ECAL EE+EB Alignment

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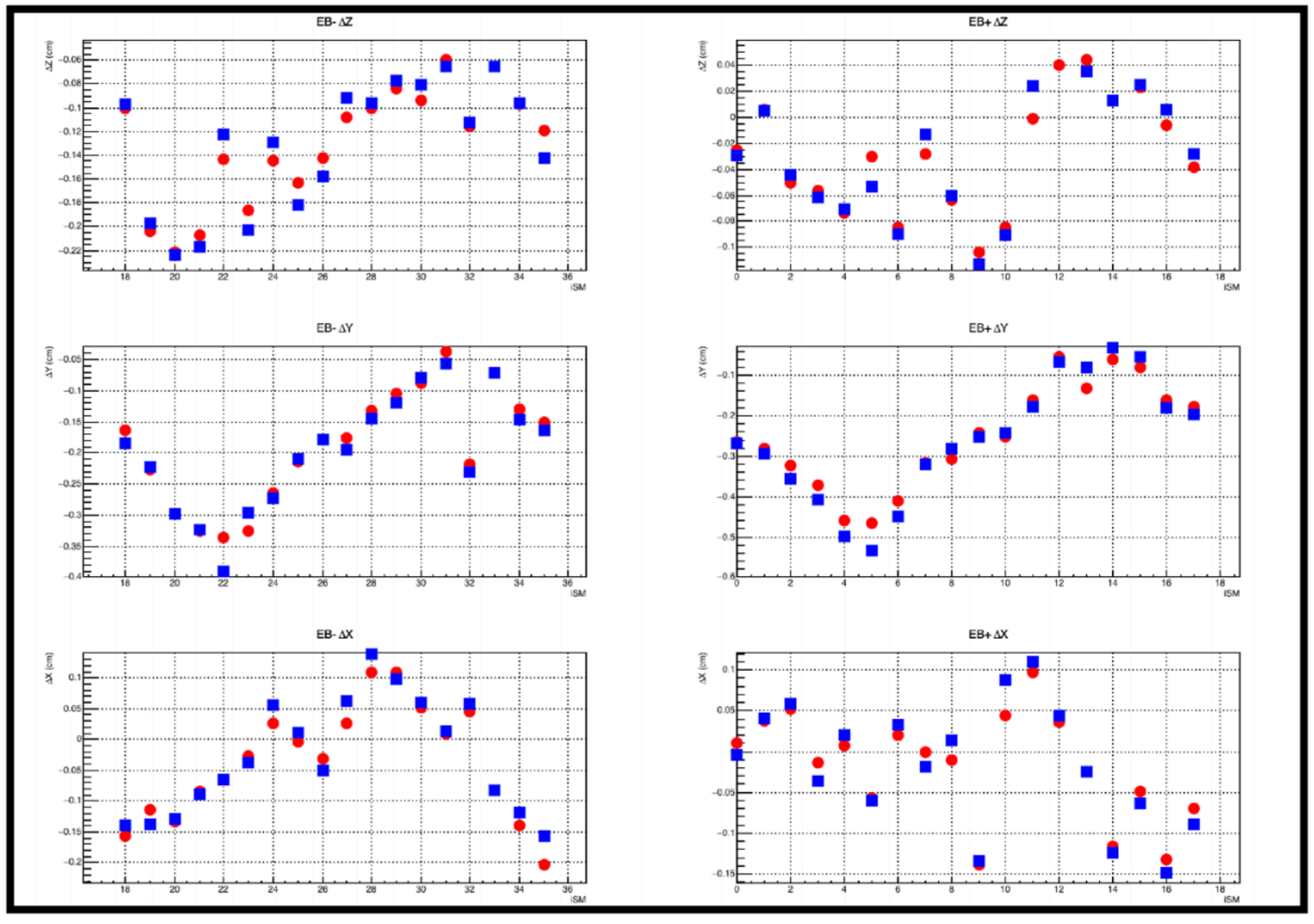
Recap to 2017

- ECAL EB and EE alignment was performed last year
- Link to 2017 Alignment presentation

- Alignment values were obtained for both EB and EE
- EB Alignment Values :

Δx, Δy and Δz shifts in EB+ and EB-
On the X-axis : Every point represents each of the 36 SM's

2016 values **2017 values**



Δx (cm)	Δy(cm)	Δz(cm)
-0.003	-0.267	-0.029
0.042	-0.293	0.005
0.059	-0.355	-0.045
-0.036	-0.409	-0.062
0.020	-0.498	-0.070
-0.061	-0.533	-0.053
0.033	-0.449	-0.089
-0.018	-0.319	-0.013
0.013	-0.281	-0.060
-0.134	-0.252	-0.113
0.087	-0.241	-0.091
0.110	-0.177	0.024
0.044	-0.067	0.062
-0.025	-0.080	0.036
-0.124	-0.032	0.013
-0.064	-0.055	0.025
-0.148	-0.180	0.006
-0.089	-0.198	-0.028
-0.140	-0.184	-0.097
-0.138	-0.222	-0.198
-0.129	-0.298	-0.223
-0.089	-0.324	-0.217
-0.066	-0.389	-0.122
-0.037	-0.296	-0.203
0.055	-0.273	-0.129
0.012	-0.210	-0.182
-0.049	-0.179	-0.158
0.062	-0.195	-0.091
0.139	-0.144	-0.096
0.098	-0.120	-0.077
0.061	-0.079	-0.081
0.013	-0.055	-0.066
0.059	-0.231	-0.113
-0.082	-0.071	-0.065
-0.118	-0.146	-0.097
-0.157	-0.163	-0.142

Recap to 2017

- EE Alignment Values :
- The end caps were opened and closed but very small shifts were observed

ΔΦ	Δϕ	ΔΨ	Δx (cm)	Δy(cm)	Δz(cm)
0.000391	0	0.000391	-0.066	-0.538	-0.634
0.000461	0	0.000461	-0.035	-0.647	-0.463
-0.000268	0	-0.000268	0.266	-0.749	0.439
-0.000450	0	-0.000450	0.329	-0.841	0.414

Comparison of 2016 and 2017

- How much did EB and EE shift in 2017 compared to 2016?
- Shown below is the difference between 2016 and 2017 values

EB

Δx(cm)	Δy(cm)	Δz(cm)
0.018	0.033	0.009
0.007	0.011	-0.006
0.034	0.049	0.011
0.044	0.076	0.021
-0.013	0.029	-0.020
-0.023	0.116	0.034
-0.055	0.121	0.052
-0.041	0.039	0.011
-0.034	0.019	0.019
0.008	0.013	-0.016
-0.079	-0.018	0.013
-0.035	0.025	-0.032
-0.008	-0.011	-0.027
-0.025	-0.020	-0.015
0.034	-0.160	0.061
0.020	-0.055	0.002
0.011	0.022	-0.004
0.003	0.080	-0.025
-0.063	0.006	0.033
-0.004	-0.018	0.019
0.015	0.014	0.011
0.030	0.056	0.007
0.036	0.106	-0.055
0.023	0.023	0.006
-0.037	0.020	-0.008
-0.051	0.070	-0.005
0.008	0.003	0.015
-0.026	0.018	-0.020
-0.074	0.005	-0.017
-0.016	0.007	-0.007
-0.020	0.002	-0.004
0.018	-0.012	-0.000
-0.033	-0.086	-0.041
0.026	-0.037	-0.016
-0.027	0.015	0.013
0.040	-0.013	-0.010

- Maximum shift seen is 0.1 cm
- ~0.3 X 10^{-3} in angular terms
- EGamma Tight working point for Barrel
  - abs(dEtaSeed) < 0.00353
- Shift seen in EB is one order of magnitude smaller
- Negligible effect on Electron ID cut for barrel since there was no movement of EB

EE

ΔΦ	Δϕ	ΔΨ	Δx(cm)	Δy(cm)	Δz(cm)
0	0	0	-0.081	-0.001	-0.040
0	0	0	-0.110	-0.003	-0.072
0	0	0	0.134	0.005	0.006
0	0	0	0.081	0.018	0.003

- The EndCaps were opened and closed last winter
- Small misalignment was expected
- Very small changes observed

2018 Alignment Plans

- Since the barrel has not been touched this year, changes in alignment values for EB are not expected.

- But, the Endcaps were opened and closed again this winter and misalignment is expected

- Therefore, a special MC tag for testing the effects on Electron ID (and HLT thresholds) was prepared only for EE : EEAlignment_2018_mc

- Thanks Pierre for preparing the tag! :)

- This tag is provided to TSG to estimate effects on the Electron ID for beginning of 2018 and delta-eta, delta-phi matching criteria.

- Tag is not submitted to GT queue since this is only for private check by TSG and not for official production.

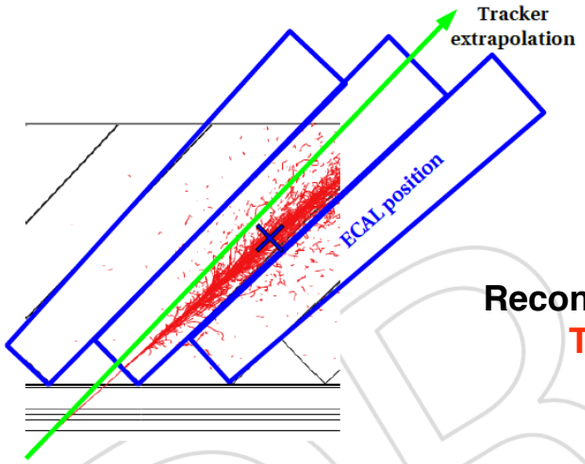
Next Steps

- Update the Alignment setup to CMSSW10_0_0
- Low statistics Rel-Val samples are available for a quick check of the Alignment setup
- Once the DYtoEE MC samples are available bias values can be calculated
- Link to the DY samples here

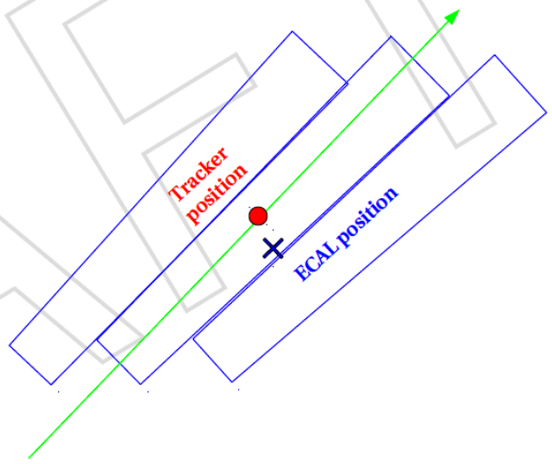
Backup

Quick Review of the Alignment Procedure

Reconstructed by ECAL



Reconstructed by Tracker



- Distance along Φ and η directions are used to construct χ^2

$$\chi^2 = \chi^2_+ + \chi^2_-$$

Positrons Electrons

$$\chi^2_\pm = \sum_{lepton} \frac{(\Delta\varphi - \langle \Delta\varphi^{MC}_\pm \rangle)^2}{\varepsilon^2_\varphi} + \frac{(\Delta\eta - \langle \Delta\eta^{MC} \rangle)^2}{\varepsilon^2_\eta}$$

- The alignment procedure is based on minimization of χ^2

Measure (for every SM in EB and Dee in EE)
- **3 Translations Δx, Δy, Δz**
- **3 Rotations(Euler angles) Δϕ ,Δθ ,Δψ**

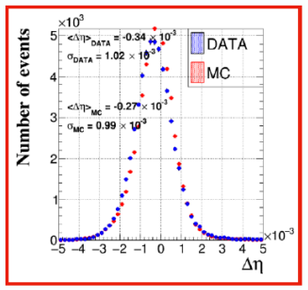
- ΔΦ and Δη are used to construct χ^2 and the difference between these variables for Data and MC is minimized in order to effectively align the ECAL with the tracker

All alignment related variables are required to be same in MC and Data

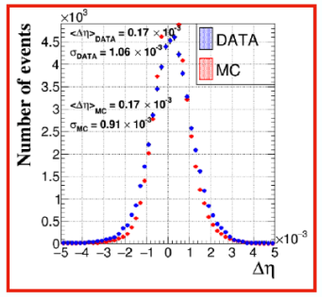
Eta Distributions

Pre-Alignment

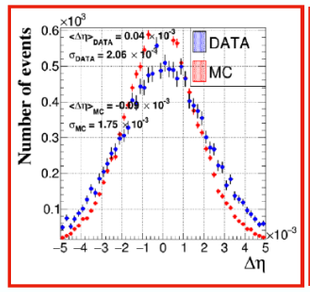
EB +



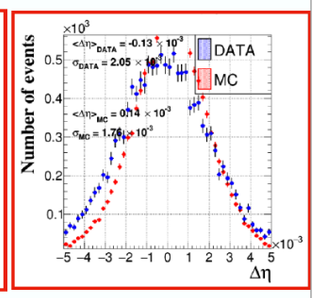
EB -



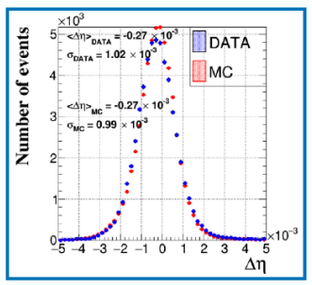
EE +

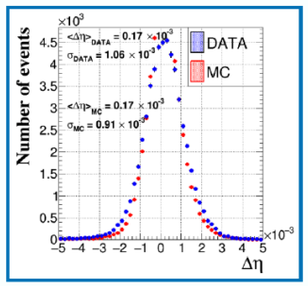


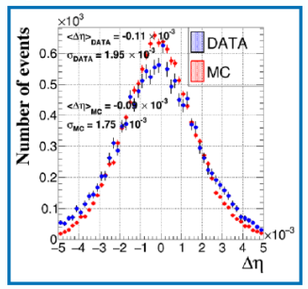
EE -

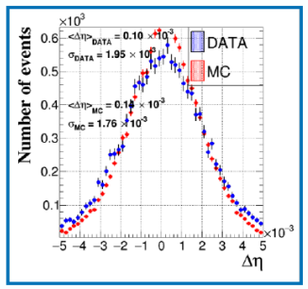


Post-Alignment









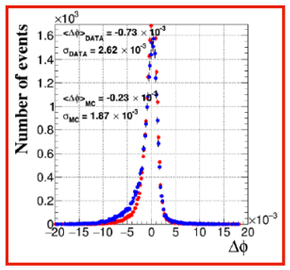
http://twamorka.web.cern.ch/twamorka/jul3_prealign/
http://twamorka.web.cern.ch/twamorka/jul3_postalign/

Phi Distributions

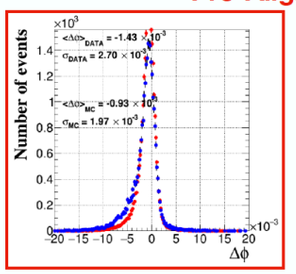
Electron

Pre-Alignment

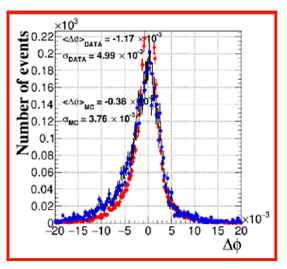
EB +



EB -



EE +



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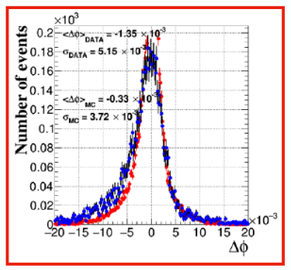

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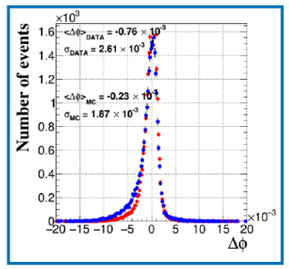

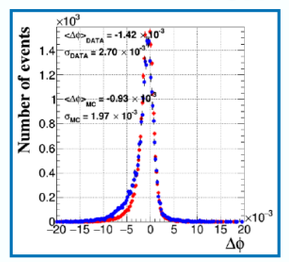

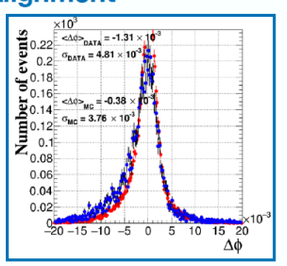

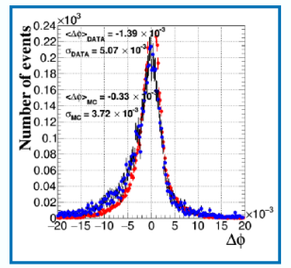

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