Sign-off of CRAFT2012 Alignment Geometry

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for the Tracker Alignment Group

CMS Alignment and Calibration Meeting
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
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
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 Median of Residuals (DMR):

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

Distribution of RMS of Residuals (DRR):

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**CRAFT2012 Alignment Geometry**  Pal Hidas, 03 April 2012
Distribution of Median of Residuals (DMR):

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

Distribution of RMS of Residuals (DRR):
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:
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

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