SL alignment studies with cosmics data on MB3 chambers
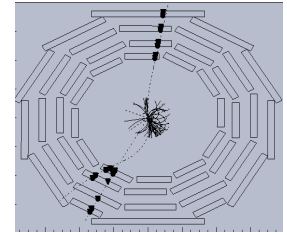
Barrel Muon week, Aachen, 28-30 April 2004

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Universita' di Padova and INFN Padova

- Method

- Comparison with layer measurements at SL assembling stage

- Results

- Towards a "common software": remarks and conclusions

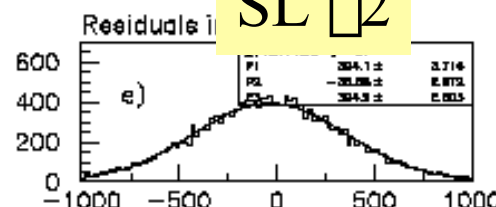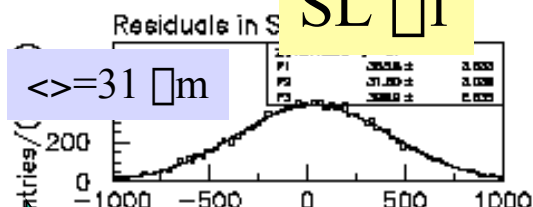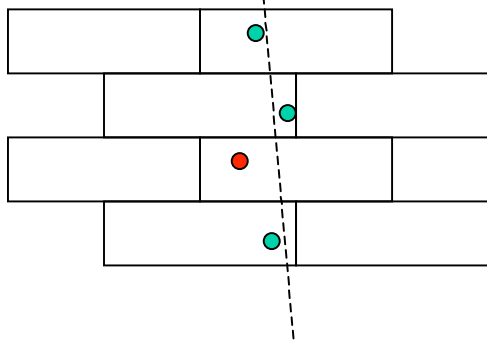Details of the analysis can be found on CMS-NOTE 2004/001
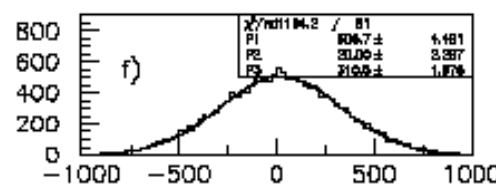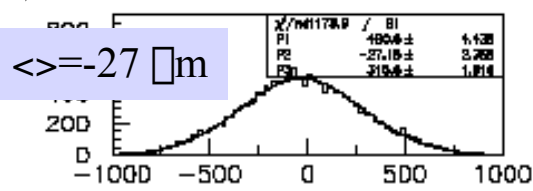
1

Alignment study

i) Look to cosmic tracks in SL:

MB3_008

SL φ1   **SL φ2**

<>=31 μm   L4

<>=-27 μm   L3

21 MB3 CHAMBERS

outer layers
σ=78 μm

<>=24 μm   L2

inner layers
σ=56 μm
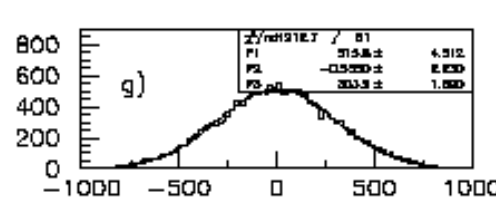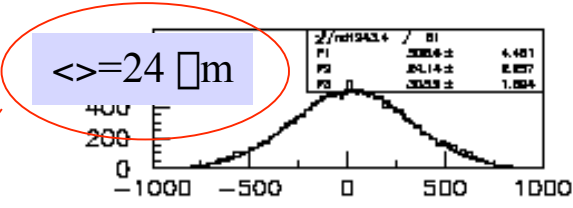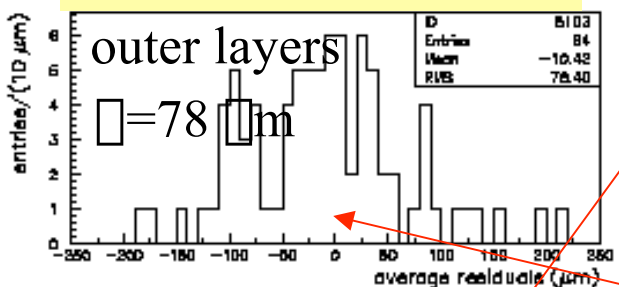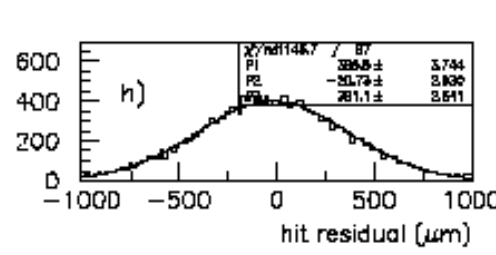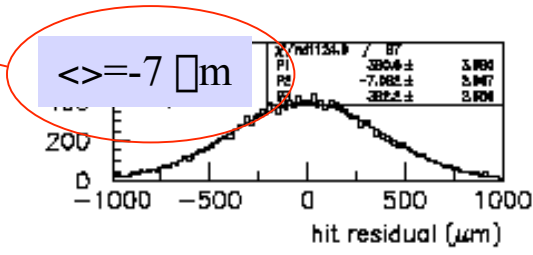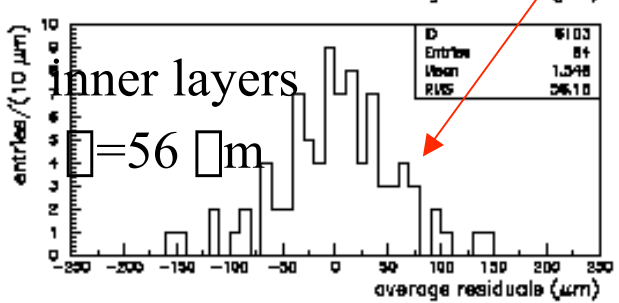
<>=-7 μm   L1

Alignment study

ii) Differences between tracks
in the 2 Φ-SL :

MB3_008

SL φ2

SL φ1
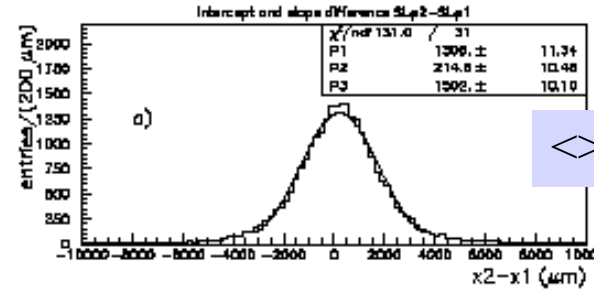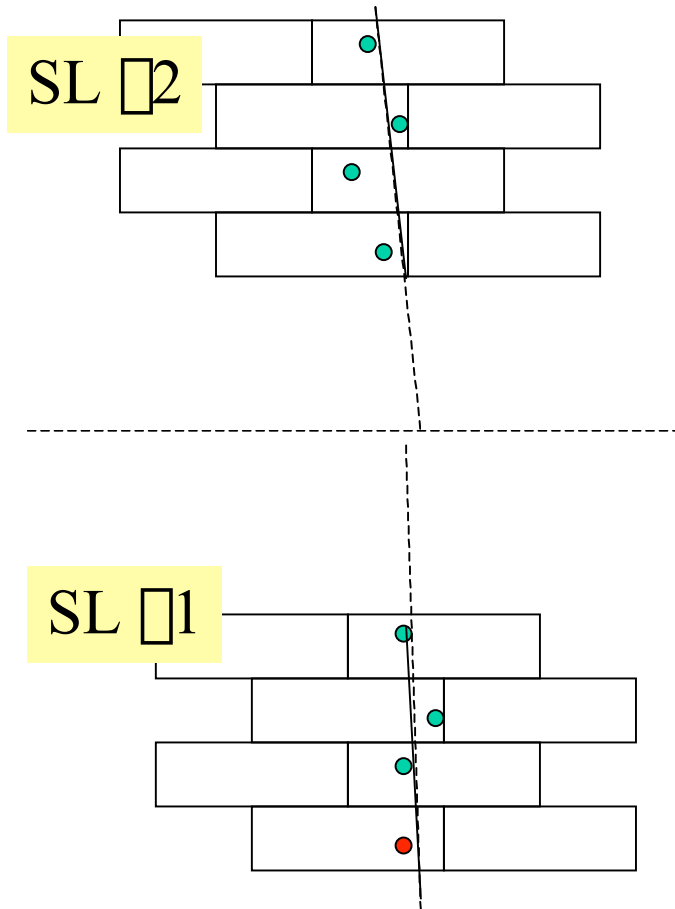
<>=215 μm
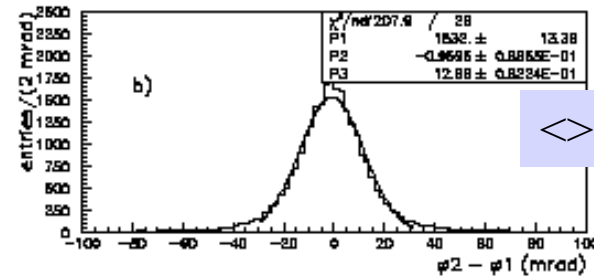
<>=0.95 mrad

21 MB3 CHAMBERS

<>=412 μm
σ= 380 μm
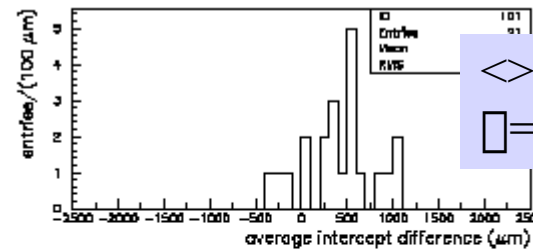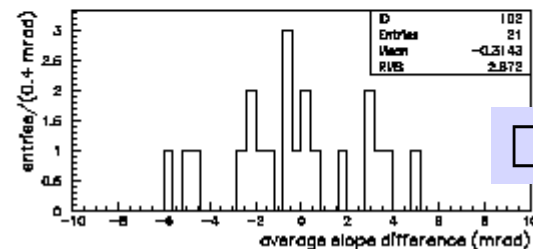
σ= 2.9 mrad

Alignment study

SL $\phi 2$

Δ_{SL}

SL $\phi 1$
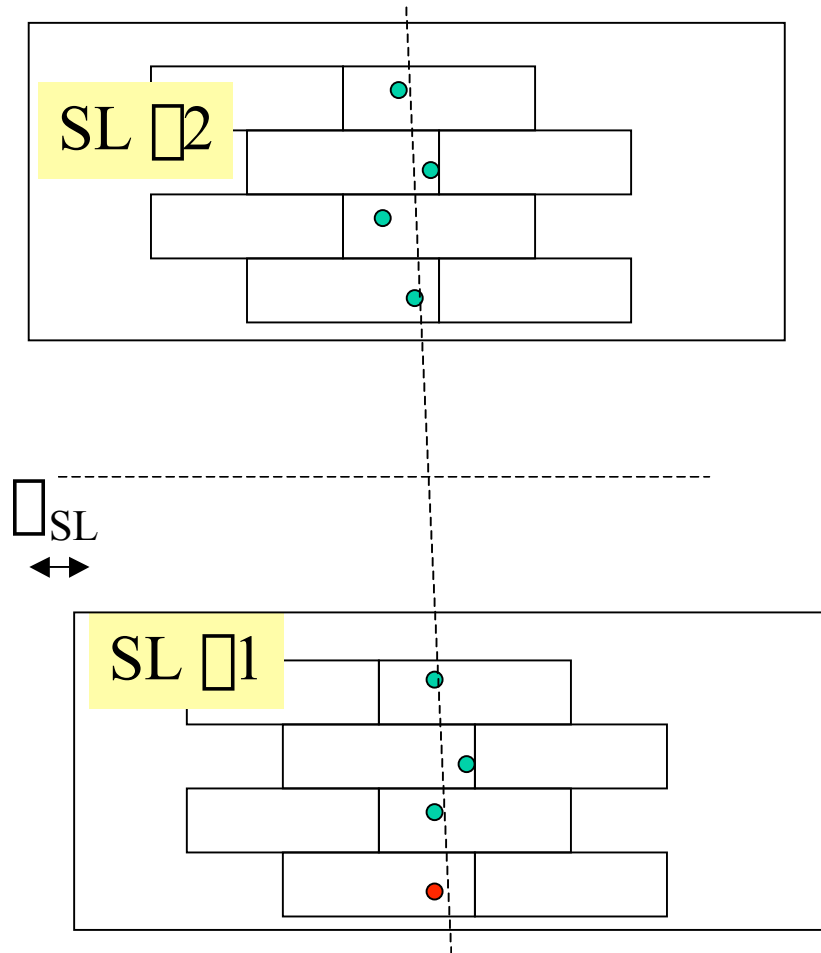
i) assume $\Delta_{SL} = 0$, and compute residuals using 7 point track ;

ii) Correlate the average of the distribution of the residuals to the measurements of the layer position inside the SL done at assembling stage; perform this study using tracks near FE and HV side of the chamber separately
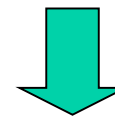
Alignment study

A clear correlation is observed:
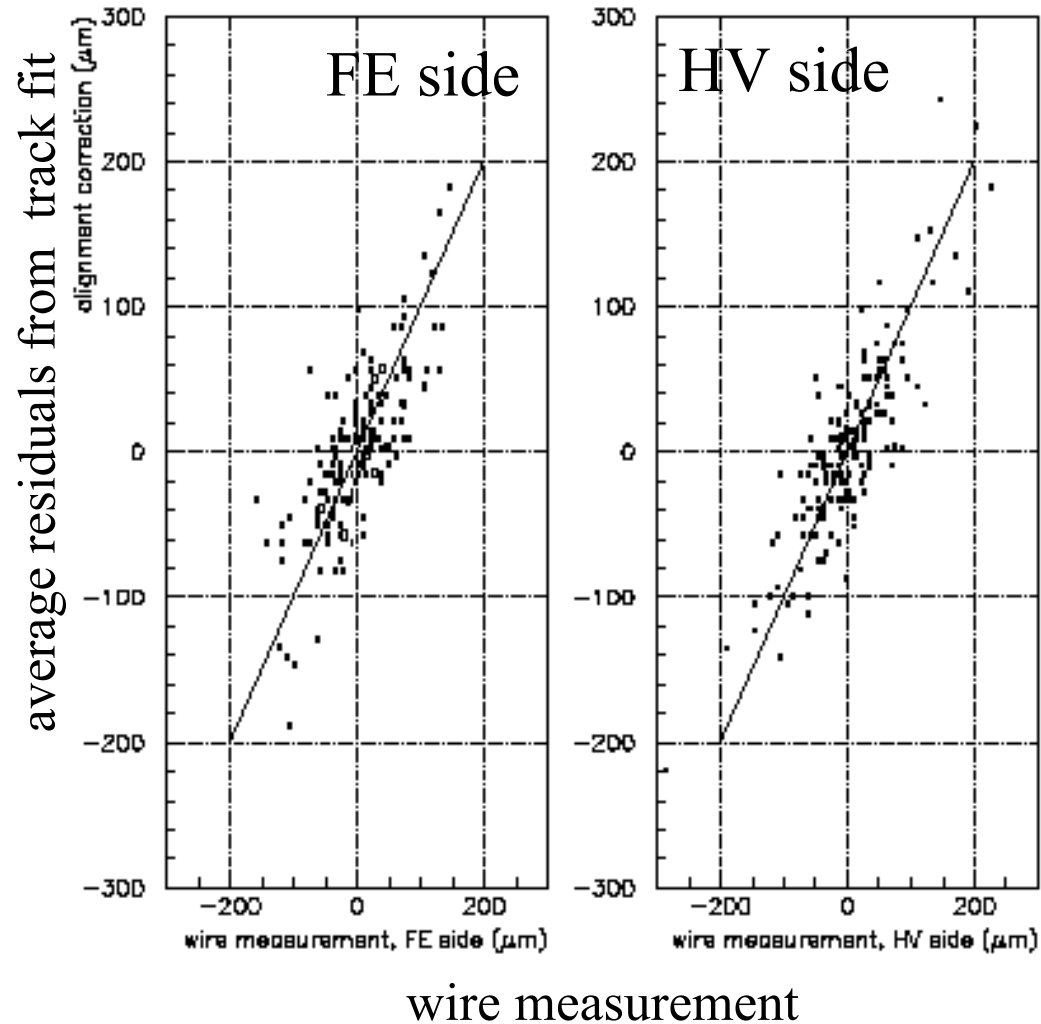
wire measurement
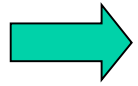
Alignment study

Use the wire measurements to correct the hit position in the SL
and repeat the 4 point fits in the SL separately
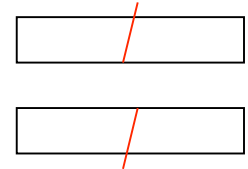
Average observed Δ_{SL}

Average slope difference

FE

HV

FE

HV

uncorrected

σ= 2.9 mrad

σ= 2.6 mrad

$\langle\rangle$=412 μm
σ= 385 μm

$\langle\rangle$= 320 μm
σ= 580 μm

with wire
corrections

$\langle\rangle$= -26 μm
σ = 202 μm

$\langle\rangle$= 69 μm
σ = 198 μm

σ= 1.3 mrad

σ= 1.2 mrad
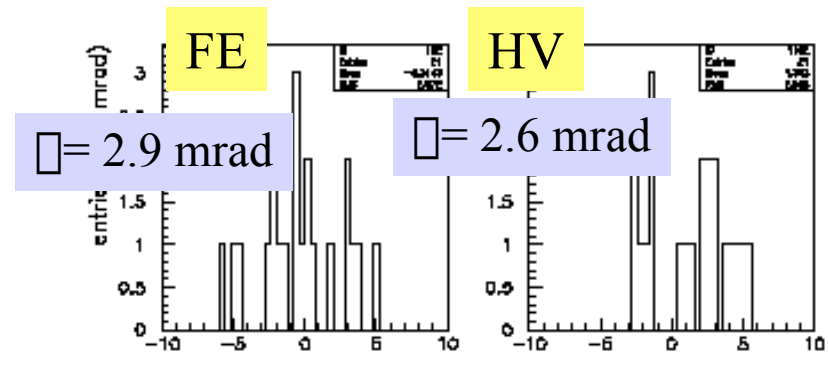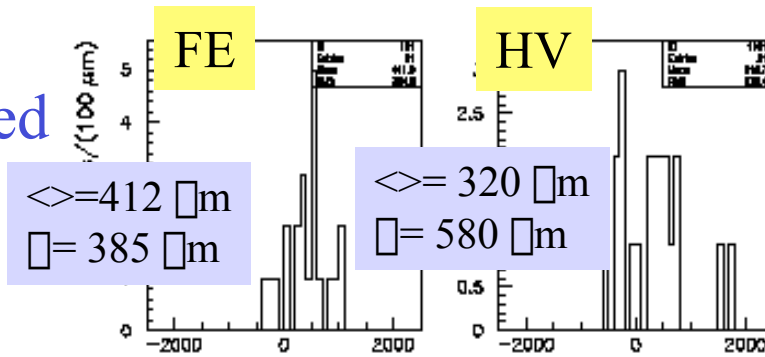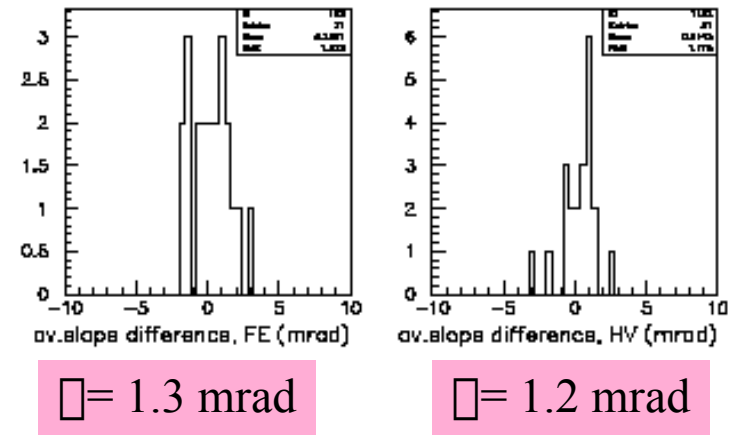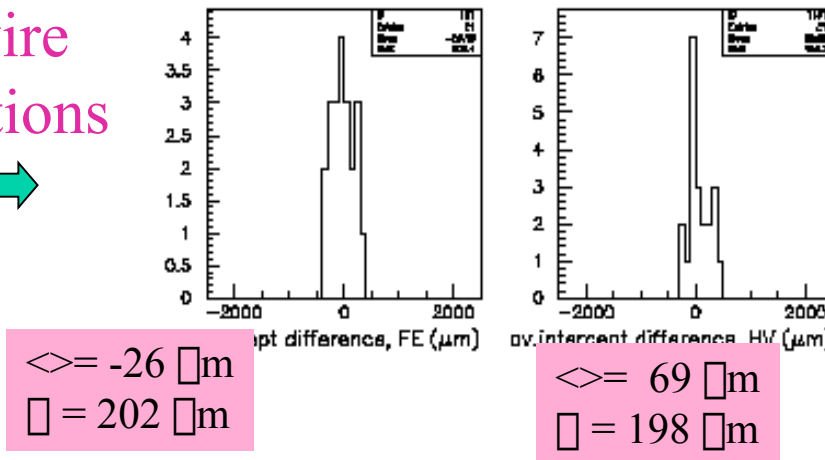
Alignment study

Distribution of the wire corrections inside the SL:
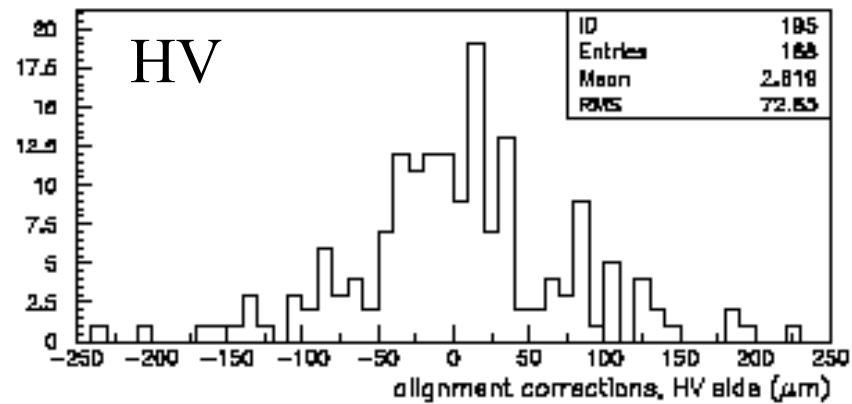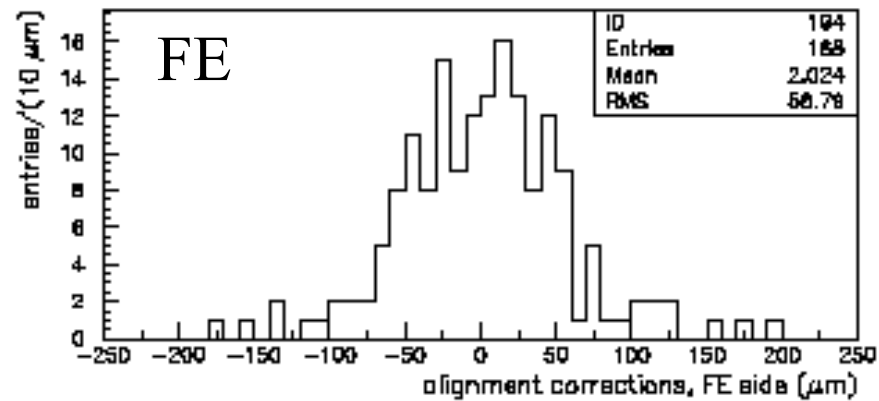
Alignment study: conclusions

- The measurements of the layer position inside a SL significantly
  improve the track fits; the r.m.s. of these measurements is
  ~ 60 μm

- The observed misalignments between SL, after the inclusion of the
  layer corrections, are small: their average, over 21 MB3 chambers, is
  30 μm (70 μm) on FE (HV) side, with r.m.s. ~ 200 μm.
  None of the chambers has an observed shift between SL
  bigger than 500 μm

- The above picture is consistent with the bench measurement at ISR
  on assembled chambers

Towards a common software:

Some remarks:

A common software for patt.recognition/track reconstruction & fit exists in ORCA; it is used in:
  - CMS simulations
  - testbeam analysis
  - cosmic ray tests

-The same ntuple/root files may be produced on MB1/2/3 data and analysed by everybody; useful x-checks should be easier than in the past

- It may be used for real data <=> MC comparisons

Just a short example:
DT resolution study & linearity check

DT resolution

ORCA simulation
(MB1, wheel 0)

Cosmic data, MB3_008

Hit res. vs xcell

Mean x	6.8
Mean y	-1.2
RMS x	
RMS y	0

7pt fit

hit res 0-5 deg

χ^2 / ndf	4550 / 97
Constant	6149 ± 31.24
Mean	-6.224e-05 ± 7.108e-05
Sigma	0.01947 ± 6.875e-05

σ=195 μm
(as in test-beam)

res, 7pt fit

χ^2 / ndf	121.1 / 76
Constant	238.4 ± 4.596
Mean	-15.75 ± 4.494
Sigma	298.4 ± 3.625

σ=300 μm

(dominated by
cosmic trigger
resolution:
σ_{trg}=220 μm)

DT resolution

ORCA simulation θ = 15-20 deg Cosmic data, MB3_008

Hit res vs xcell

Mean y -0.0003
RMS x   1.
RMS y   0.02

hits res 15-20 deg

χ² / ndf	440.2 / 94
Constant	623.4 ± 8.746
Mean	0.0006103 ± 0.0002478
Sigma	0.0239 ± 0.0002264

σ=240 μm

res, 7pt fit

χ² / ndf	259 / 95
Constant	394.3 ± 5.807
Mean	12.54 ± 3.643
Sigma	327.7 ± 3.165

σ=330 μm

σ=250 μm

DT resolution

Cosmic data, MB3_008

θ = 25-35 deg

test beam study

res vs xcell, 7pt fit

res, 7pt fit

χ² / ndf	181 / 91
Constant	215 ± 3.978
Mean	19.73 ± 5.304
Sigma	378.5 ± 4.579

σ=378 μm

σ$_{DT}$=300 μm

res, 7pt fit

χ² / ndf	117.7 / 91
Constant	121.7 ± 2.782
Mean	29.47 ± 7.376
Sigma	412 ± 5.901

No angle correction on v$_{drift}$

σ=412 μm

σ$_{DT}$=350 μm