



Validation of Alignment DB with Real Cosmic Muon Data

A. Calderon, U. Gasparini, P. Martinez*, F. Matorras*

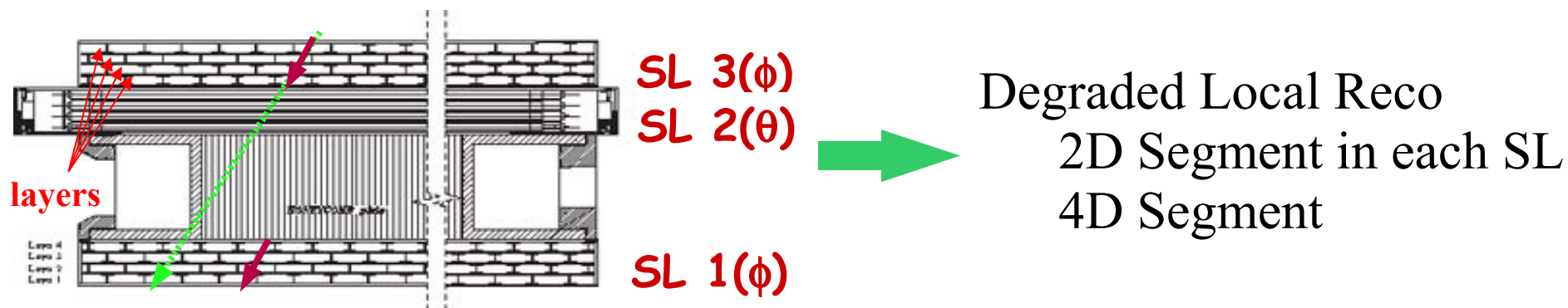
CMS Week February 2008
MU Barrel DT Meeting

* Instituto de Fisica de Cantabria (IFCA)



Motivation

Observed relative mis-alignment in the internal geometry of DT chambers between Layers & SL inside a chamber wrt to nominal geometry



Internal DB

(Long-term stable geometry)

P. Martinez et al.

Provide relative position and orientation of layers and superlayers:

QC at production sites (done)

Photogrammetry (PG; done)

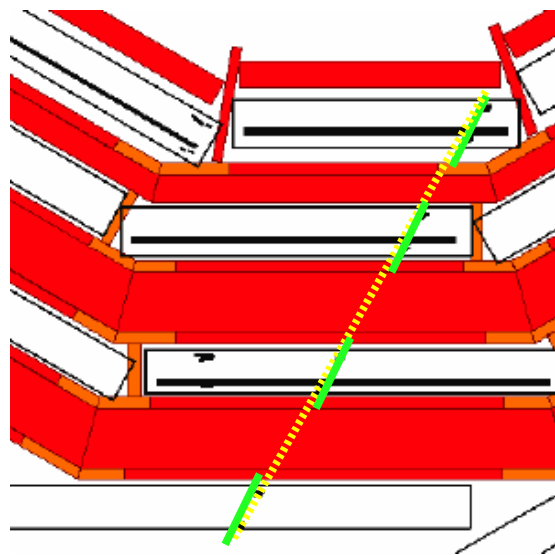
Commissioning cosmic data (done)



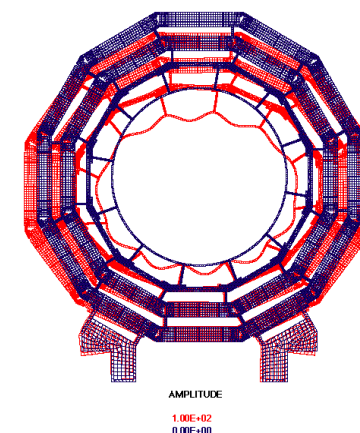
Motivation



Observed relative mis-alignment between DT location inside CMS wheels wrt to nominal geometry



Degraded reconstruction
SA tracks



Position and orientation of the chambers are calculated from PG measurements available (documents at EDMS server)

Survey DB

P. Martinez et al.

Relative position/orientation of DT chambers inside a wheel (done)

Position of the wheel yoke (on work)

Position/orientation of wheels wrt YB0 (on work)



'Zero Geometry'

Up to now... an initial 'Zero Geometry' for the first day data taking

Provided by P. Martinez

Internal Alignment of Chambers

Completed for 250 DT chambers (when available all information: QC, survey and/or commissioning data is used)

Alignment of the Chambers inside the wheel

Completed survey of the chambers inside

YB0, YB-1, YB-2, YB+1 and YB+2 wheels at the pit

Alignment with Tracks using cosmic data (on work)

All the information is being collected, processed and converted into CMSSW readable databases, available at afs, using the Alignment/SurveyAnalysis module at CVS

Next step ... upload to official database at CERN to be used in the next global runs

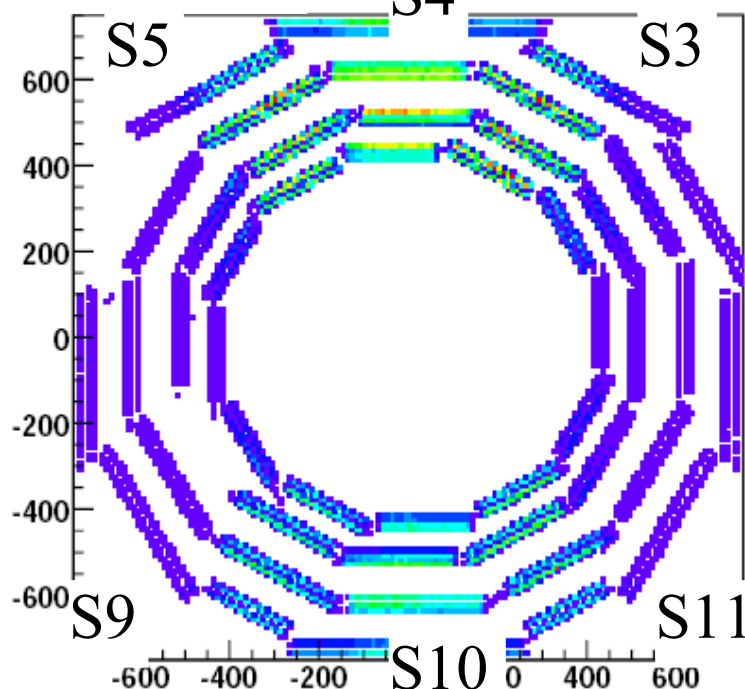


Validation of the alignment DB

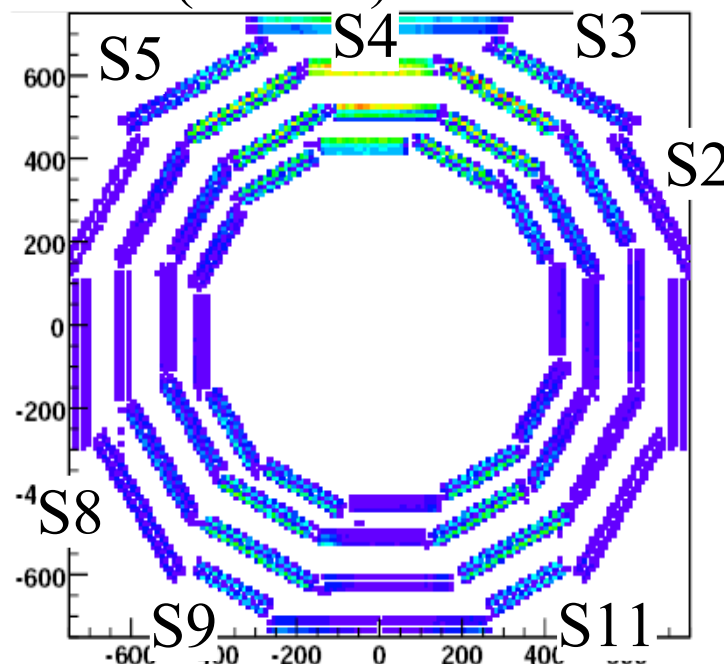


Data used (running on CMSSW175) on YB0:

GREN 30625



LR 35115 (Feb 08)



Check of results looking at the residual distribution:

- Extrapolation 2D segments between SL inside each chamber
- Extrapolation 4D segments between consecutive chambers (same sector)

 Next slides



Global Runs vs Local Runs

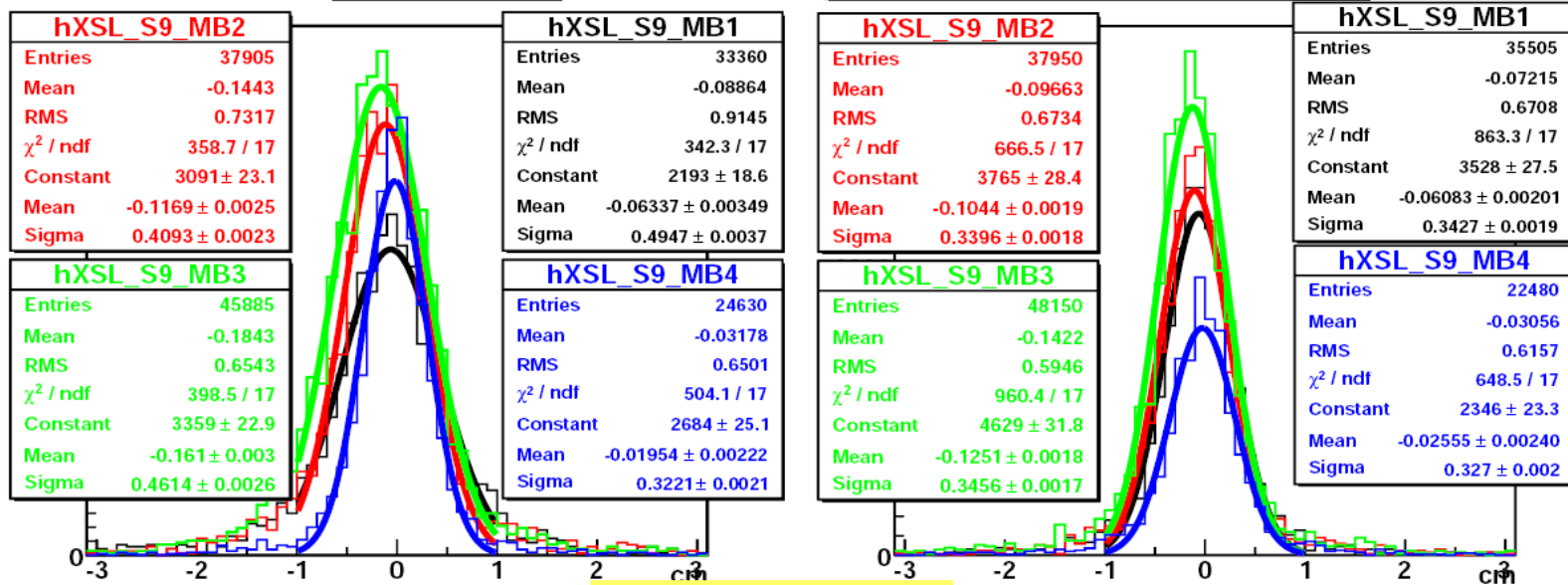


GREN 30625 **YB0, Sector 9** Local Run 35110

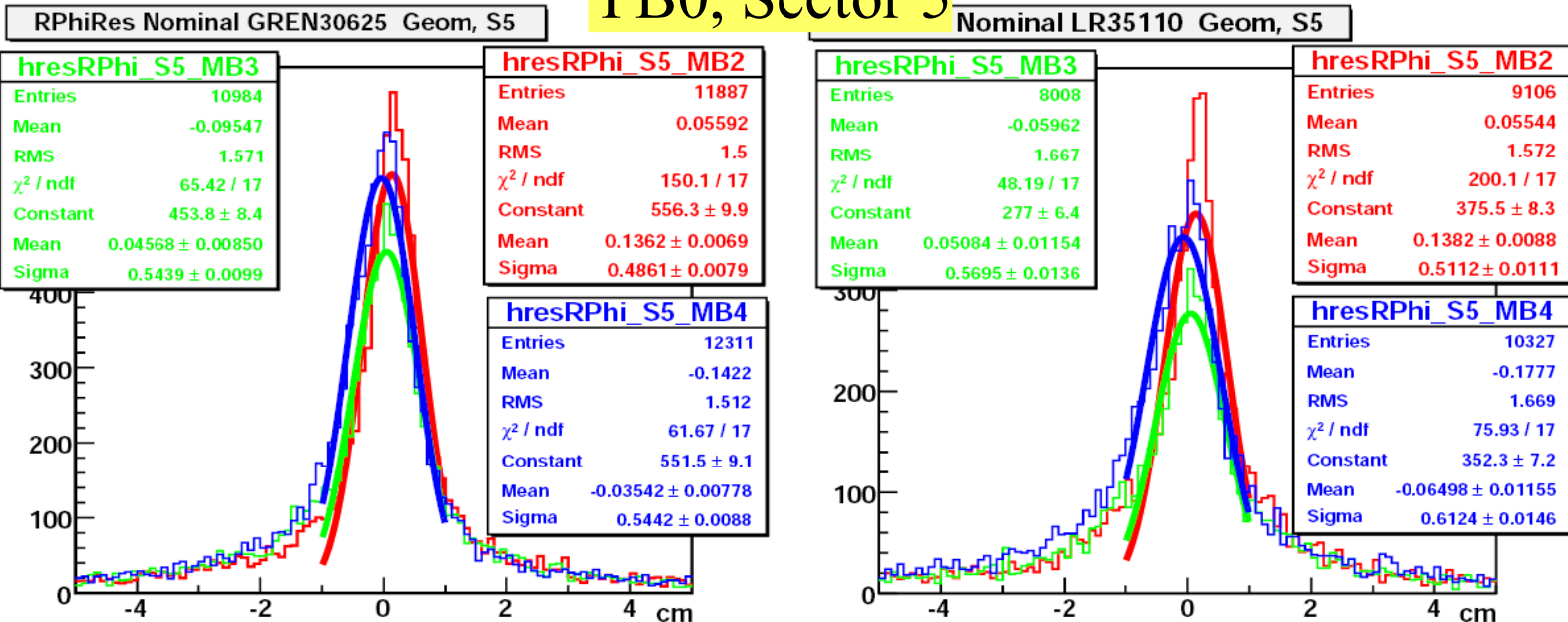
Global GREN30625, S9 **YB0, Sector 9** Local Run 35110 Layer X-posit

MB2 **MB1**
MB4 **MB3**

Residuals
between
SL
(Rphi plane)



YB0, Sector 5



Extrapolations:

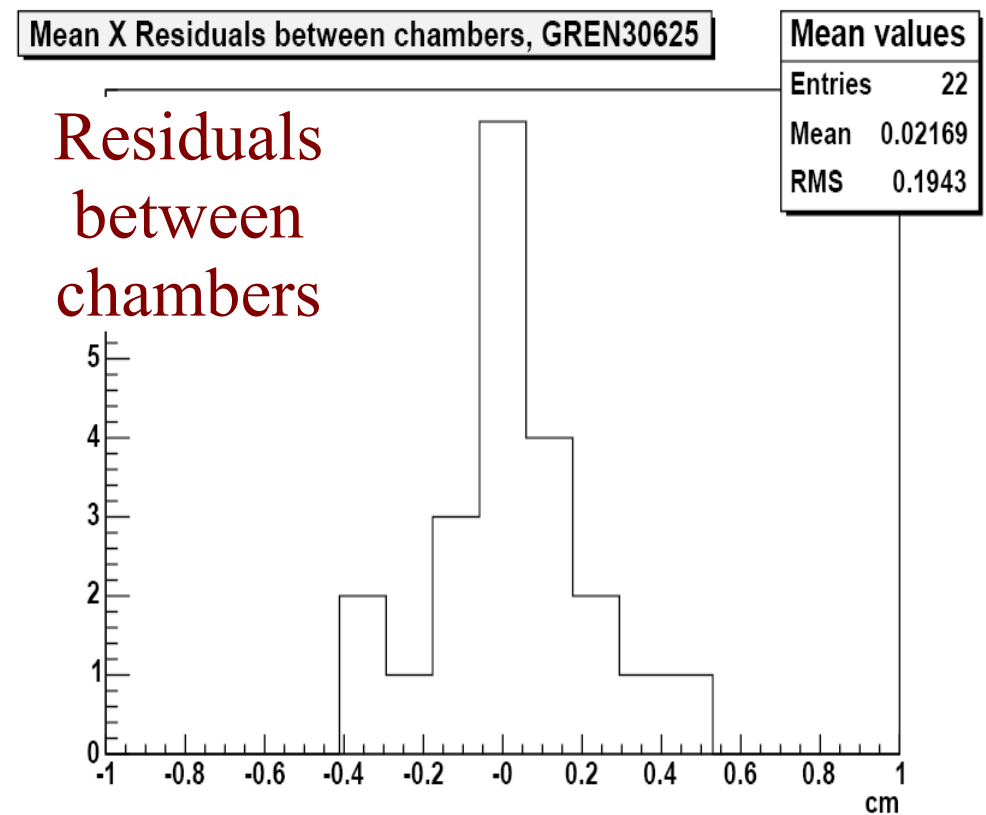
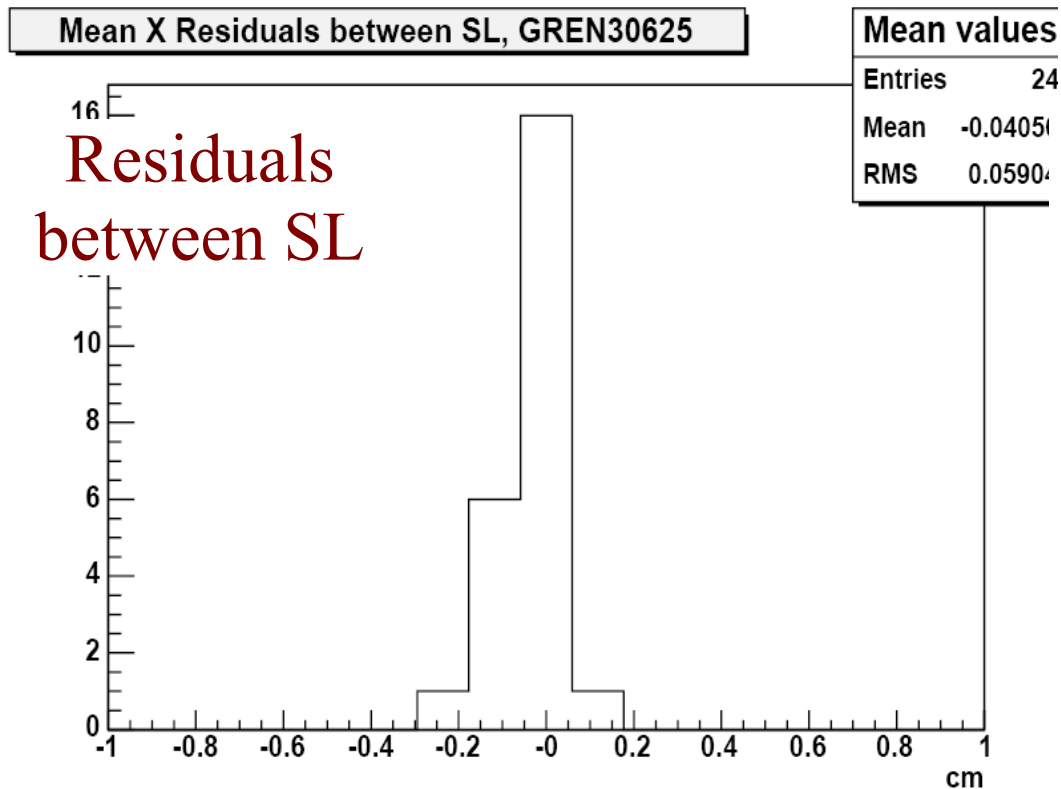
MB2 → MB1
MB3 → MB2
MB4 → MB3



Global Runs vs Local Runs



Observed mis-alignment GREN 30625 from residual distribution
(6 sectors triggered S3, S4, S5, S9, S10 & S11)



Observed mis-align up to ~ mm

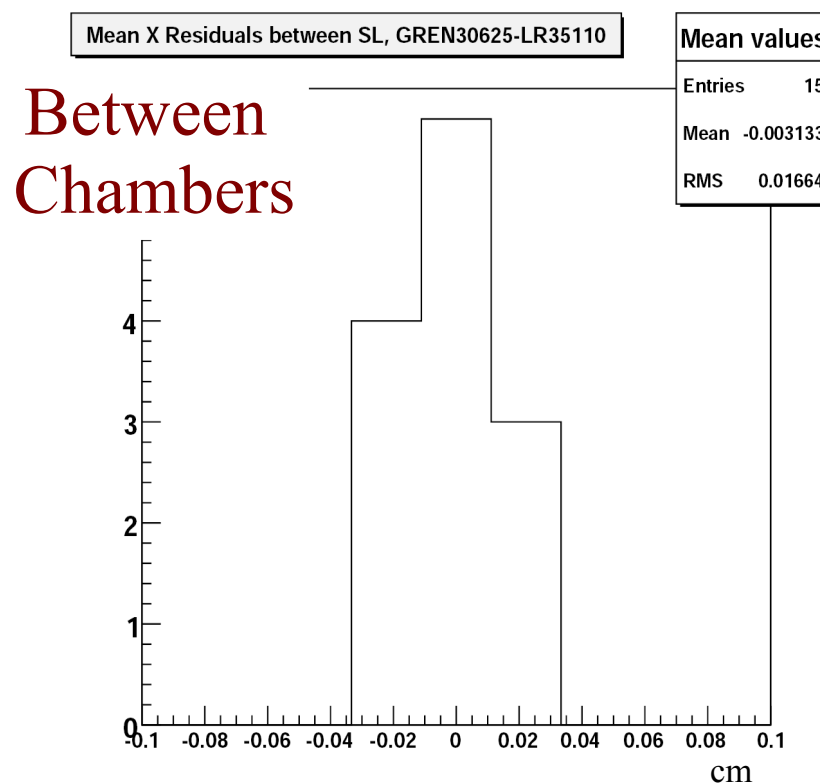
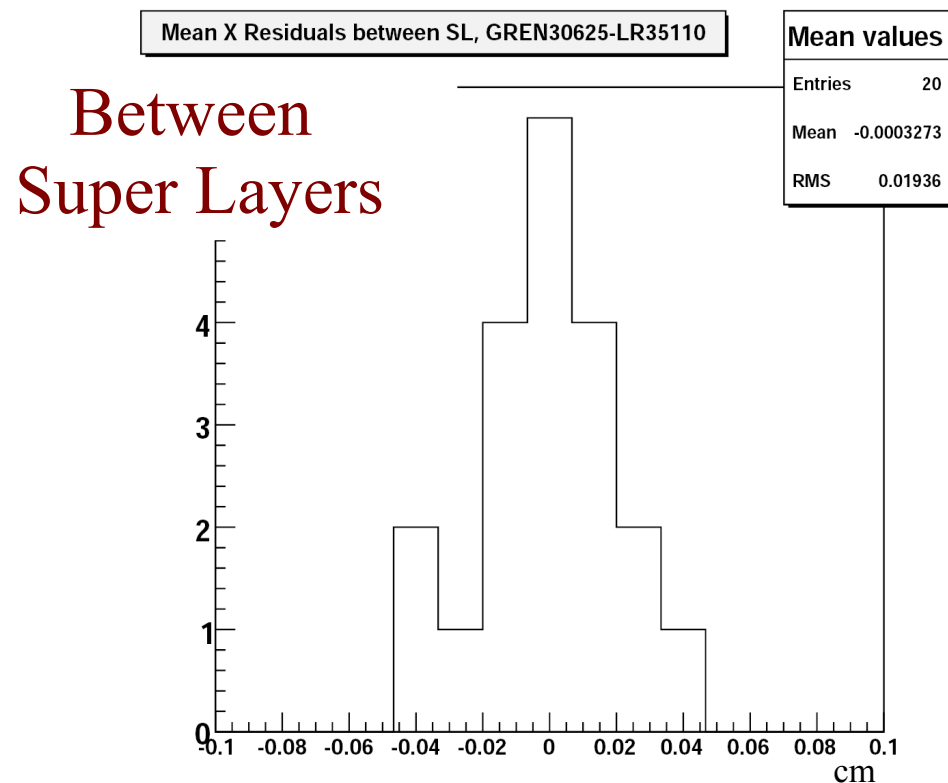


Global Runs vs Local Runs

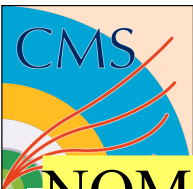
Reproducibility of data



Difference distribution GREN 30625 - LR 35110
(five common sectors S3,S4,S5,S9 & S11 triggered in both runs)



Over all common sectors differences < 400 μm (preliminary) between SL and between consecutive chambers (under study due to effects of t_0 calibration, fitting performance...)



Checks of Internal data



NOMINAL

YB0, Sector 3

Corrected geometry

GREN 30625
Residuals between
Super Layers
(Rphi plane)

| | |
|-----------------------|----------------------|
| hXSL_S3_MB2 | |
| Entries | 62790 |
| Mean | -0.1624 |
| RMS | 0.7857 |
| χ^2 / ndf | 964.9 / 17 |
| Constant | 3244 ± 31.4 |
| Mean | -0.1499 ± 0.0019 |
| Sigma | 0.3900 ± 0.0012 |

| | |
|-----------------------|-----------------------|
| hXSL_S3_MB1 | |
| Entries | 61410 |
| Mean | 0.08391 |
| RMS | 0.8724 |
| χ^2 / ndf | 702.7 / 17 |
| Constant | 5087 ± 30.6 |
| Mean | 0.06414 ± 0.00186 |
| Sigma | 0.3933 ± 0.0017 |

| | |
|-----------------------|-----------------------|
| hXSL_S3_MB2 | |
| Entries | 63045 |
| Mean | 0.002407 |
| RMS | 0.7942 |
| χ^2 / ndf | 776.3 / 17 |
| Constant | 5147 ± 30.4 |
| Mean | 0.01251 ± 0.00190 |
| Sigma | 0.4169 ± 0.0018 |

| | |
|-----------------------|-----------------------|
| hXSL_S3_MB1 | |
| Entries | 61875 |
| Mean | 0.08321 |
| RMS | 0.8848 |
| χ^2 / ndf | 911.4 / 17 |
| Constant | 4979 ± 30.2 |
| Mean | 0.06927 ± 0.00194 |
| Sigma | 0.4084 ± 0.0019 |

| | |
|-----------------------|------------------------|
| hXSL_S3_MB3 | |
| Entries | 101385 |
| Mean | -0.04528 |
| RMS | 0.6194 |
| χ^2 / ndf | 1766 / 17 |
| Constant | 9148 ± 43.1 |
| Mean | -0.03957 ± 0.00132 |
| Sigma | 0.3704 ± 0.0013 |

| | |
|-----------------------|------------------------|
| hXSL_S3_MB4 | |
| Entries | 53190 |
| Mean | -0.04819 |
| RMS | 0.6584 |
| χ^2 / ndf | 795.9 / 17 |
| Constant | 5309 ± 33.8 |
| Mean | -0.04252 ± 0.00162 |
| Sigma | 0.3372 ± 0.0015 |

| | |
|-----------------------|-----------------------|
| hXSL_S3_MB3 | |
| Entries | 101400 |
| Mean | 0.05147 |
| RMS | 0.6258 |
| χ^2 / ndf | 1574 / 17 |
| Constant | 9062 ± 42.6 |
| Mean | 0.05614 ± 0.00133 |
| Sigma | 0.3744 ± 0.0013 |

| | |
|-----------------------|------------------------|
| hXSL_S3_MB4 | |
| Entries | 53210 |
| Mean | -0.05126 |
| RMS | 0.6586 |
| χ^2 / ndf | 740.6 / 17 |
| Constant | 5284 ± 33.6 |
| Mean | -0.05041 ± 0.00161 |
| Sigma | 0.3333 ± 0.0014 |

SuperLayer X-position Nominal , S10

YB0, Sector 10

SuperLayer X-position Survey , S10

| | |
|-----------------------|-------------------------|
| hXSL_S10_MB2 | |
| Entries | 62700 |
| Mean | 0.01093 |
| RMS | 0.6445 |
| χ^2 / ndf | 503.1 / 17 |
| Constant | 6333 ± 35.3 |
| Mean | 0.006395 ± 0.001521 |
| Sigma | 0.3514 ± 0.0013 |

| | |
|-----------------------|-------------------------|
| hXSL_S10_MB1 | |
| Entries | 50775 |
| Mean | 0.01577 |
| RMS | 0.6673 |
| χ^2 / ndf | 565.5 / 17 |
| Constant | 5334 ± 33.1 |
| Mean | 0.005331 ± 0.001615 |
| Sigma | 0.3354 ± 0.0014 |

| | |
|-----------------------|-------------------------|
| hXSL_S10_MB2 | |
| Entries | 62700 |
| Mean | 0.01364 |
| RMS | 0.6471 |
| χ^2 / ndf | 571.6 / 17 |
| Constant | 6329 ± 35.3 |
| Mean | 0.007602 ± 0.001523 |
| Sigma | 0.3518 ± 0.0013 |

| | |
|-----------------------|--------------------------|
| hXSL_S10_MB1 | |
| Entries | 50790 |
| Mean | 0.002527 |
| RMS | 0.6881 |
| χ^2 / ndf | 589.6 / 17 |
| Constant | 5111 ± 31.6 |
| Mean | -0.006151 ± 0.001684 |
| Sigma | 0.3468 ± 0.0014 |

| | |
|-----------------------|-------------------------|
| hXSL_S10_MB3 | |
| Entries | 69180 |
| Mean | 0.004035 |
| RMS | 0.4924 |
| χ^2 / ndf | 314.2 / 17 |
| Constant | 7229 ± 37.2 |
| Mean | 0.009977 ± 0.001403 |
| Sigma | 0.3435 ± 0.0011 |

| | |
|-----------------------|------------------------|
| hXSL_S10_MB4 | |
| Entries | 22470 |
| Mean | -0.103 |
| RMS | 0.6631 |
| χ^2 / ndf | 288.9 / 17 |
| Constant | 2048 ± 18.8 |
| Mean | -0.07242 ± 0.00287 |
| Sigma | 0.3843 ± 0.0024 |

| | |
|-----------------------|---------------------------|
| hXSL_S10_MB3 | |
| Entries | 69735 |
| Mean | -0.008507 |
| RMS | 0.4986 |
| χ^2 / ndf | 297.3 / 17 |
| Constant | 7206 ± 36.9 |
| Mean | 0.0002646 ± 0.0014152 |
| Sigma | 0.3473 ± 0.0011 |

| | |
|-----------------------|------------------------|
| hXSL_S10_MB4 | |
| Entries | 22460 |
| Mean | -0.09885 |
| RMS | 0.6593 |
| χ^2 / ndf | 257 / 17 |
| Constant | 2050 ± 18.7 |
| Mean | -0.07601 ± 0.00288 |
| Sigma | 0.3856 ± 0.0024 |

MB2 MB1
MB4 MB3

General improvements
of residuals in all
chambers checked at
the level of 500 um
(~ reproducibility)



Checks of Survey + Internal data



NOMINAL

YB0, Sector 9

Corrected geometry

GREN 30625

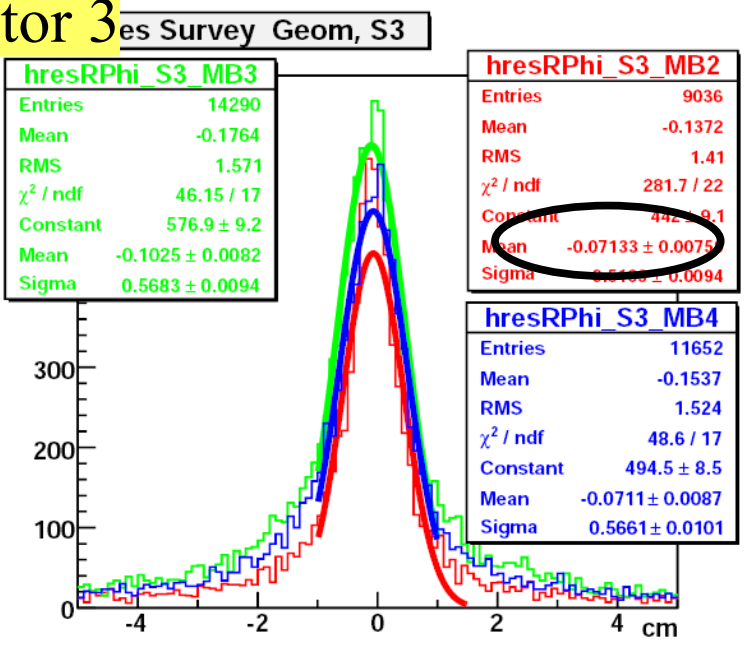
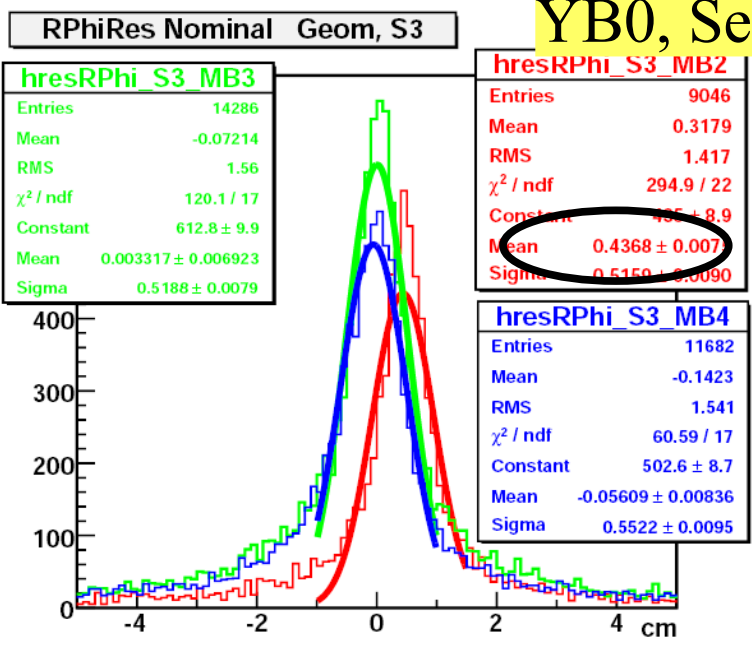
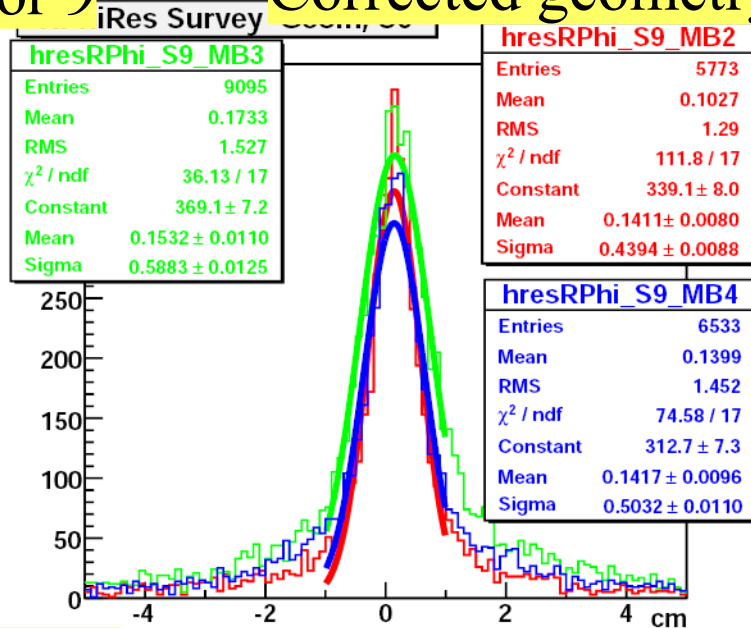
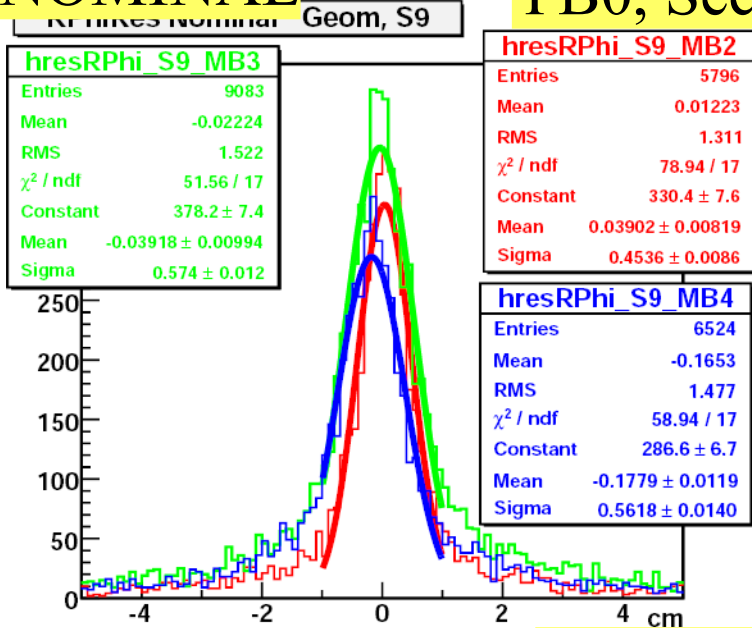
Residuals between chambers (Rphi plane)

Extrapolations:

MB2 → MB1

MB3 → MB2

MB4 → MB3



General improvements of residuals in all sectors checked at the level of the reproducibility between data sets



YB0: Alignment between chambers

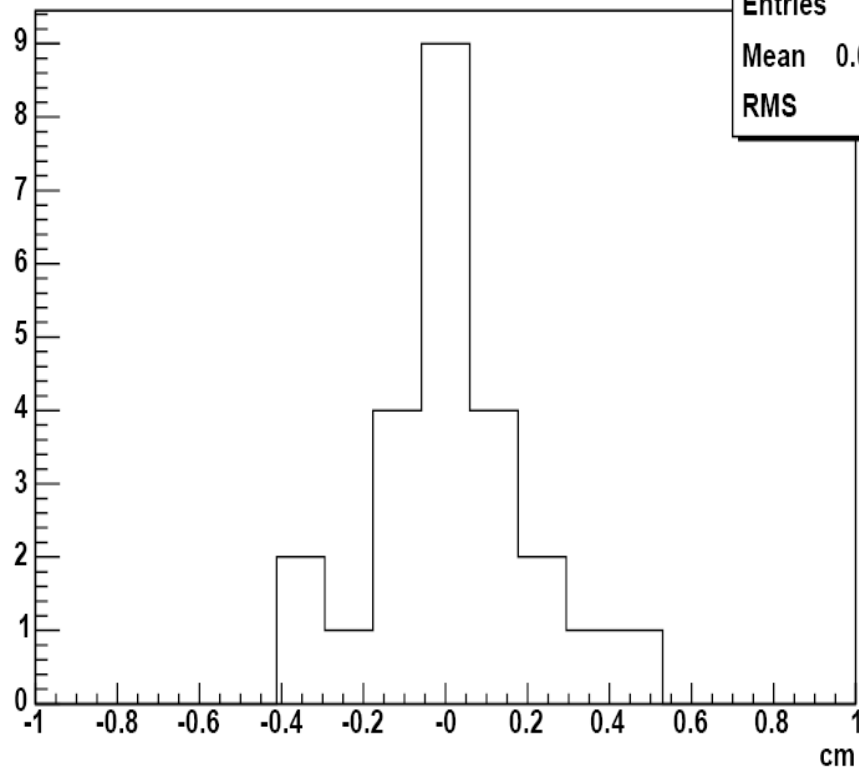


- Correlate with survey measurements (preliminary results for YB0)
- Data from 8 sectors S2,S3,S4,S5,S8,S9,S10 & S11

Nominal Geometry

m, GREN30625

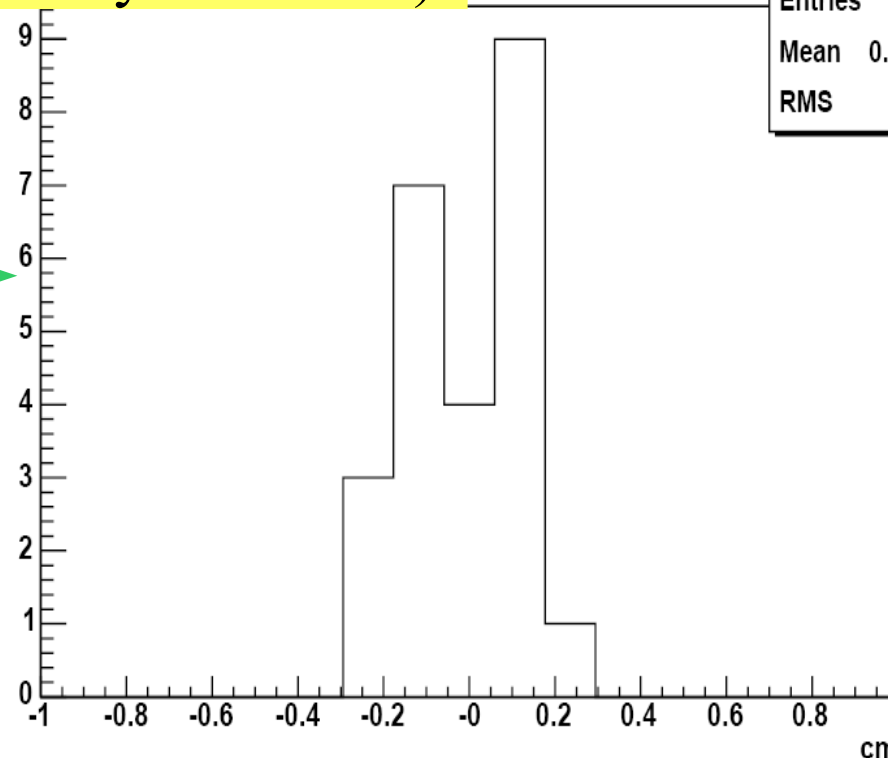
| Mean values | |
|-------------|---------|
| Entries | 24 |
| Mean | 0.01253 |
| RMS | 0.189 |



Corrected Geometry (Survey + Internal)

m, GREN30625

| Mean values | |
|-------------|----------|
| Entries | 24 |
| Mean | 0.006416 |
| RMS | 0.1375 |



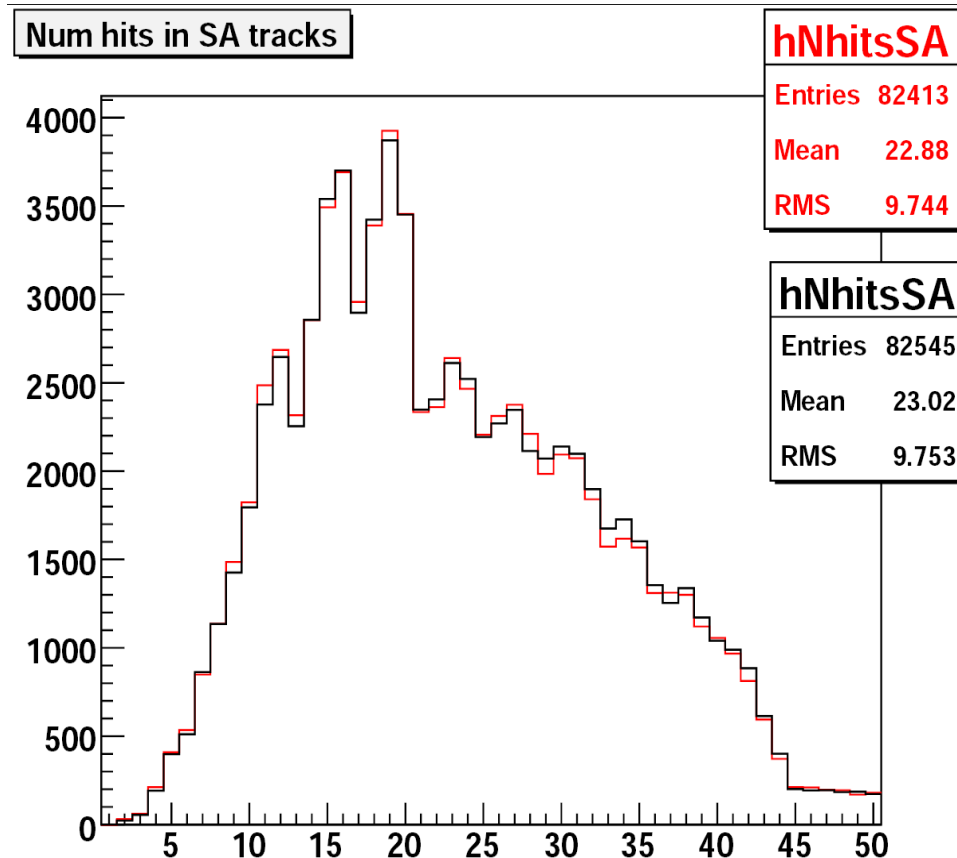
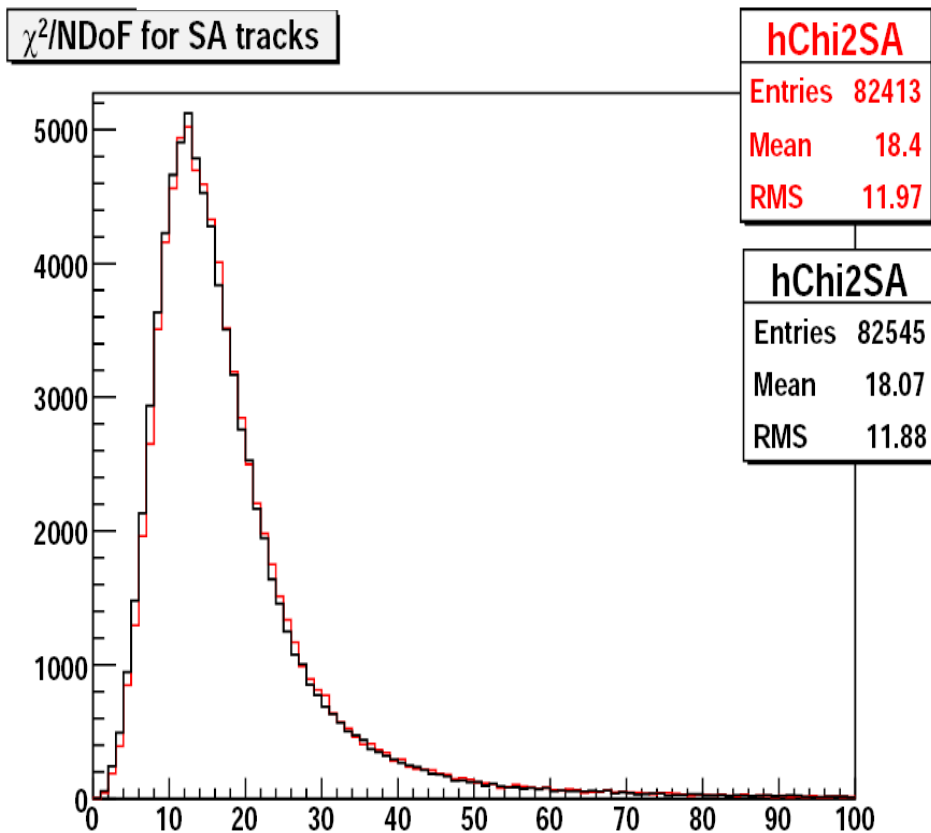
Mis-align up to ~ mm are shown and corrected by survey data
Still some systematic displacements that must be understood (under study)



Check the alignment on SA reco



YB0, GREN 30625



— Nominal
— Survey+Internal

Marginal improvement is observed due to the scattering multiple is largely dominant.



Summary



- Completed the **internal alignment DB** for all the **250 DT chambers**
 - using information coming from survey, QC and tracks when is available.
- Completed the **survey alignment DB** for all the DT chambers inside each CMS wheel
 - survey information available for all chambers
- Still some systematic effects (t0 calibration, fitting procedure...) affecting the reproducibility of data at O(100um) (under study).
- O-work a systematic study over all DT chambers inside YB0 (to do for all wheels)
 - Good improvement of the residuals, both between SL and between chambers, at the level of our reproducibility values (on-going study)