forward region

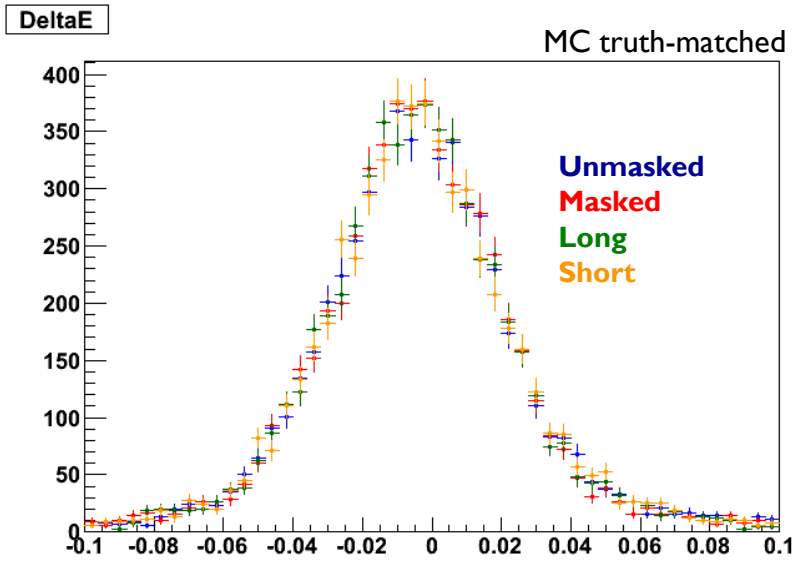


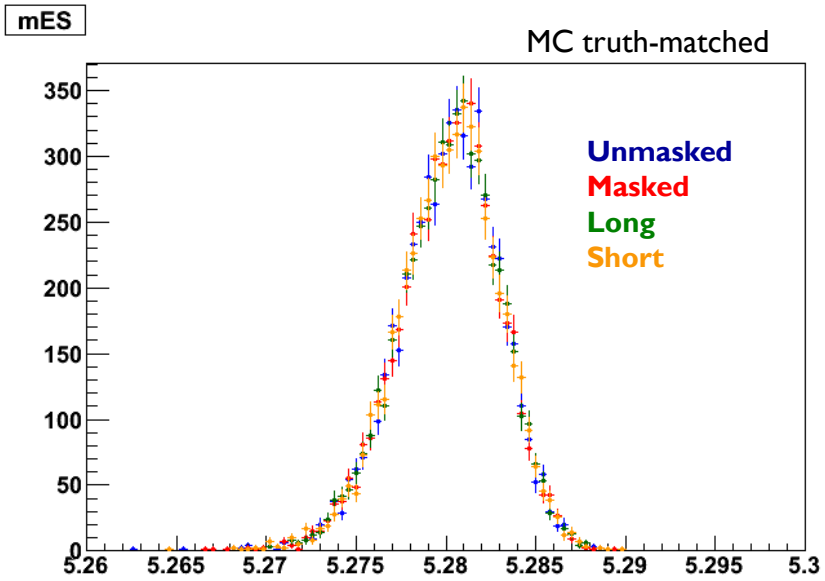
backward region



similar pt and angular resolutions for tracks from $B^0 \to \pi^+\pi^-$

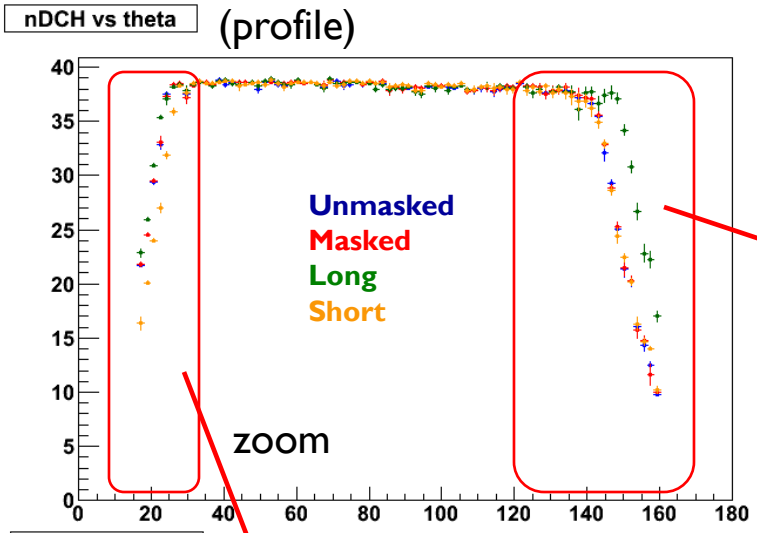
B→ππ: ΔE and m_{ES}





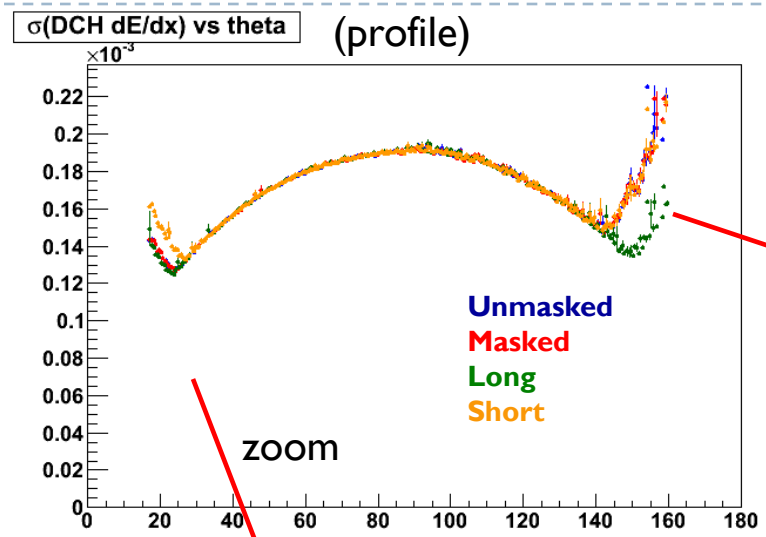
no significant difference in ΔE and m_{ES} resolution

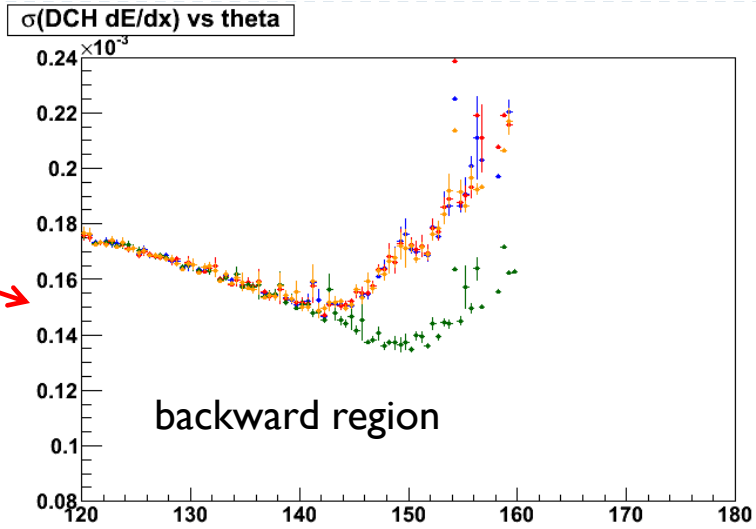
B→ππ: #DCH hits vs polar angle

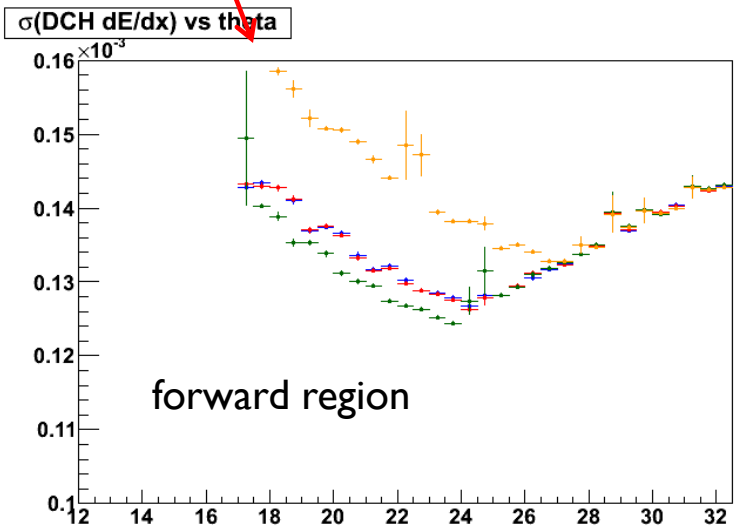


- The number of DCH dE/dx sample hits has an analogous pattern (it is scaled by 80%, which is the truncation value)

σ(DCH dE/dx) vs polar angle





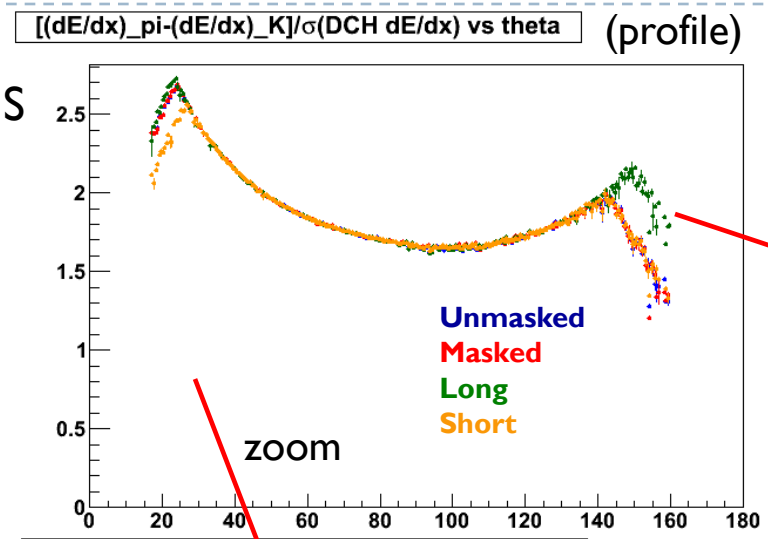


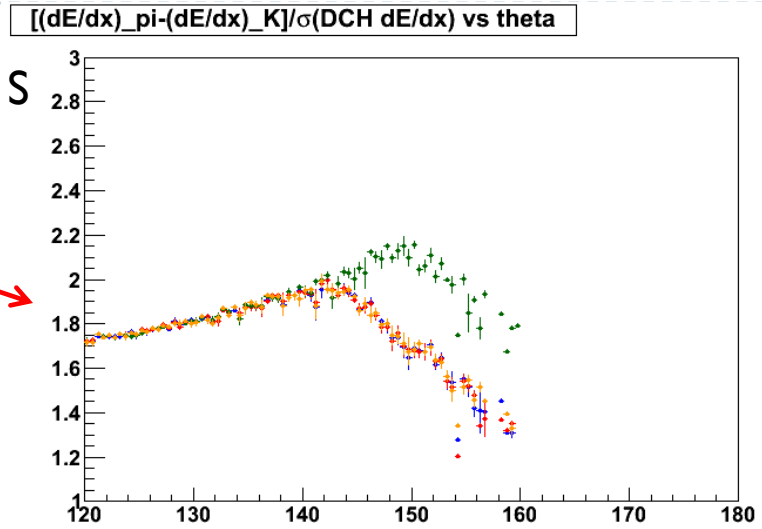
Note: the spread of the dE/dx measurement of the single hit is parameterized as:

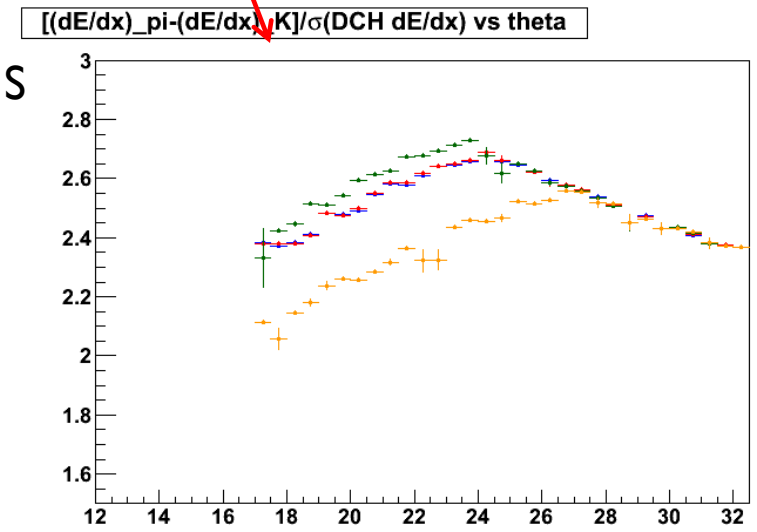
$\sigma = dedx\_par1 * ((dE/dx) / 1.622*10^{-3})* dx^{-0.5}$

dedx_par1 is tuned to resemble the dE/dx π/K separation measured in Babar data (BAD#1500)

DCH dE/dx K-π separation vs theta





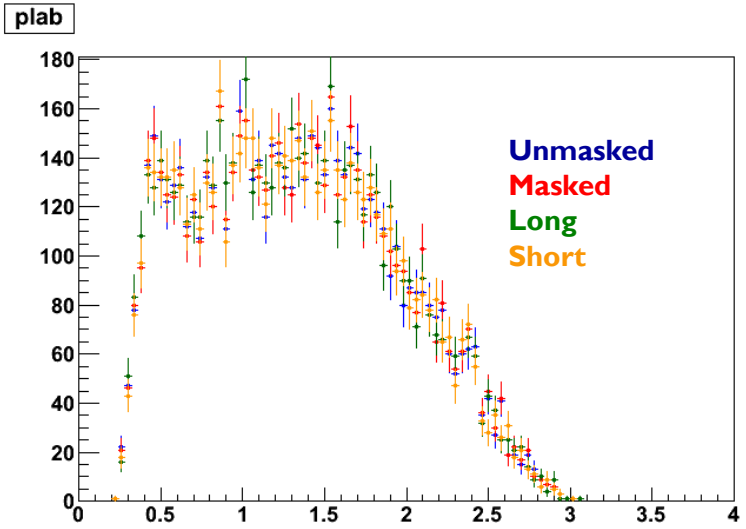


S=[Expected_dE/dx(pi)-Expected_dE/dx(K))]/σ(dE/dx)

Long DCH w.r.t. Masked:

- 3.6% of tracks fall in the fwd region, where the dE/dx separation increases by ~0.08σ
  - to be compared with TOF pi/K separation in this momentum range (3.2-3.6 GeV)
- 2.8% of tracks fall in the bwd region, where the dE/dx separation increases by ~0.4σ ([1.4,1.8]→[1.8,2.2])
  - to be compared with possible PID from the bwd calorimeter in this momentum range (1.9-2.2 GeV)

B→D*K

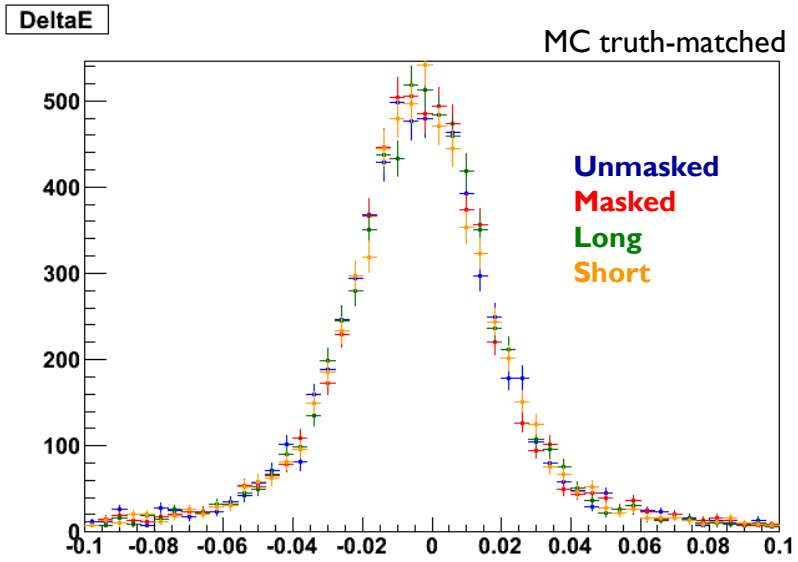


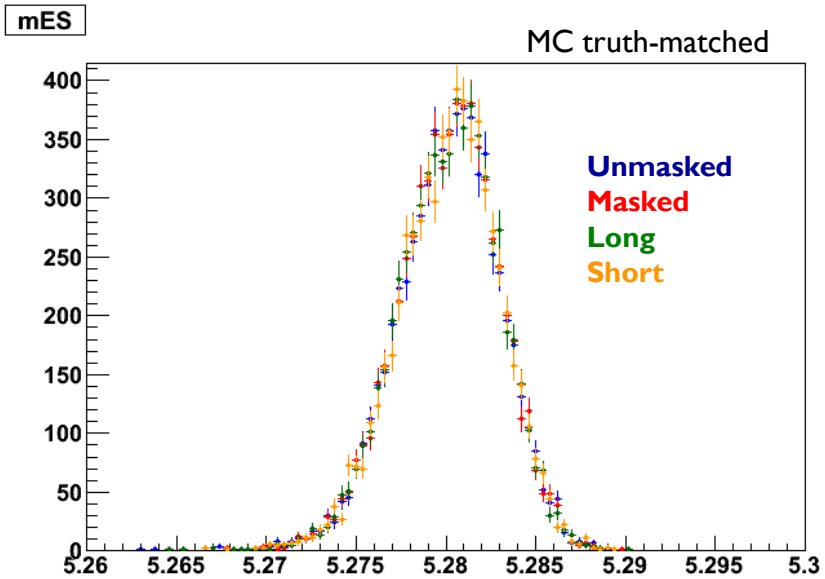
DCH configuration	eff. mc-truth
Unmasked	0.650 +/- 0.005
Masked	0.652 +/- 0.005
Long	0.655 +/- 0.005
Short	0.647 +/- 0.005

note: same run numbers (i.e. same generated events) for the 4 configurations

the difference in the $B^0 \rightarrow D^{*-}K$ reconstruction efficiency is very small

B→D*K: ΔE and m_{ES}

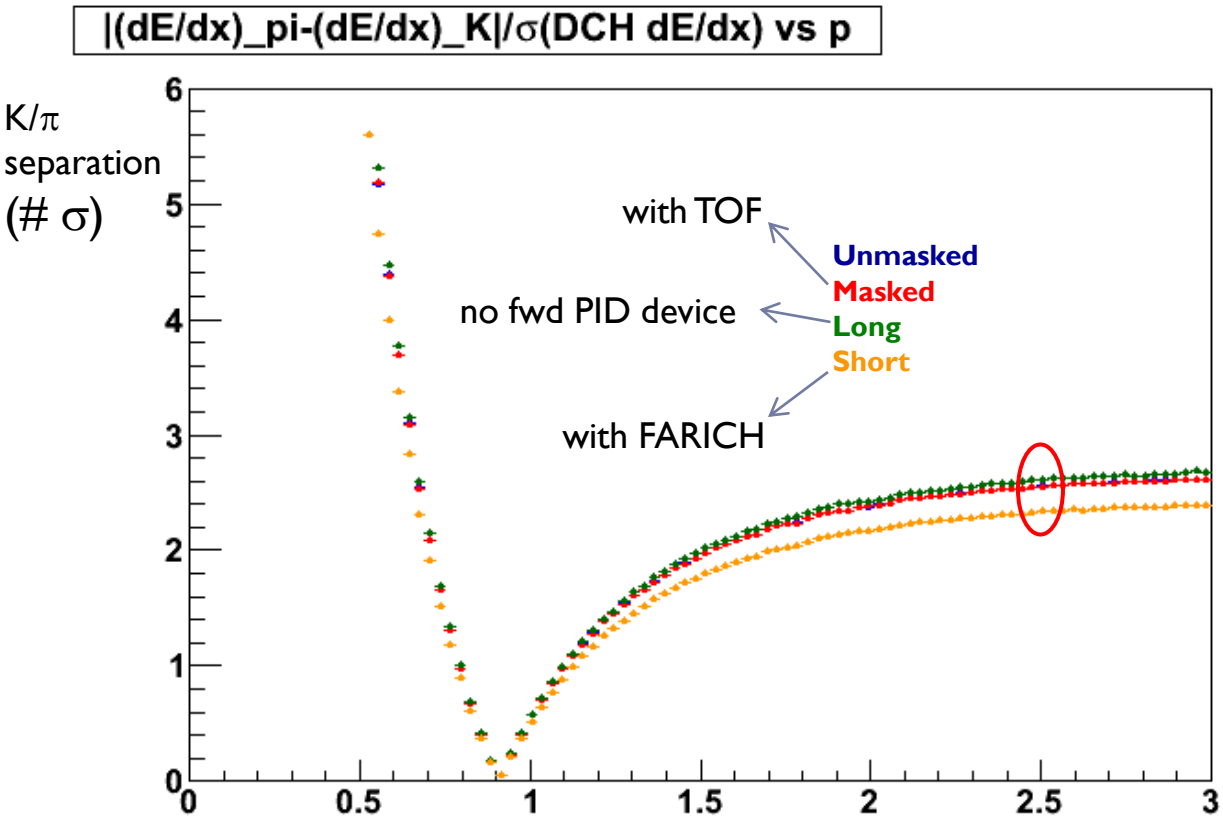




no significant difference in ΔE and m_{ES} resolution

single particles: K/π separation vs p at θ=23°

see drawings in sl. 9-10

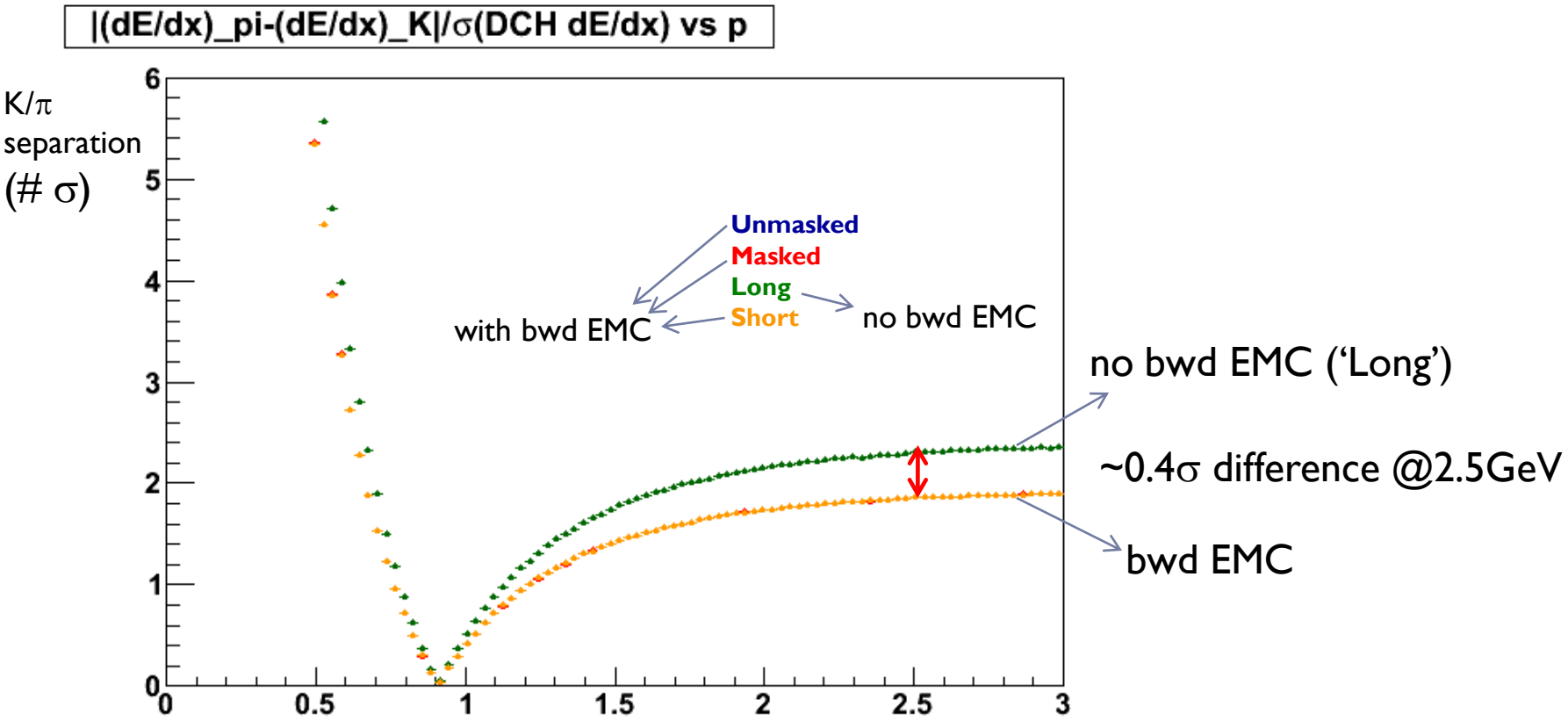


between Short and Masked: 0.2σ difference @2.5GeV

between Long and Masked: ~0.07σ difference @2.5GeV

single particles: K/π separation vs p at θ=150°

see drawings in sl. 9-10



Summary

- Preliminary study of tracking and $(dE/dx)_{DCH}$ performance vs DCH length
  - small or negligible impact on track momentum resolution and efficiency in all the configurations considered
  - when a fwd TOF device is installed the decrease of the $(dE/dx)_{DCH}$ PID power is very small
  - when a fwd RICH device is installed (according to E. Kravchenko's requirements @Oct09 SuperB meeting) a somewhat larger impact on the $(dE/dx)_{DCH}$ PID power is observed (a decrease of the K/π separation up to ~0.2σ @23°)
  - if the DCH bwd length is increased by 30cm (no bwd EMC) an increase of the K/π separation up to ~0.5σ @150° is observed
  - obviously it is the combined dE/dx+other-PID-devices performance that must be compared eventually, together with the evaluation of the impact on the other systems (such as the fwd EMC)

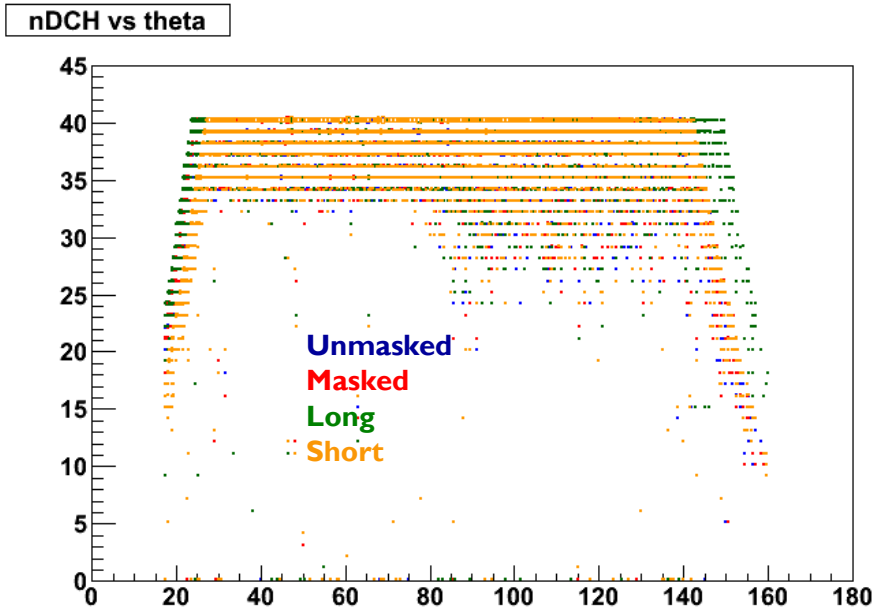
Next steps

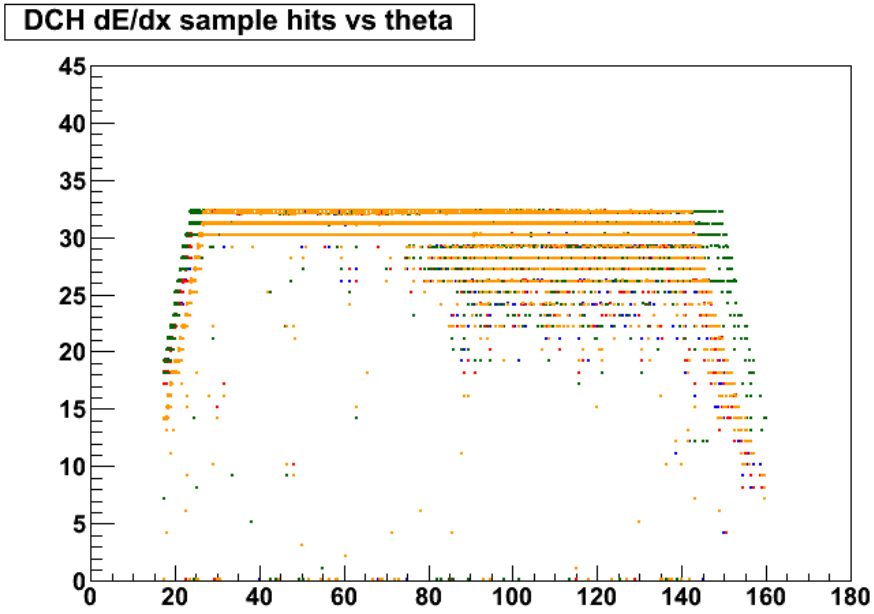
- Consolidate this study
- Review the tuning of $(dE/dx)_{DCH}$
- performance of combined PID information vs theta,p (together with the PID group)
- other possible configurations
  - detector shifted w.r.t. the IP+SVT
  - wedding-cake DCH /conic endcap

backup

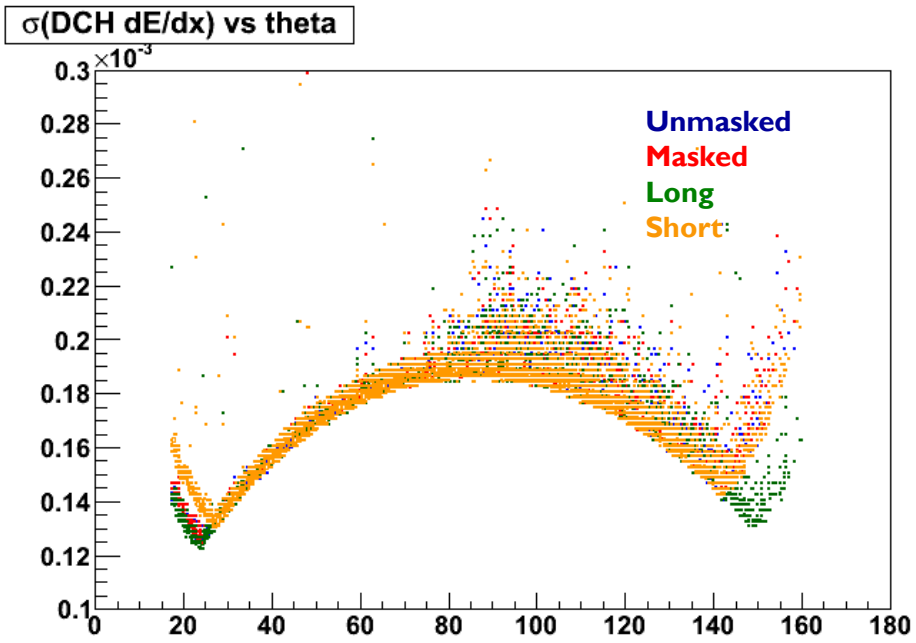
$B \rightarrow \pi^+\pi^-$: #DCH hits and #DCH dE/dx hits vs theta

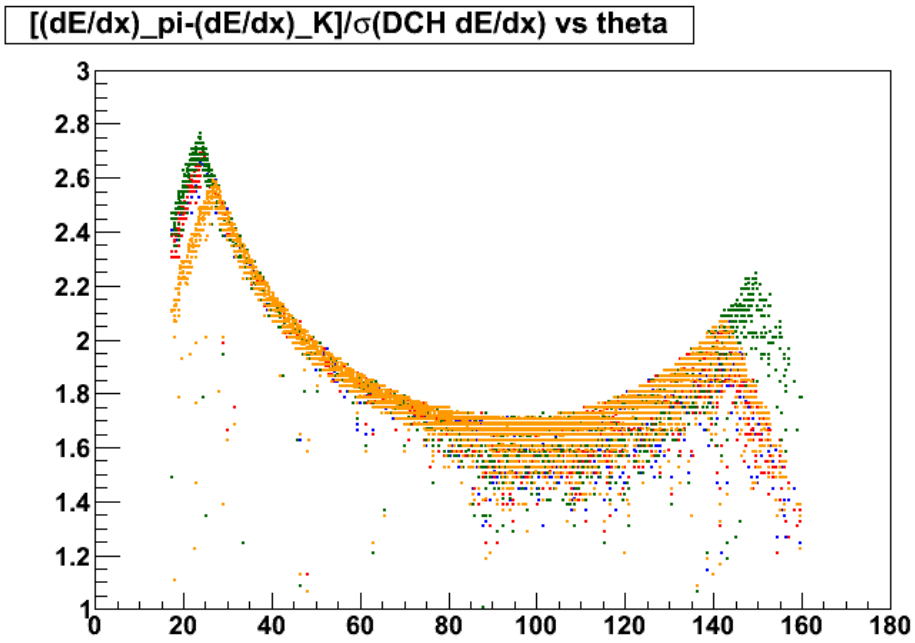
$B \rightarrow \pi\pi$





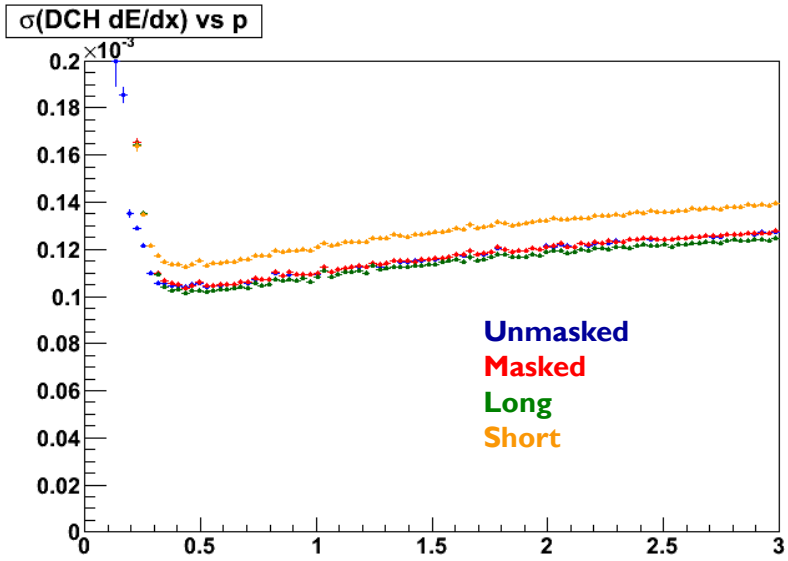
$B \rightarrow \pi^+\pi^-$

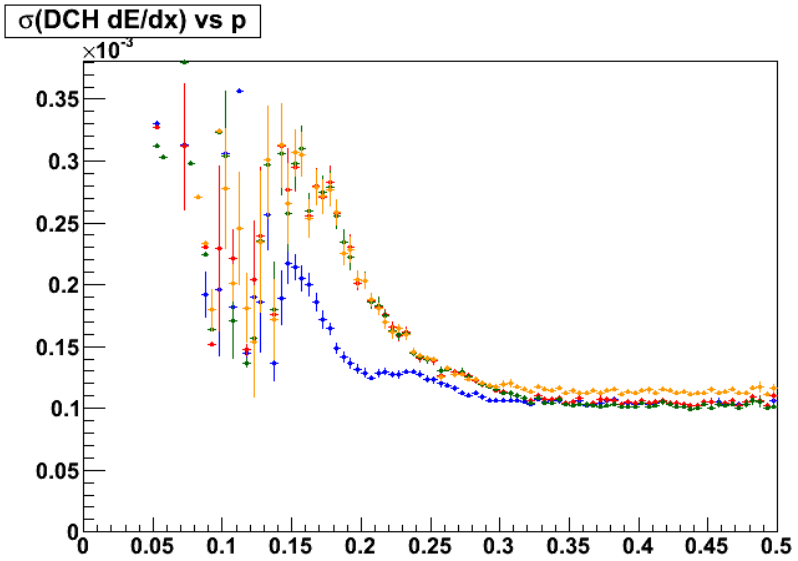




single particles

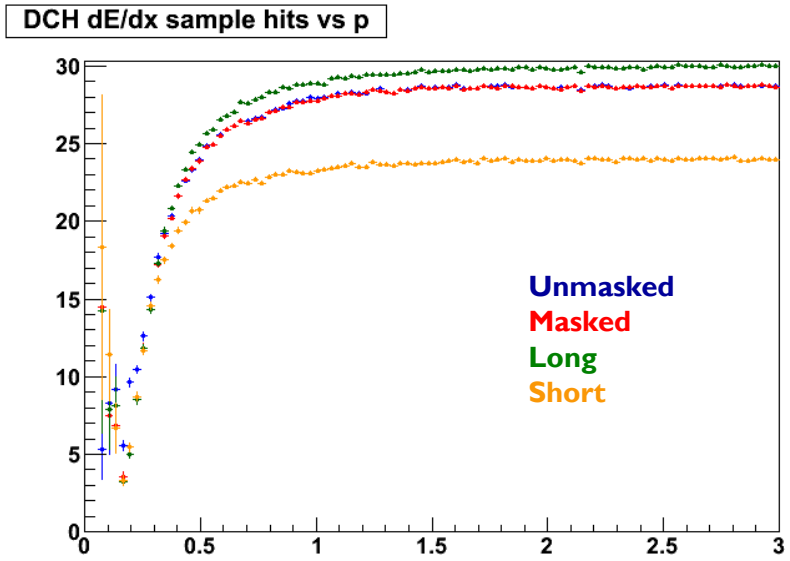
θ=22° forward region

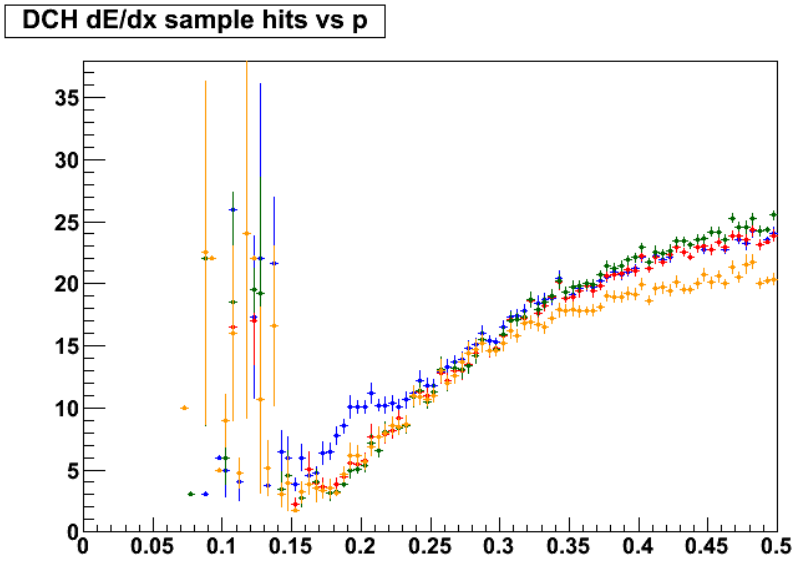




single particles

θ=22° forward region





single particles

θ=150° backward region