

# RPC Hits Contribution to CMS Muon Reconstruction at LHC

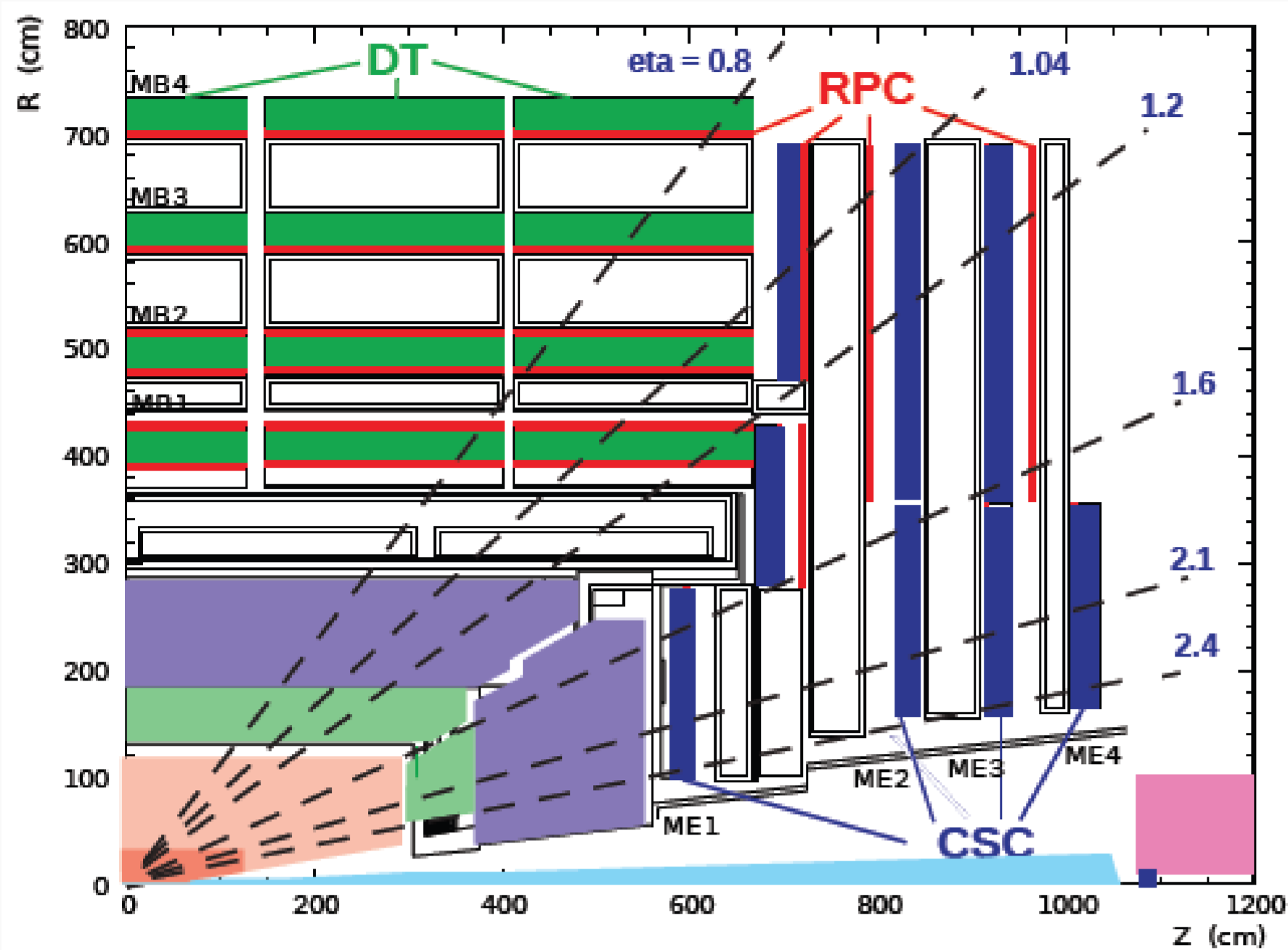


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## Muon reconstruction in CMS detector



A schematic view of the CMS detector

CMS muon reconstruction is performed with the silicon tracker at the heart of the detector and with gas-ionization muon detectors outside the solenoid. There are three categories of muons according to reconstruction approaches.

- **Standalone muon** : reconstructed in the muon system
- **Global muon** : fitted combining hits from muon system and tracker track
- **Tracker muon** : tracker track matched with at least one muon segment (short track stub made of DT or CSC hits) qualifies as tracker muon

Global muon is the one widely used in physics analyses with the additional quality requirements according to their goal. The contribution of RPC hits to global muon reconstruction is reported here.

### ► Pseudorapidity ( $\eta$ ) region of CMS muon system

- Drift Tubes (DT) cover  $|\eta| < 1.2$
- Cathode Strip Chambers (CSC) cover  $0.9 < |\eta| < 2.4$
- Resistive Plate Chambers (RPC) cover  $|\eta| < 1.6$

### ► The condition for global muon reconstruction

- '2 matched segments (DT/CSC)' or
- '1 matched segment (DT/CSC) + 1 RPC hits'

### Reference

CMS Collaboration, "Performance of CMS muon reconstruction in pp collisions at  $\sqrt{s} = 7$  TeV", CMS PAPER MUO-10-004 (2011)

## RPC contribution to muon reconstruction

RPC is used as dedicated trigger detector in both barrel and endcap regions of the CMS experiment together with DT and CSC. This redundancy of the muon system in CMS is used also to improve the muon identification including the RPC hits in the muon identification and reconstruction algorithms.

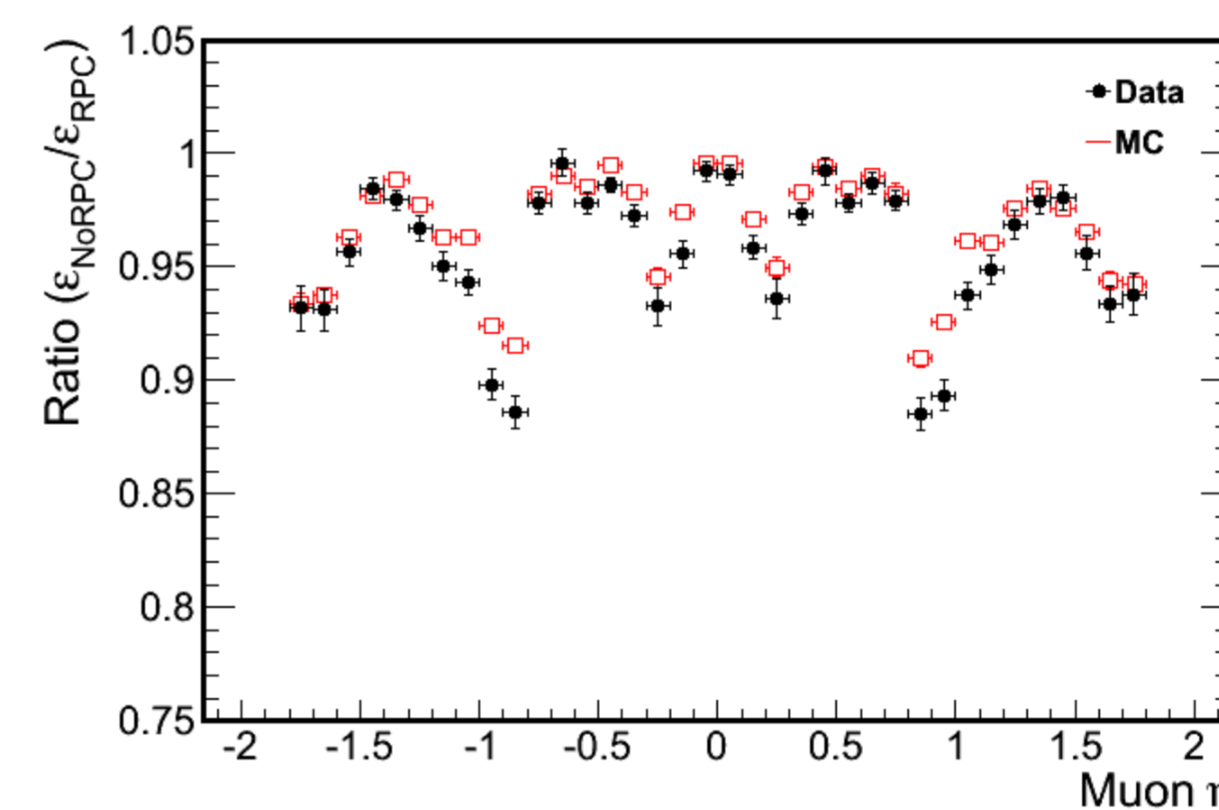
### Muon selections to which RPC contribution is investigated

Variables	Tight Muon	Medium-Tight Muon
Global muon	yes	yes
$ \eta $	$< 2.4$	$< 2.4$
$ dB $ *	$< 2$ mm	$< 2$ mm
$x^2/ndof$	$< 10$	$< 10$
$N_{ValidHits}$ **	$> 10$	$> 10$
$N_{ValidMuonHits}$ **	$> 0$	-
$N_{ValidPixelHits}$	$> 0$	$> 0$
$N_{ValidTrackerLayer}$ with hits	$> 8$	$> 8$
$N_{MatchedStation}$	$> 1$	-

\*  $dB$  is the transverse impact parameter of tracker track w.r.t. the primary vertex.

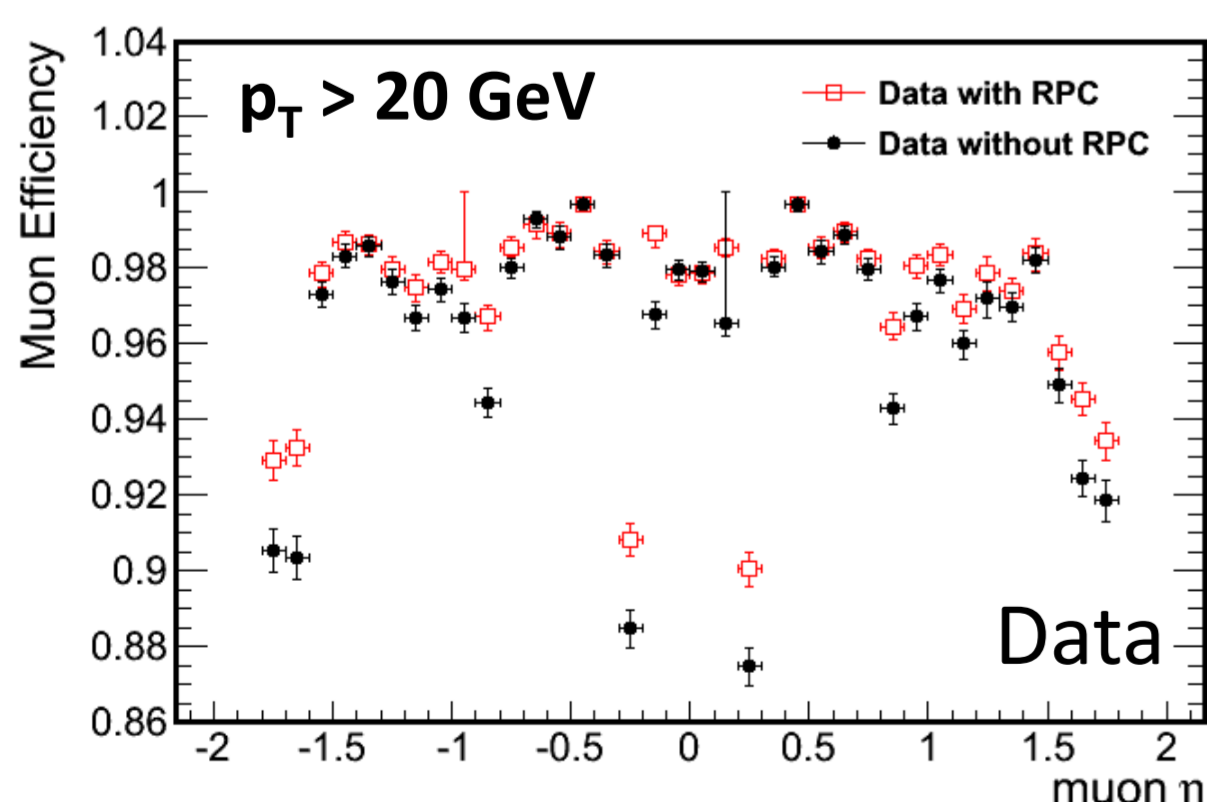
\*\* **ValidHits** is the hits used in the fit. (ValidMuonHits is the ValidHits in muon system)

### Ratio ( $\epsilon_{NoRPC} / \epsilon_{RPC}$ ) for Tight Muon

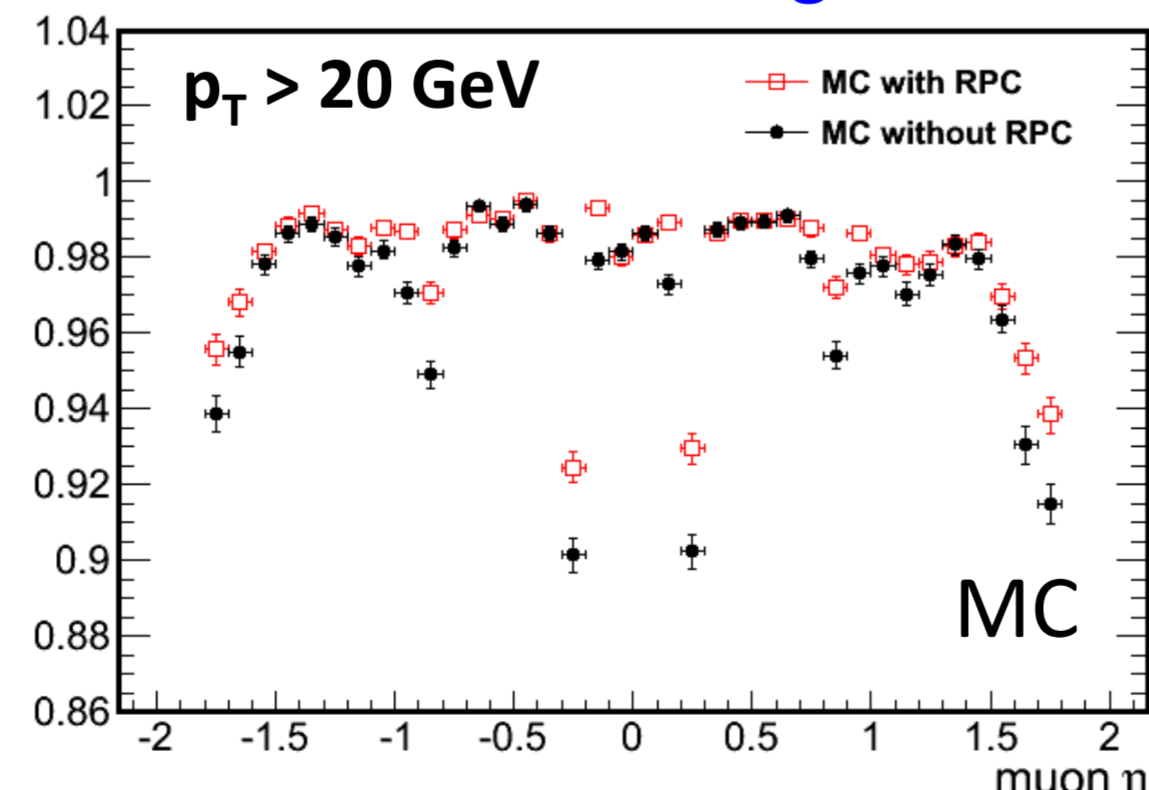


RPC contribution is more evident for Tight Muon selection. We identified that this is because ' $N_{ValidMuonHits} > 0$ ' is affected by exclusion of RPC hits much while the other requirements are not influenced by RPC.

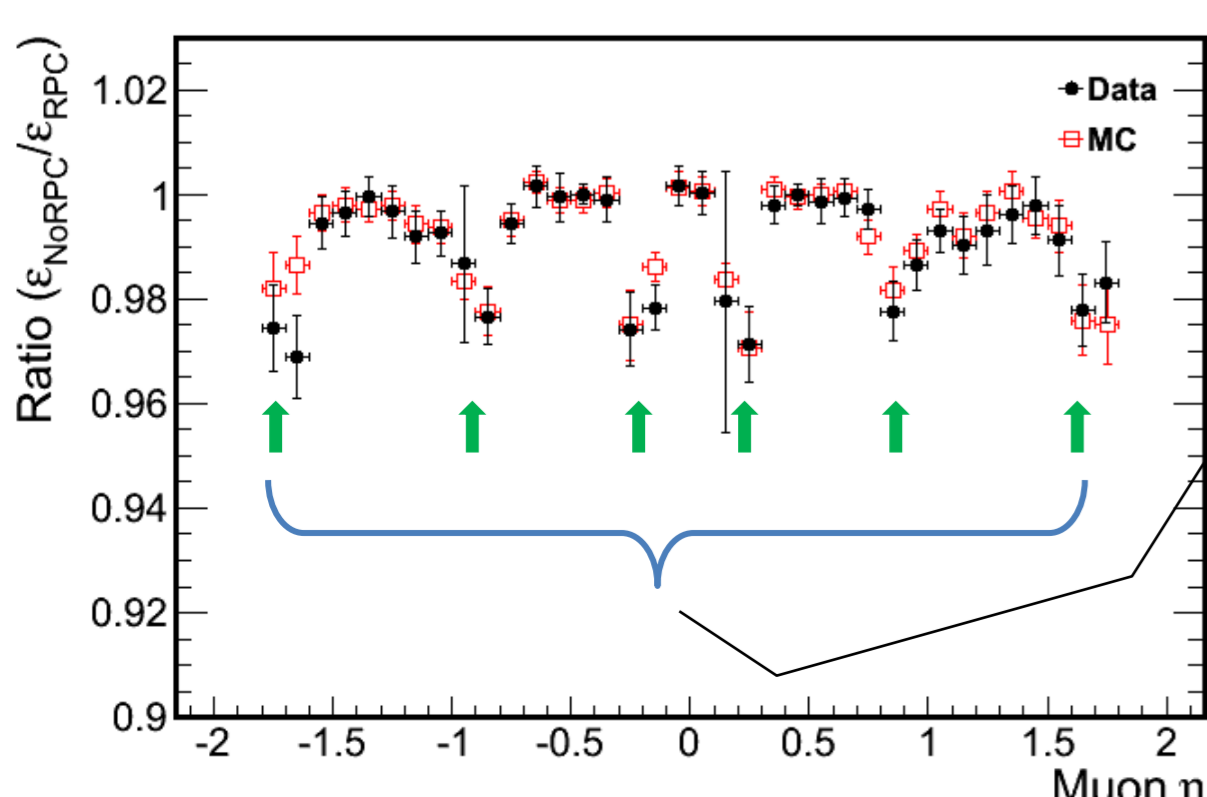
## Muon reconstruction efficiency vs. $\eta$



### For Medium-Tight Muon

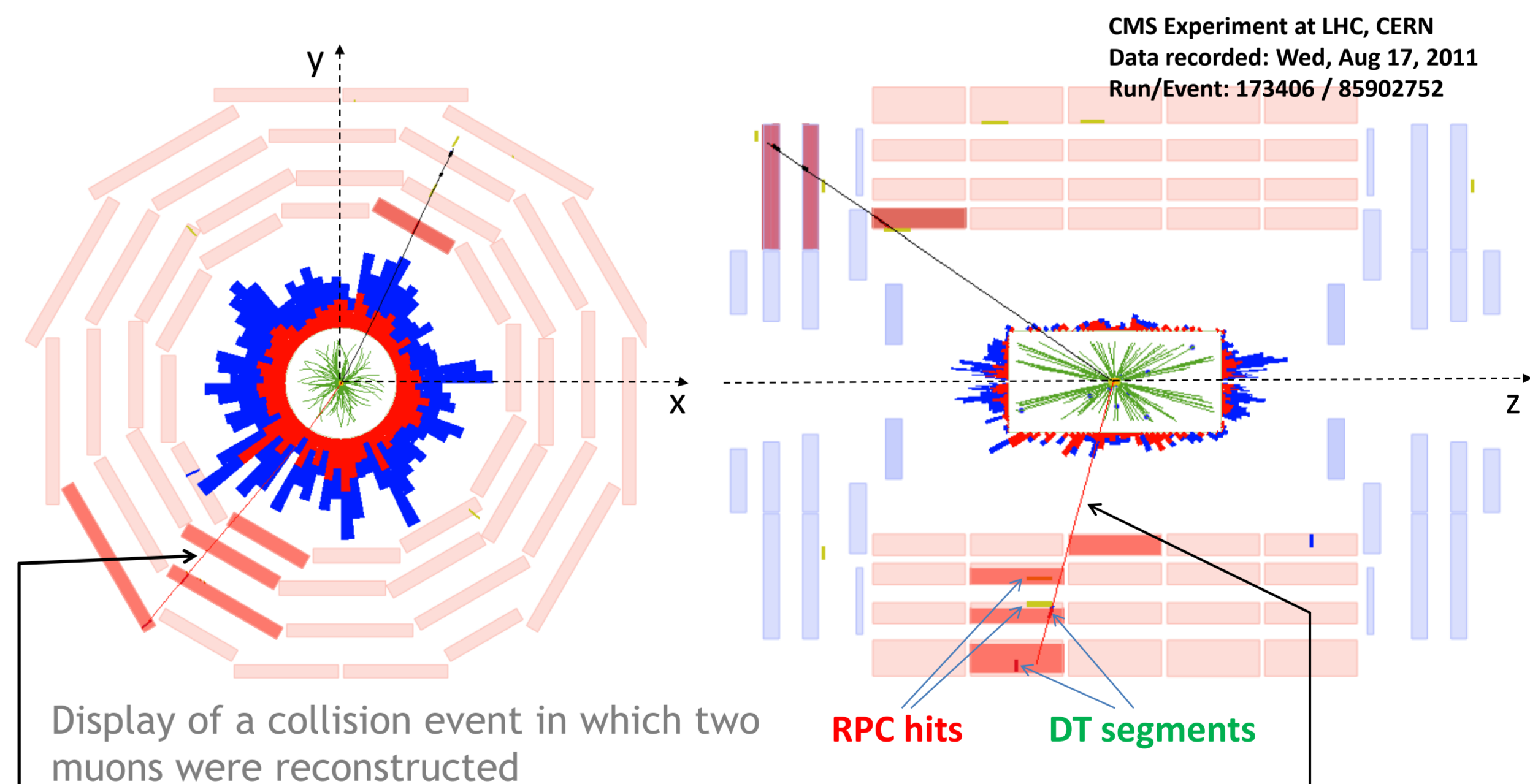


Ratio =  $\epsilon_{NoRPC} / \epsilon_{RPC}$  (for both MC and data)



3-4 % of muons are lost at the cracks between adjacent wheels if RPC hits are not used in muon identification and reconstruction

### Example of muon recovered by RPCs



The red track have two DT segments and two RPC hits. This track, however, will fail in reconstruction when the RPC hits are removed in track fitting because one of the two DT segments have no Z coordinate.

## Summary

RPC contribution to CMS muon reconstruction was reported here using muons from Z candidates. It is observed that RPC hits could recover 3-4 % of muons at some  $\eta$  regions. RPC contribution has no dependence on muon  $p_T$  in case the  $p_T$  is greater than 20 GeV. The same study is being performed using muons from  $J/\psi$  candidates in order to investigate RPC contribution to lower  $p_T$  muons.