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The Compact Muon Solenoid Experiment

CMS Performance Note

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DT Chamber Performance in 2015

CMS Collaboration

Abstract

The hit efficiency and the hit resolution of the CMS Drift Tube Chambers (DT) were measured with 2015 data and found to be comparable or better than in LHC Run 1 (2012). In addition, the implementation of the Mean Timer algorithm to reconstruct track segments provides an accurate measurement of the track crossing time, that is efficient for a few hundreds ns before and after the triggering bunch crossing.

DT CHAMBER PERFORMANCE RESULTS IN 2015

1) Efficiency
2) Resolution
3) Timing

1) DT HIT EFFICIENCY

* The DT efficiency to detect a single hit was defined and measured as the ratio between the number of detected and expected hits.

* The position of expected hits was determined using sets of well reconstructed track segments: at least 7 or at least 3 hits were required to be associated to a segment, in the Phi and Theta view respectively. Moreover the segment itself was required to cross the chamber with an inclination lower than 45 degrees.

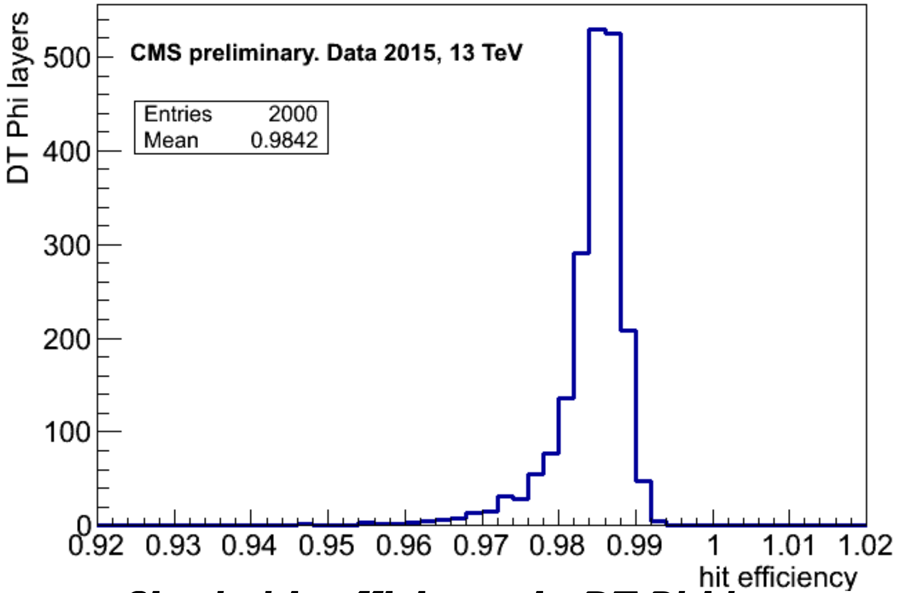
* The intersection of such a high quality track segment with a DT layer determined the position of the expected hit.

* The DT was considered efficient if a hit was found within the tube where it was expected to be.

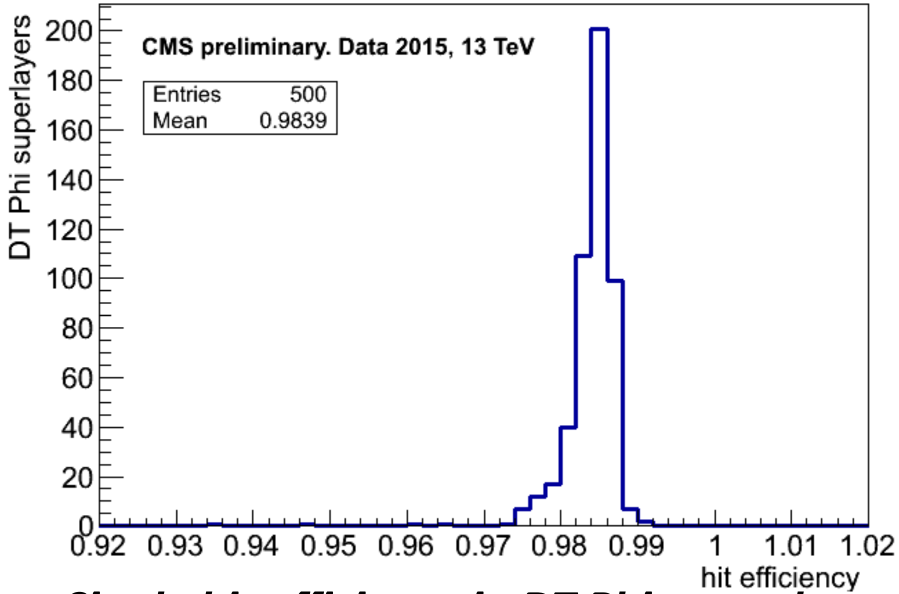
* Such efficiency can be computed choosing different detector granularities.

* We present results for Phi layer efficiency, Phi superlayer efficiency and chamber efficiency.

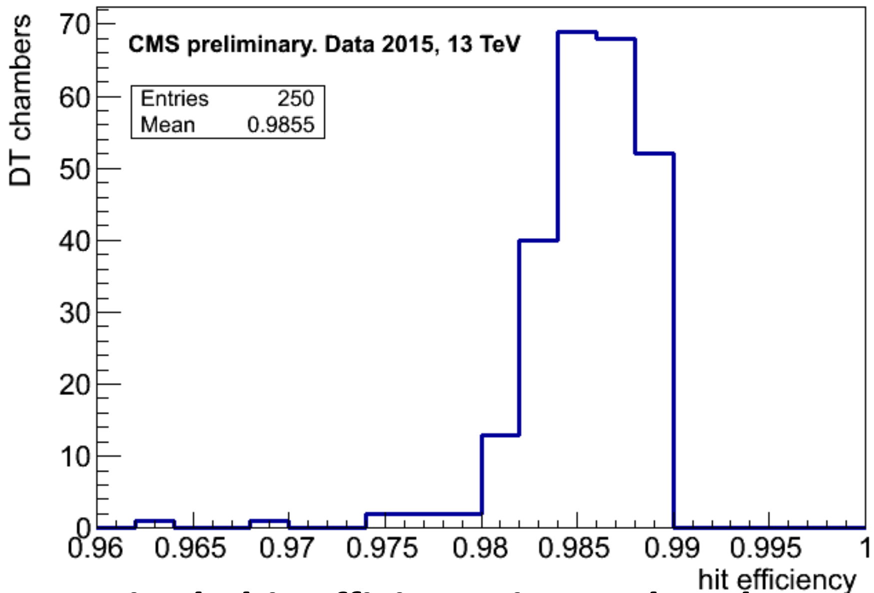
* The plots show the efficiency distributions of the considered detector components.



Single hit efficiency in DT Phi layers



Single hit efficiency in DT Phi super-layers



Single hit efficiency in DT chambers

2) DT SINGLE HIT RESOLUTION

The DT single hit resolution was measured using 2015 data and applying the same method discribed in https://twiki.cern.ch/twiki/bin/view/CMSPublic/DTDPGResults04032014-1 **[1]**

→ Phi and Theta Super Layers (SL) were kept apart because their geometrical differences determine intrinsically different performances.

MAIN FEATURES:

1) Within every station, both Theta and Phi Super Layers show a symmetric behaviour w.r.t. to the z=0 plane, as expected from the detector symmetry.

2) In Wheel 0, where tracks from the interaction region are mostly normal to all layers, the resolution is the same for Theta and Phi SL's.

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[1] CMS DP-2014/004

MAIN FEATURES:

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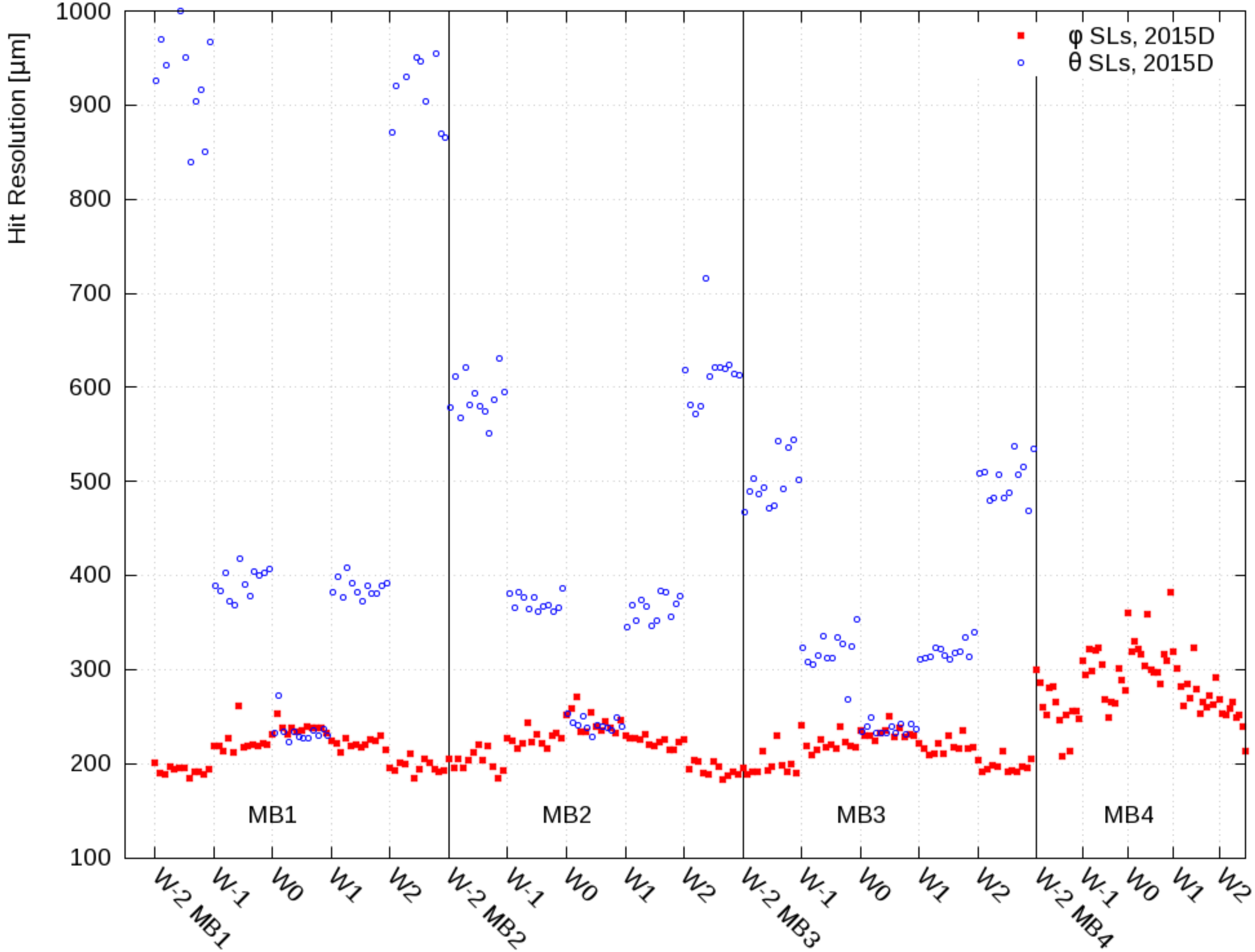
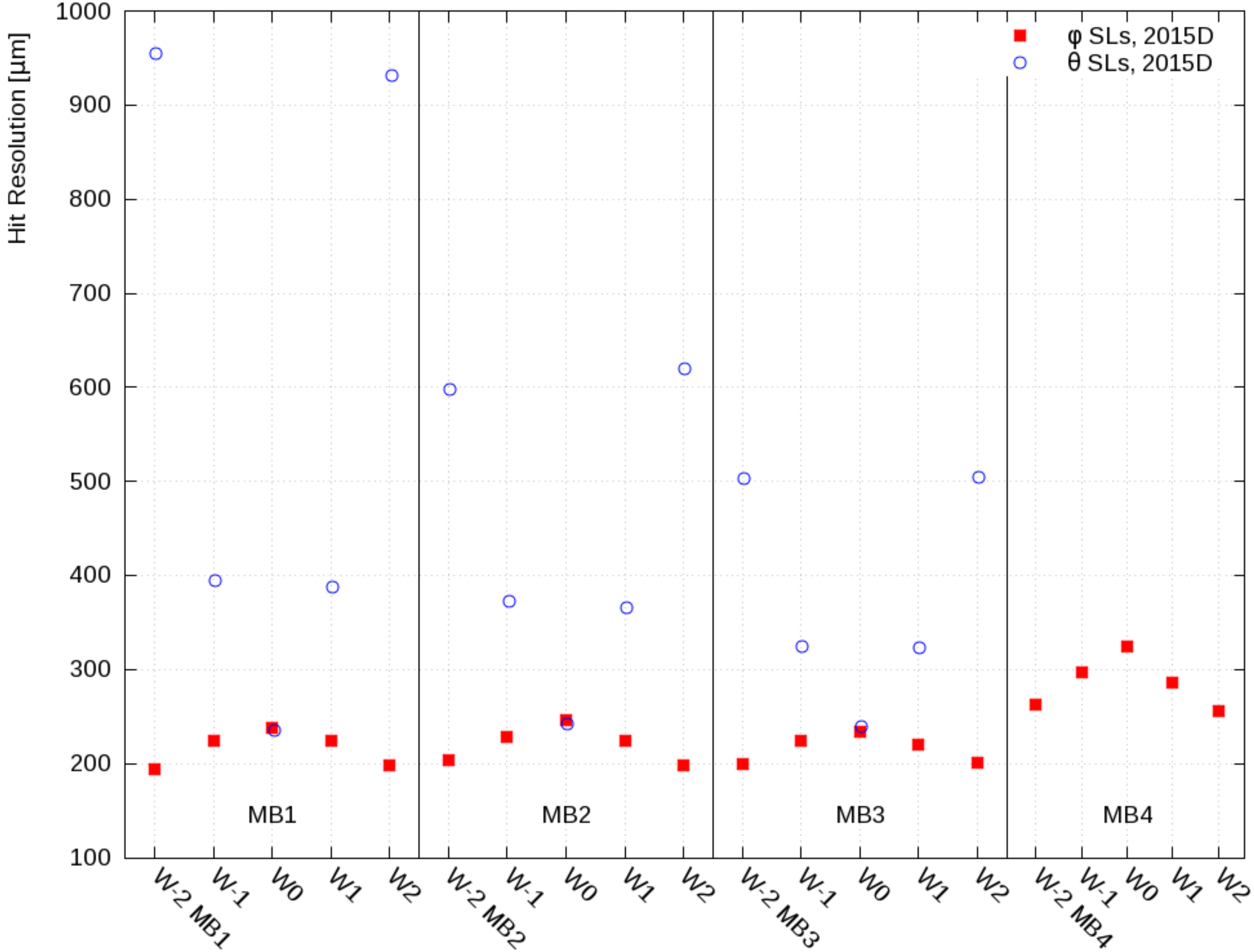
3) Going from z=0 towards the forward regions, tracks from the interaction region have increasing values of pseudorapidity: this feature affects Phi and Theta SL's in opposite ways. In fact the theta angle lies on the measurement plane of Theta layers, while it is orthogonal to it for Phi layers. The result is that in Theta SL's the increasing inclination angle, by spoiling the cell linearity, also worsen the resolution.
Instead, in Phi SL's the inclination angle increases the path of the track within the tube (along the wire direction), thus increasing the ionization charge and improving the resolution.

4) The poorer resolution of the Phi SL's in MB4, compared to MB1-MB3, is because in MB4 no corrections are applied to the hit position in order to take into account the muon time-of-flight and the signal propagation time along the wire. In fact in the MB4's no position information is available in the direction parallel to the wires.



DT measured resolution for Phi and Theta Super Layers, shown chamber by chamber.



DT measured resolution for Phi and Theta Super Layers, shown station by station.

COMMENT ON SNGLE HIT RESOLUTION

Apart from Theta SL's in MB1 stations of external wheels (where in any case the track inclination and the transverse component of magnetic field bias the residual distributions and make the gaussian fit unstable),
the resolution observed this year is compatible or slightly better than the one obtained with 2012 data.

3) DT TIMING PERFORMANCE

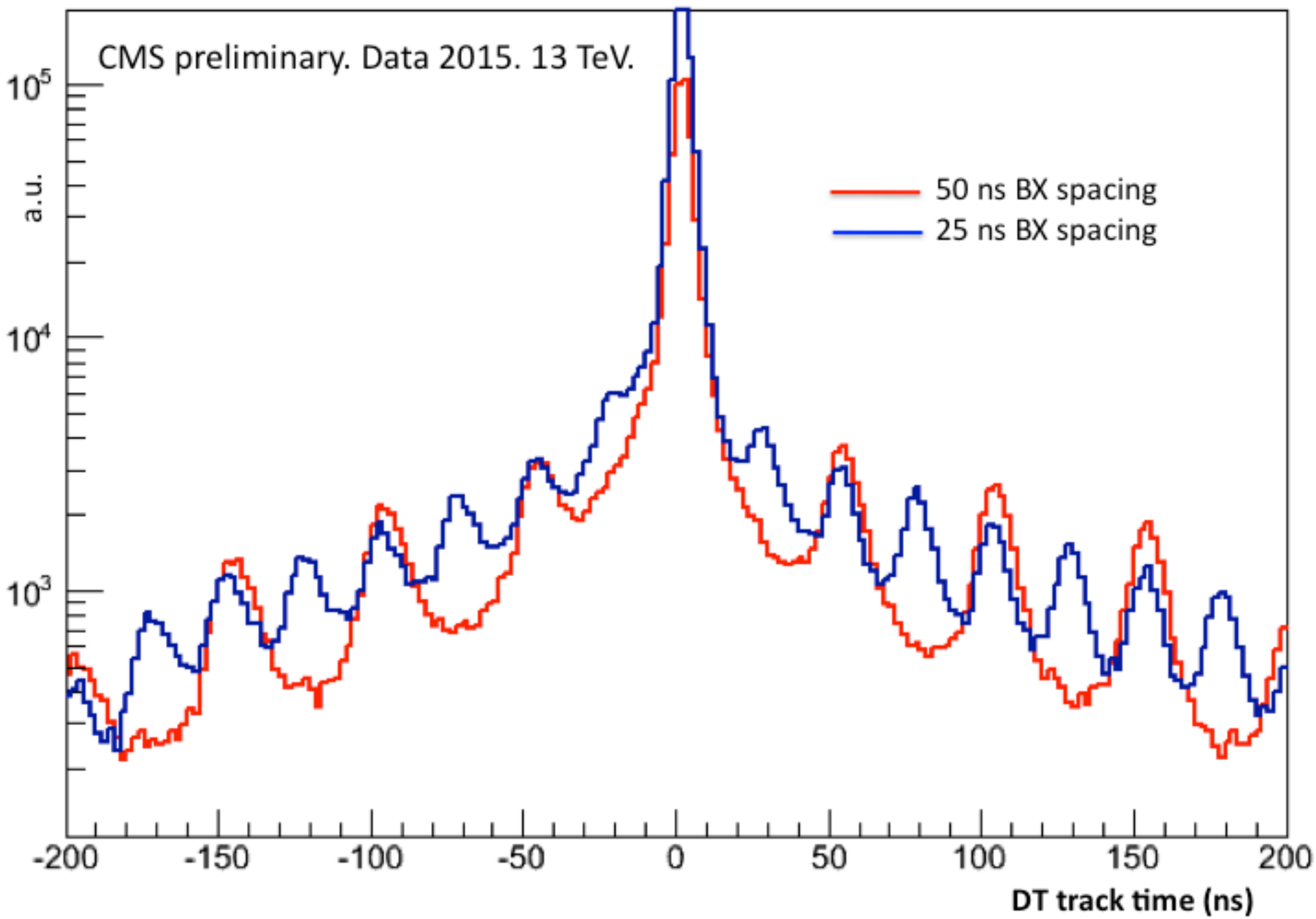
The Mean Timer (MT) method to reconstruct track segments in the Drift Tube (DT) was described in detail in:
https://twiki.cern.ch/twiki/bin/view/CMSPublic/DTDPGResults10072015 **[2]**
The same method was applied on LHC Run II data.

* The plot shows the distribution of the measured track segment time for two different runs: one with LHC bunch spacing of 50 ns and the other one with 25 ns bunch spacing.

* The normalization of the two histograms is arbitrary. They show that the MT is efficient to reconstruct tracks as far in time from the triggering bunch crossing as 200 ns, as we expected from the simulation.

* The superimposition of the two histograms makes the beam structure visible in the two different configurations, with the even peaks of the 25 ns histogram (blue) superimposed to the 50 ns ones (red).

[2] CMS DP-2014/021



Distribution of the DT track segment time, determined with the MT reconstruction method, for a LHC bunch spacing of 50 ns (red) and a spacing of 25 ns (blue)