



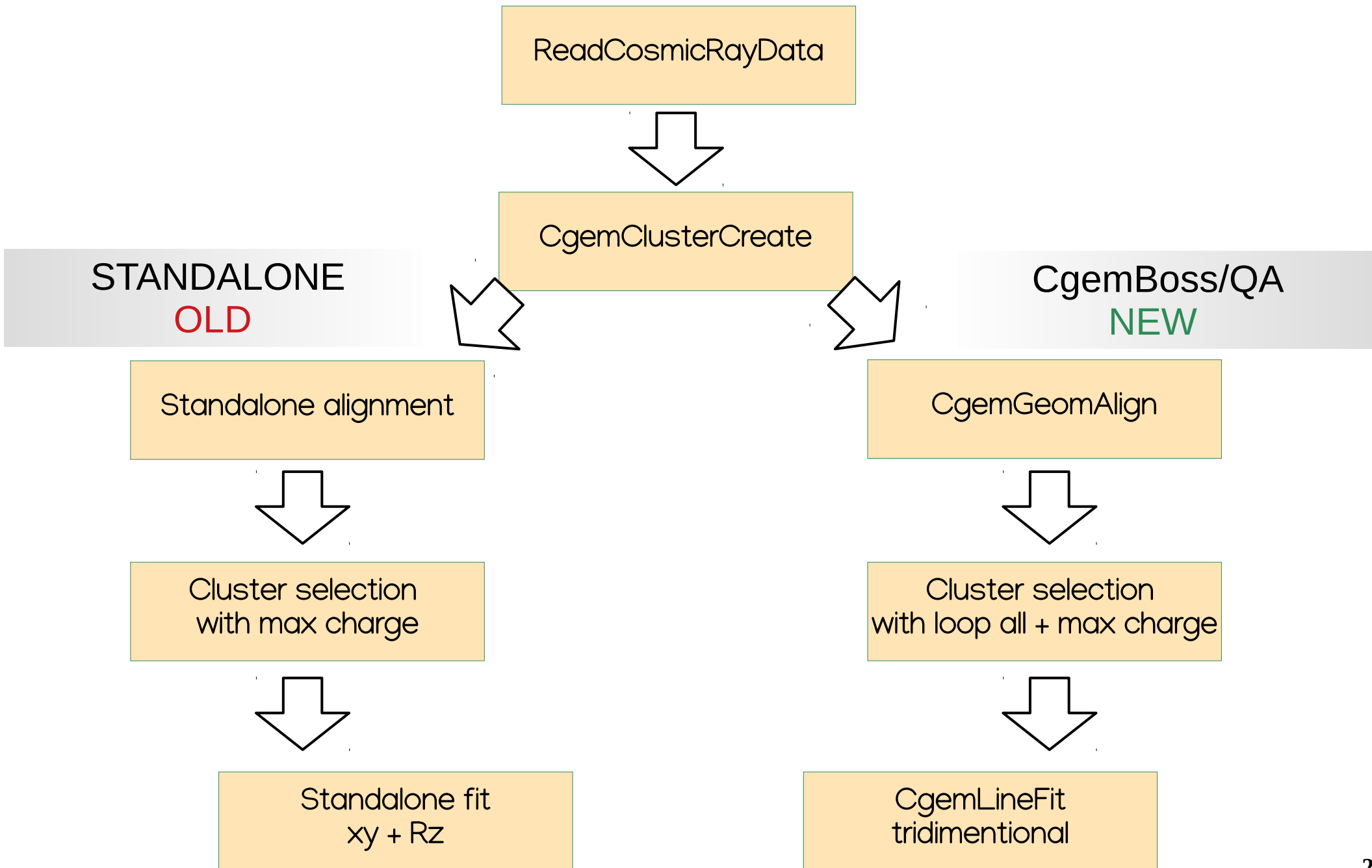
Update of cosmic-ray analysis
with 3D-line fit



Quality assurance procedure in CgemBoss
for cosmic-ray analysis

Lia Lavezzi

The two procedures



Validation with run 17

234154 total events

Statistics

	STANDALONE		CgemBoss	
L1 bottom	<i>n fitted 1</i>	123607	<i>n fitted 2</i>	153167
L1 top	<i>n fitted 1</i>	124799	<i>n fitted 2</i>	151822
L2 bottom	<i>n fitted 1</i>	65932	<i>n fitted 2</i>	150589
L2 top	<i>n fitted 1</i>	69937	<i>n fitted 2</i>	153432

STANDALONE

Selection (on trackers):

- Three trackers fired
- Total cluster charge

L1, x view, $Q_{\text{CLUSTER}} > 20 \text{ fC}$
L2, x view, $Q_{\text{CLUSTER}} > 15 \text{ fC}$

L1, v view, $Q_{\text{CLUSTER}} > 10 \text{ fC}$
L2, v view, $Q_{\text{CLUSTER}} > 10 \text{ fC}$

- No cut on cluster size
- L1 2D-clusters shall not share the same v cluster

n fitted 1 → the track is fitted (no limit on chi2)

CgemBoss

Selection (on trackers):

- Three trackers fired
- No cut on charge
- No cut on cluster size
- Loop all + max Q

n fitted 2 → the track is fitted, with $\text{chi}^2 < 2000$

The **Loop all + max Q** method, which loops on all combinations of highest charged clusters to find the usable ones, provides higher statistics

New QA in CgemBoss

Quality Assurance

Two packages:

- **TestTrack**: all the hit/ + cluster 1D + cluster 2D + fitted track are saved to a TTree (root file)
- **CgemCosmicRayQA** reads the TTree and fills all the histograms

[/\[BESIII\]/CgemBossCvs/Reconstruction/CgemLineFit/src/CgemCosmicRayQA.cxx](#)

HISTOGRAMS

HIT – for each plane, each sheet, each view

hit charge (fC), hit time (ns), hit charge (fC) vs stripID,
hit time (ns) vs stripID, hit charge (fC) vs time (ns),
hit charge (fC) vs length (mm)

CLUSTER 1D – for each plane, each sheet, each view

number of cluster1d, cluster1d size, cluster1d charge (fC) vs phi (deg)

CLUSTER 2D – for each plane, each sheet

number of cluster2d
cluster2d charge (fC) vs phi (deg)
cluster2d charge (fC) vs z (mm)

TRACK and RESIDUALS

number of fitted tracks
fitted track chi2
fitted track point of closest approach x (mm)
test plane: residual in R * phi (mm)
test plane: residual in z (mm)
residual in R * phi (mm) on each plane/sheet
residual in z (mm) on each plane/sheet

SIGNAL

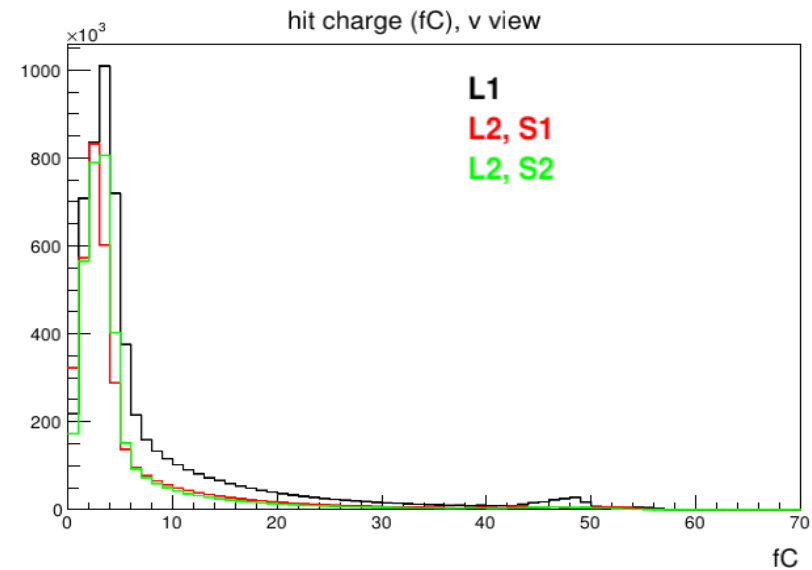
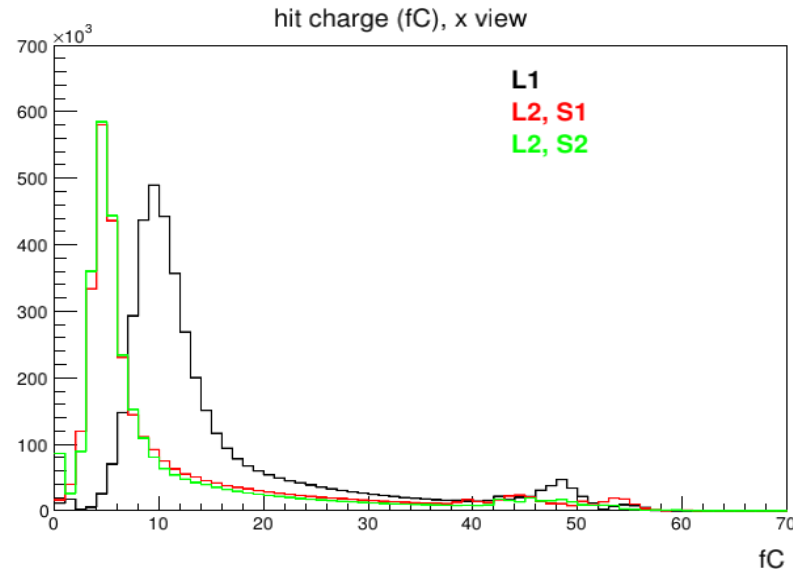
total charge of the signal (fC)
charge x of the signal (fC)
charge v of the signal (fC)
cl.size x of the signal
cl.size v of the signal

BACKGROUND

total charge of the background (fC)
charge x of the background (fC)
charge v of the background (fC)
cl.size x of the background
cl.size v of the background

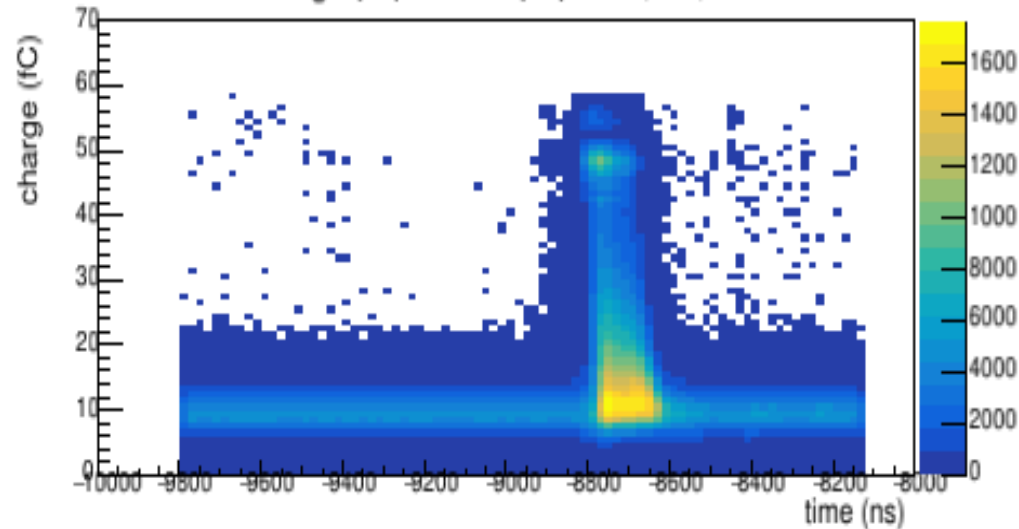
hit charge (fC)

All hits, no cut on time window (histograms not normalised)

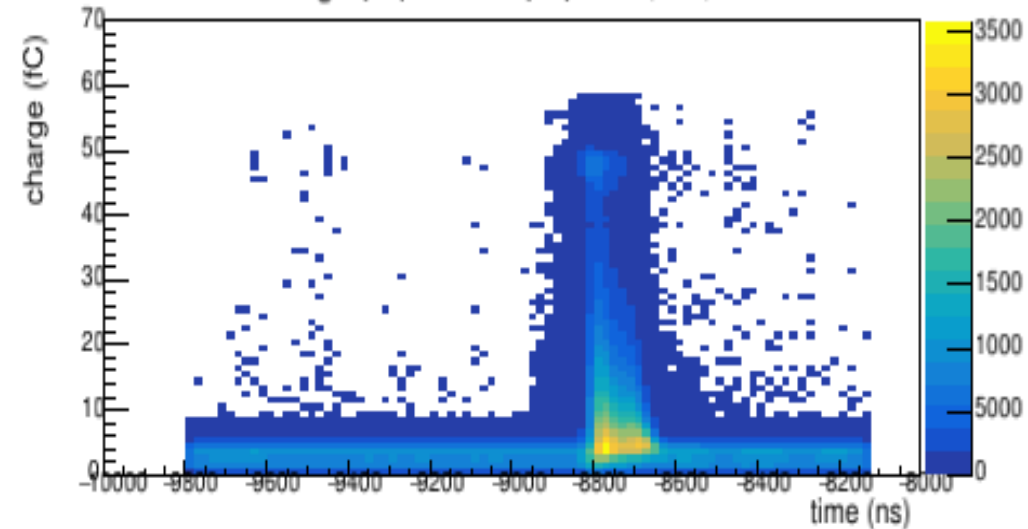


Charge (fC) vs time (ns)

hit charge (fC) vs time (ns) in L1, S1, x view



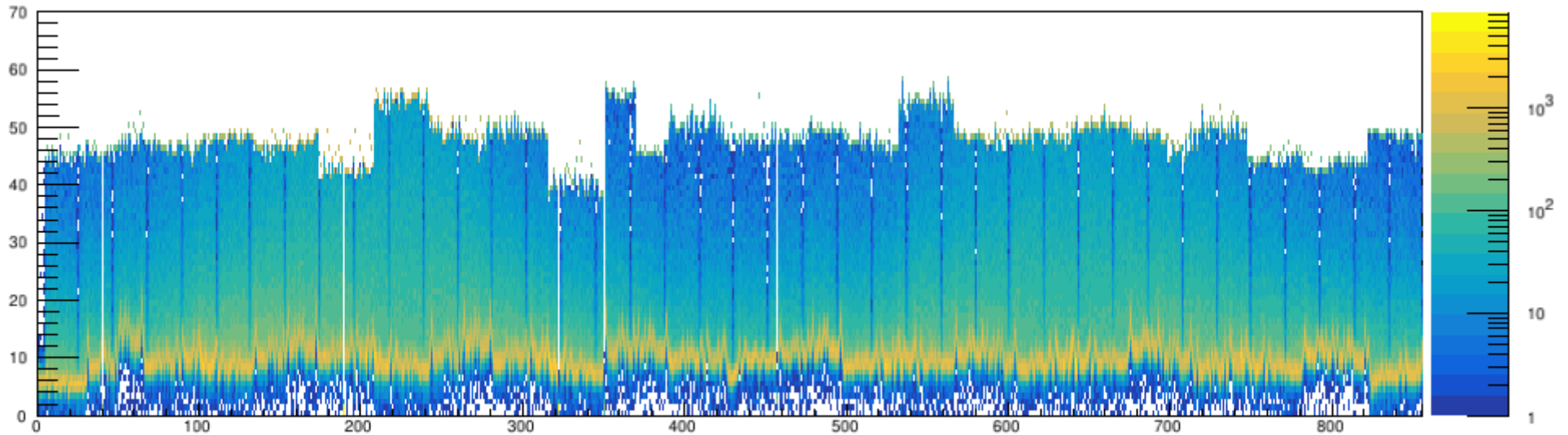
hit charge (fC) vs time (ns) in L1, S1, v view



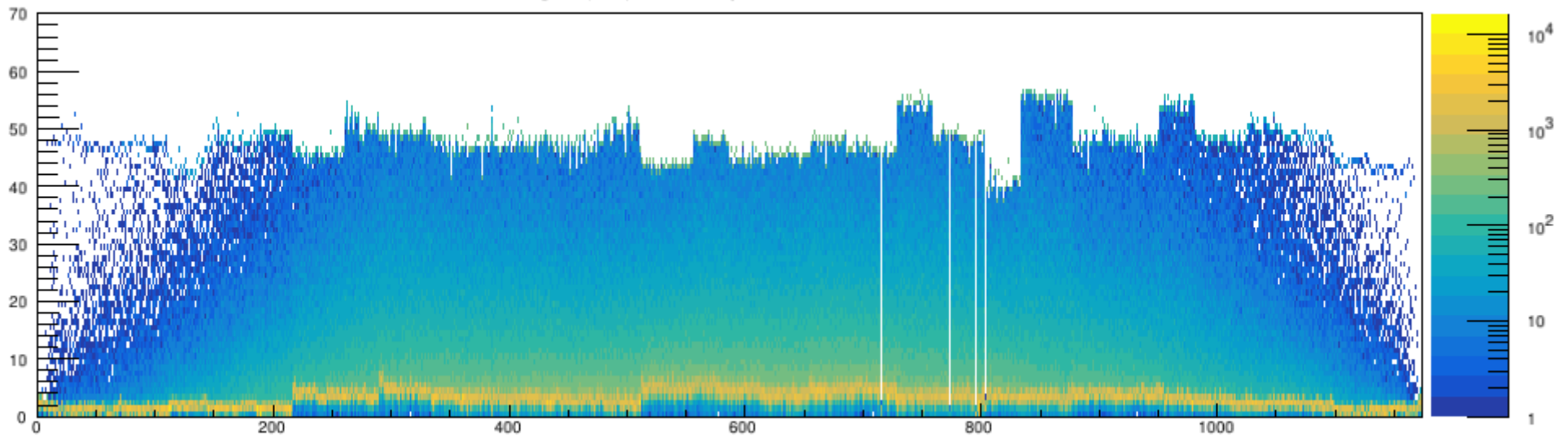
hit charge (fC) vs strip ID

LAYER 1

hit charge (fC) vs stripID in L1, S1, x view



hit charge (fC) vs stripID in L1, S1, v view

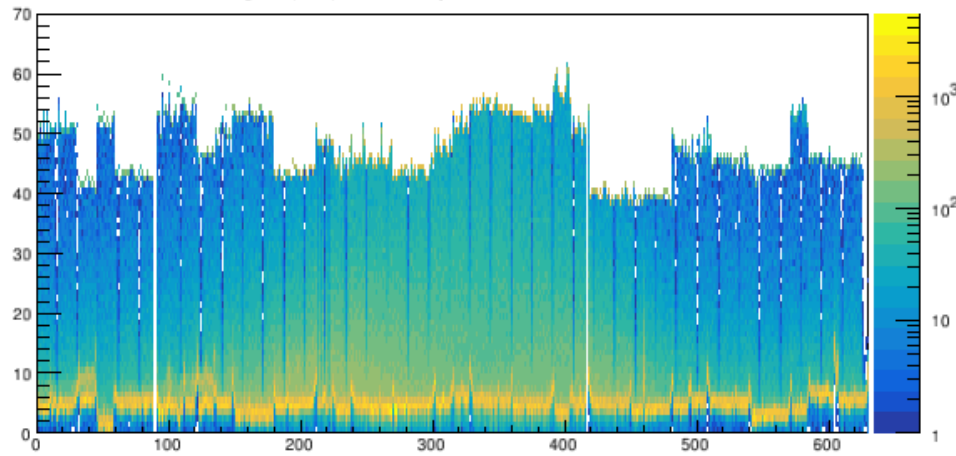


hit charge (fC) vs strip ID

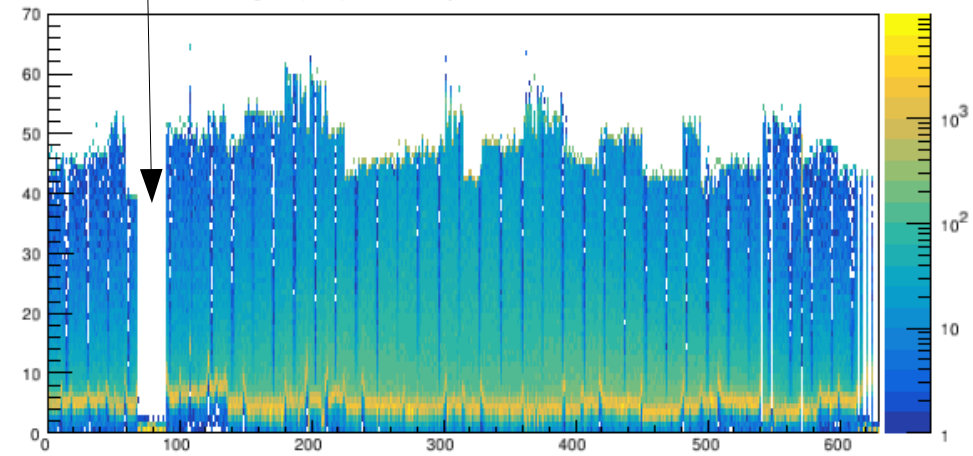
LAYER 2

broken tail

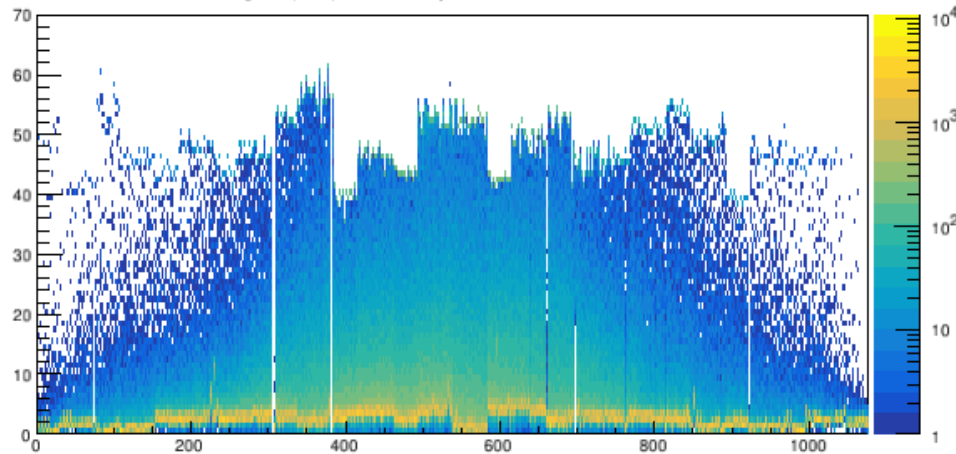
hit charge (fC) vs stripID in L2, S1, x view



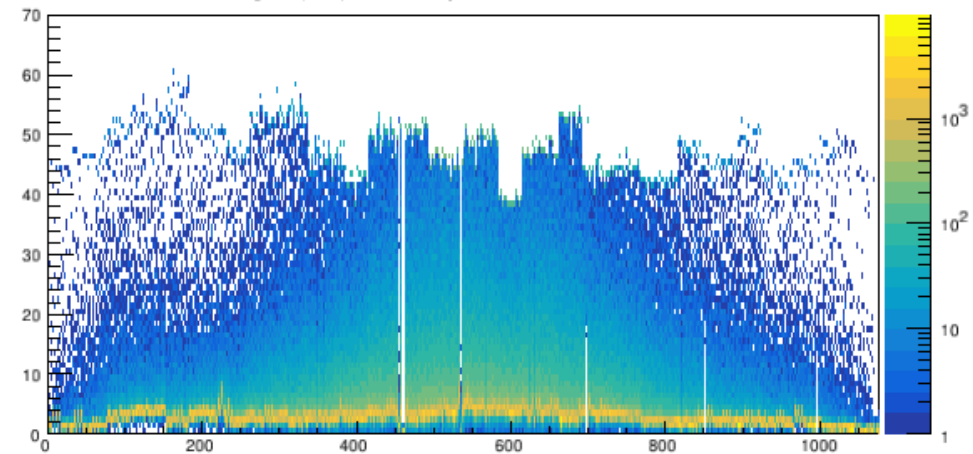
hit charge (fC) vs stripID in L2, S2, x view



hit charge (fC) vs stripID in L2, S1, v view



hit charge (fC) vs stripID in L2, S2, v view

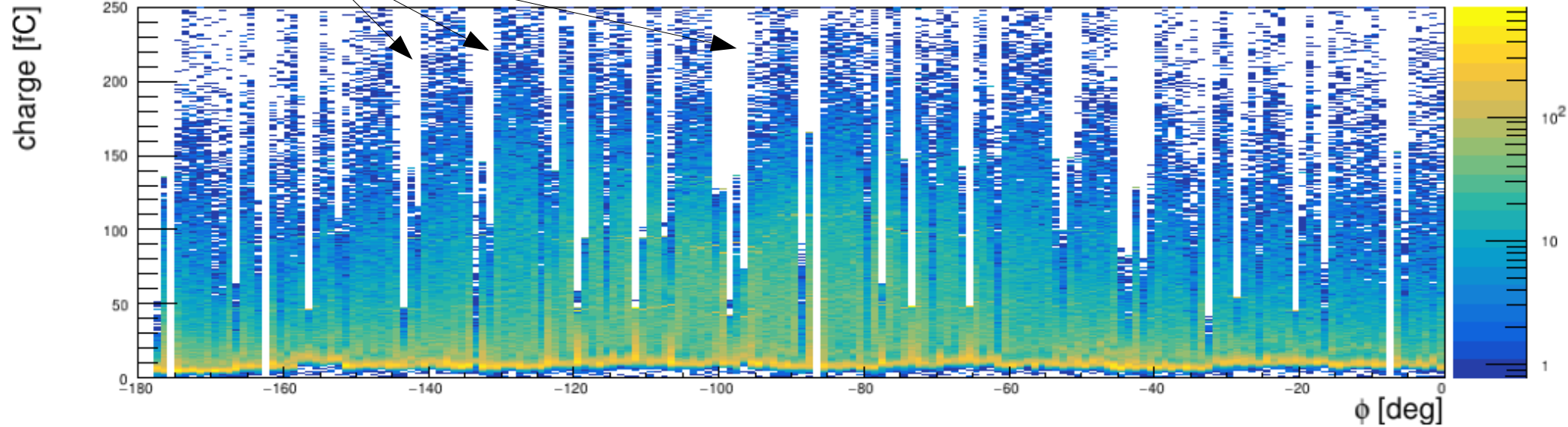


1D cluster charge (fC) vs ϕ/v

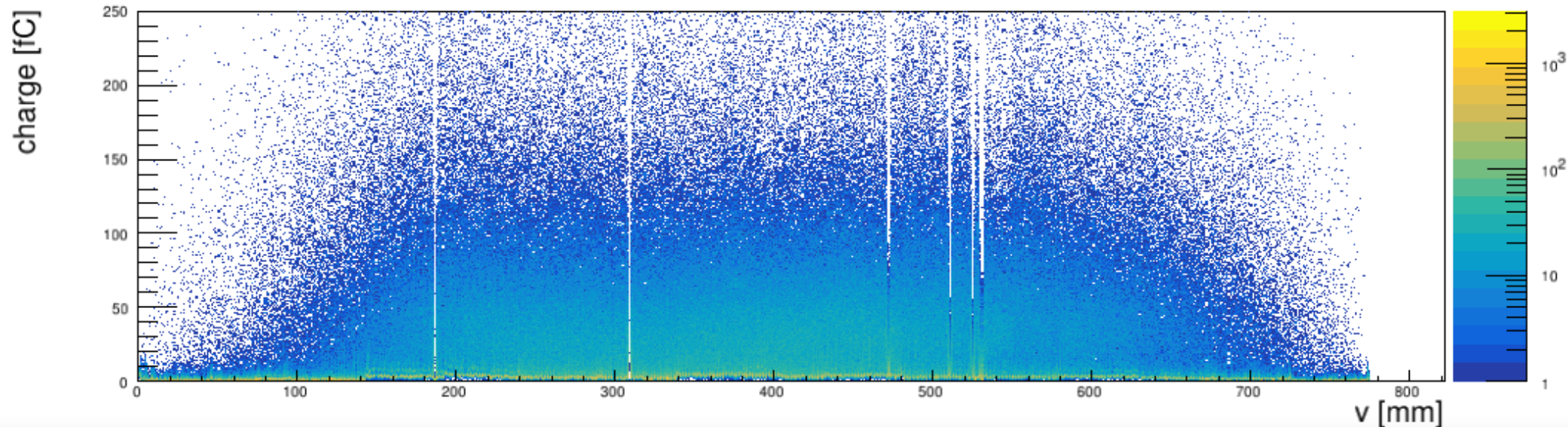
Microsectors register less charge

LAYER 1

cluster1d charge (fC) vs phi (deg) in L1, S1, x view



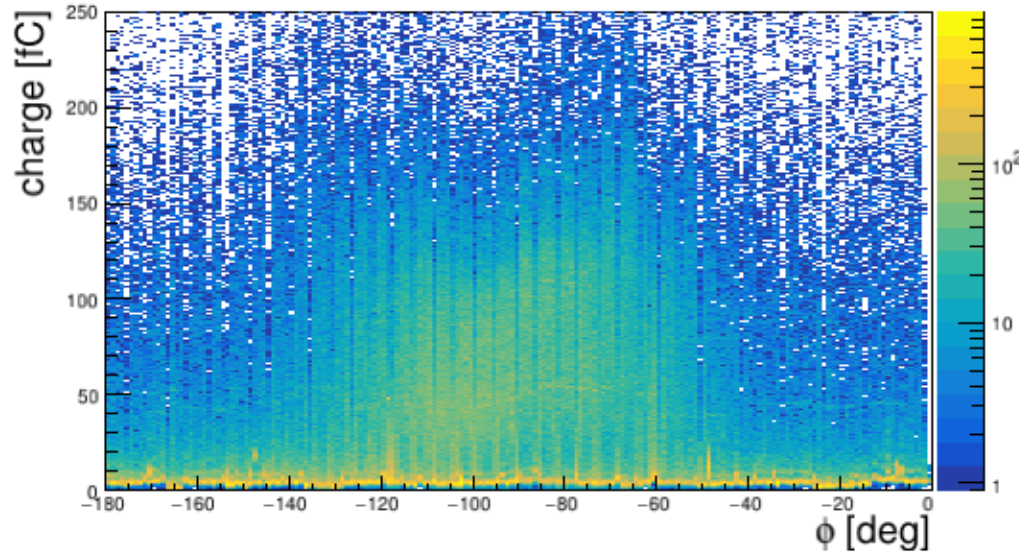
cluster1d charge (fC) vs v (mm) in L1, S1, v view



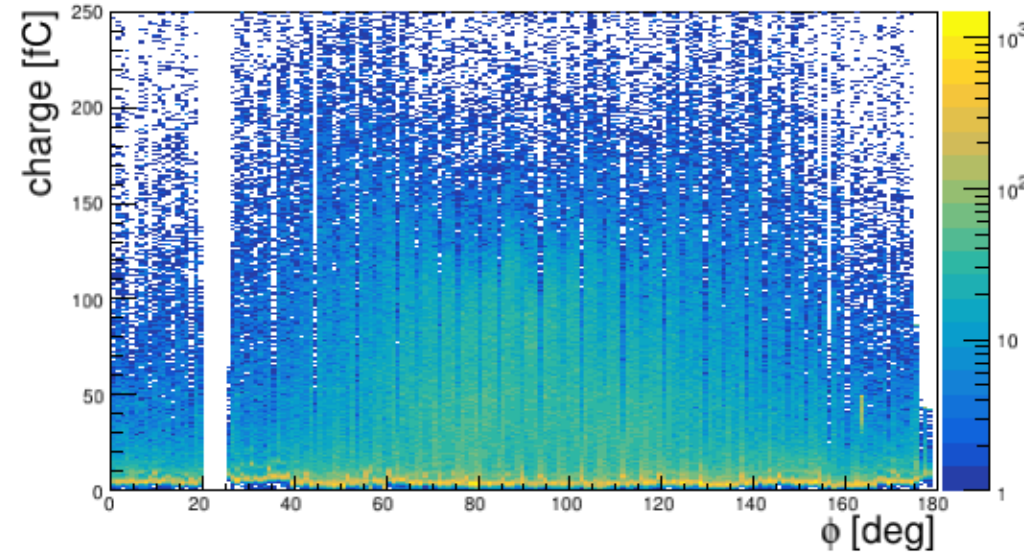
1D cluster charge (fC) vs ϕ/v

LAYER 2

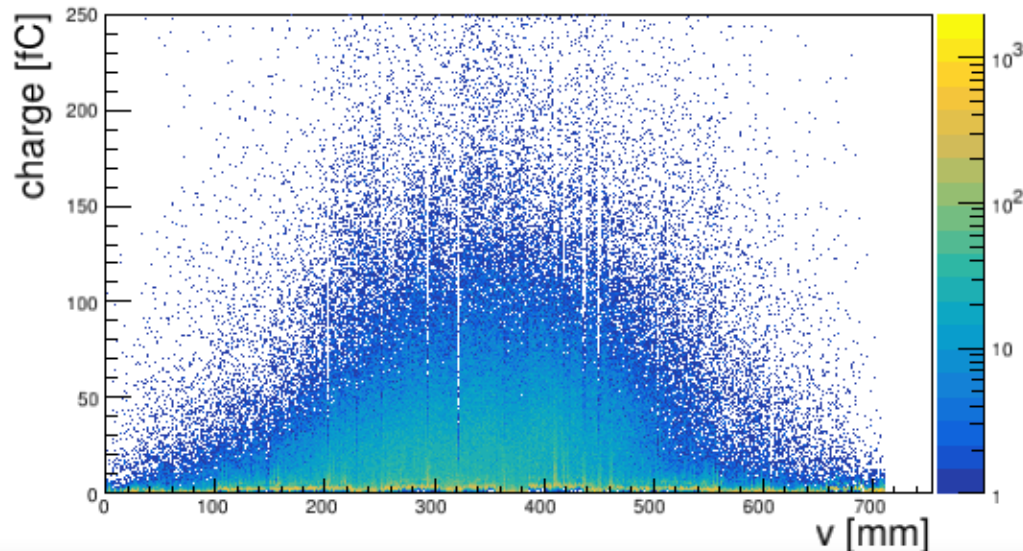
cluster1d charge (fC) vs phi (deg) in L2, S1, x view



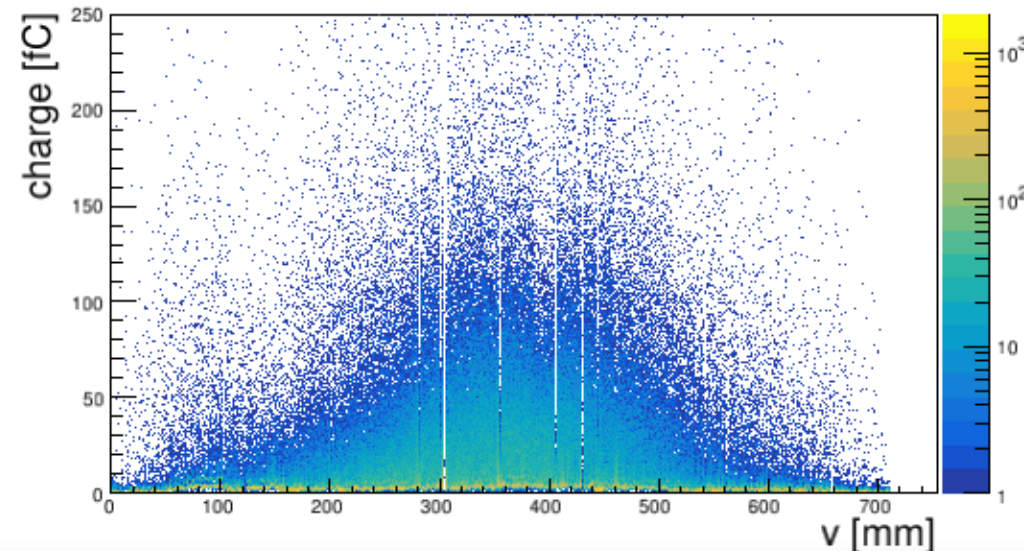
cluster1d charge (fC) vs phi (deg) in L2, S2, x view



cluster1d charge (fC) vs v (mm) in L2, S1, v view

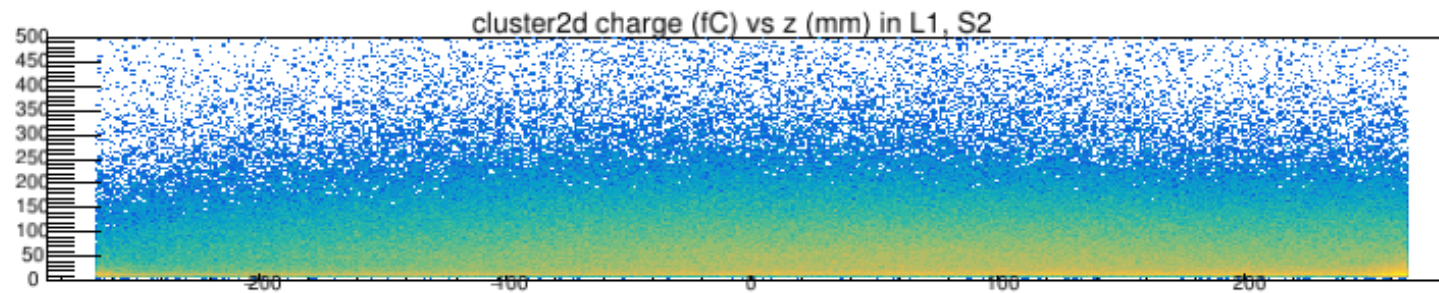
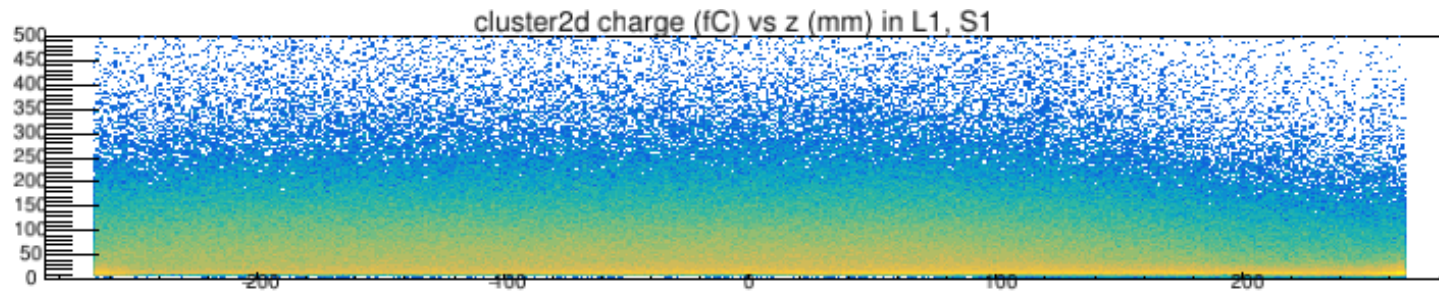


cluster1d charge (fC) vs v (mm) in L2, S2, v view

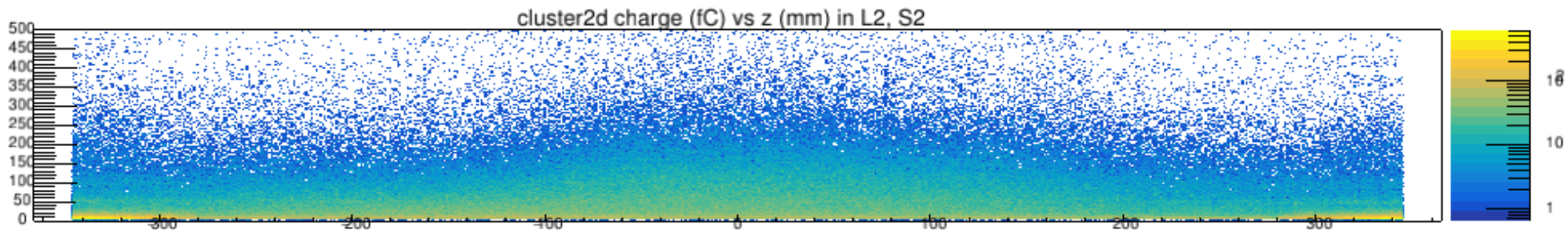
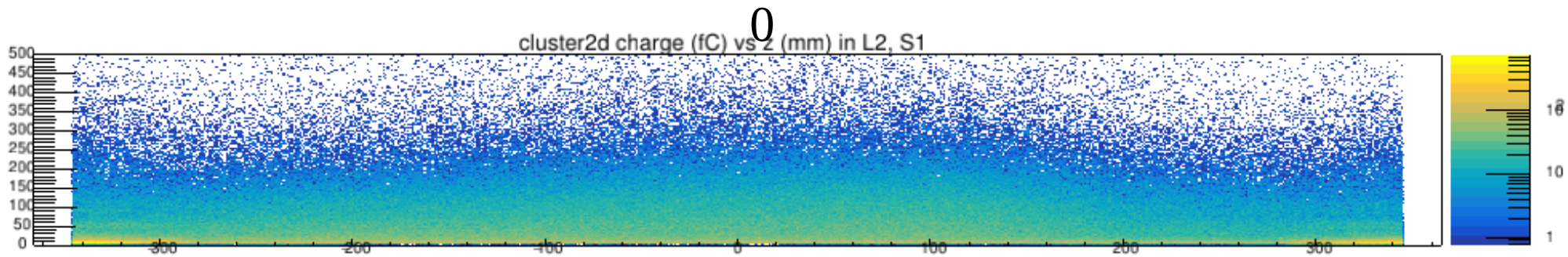


2D cluster charge (fC) vs z (mm)

LAYER 1

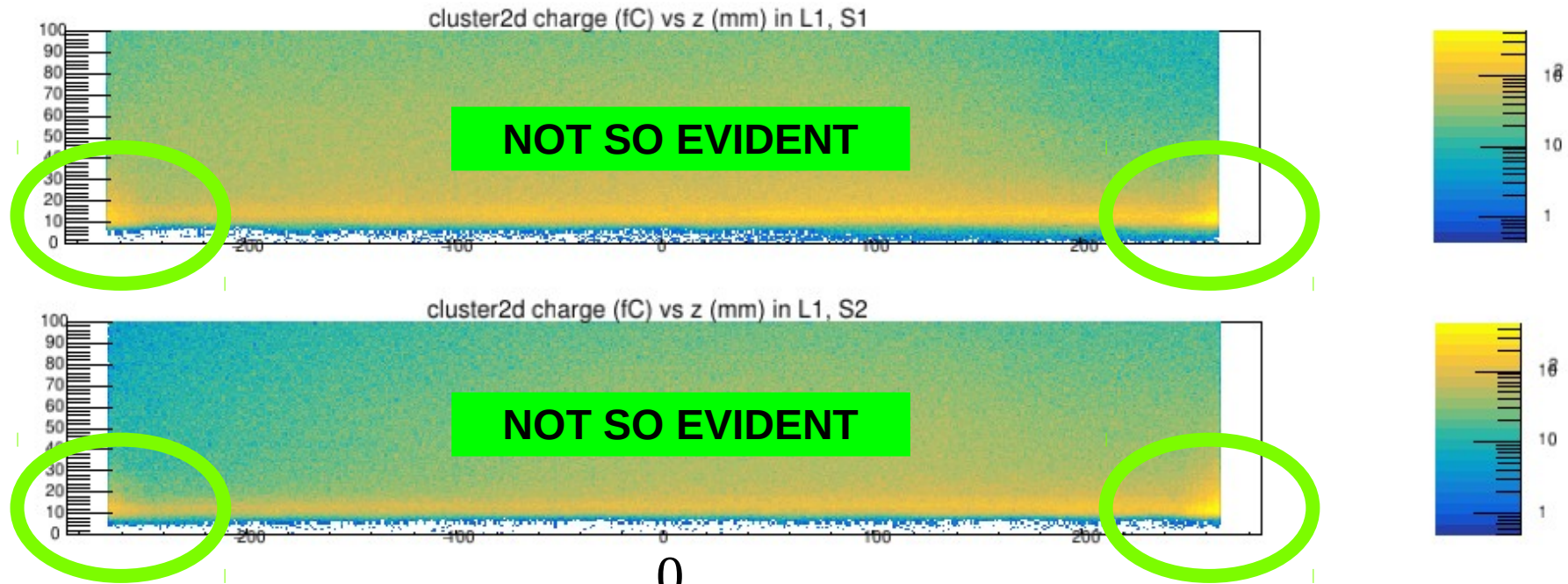


LAYER 2

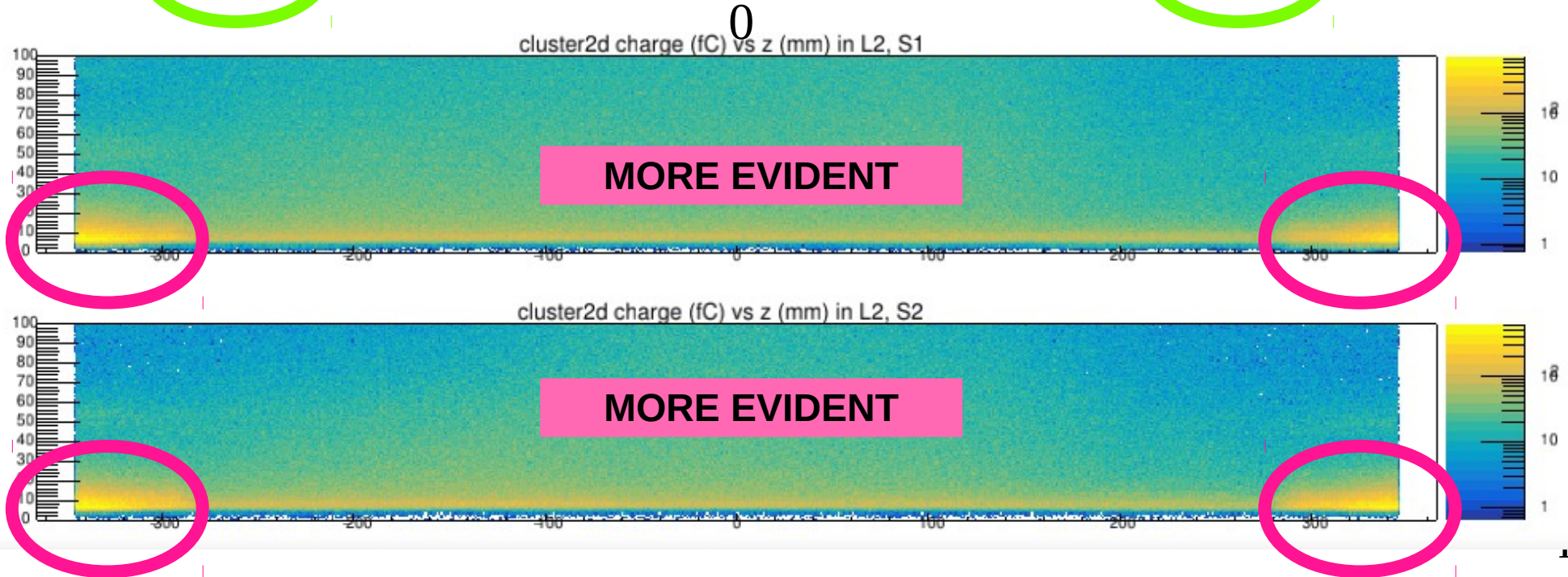


2D cluster charge (fC) vs z (mm) - ZOOM

LAYER 1

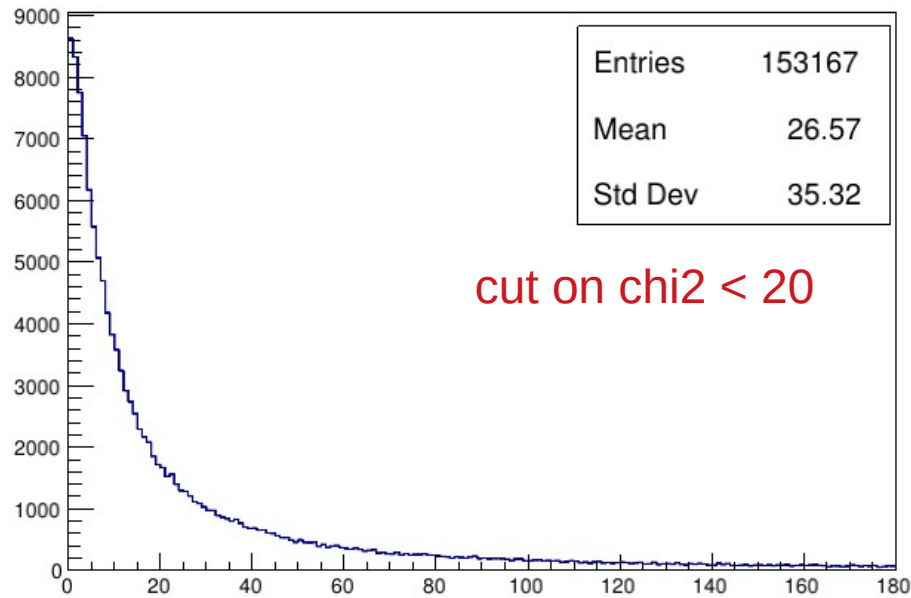


LAYER 2



Reconstructed track – residual distro – L1 bottom

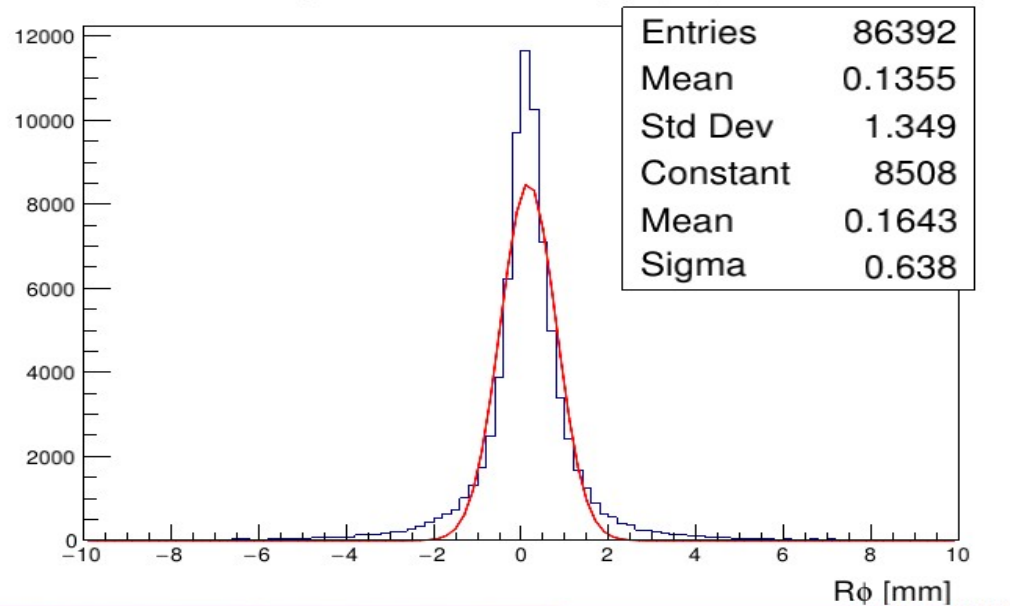
fitted track chi2



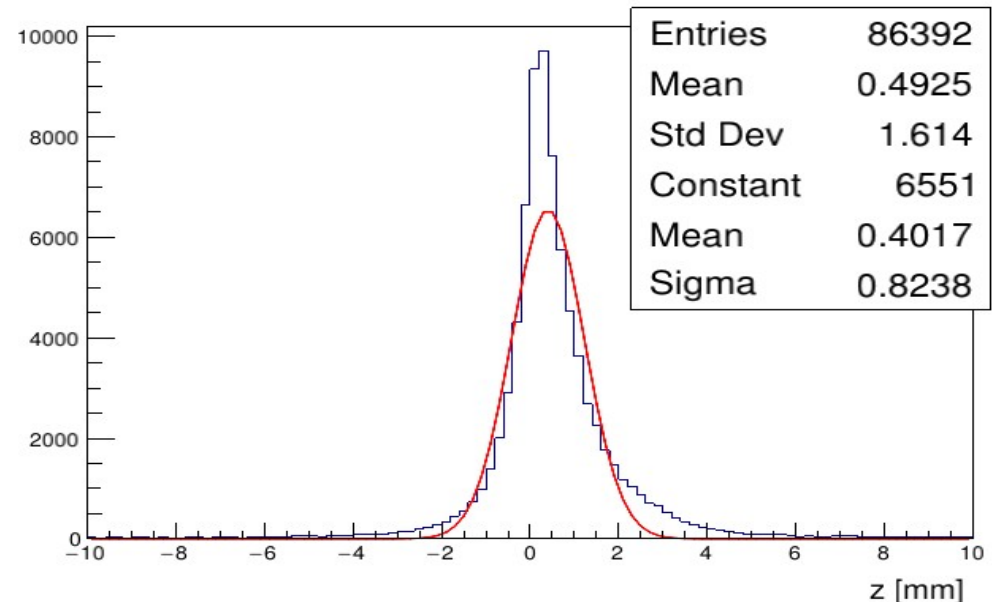
	STANDALONE	QA procedure
$R * \phi$ [mm] (mean, sigma)	0.01388	0.1643
	0.3617	0.638
Z [mm] (mean, sigma)	0.004913	0.4017
	0.6144	0.8238

NO ACCORDANCE

test plane: residual in $R * \phi$ (mm)



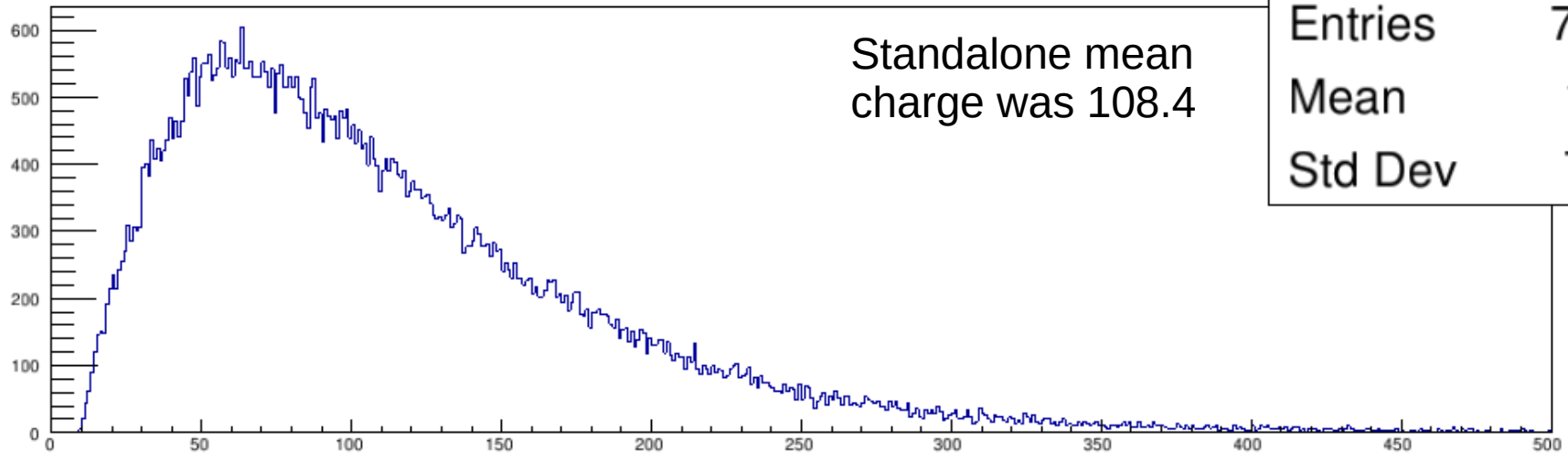
test plane: residual in z (mm)



Reconstructed track – signal – L1 bottom

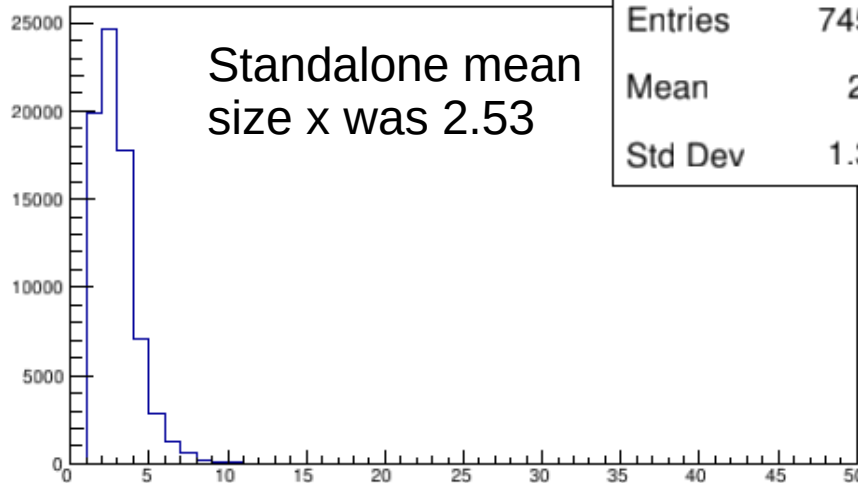
Inside 5 sigma

total charge of the signal (fC)



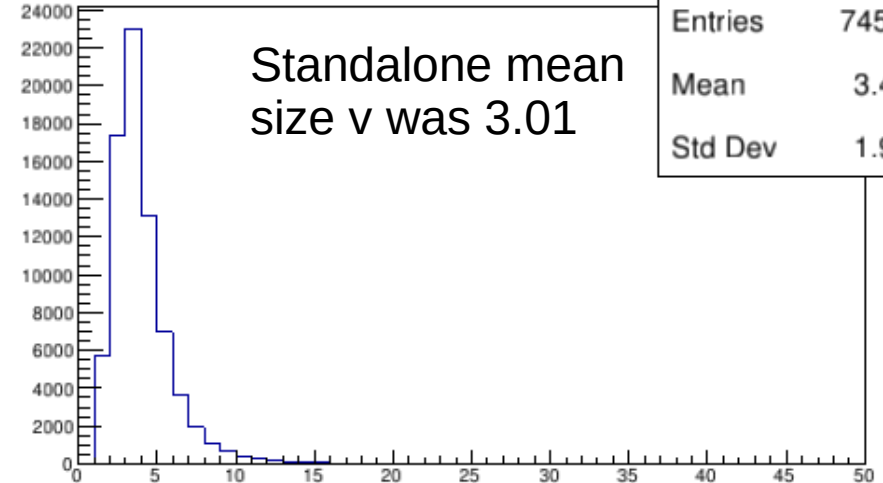
Standalone mean
charge was 108.4

cl.size x of the signal



Standalone mean
size x was 2.53

cl.size v of the signal



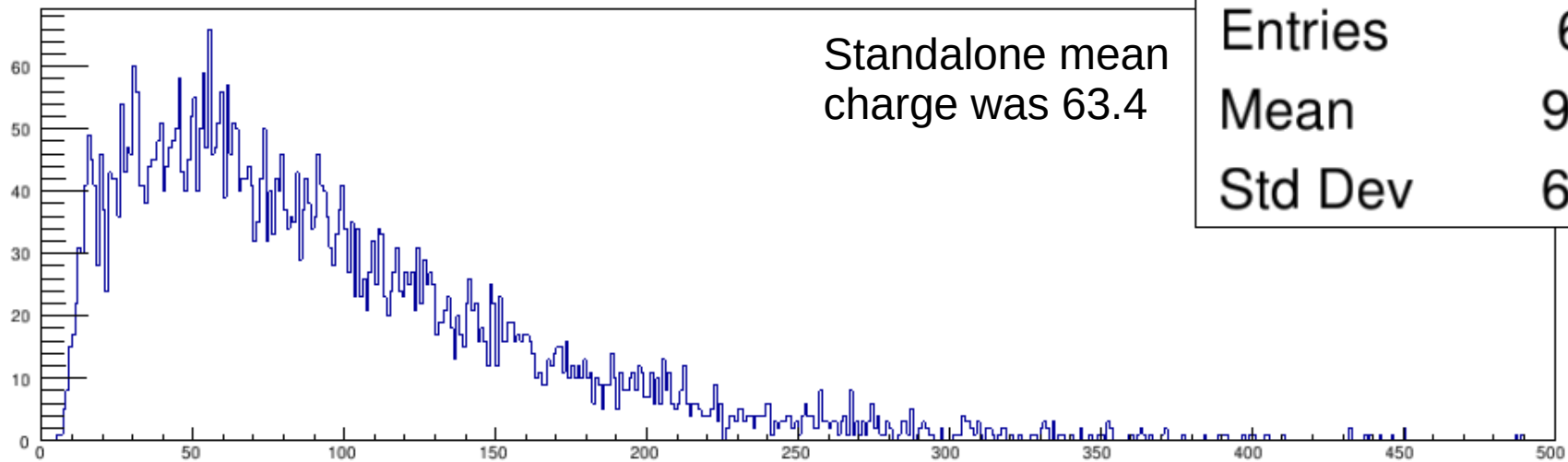
Standalone mean
size v was 3.01

The accordance is not so bad...

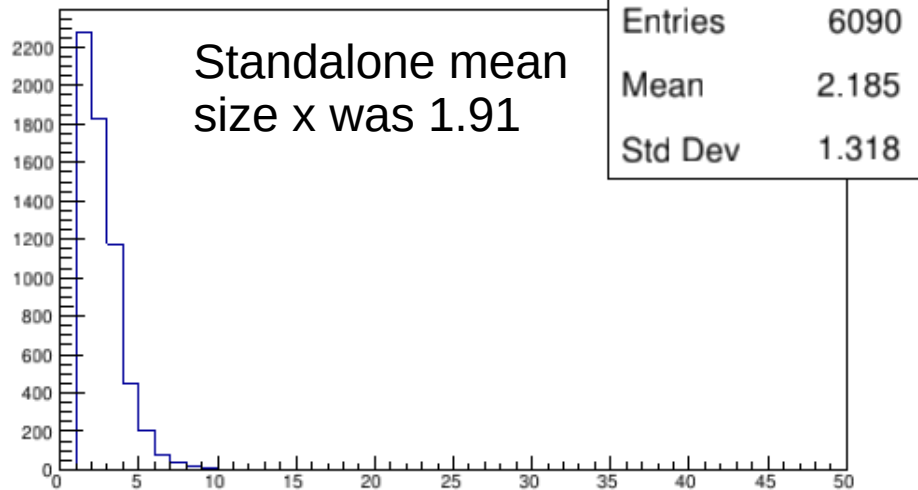
Reconstructed track – background – L1 bottom

outside 10 sigma

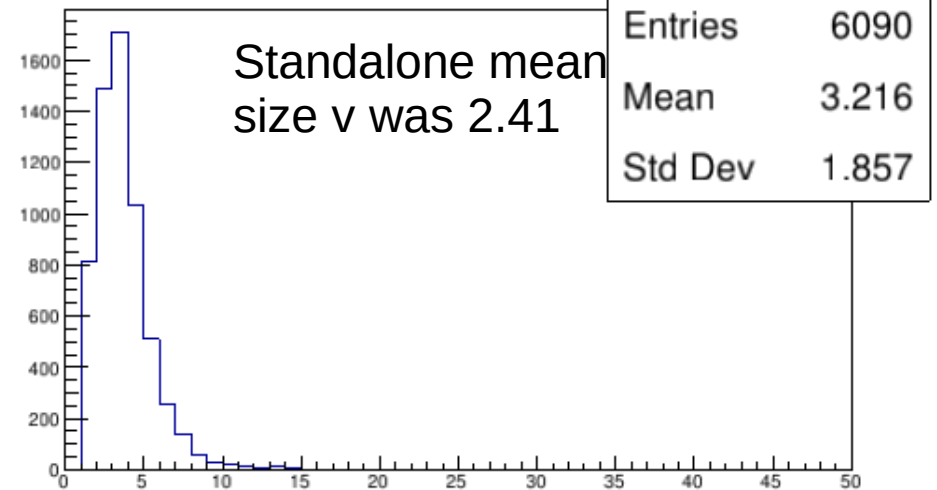
total charge of the background (fC)



cl.size x of the background



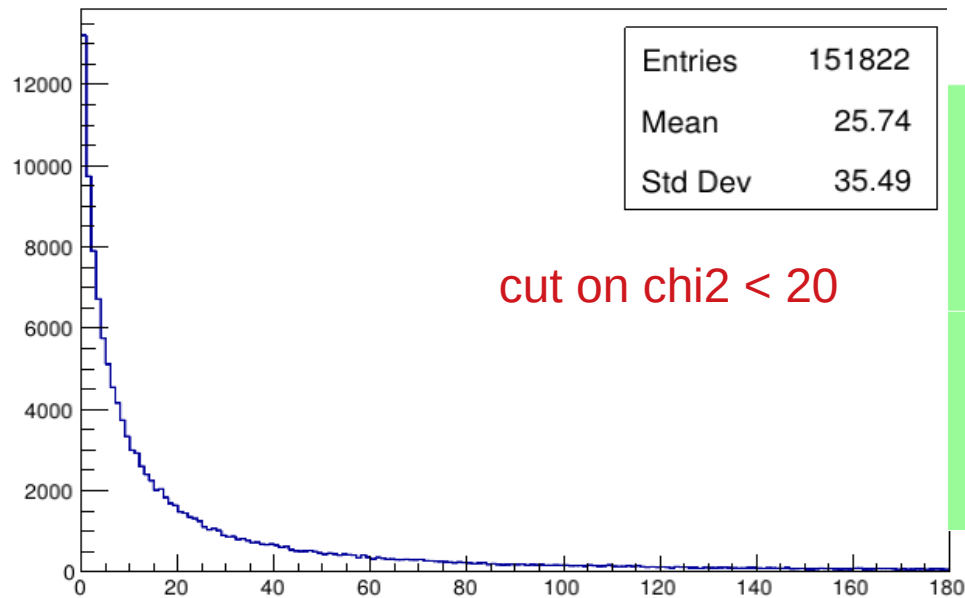
cl.size v of the background



The accordance is **not good**...

Reconstructed track – residual distro – L1 top

titted track chi2



STANDALONE

QA procedure

$R * \phi$ [mm]
(mean,
sigma)

-0.03825

0.3201

0.318

0.619

Z [mm]
(mean,
sigma)

-0.03851

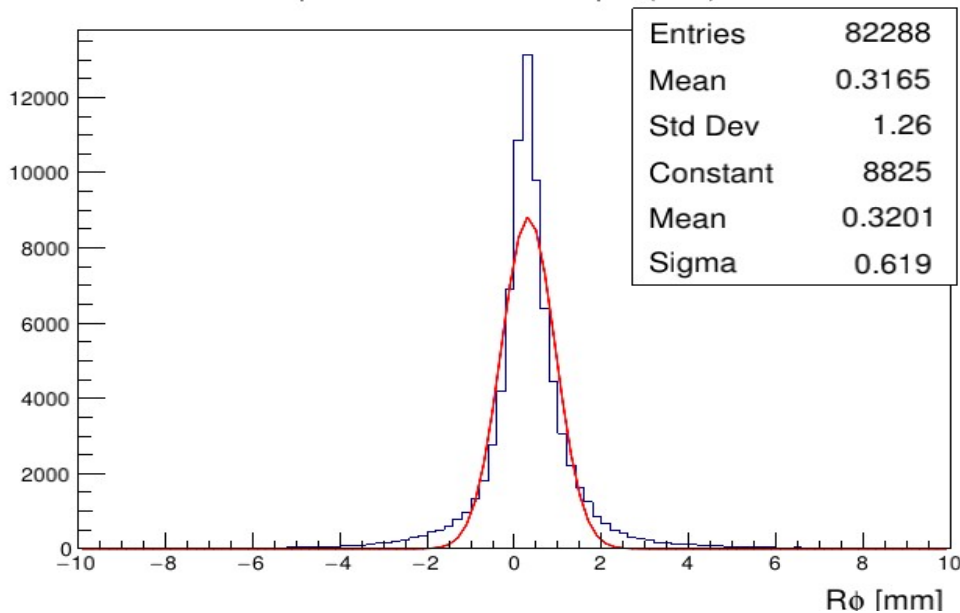
-0.1311

0.5585

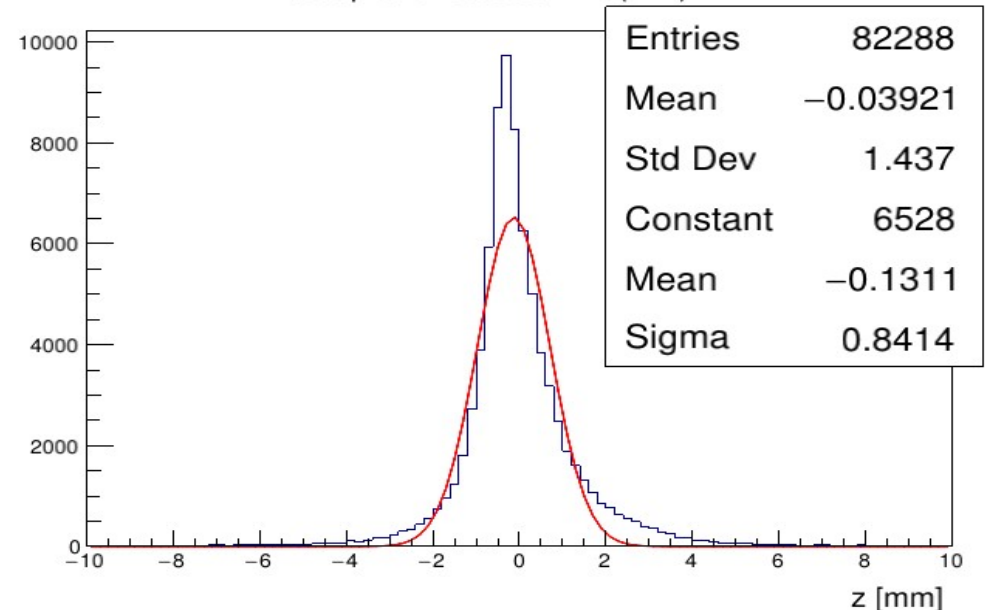
0.8414

NO ACCORDANCE

test plane: residual in $R * \phi$ (mm)

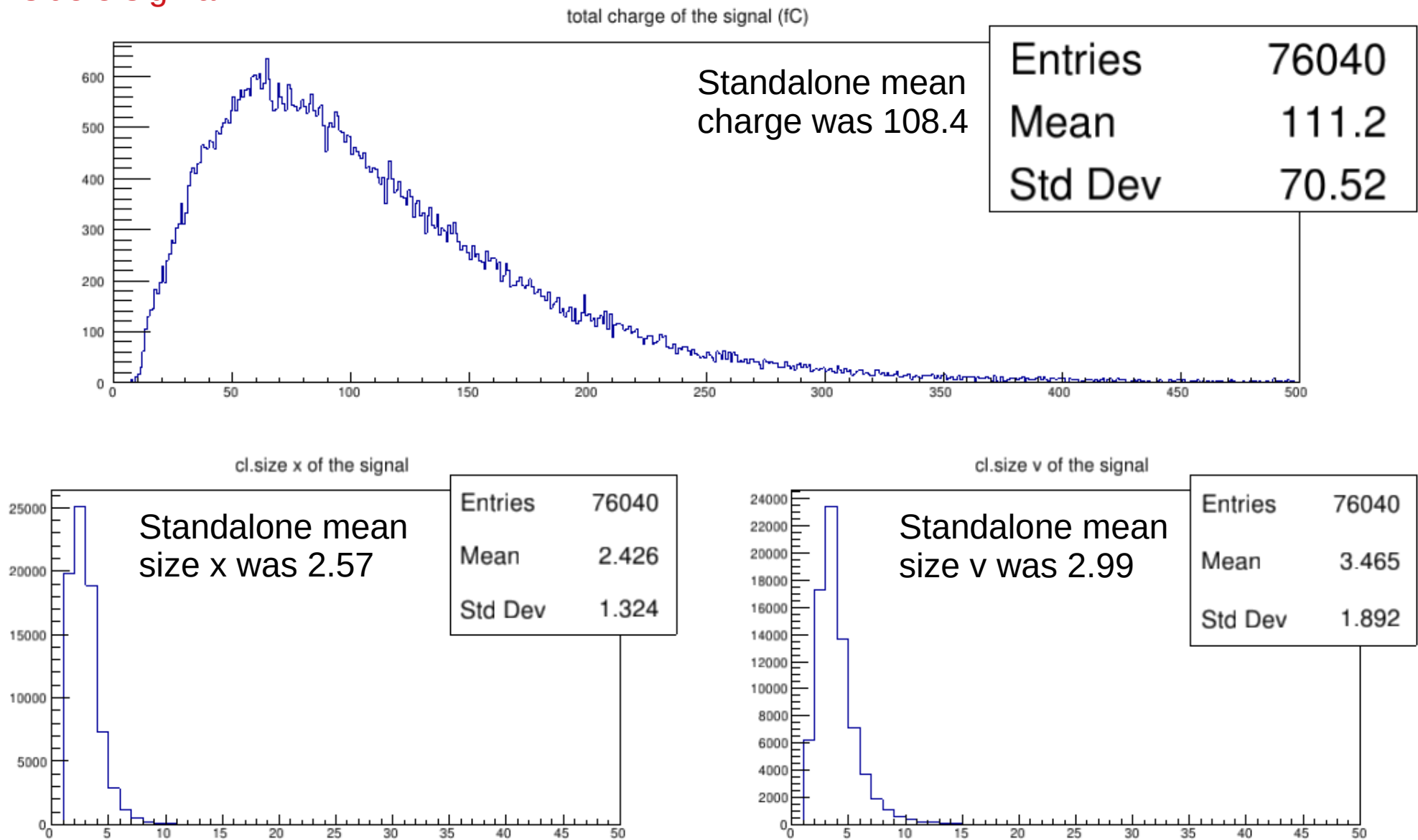


test plane: residual in z (mm)



Reconstructed track – signal – L1 top

Inside 5 sigma

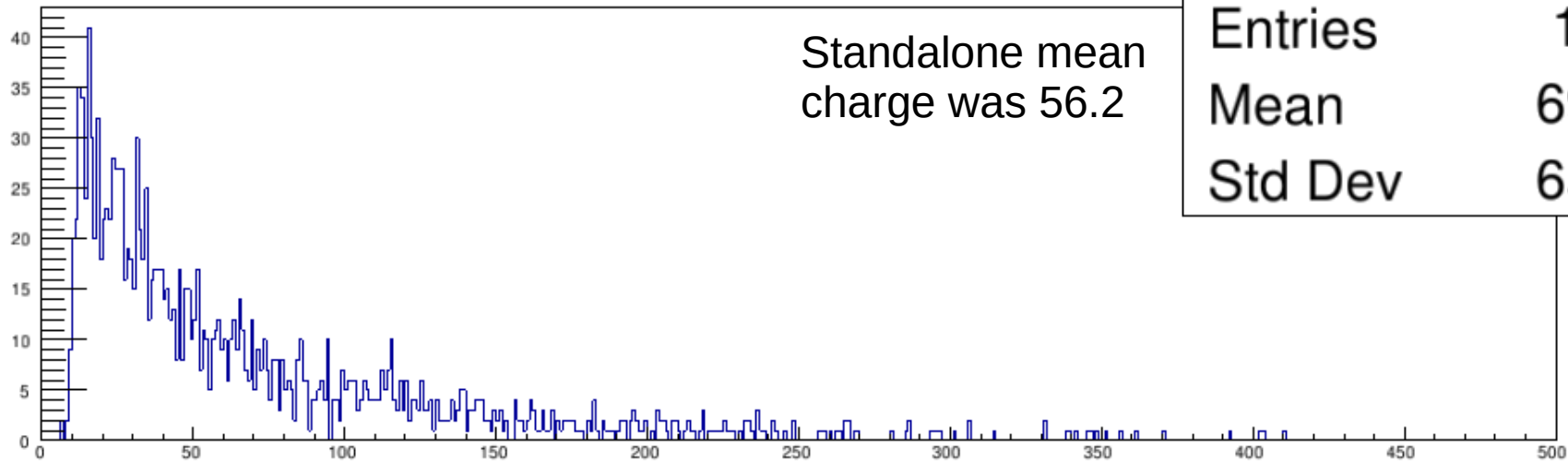


The accordance is not so bad...

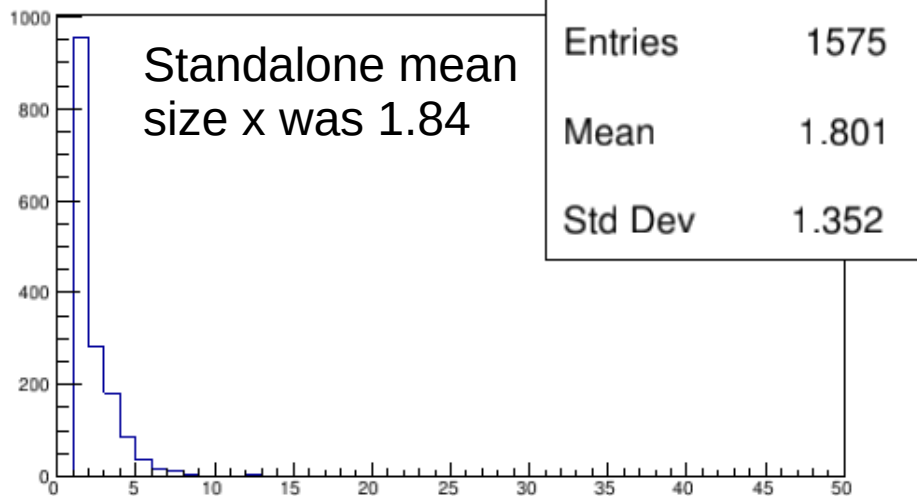
Reconstructed track – background – L1 top

outside 10 sigma

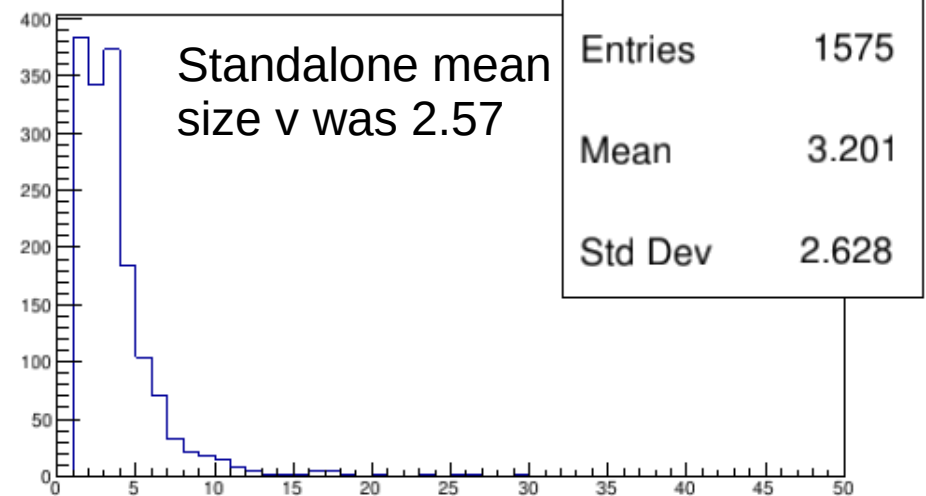
total charge of the background (fC)



cl.size x of the background

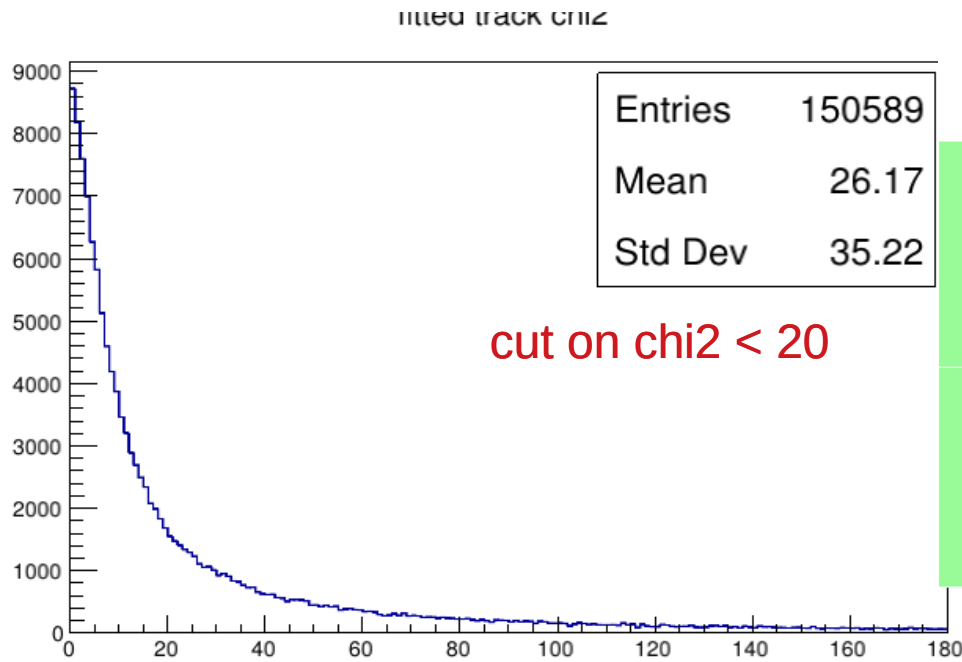


cl.size v of the background



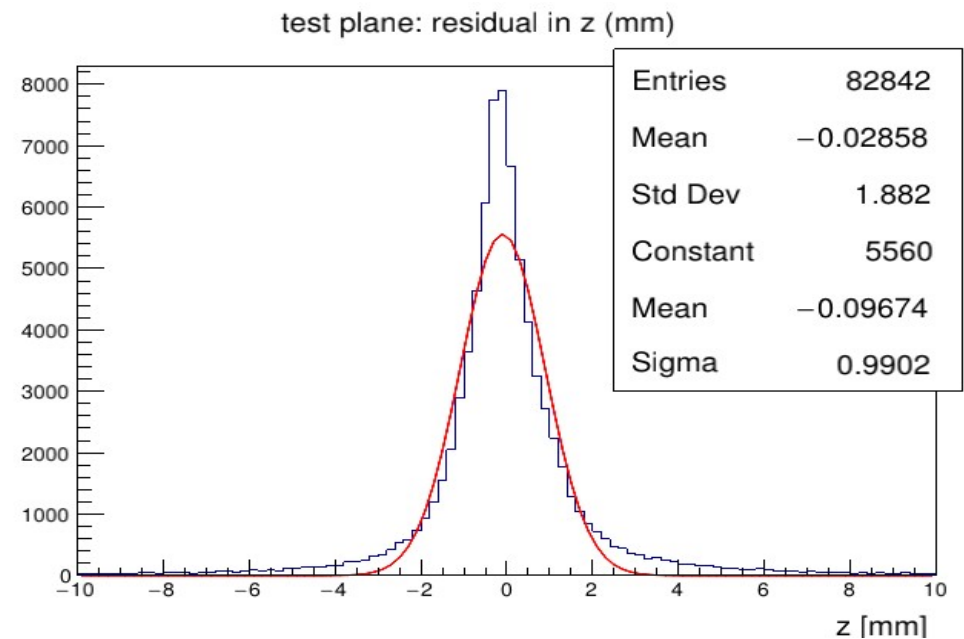
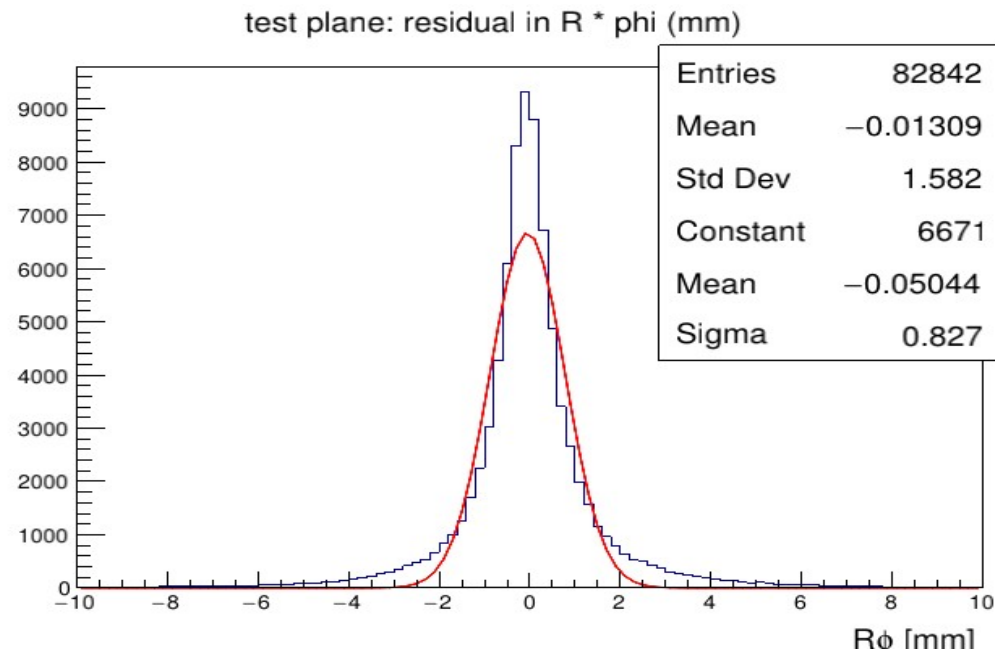
The accordance is **not good**...

Reconstructed track – residual distro – L2 bottom



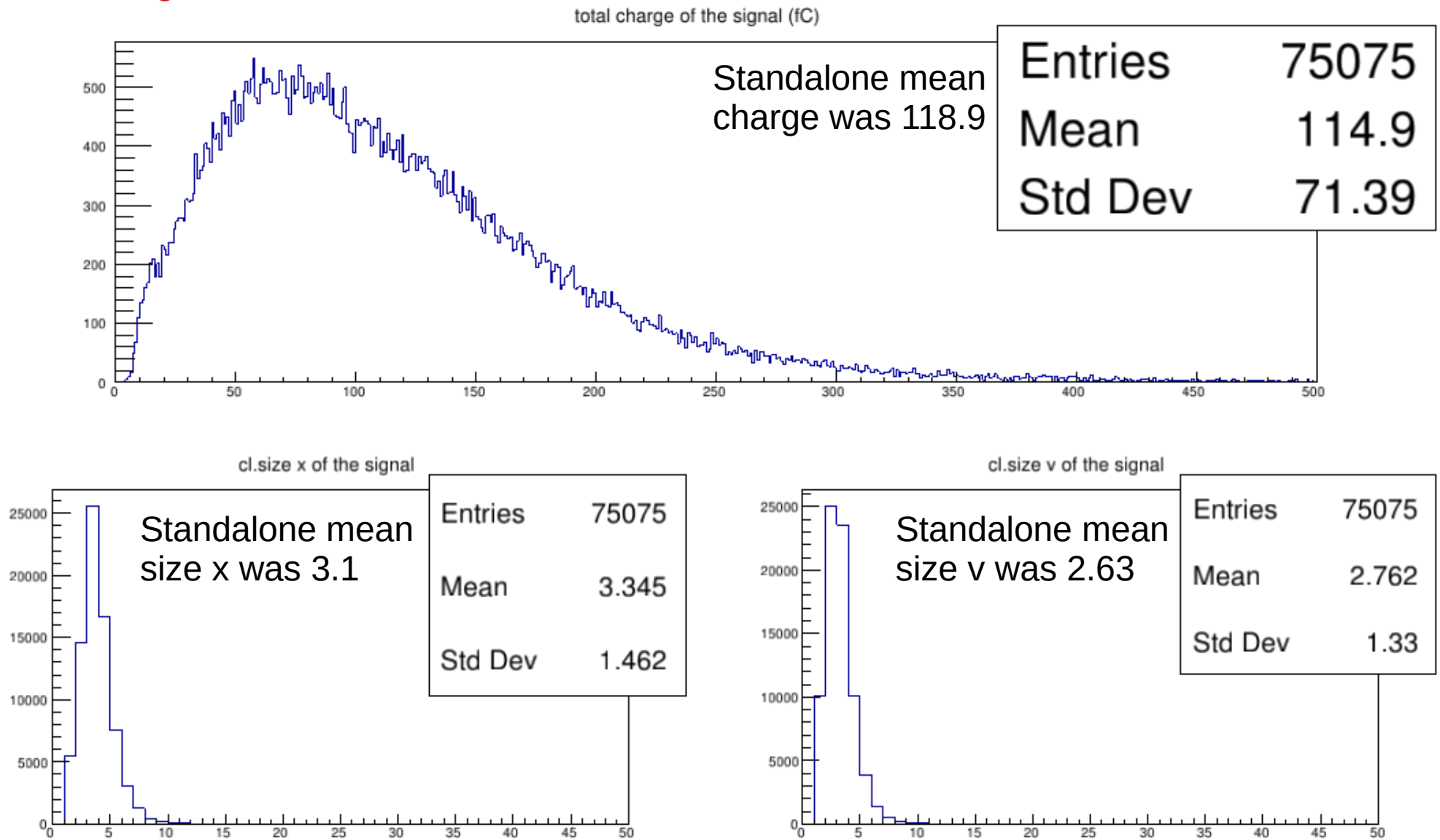
	STANDALONE	QA procedure
$R * \phi$ [mm] (mean, sigma)	-0.004101	-0.05044
	0.4534	0.827
Z [mm] (mean, sigma)	0.0141	-0.09674
	0.8019	0.9902

NO ACCORDANCE



Reconstructed track – signal – L2 bottom

Inside 5 sigma

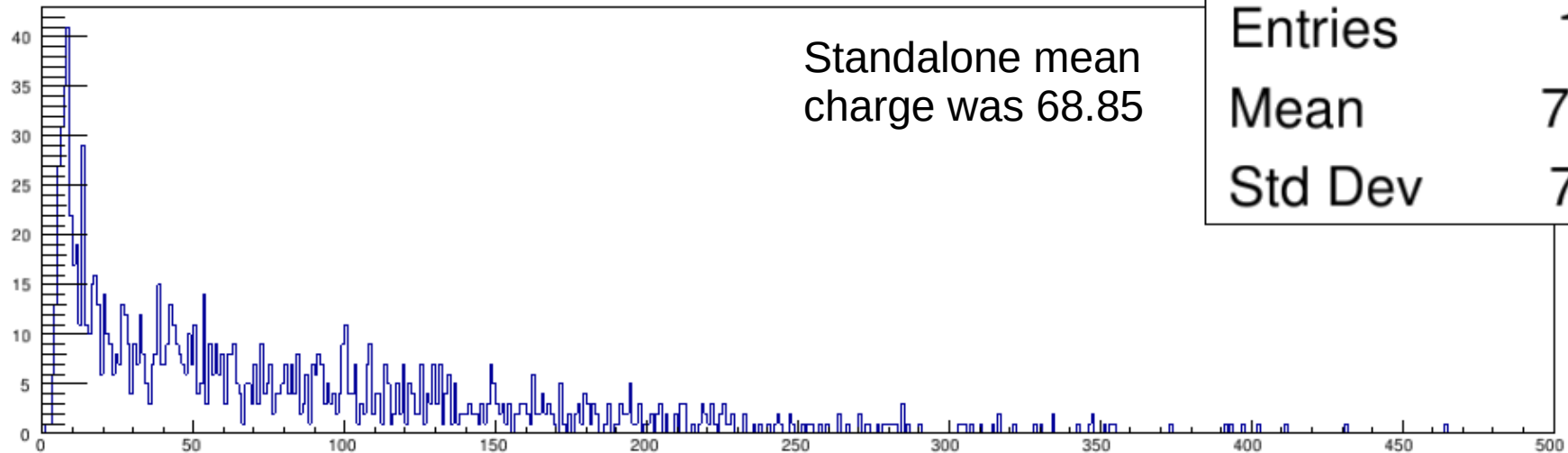


The accordance is not so bad...

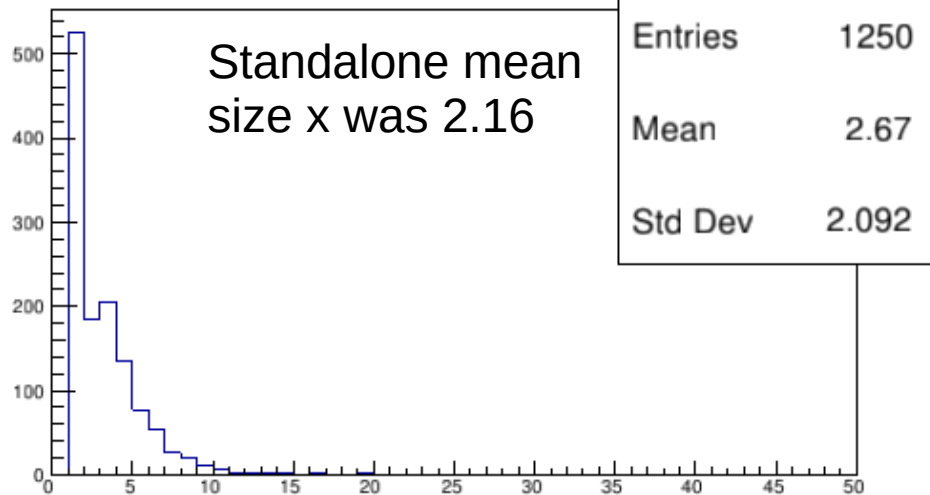
Reconstructed track – background – L2 bottom

outside 10 sigma

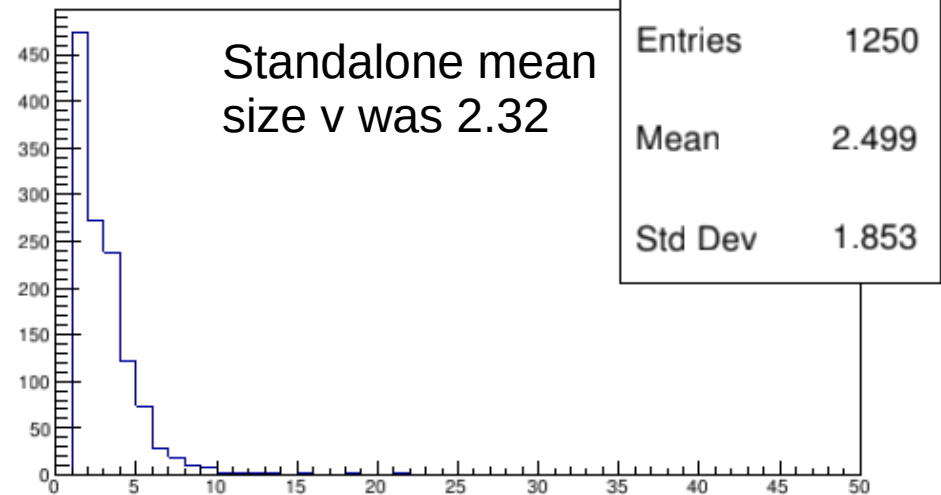
total charge of the background (fC)



cl.size x of the background



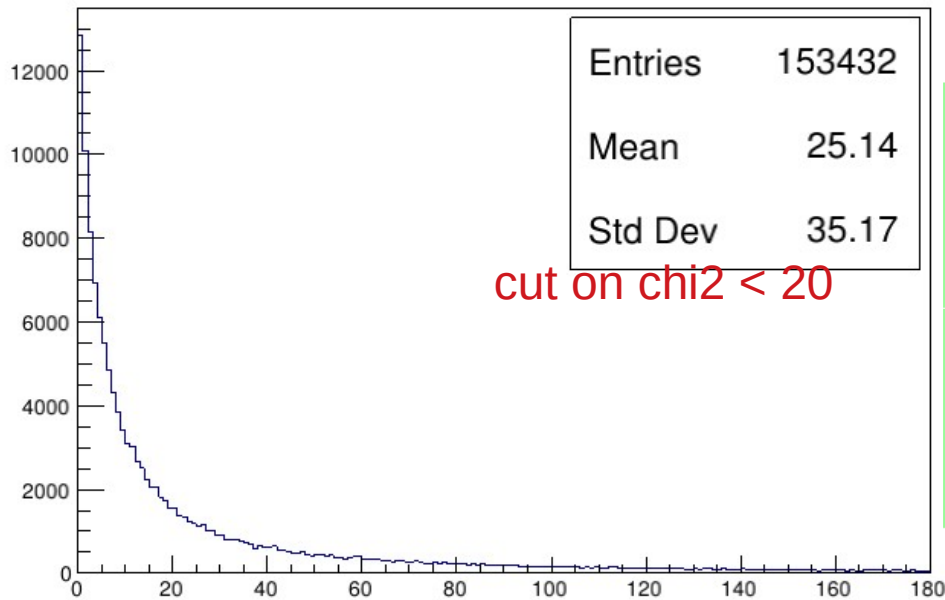
cl.size v of the background



The accordance is not so bad... look a the peak @ 1 in the size

Reconstructed track – residual distro – L2 top

titted track chi2



STANDALONE

QA procedure

$R * \phi$ [mm]
(mean,
sigma)

0.03189

-0.2625

0.402

0.8086

Z [mm]
(mean,
sigma)

0.01888

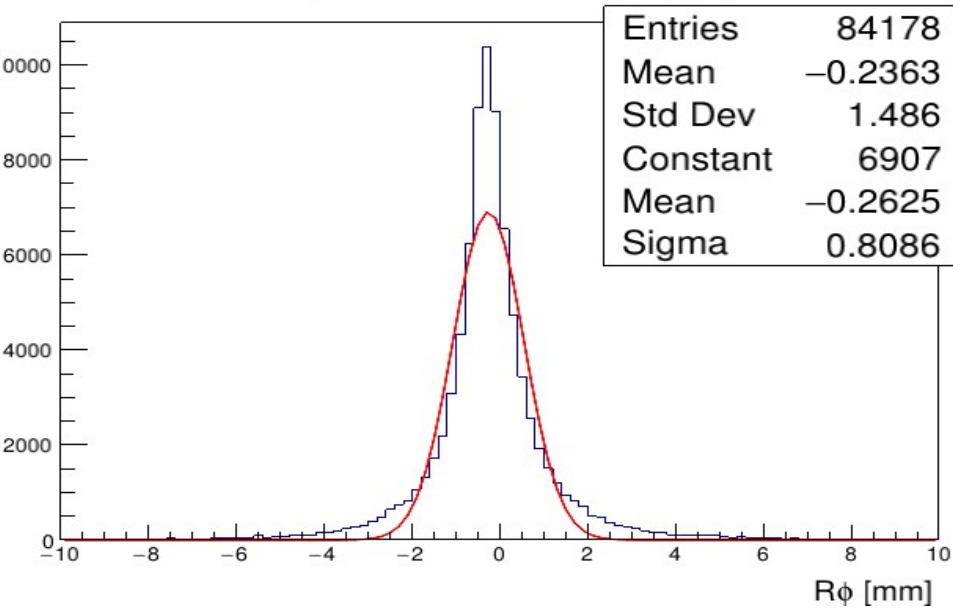
0.3181

0.6842

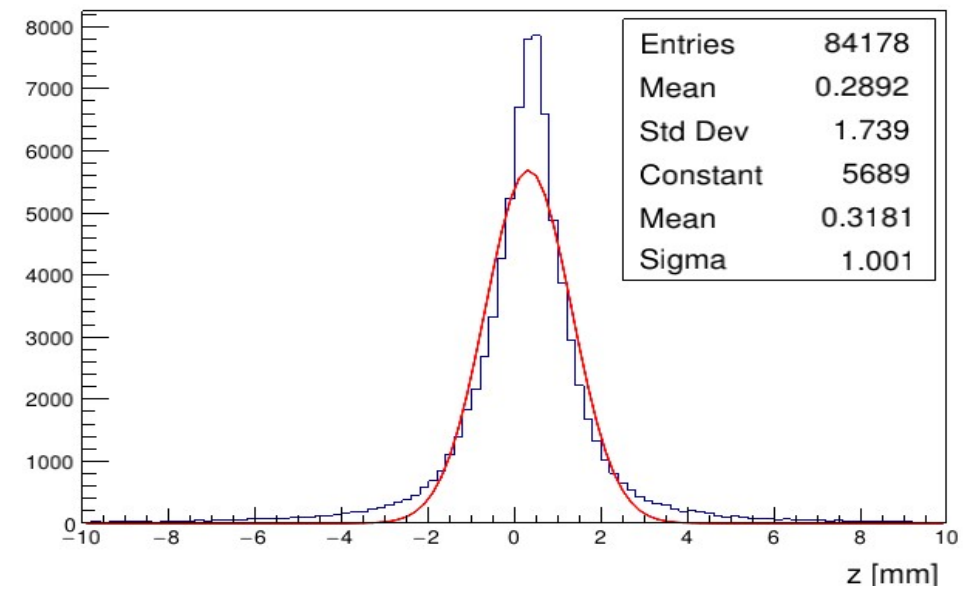
1.001

NO ACCORDANCE

test plane: residual in $R * \phi$ (mm)

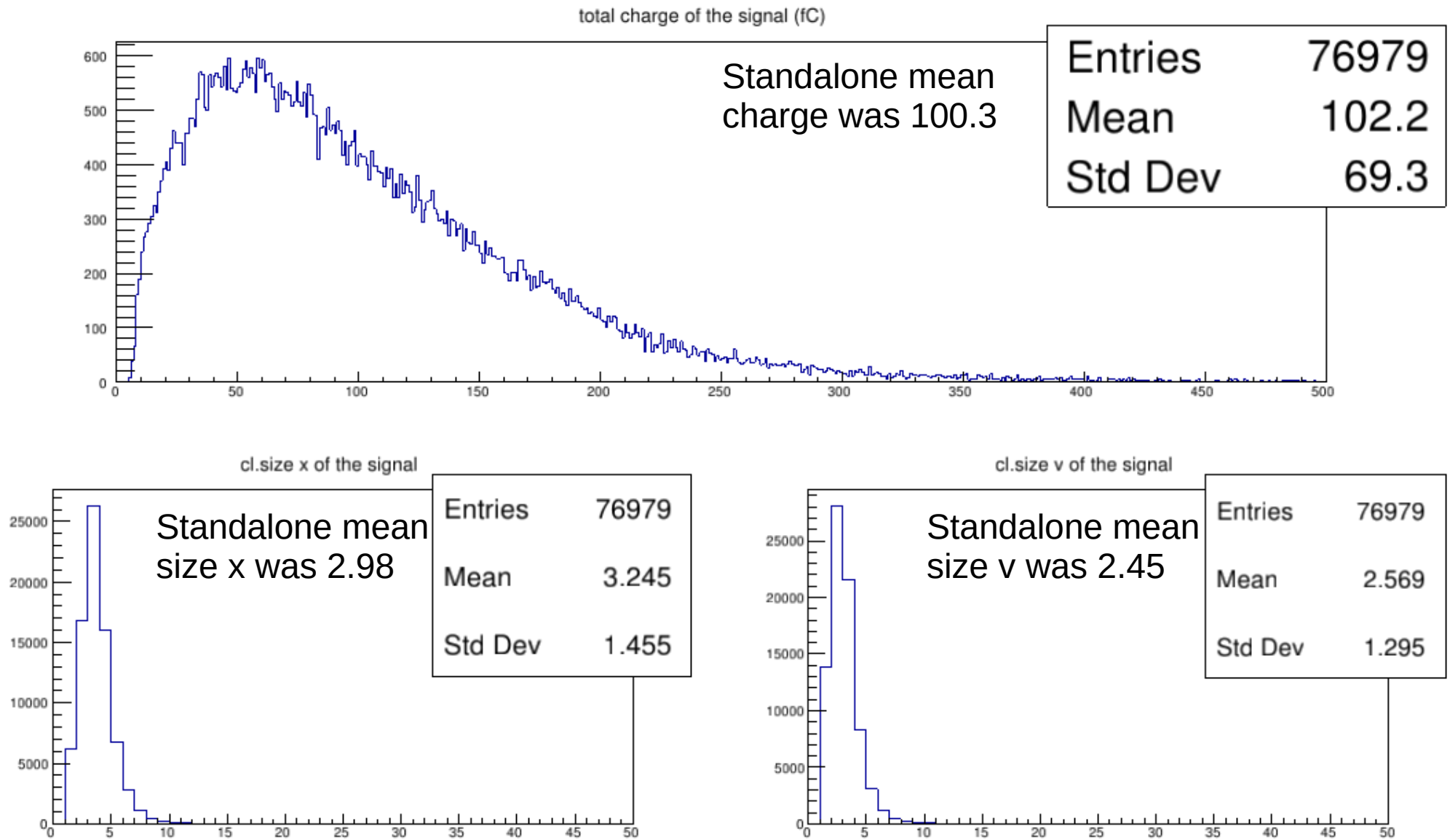


test plane: residual in z (mm)



Reconstructed track – signal – L2 top

Inside 5 sigma

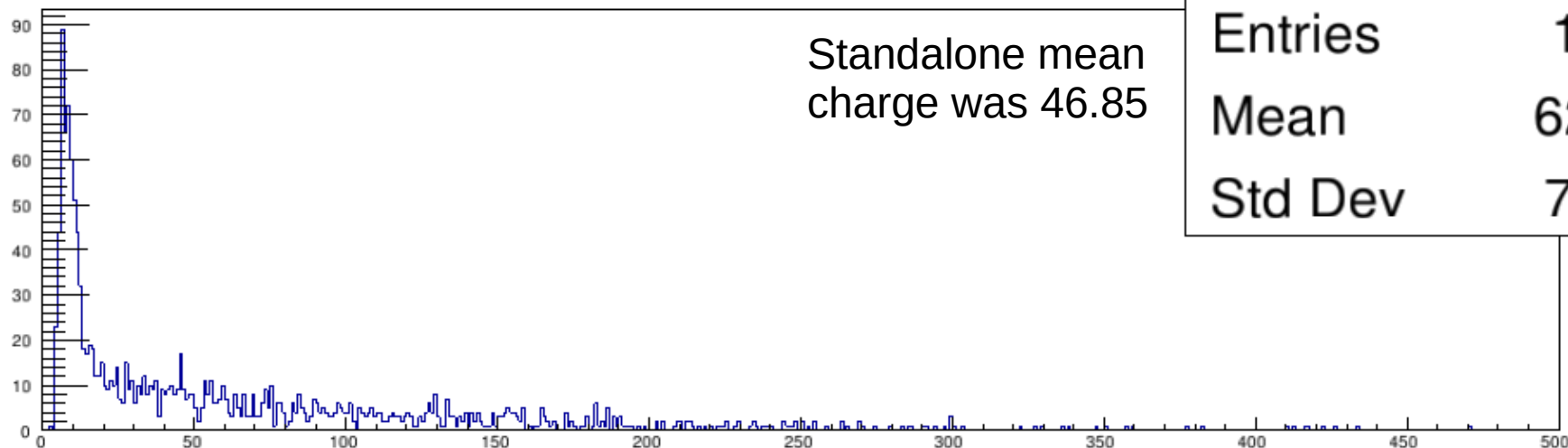


The accordance is not so bad...

Reconstructed track – background – L2 top

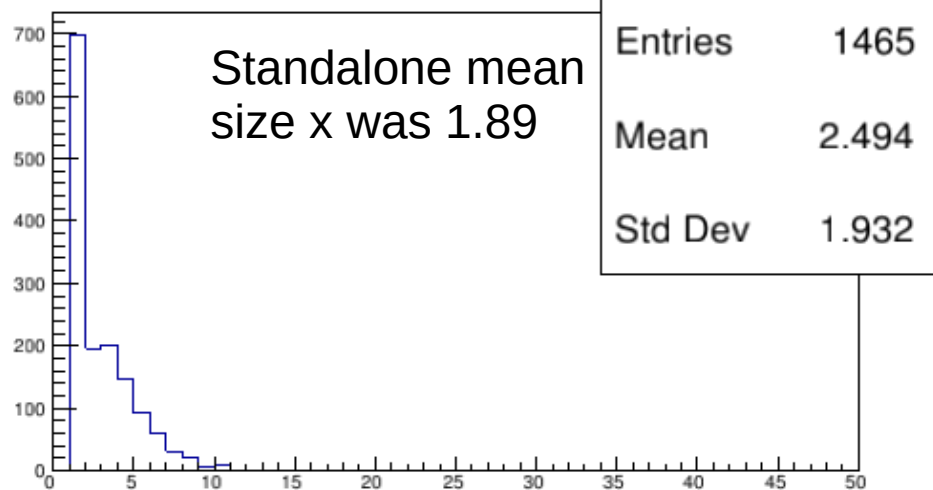
outside 10 sigma

total charge of the background (fC)



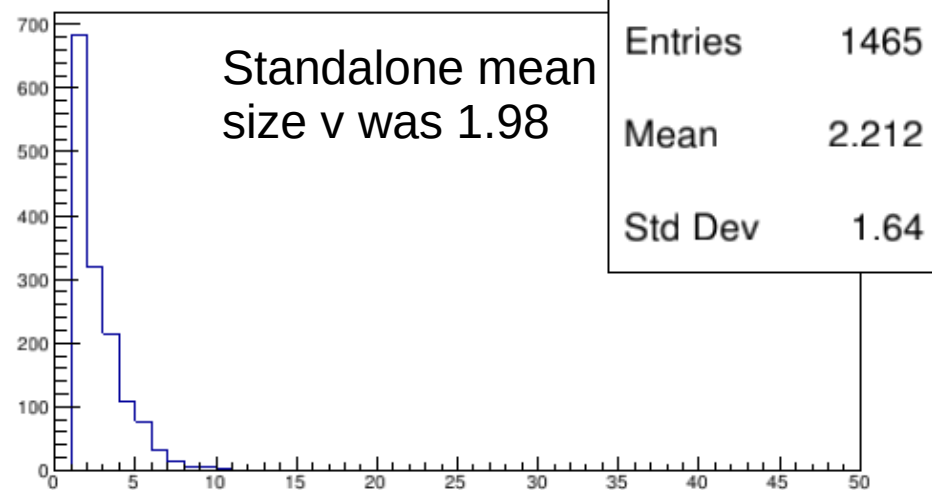
Standalone mean
charge was 46.85

cl.size x of the background



Standalone mean
size x was 1.89

cl.size v of the background



Standalone mean
size v was 1.98

The accordance is not so bad... look a the peak @ 1 in the size

Alignment?

I use the cluster 2D position (pre_aligned) transformed this way:

HepPoint3D aligned = alignment->point_invTransform(layer, pre_aligned)

And used aligned for the residuals

Is this correct?

Efficiency

EFFICIENCY	STANDALONE	QA procedure
L1 bottom	0.86234	0.86346
L1 top	0.8747	0.87784
L2 bottom	0.870972	0.8726
L2 top	0.866423	0.866998

The values of the efficiency are compatible

Conclusions

- The **statistics** is enhanced by the loop all + max Q, as expected
- The histograms of the **hits, the cluster 1D and cluster 2D** are compatible with what seen before
- The **efficiency** is the same as from the standalone, around 87%
- The **residual distributions** still have some problem:
 - They are not completely Gaussian, there are tails
 - They are not centered exactly in zero (maybe I did not apply alignment correctly when computing the residual values?)

The code is on CVS (not the last changes, but I will upload them soon)