Comparison of on-track and off-track clusters in TPM1

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1 Outline

The TPCs of BRAHMS produced a lot of data during the run of 2000. Now these days we are attempting to estimate efficiencies from the TPCs. This work includes estimation of tracking as well as vertexing efficiency.

Especially TPM1 has shown to contain a lot of noise. Among other things this makes vertexing difficult with the BrTPMClusterVertexModule at forward angles due to high multiplicity. In this note I present some attempts to apply some addtional cuts on clusters in TPM1 in order to ease the tracking and vertexing at high multiplicity. It is very similar to what I presented in the collaboration meeting in November 2000, but I now have higher statistics.

For this investigation I used run 2535, with MRS at 90°, D5 at A polarity and $I = 350A$. I have looked at the efficiency loss in tracking in TPM1 and in the whole of MRS when applying my cuts.

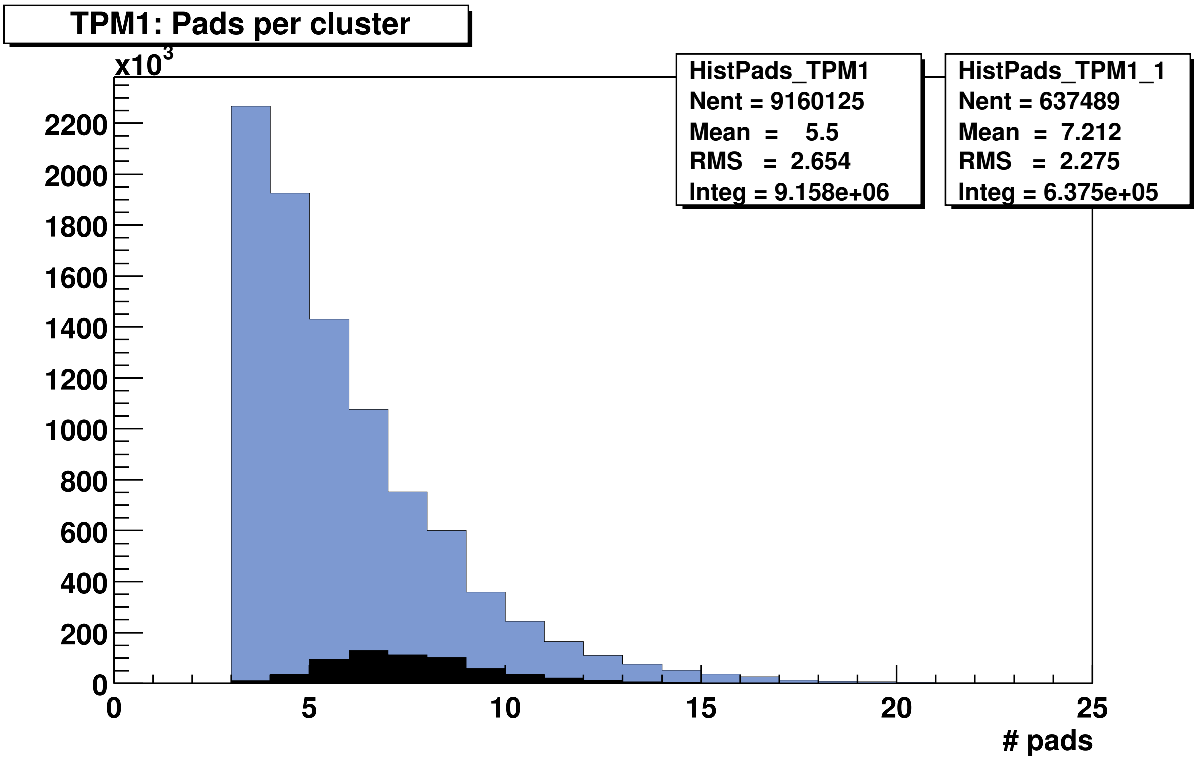
2 Analysis

Already included in BrTPCClusterFinder is a cut on max ADC value within a cluster. If the pixel with the highest ADC values is below this cut, *MaxPixelCutoff*, then the cluster is characterized as noise. It seems that different people use different values for MaxPixelCutoff. Norway seems to have used mainly 20, while the NBI people often use 10. (Correct me if I'm wrong.) However, as I show here there is not much difference when choosing either one of them.

The MaxPixelCutoff I consider as a primary cut, and it is the first cut to be tested. The cluster that pass the primary cut, i.e. that are still considered good clusters, are then subject to my secondary cuts. These cuts involve number of pads and time bins, *LowPadCutoff* and *LowTimeCutoff* respectively, max ADC value (yes, once more), *LowMaxADCCutoff*, and summed ADC for the entire cluster, *LowADCSumCutoff*. In order to do this, I modified BrTPCClusterFinder::FindHitStatus(BrTPCCluster *) a little bit. I also added some new data members to BrTPCClusterFinderClass. These data members correspond to the new cuts. I also added "Getters" and "Setters" for these data members, as well as initialization to 0 for all of them, done in BrTPCClusterFinder::Init(). Therefore the new cuts will not affect any analysis if one does not explicitly change the value of the cut parameters.

Applying only the primary cut I plotted the correlation of number of pads and time bins for on-track and off-track clusters. One immediately sees differences between these two "types" of clusters. In fig. 1 I have plotted the number of pads and time bins for on-track and off-track clusters. (**Throughout this note, all plots related to on-track clusters are black. Also, the right pave stats in plots correspond to on-track clusters, while the left one corresponds to off-track clusters.**) When plotting them in correlation, fig. 2, one gets a feeling for how to separate on-track and off-track clusters. It is clear that many noise clusters have a low number of both pads and time bins.

Similarly, plotting integrated and max ADC of clusters, in 1 and 2 dimensional histograms, one sees that also here some cuts can be applied to separate on-track and off-track clusters, fig. 3 and 4. The sudden drop in the max ADC distribution comes from the primary cut.



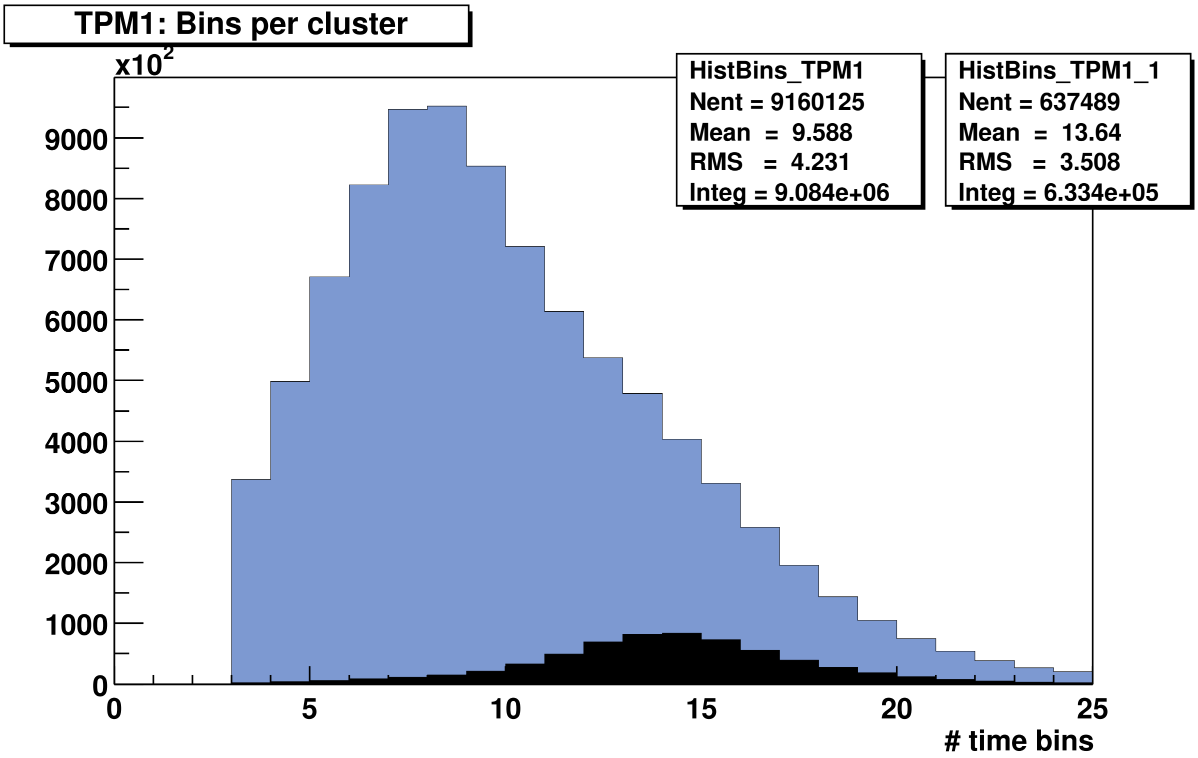


fig. 1 *Number of pads (top) and time bins in on-track (black) and off-track clusters.*

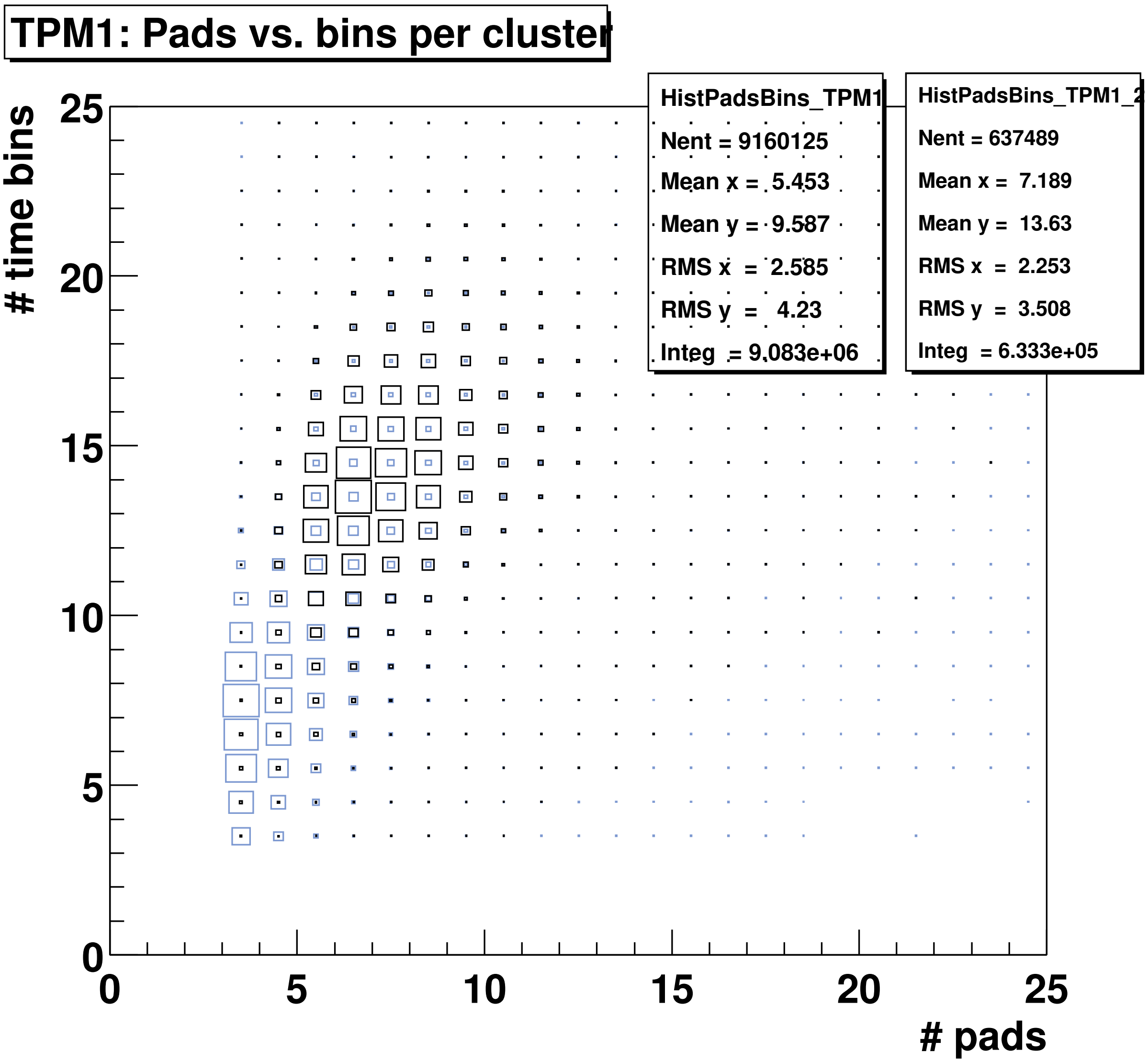


fig. 2 *Correlation in number of pads and time bins in on-track (black) and off-track clusters.*

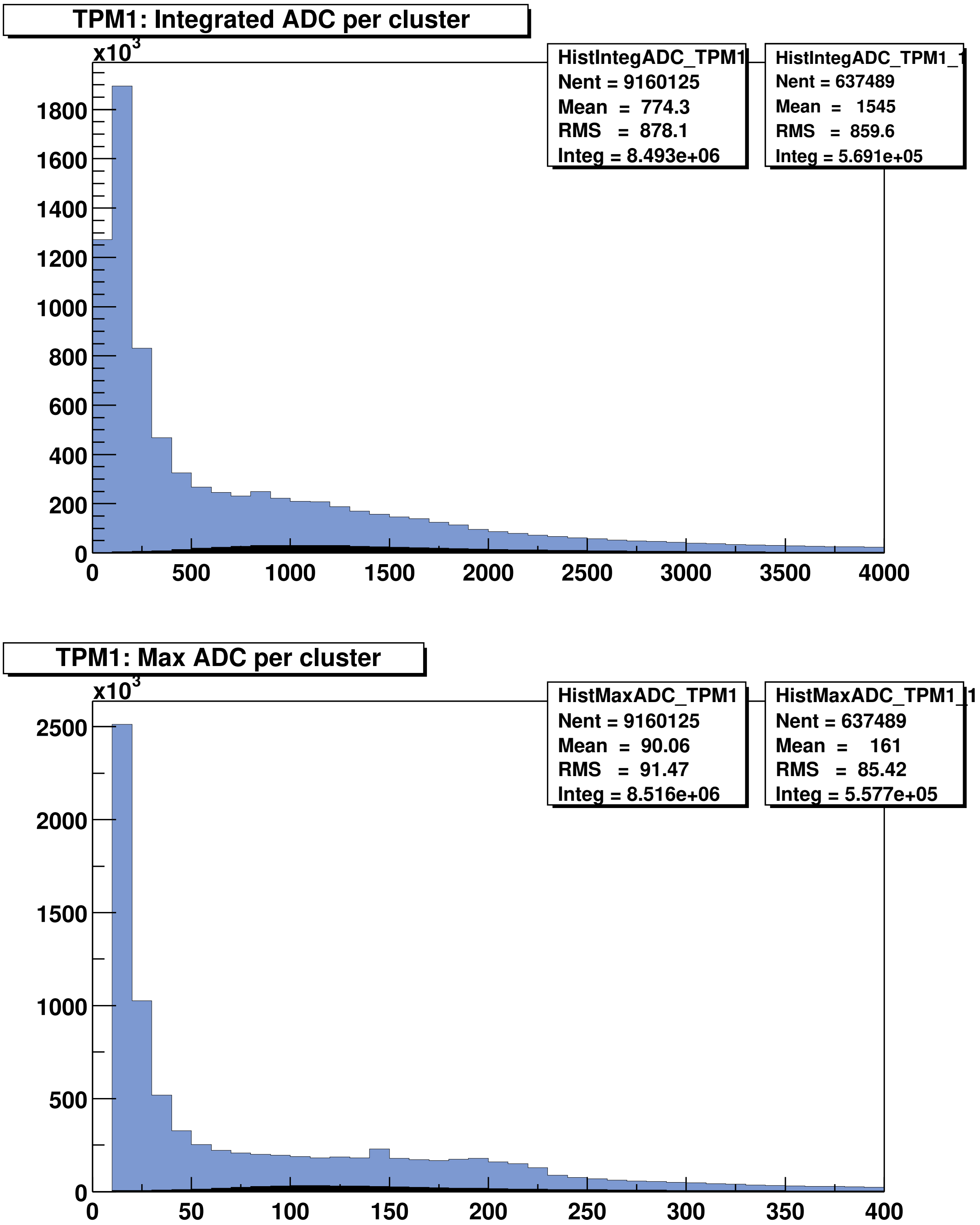


fig. 3 *Integrated ADC (top) and max ADC in on-track (black) and off-track clusters.*

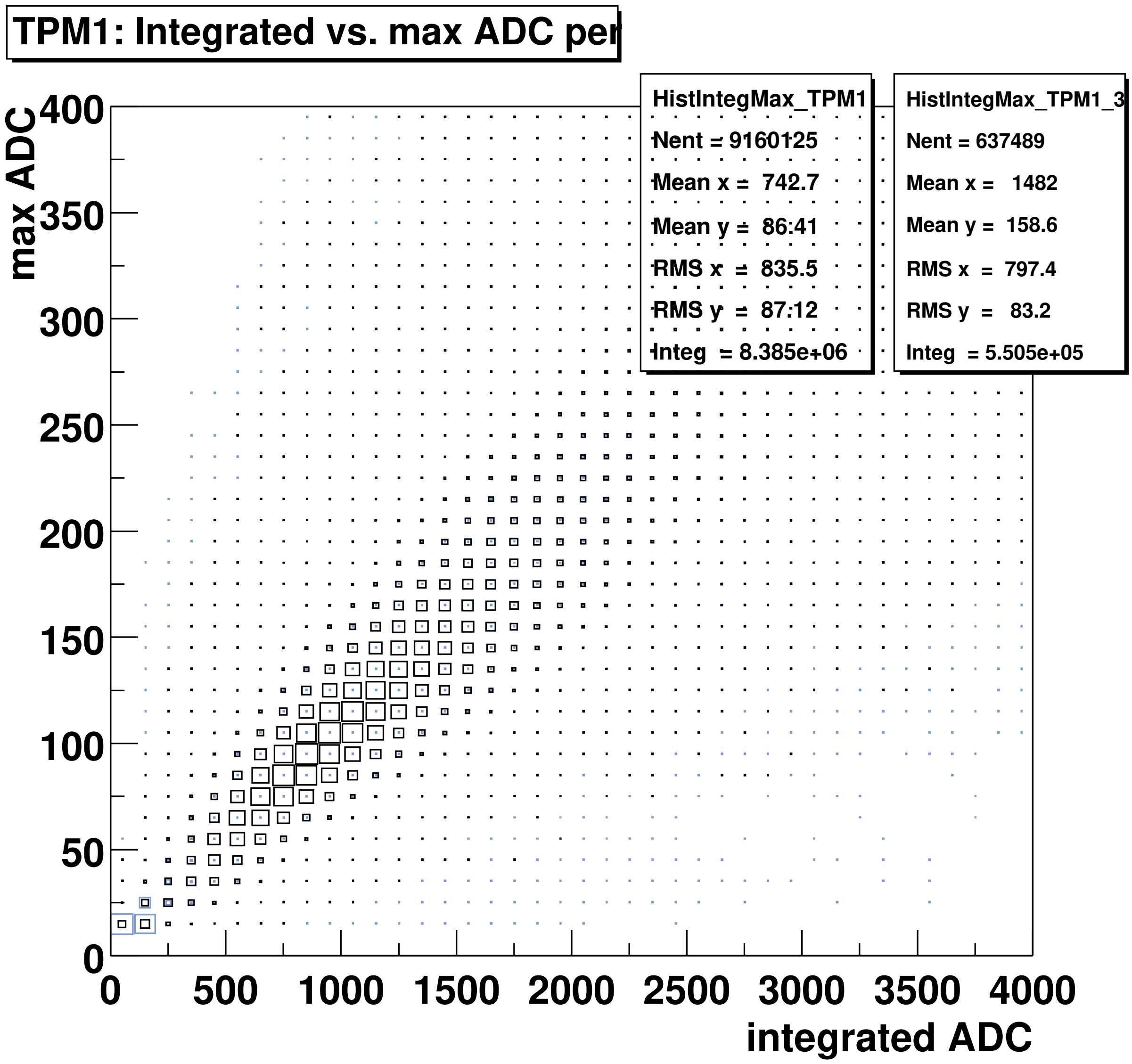


fig. 4 *Correlation in integrated and max ADC in on-track (black) and off-track clusters.*

In order to figure out the best cuts for clusters, I applied cuts with both different values and different logical operators between them. Below are listed the values in the cuts I applied and also the logical operators. As mentioned above, the primary cut, MaxPixelCutoff, is separate from the other ones. My attempts on using different logical operators involve therefore only the four last parameters in the table.

Cut #	**MaxPixel**	**# Pads**		**# Bins**		**MaxADC**		**ADCSum**
0	10	(0	AND	0)	OR	(0	AND	0)
1	10	(5	AND	10)	OR	(30	AND	200)
2	20	(0	AND	0)	OR	(0	AND	0)
3	10	(4	AND	7)	OR	(20	AND	100)
4	10	(6	AND	10)	AND	(50	AND	500)
5	10	(6	AND	11)	AND	(70	AND	600)
5	10	(7	AND	11)	AND	(70	AND	700)

I analyzed 31395 trig 6 events from the 2535 run. In order to see how my cuts affected the tracking, I list the numbers of hits and tracks (h/tr) in TPM1 and TPM2, as well as tracks through the entire MRS. The number of hits includes both on-track and off-track hits. Clusters in TPM2 were only subject to the cut applied by MaxPixelCutoff = 10. Cut 0, which is equivalent to no cut other than MaxPixelCutoff, is used as reference for determining the efficiency. It is this cut that generated figs. 1 through 4.

Cut #	**TPM1: h/tr**	**TPM2: h/tr**	**MRS: tr**	**TPM1: h/tr [%]**	**MRS: tr [%]**
0	9797614 / 61925	685110 / 4595	1854	100 / 100	100
1	5461274 / 56482	685110 / 4595	1787	55.7 / 91.2	96.4
2	7280398 / 60561	685110 / 4595	1849	74.3 / 97.8	99.7
3	8028147 / 60163	685110 / 4595	1838	81.9 / 97.2	99.1
4	6886646 / 59675	685110 / 4595	1836	70.3 / 96.4	99.0
5	6380252 / 58541	685110 / 4595	1812	65.1 / 94.5	97.7
6	6084126 / 57958	685110 / 4595	1801	62.1 / 93.6	97.1

3 Conclusions

The last table shows that one can apply more stringent cuts on clusters in TPM1. Looking at cut 1 one can easily remove almost 50% of the clusters in TPM1 and only lose less than 4% of the tracks in MRS. The fact that the loss in MRS is lower than the loss in TPM1, may also indicate that the one gets rid of some ghosts in applying these cuts.

Looking at fig. 5 and 6 it seems to be possible also to apply similar cuts on TPM2. However, this may not be so urgent, as the occupancy in TPM2 is much lower than TPM1.

Finally, depending on the performance of T1 and T2, cuts on clusters may be applied here as well. I have not looked into this so far.

At the end of this note follow all the plots from this analysis of cuts on TPM1 clusters. In addition to the parameteres plotted in fig. 1 through 4, they include also the cluster variance in pad and time direction. Actually, in the last minute I found out that I was fooled here, because the members of BrTPCCluster called *fVarPad* and *fVarTime* actually contain the standard deviations, not the squared standard deviations. So what I plot is actually σ_{pad} and σ_{time} calculated for each cluster, even though the title of the histogram includes "variance". Anyway, the width of clusters may be used my those currently looking in to the digitization of simulated hits, the Oslo people and others.

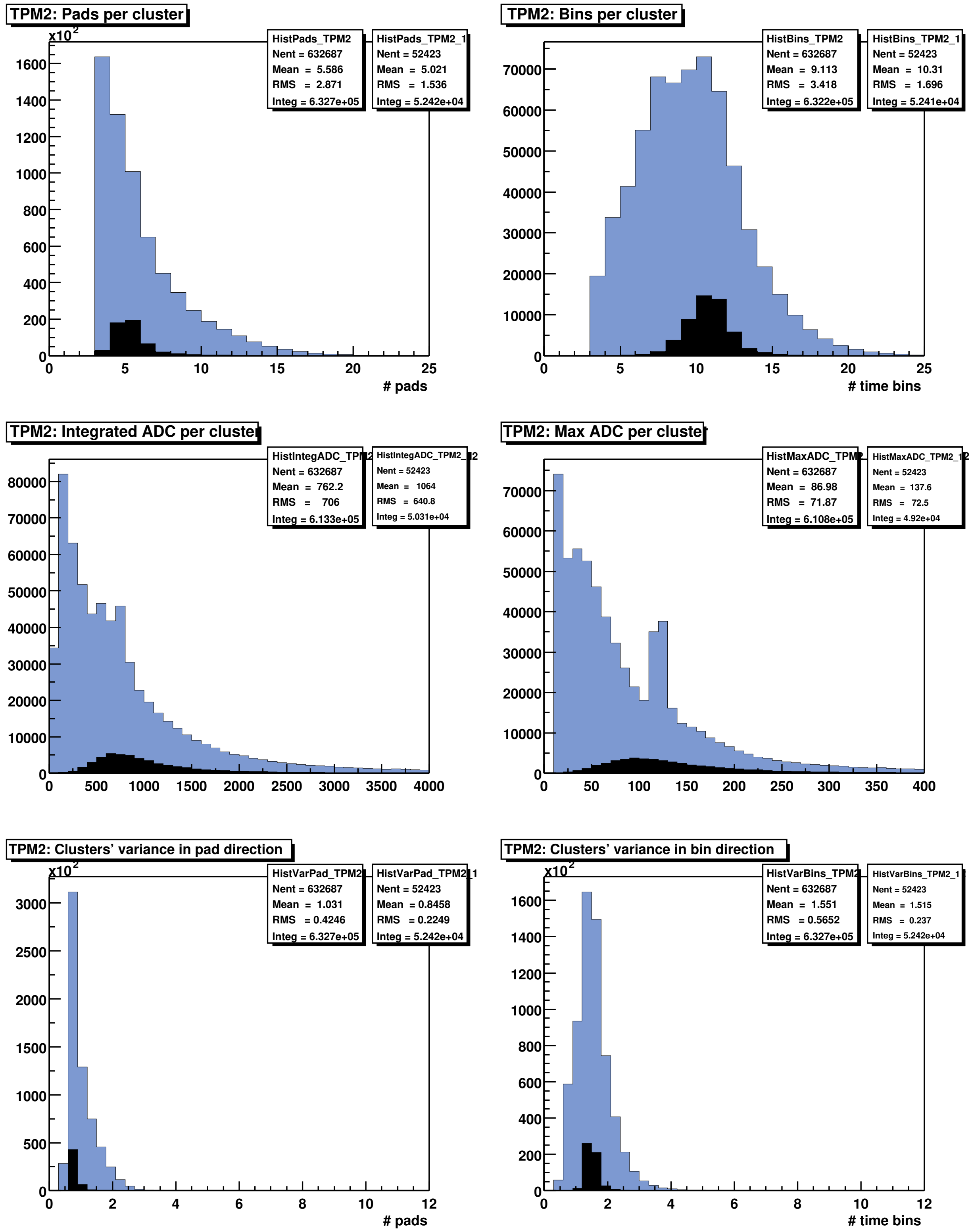
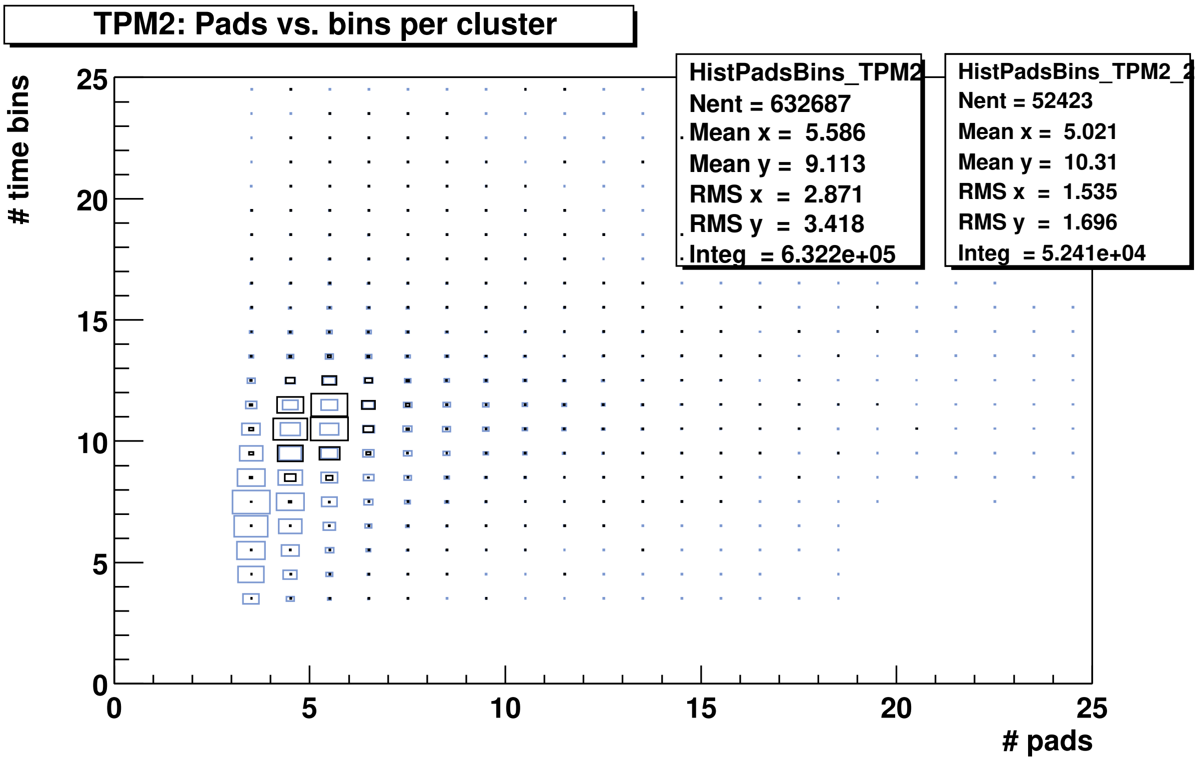


fig. 5 TPM2!! *Number of pads and time bins (top left and right), integrated and max ADC (middle left and right) and variance in pads and time bins (bottom left and right) in on-track (black) and off-track clusters.*



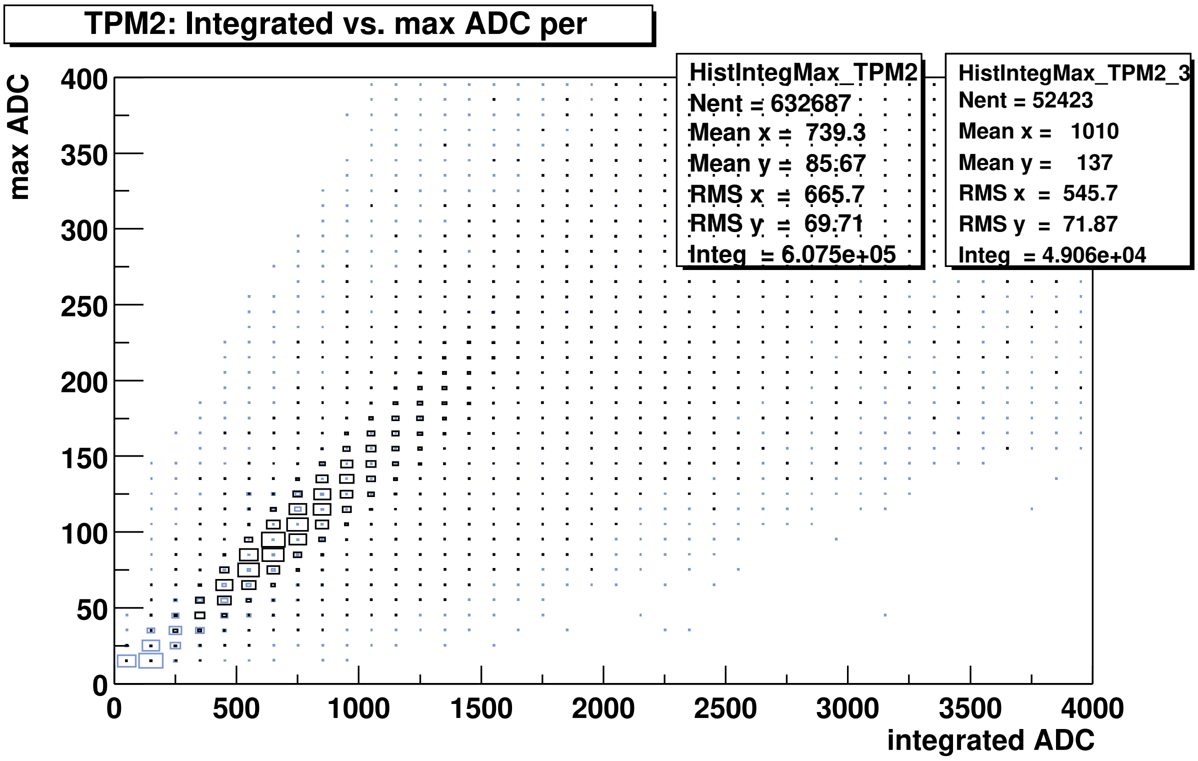


fig. 6 TPM2!! *Correlation in number of pads and time bins (top) and integrated and max ADC in on-track (black) and off-track clusters.*

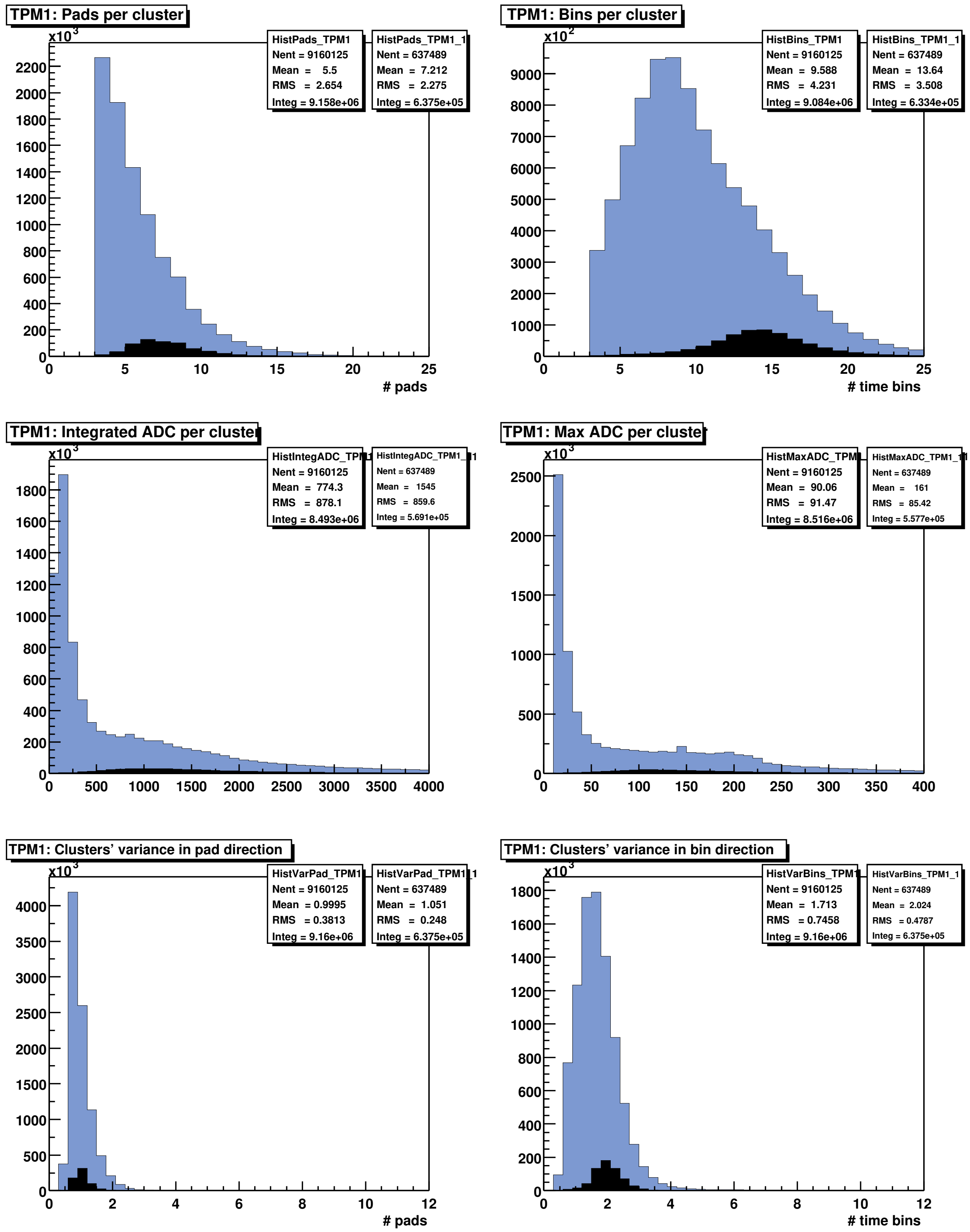


fig. 7 *Cut 0: Number of pads and time bins (top left and right), integrated and max ADC (middle left and right) and variance in pads and time bins (bottom left and right) in on-track (black) and off-track clusters.*

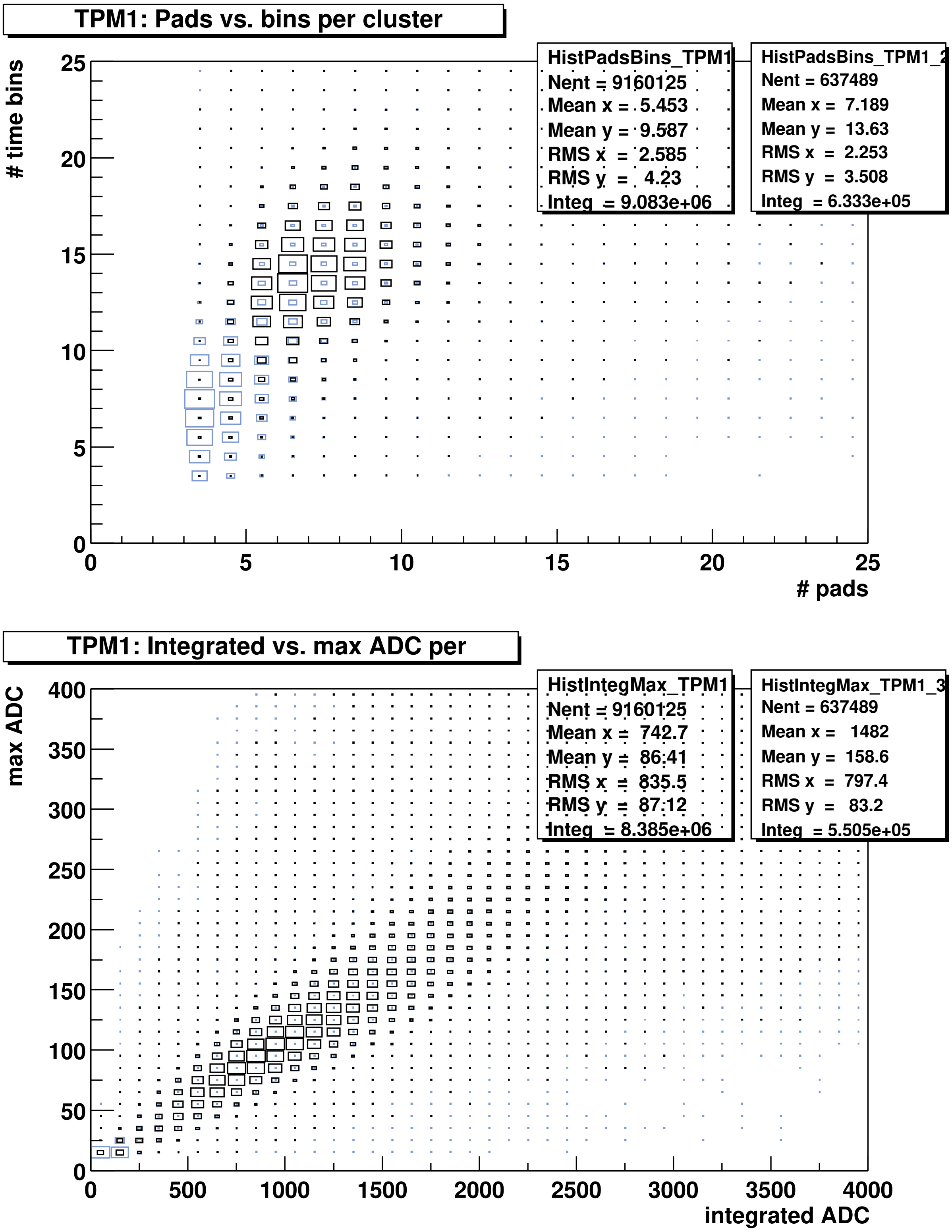


fig. 8 *Cut 0: Correlation in number of pads and time bins (top) and integrated and max ADC in on-track (black) and off-track clusters.*

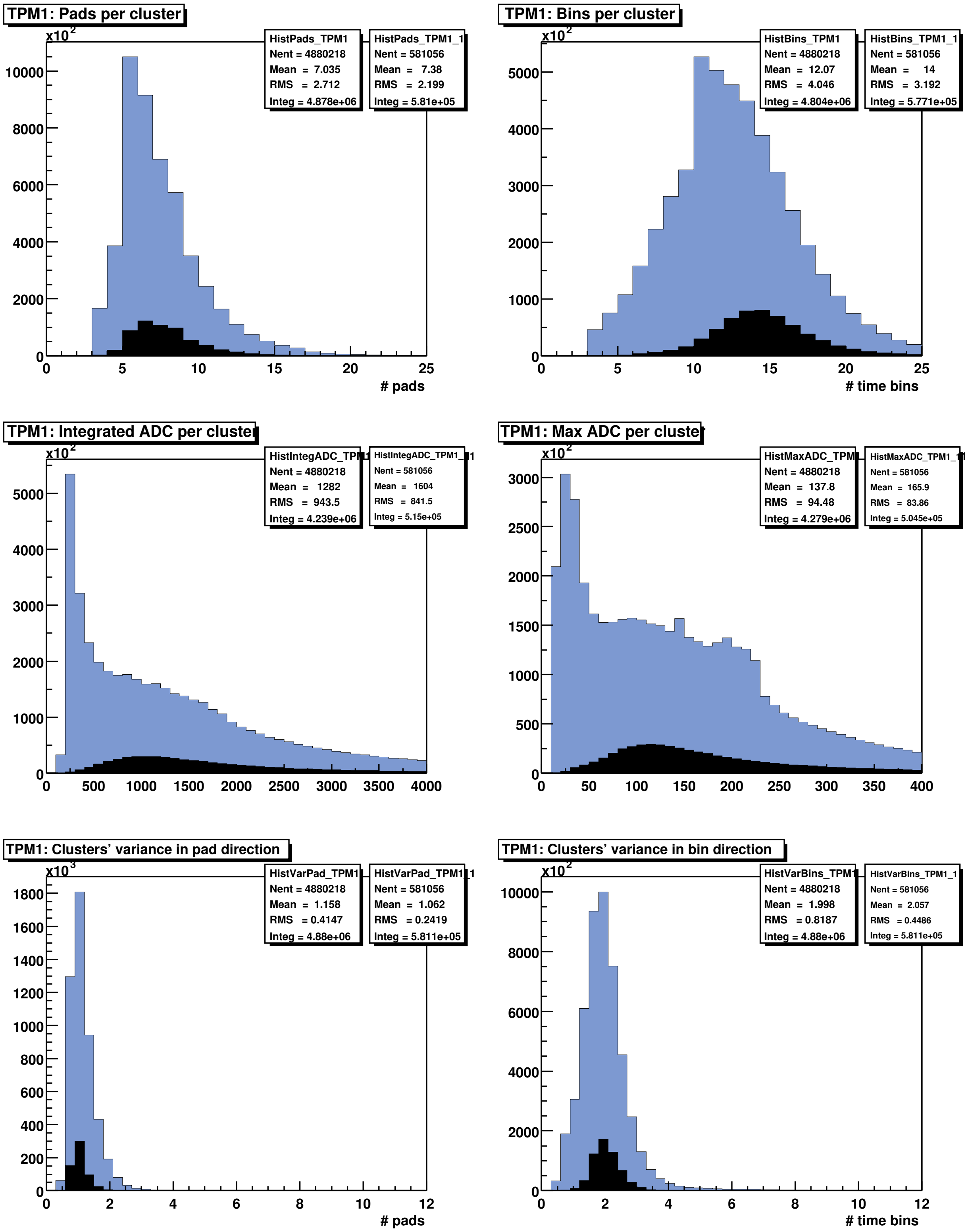
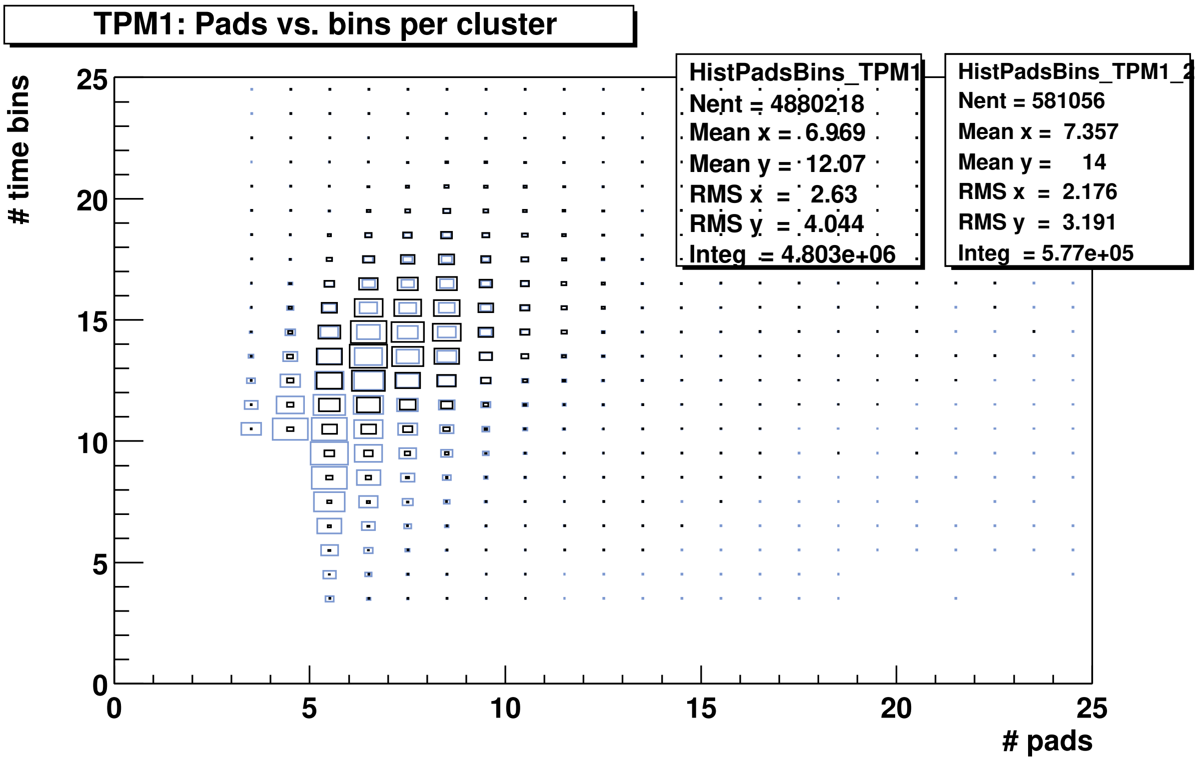


fig. 9 *Cut 1: Number of pads and time bins (top left and right), integrated and max ADC (middle left and right) and variance in pads and time bins (bottom left and right) in on-track (black) and off-track clusters.*



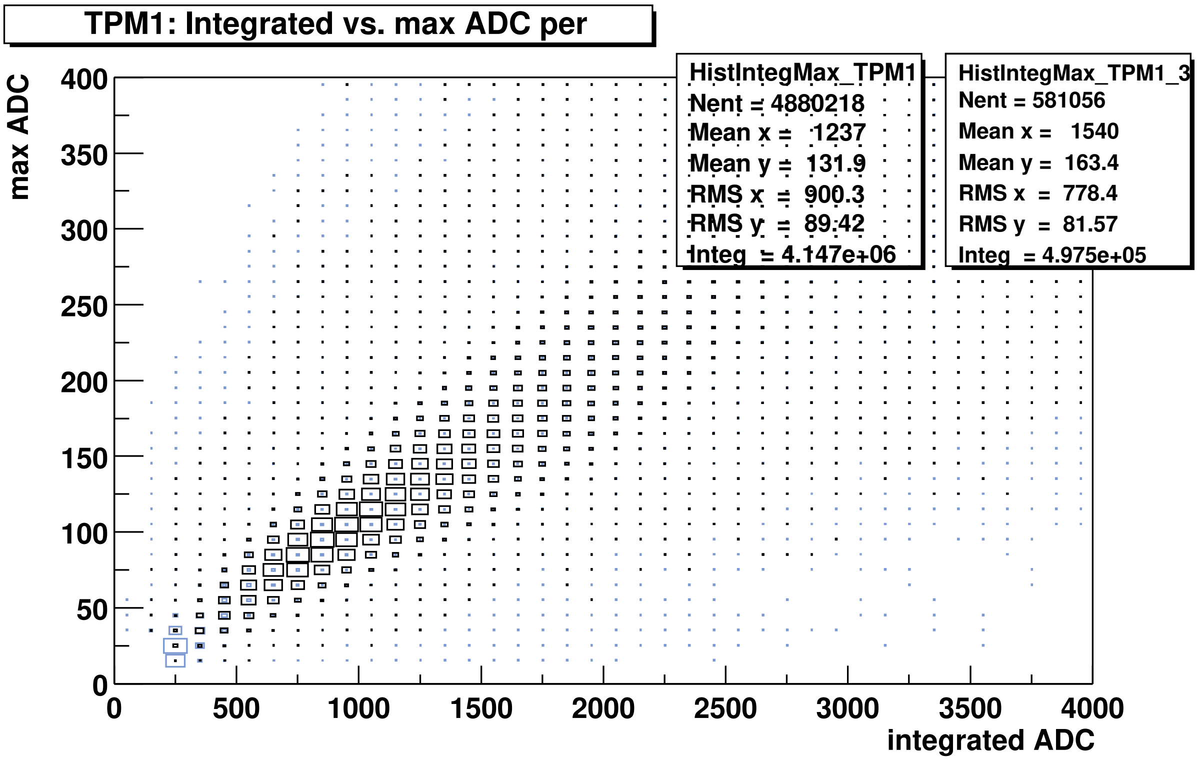


fig. 10 *Cut 1: Correlation in number of pads and time bins (top) and integrated and max ADC in on-track (black) and off-track clusters.*

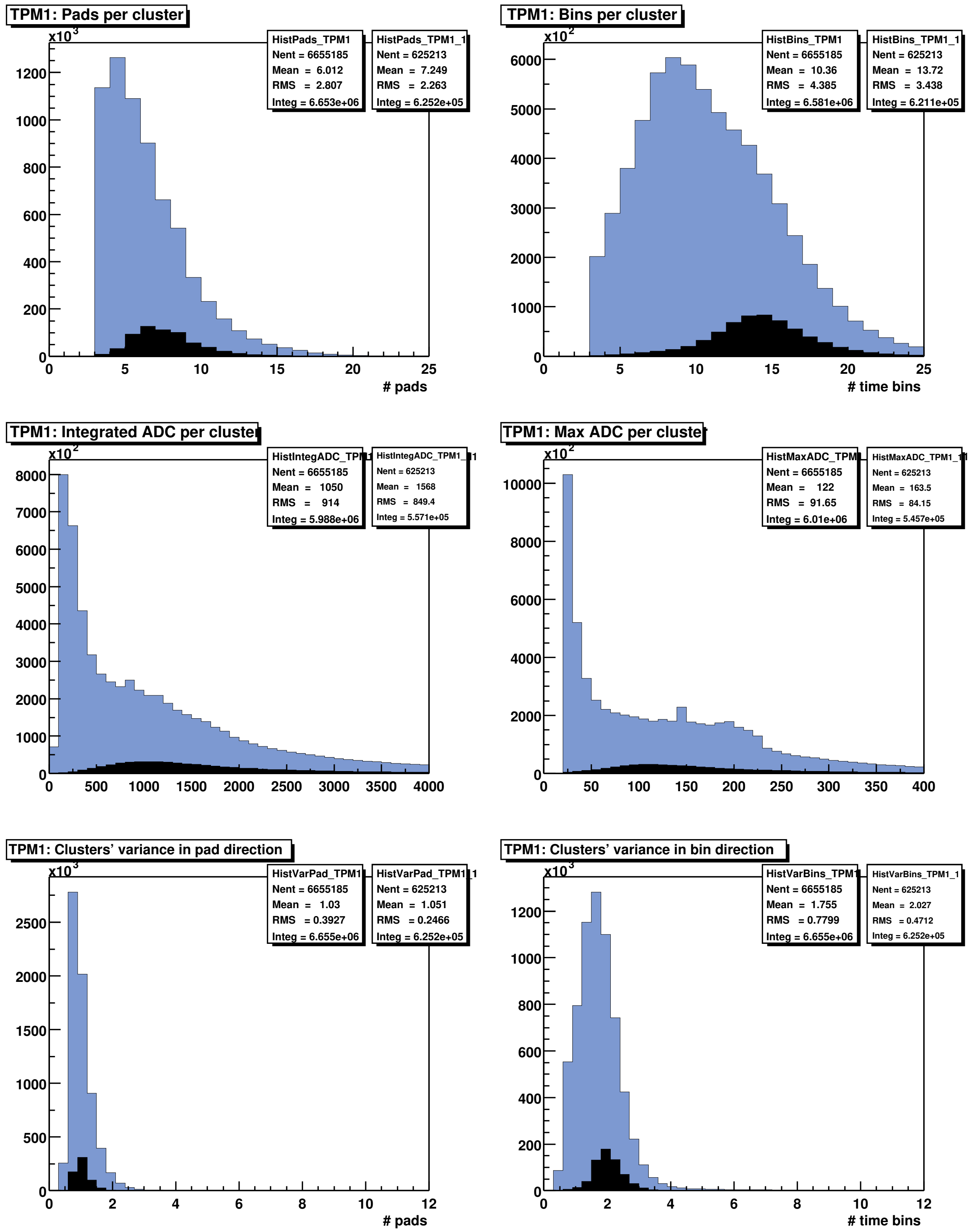
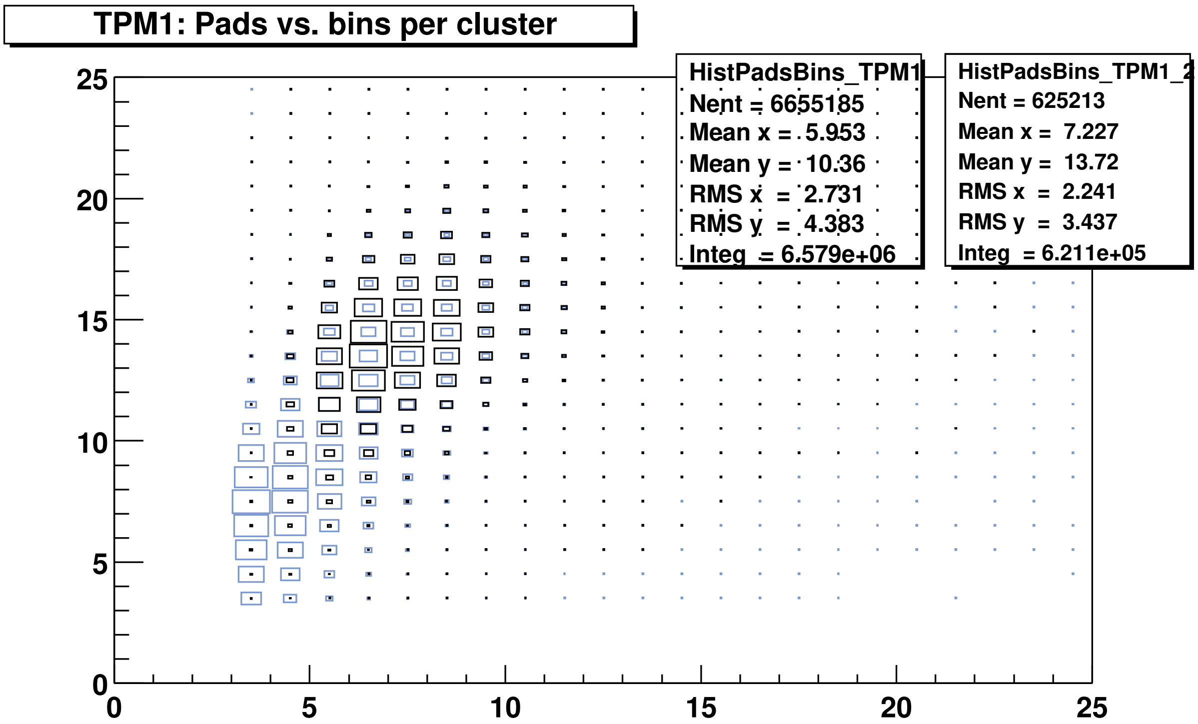


fig. 11 *Cut 2: Number of pads and time bins (top left and right), integrated and max ADC (middle left and right) and variance in pads and time bins (bottom left and right) in on-track (black) and off-track clusters.*



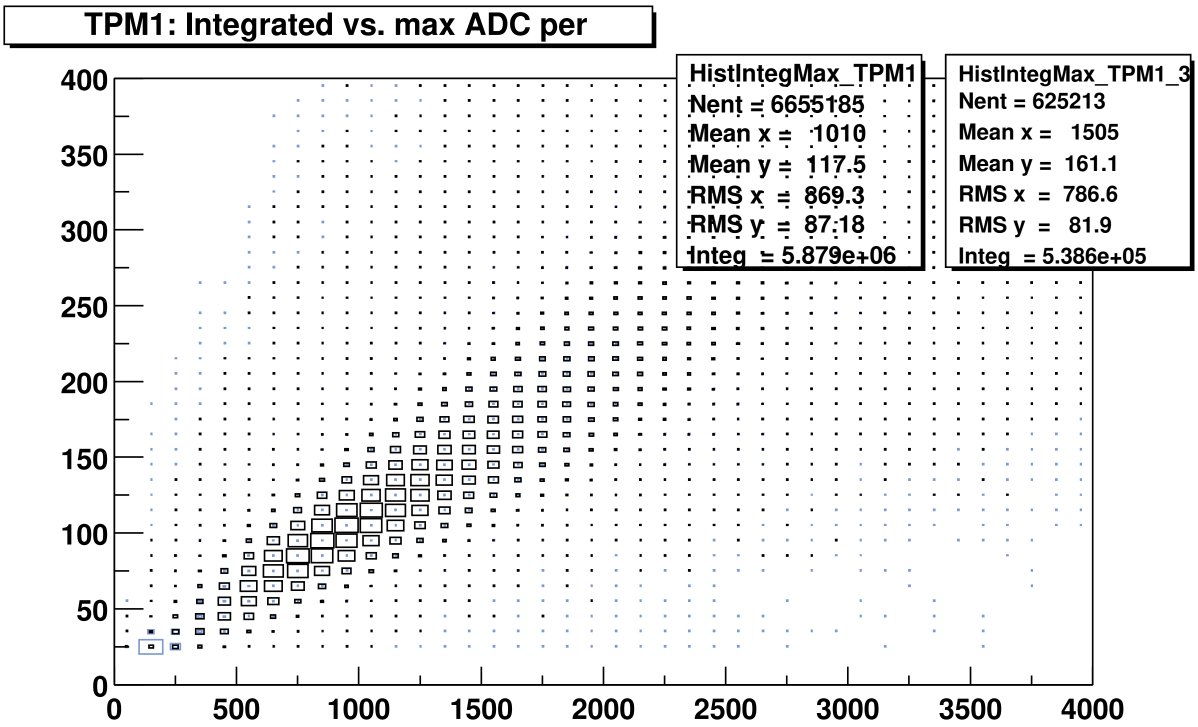


fig. 12 *Cut 2: Correlation in number of pads and time bins (top) and integrated and max ADC in on-track (black) and off-track clusters.*

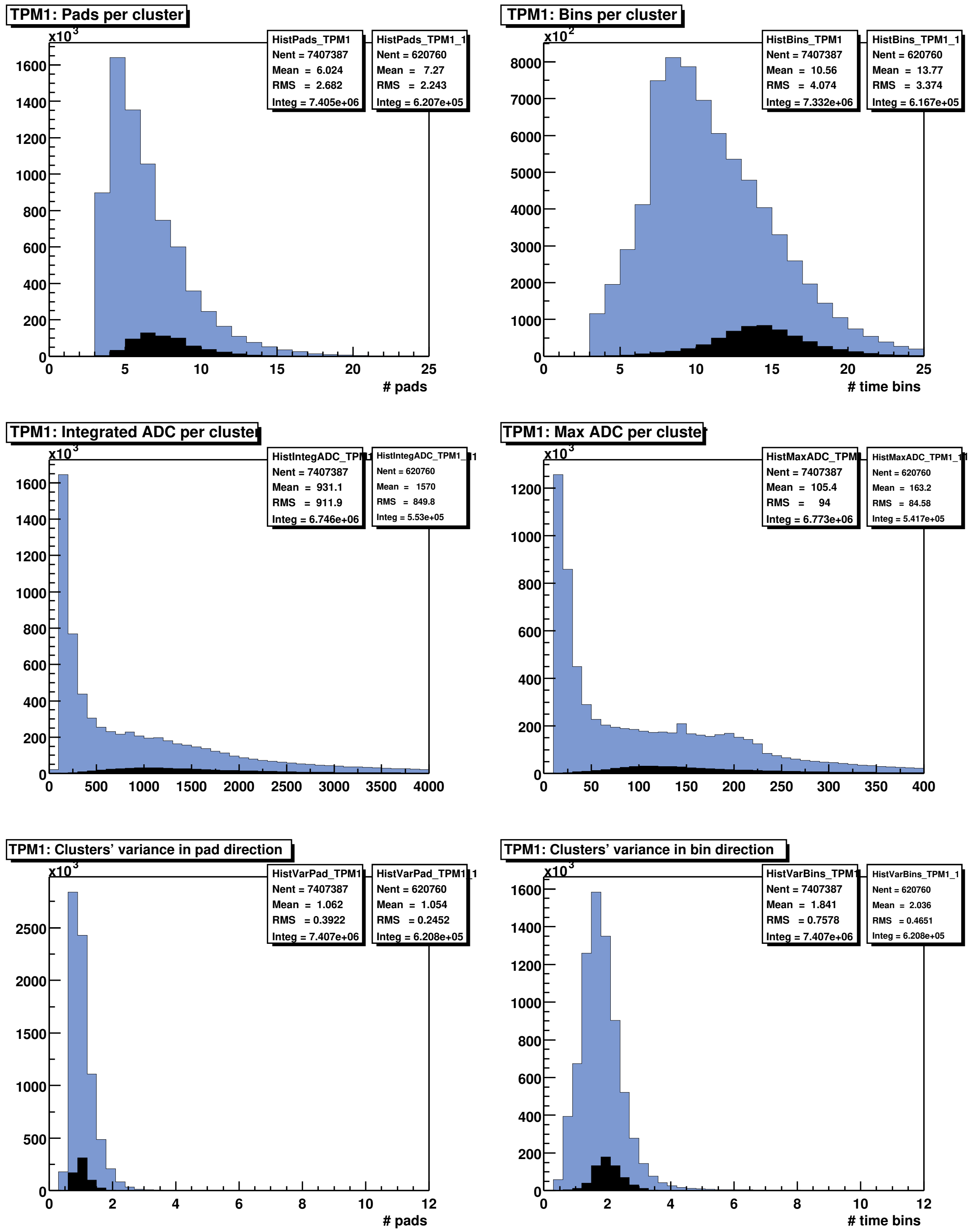
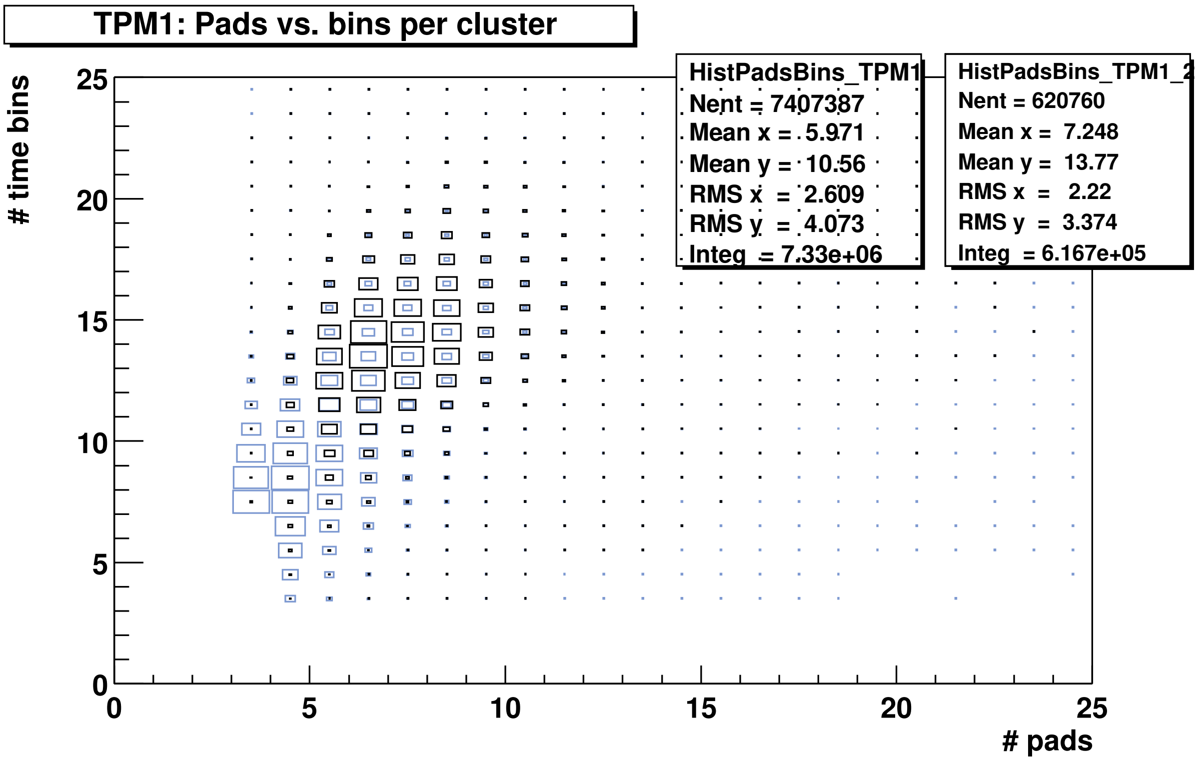


fig. 13 *Cut 3: Number of pads and time bins (top left and right), integrated and max ADC (middle left and right) and variance in pads and time bins (bottom left and right) in on-track (black) and off-track clusters.*



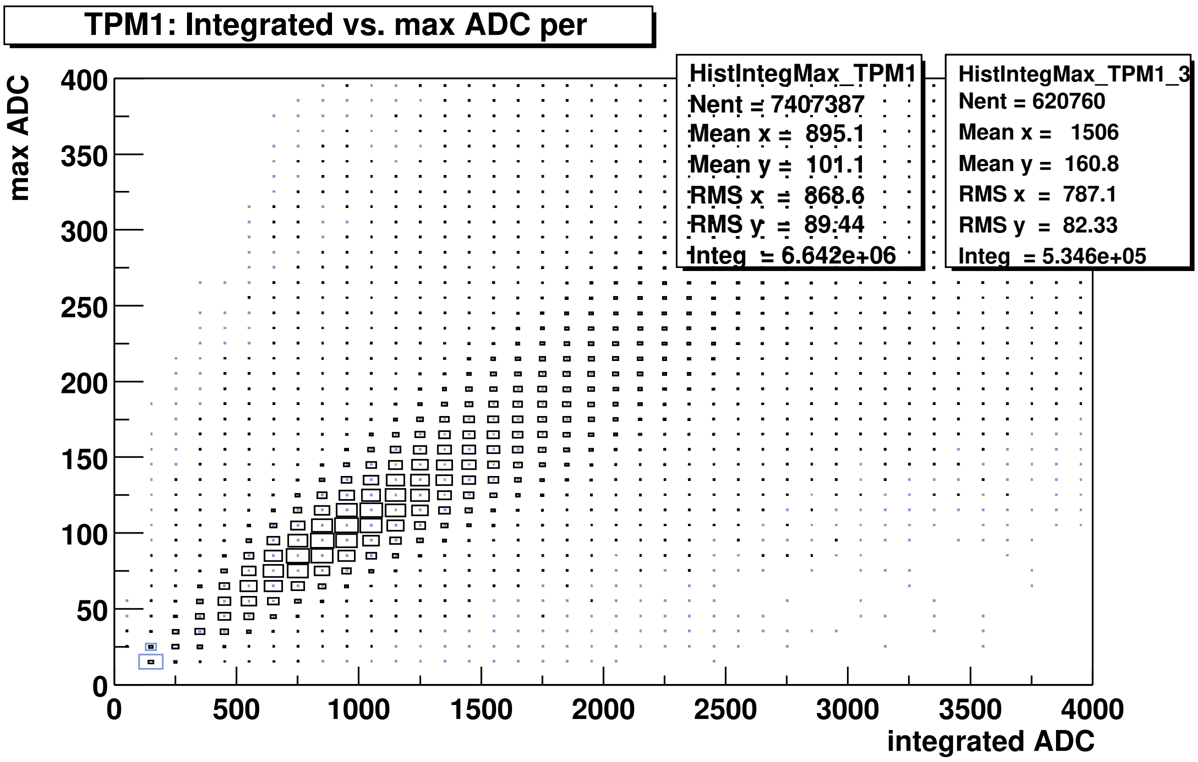


fig. 14 *Cut 3: Correlation in number of pads and time bins (top) and integrated and max ADC in on-track (black) and off-track clusters.*

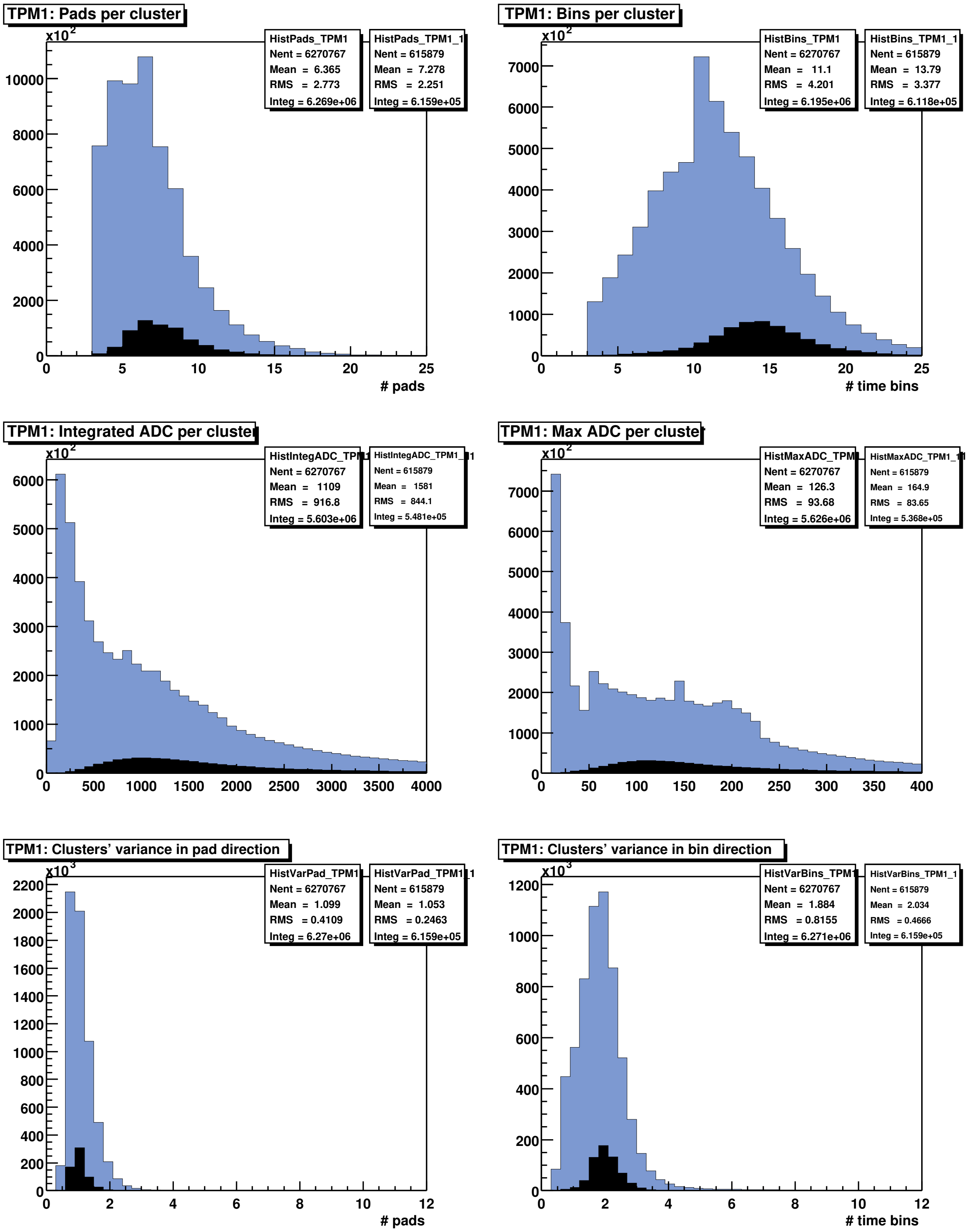


fig. 15 *Cut 4: Number of pads and time bins (top left and right), integrated and max ADC (middle left and right) and variance in pads and time bins (bottom left and right) in on-track (black) and off-track clusters.*

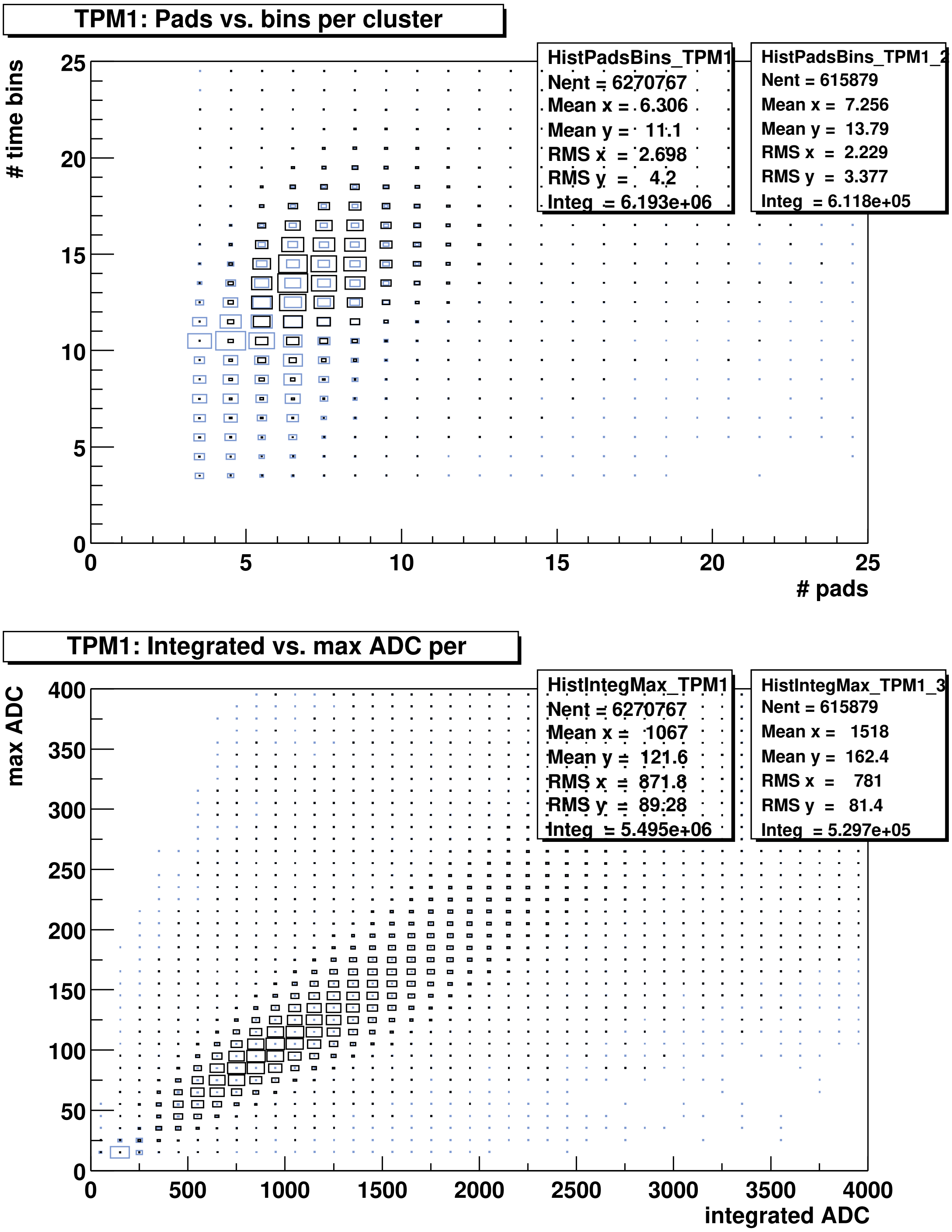


fig. 16 *Cut 4: Correlation in number of pads and time bins (top) and integrated and max ADC in on-track (black) and off-track clusters.*

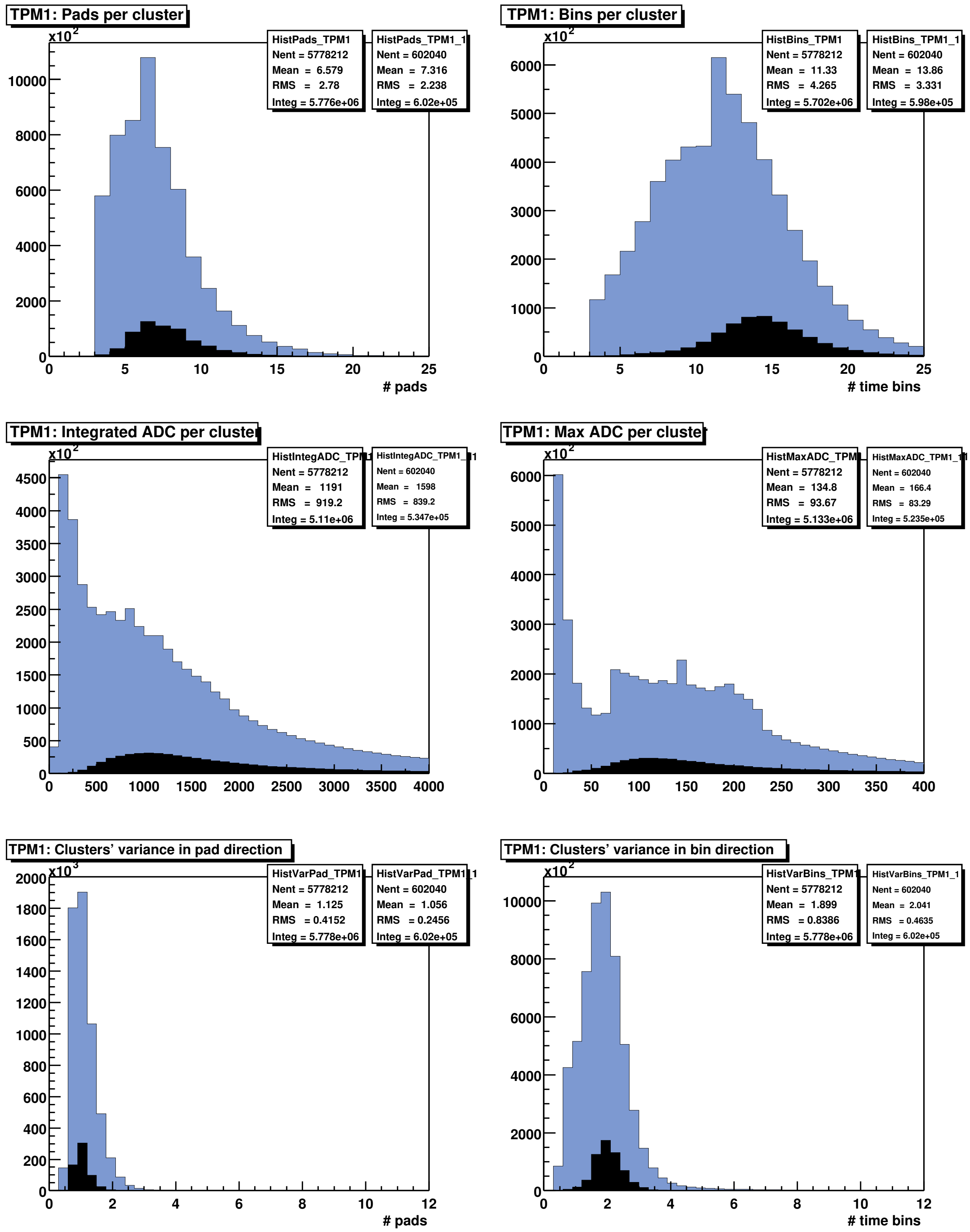
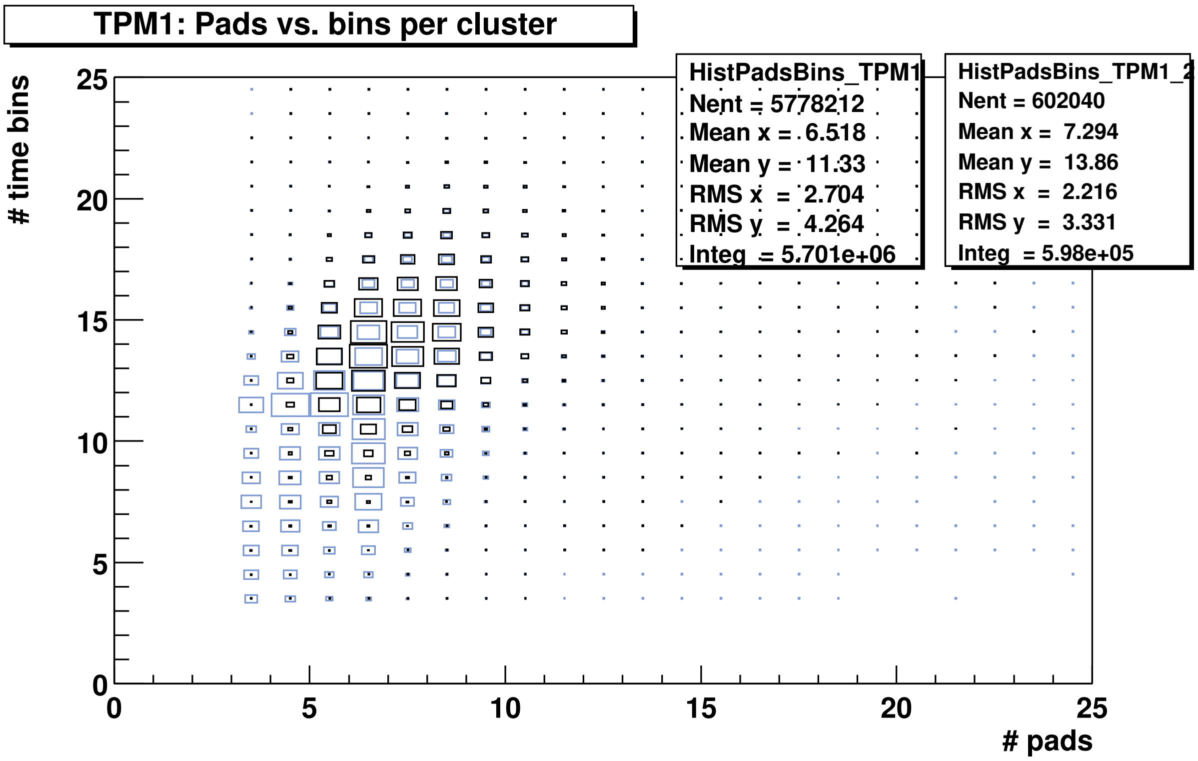


fig. 17 *Cut 5: Number of pads and time bins (top left and right), integrated and max ADC (middle left and right) and variance in pads and time bins (bottom left and right) in on-track (black) and off-track clusters.*



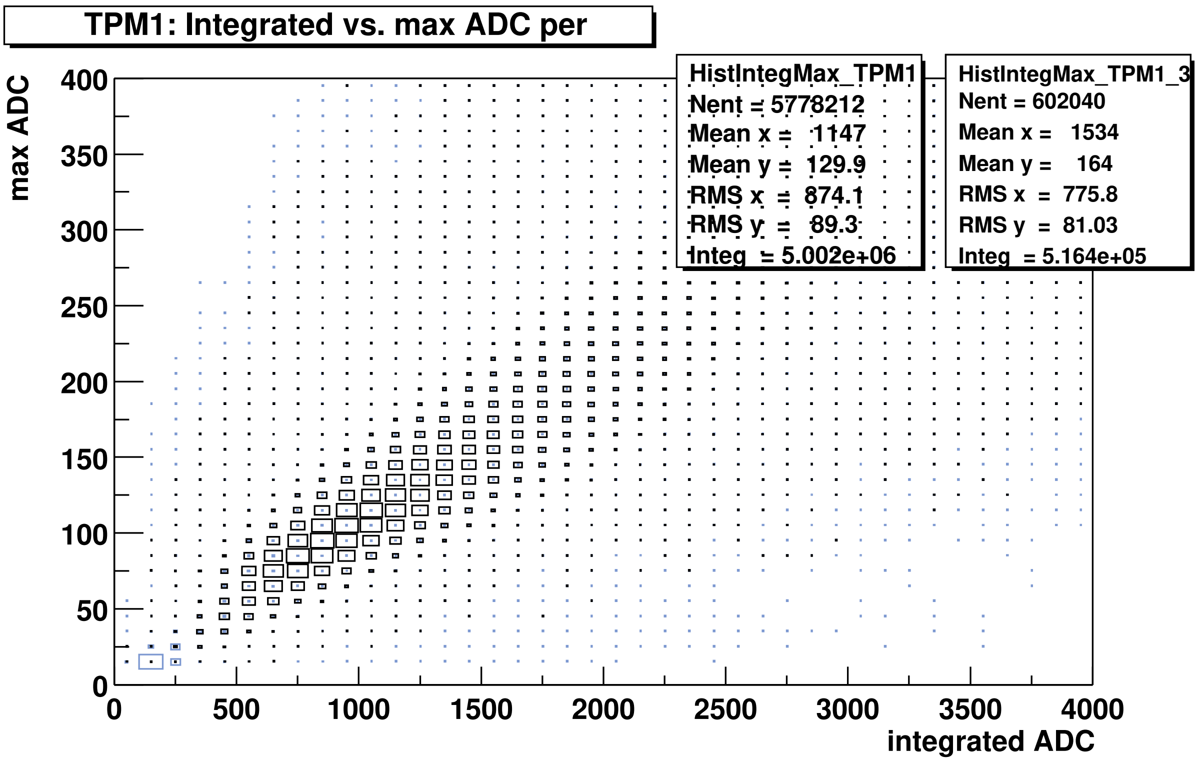


fig. 18 *Cut 5: Correlation in number of pads and time bins (top) and integrated and max ADC in on-track (black) and off-track clusters.*

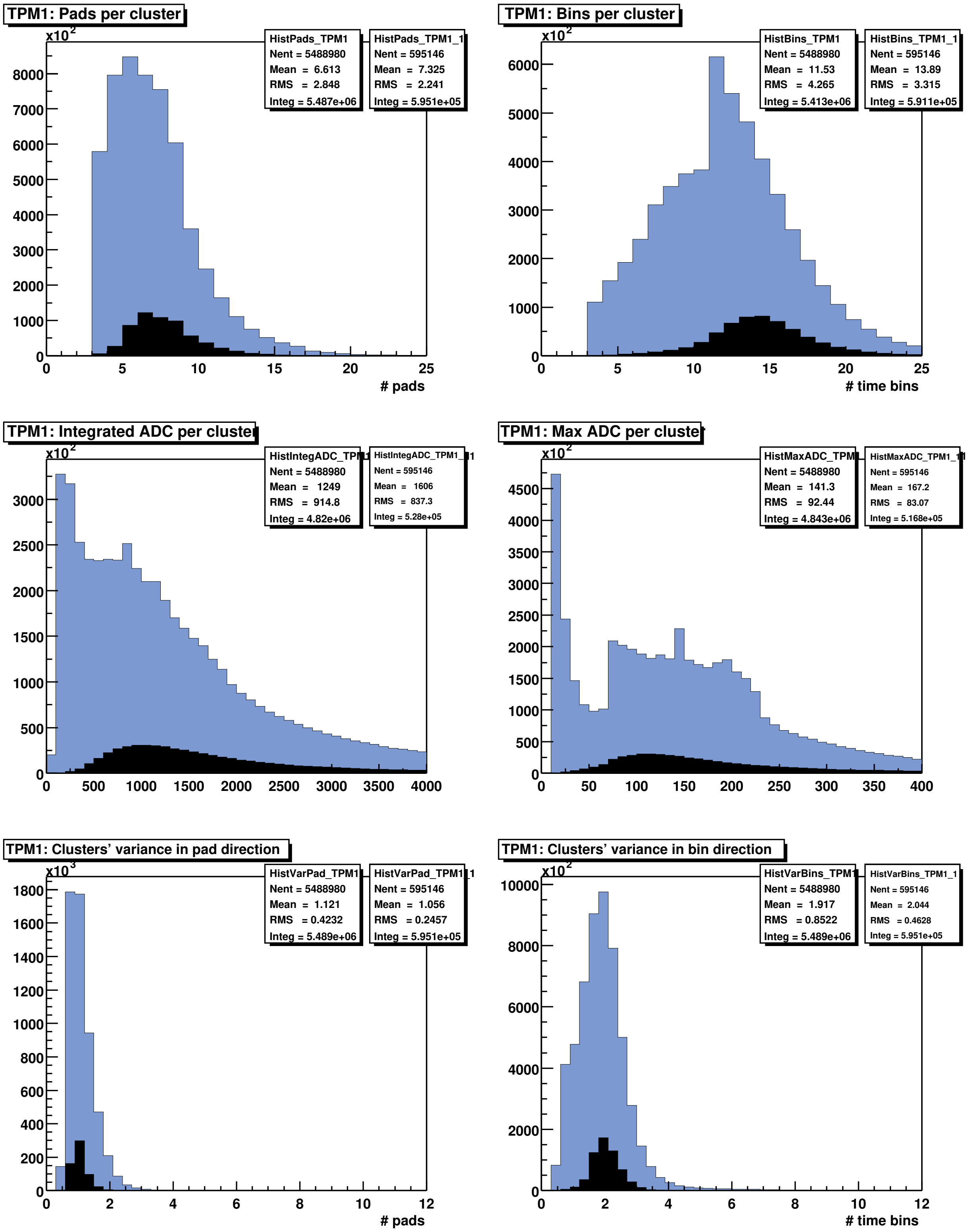
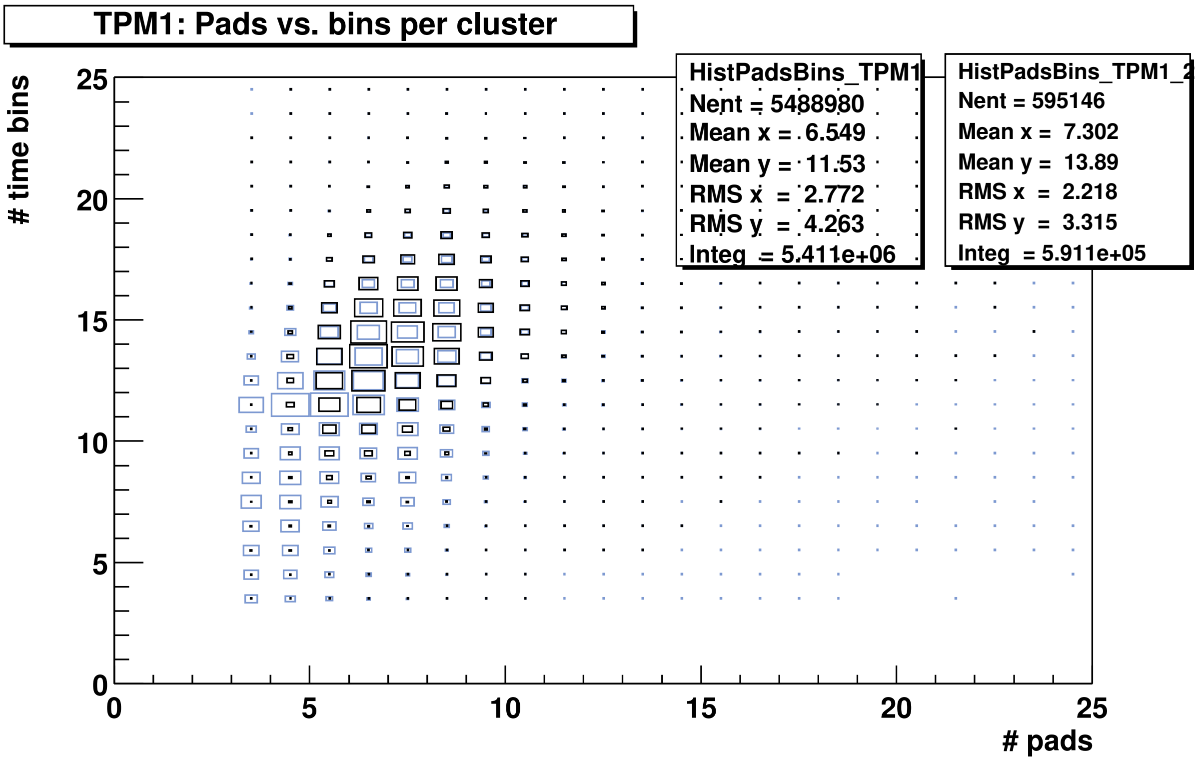


fig. 19 *Cut 6: Number of pads and time bins (top left and right), integrated and max ADC (middle left and right) and variance in pads and time bins (bottom left and right) in on-track (black) and off-track clusters.*



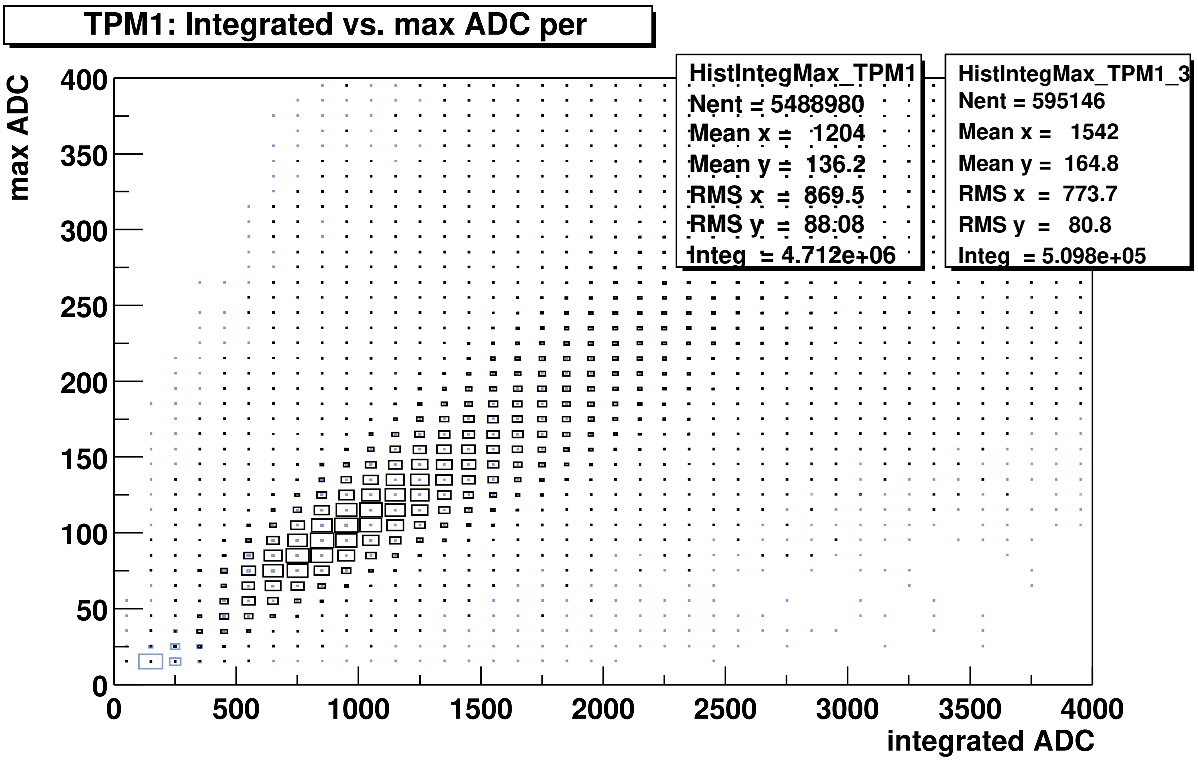


fig. 20 *Cut 6: Correlation in number of pads and time bins (top) and integrated and max ADC in on-track (black) and off-track clusters.*