

Straw analysis status, *[2023-02-06 Mon]*

Straw TB team

February 7, 2023

X-talks in APV

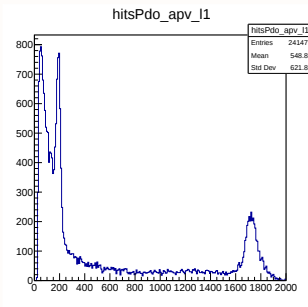
During improving of clusterization on July TB we found:

- On July TB there are a large number of hits with overflow
- There are x-talks inside APV25 chip

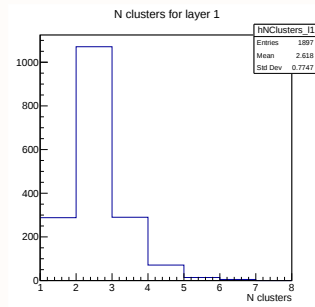
After consultation with MicroMegas experts, there was found way to remove x-talks:

- X-talks in APV are known and there is a standard map of x-talks between channels ([link](#)).
- After calibration, it is possible to reconstruct correct energy for overflow hits from x-talk data
- We also have x-talks on April TB data, but with less effect

PDO for hits in MM Layer 1



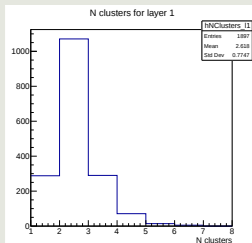
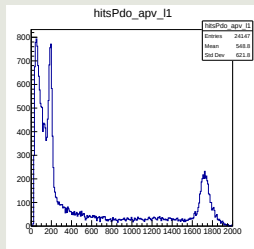
N clusters in MM Layer 1



Reminder: X-talk overflow

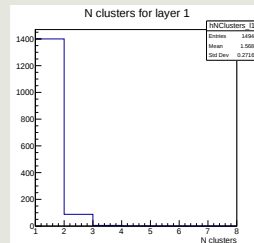
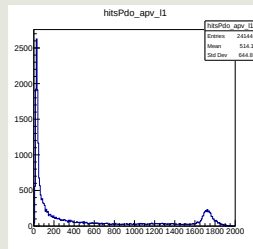
Before x-talk removing:

PDO for hits in MM Layer 1 N clusters in MM Layer 1



After x-talk removing:

PDO for hits in MM Layer 1 N clusters in MM Layer 1



- Removing X-talks effectively reduces number of clusters in layer
- Understanding of MicroMegas specifics is necessary for next TBs

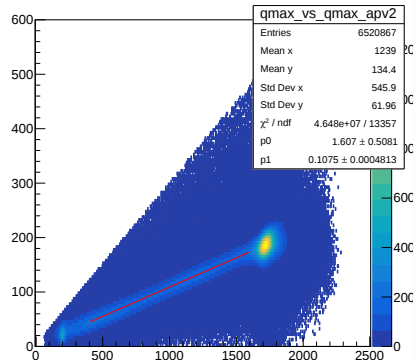
What done

1 Cuts:

- ▶ $\max Q_{\text{orig}} > \text{StDev}_{\text{orig}}$
- ▶ $\max Q_{\text{ghost}} > \text{StDev}_{\text{ghost}}$
- ▶ $\max Q_{\text{orig}} > \max Q_{\text{ghost}}$
- ▶ $Q_{\text{ghost}}(t^{\max Q_{\text{orig}}})$ above baseline
- ▶ $\max Q_{\text{ghost}} < 0.3 * \max Q_{\text{orig}}$

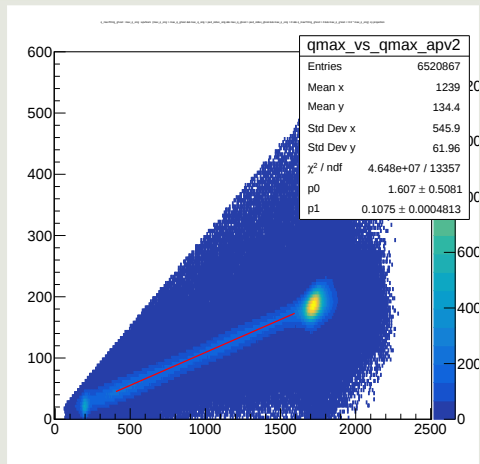
2 Fits:

- ▶ $Q_{\text{ghost}}(t^{\max Q_{\text{orig}}})$ vs $\max Q_{\text{orig}}$: fitted with **pol1**
Fit range: $400 < \max Q_{\text{orig}} < 1600$
For most of channels, p_0 (intercept) is around 0.
- ▶ $Q_{\text{ghost}}(t^{\max Q_{\text{orig}}}) / \max Q_{\text{orig}}$ with **gaus** function
Additional cut: $400 < \max Q_{\text{orig}} < 1600$
Fit range: $0.0 < Q_{\text{ghost}}(t^{\max Q_{\text{orig}}}) / \max Q_{\text{orig}} < 0.3$

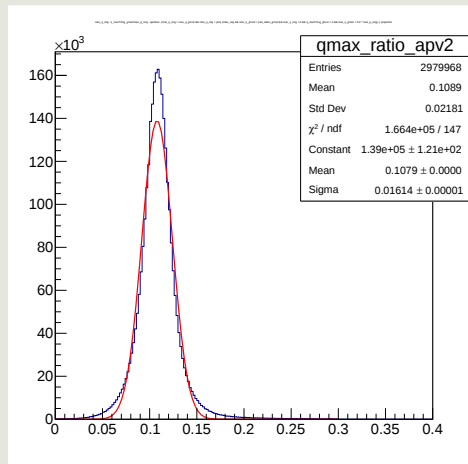


Next step: calibration of x-talks

$Q_{\text{ghost}}(t^{\text{max}Q}_{\text{orig}})$ vs $\text{max}Q_{\text{orig}}$



$Q_{\text{ghost}}(t^{\text{max}Q}_{\text{orig}}) / \text{max}Q_{\text{orig}}$



Seems, logical. Gauss sigma around 1.5

Next step: calibration of x-talks

July TB

APV port	APV num	Layer	Comment	x-talk fraction, %	sigma, %
0	MG2	0	DR, under X-board	10.98	3.24
2		1		10.79	1.61
4	MG1	2		10.37	1.61
6	M046	3		10.96	1.52
8	M045	3		10.37	1.51
9	SG1	3		5.98	1.36
10	M128	4	SYNC	-	

April TB

APV port	APV num	Layer	Comment	x-talk fraction, %	sigma, %
0	M046	0		10.10	2.01
1	S046	0		4.71	1.56
2	M128	4	SYNC	-	
4	M127	1		9.75	1.88
5	S127	1		3.77	1.41
6	M129	1		10.76	1.97
8	M038	2		9.61	1.47
9	S038	2	DR	7.73	2.80
10	M045	2		8.06	1.50
12	MG1	3	From Givi	???	
13	SG1	3		3.53	1.46
14	MG2	3	From Givi	10.83	2.01

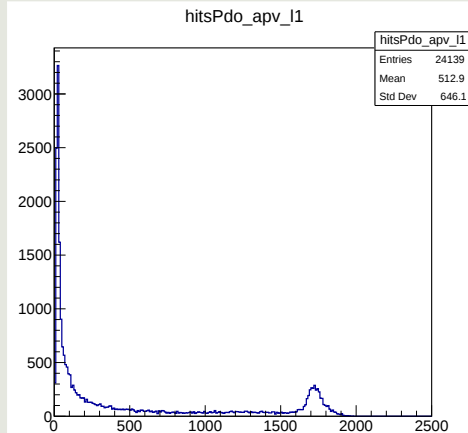
Next step: calibration of x-talks

Results

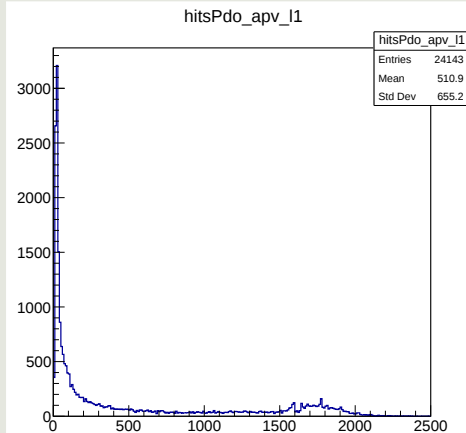
- 1 There are two types: 5% and 10% x-talks
- 2 They are the same for different runs inside TB
- 3 But differs between TB
- 4 Dependency for DR-APV wider then for other APV

Reconstruction overflow from x-talks

Before everflow reco



After



Possible methods of improving

Possible methods of improving

- 1 We still have the overflow peak (but wider).
Options to cluster creation & center calculation:
 - 1 Check clusters in timebins without overflow
 - 2 Gaussian fit strip/pdo distribution for cluster without overflow
 - 3 Geometrical centers of clusters

Example of cluster changes in time

o	o	o	o	o	88	95	84	119	234	323	305	257	202	178	142	123	134	175	191
o	o	71	78	161	335	460	458	451	476	465	402	296	228	222	236	245	355	611	872
o	68	220	403	888	1565	1710	1530	1477	1435	1333	1172	1002	898	824	776	687	631	658	654
o	o	69	174	696	1551	1719	1559	1574	1562	1461	1316	1204	1120	1036	991	908	829	782	698
o	o	o	o	177	415	588	634	617	568	473	380	392	474	550	561	517	471	441	406
o	o	o	o	71	112	122	97	67	56	o	o	54	73	92	100	88	73	67	66
o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Last Maximum
before
overflow

Next step

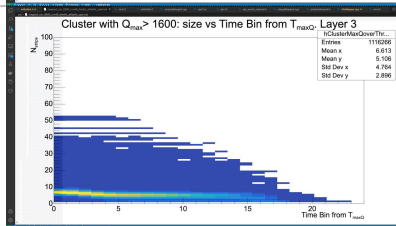
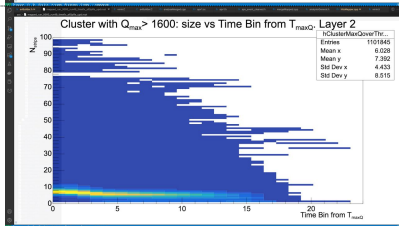
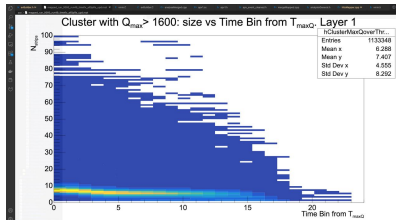
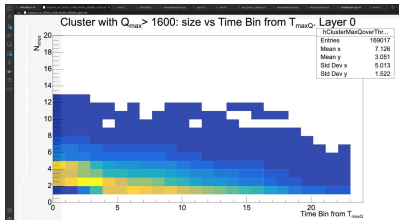
We need to find the cluster time bin on which we have no overflow

To check if we can optimize that way, cluster with overflow was checked

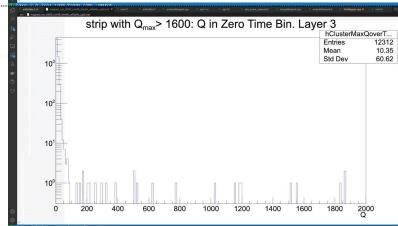
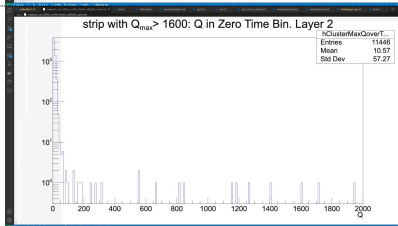
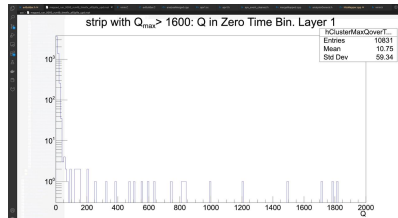
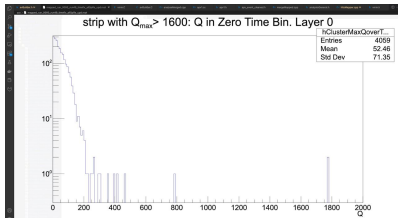
$$Q_{max} > 1600$$

- Check the cluster evolution back in time ($t_{maxQ} - 1, \dots, t_{maxQ} - n$)
- Check the Q in TimeBin = 0 of the strip with $Q_{max} > 1600$
- Check the strip (with $Q_{max} > 1600$) Q_i evolution back in time ($t_{maxQ} - 1, \dots, t_{maxQ} - n$)

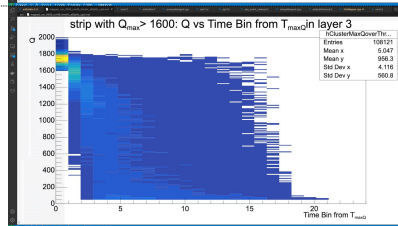
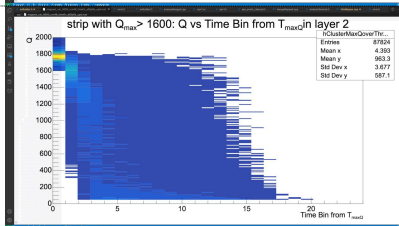
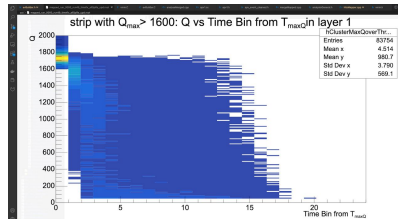
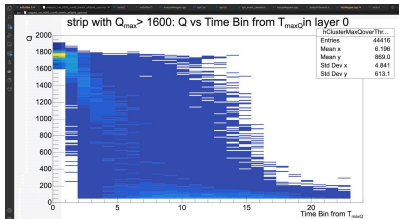
Cluster evolution



$$Q_0$$

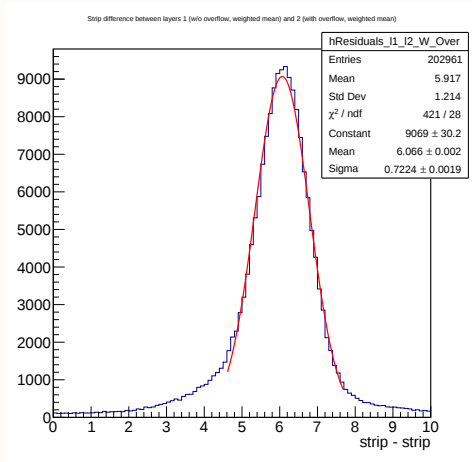


Q_i

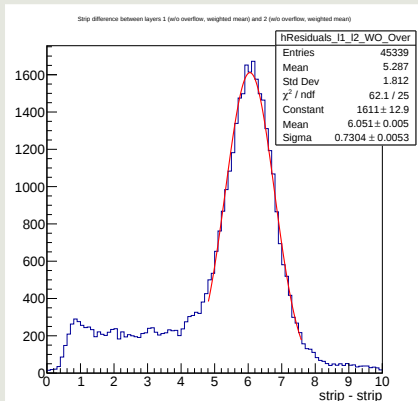


Residuals

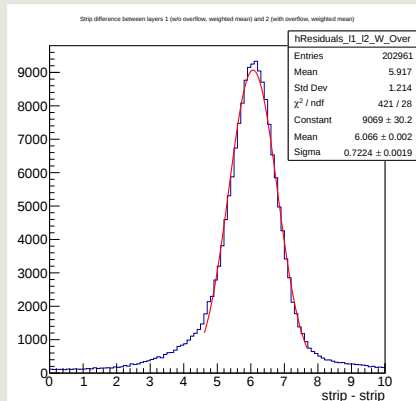
- To check if the optimization works we need the method of "quality" cluster center calculation
- For that, events with non-overflow clusters on MicroMegas 1 selected
- Checked the difference between strips on MicroMegas 1 - MicroMegas 2
- Cluster center on MicroMegas 2 calculated by different methods



MicroMegas 2 clusters without overflow, weighted mean



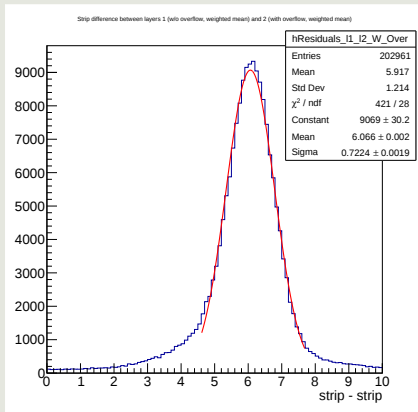
MicroMegas 2 clusters with overflow, weighted mean



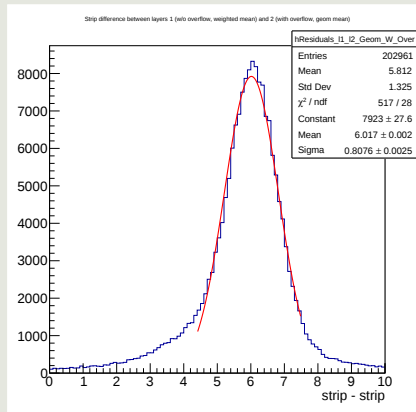
Fitting can be optimized after noise cluster cancellation

Residuals for geometrical cluster center

MicroMegas 2 clusters with overflow, weighted mean

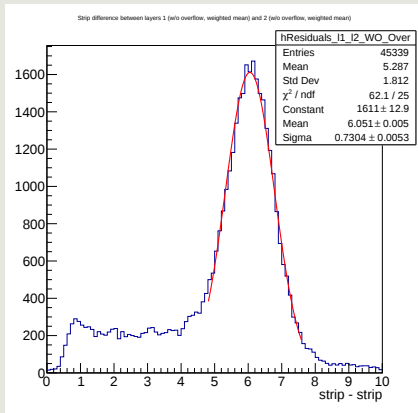


MicroMegas 2 clusters with overflow, geometrical cluster center

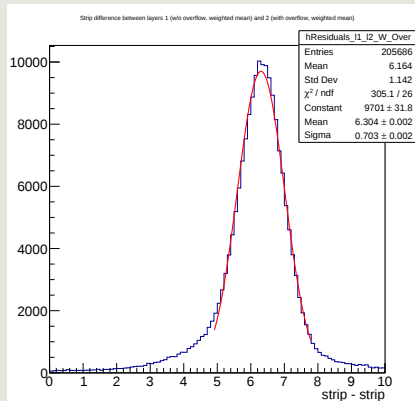


We can see difference with geometrical center

MicroMegas 2 clusters without overflow, weighted mean

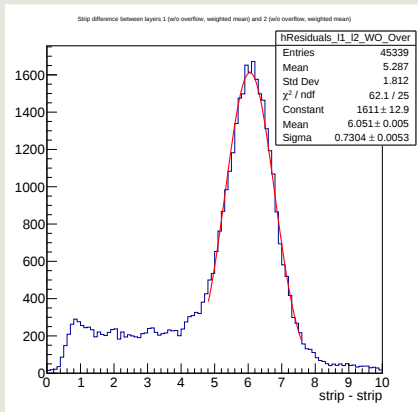


MicroMegas 2 clusters with overflow, weighted mean, selected last timebin without overflow

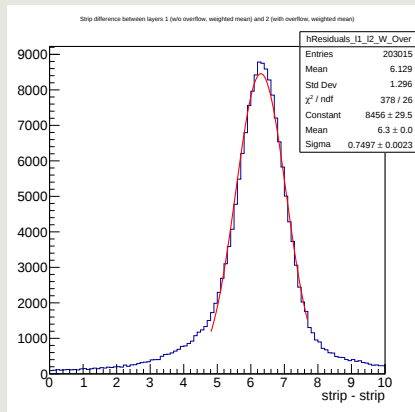


But we can't see difference between weighted means

MicroMegas 2 clusters without overflow, weighted mean



MicroMegas 2 clusters with overflow, weighted mean, timebin = $t_{\text{MaxQ}} - 3$

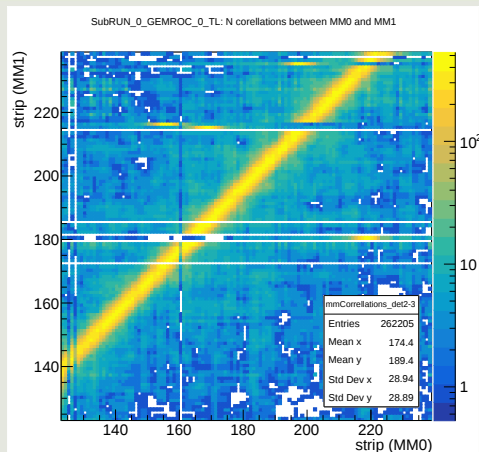


But we can't see difference between weighted means

October TB: epic mapping problems:

- Firstly during october TB we havd outdated FEB pinout
- We use 3-stage strip conversion:
 - 1 MM strip - panasonic(?) connector
 - 2 panasonic(?) connector - FEB connector
 - 3 FEB connector - TIGER channers
- But after correct pinout was found, some strips still seems misplaced

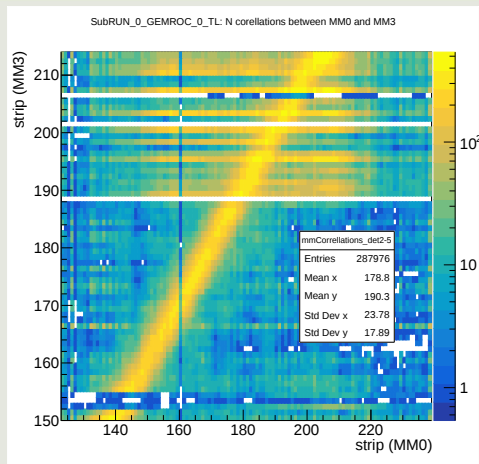
Corellation between MM0 and MM1. Both cards connected with B2-boards



October TB: MicroMegas 3 (board with LEMO connectors):

- Was found, that on noise on some strips in MM3 are not fully reduced,
- That cause noise hits and strange drift time for over-active strips
- Will be fixed shortly

Corellation between MM0 and MM3. MM0: B2-board, MM3: B-board



Summary

- ❶ April / July TB (merging):
 - ▶ Seems, problem with statistics is fixed (full data now available)
 - ▶ APV X-talk dependency calibrated
 - ▶ Found that APV reconstruction does not fixes overflow problem
 - ▶ Checked two methods of cluster optimizing,
 - ▶ Need method to check quality of cluster center calculation
- ❷ October TB
 - ▶ There is still a minor problem with mapping
 - ▶ Need to reduce noise some strips in MicroMegas 3

