Alignment with Beam Halo

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28/10/2008

Combined Alignment (1)

- CMSSW 2_0_12
- Configurations (alignment at detector level):
  - alignParams = {"PixelDets,111001,pixEnd", "BarrelDetsDS,111001", "BarrelDetsSS,101001", "TIDDets,111001,tecDS", "TIDDets, 101001,tecSS", "TECDets,111001,tecDS", "TECDets, 101001,tecSS"}
  - GlobalTag.globaltag = "1PB_V2_RECO::All"
- Samples:
  - CSA08 Minimum Bias (1PB_V2_RECO): 1M events
  - CSA08 Cosmics (1PB_V2_RECO): 3M events
  - CSA08 Beam Halo (STARTUP_V2): ~60k events
    - STARTUP_V2: same misalignment scenario as 1PB_V2_RECO

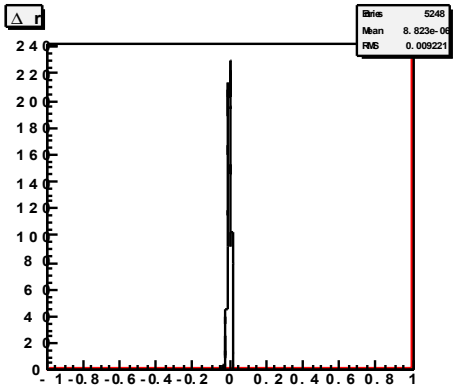
Combined Alignment (2)

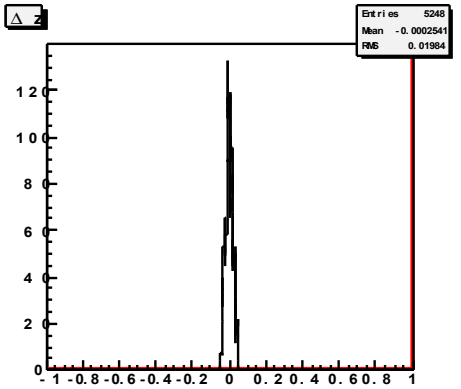
- Strategy:
  - align with cosmics and minimum bias
  - as above + beam halo (5x weight)
  - compare geometries
- cosmic + minimum bias sample
  - 4203871 tracks
  - 44244 parameters to determine
- cosmic + minimum bias + beam halo
  - 4492606 tracks (5x 57747 beam halo tracks in it)
  - same number of parameters

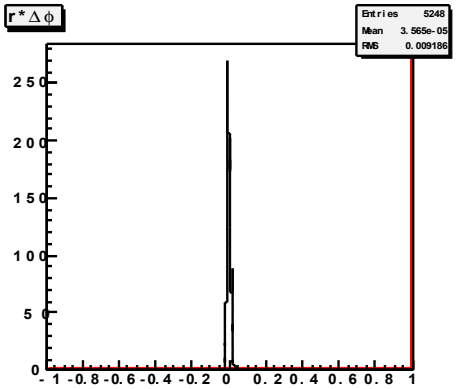
Combined Alignment (3)

- TEC. Comparison to ideal geometry (Subdet global displacements are subtracted):

Misaligned geometry:





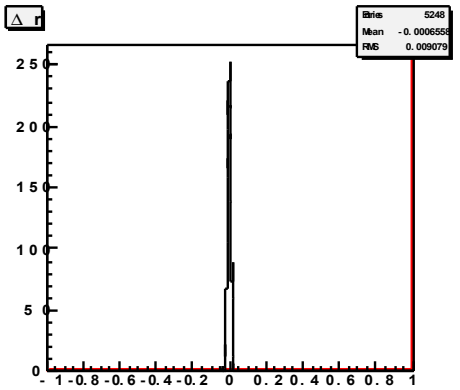


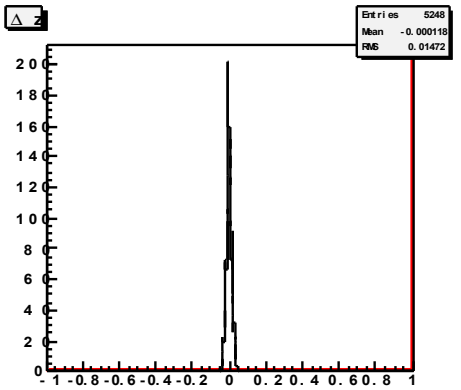
Δr=90 mμ

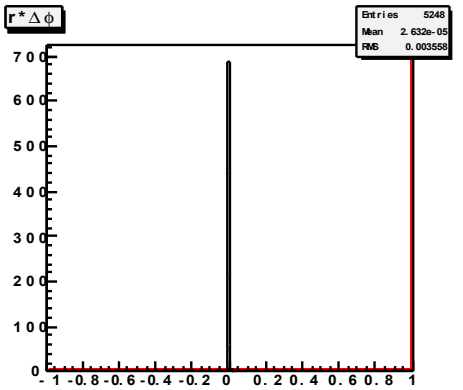
Δz=200mμ

rΔφ=90mμ

Aligned w/ MinBias+ Cosmics:







Δr=90 mμ

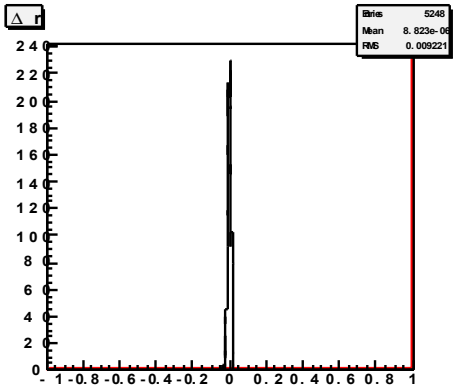
Δz=150mμ

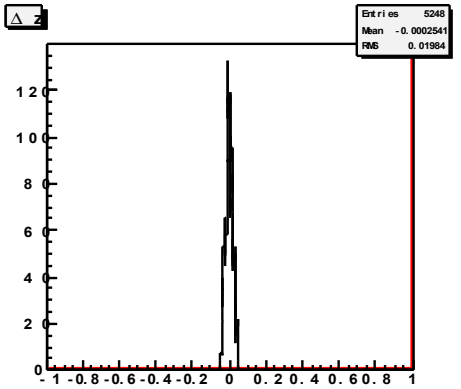
rΔφ=35mμ

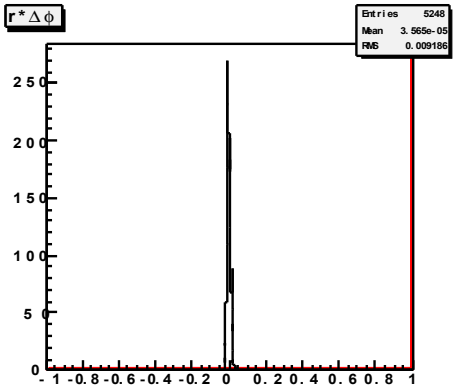
Combined Alignment (4)

- TEC. Comparison to ideal geometry (Subdet global displacements are subtracted):

Misaligned geometry:





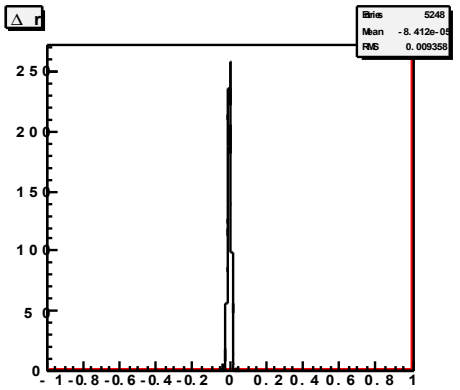


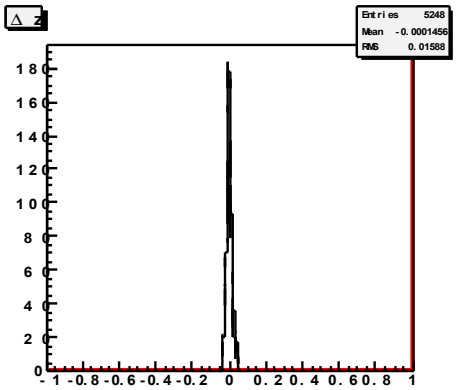
Δr=90 mμ

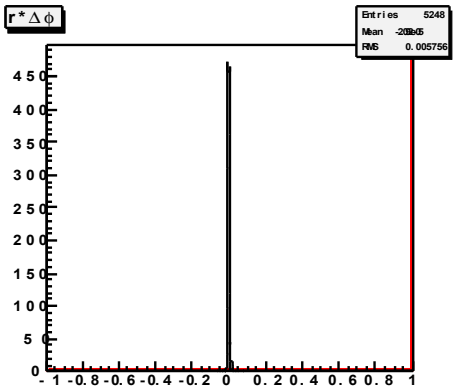
Δz=200mμ

rΔφ=90mμ

Aligned w/ MinBias+ Cosmics+ BeamHalo:







Δr=90 mμ

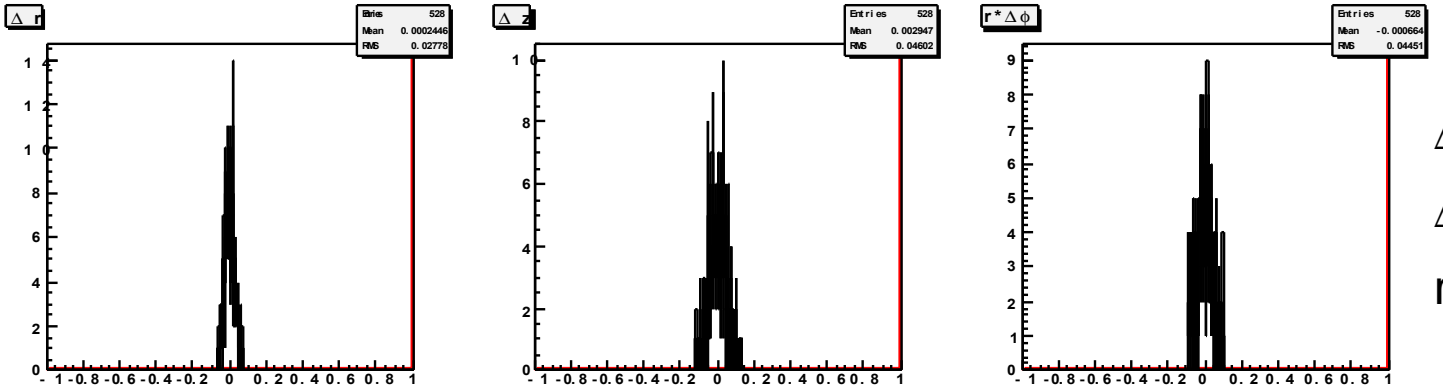
Δz=160mμ

rΔφ=60mμ

Combined Alignment (5)

- TID. Comparison to ideal geometry (Subdet global displacements are subtracted):

Misaligned geometry:

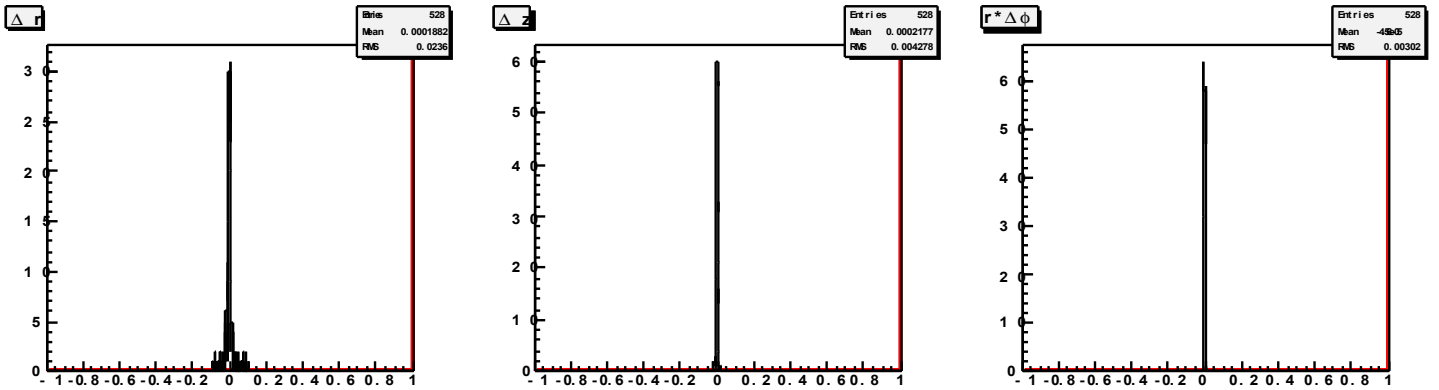


Δr=280 mμ

Δz=460mμ

rΔφ=450mμ

Aligned w/ MinBias+ Cosmics:



Δr=240 mμ

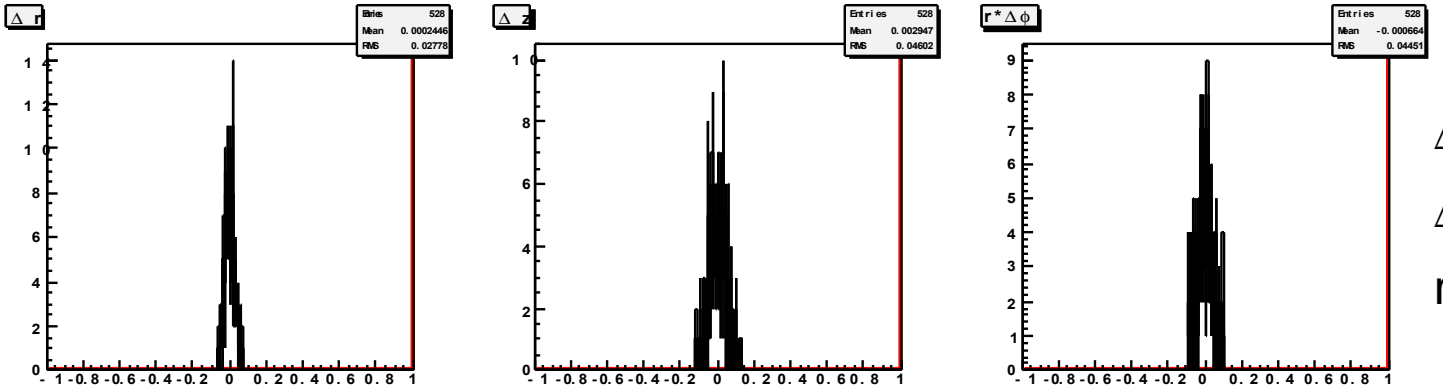
Δz=45mμ

rΔφ=30mμ

Combined Alignment (6)

- TID. Comparison to ideal geometry (Subdet global displacements are subtracted):

Misaligned geometry:

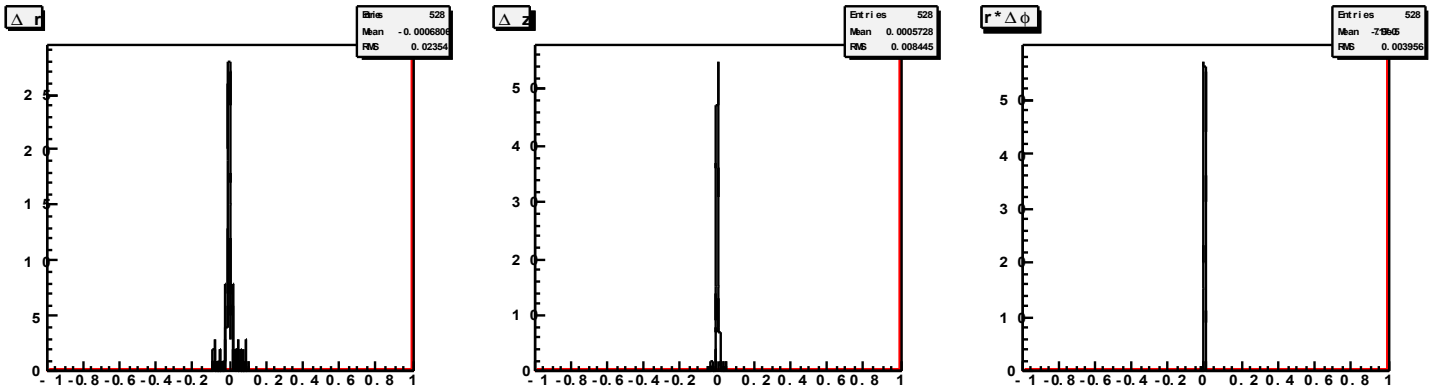


Δr=280 mμ

Δz=460mμ

rΔφ=450mμ

Aligned w/ MinBias+ Cosmics+ BeamHalo:



Δr=240 mμ

Δz=85mμ

rΔφ=40mμ

Combined Alignment (7)

- Minimum bias and cosmics allow to align endcaps
  - noticeable improvement, especially in TID
- Beam halo tracks do not help:
  - Too many parameters and few beam halo tracks? Waiting for 21X production
  - Moreover there are few tracks connecting the two endcaps... (maybe due to the reconstruction)

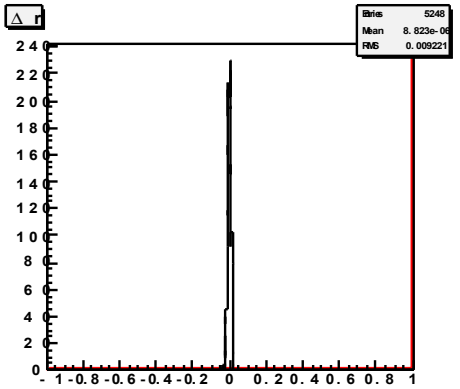
Beam Halo only alignment (1)

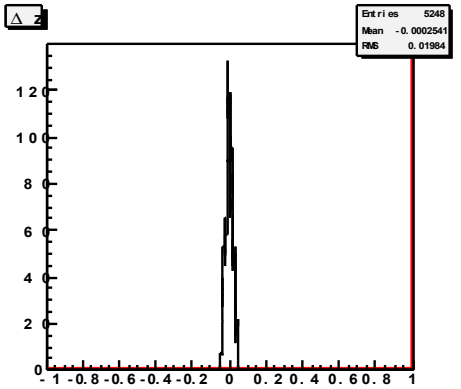
- CMSSW 2_0_12
- Configuration file (alignment of endcap high-level structures only):
  - alignParams = {"PixelDets,000000,pixEnd", "BarrelDetsDS, 000000", "BarrelDetsSS,000000", "TIDRings,111000","TECPetals, 110000"}
  - GlobalTag.globaltag = "1PB_V2_RECO::All"
- Samples:
  - CSA08 Beam Halo (STARTUP_V2): ~60k events
- Parameters to align: 630

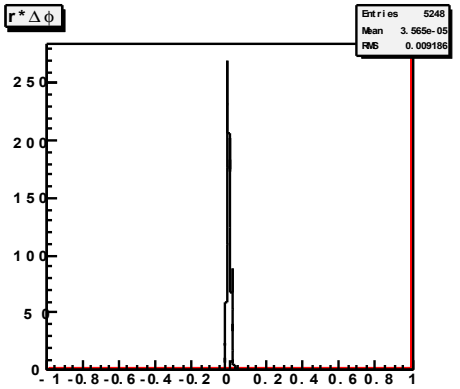
Beam Halo only alignment (2)

- TEC. Comparison to ideal geometry (Subdet global displacements are subtracted):

Misaligned geometry:





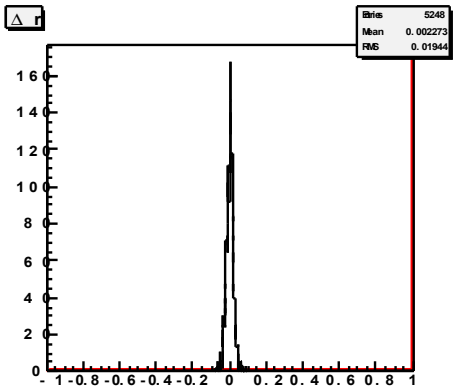


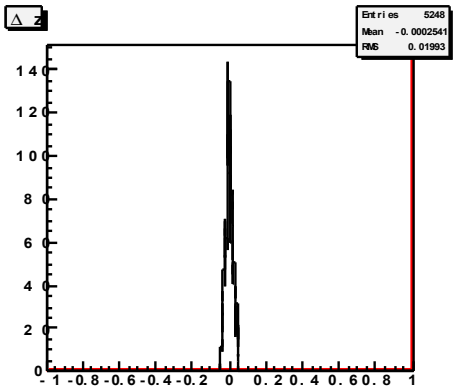
Δr=90 mμ

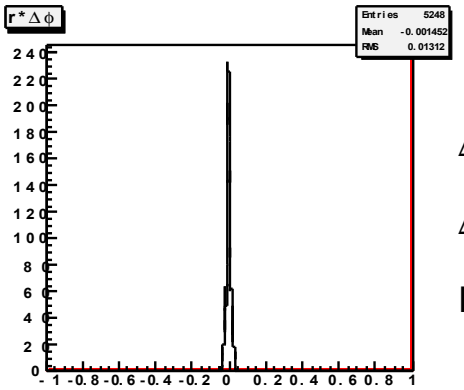
Δz=200mμ

rΔφ=90mμ

Aligned w/ BeamHalo:







Δr=190 mμ

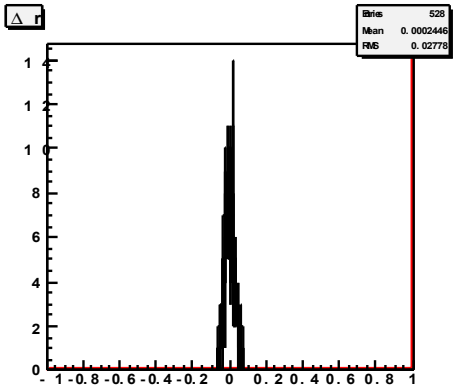
Δz=200mμ

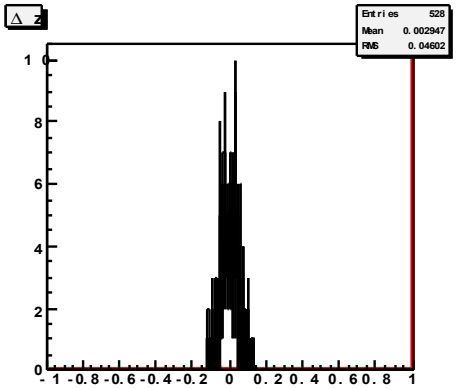
rΔφ=130mμ

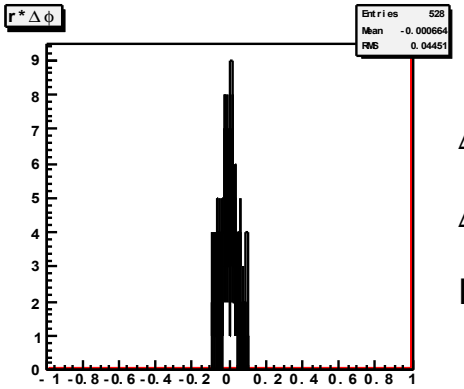
Beam Halo only alignment (3)

- TID. Comparison to ideal geometry (Subdet global displacements are subtracted):

Misaligned geometry:





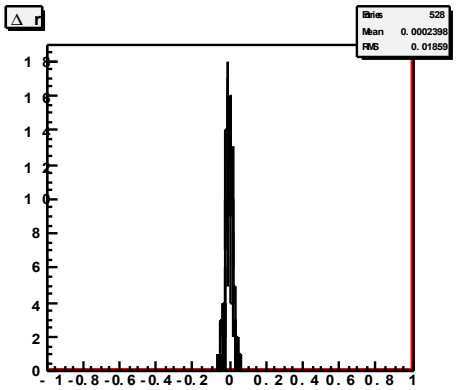


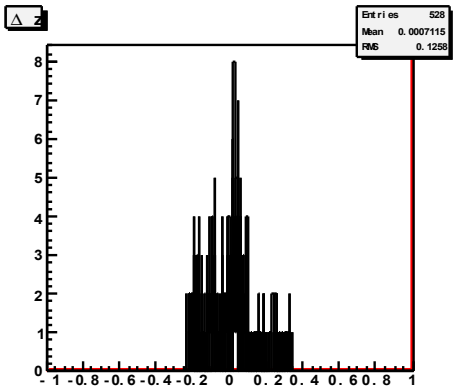
Δr=280 mμ

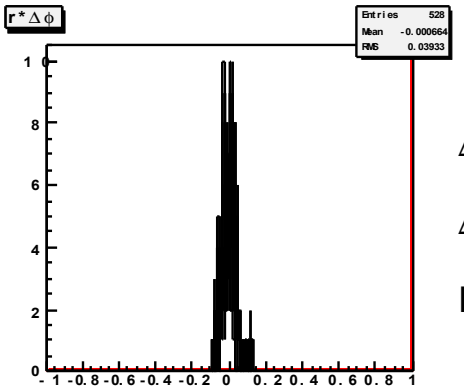
Δz=460mμ

rΔφ=450mμ

Aligned w/ BeamHalo:







Δr=190 mμ

Δz=1.3mm

rΔφ=400mμ

Beam Halo only alignment (4)

- Alignment done on high-level structures only... but plots show displacement of detectors wrt to the subdetectors:
  - Are they significant? Probably not
  - Plots should be made of subdetectors' displacements wrt whole tracker

Status and Plans

- Use of beam halo events together with minimum bias and cosmics in a global alignment
  - minimum bias and cosmics improve detectors' alignment
  - only small changes adding beam halo too (maybe too few tracks?)
- Second attempt: beam halo standalone alignment of high-level structures in end-caps: ongoing

That's all.

Thanks!