



ECAL and ES Alignment 2018

First Results

AlCaDB Meeting
7th May 2018

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Outline

- Quick review of ECAL and ES alignment procedure
- Datasets used to perform ECAL/ES alignment
- ECAL :
 - Comparison of 2017 and 2018 alignment values
 - Validation plots
- ES :
 - Alignment performance
- Conclusion



ECAL Alignment : Quick Review

- Alignment of ECAL barrel and endcap with respect to tracking system.
- Measured using electrons from $Z \rightarrow ee$ events.
- The alignment procedure is based on a minimization of χ^2 (sum of χ_+^2 for positrons and χ_-^2 for electrons).
$$\chi^2 = \chi_+^2 + \chi_-^2$$
- The is based on $\Delta\eta$ and $\Delta\phi$ and it minimizes the differences b/w MC and Data for these variables. Under the assumption that in a perfectly aligned system MC and data should agree in these variables, by means of minimization we are effectively aligning ECAL.

$$\chi_{\pm}^2 = \sum_{lepton} \frac{(\Delta\phi - \langle \Delta\phi_{\pm}^{MC} \rangle)^2}{\epsilon_{\phi}^2} + \frac{(\Delta\eta - \langle \Delta\eta^{MC} \rangle)^2}{\epsilon_{\eta}^2}$$

- More details on the alignment procedure can be found here:
 - CMS AN-2013/328 - CMS ECAL alignment in the LHC RUN1
 - CMS DN-2015/026 - CMS ECAL alignment in the LHC RUN II



ES Alignment : Quick Review

- Preshower (ES) sits between the strip tracker and ECAL endcap crystals.
- Each side consists of 2 detect disks (front and rear) set to different directions. Thus, the front (rear) plane is sensitive to X (Y) axis.
- The coordinate of each plane are aligned with the tracker.
 - Done by matching the expected hit point of reconstructed tracks with trajectory extrapolation to data.
 - Minimization of χ^2 value is performed for several iterations until a stable final result is reached with respect to the tracker.

Work by Pei-Rong Yu (National Taiwan University) and Chia-Ming Kuo (National Central University, Taiwan)



Datasets

- CMSSW release used : CMSSW_10_1_2_patch2
- MC dataset used to extract bias values : /DYJetsToLL_M-50_TuneCP5_13TeV-madgraphMLM-pythia8/RunIISpring18MiniAOD-NZSPU40to70_100X_upgrade2018_realistic_v10-v2/MINIAODSIM
- Global tag used : 101X_dataRun2_Prompt_v9
- /EGamma/Run2018A-ZElectron-PromptReco-v1/RAW-RECO
- DCS JSON used

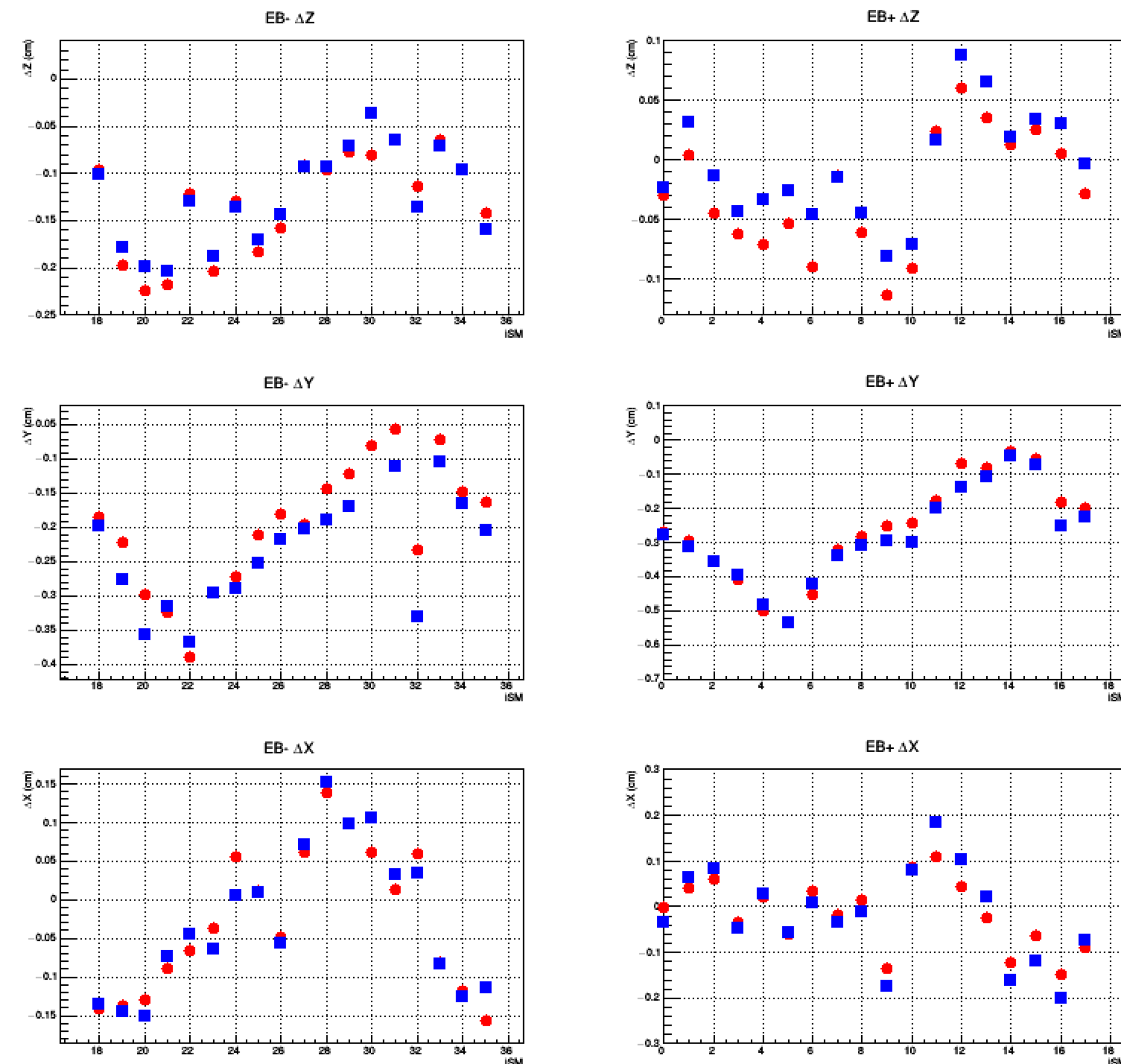
ECAL
Alignment

- CMSSW release used : CMSSW_10_1_2_patch2
- Global tag used : 101X_dataRun2_Prompt_v9
- /EGamma/Run2018A-EcalESAlign-PromptReco-v1/ALCARECO
- DCS JSON used

ES
Alignment



Alignment values : ECAL barrel



- Δx , Δy , Δz values for EB + and - compared for 2017 and 2018
- On y axis: Supermodule number
- Red circles : 2017 values
- Blue squares : 2018 values
- No significant change observed
 - Expected since during the winter shutdown, only the endcaps were opened and closed
- Alignment values are stored here:

[/afs/cern.ch/user/t/twamorka/public/ECALalignment_2018/myEBAlignment_2018_combined_v0.txt](https://cds.cern.ch/record/2788812/files/alignment_2018_myEBAlignment_2018_combined_v0.txt)



Alignment values : ECAL endcap

		$\Delta\Phi$	$\Delta\phi$	$\Delta\Psi$	Δx	Δy	Δz	
EE - {	Dee 0	0.00039112	0	0.00039112	-0.065725	-0.53779	-0.63415	2017 values
	Dee 1	0.00046148	0	0.00046148	-0.03533	-0.64747	-0.46271	
EE + {	Dee 2	-0.00026845	0	-0.00026845	0.26558	-0.74857	0.43904	
	Dee 3	-0.00045037	0	-0.00045037	0.32866	-0.84081	0.41354	

EE - {	Dee 0	0.00039112	0	0.00039112	-0.093372	-0.62537	-0.66182	2018 values
	Dee 1	0.00046148	0	0.00046148	-0.087034	-0.76022	-0.46897	
EE + {	Dee 2	-0.00026845	0	-0.00026845	0.07638	-0.79304	0.46977	
	Dee 3	-0.00045037	0	-0.00045037	0.12154	-0.8734	0.4397	

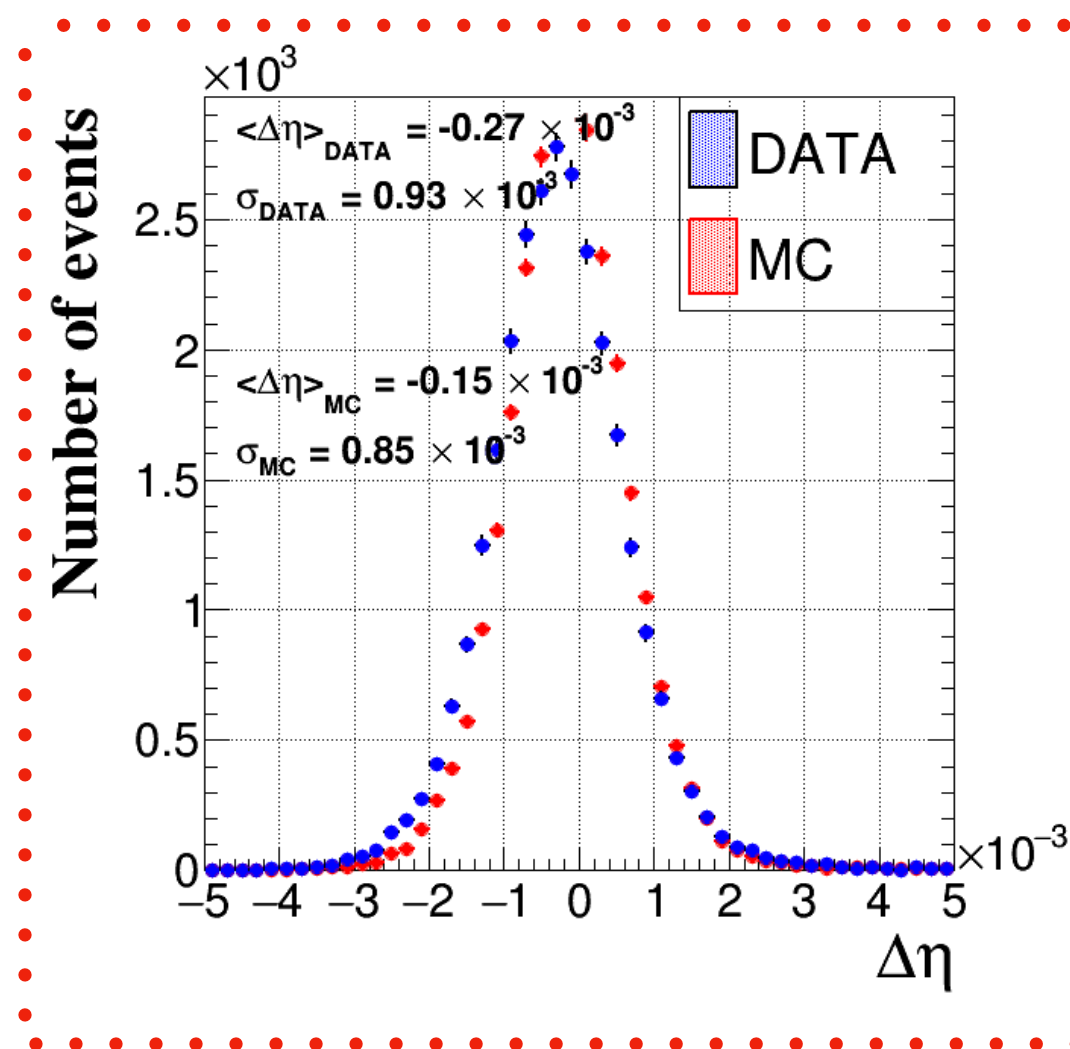
Units are cm

- Alignment values are stored here:
/afs/cern.ch/user/t/twamorka/public/ECALalignment_2018/myEEAlignment_2018_combined_v0.txt

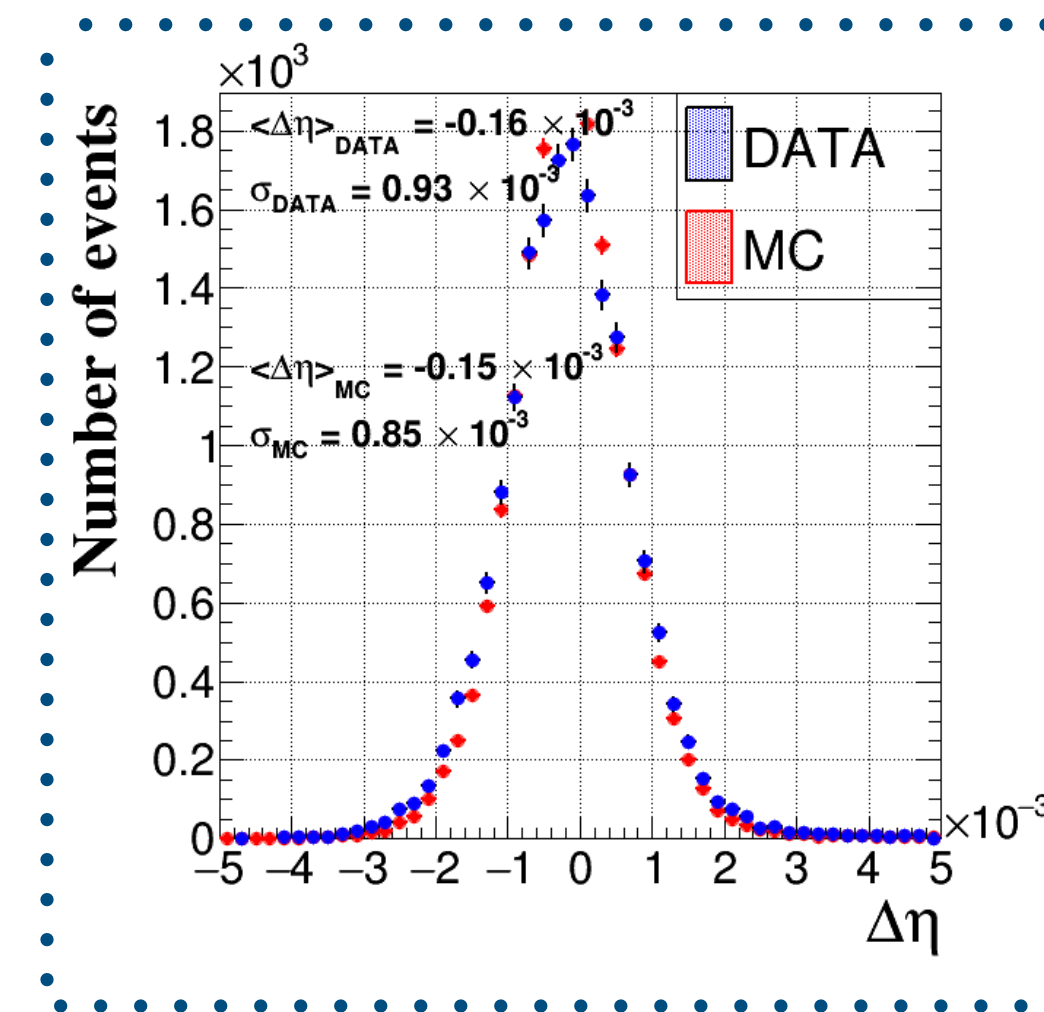


$\Delta\eta$ Distributions : ECAL barrel

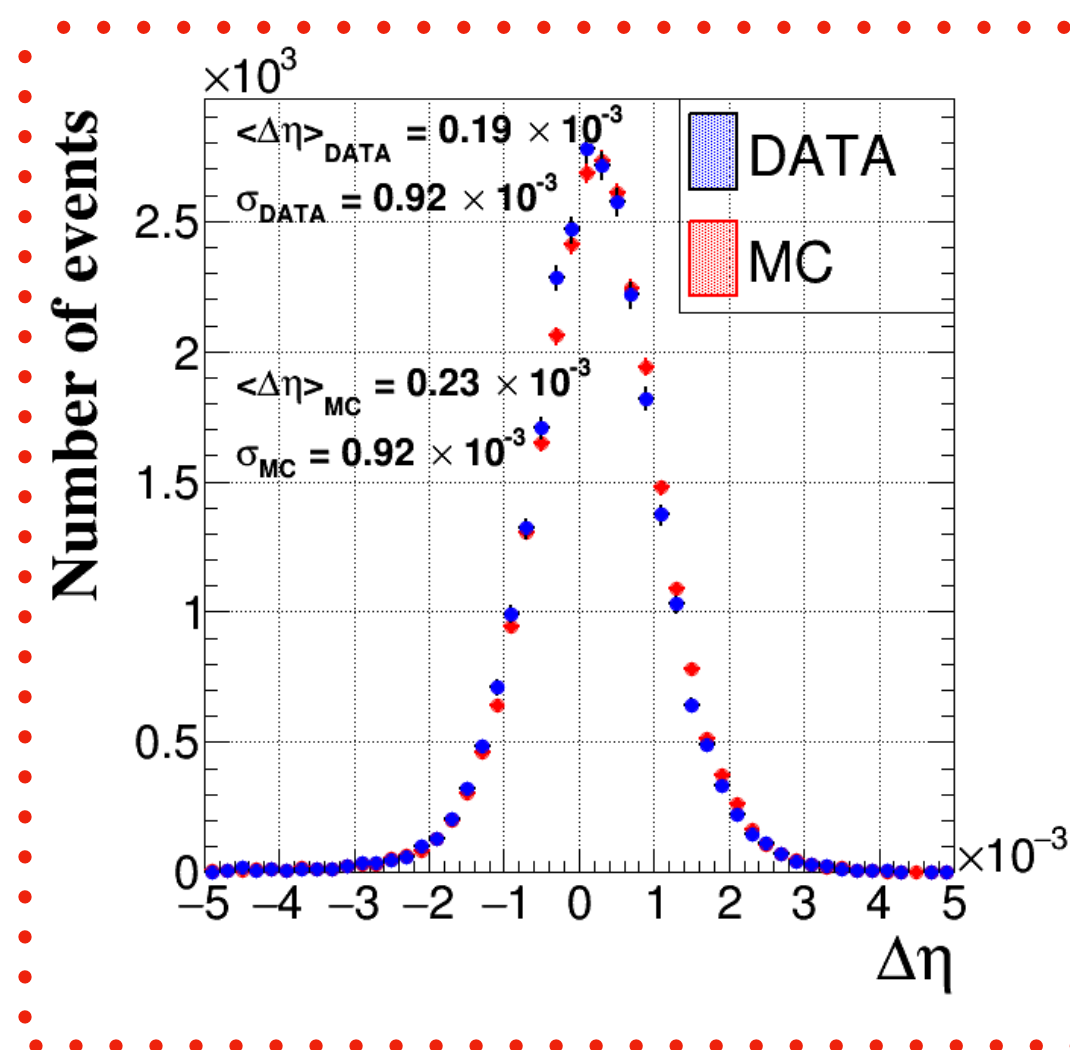
Pre-Alignment



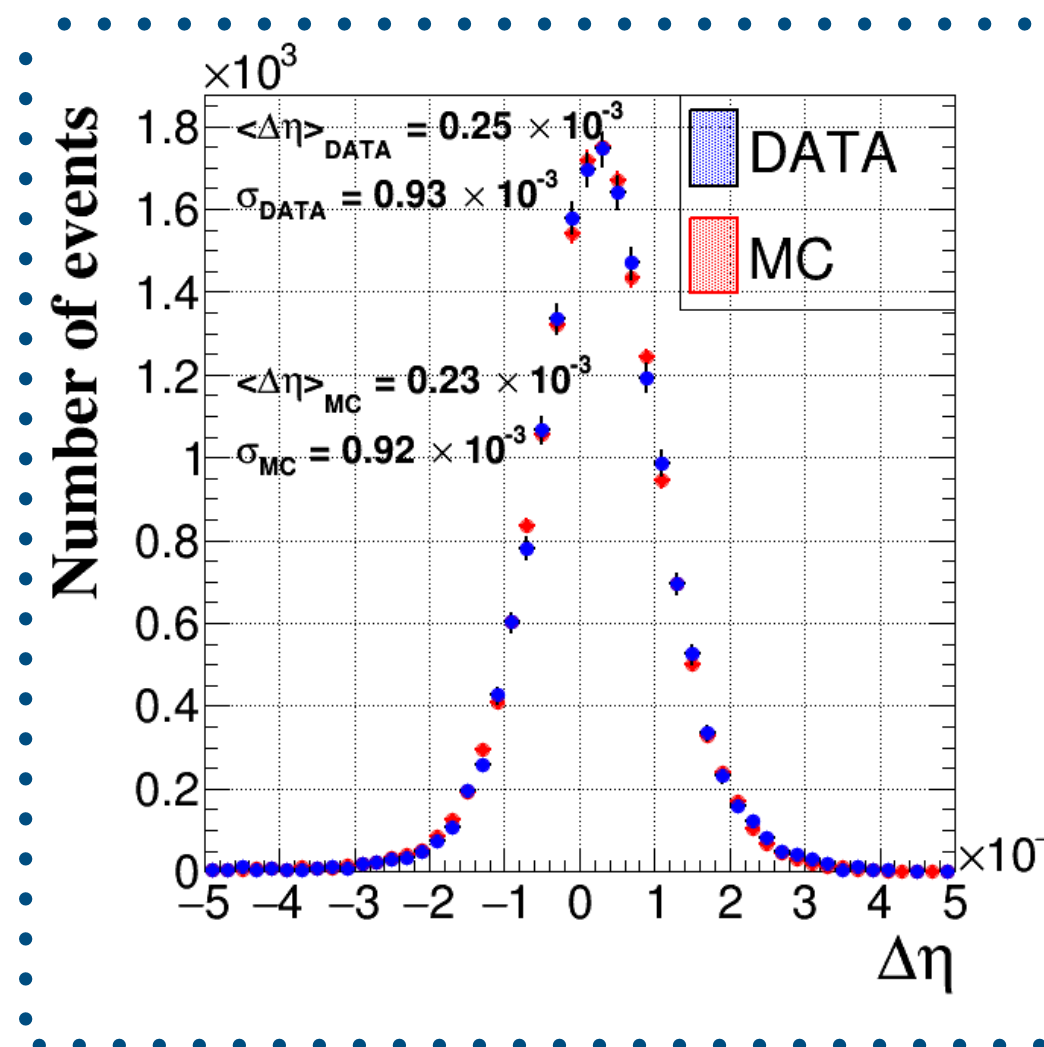
EB +



Post-Alignment



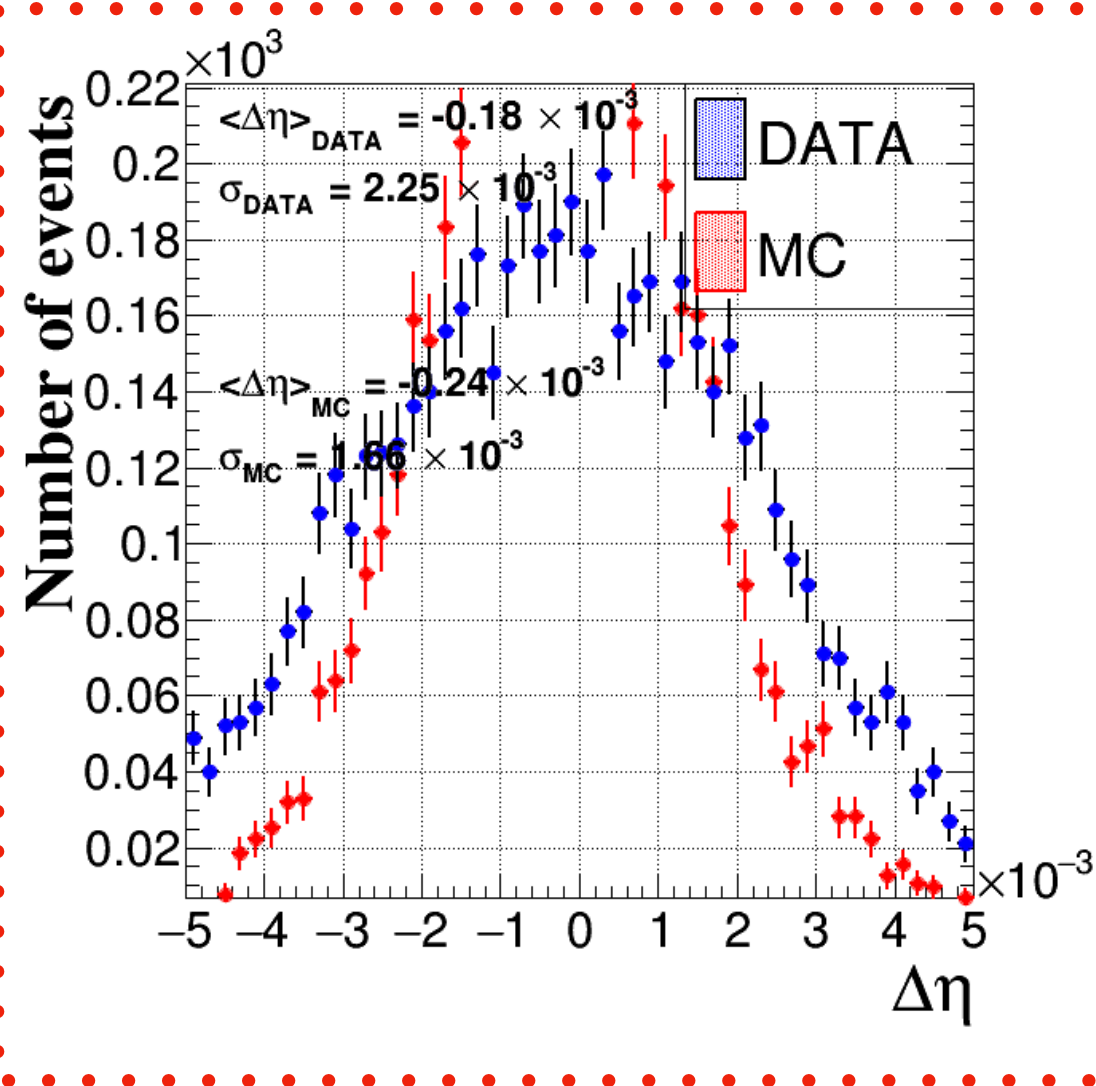
EB -



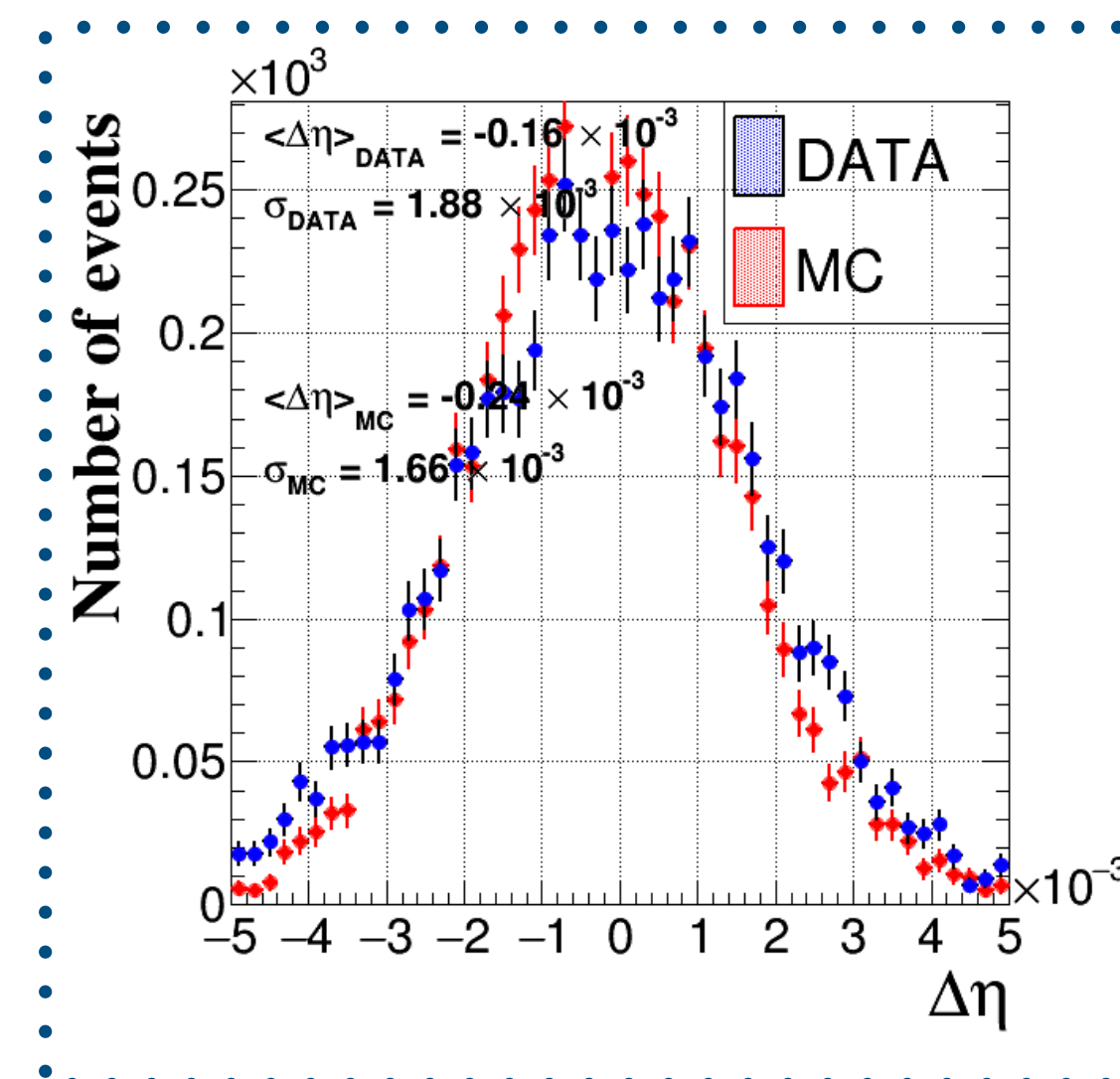


$\Delta\eta$ Distributions : ECAL endcap

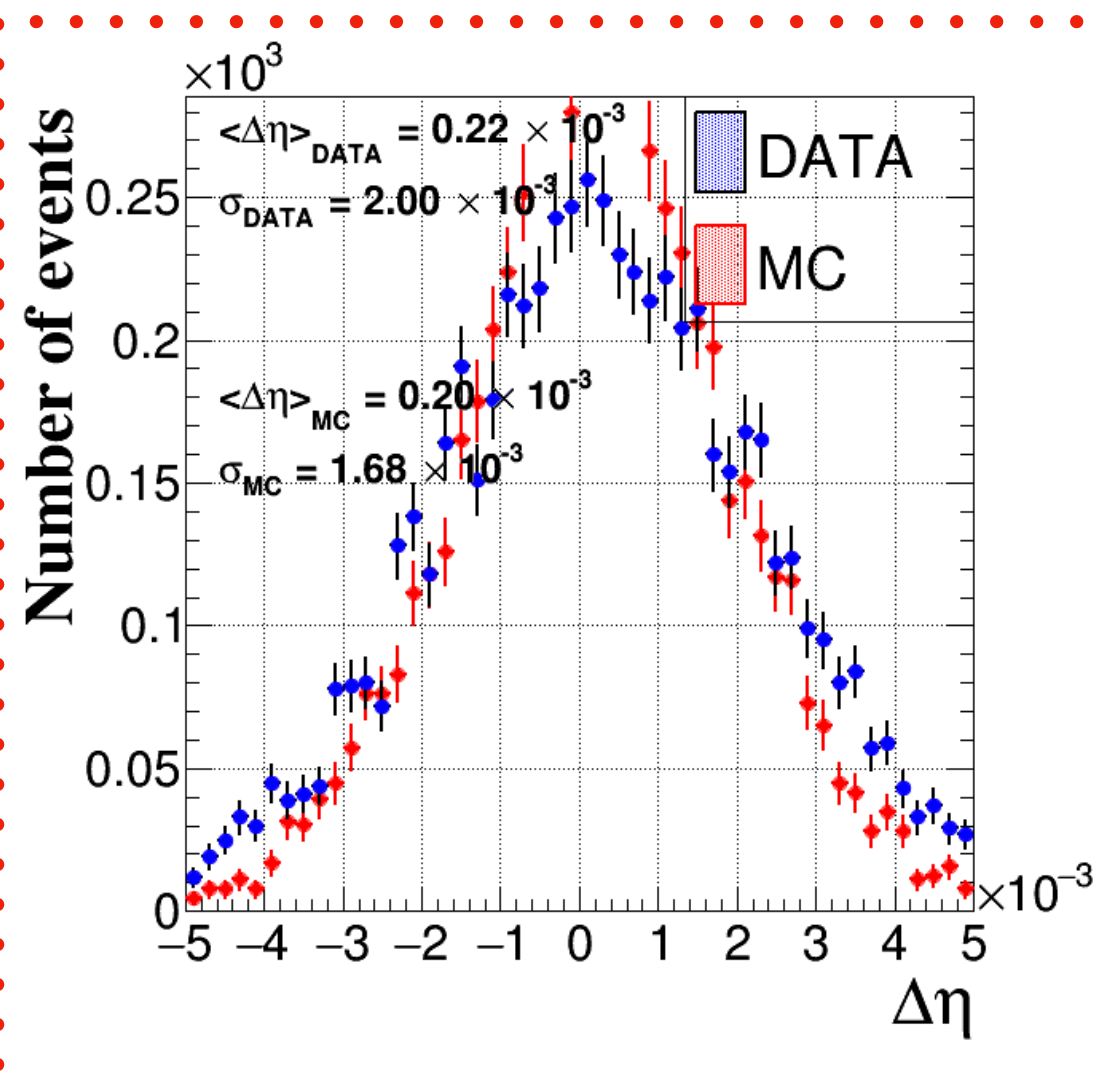
Pre-Alignment



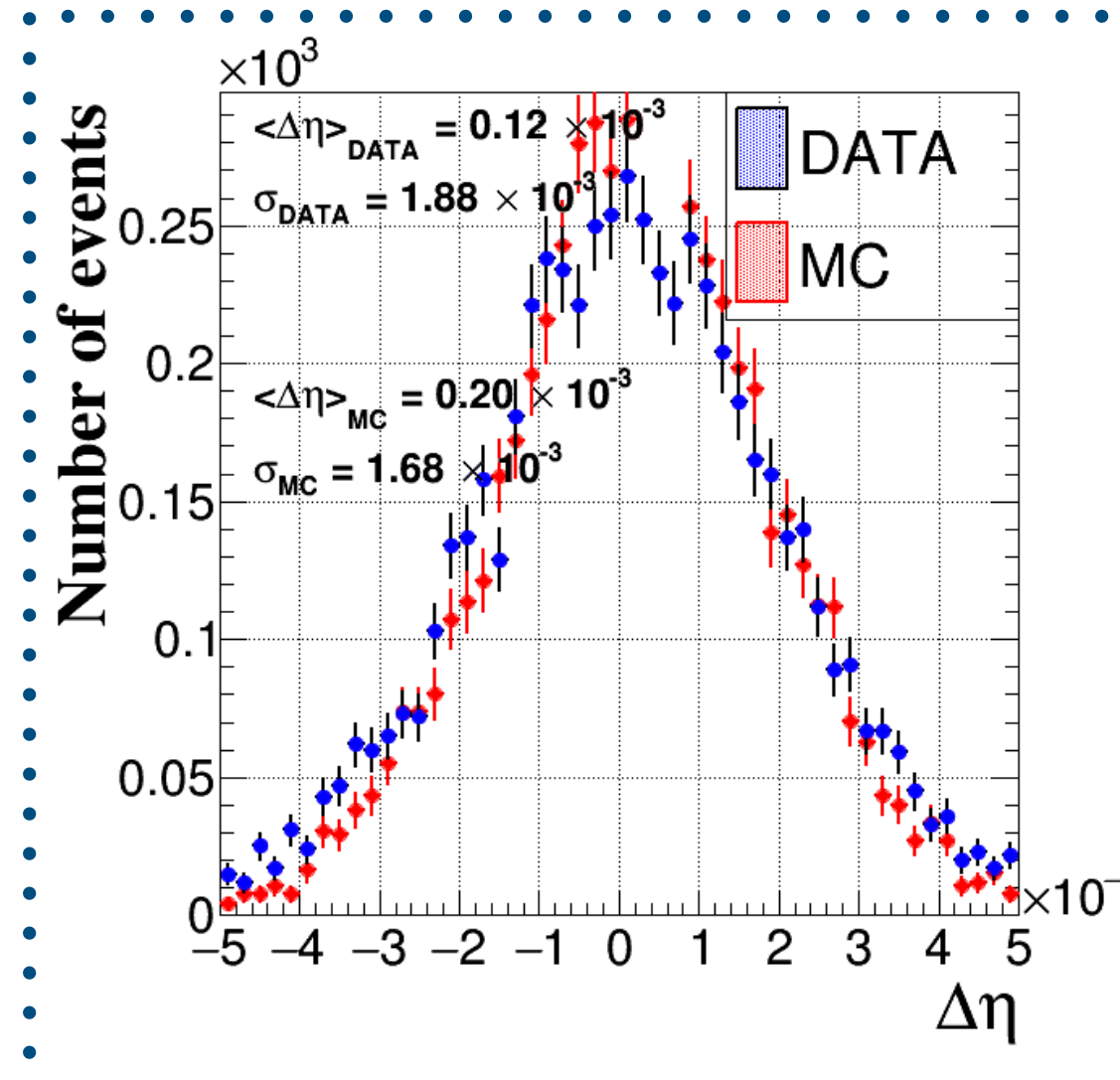
EE +



Post-Alignment



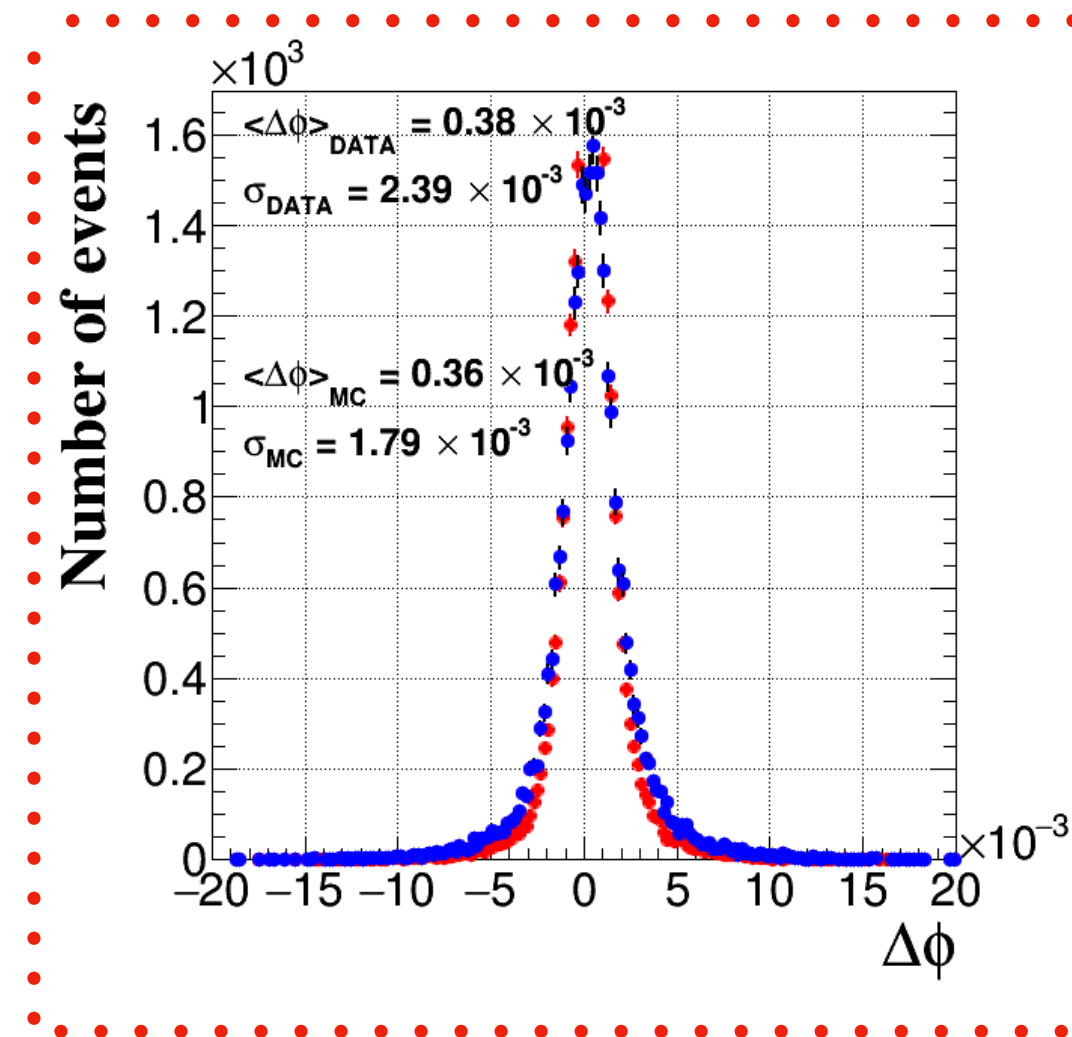
EE -



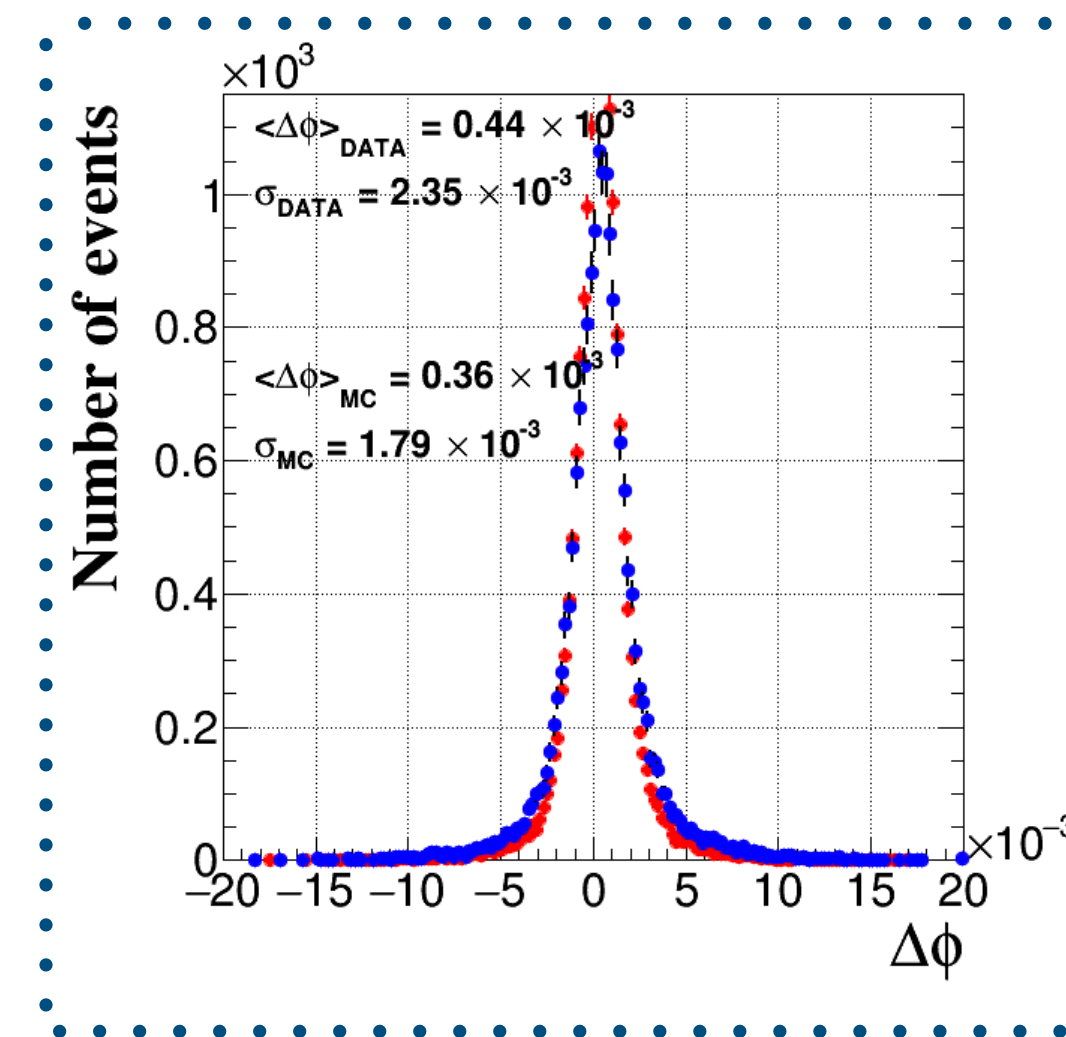


$\Delta\phi$ Distributions: ECAL barrel

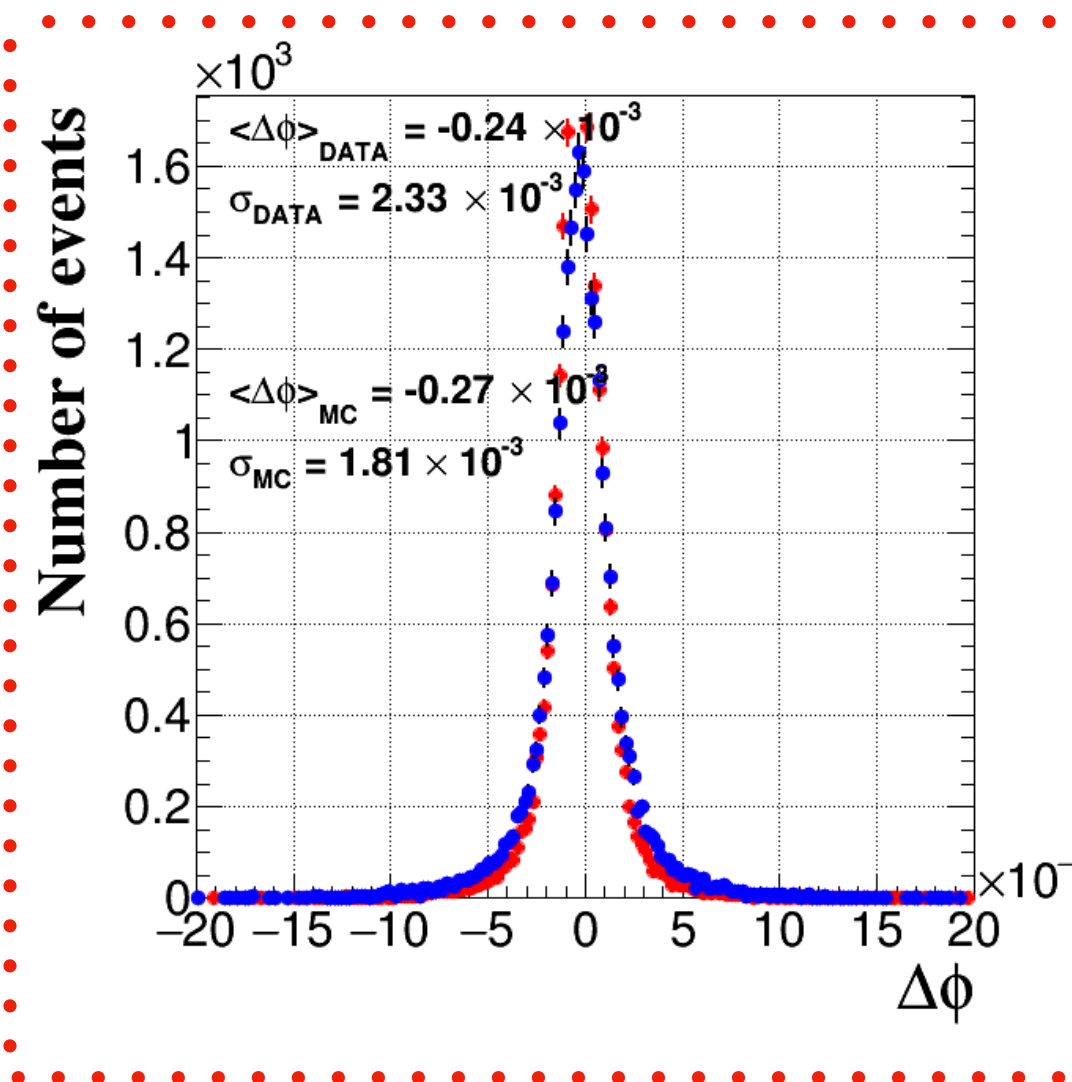
Pre-Alignment



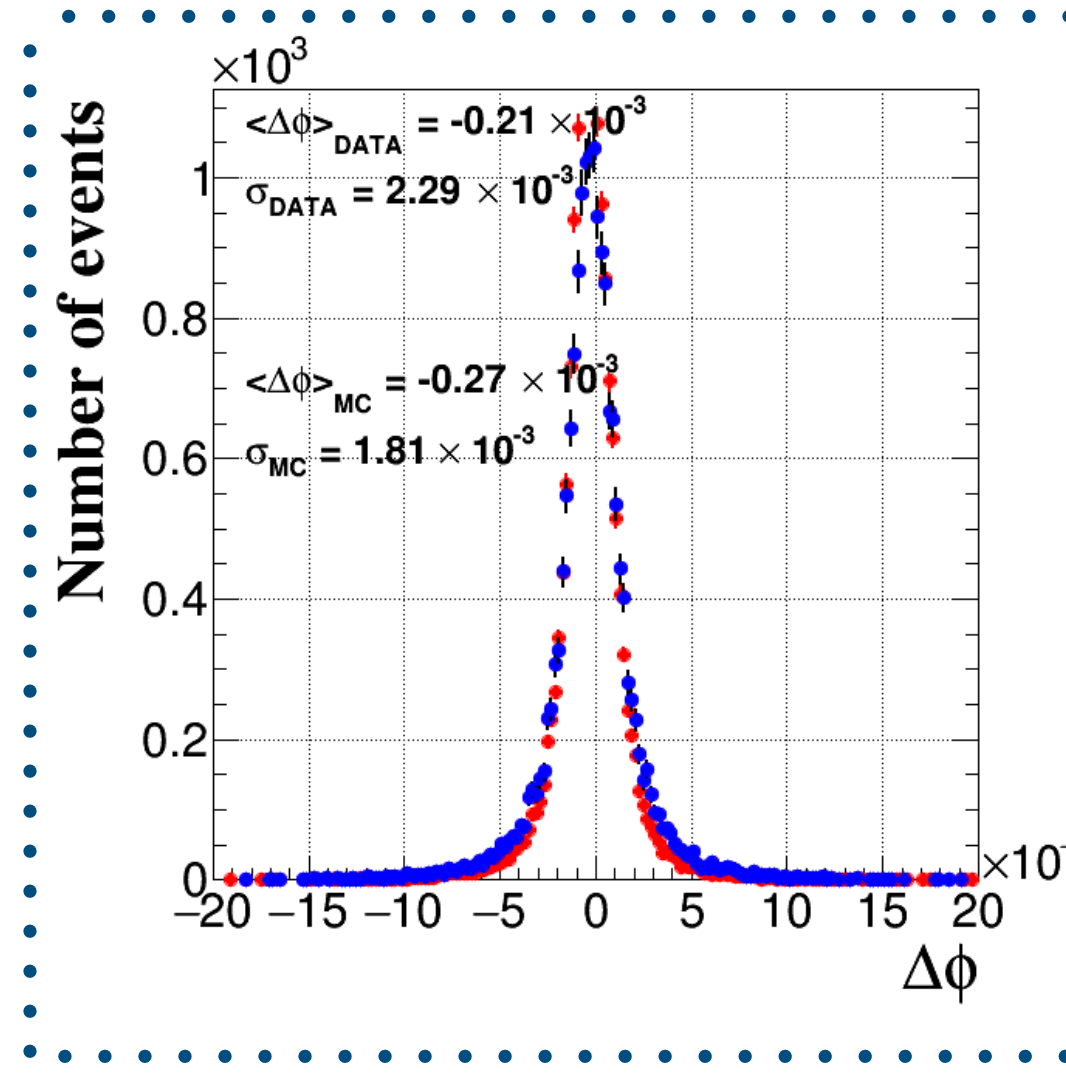
EB +



Post-Alignment



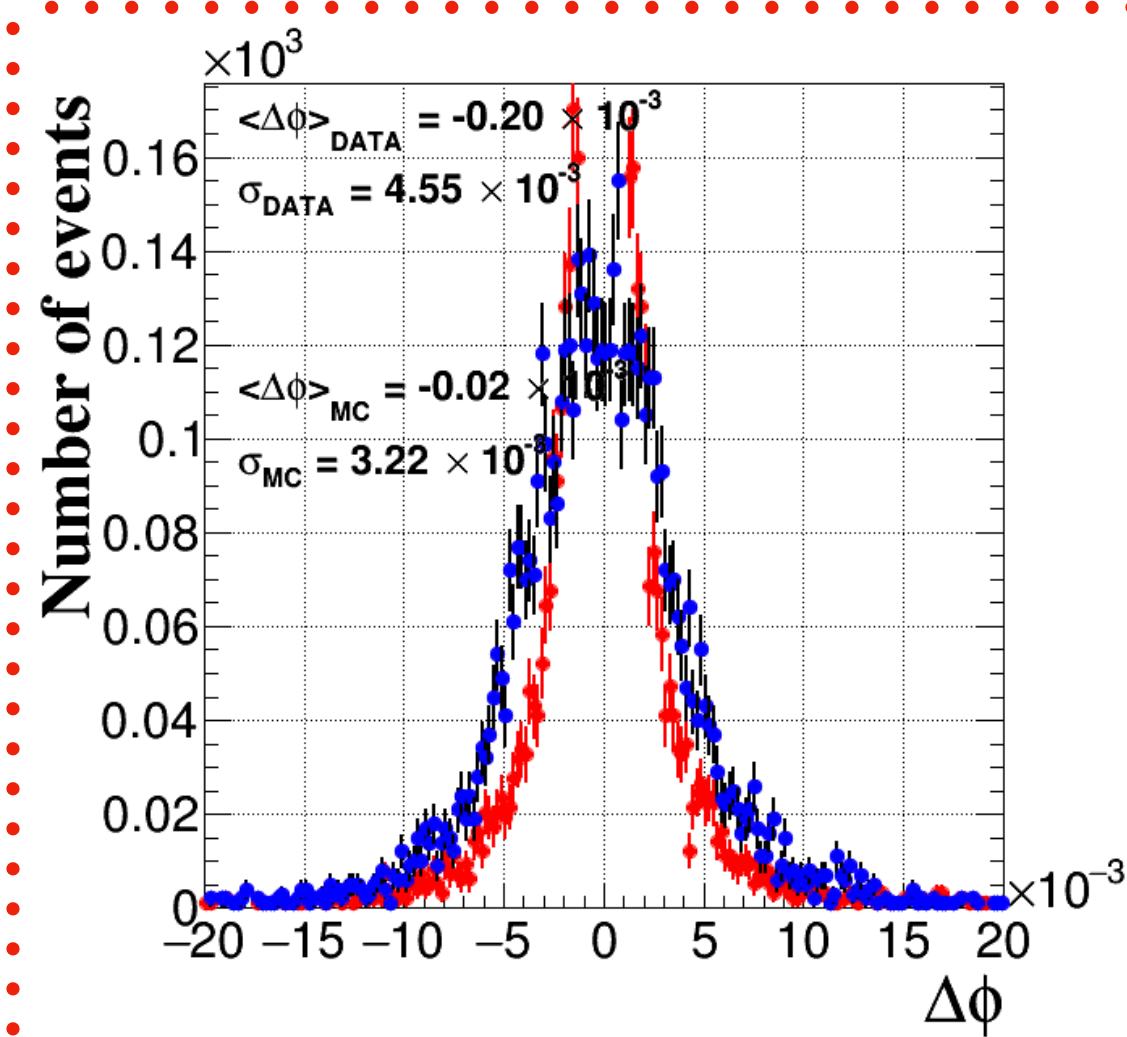
EB -



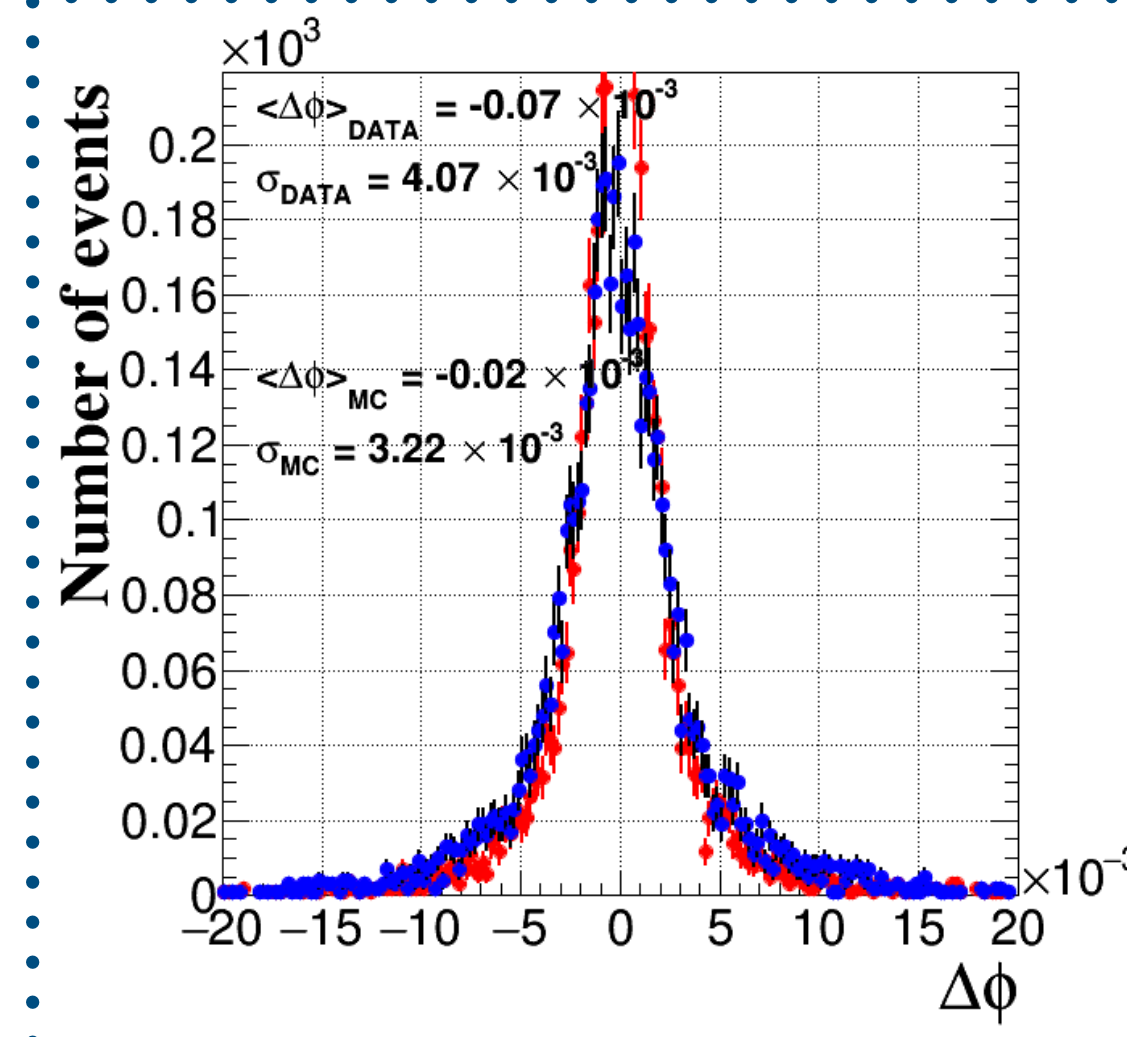


$\Delta\phi$ Distributions: ECAL endcap

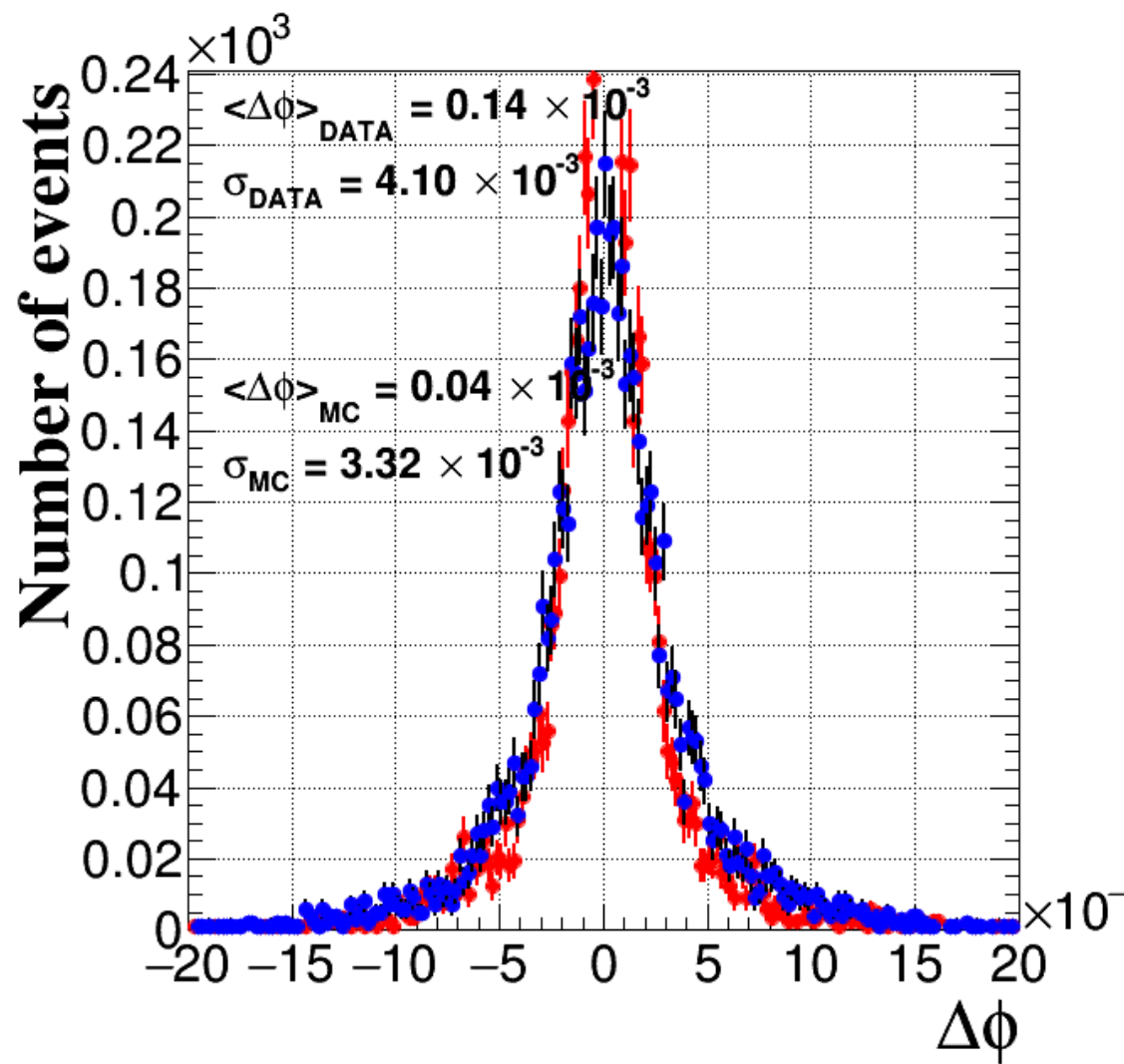
Pre-Alignment



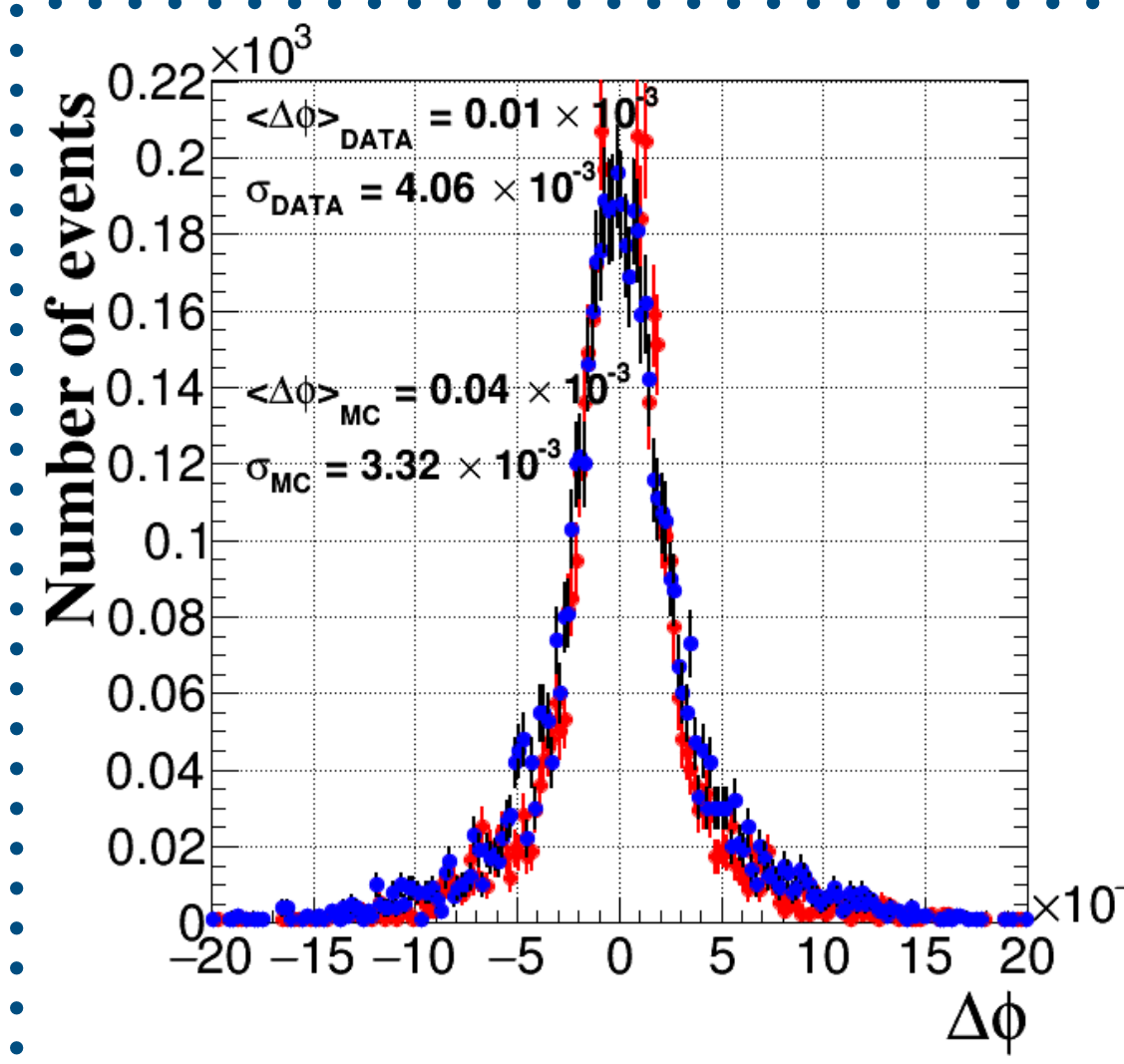
EE +



Post-Alignment

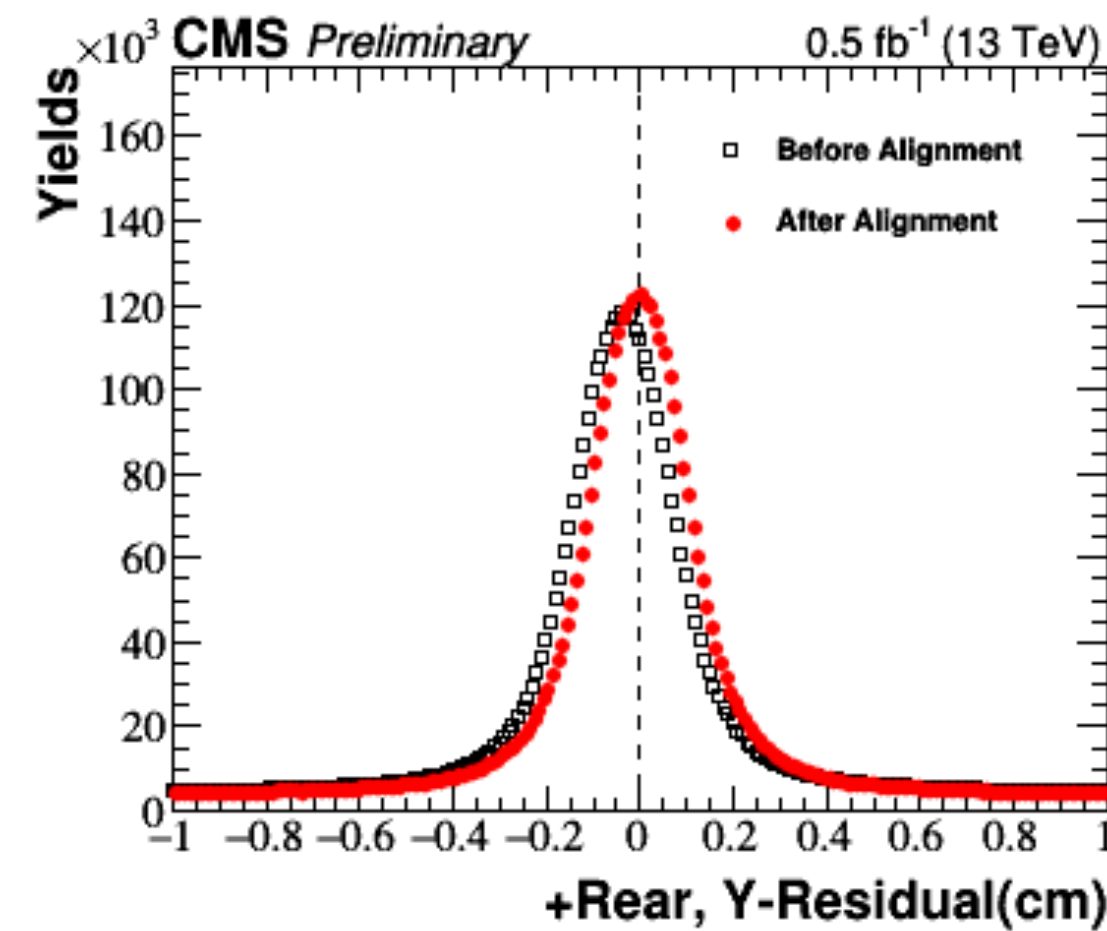
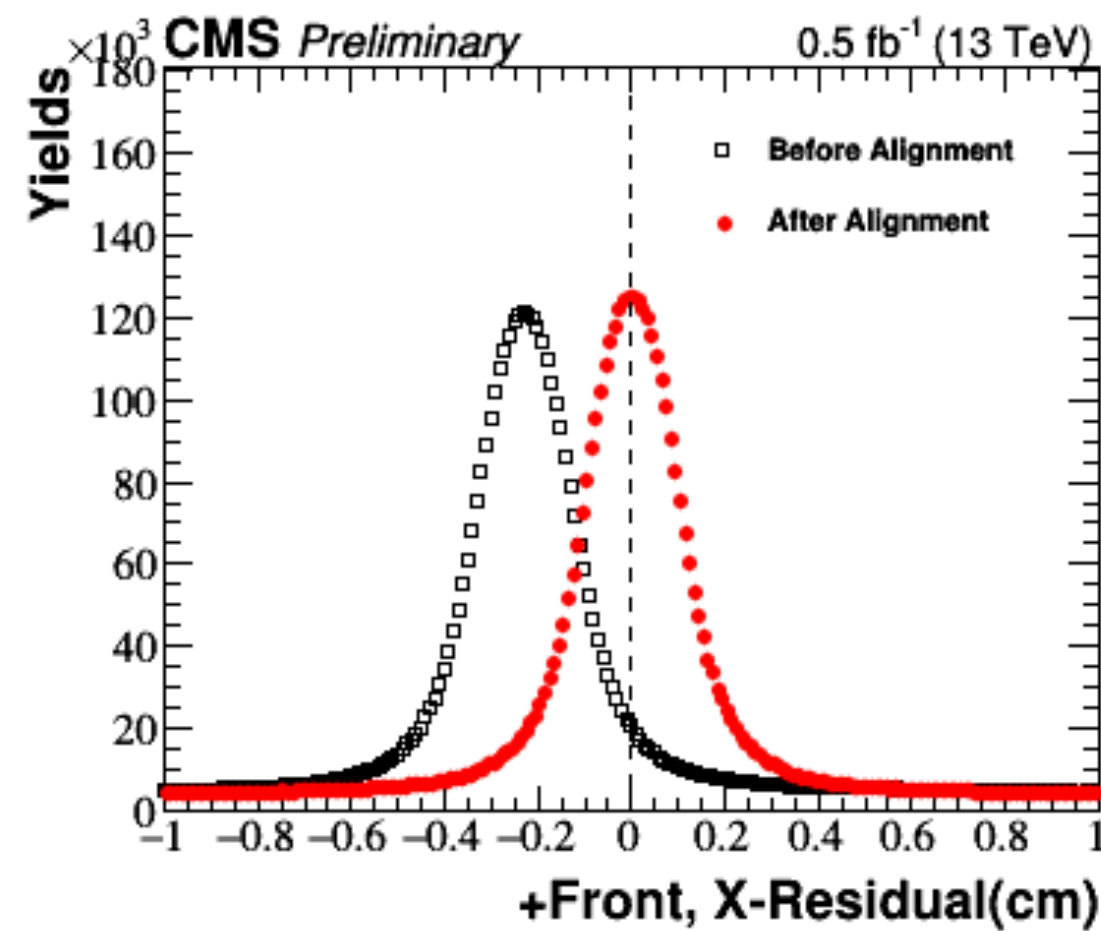


EE -

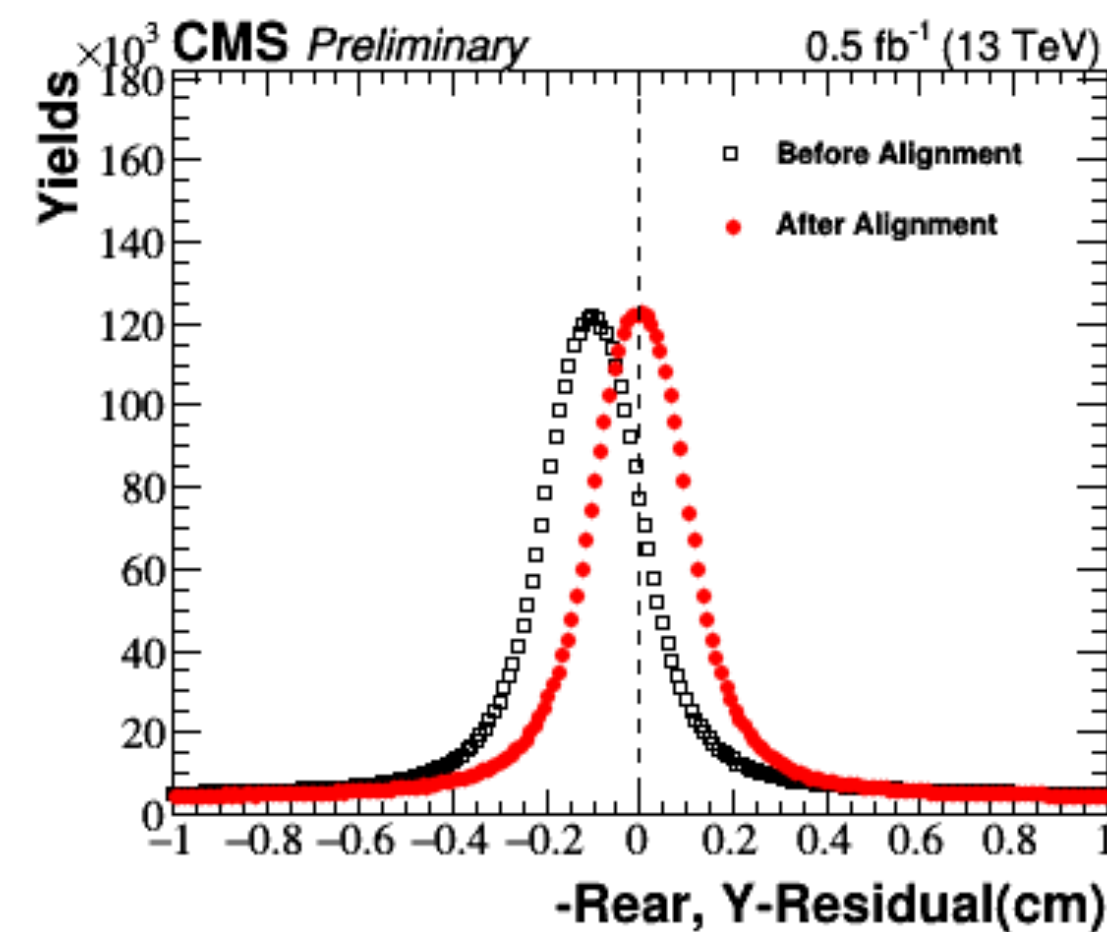
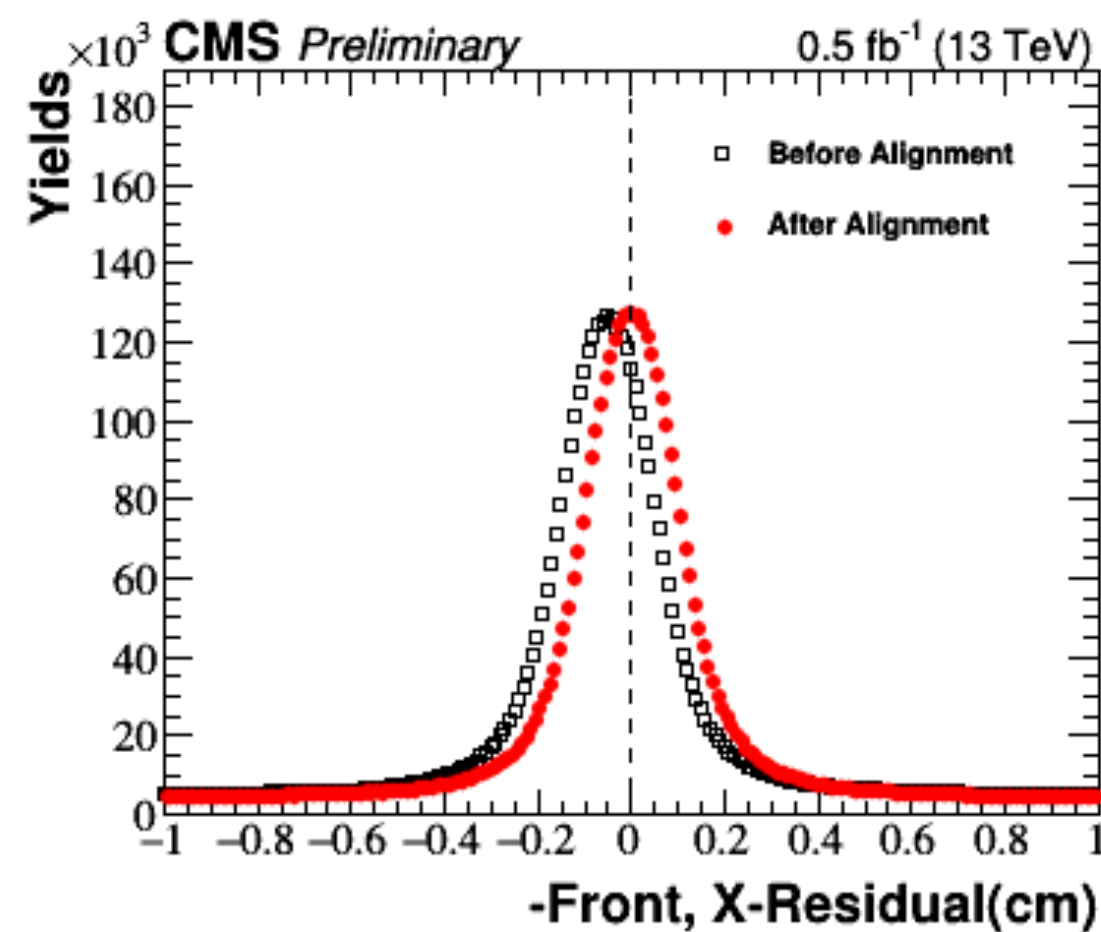




ES Alignment : Performance



- The plots on the left show the residual distribution before and after ES alignment for the four planes.



Work by Pei-Rong Yu (National Taiwan University) and Chia-Ming Kuo (National Central University, Taiwan)



Conclusion

- ECAL barrel and endcap plus Pre-shower (ES) alignment performed with 2018 data.
- New ECAL DB shows improved agreement between Data and MC.
- New ECAL EB and EE alignment values here:
/afs/cern.ch/user/t/twamorka/public/ECALalignment_2018/myEBAlignment_2018_combined_v0.txt
/afs/cern.ch/user/t/twamorka/public/ECALalignment_2018/myEEAlignment_2018_combined_v0.txt

- ECAL and ES alignment validated and are ready to be deployed!

Approved by
ECAL DPG



Backup

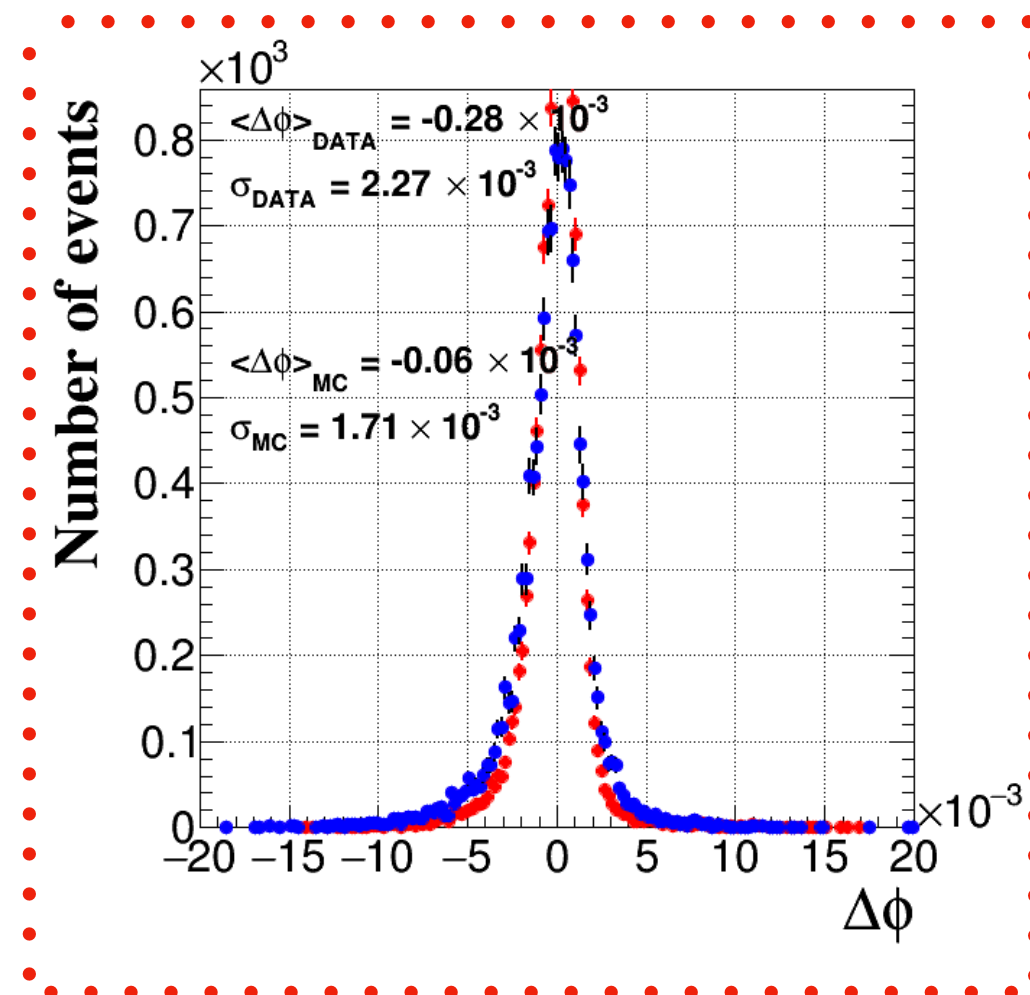
0	0	0	-0.030205	-0.010513	0.0059165
0	0	0	0.020805	-0.019818	0.027511
0	0	0	0.024368	0.0021255	0.030943
0	0	0	-0.010725	0.015078	0.018728
0	0	0	0.0083447	0.018832	0.036616
0	0	0	0.0026953	0.0014639	0.027583
0	0	0	-0.024597	0.030849	0.04396
0	0	0	-0.014708	-0.016936	-0.0015252
0	0	0	-0.023765	-0.024946	0.016137
0	0	0	-0.038689	-0.042868	0.032129
0	0	0	-0.0063553	-0.056835	0.020229
0	0	0	0.074584	-0.021453	-0.0079159
0	0	0	0.059957	-0.067997	0.027082
0	0	0	0.046182	-0.026456	0.029626
0	0	0	-0.03922	-0.013426	0.0066461
0	0	0	-0.05598	-0.017511	0.0096386
0	0	0	-0.053563	-0.070452	0.024857
0	0	0	0.015049	-0.025962	0.024303
0	0	0	0.0058137	-0.012952	-0.0041128
0	0	0	-0.0083776	-0.052647	0.019064
0	0	0	-0.022586	-0.058122	0.024516
0	0	0	0.016053	0.0092857	0.014064
0	0	0	0.021024	0.021458	-0.0080467
0	0	0	-0.026797	0.00034987	0.014887
0	0	0	-0.04931	-0.017304	-0.0070399
0	0	0	-0.0037254	-0.040976	0.011542
0	0	0	-0.0072039	-0.037526	0.014459
0	0	0	0.0090411	-0.0068026	-0.0014003
0	0	0	0.01299	-0.044767	0.0031752
0	0	0	0.00010993	-0.048688	0.0058803
0	0	0	0.043883	0.065846	0.043642
0	0	0	0.018258	-0.05576	0.0013514
0	0	0	-0.024014	-0.10016	-0.022005
0	0	0	-0.0020234	-0.033327	-0.0059957
0	0	0	-0.0080323	-0.019199	-0.00031756
0	0	0	0.042269	-0.04066	-0.017216

2018 alignment values EB (Units are in cm)

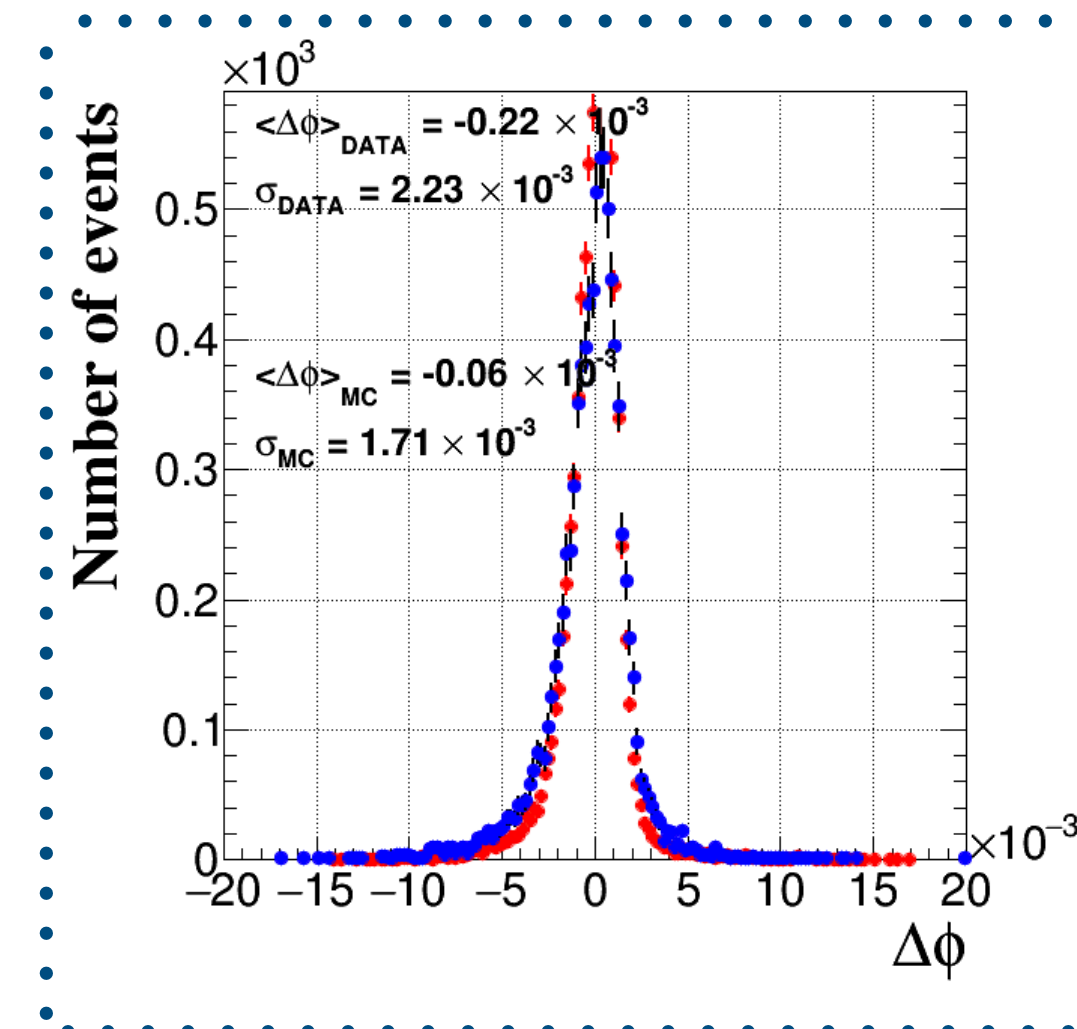


$\Delta\phi$ Distributions: ECAL barrel (Electrons)

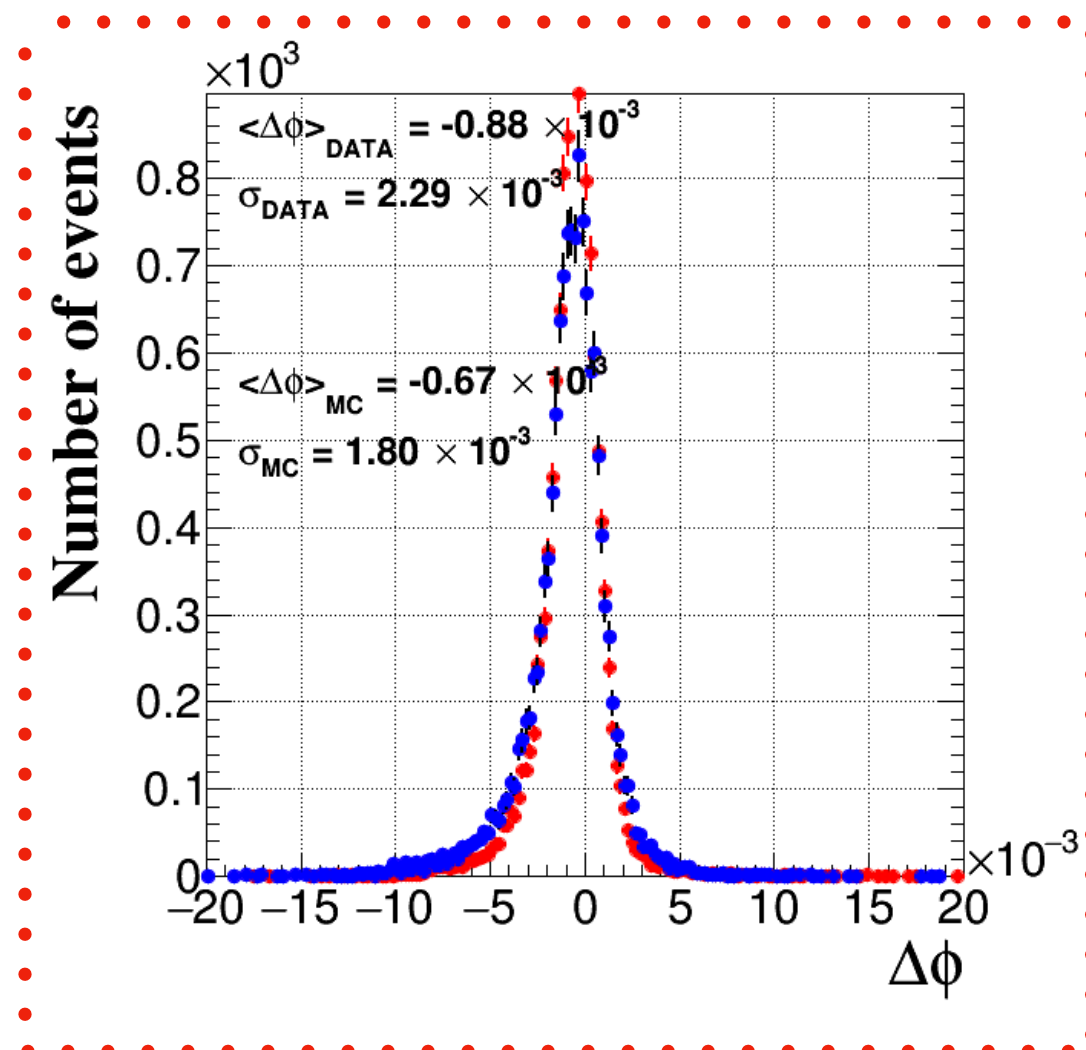
Pre-Alignment



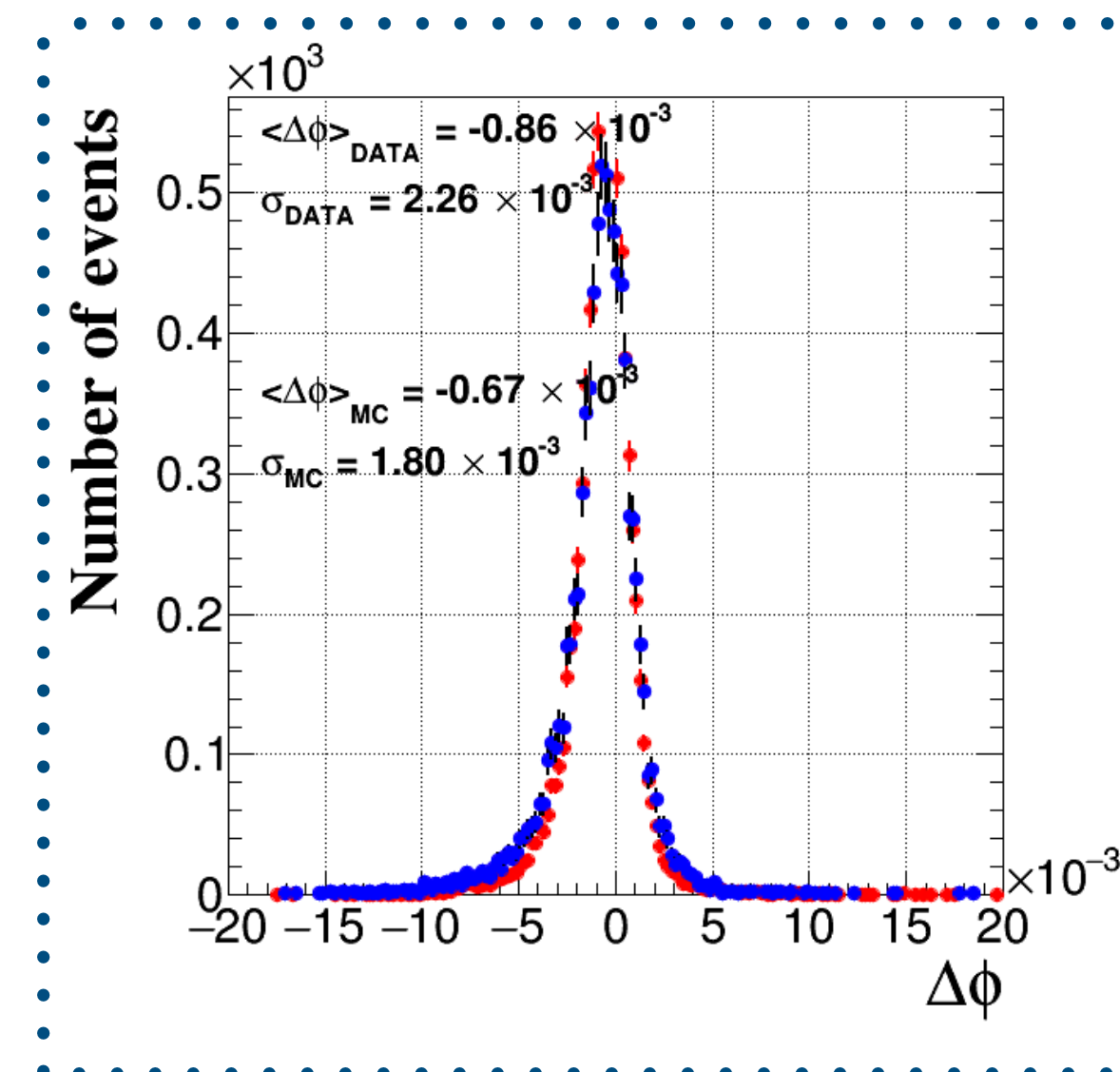
EB +



Post-Alignment



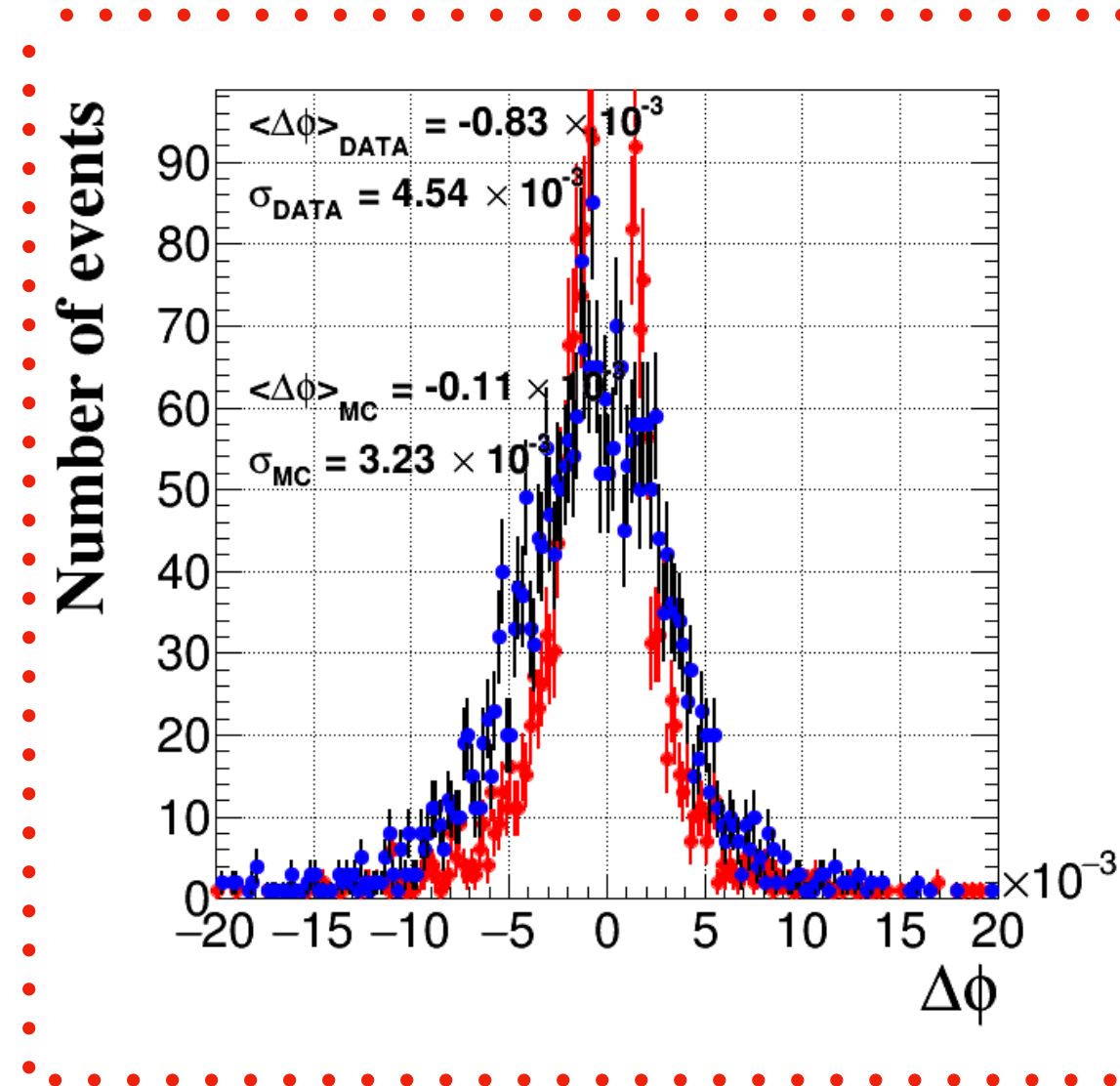
EB -



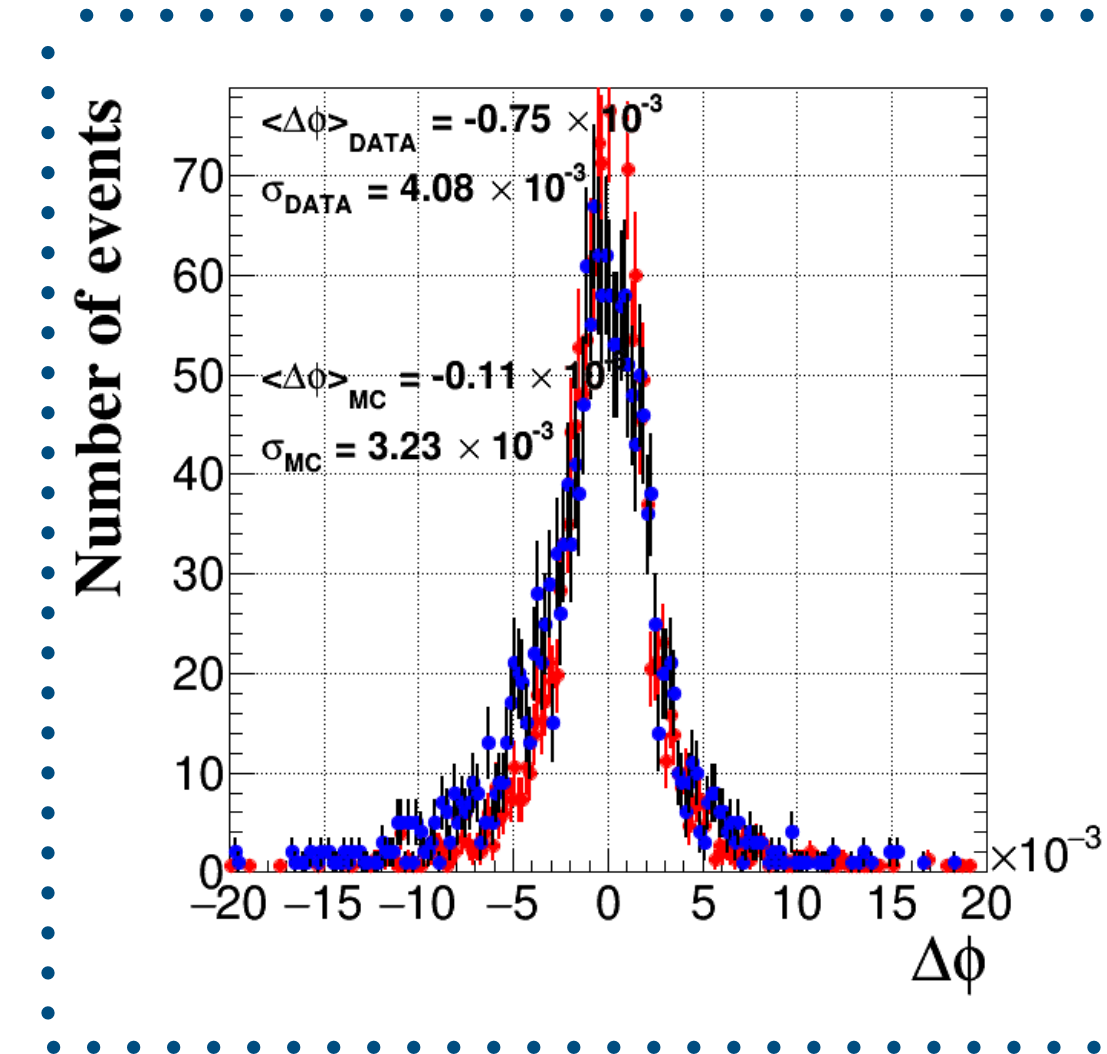


$\Delta\phi$ Distributions: ECAL endcap (Electrons)

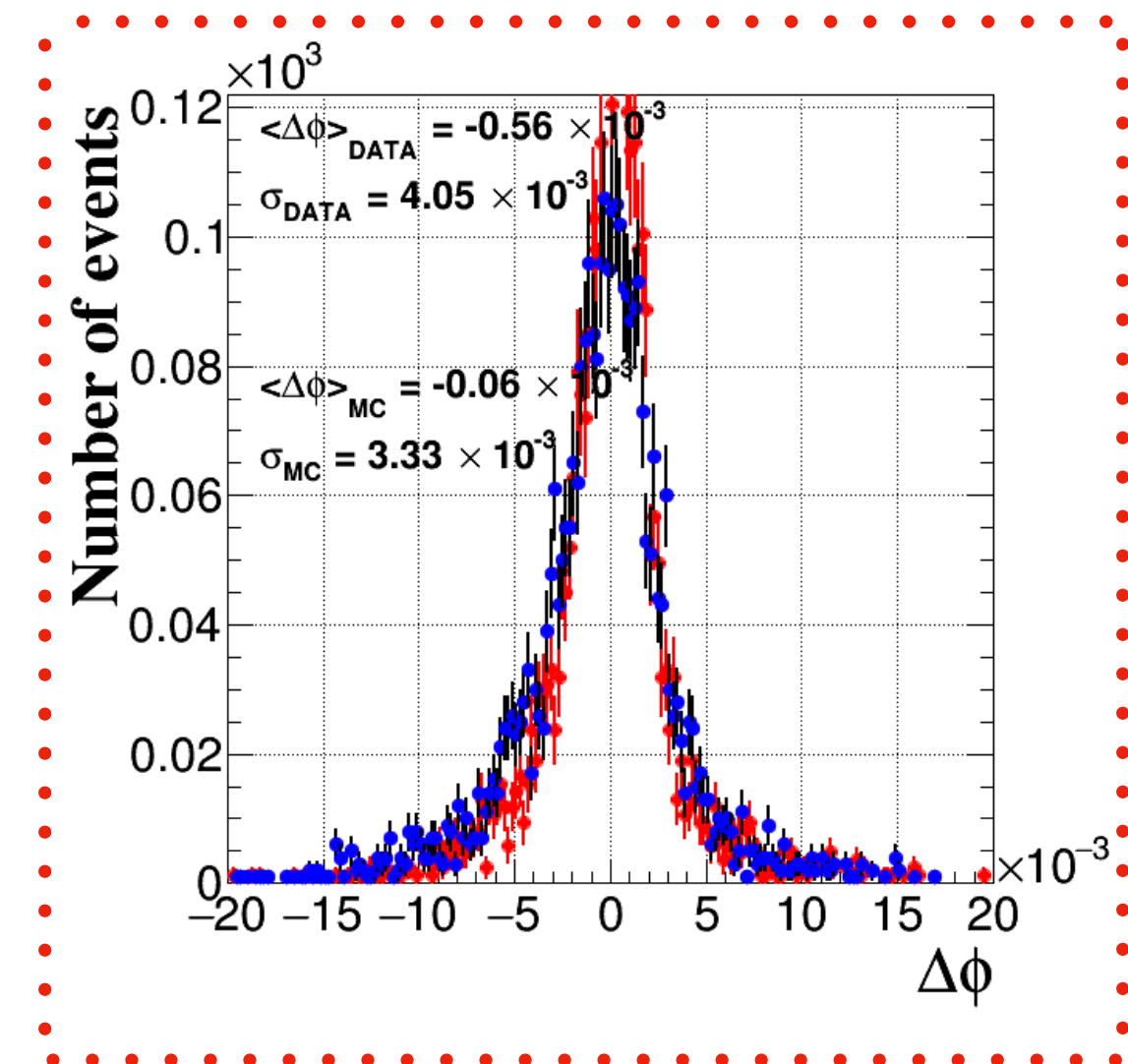
Pre-Alignment



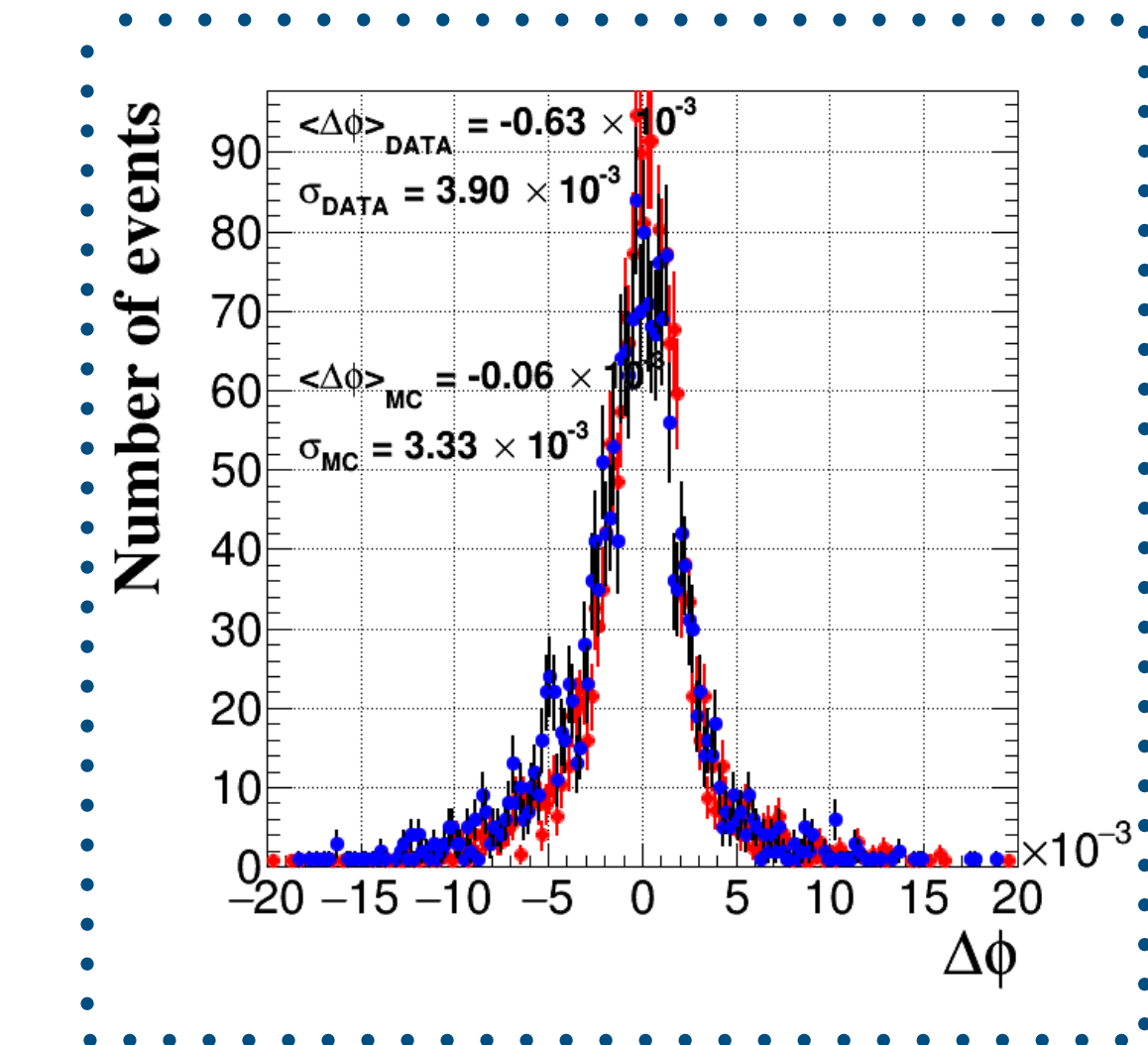
EE +



Post-Alignment



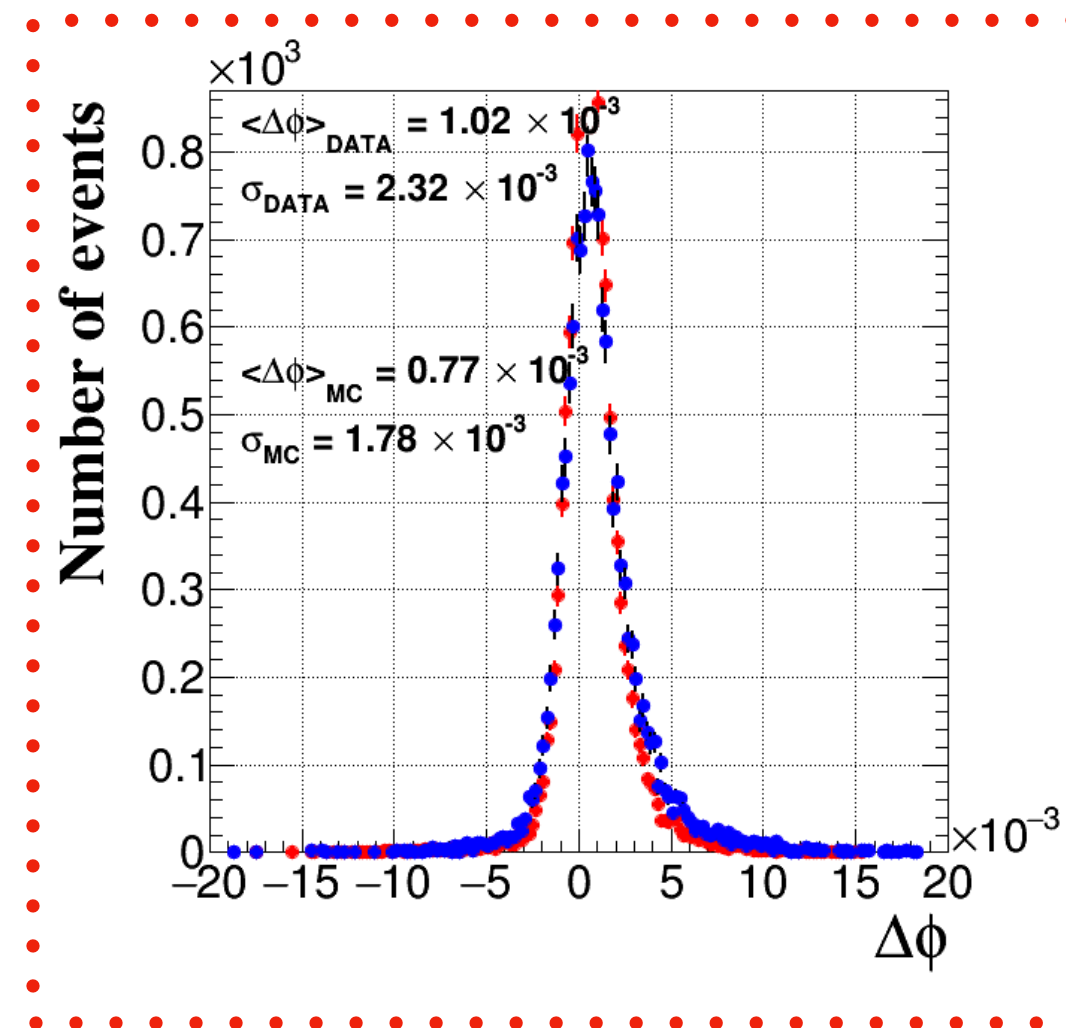
EE -



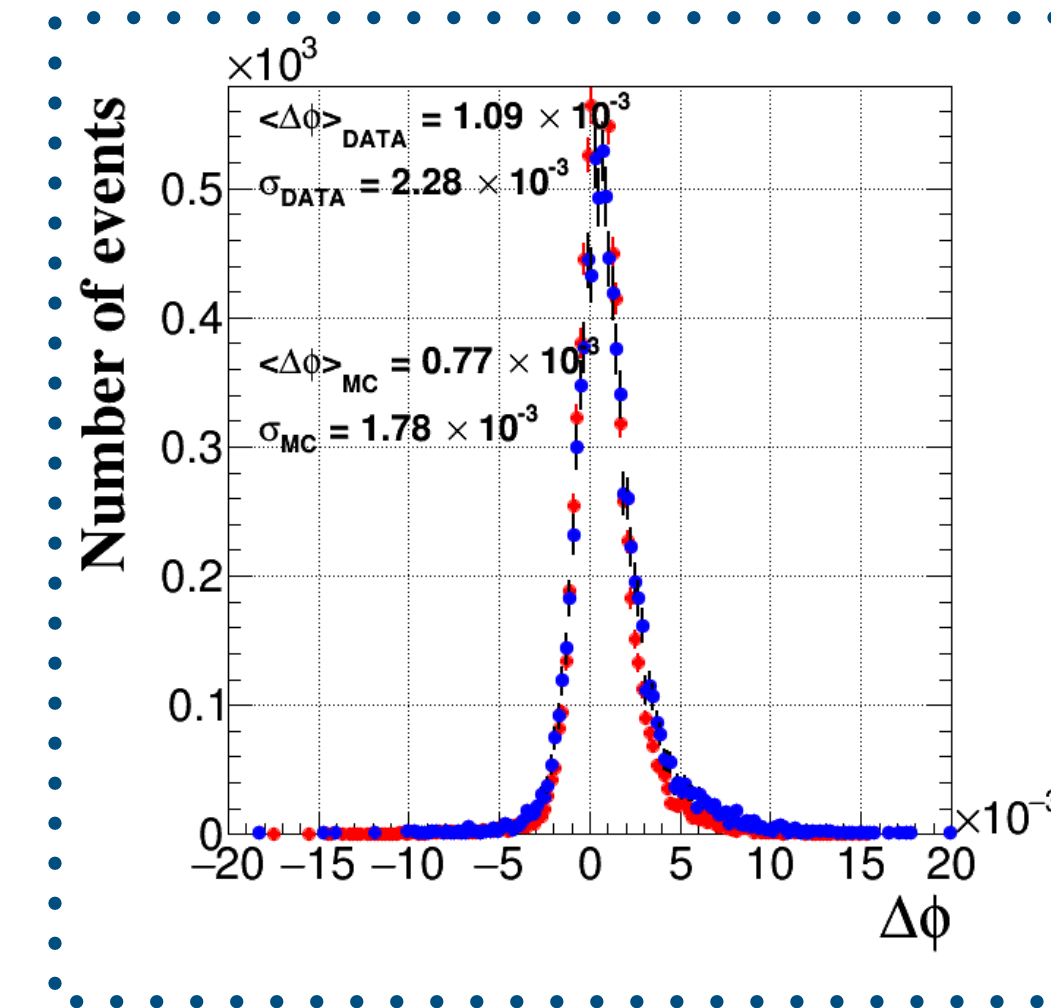


$\Delta\phi$ Distributions: ECAL barrel (Positron)

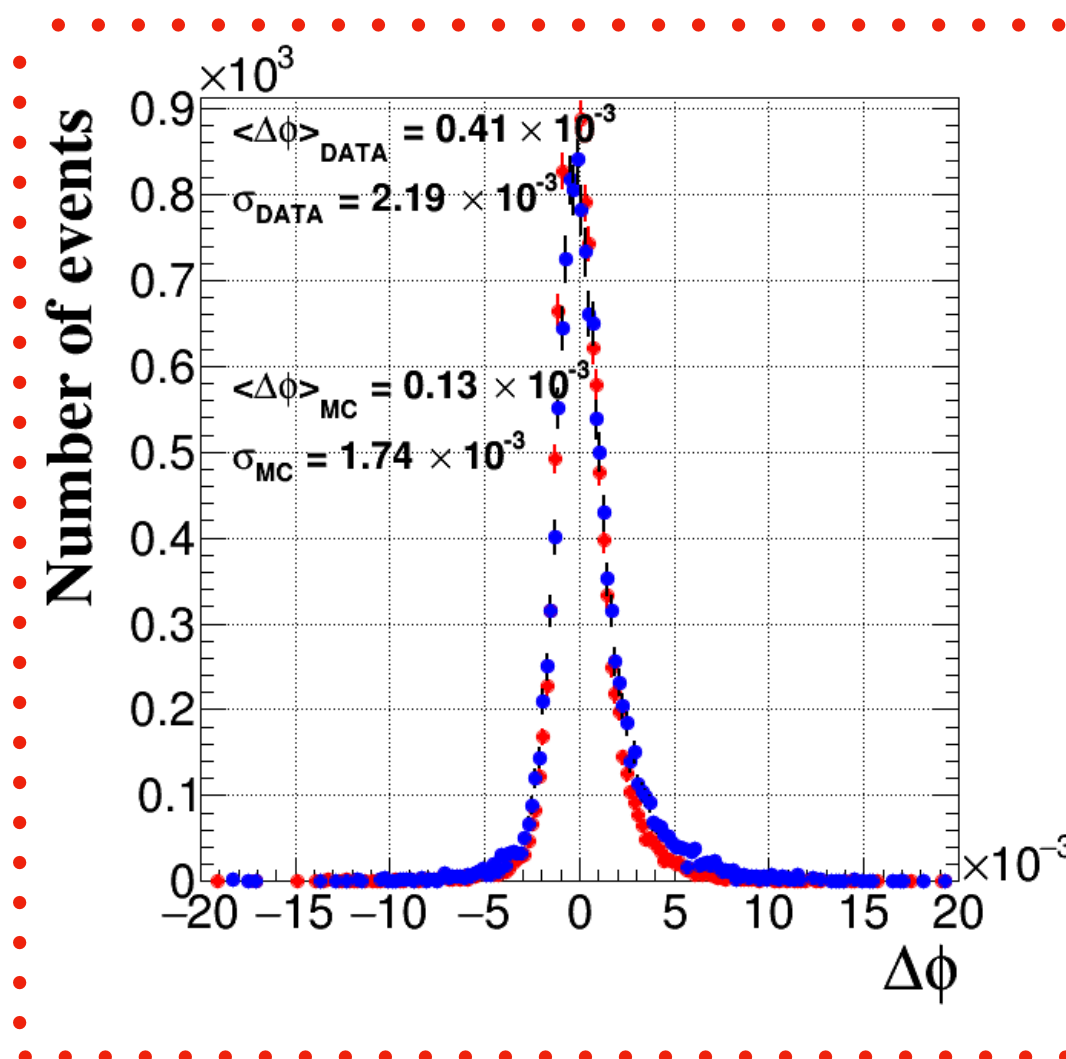
Pre-Alignment



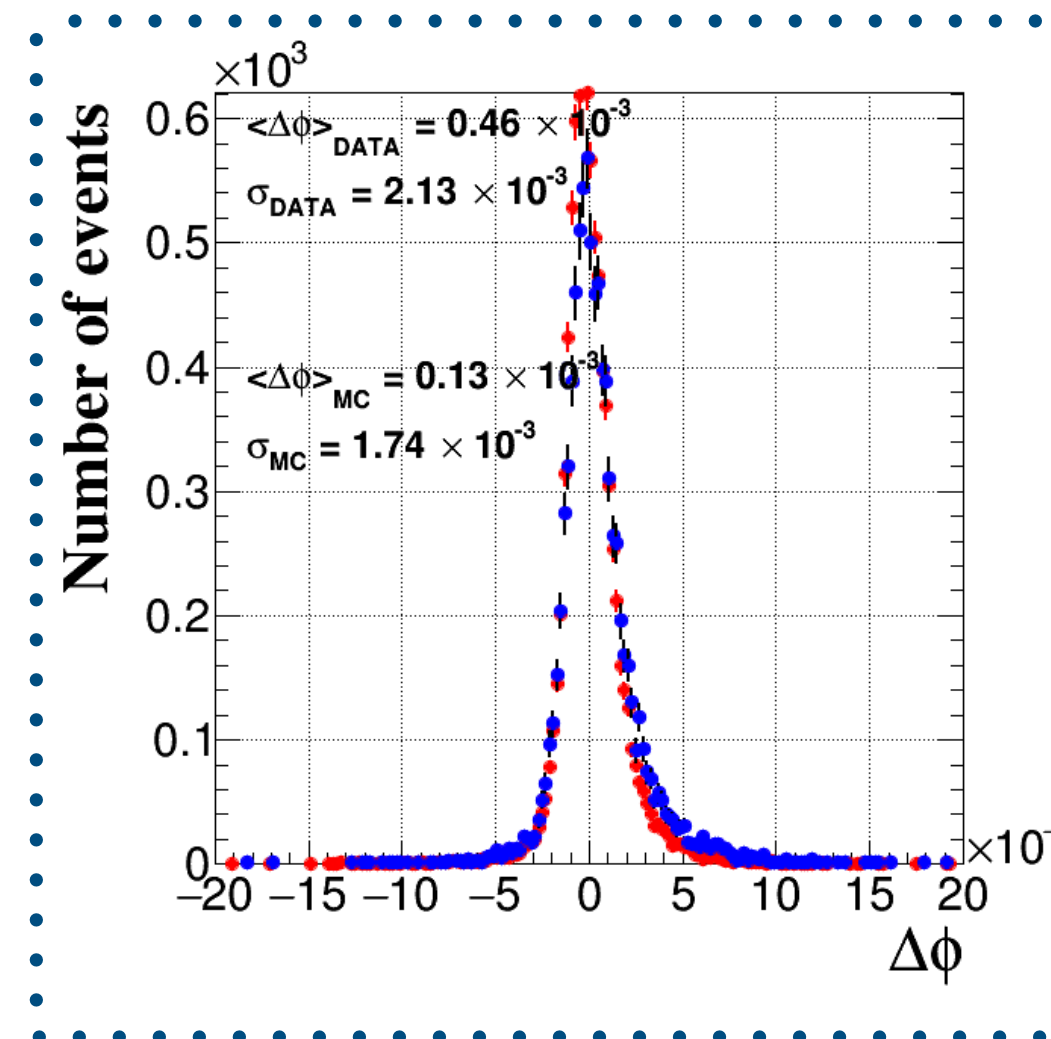
EB +



Post-Alignment



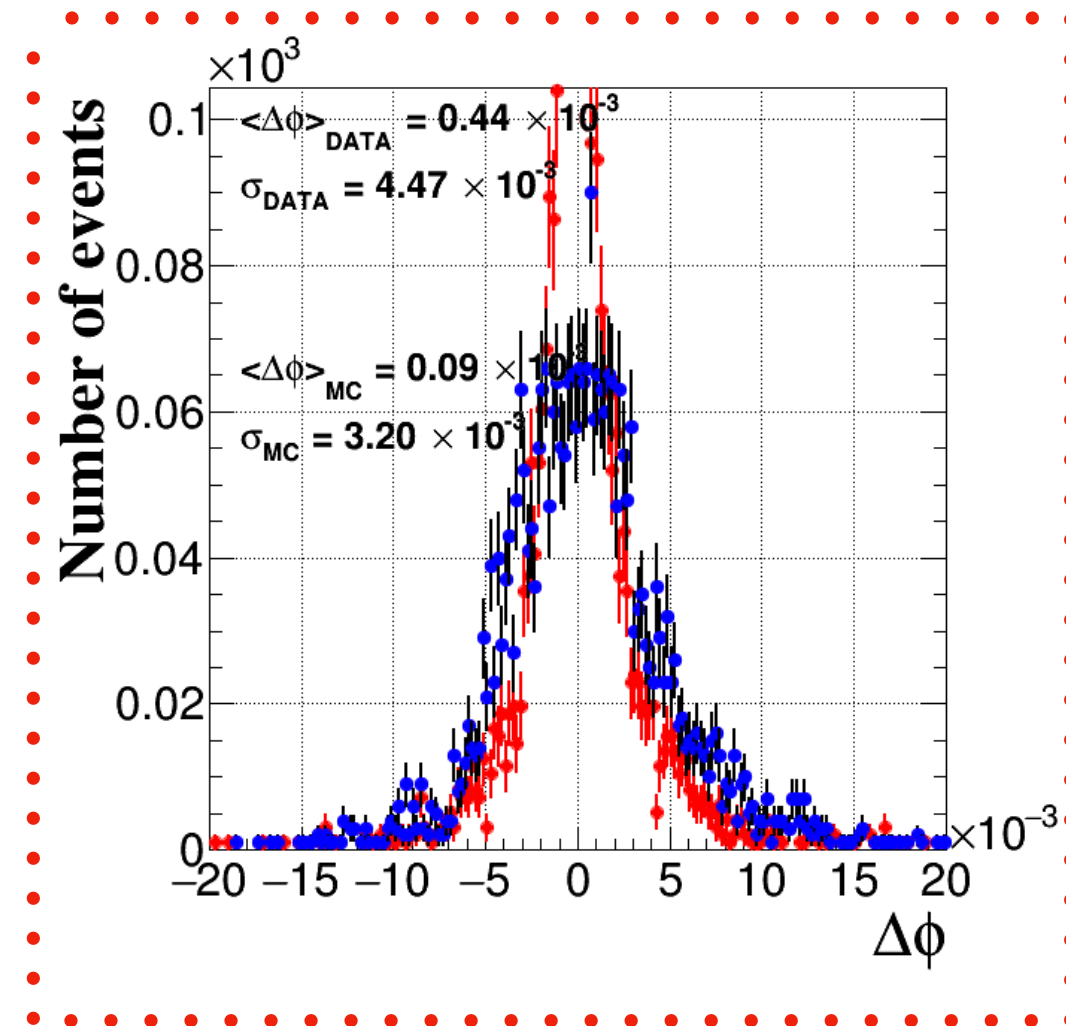
EB -



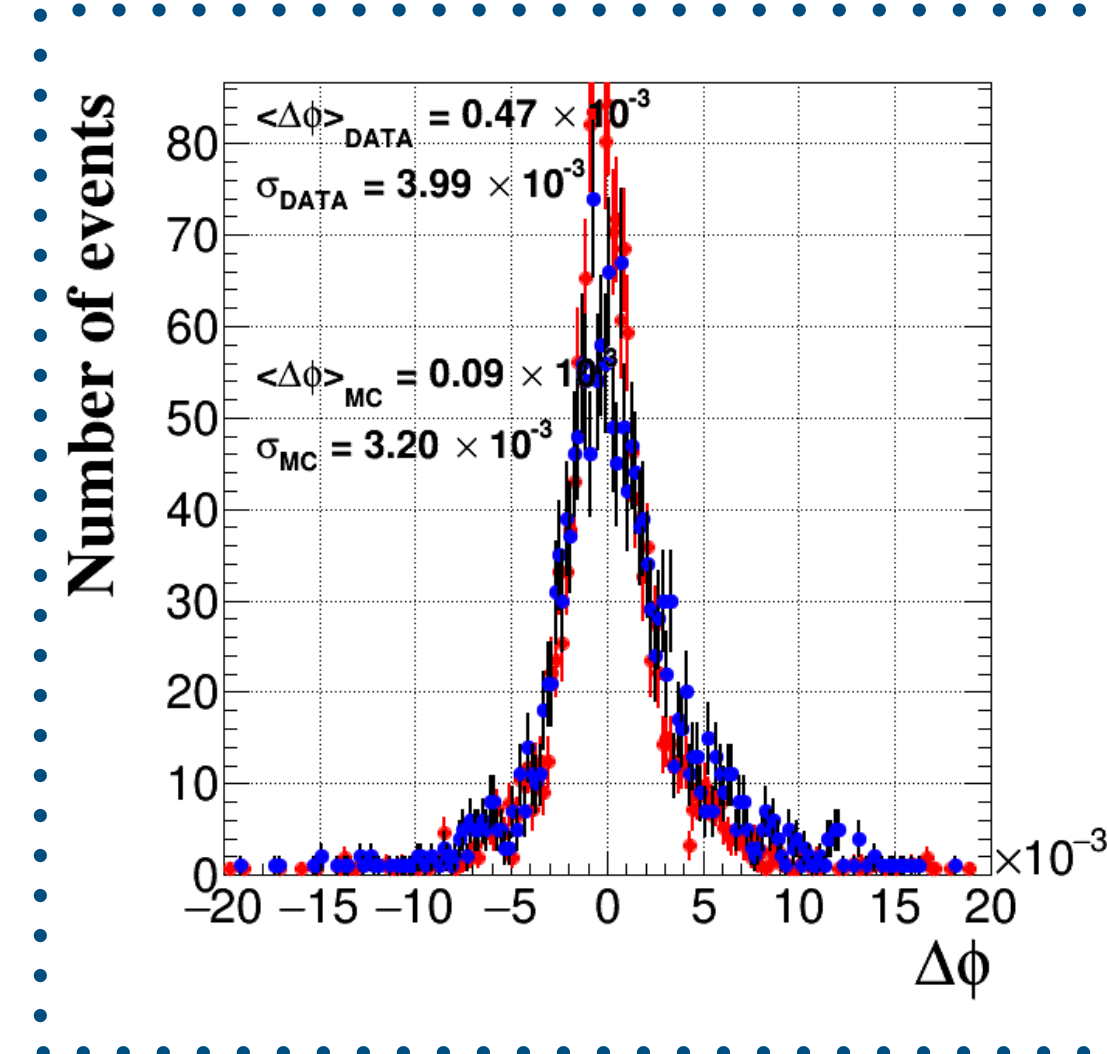


$\Delta\phi$ Distributions: ECAL endcap (Positron)

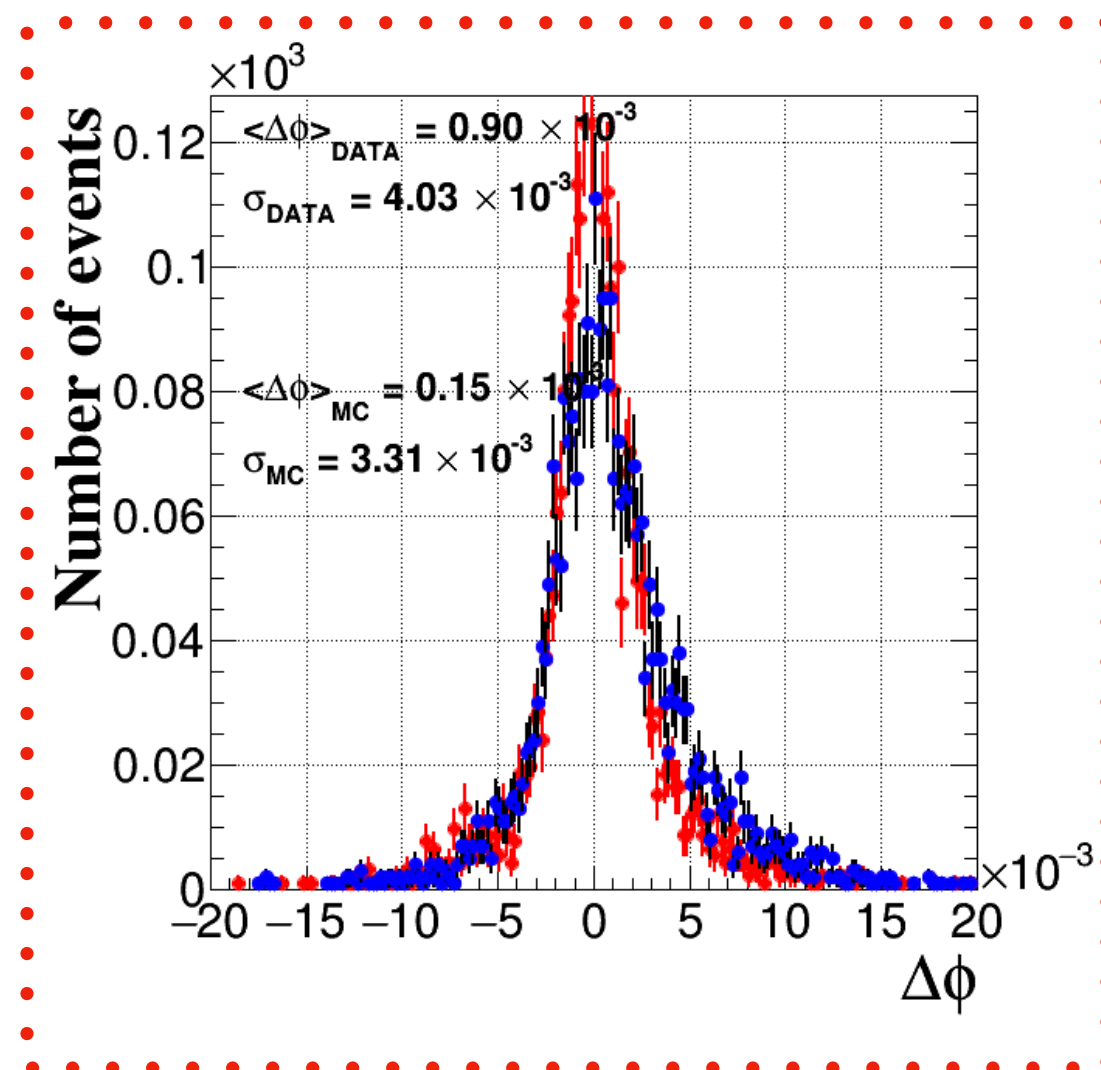
Pre-Alignment



EE +



Post-Alignment



EE -

