

2026 SPS TB - HGCROC Readout

September 15, 2026

Friederike Bock



- 1 SPS 2026 Set B - 43V
 - Overview
 - Pedestals
 - TOA offset calibration
 - Muon Calibrations

- 2 Calibrations Summary

2026 SPS TB - HGCROC Readout Full Set B - analysis status



Overview - Set B



Full Set B

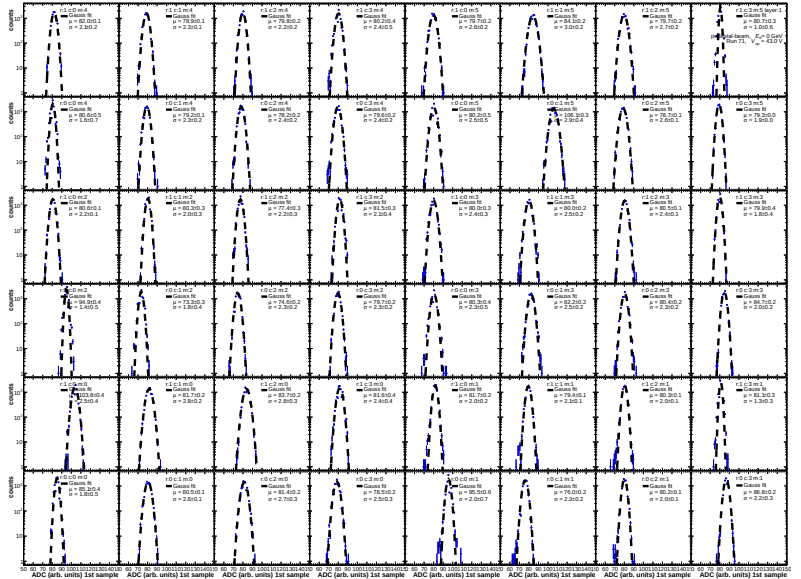
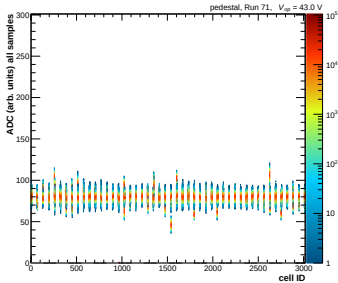
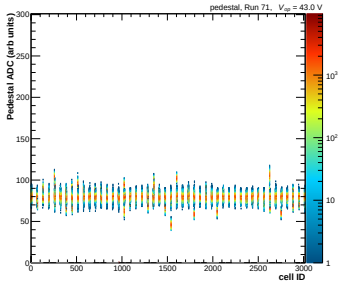
Summing Board V2, $V_{op} = 43$ V, gain settings: RF = 9, CF = 7, CC= 10, CFcomp=1

May 15, 9:15 - May 16, 0:59

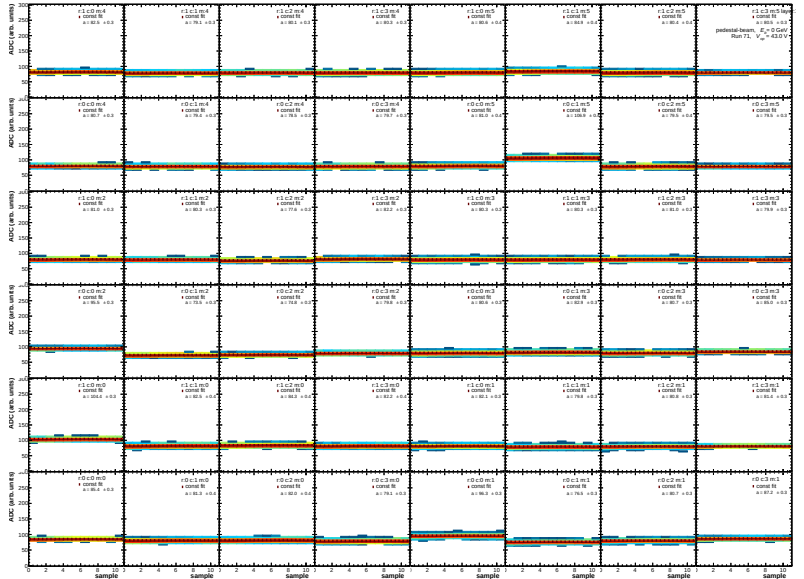
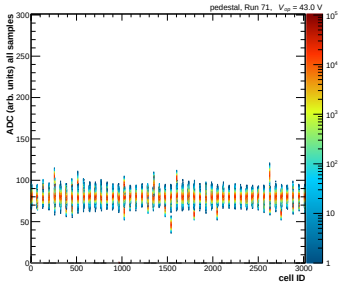
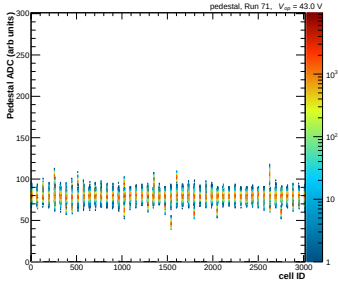
Calibration sets:													
μ table position	ped	(-15,10)	(15,0)	(-15, -10)	(-5,10)	(-5,0)	(-5,-10)	(5,10)	(5,0)	(5,-10)	(-15,10)	(15,0)	(-15, -10)
1 st	runs	71	73	74	75	78	77	76	79	80	81	84	82
	tot events	10K	155K	155K	154K	157K	158K	159K	158K	181K	154K	161K	157K
μ table position	ped	(10,-5)	(10,5)	(-10, -5)	(-10,5)								
2 nd	runs	126	133	132	131	130							
	tot events	10K	155K	154K	154K	160K							
Electron set:													
E (GeV)	20	30	40	50	80	100							
e ⁻	runs	85	86	87	88	89	90						
	tot events	253K	259K	291K	250K	250K	255K						
e ⁺	runs	91-92	93	94	95	96	97						
	tot events	259K	250K	250K	258K	256K	251K						
Hadron set:													
E (GeV)	20	30	40	50	60	70	80	90	100	150	200	250	
h ⁻	runs	113	114	115	116	117	118	119	120	121	122-123	124	125
	tot events	260K	256K	257K	272K	259K	324K	292K	272K	256K	258K	283K	277K
h ⁺	runs	98-99	100	101	102	103	104	105	106-107	108-109	110	111	112
	tot events	301K	255K	273K	257K	253K	256K	252K	259K	275K	258K	258K	257K

- time: 15.5.2026 9:15 - 16.5.2026 0:59
- $V_{op} = 43$ V, $V_{br} = 38.3$ V
- Gain settings:
 - RF = 9, CF = 7, CC= 10, CFcomp=1
- μ with large scintillator triggers:
 - 12 positions Scan “_1”
 - 4 positions Scan “_2”
- e⁻ and h[±] with small scintillators

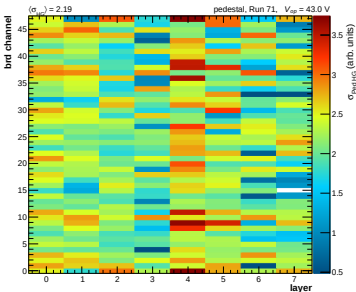
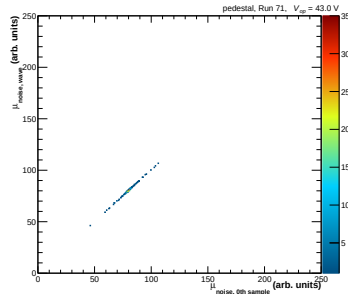
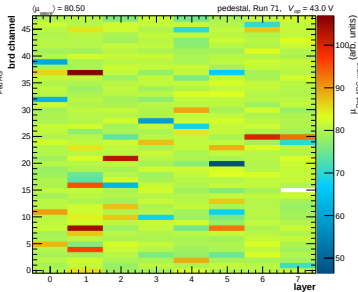
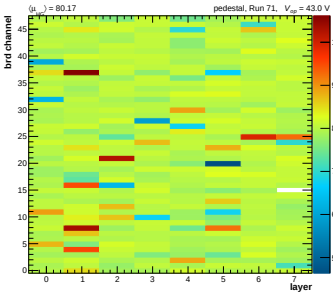
Muon calibration - Set 1: Pedestals



Muon calibration - Set 1: Pedestals

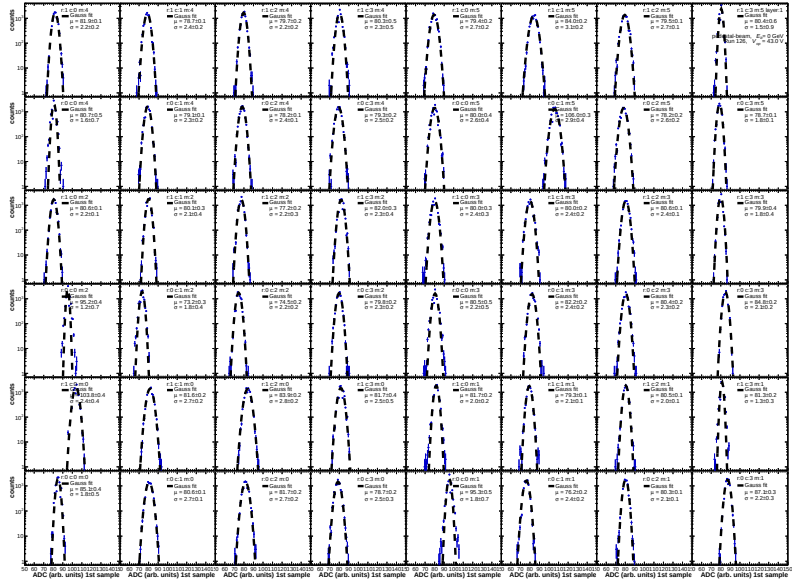
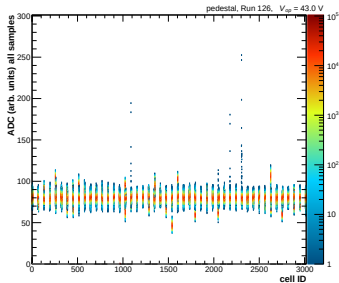
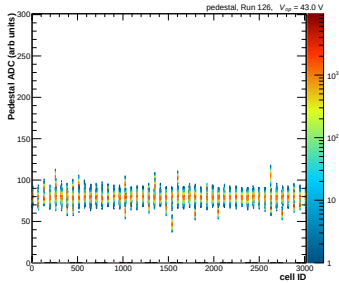


Muon calibration - Set 1: Pedestals

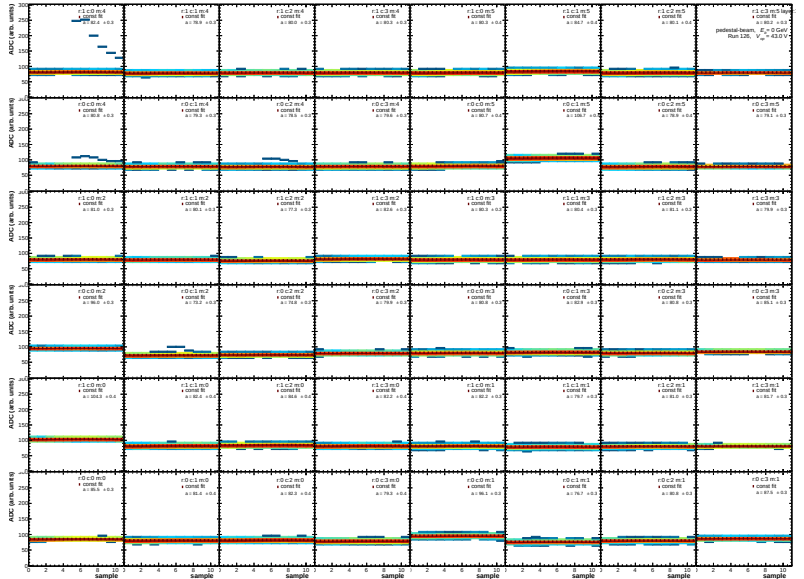
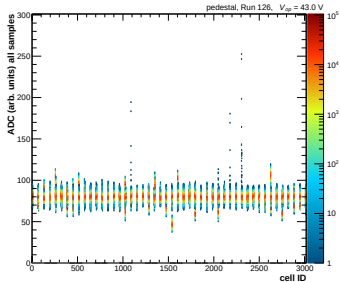
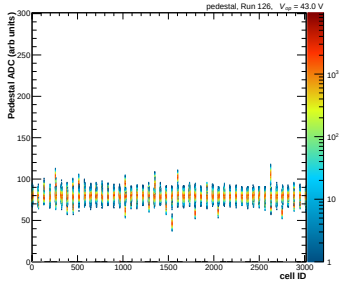


- Pedestal for all readout units set to 80 ADC
- Online calibration verified
- Fitting converges for most cells (1 missing)
- Good correlation between alternative fitting methods for pedestal

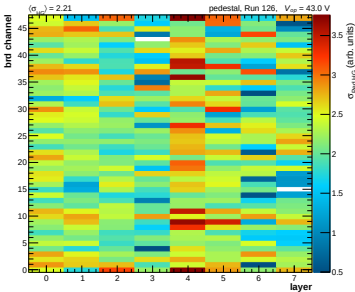
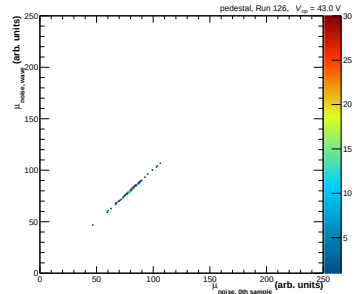
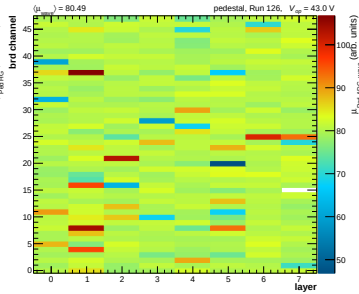
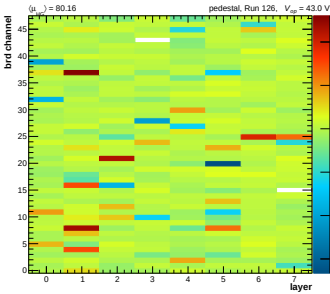
Muon calibration - Set 2: Pedestals



Muon calibration - Set 2: Pedestals

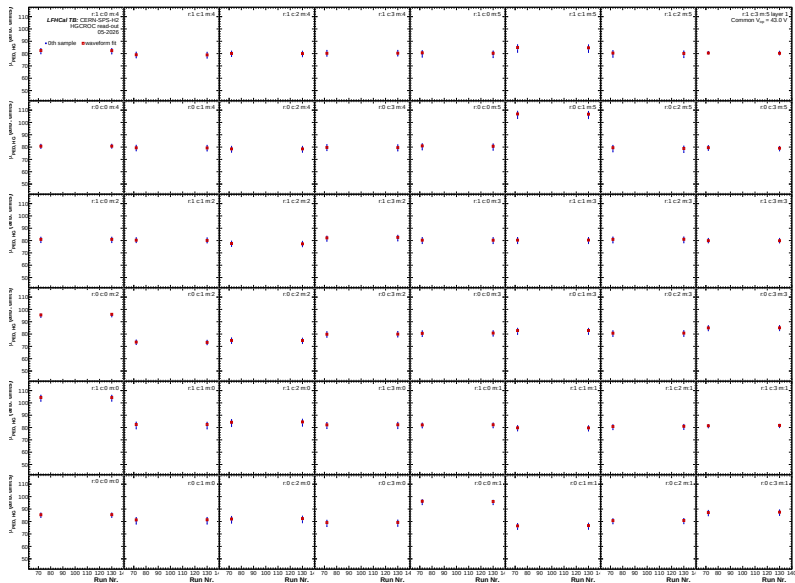
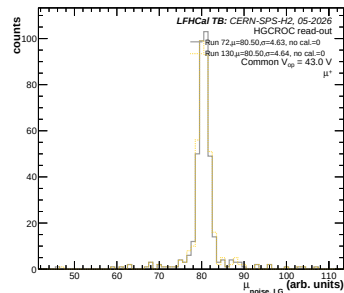
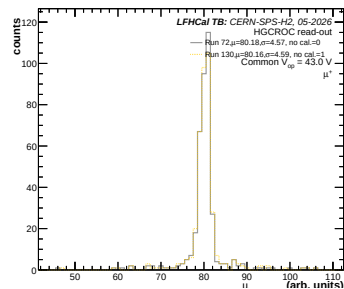


Muon calibration - Set 2: Pedestals

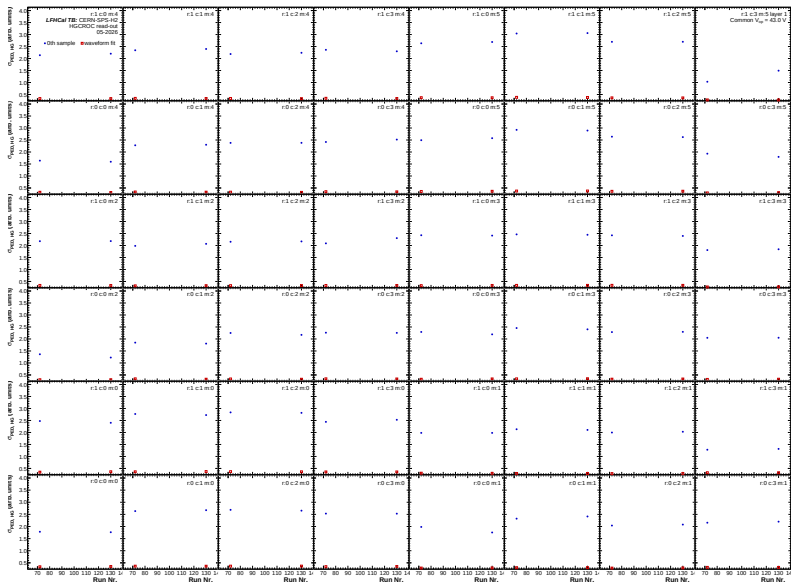
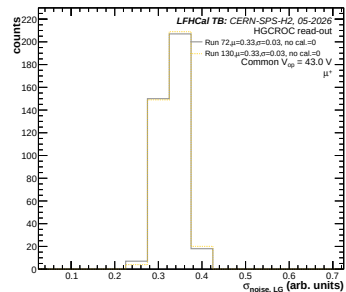
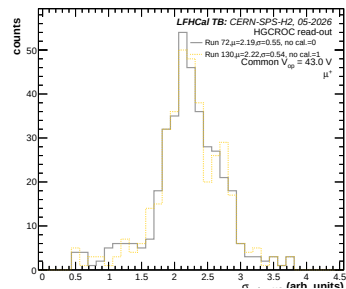


- Pedestal for all readout units set to 80 ADC
- Online calibration verified
- Fitting converges for most cells (2 missing)
- Good correlation between alternative fitting methods for pedestal

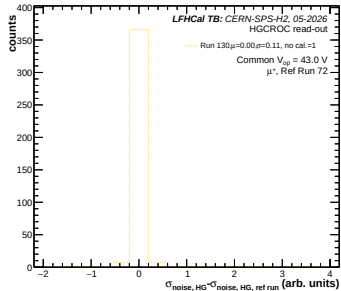
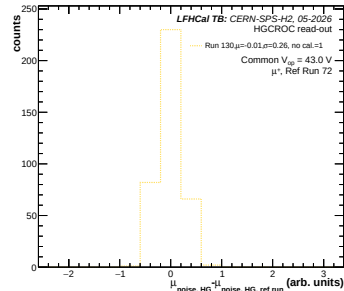
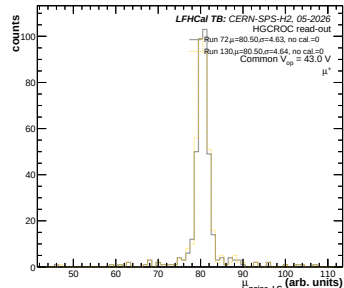
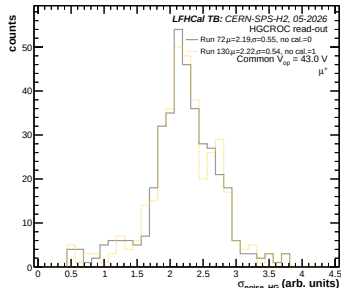
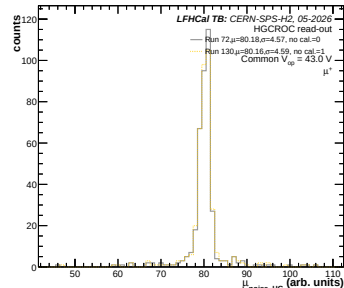
Muon calibration - Pedestal Comparison



Muon calibration - Pedestal Comparison

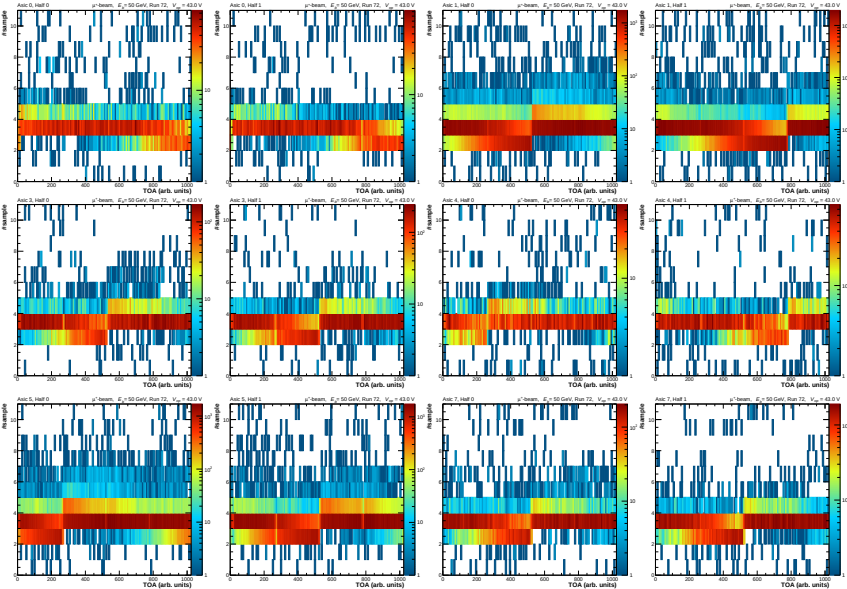


Muon calibration - Pedestal Comparison



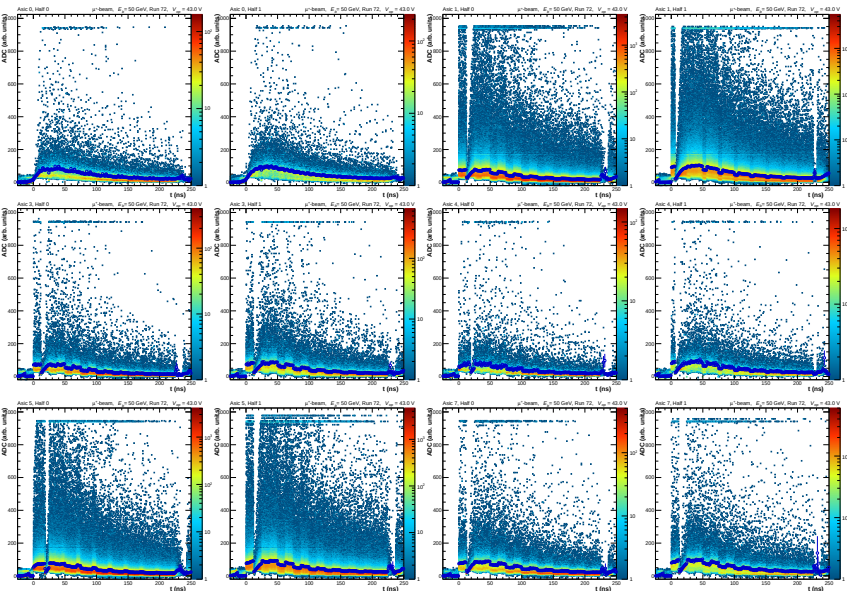
- Very similar pedestal position for both pedestal runs
- Width varies slightly between runs, but within fitting uncertainties
- Either run could be used for corrections

TOA offset calibration



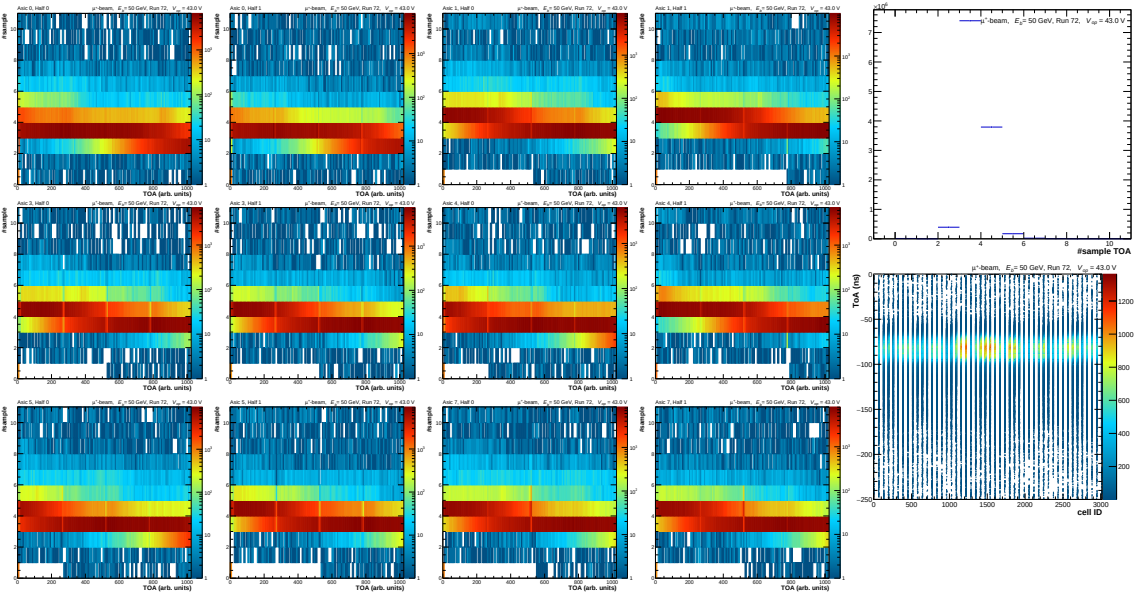
- Estimated using first muon run (72)
- Based on ToA vs nSample plot
- Applied consistently to full set
- [TOA calib offset file]

TOA offset calibration

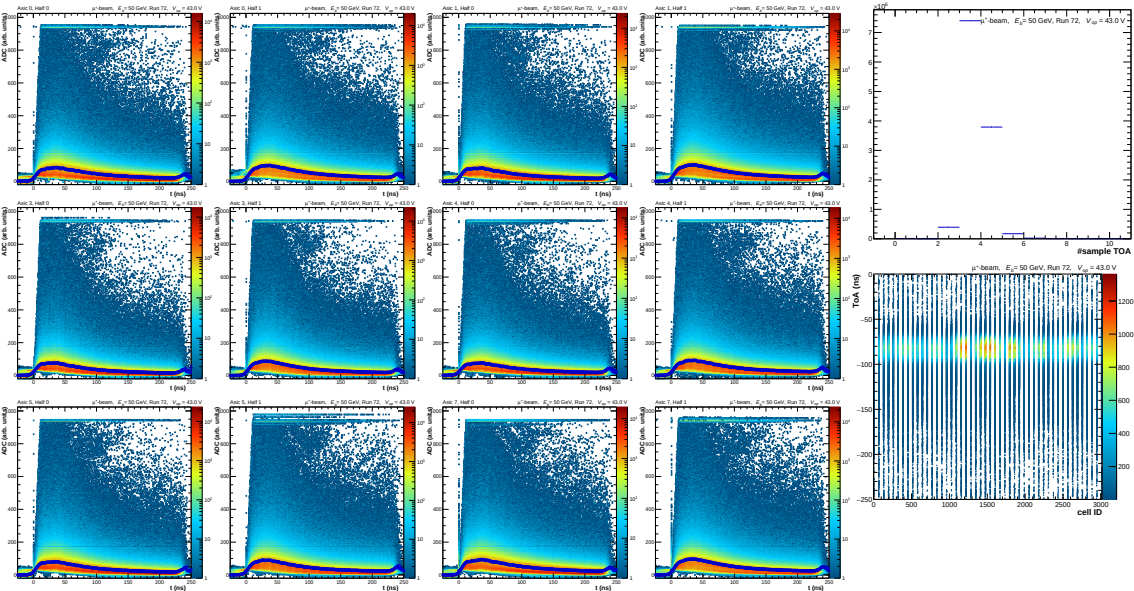


- Estimated using first muon run (72)
- Based on ToA vs nSample plot
- Applied consistently to full set
- [TOA calib offset file]

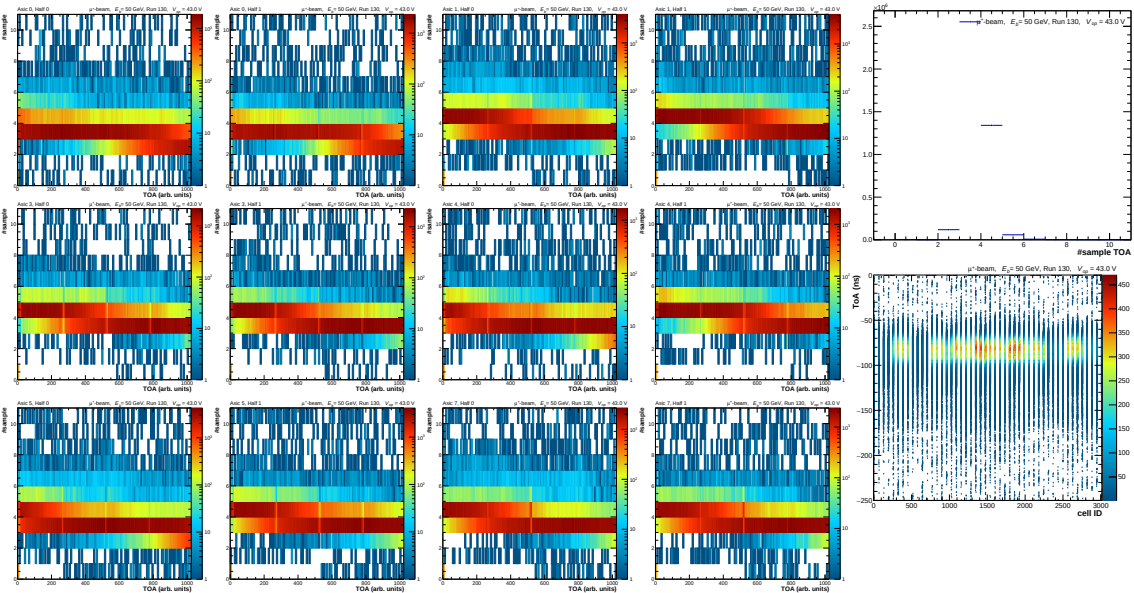
TOA offset calibration - Applied Set 1



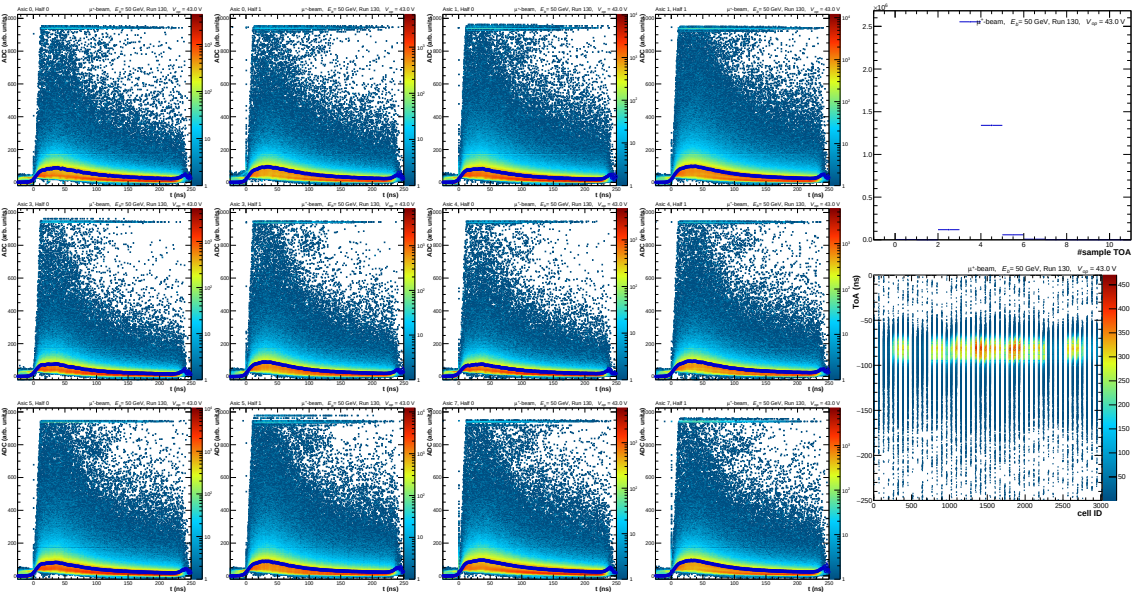
TOA offset calibration - Applied Set 1



TOA offset calibration - Applied Set 2

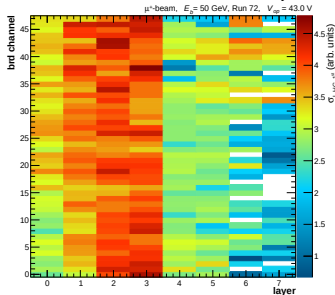
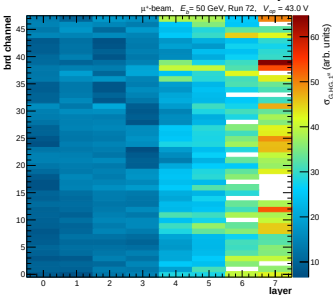
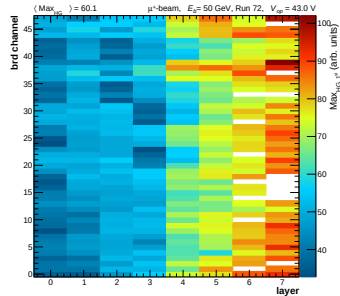
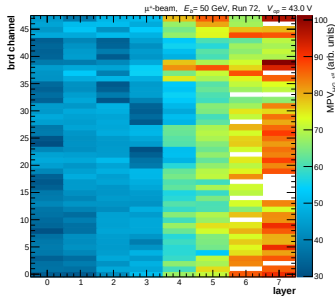
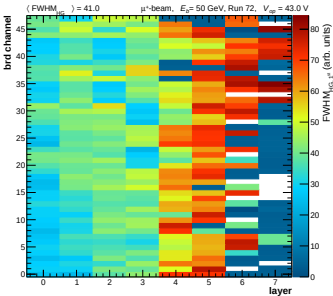


TOA offset calibration - Applied Set 2



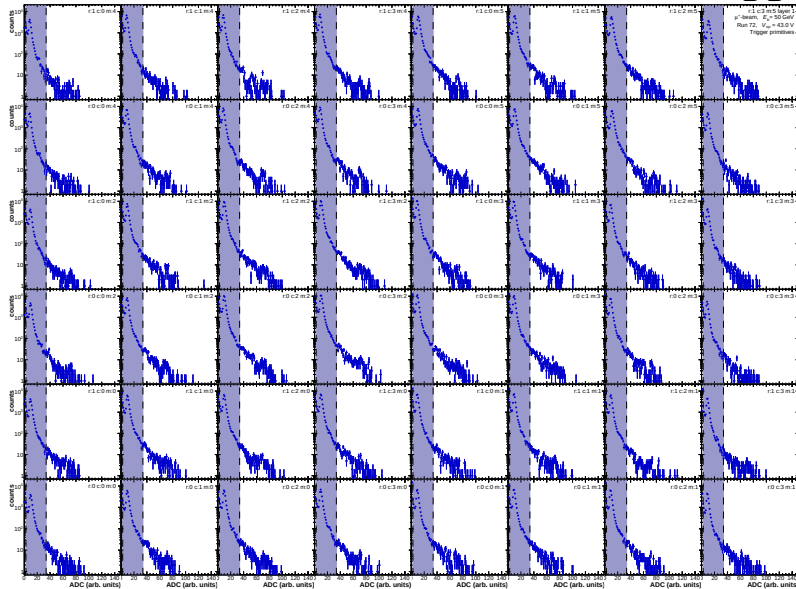


Muon calibration - Set 1: Muons - init (blue)

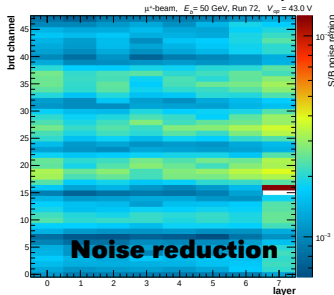
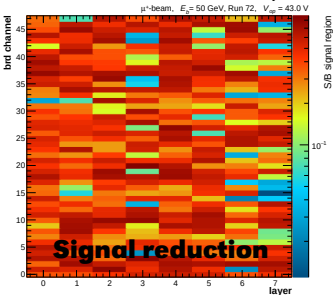
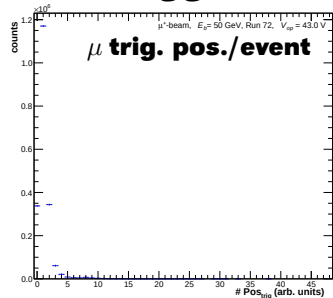
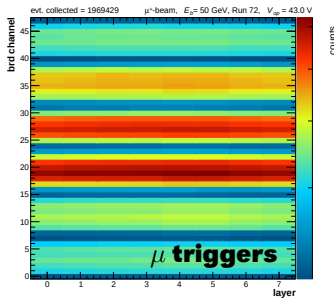
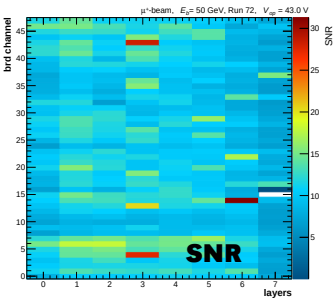


- Initial fit for 43 V & RF=9 quite stable, only layers in the back fail partially in initial fit (blue distribution previous slide)
- $\langle \text{Max}_{mip} \rangle = 60.1$
- channels with lower statistics not well fitted

Muon calibration - Set 1: Muons - Trigger

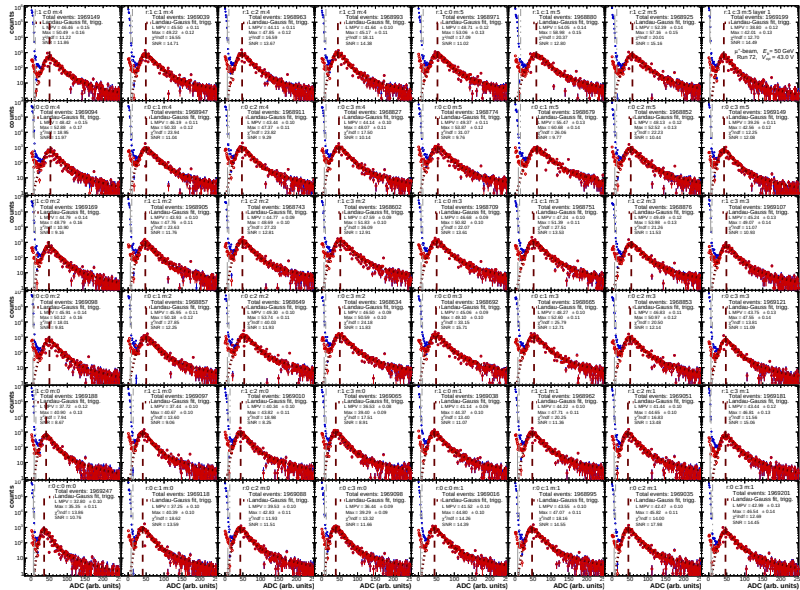


Muon calibration - Set 1: Muons - Trigger

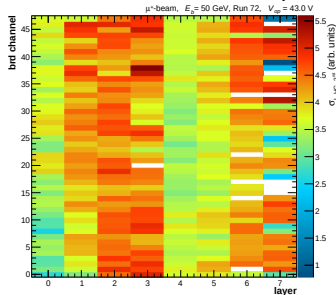
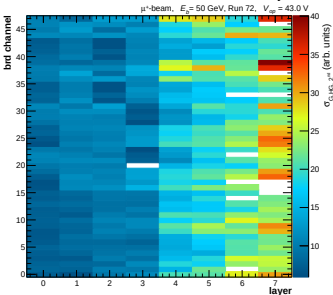
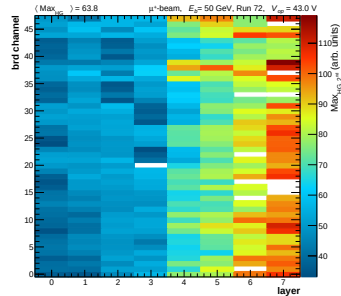
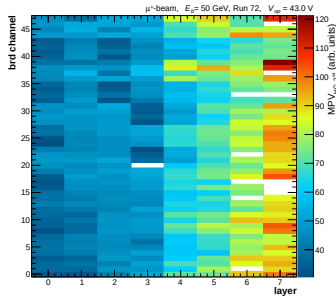
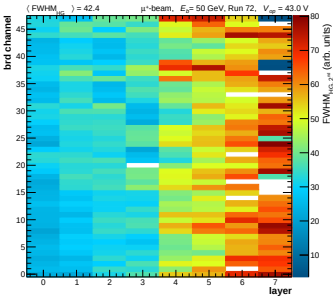


- Trigger evaluation for fixed column and row (all z-segments) if average signal summed over all active cells in $z > 3\sigma_{ped}$
- ⇒ Noise suppression could be improved by increasing $n\sigma_{ped}$
- Clear enhancement in trigger primitives, 0th level muon selection within $0.3\langle Max_{mip} \rangle < trigg_{prim} < 4\langle Max_{mip} \rangle$
- Same range used for skimming
- Significant reduction of noise peak (red vs. blue on next page)

Muon calibration - Set 1: Muons - 0th ite



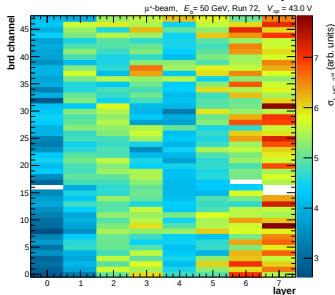
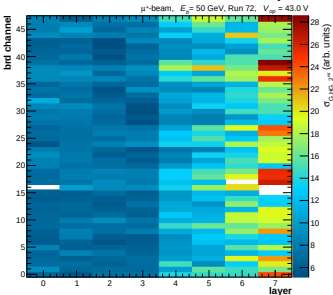
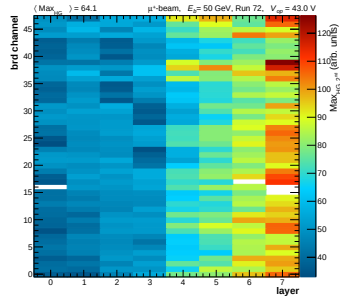
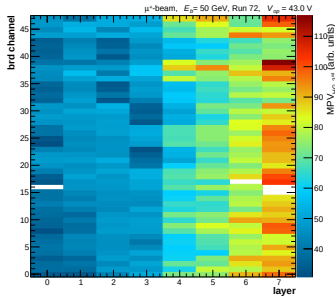
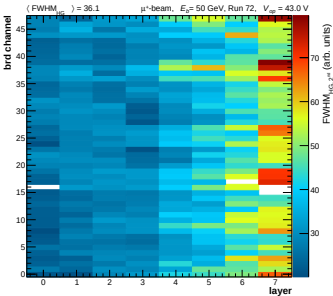
Muon calibration - Set 1: Muons - 0th ite



- Most channels "fitable"
- 2 channels identified as bad
- Poor χ^2/ndf for some
- Constrained fit much more in width
- $\langle \text{Max}_{mip} \rangle = 63.8$

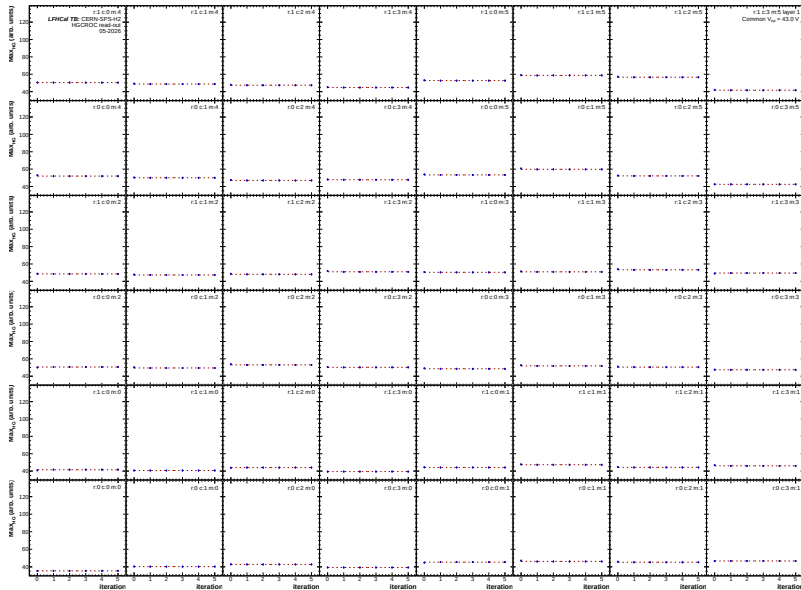


Muon calibration - Set 1: Muons - 5th ite

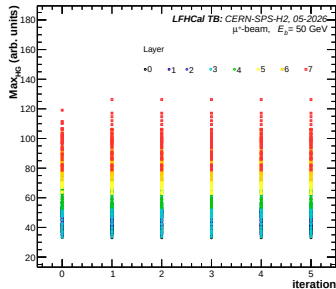
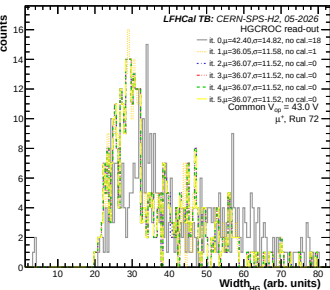
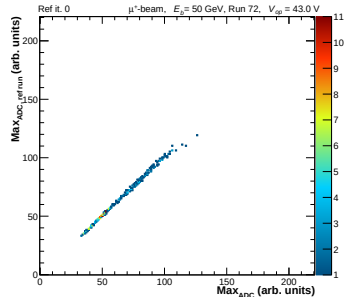
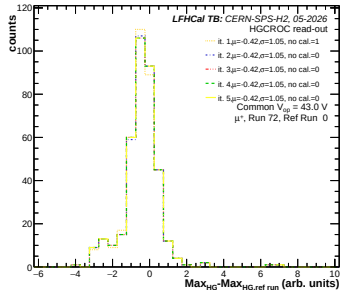
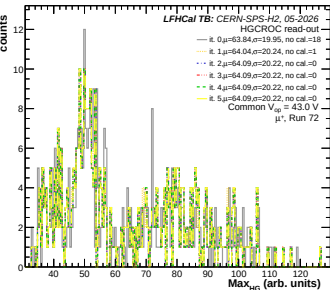


- Nearly all channels "fitable"
- 2 channels identified as bad
- $\langle \text{Max}_{\text{mip}} \rangle = 64.1$

Muon calibration - Set 1: Muons - Iterations



Muon calibration - Set 1: Muons - Iterations



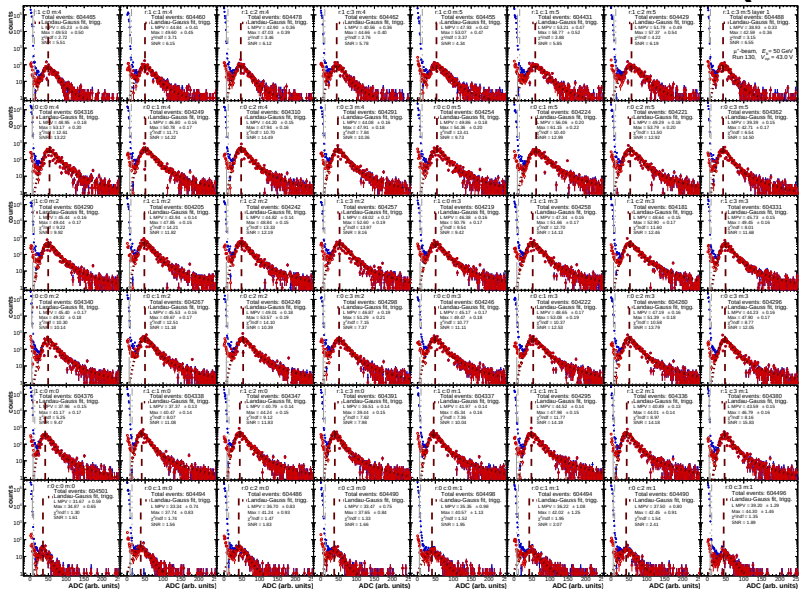
- Reduced mip selection range for trigger primitives

$$0.8 \langle Max_{mip} \rangle < trigg_{prim} < 2.5 \langle Max_{mip} \rangle$$

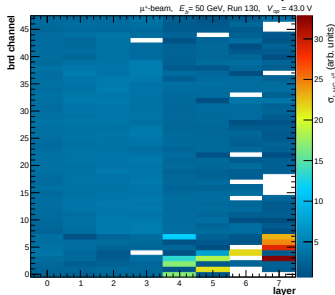
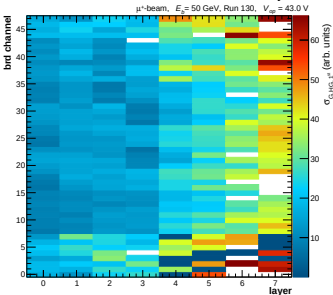
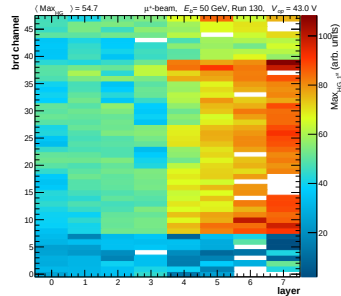
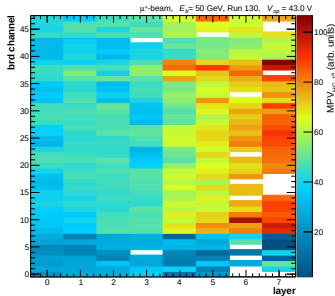
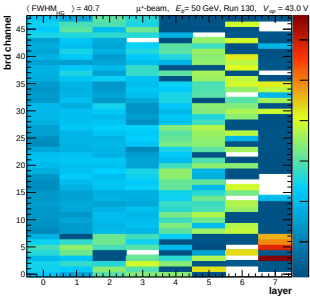
⇒ Further reduction of noise peak

- Refined fitting during improved iterations using average mip from previous iteration as basis for constraints
- Convergence of most cells within 2-3 iterations

Muon calibration - Set 2: Muons - init (blue)

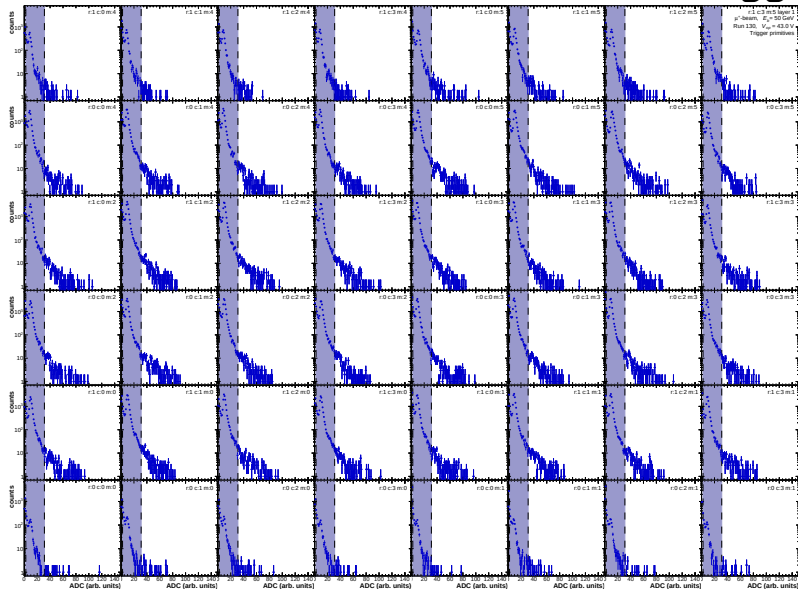


Muon calibration - Set 2: Muons - init (blue)

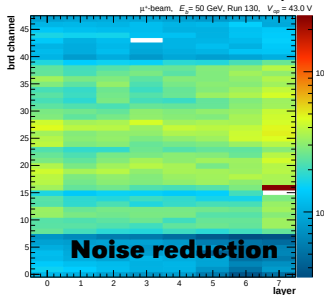
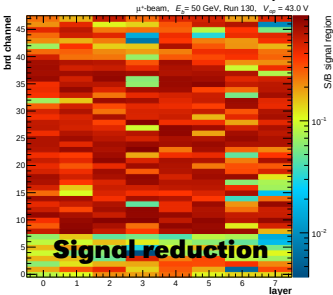
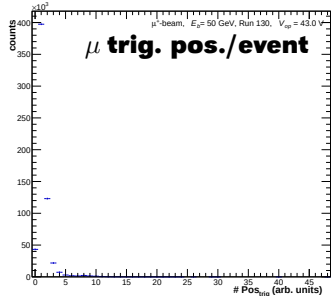
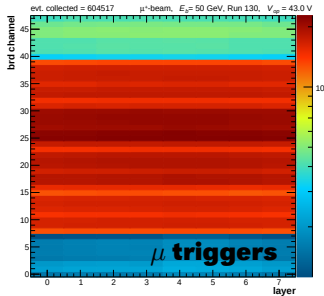
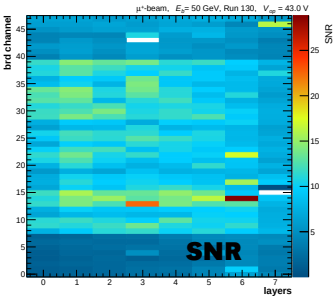


- Initial fit for 43 V & RF=9 slightly less stable, primarily layers in the back fail in initial fit (blue distribution previous slide)
- $\langle Max_{mip} \rangle = 54.7$
- No strong ch-by-ch variations in individual parameters per layer

Muon calibration - Set 2: Muons - Trigger

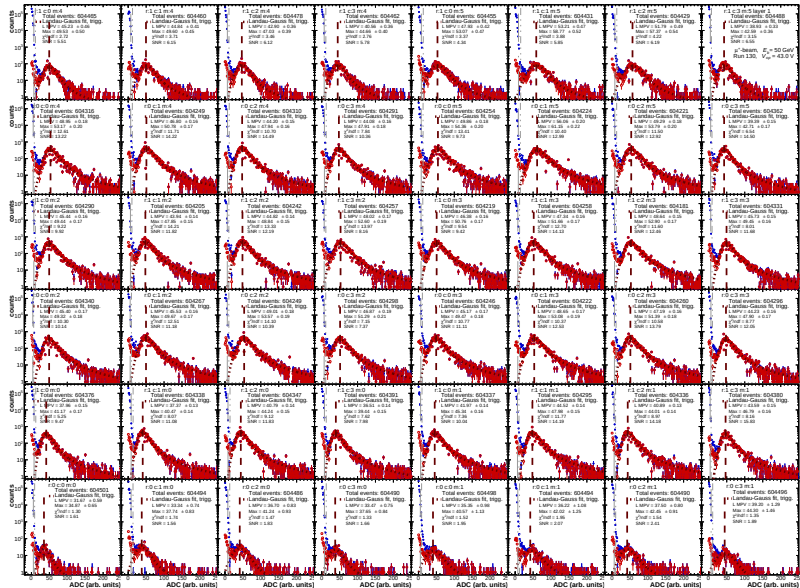


Muon calibration - Set 2: Muons - Trigger

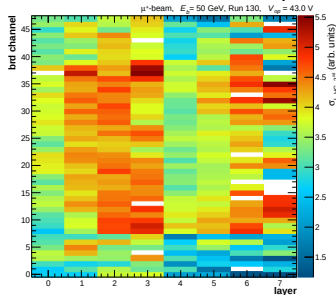
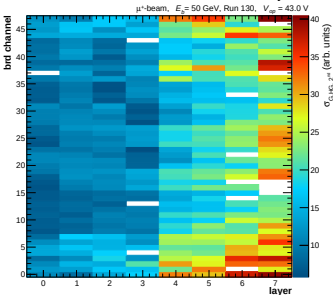
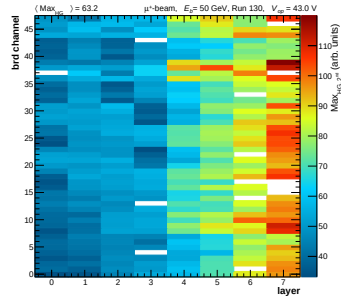
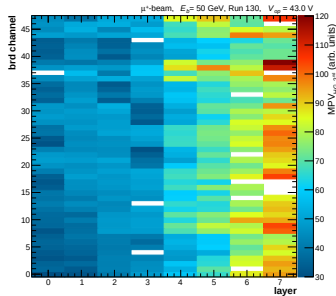
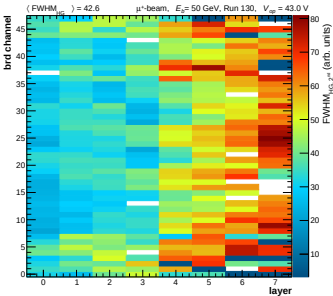


- Trigger evaluation for fixed column and row (all z-segments) if average signal summed over all active cells in $z > 3\sigma_{ped}$
- ⇒ Noise suppression could be improved by increasing $n\sigma_{ped}$
- Clear enhancement in trigger primitives, 0th level muon selection within $0.3\langle Max_{mip} \rangle < trigg_{prim} < 4\langle Max_{mip} \rangle$
- Same range used for skimming
- Significant reduction of noise peak (red vs. blue on next page)

Muon calibration - Set 2: Muons - 0th ite

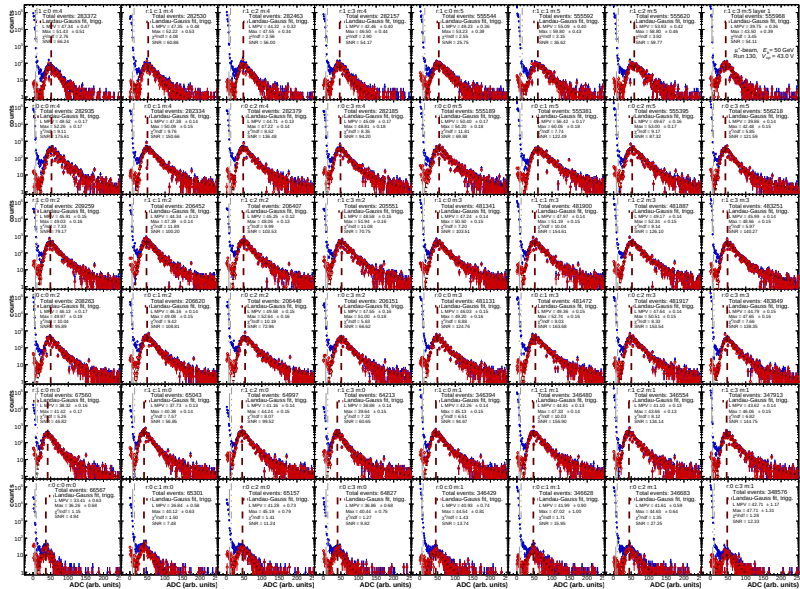


Muon calibration - Set 2: Muons - 0th ite

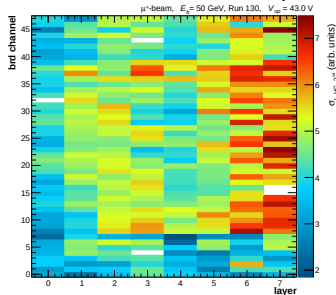
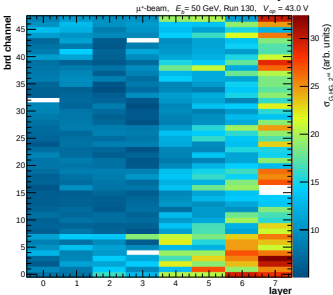
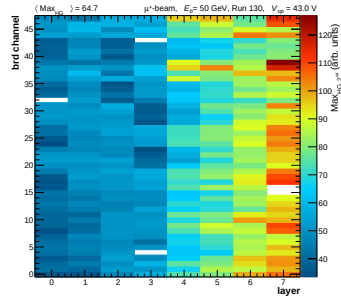
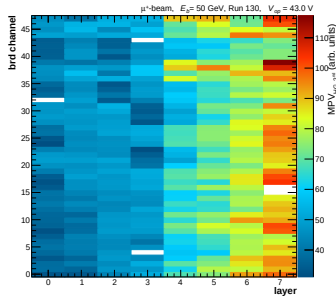
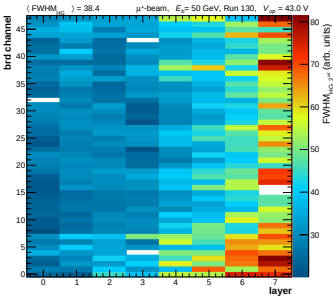


- Nearly all channels "fitable"
- 2 channels identified as bad
- Poor χ^2/ndf for some
- Constrained fit much more in width
- $\langle \text{Max}_{\text{mip}} \rangle = 63.2$

Muon calibration - Set 2: Muons - 5th ite

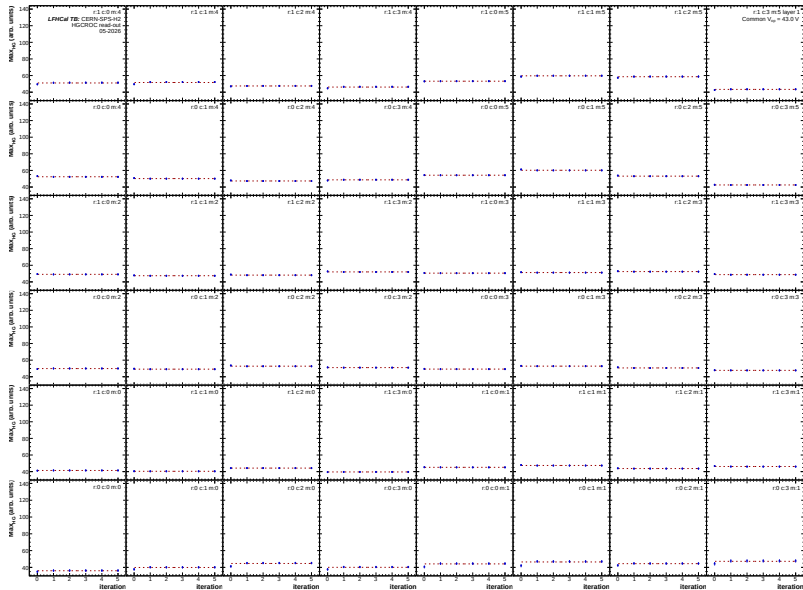


Muon calibration - Set 2: Muons - 5th ite

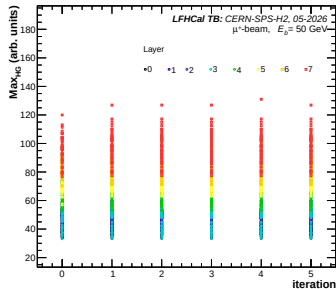
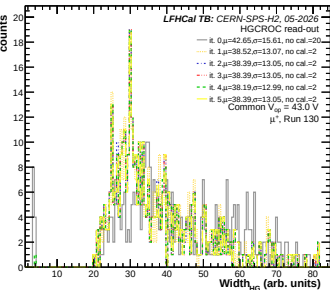
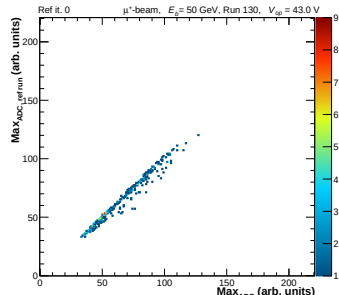
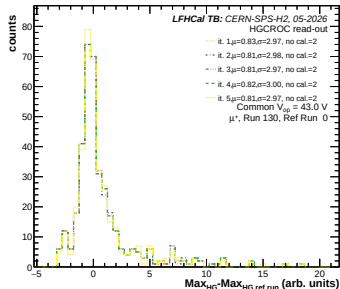
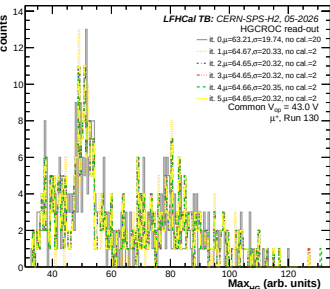


- Nearly all channels "fitable"
- 2 channels identified as bad
- $\langle \text{Max}_{mip} \rangle = 64.7$

Muon calibration - Set 2: Muons - Iterations



Muon calibration - Set 2: Muons - Iterations

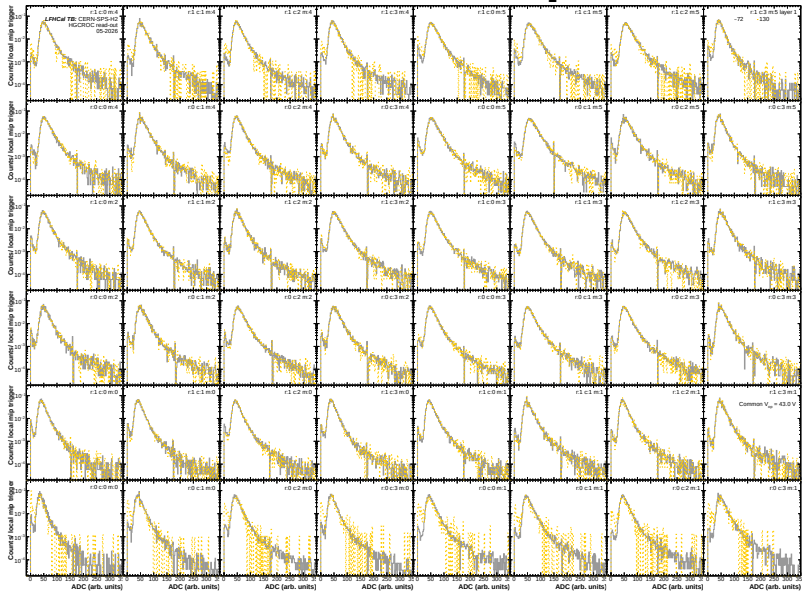


- Reduced mip selection range for trigger primitives
 $0.8 \langle Max_{mip} \rangle < trigg_{prim} < 2.5 \langle Max_{mip} \rangle$

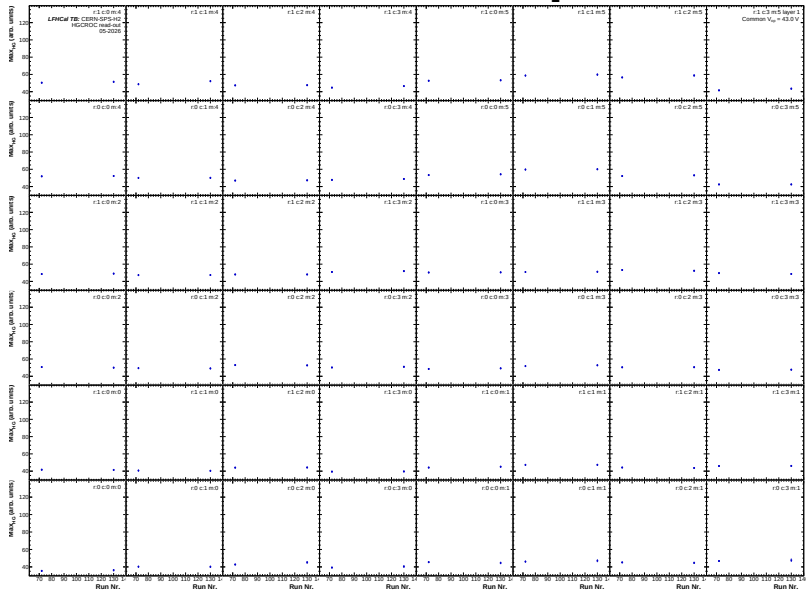
⇒ Further reduction of noise peak

- Refined fitting during improved iterations using average mip from previous iteration as basis for constraints
- Convergence of most cells within 2-3 iterations

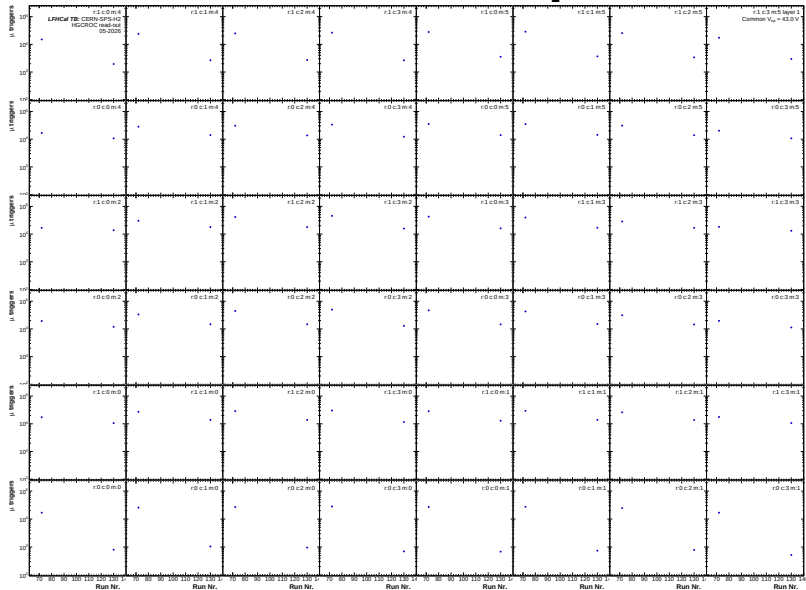
Muon calibration - Comparison Sets



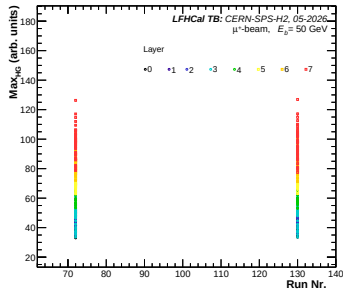
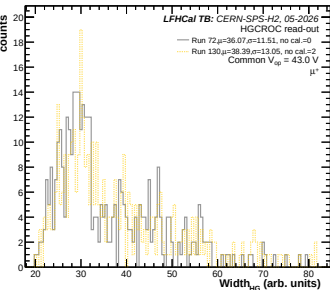
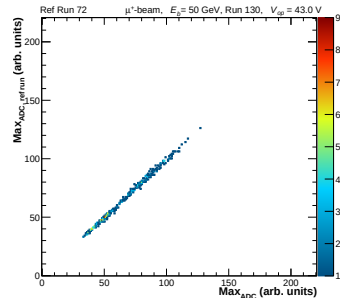
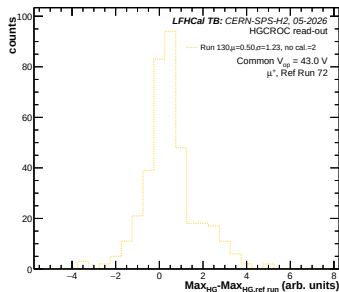
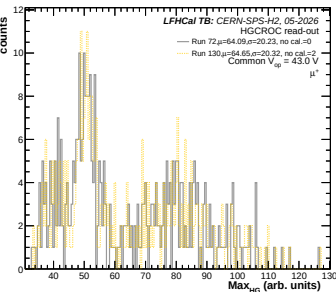
Muon calibration - Comparison Sets



Muon calibration - Comparison Sets



Muon calibration - Comparison Sets



- 2nd set significantly lower statistics
- mip deviations within estimated fitting uncertainties
- very good correlation for same channel
- will use 1st set for final calibration (2nd for possible error estimates)

Calibration summary - Set B



Calibration summary

- Besides 2 bad channels identified in this data set no further channels found problematic
- ToA offset calibration estimated on initial muon run valid for all runs of set B
- Final calibration based off 'Set_1' (12 beam positions) due to higher statistics & better coverage
 - ▶ Calib file FullSet B 1st [txt-file]
 - ▶ Calib file FullSet B 2nd [txt-file]