

Effects of the electronic threshold on the performance of the RPC system of the CMS experiment



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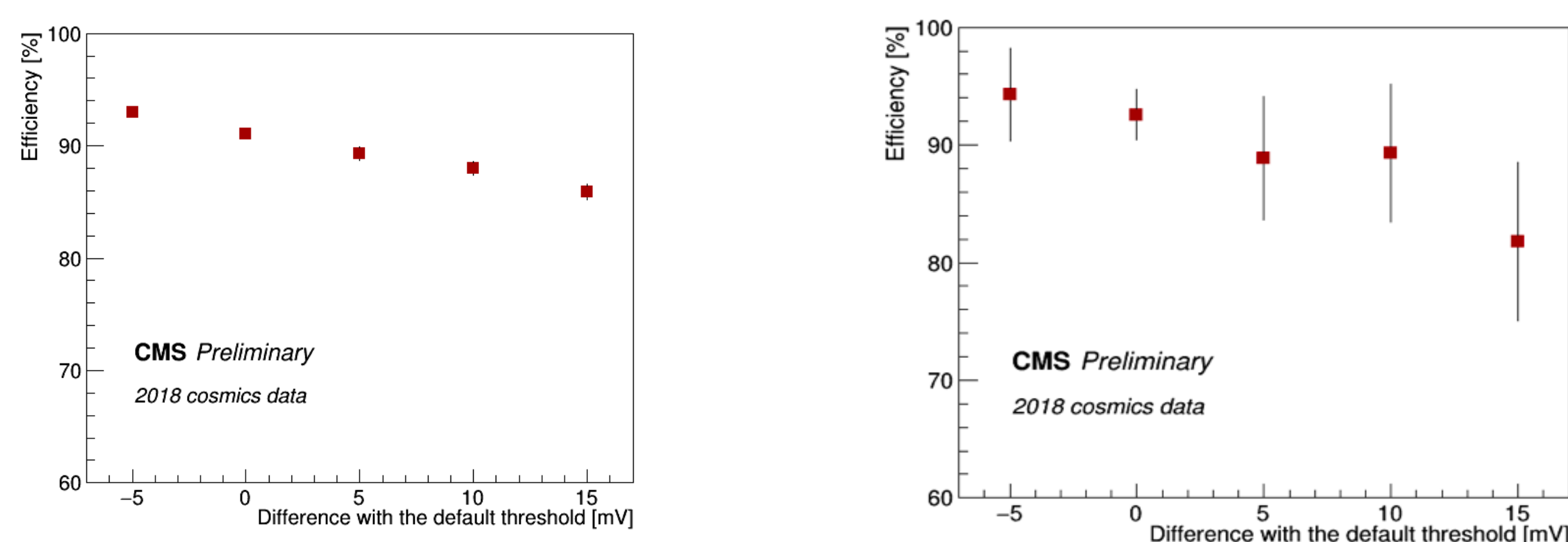
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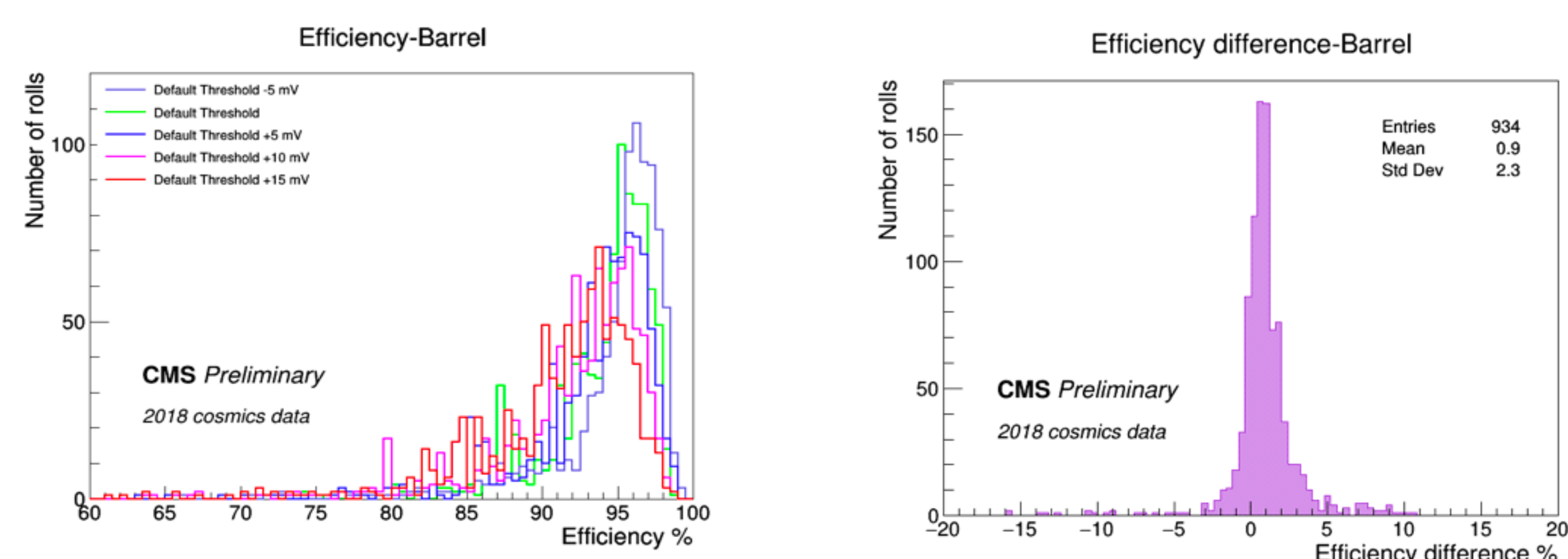
Abstract

Resistive Plate Chambers (RPCs in the following) play a very important role as the dedicated system for muon triggering both in the barrel and in the endcap of the CMS experiment at the Large Hadron Collider. It is therefore of primary importance to tune the operating voltage and the electronic threshold of the front-end boards reading the signals from these detectors⁽¹⁾ in order to optimize the RPC system performance. In this study we present the effects of changing the electronics threshold voltage on the CMS RPC efficiency, cluster size and detector intrinsic noise rate.

The Effect on the Efficiency



The plots show the RPC efficiency vs. the difference with the default threshold ($V_{thr-app} - V_{thr-def}$). One roll^(*) for the barrel (left) and one for the endcap (right) are shown. Due to the low statistics in the endcap, a detailed study was possible in the barrel region only.

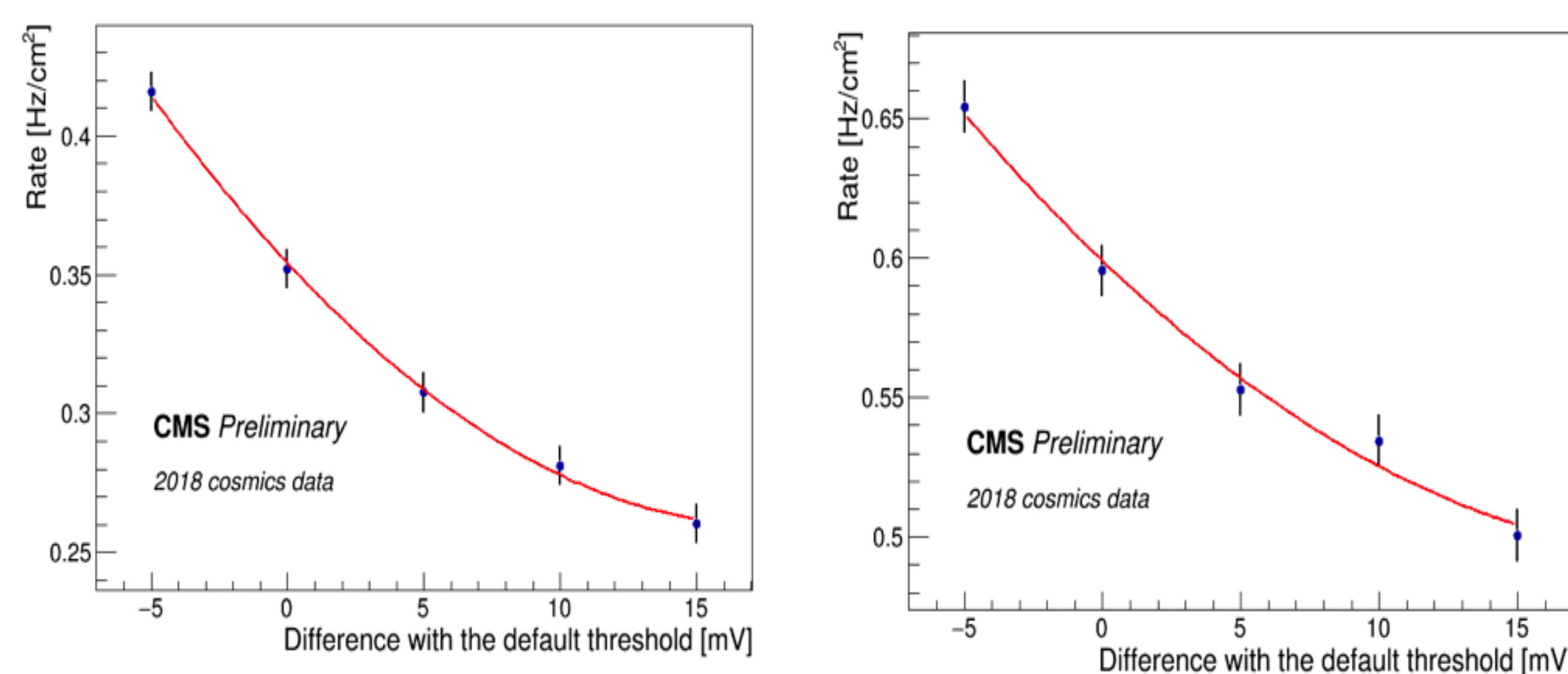


The plot shows the RPC barrel efficiency distribution at the different applied thresholds of the voltage scan.

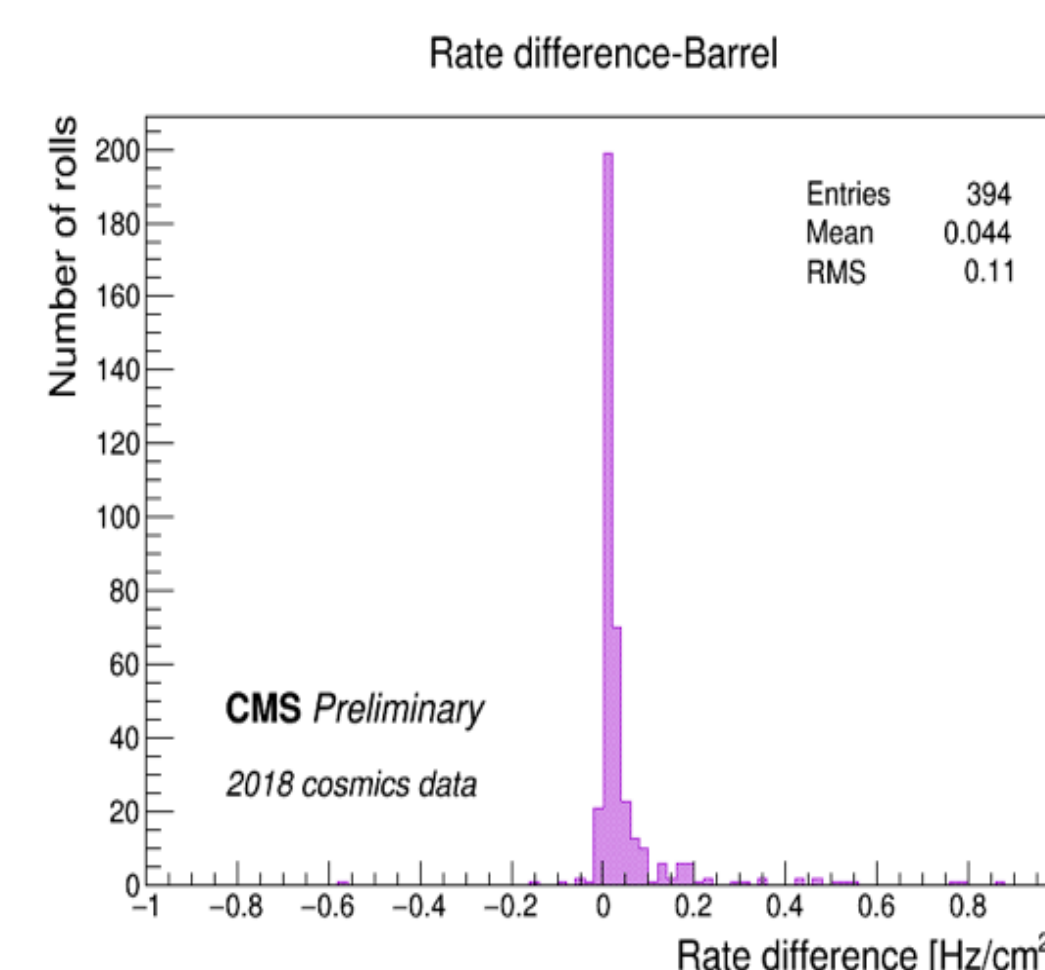
The plot shows the efficiency variation when decreasing the threshold voltage by 5 mV.

(*) Every CMS RPC chamber is subdivided in three eta partitions (rolls) in the endcap and in two or three eta partitions in the barrel

The Effect on the intrinsic noise rate

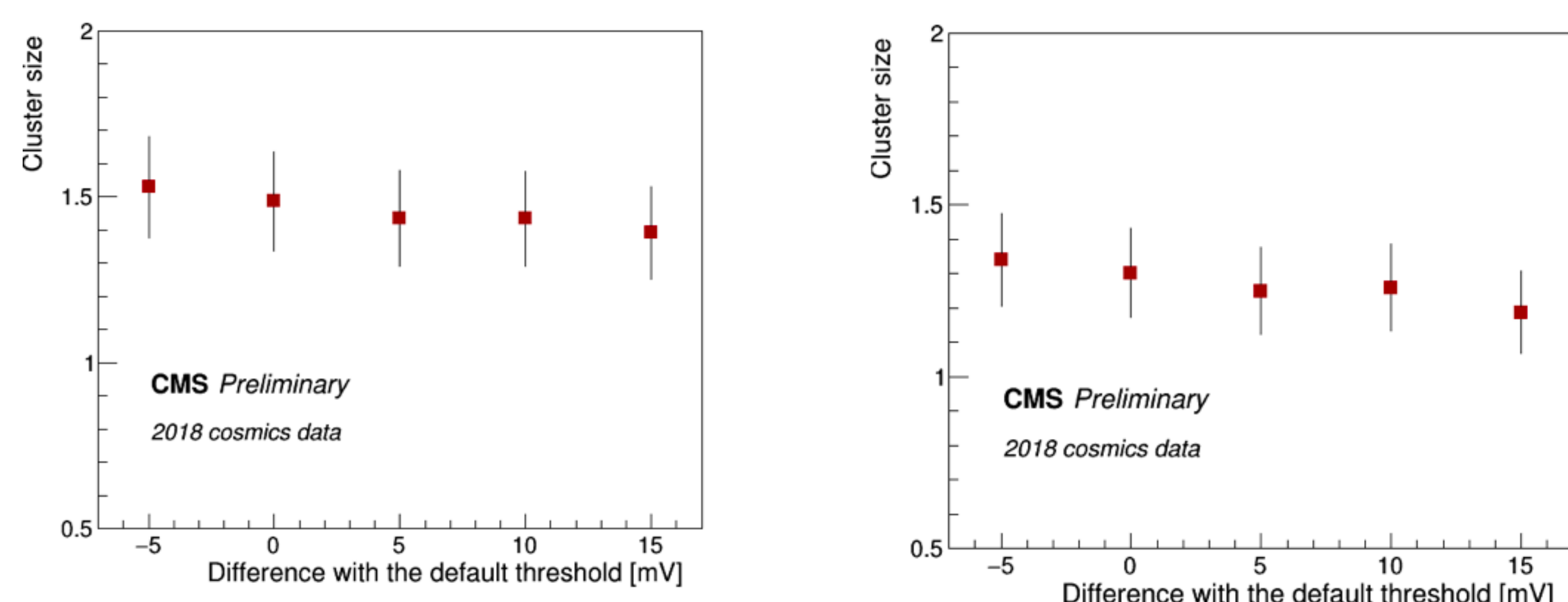


The plots show the intrinsic noise rate vs. the difference with the default threshold ($V_{thr-app} - V_{thr-def}$) for one roll in the barrel (left) and one in the endcap (right). Quadratic polynomial function is used for the fit.

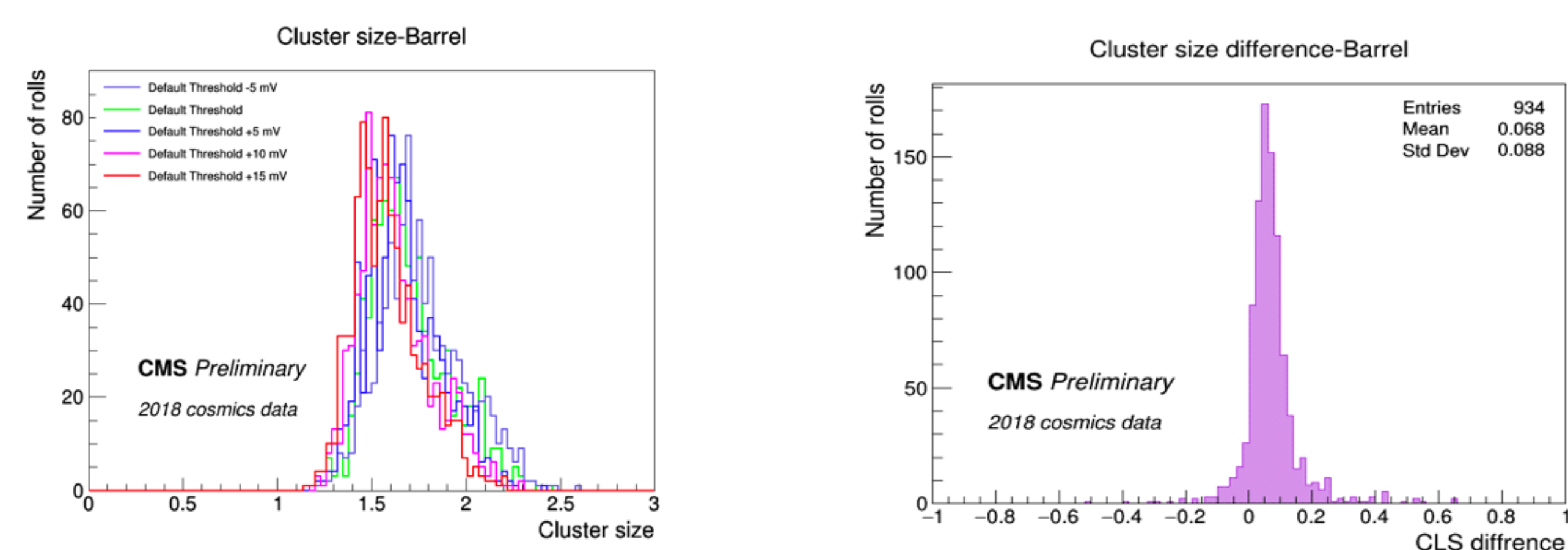


The plot shows the variation of the rate when decreasing the threshold voltage by 5 mV.

The Effect on the Cluster Size



The plots show the RPC Cluster size vs. the difference with the default threshold ($V_{thr-app} - V_{thr-def}$) for one roll in the barrel (left) and one in the endcap (right).



The plot shows the RPC Cluster size distribution at the different applied thresholds of the voltage scan.

The plot shows the variation in the Cluster size when decreasing the threshold voltage by 5 mV.

Summary

- In the barrel region, an **efficiency increase** of about **0.9%** due to a **5 mV** decrease of the electronics threshold⁽²⁾ is observed.
- In the barrel region, a slight **increase in the cluster size** of **0.068** due to a **5 mV** decrease of the electronics threshold is observed.
- In the barrel region, an increase in the intrinsic noise rate of **about 0.04 Hz/cm²** due to a **5 mV** decrease of the electronics threshold is observed.

References

- (1) F. Loddo et. al., "Front End electronics for RPC detector of CMS" Proceedings of the IV International Workshop on Resistive Plate Chambers and related detectors, Napoli, October 15-16, 1997
- (2) M. Abbrescia et al., "New developments on front-end electronics for the CMS Resistive Plate Chambers", Nucl. Instr. and Meth. in Phys. Res., Volume 456, Issues 1?2, 21 December 2000, Pages 143-149.