Sign-off of CRAFT2012 Alignment Geometry

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for the Tracker Alignment Group

CMS Alignment and Calibration Meeting

Overview

Goal

Spot and correct any movements of the pixel detectors after the Winter Technical Stop (strip detector fixed)

Alignment Setup

We are using cosmic tracks collected during Marck 2012

Validation

Compare CRAFT2012 and

GR10_v6 (starting geometry, it is used now for HLT, express and prompt reco)

Summary

Alignment Setup

Alignable structures and parameters

BPIX: 6 half layers – 3 shifts, 3 angles

FPIX: 8 half disks – 3 shifts (angles fixed)

strip detector fixed

Starting geometry

GR10_v6 – last IOV included in 2011 rereco with CMSSW_4_2_4_patch1

Alignment

Millepede II using General Broken Lines (GBL) track parametrization

CMSSW

CMSSW_5_1_1_patch2, global tag: GR_P_V28::All

Data

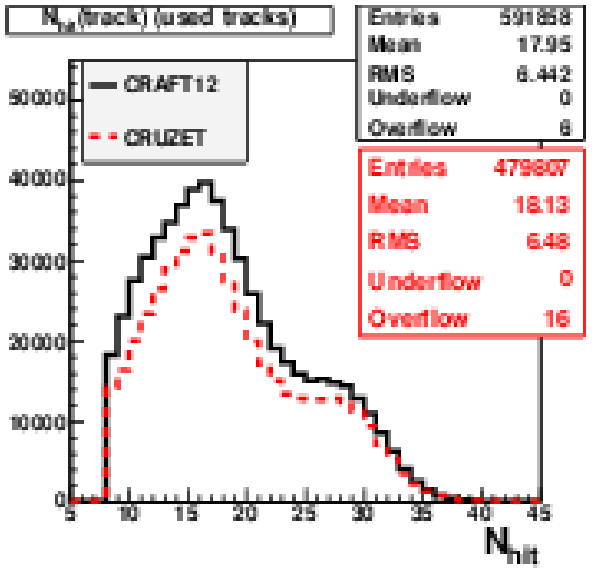
CRAFT12 Runs based on the internal tracker certification

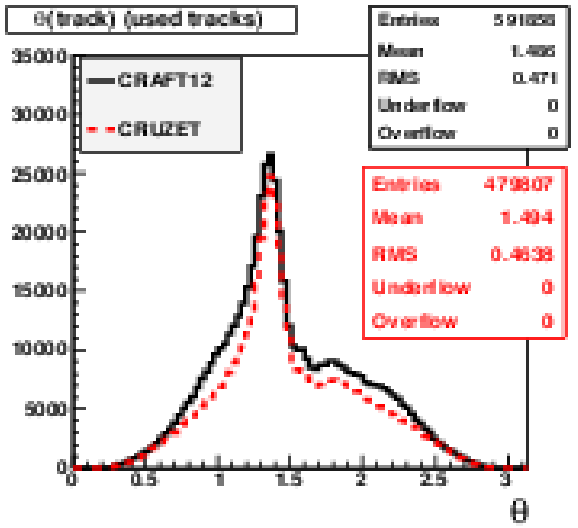
186785, 186791, 186817, 186822, 186989, 186996, 187446,

187461, 187464, 187466, 187467, 187468, 187469

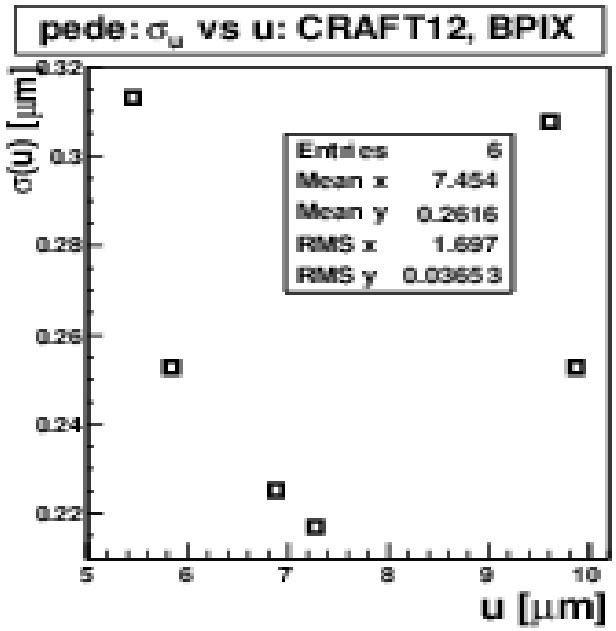
~ 580000 tracks used

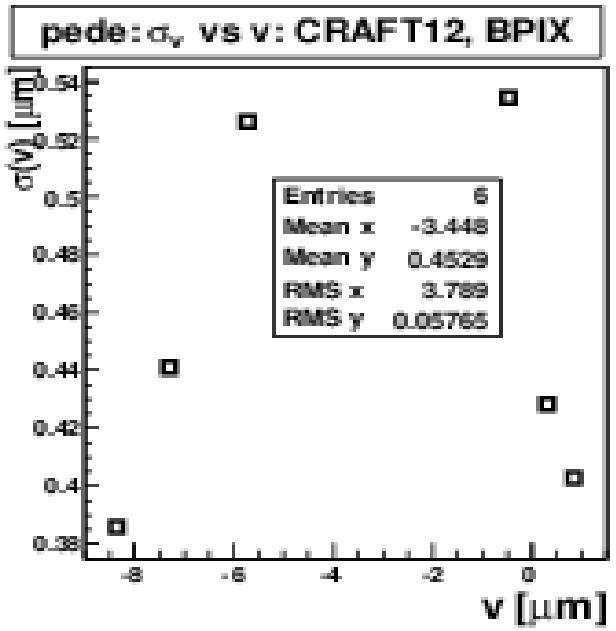
- after algorithm internal track selection filter
- including tracks without pixel hits

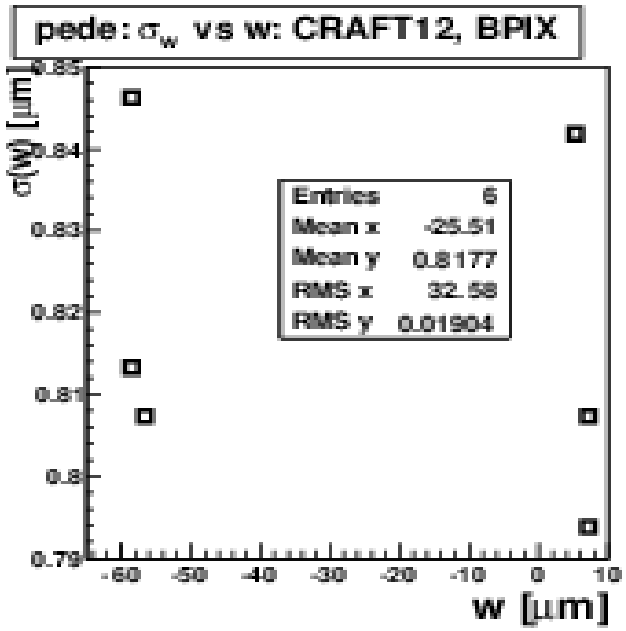




Results – BPIX layer shifts



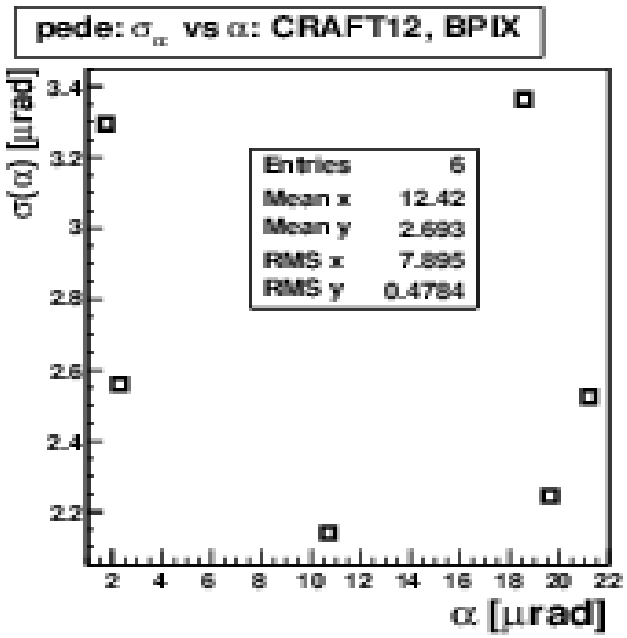


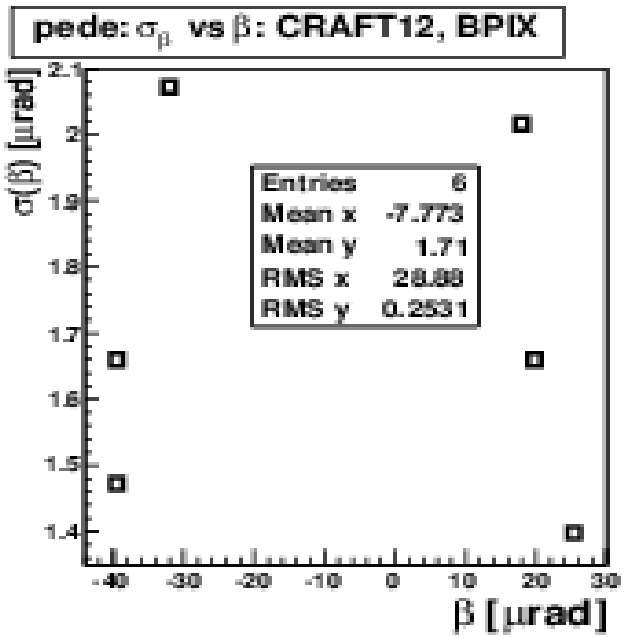


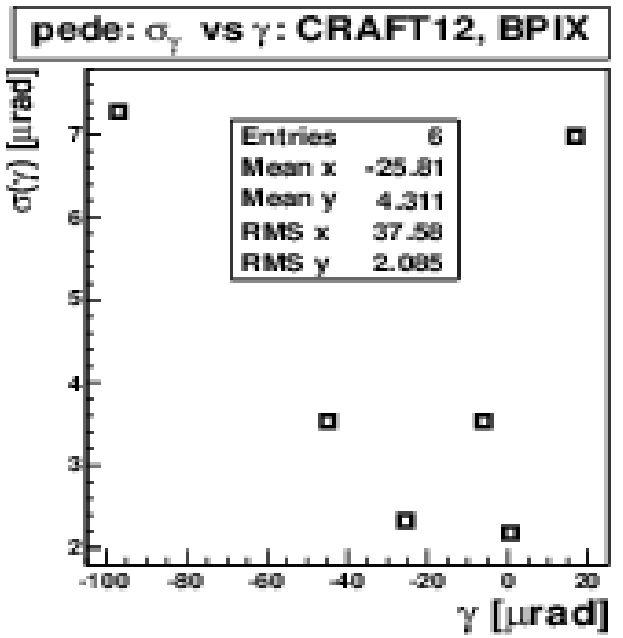
Show estimated parameter uncertainties vs determined values (u, v, w = x, y, z in global coordinates)

- modules of the same half barrel have similar shifts
- one half barrel moved 60 microns, the other 10 microns in z-direction
- estimated uncertainties < 1 micron

Results – BPIX layer rotations



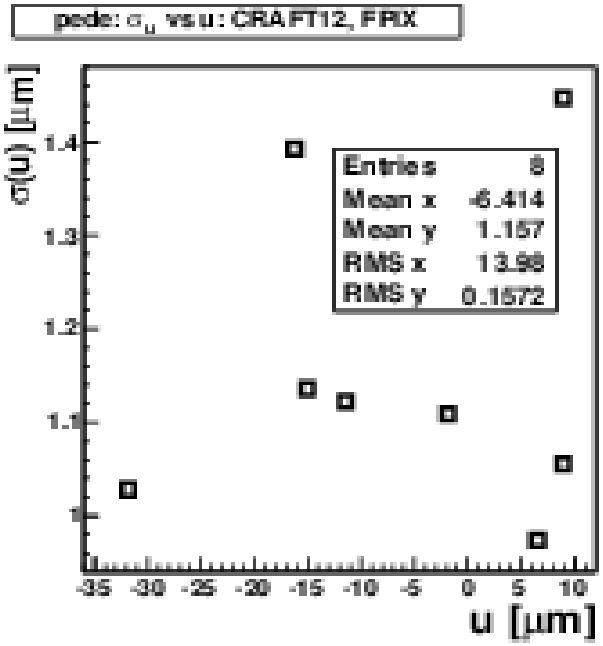


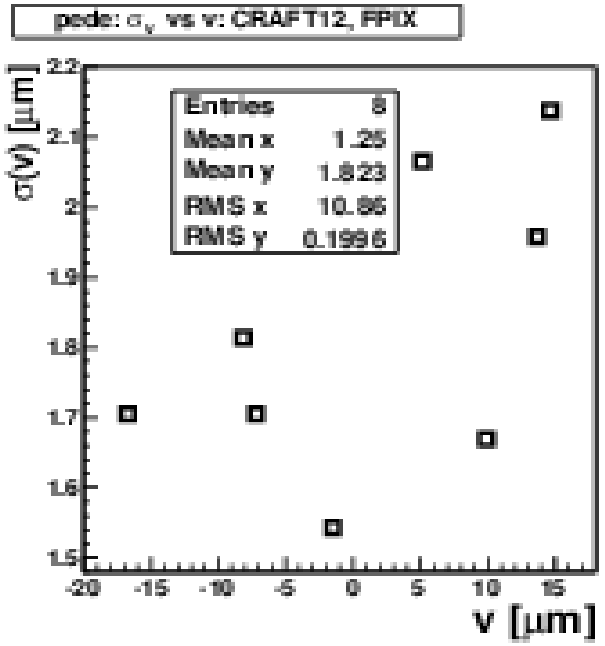


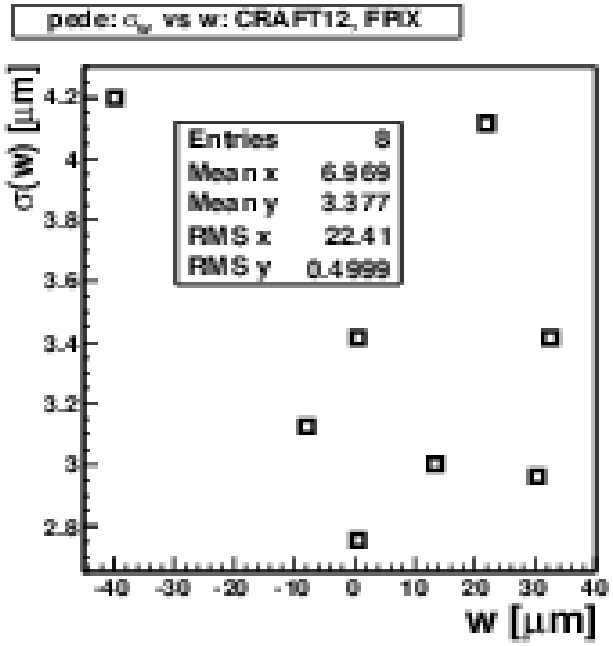
Show estimated parameter uncertainties vs determined values (alpha, beta, gamma = rotations around x, y, z)

- modules of the same half barrel have similar rotations, except gamma for one half barrel
- estimated uncertainties: a few microrads

Results – FPIX layer shifts







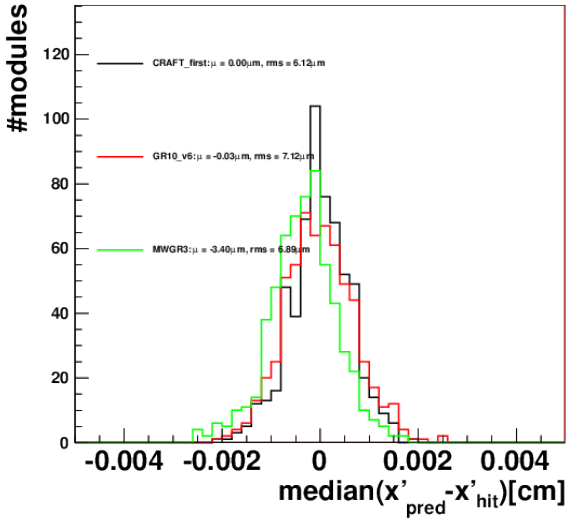
Show estimated parameter uncertainties vs determined values (u, v, w = x, y, z in global coordinates)

- no clear pattern for movement
- estimated uncertainties: a few microns

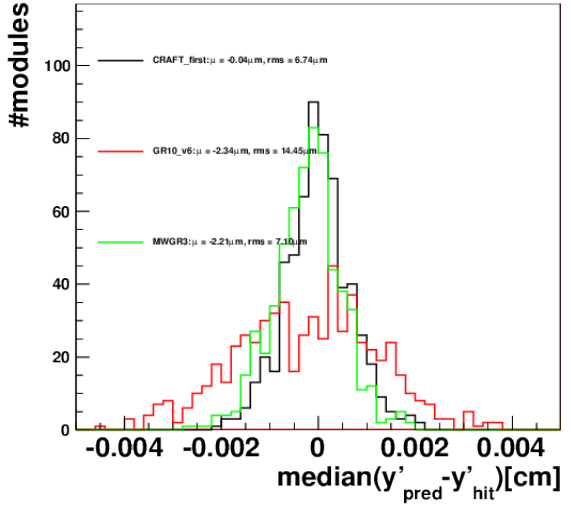
angles kept fixed

TPB (BPIX) – DMR validation

Distribution of the median of the residuals in TPB



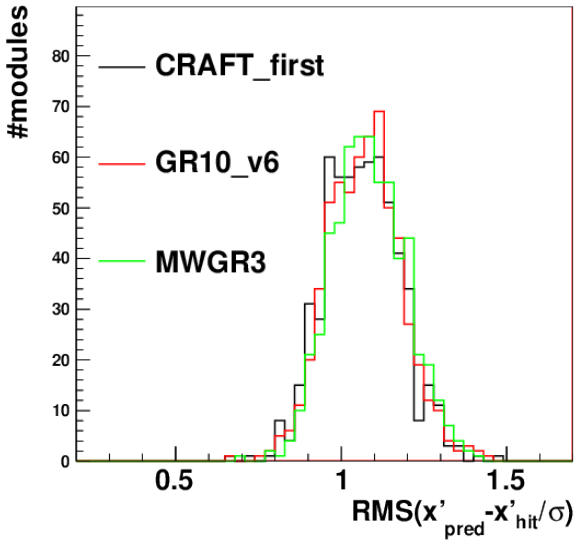
Distribution of the median of the y residuals in TPB



Distribution of Median of Residuals (DMR):

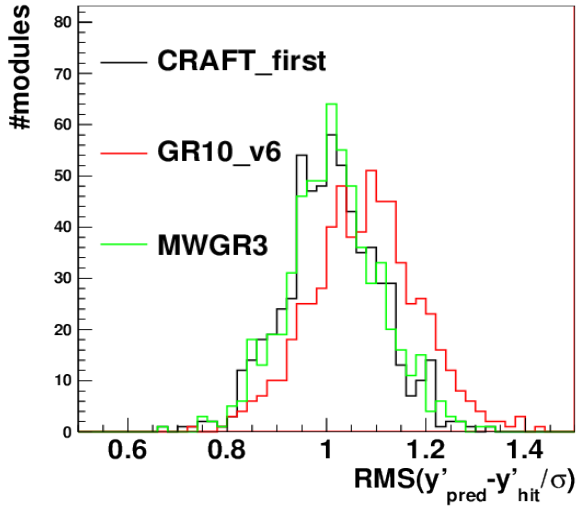
- **CRAFT2012 GR10_v6 CRUZET**
- for each modules of $N_{hits} > 30$
- using CRAFT2012 data for validation
- CRAFT2012 improves, especially significantly for y (loc. y || glob. z (i.e. w))
- CRUZET is the alignment geometry obtained at 0 T with the same alignables

Pixel Barrel



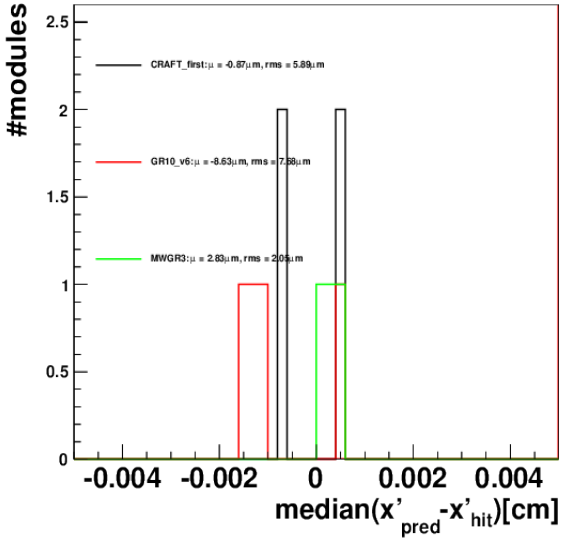
Distribution of RMS of Residuals (DRR):

Pixel Barrel

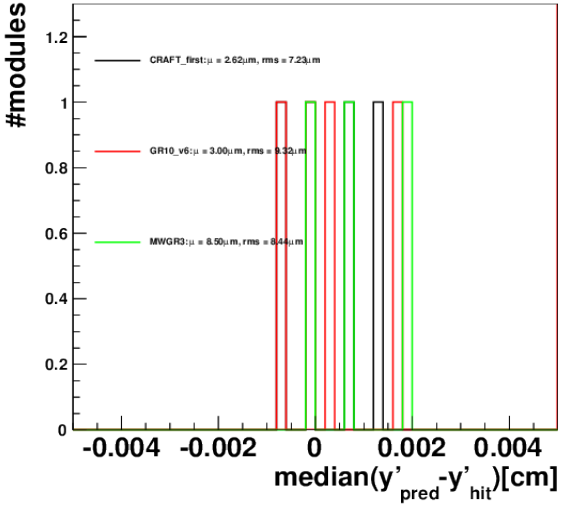


TPE (FPIX) – DMR validation

Distribution of the median of the residuals in TPE



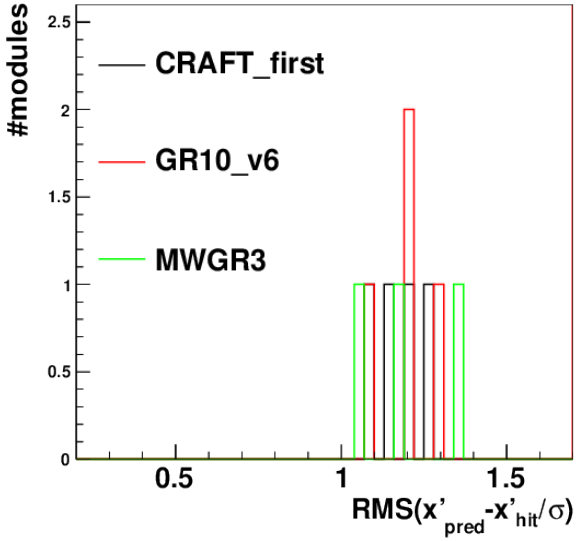
Distribution of the median of the y residuals in TPE



Distribution of Median of Residuals (DMR):

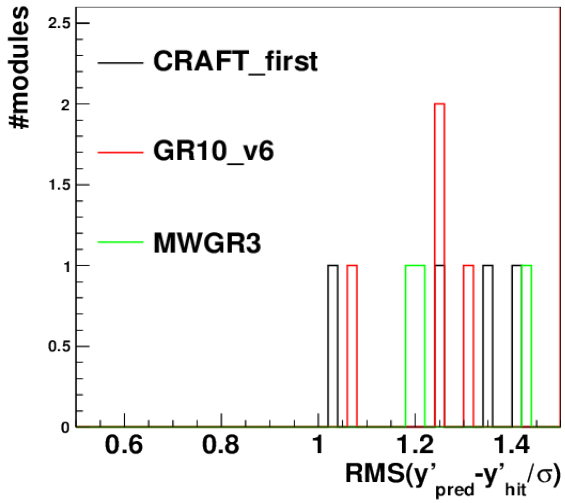
- not enough statistics for per-module validation
- but no contradiction
- see next slide for the residuals directly

Pixel Endcap

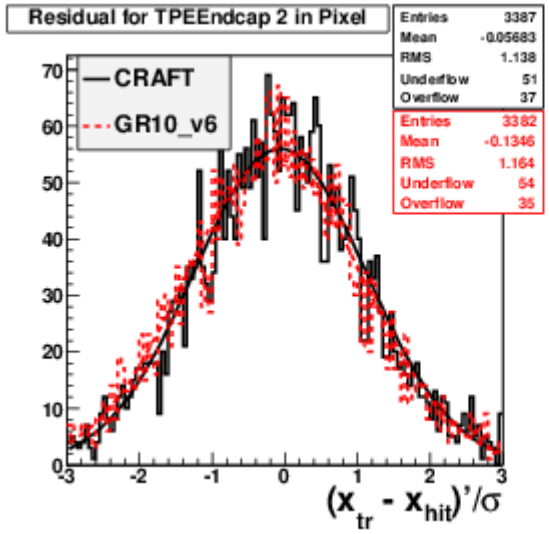


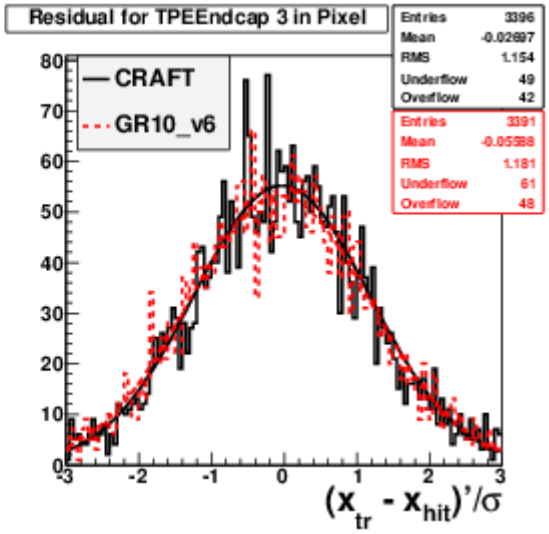
Distribution of RMS of Residuals (DRR):

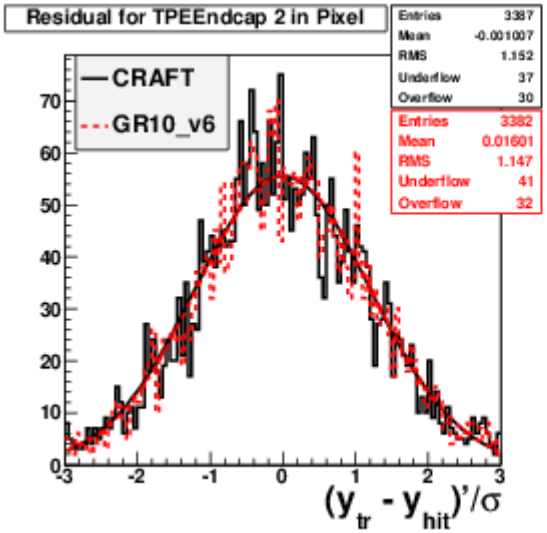
Pixel Endcap

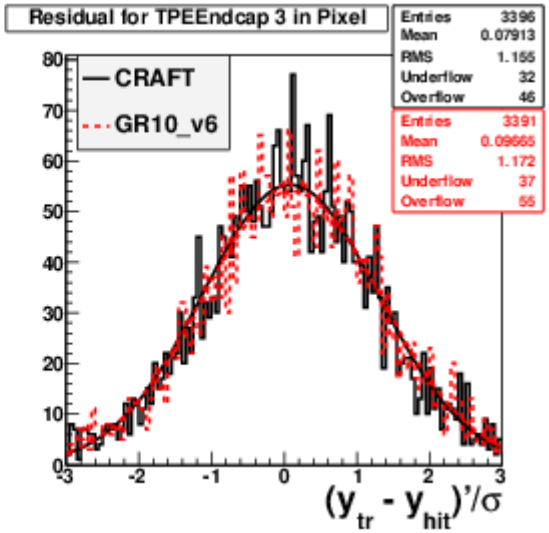


TPE (FPIX) – overall validation









Distribution of normalized x-residuals:

left: FPIX+ right: FPIX-

CRAFT12 vs **GR10_v6**

- changes are tiny
- mean closer to 0
- RMS generally smaller
- less overflow and underflow

Distribution of normalized y-residuals:

Conclusion

Summary

Pixel large structure alignment has been determined using CRAFT12 data
Pixel moved significantly (e.g. half barrel ~60 microns)
Validation shows expected improvement

- usual DMR for BPIX
- normalized residuals for FPIX (no DMR due to low statistics)

We request sign-off to append this new tracker geometry to the alignment tags in use for hlt, prompt and express streams during 2012 data taking.

Outlook

We shall recheck with first collision data

Thanks for discussion and help

Ádám Agócs
Joerg Behr
Roberto Castello
Gero Flucke
Krisztián Krajczár