DCH geometry options

G. Finocchiaro
INFN – LNF
DCH TDR Meeting 21 June 2012

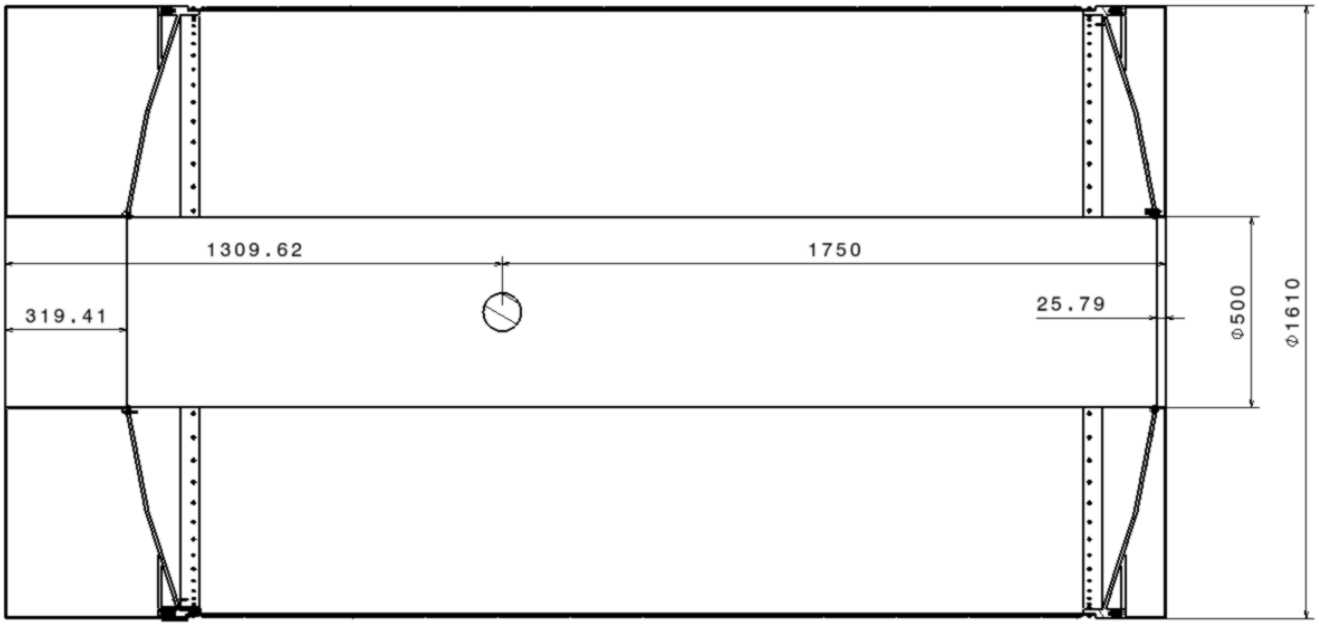
DCH Performance Studies

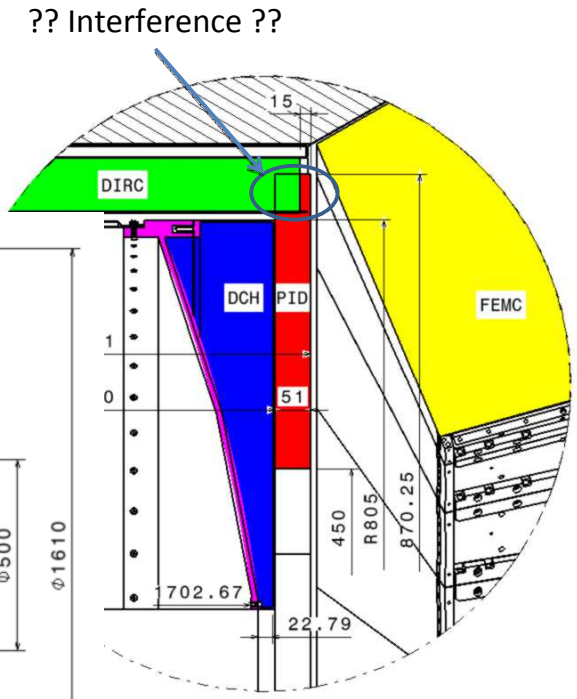
- In the TDR we need to discuss the expected performances of the detector
- Latest DCH performance studies in 2010, with R_{min}=236mm (BaBar), or less
- Now (4.5 thick W shields) R_{min}=265mm
- Need to work out new realistic wire arrangements to use (next talk)
- Finalize (?!) studies on the minimum thickness of the inner cylinder

Revise endplate options

- We have also been asked to compare different geometry options
  - spherical convex
    - better match to FW EMC shape ➔ minimize traversed thickness, minimize spatial separation of e^+e^- from converted photons (however, we never got specific requirements from EMC people)
    - allows longer chamber
  - spherical concave
    - Works in "traction" mode (more stable than "compression": Stefano is quantifying this)
  - flat endplates (thicker for fixed deformation)

"Present" (i.e., shown at Elba) Nominal Geometry



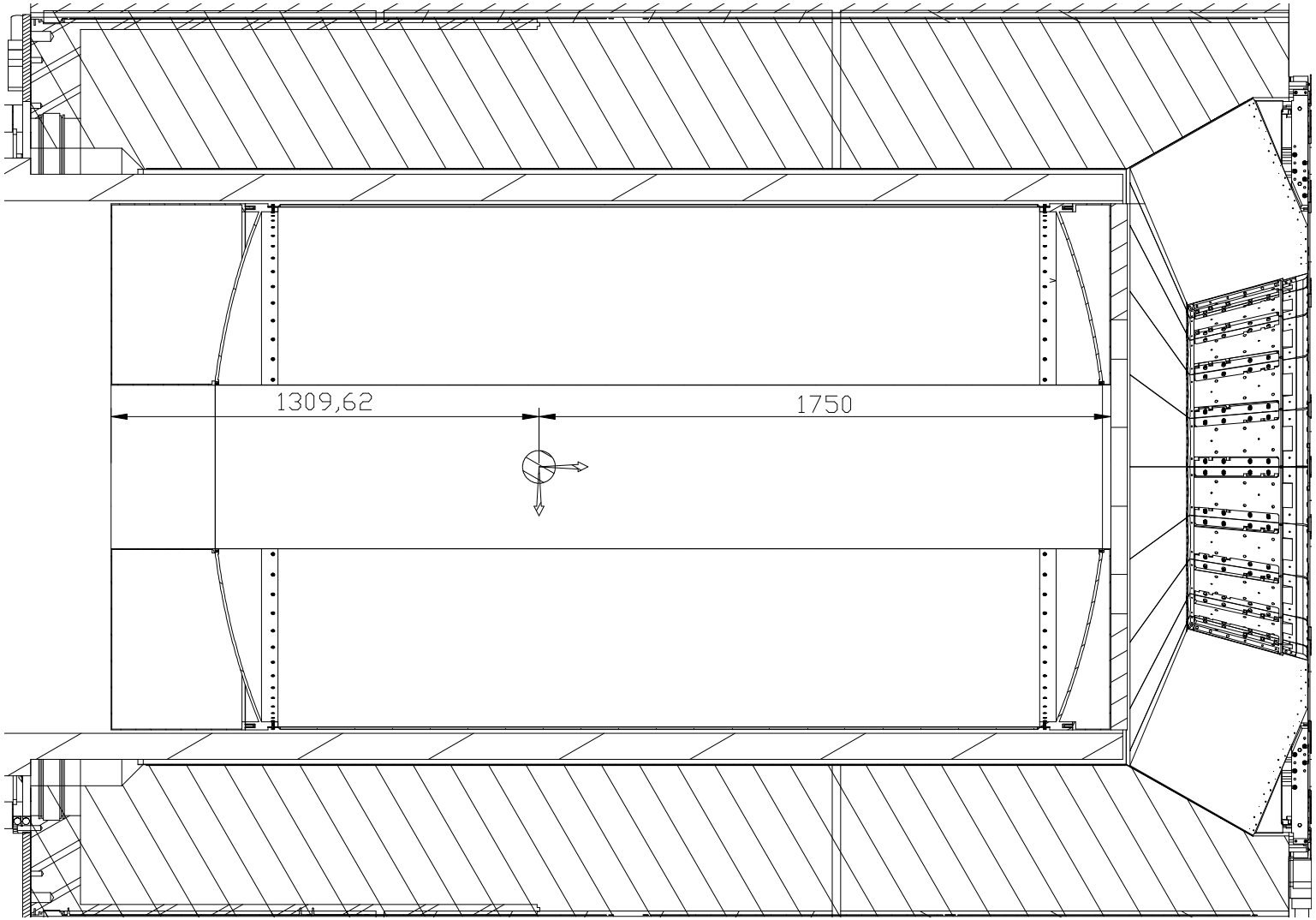


Options for DCH Endplates and Length

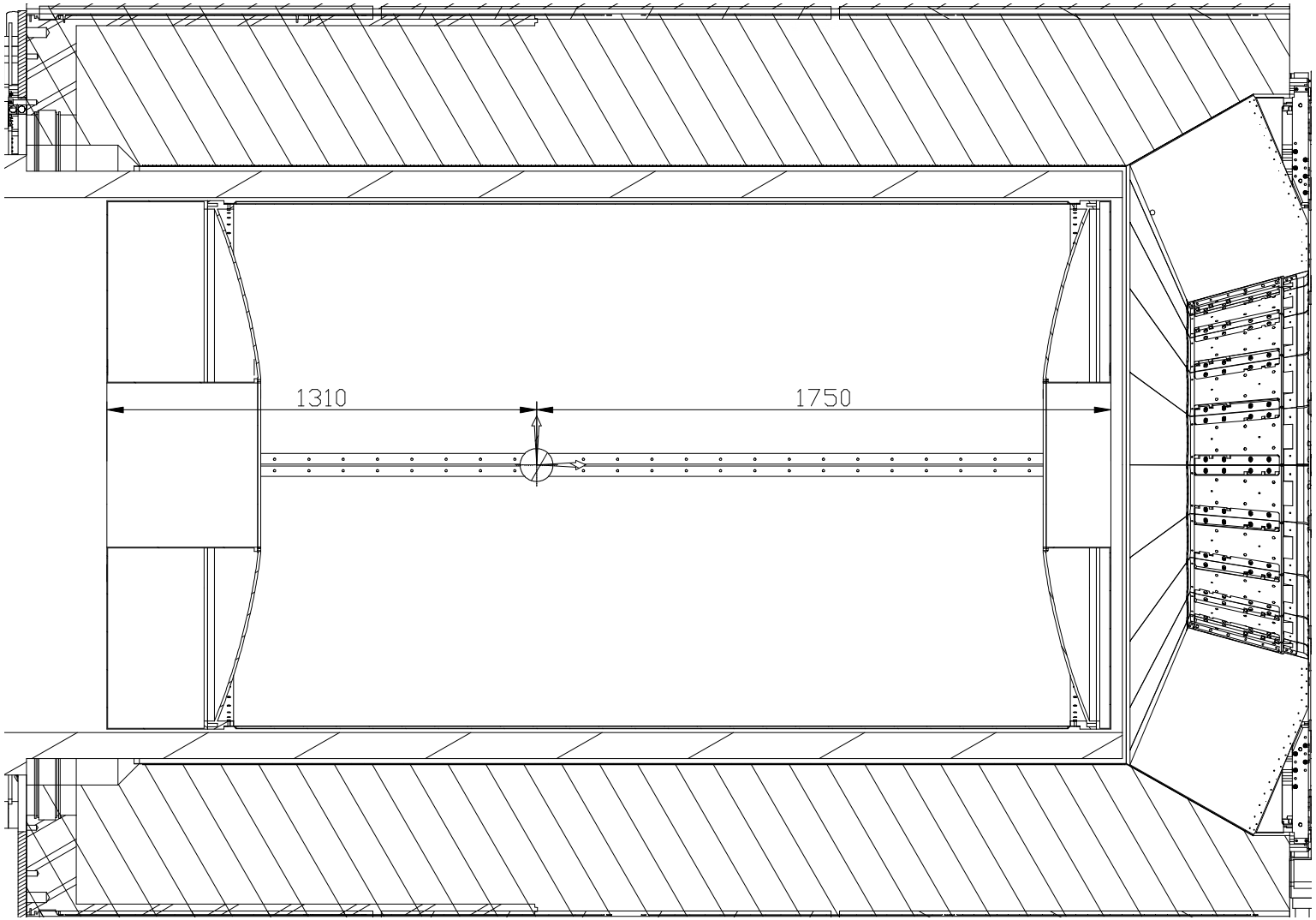
1. convex endplates, zmax=+1750mm
2. concave endplates, zmax=+1750mm
3. convex endplates, zmax=+1793mm (+43mm)
4. concave endplates, zmax=+1793mm (+43mm)
5. convex endplates, zmax=+1914mm (+164mm)

- A minimum of 60mm is considered for the FW gas enclosure (the blue region in the previous slide)
- The FTOF is vertical in 1-4, parallel to the EMC crystals in 5
  - About 15mm for EMC calibration system + FTOF support
- In all cases, the length on the backward side is the same: zmin=-980/-840mm (-1310mm including the case for electronics)
  - At some point we should optimize that too

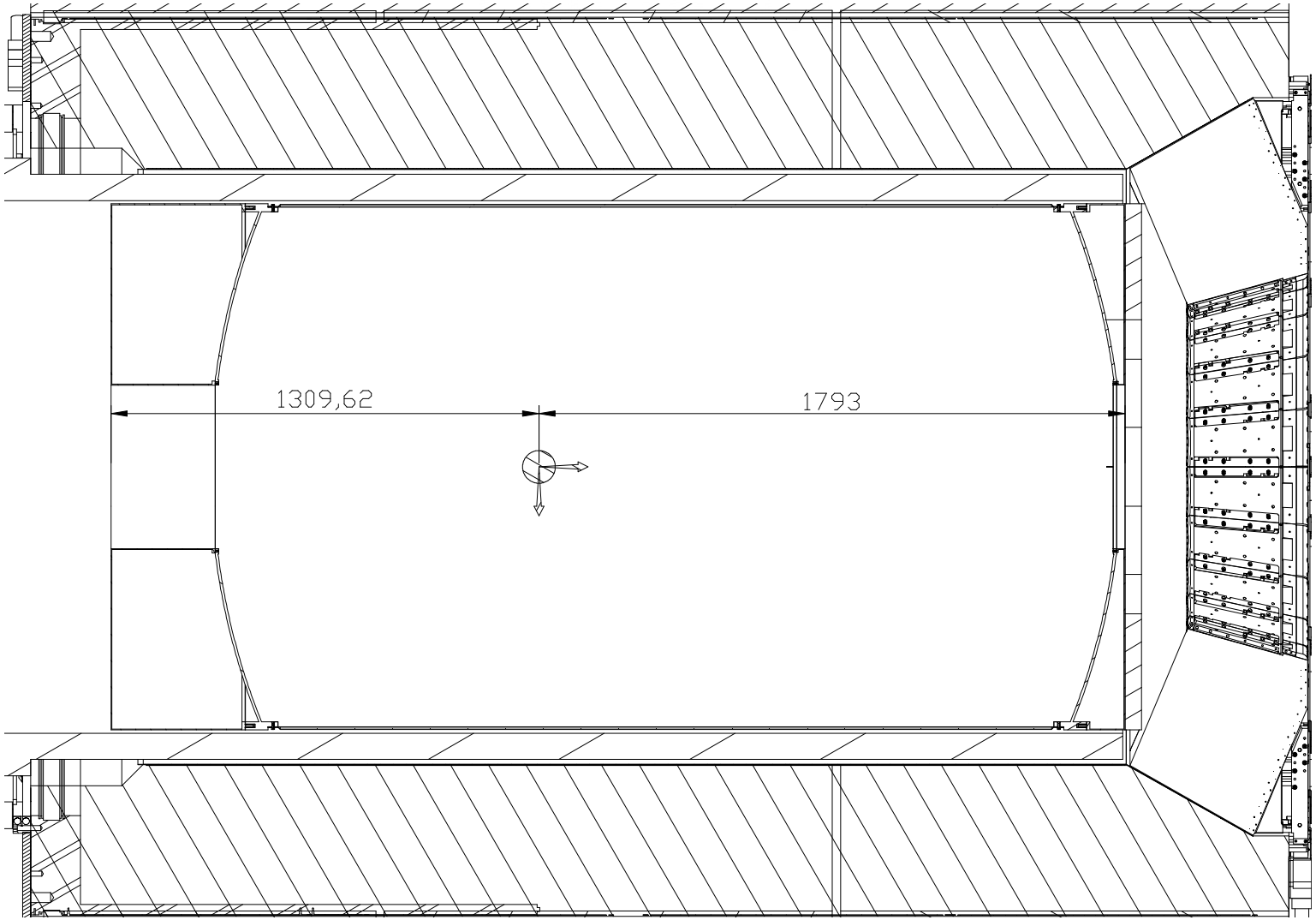
Option #1



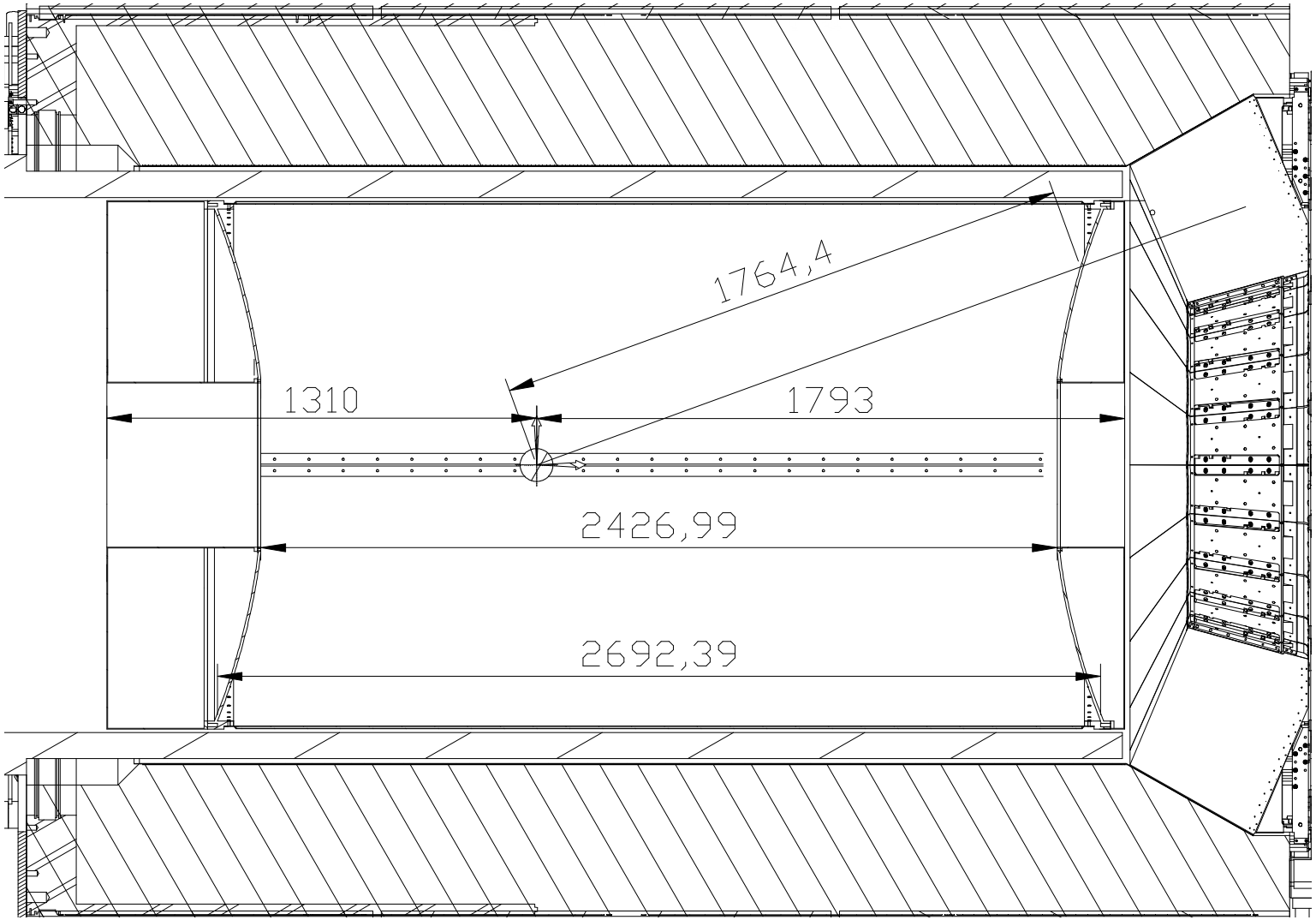
Option #2



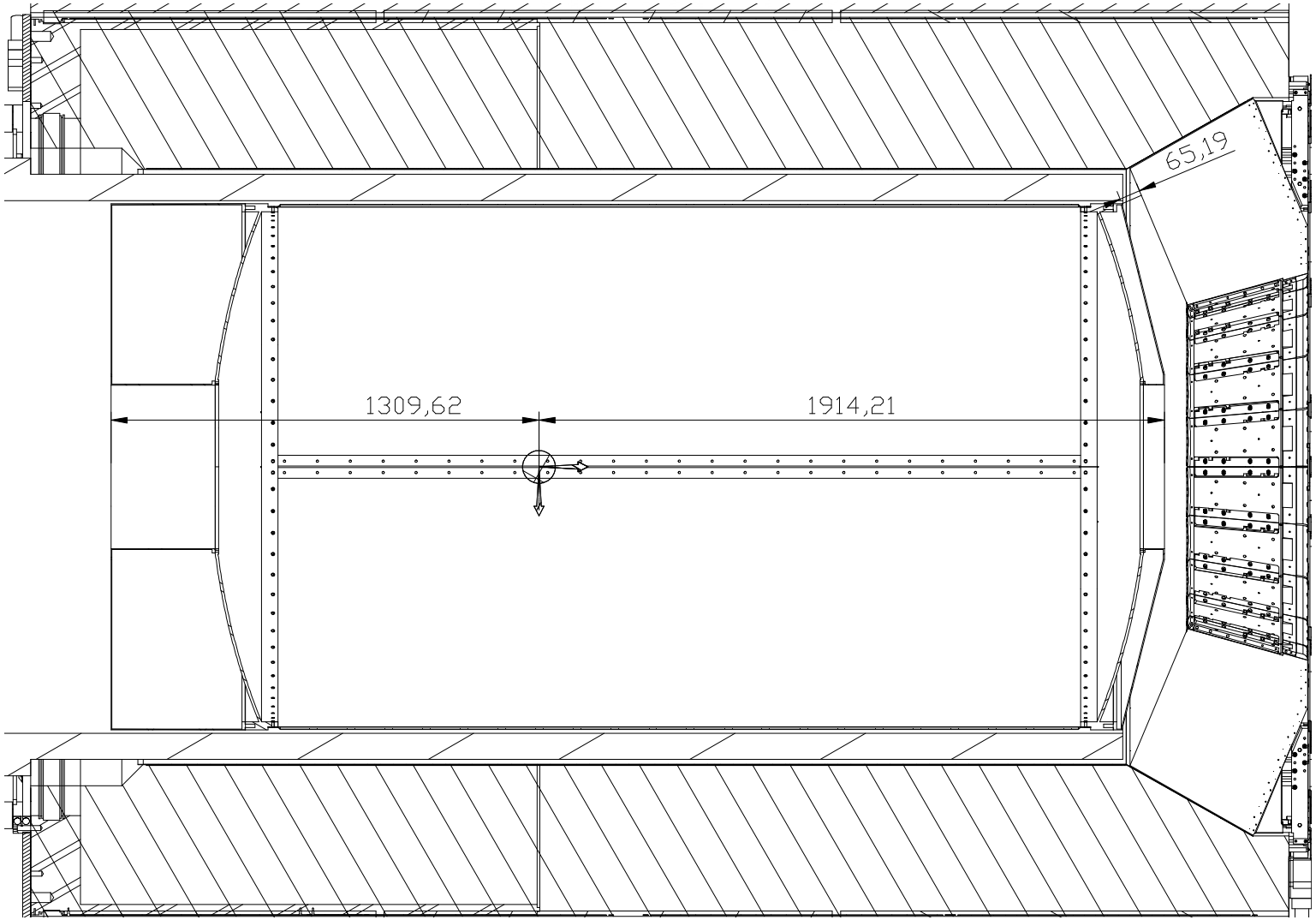
Option #3



Option #4



Option #5



Option Summary

#	Spherical R=2100mm	z_{MIN}(DCH) [mm]	z_{Max}(DCH) [mm]	z_{Max}(20°) [mm]	R_{Max}(20°) [mm]
1	Convex	−980	+1750	+1751	599
2	Concave	−980	+1750	+1713	585
3	Convex	−980	+1793	+1793 (+42)	613 (+14)
4	Concave	−980	+1793	+1764 (+51)	603 (+18)
5	Convex	−980	+1914	+1871 (+120)	639 (+40)

- Pro of spherical shape:
  - (much) smaller thickness than for flat endplates for fixed deformation under load - exact calculation underway (S. Lauciani)
  - more shapes (e.g. cubic splines) attempted, but would imply larger angle, thus more material lost for the feed-through flat seats
- Pro of convex: longer by up to 16cm (option 5)
- Pro of concave:
  - shorter wires for smaller radii (background) - Swersky: non relevant because already shielded
  - works in traction mode (quantify vs. compression mode)
  - more track length for more “useful tracks”? ➔ FastSim
- Concave FW and convex BW
  - more space for cables where there are more (@larger radii)

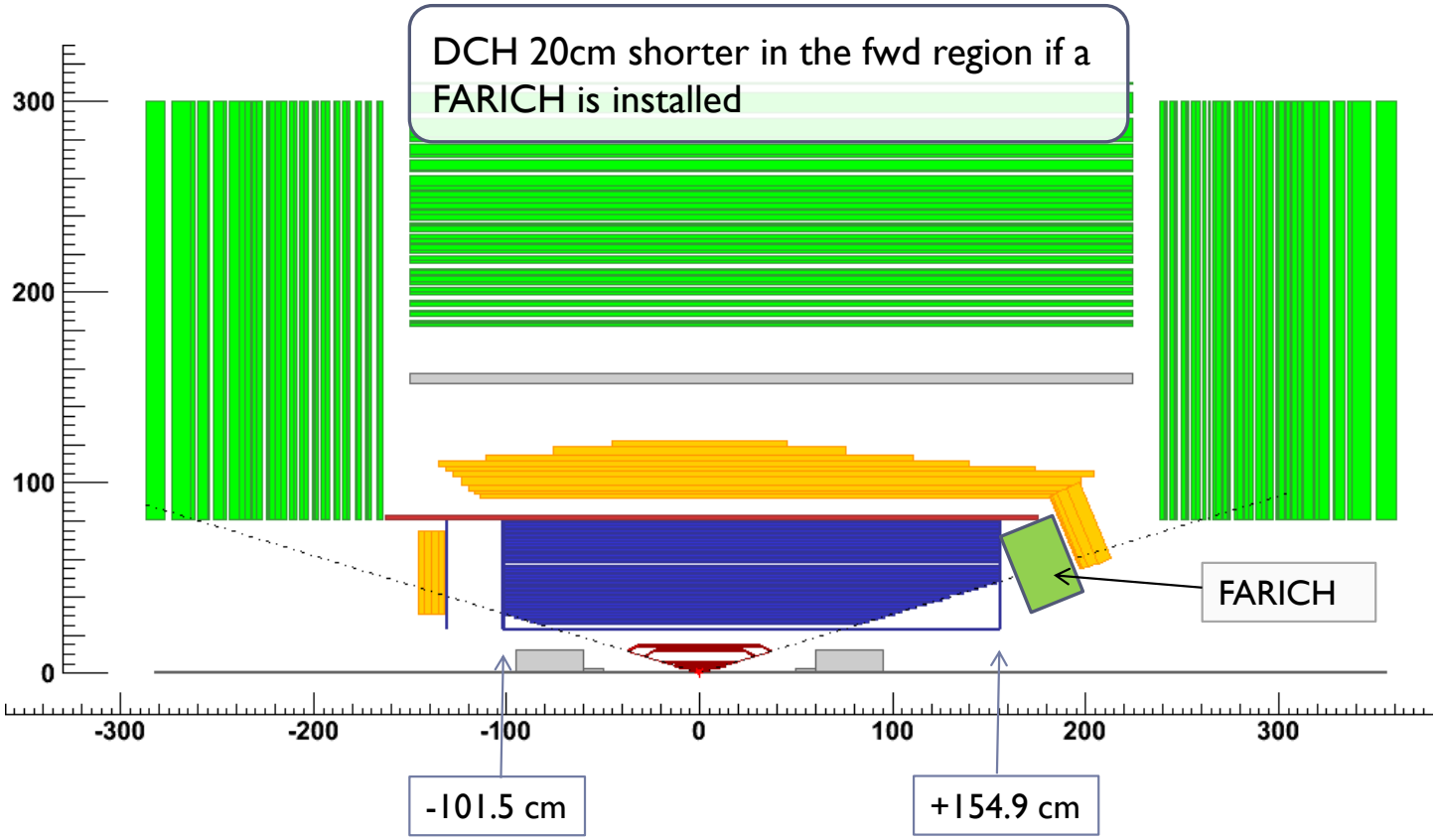
Past FastSim Studies in the DGWG

- Tracking performance as a function of the DCH inner radius: Perugia09
- Tracking as a function of the DCH length: CalTech10
- dE/dx as a function of the DCH length: Frascati09
- Tracking as a function of stereo angle and cell layout: Annecy10

Can we extrapolate from the previous results?

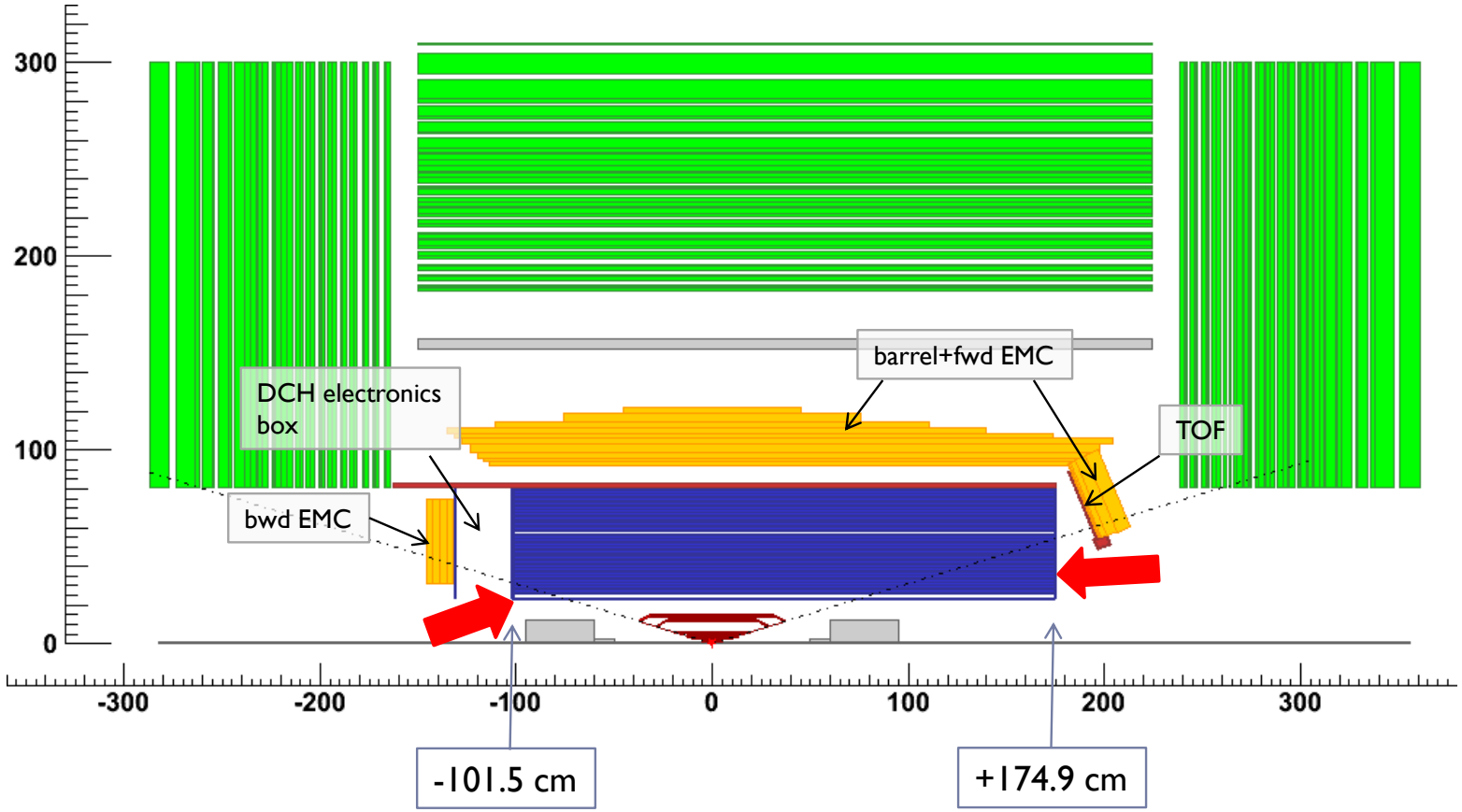
Tracking vs. DCH length

Short DCH

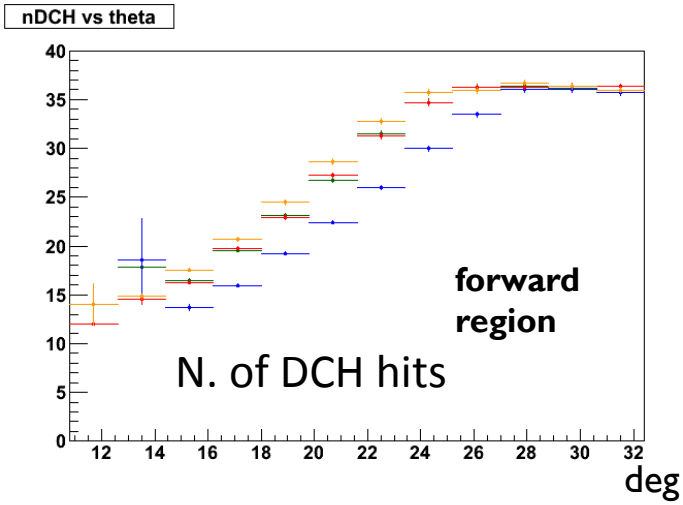


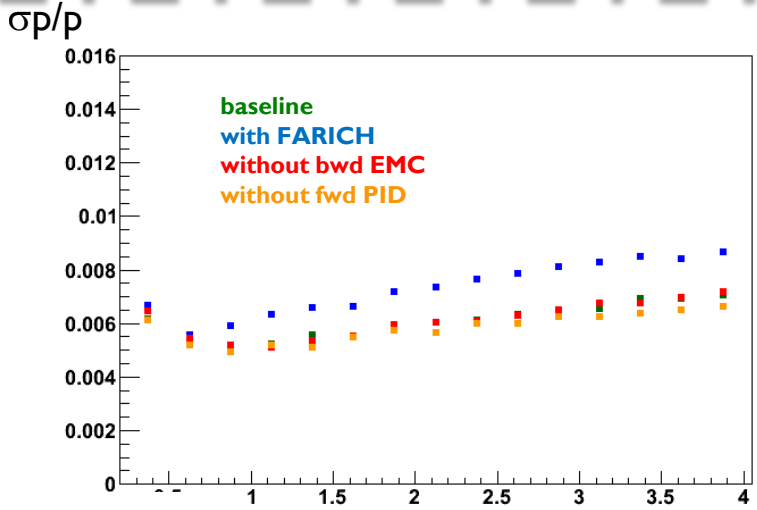
Tracking vs. DCH length

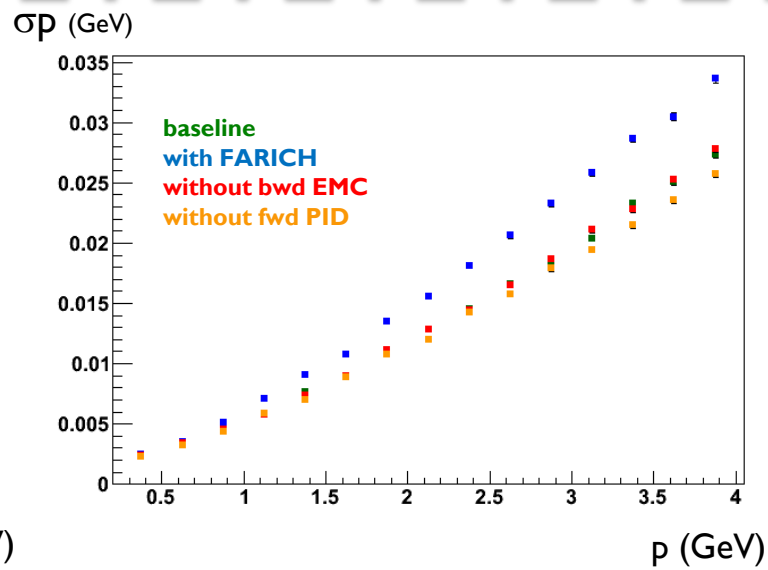
baseline DCH



Tracking vs. DCH length (ΔL=20cm)





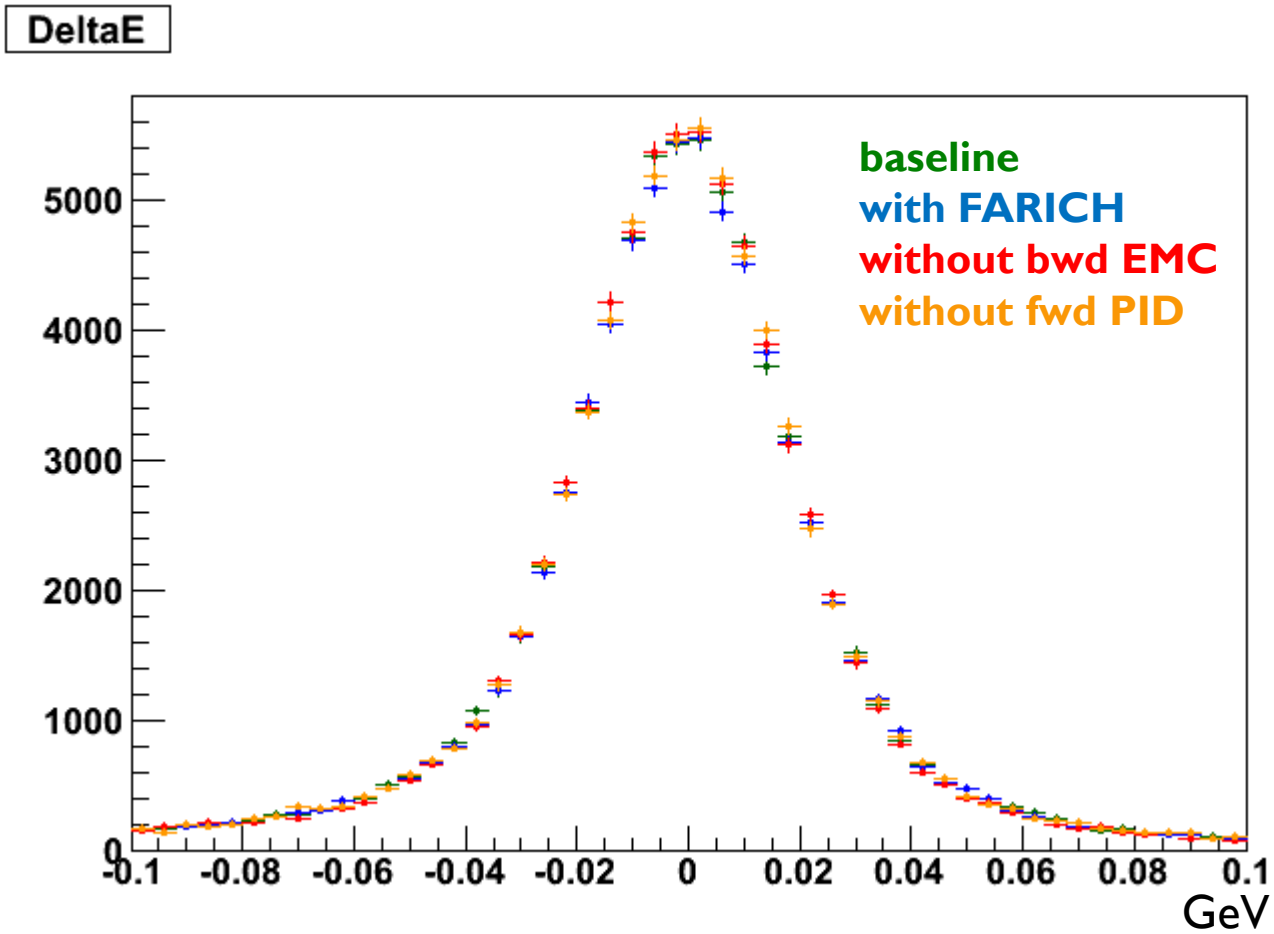


Single particles:
σ(p)/p at θ=23°

p resolution in Short DCH worsens by ~20% in fwd region (for θ=23°)
negligible effect in Long DCH vs. Masked DCH

Effect on $B^0 \rightarrow D^{*-} K^+$ reconstruction

$B^0 \rightarrow D^{*-} K^+$, $D^{*-} \rightarrow D^0 \pi^-$, $D^0 \rightarrow K\pi$ no selection cuts applied, just MC truth matching



the effect on the overall ΔE distribution is hardly visible

Reconstruction efficiency of $B^0 \rightarrow D^{*-} K^+$

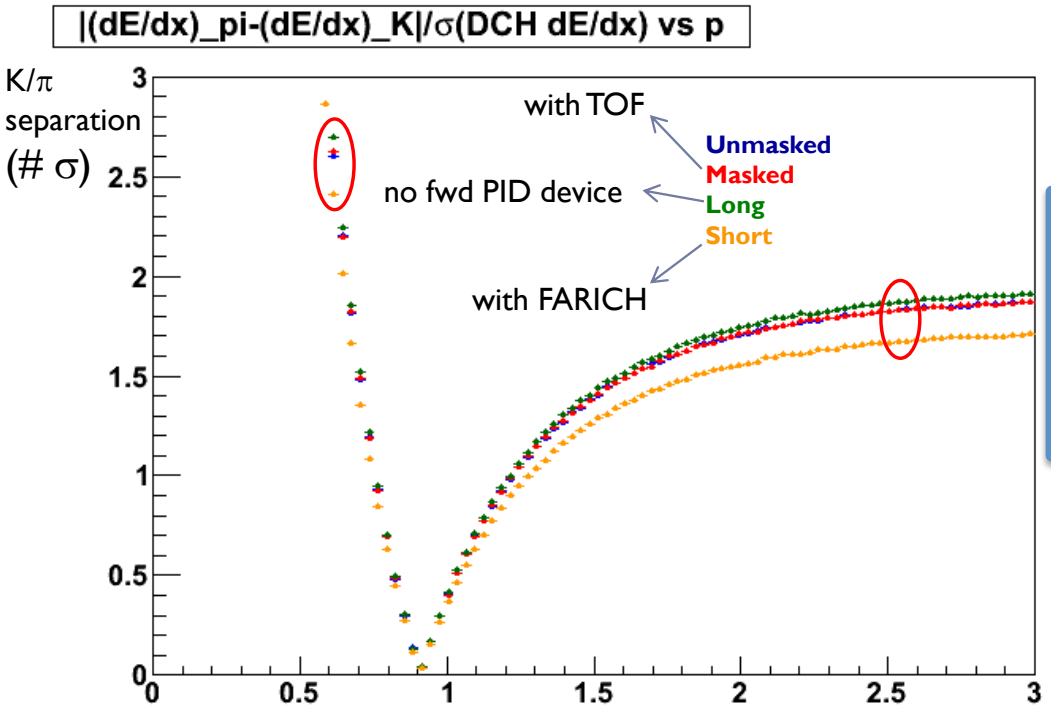
DCH configuration	reco. efficiency [%] ($\|\Delta E\|<100$ MeV)
baseline	70.9 ± 0.1
20cm shorter in fwd region (FARICH)	70.2 ± 0.1
20cm longer in bwd region (no bwd EMC)	70.9 ± 0.1
6cm longer in fwd region (no fwd PID)	71.2 ± 0.1

DCH configuration	reco. efficiency [%] ($\|\Delta E\|<50$ MeV ~2.5σ)
baseline	65.5 ± 0.2
20cm shorter in fwd region (FARICH)	64.8 ± 0.2
20cm longer in bwd region (no bwd EMC)	65.9 ± 0.2
6cm longer in fwd region (no fwd PID)	65.9 ± 0.2

Effect on dE/dx

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

see drawings in sl. 10-11



between Short and Masked:
0.16σ difference @2.5GeV
0.21σ difference @0.6 GeV

between Long and Masked:
~0.04σ difference @2.5GeV
~0.07σ difference @0.6GeV

My Summary

- Past FastSim results indicate that 1cm increase of track length implies 1% better $\sigma(p)/p$
  - Weighting with tracks from the whole chamber, the effect e.g. on ΔE is hardly visible
- Effects on dE/dx on forward-going tracks are evident, but probably the overall effect is not enormous
- In the TDR it's worth to repeat the sensitivity studies with the most updated parameters
- For the review we have been asked to present at next week's Tech Board (time is very short anyway for obtaining results for it), past studies indicate that a longer DCH certainly grants better performances, but the size of the effects is not huge