

2026 SPS TB - HGCROC Readout

September 15, 2026

Friederike Bock



- 1 SPS 2026 Set F - 45V
 - Overview
 - Pedestals
 - TOA offset calibration
 - Muon Calibrations
- 2 Calibrations Summary

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



Overview - Set F

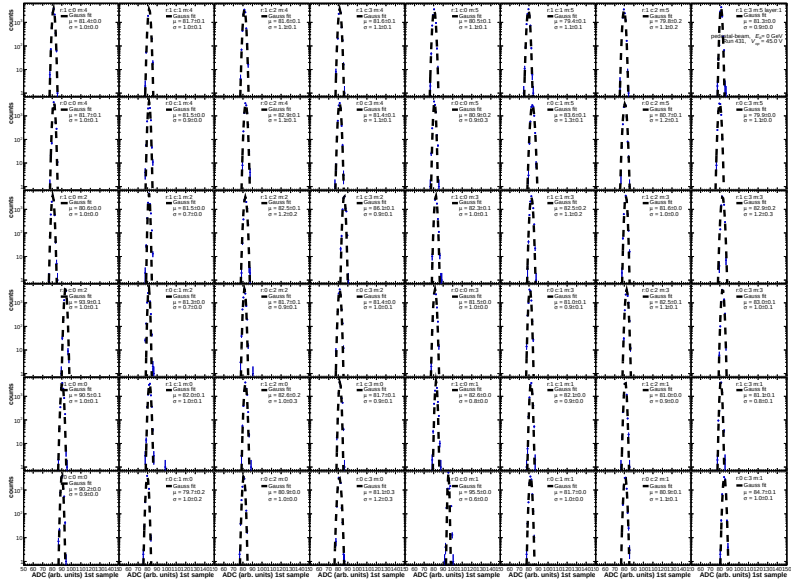
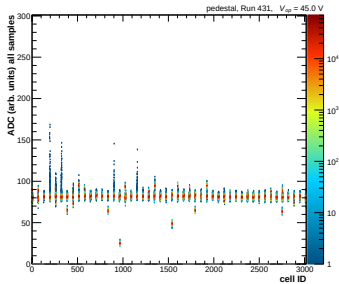
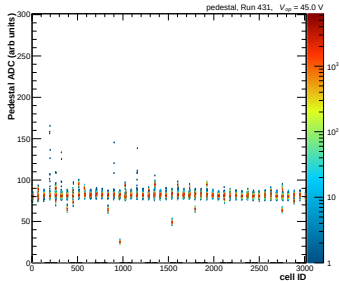
Full Set F

Summing Board V2, $V_{op} = 45$ V, gain settings: RF = 12, CF = 7, CC = 3, CFcomp=1
May 19, 2:40 - May 19, 19:01

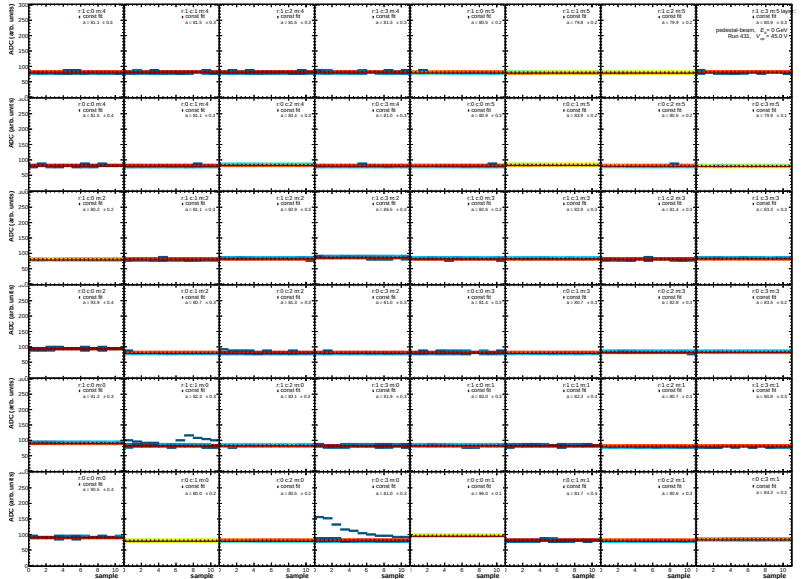
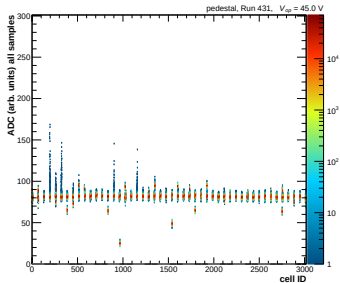
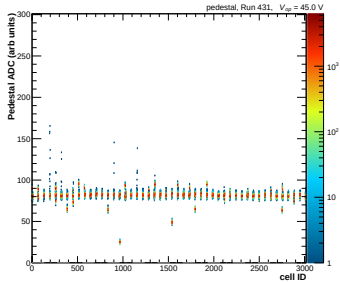
Calibration sets:																
μ table position	ped	(10,-5)	(10,5)	(-10, -5)	(-10,5)	(0,0)										
1 st	runs	431	429	430	426	427	428									
	tot events	10K	154K	155K	152K	153K	153K									
μ table position	ped	(10,-10)	(10,0)	(10,10)	(-10, -10)	(-10,0)	(-10,10)									
2 nd	runs	471	472	475	476	483	480									
	tot events	10K	157K	155K	160K	158K	156K									
Electron set:																
E (GeV)	20	30	40	50	80	100										
e ⁻	runs	432	433	434	435	436	437									
	tot events	254K	250K	279K	257K	254K	256K									
e ⁺	runs	438	439	440	441	442	443									
	tot events	285K	256K	251K	255K	251K	252K									
Hadron set:																
E (GeV)	20	30	40	50	60	70	80	90	100	150	200	250	300	325	350	
h ⁻	runs	444	445	446	447	448	449	450	451	452	453	454	455			
	tot events	273K	281K	262K	278K	253K	256K	251K	254K	255K	255K	261K	255K			
h ⁺	runs	470	469	468	467	466	465	464	463	462	461	460	459	458	457	456
	tot events	164K	154K	154K	150K	154K	253K	255K	256K	255K	256K	259K	264K	256K	253K	257K

- time:
19.5.2026 2:40 - 19.5.2026 19:01
- $V_{op} = 45$ V, $V_{br} = 38.3$ V
- Gain settings:
 - RF = 12, CF = 7, CC = 3, CFcomp=1
- μ with large scintillator triggers:
 - 5 positions Scan “_1”
 - 6 positions Scan “_2”
- e⁻ and h[±] with small scintillators

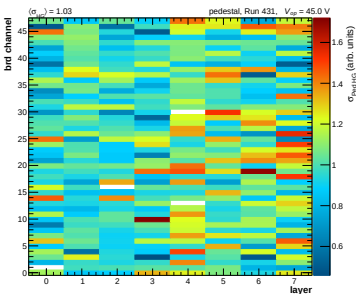
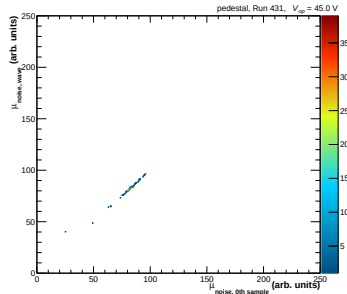
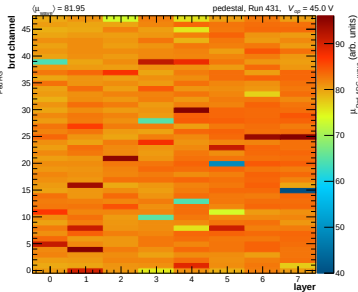
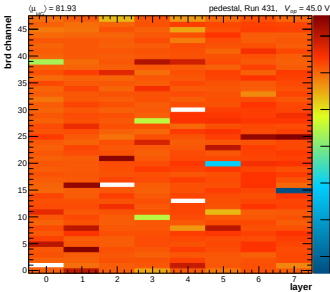
Muon calibration - Set 1: Pedestals



Muon calibration - Set 1: Pedestals

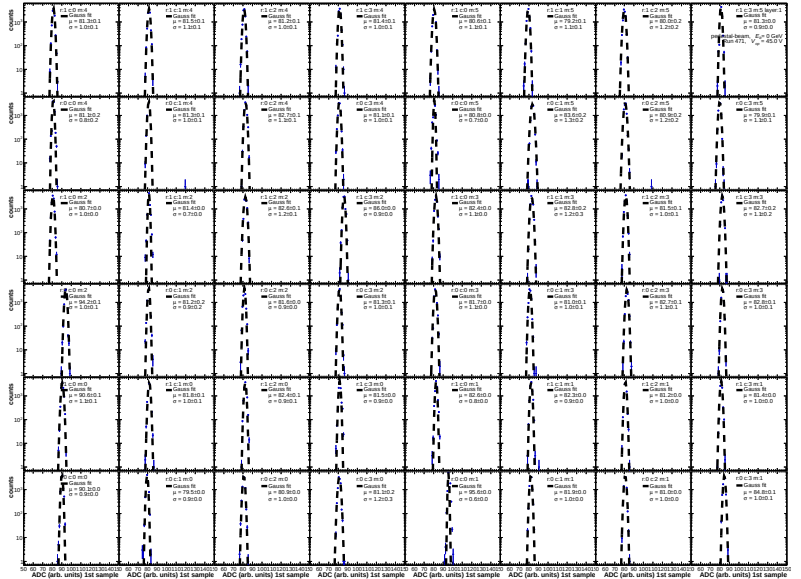
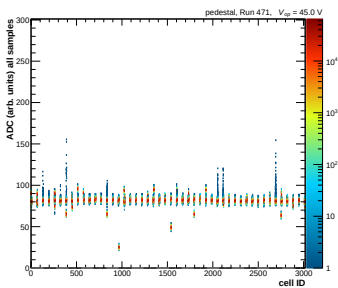
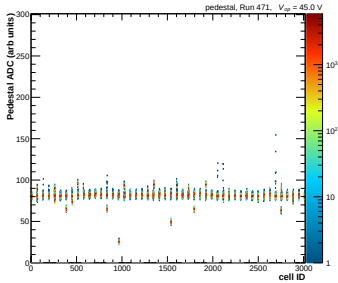


Muon calibration - Set 1: Pedestals

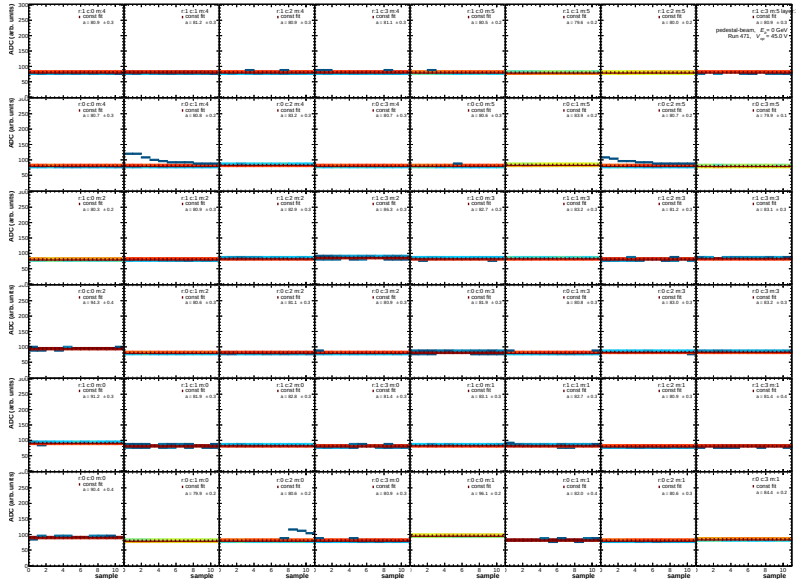
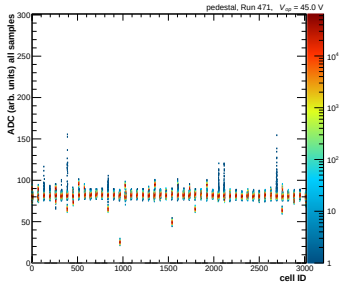
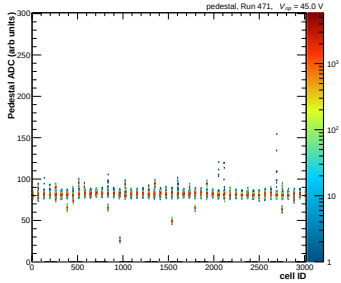


- Pedestal for all readout units set to 80 ADC
- Online calibration verified
- Fitting converges for most cells (4 missing)
- Good correlation between alternative fitting methods for pedestal

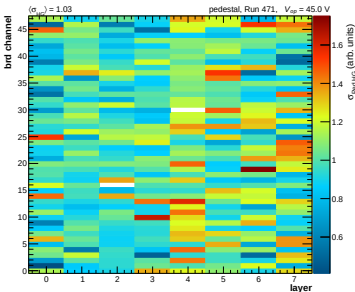
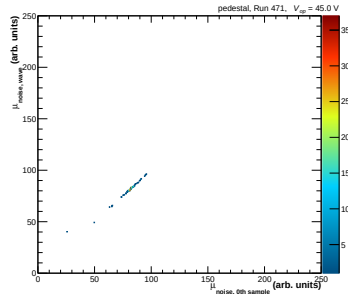
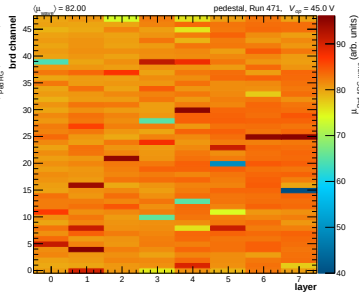
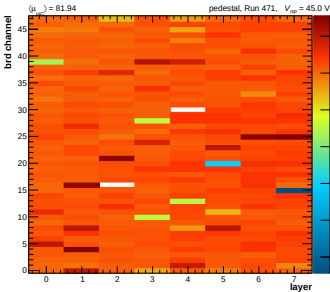
Muon calibration - Set 2: Pedestals



Muon calibration - Set 2: Pedestals

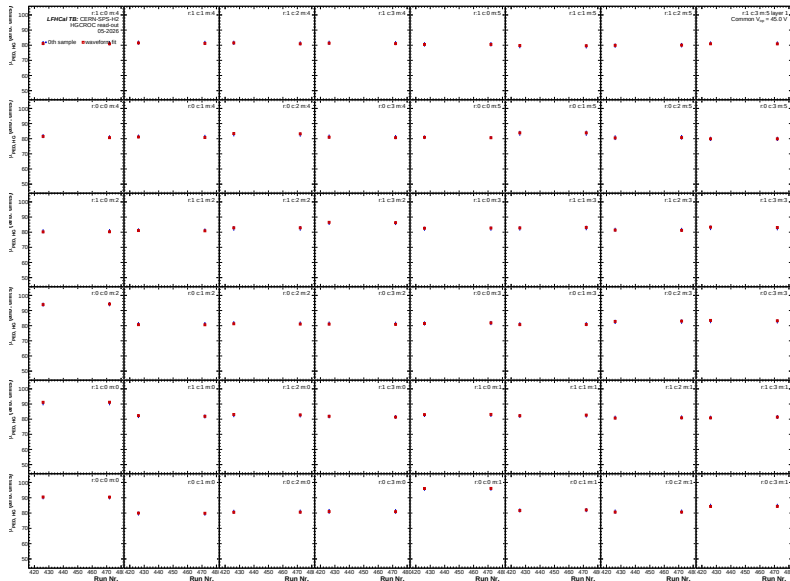
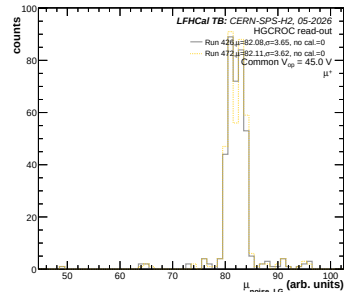
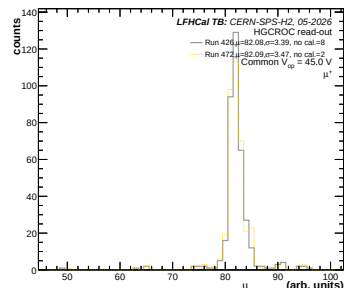


Muon calibration - Set 2: Pedestals

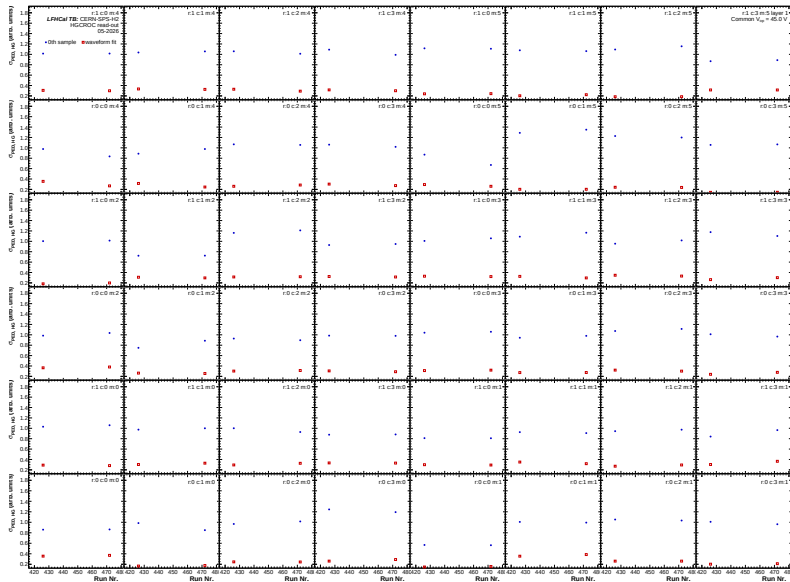
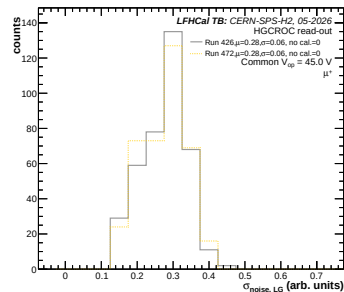
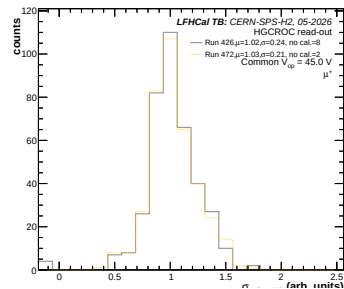


- Pedestal for all readout units set to 80 ADC
- Online calibration verified
- Fitting converges for most cells (2 missing)
- Good correlation between alternative fitting methods for pedestal

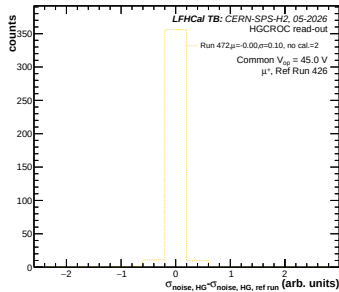
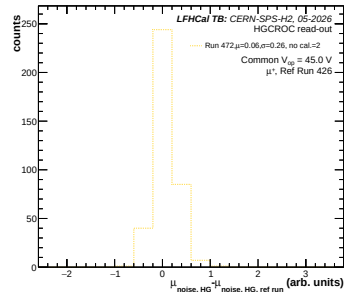
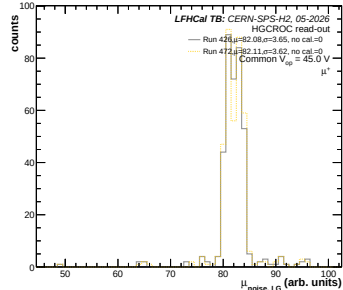
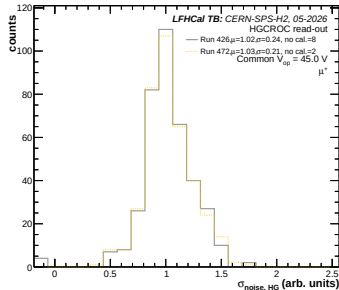
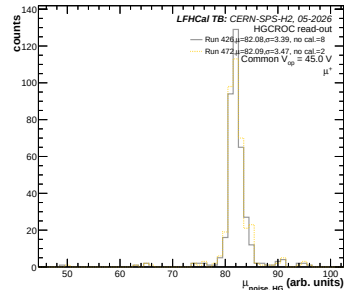
Muon calibration - Pedestal Comparison



Muon calibration - Pedestal Comparison

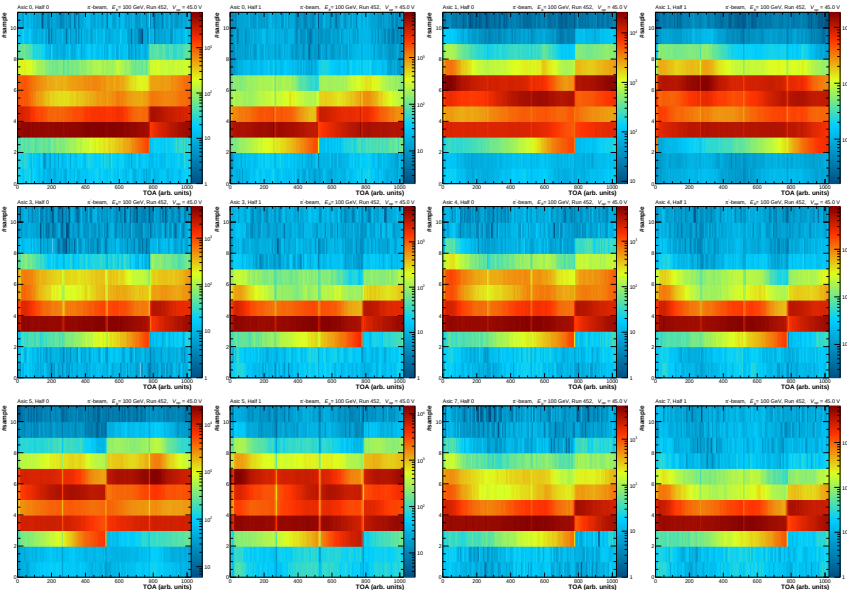


Muon calibration - Pedestal Comparison



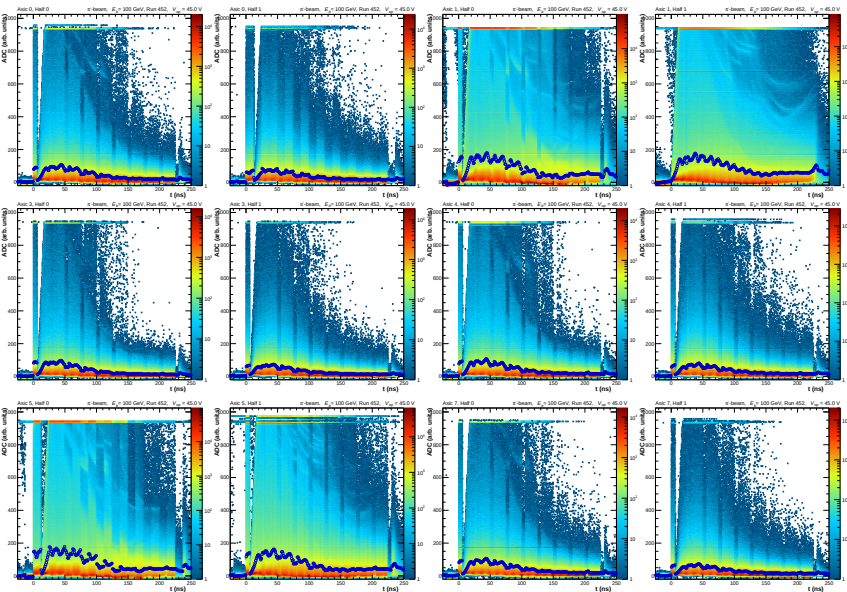
- Very similar pedestal position for both pedestal runs
- Width varies slightly between runs, but within fitting uncertainties
- Either run could be used for corrections

TOA offset calibration



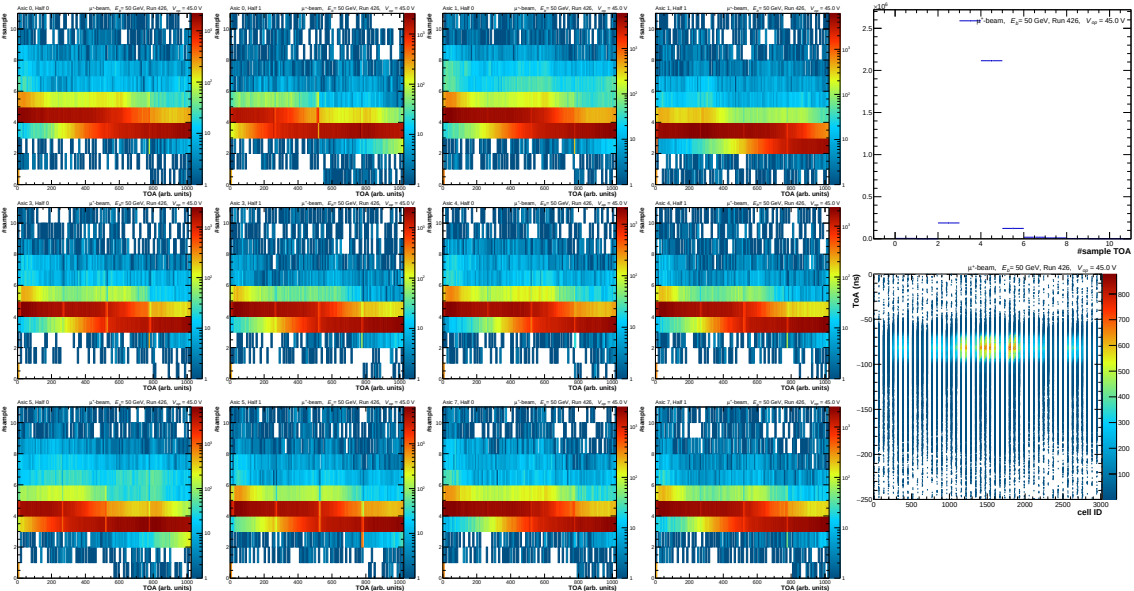
- Estimated using first negative pion run (452) at 100 GeV
- Based on ToA vs nSample plot
- Applied consistently to full set
- [TOA calib offset file]

TOA offset calibration

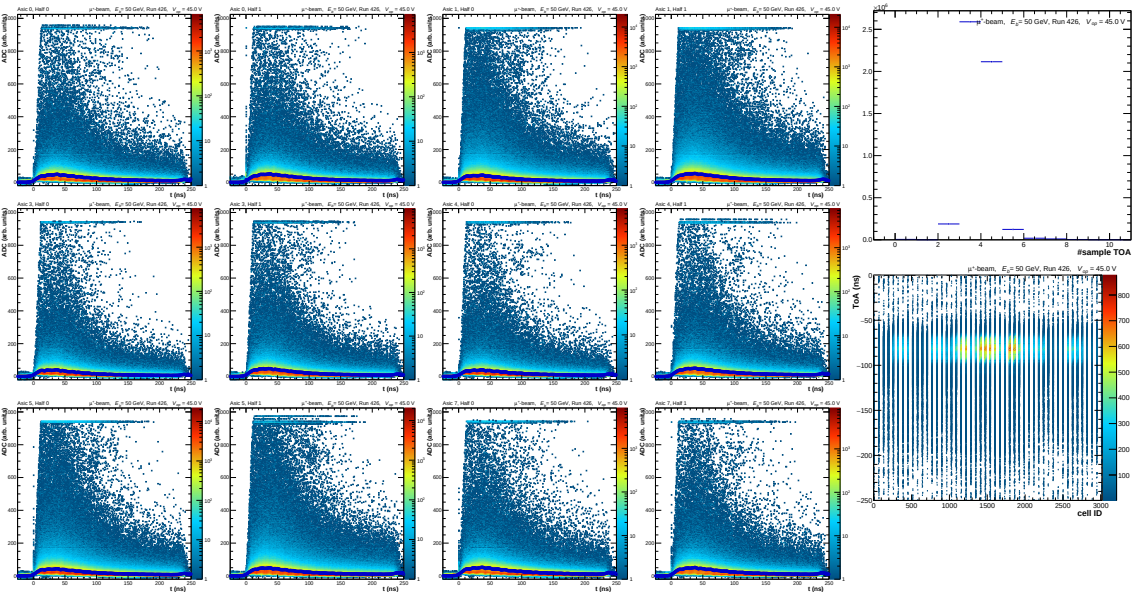


- Estimated using first negative pion run (452) at 100 GeV
- Based on ToA vs nSample plot
- Applied consistently to full set
- [TOA calib offset file]

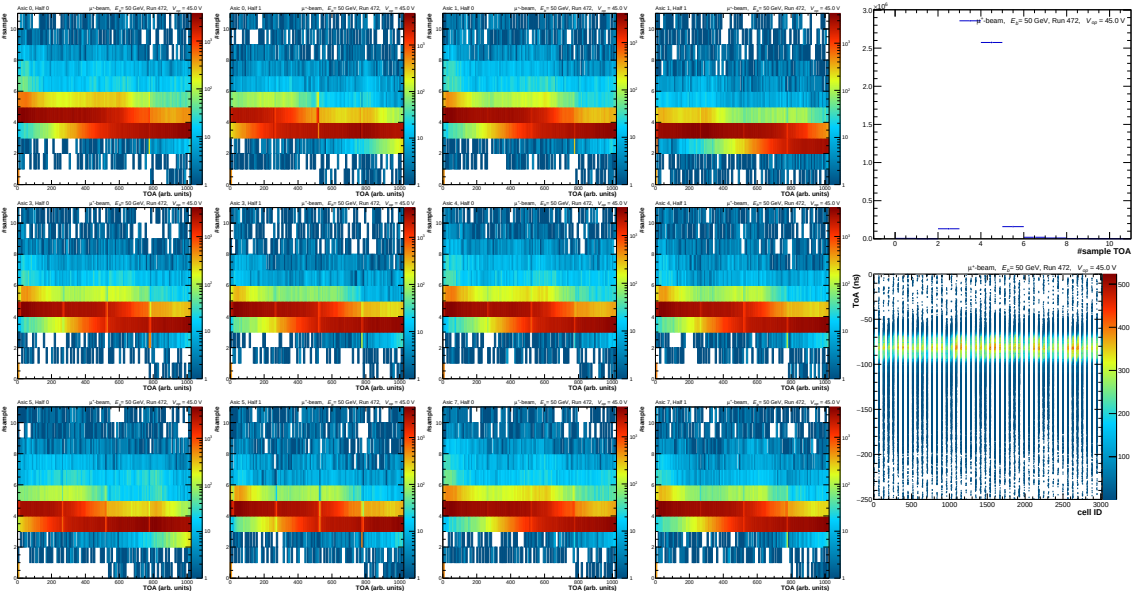
TOA offset calibration - Applied Set 1



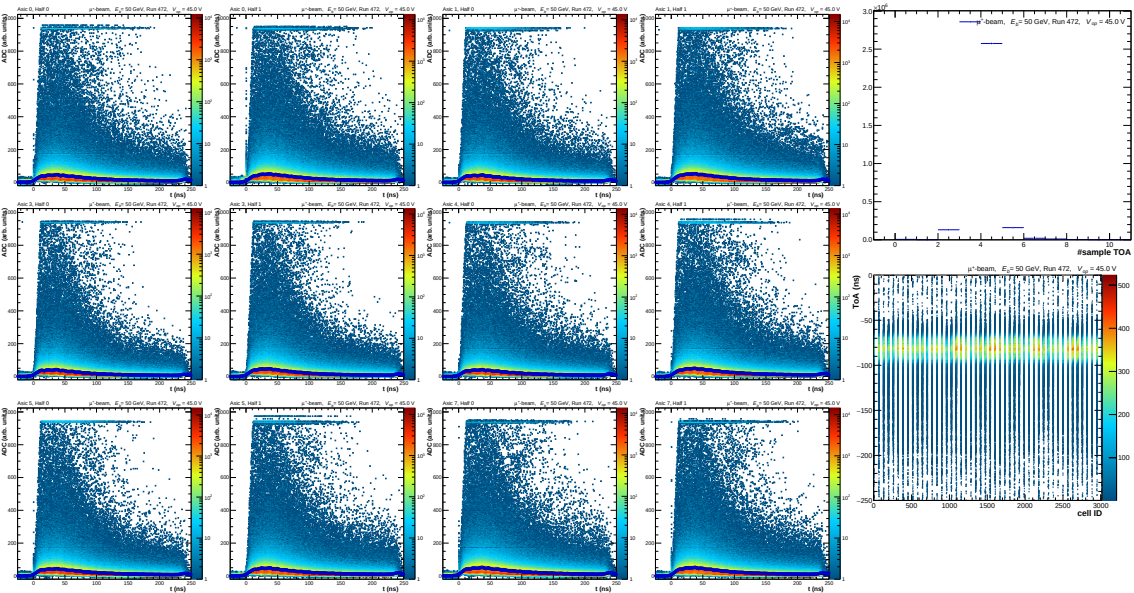
TOA offset calibration - Applied Set 1



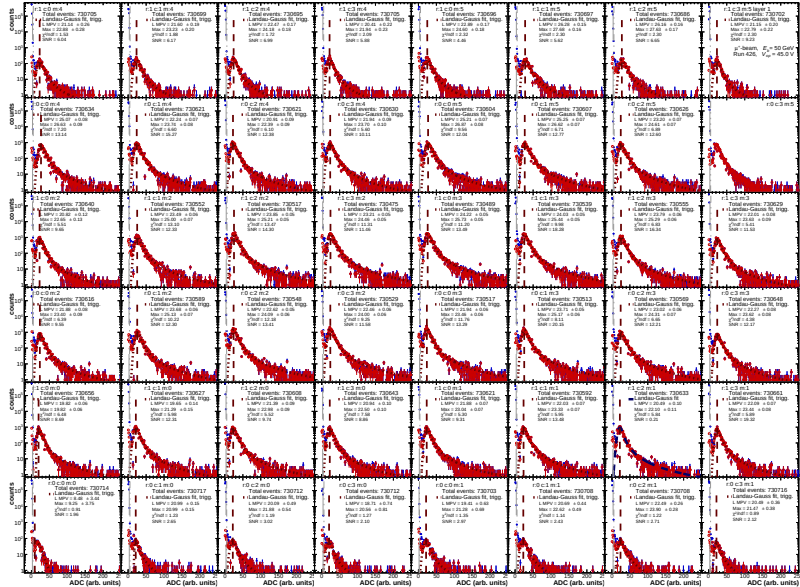
TOA offset calibration - Applied Set 2



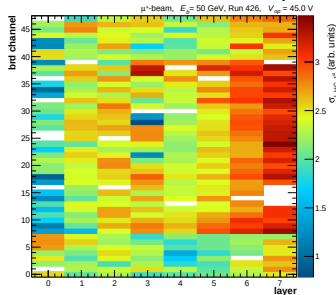
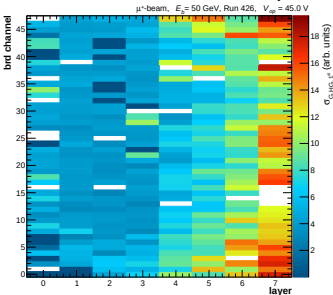
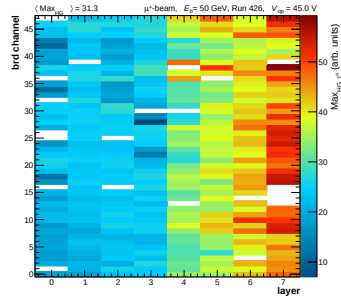
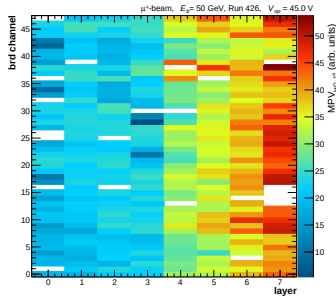
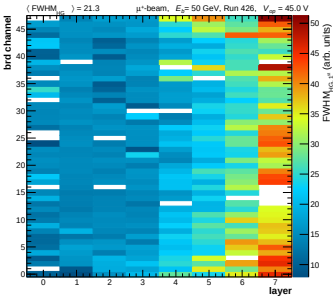
TOA offset calibration - Applied Set 2



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

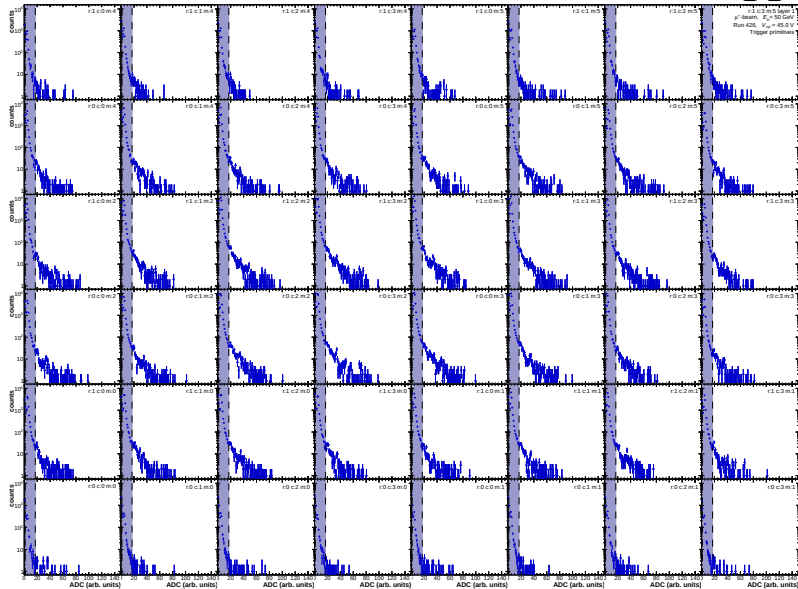


Muon calibration - Set 1: Muons - init (blue)

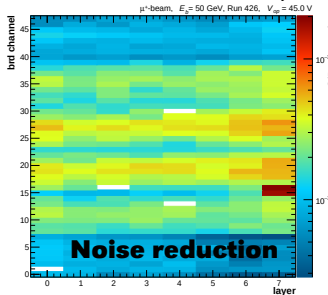
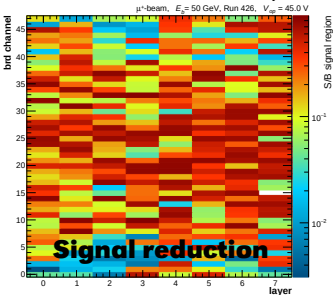
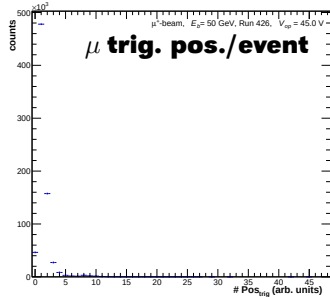
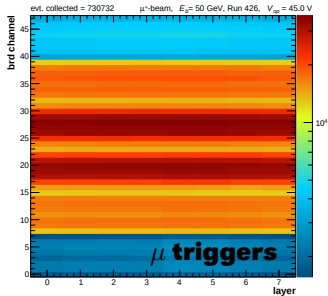
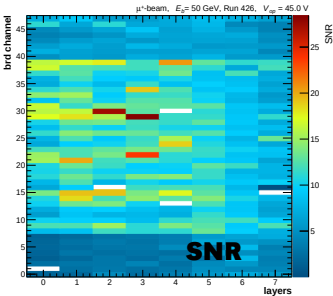


- Initial fit for 45 V & RF=12 quite stable, only few failures
- $\langle Max_{mip} \rangle = 31.3$
- channels with lower statistics not well fitted

Muon calibration - Set 1: Muons - Trigger



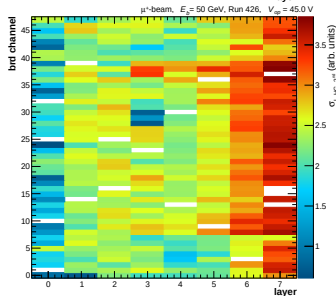
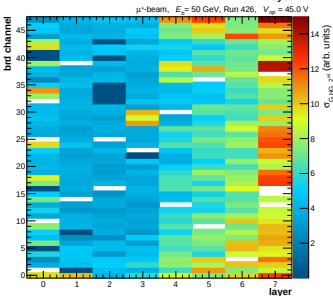
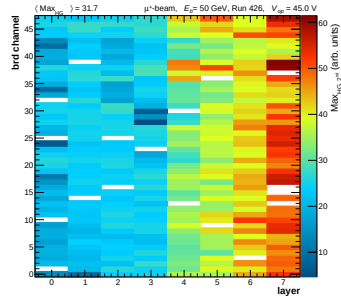
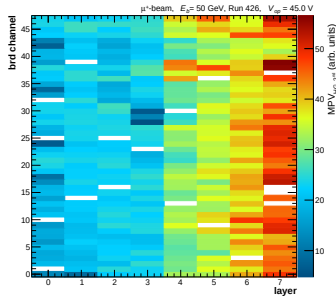
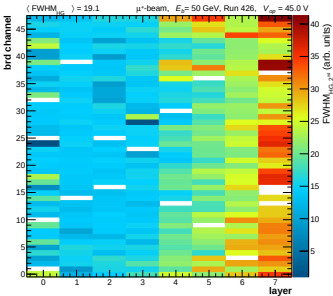
Muon calibration - Set 1: Muons - Trigger



- 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)

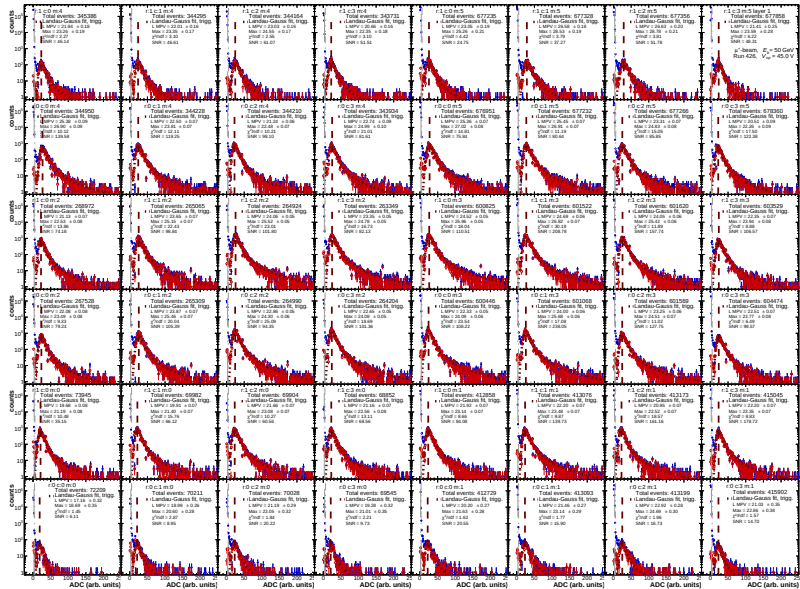


Muon calibration - Set 1: Muons - 0th ite

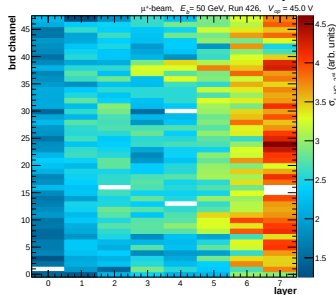
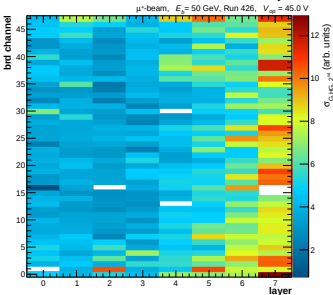
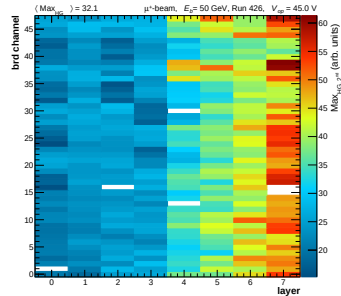
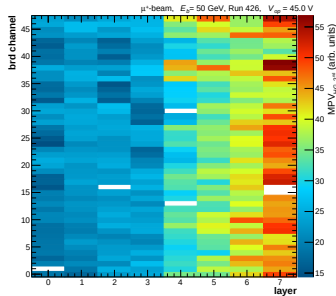
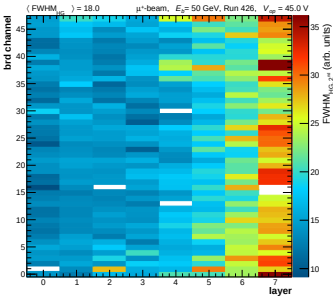


- Large fraction of channels succeeds
- 2 channels identified as bad
- Constrained fit much more in width
- $\langle \text{Max}_{mip} \rangle = 31.7$

Muon calibration - Set 1: Muons - 5th ite

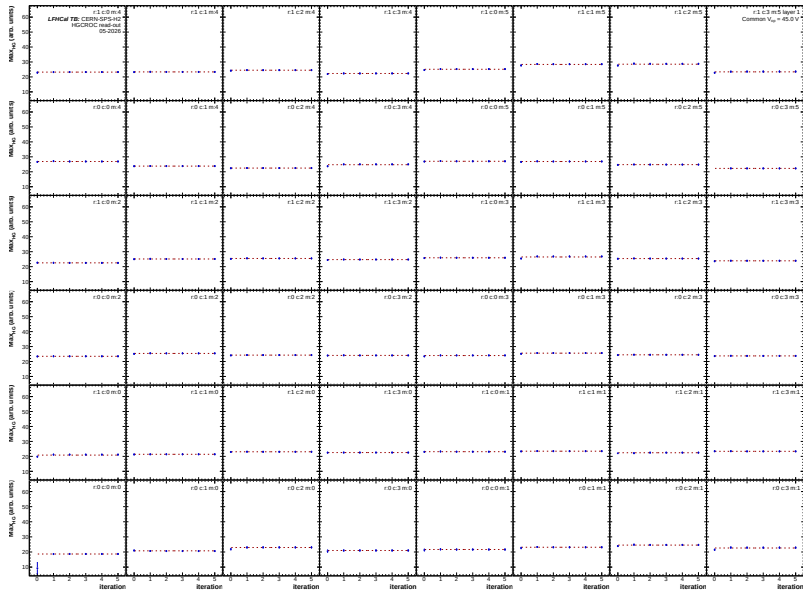


Muon calibration - Set 1: Muons - 5th ite

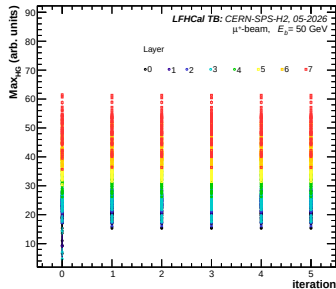
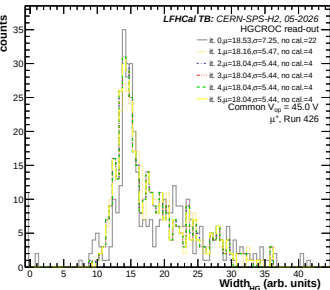
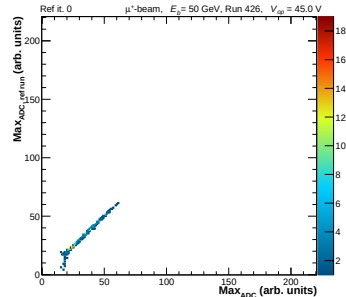
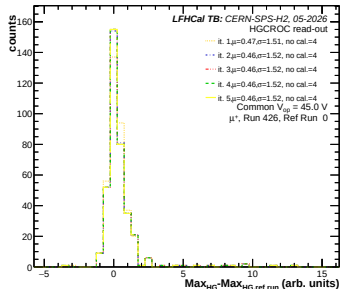
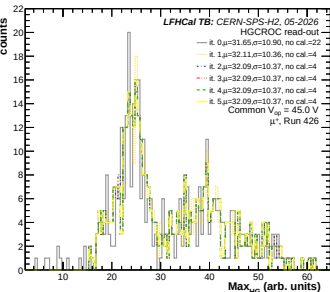


- Nearly all channels "fitable"
- 2 channels identified as bad
- $\langle \text{Max}_{mip} \rangle = 32.1$

Muon calibration - Set 1: Muons - Iterations



Muon calibration - Set 1: Muons - Iterations



- Reduced mip selection range for trigger primitives

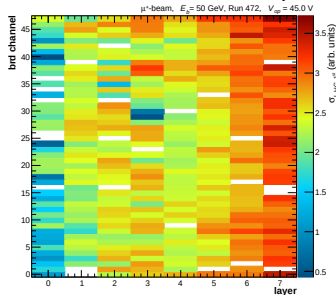
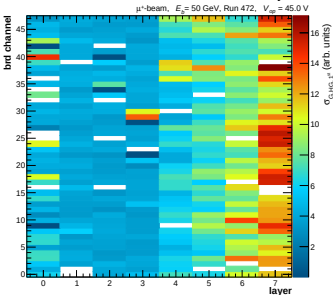
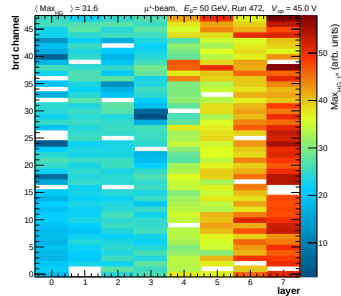
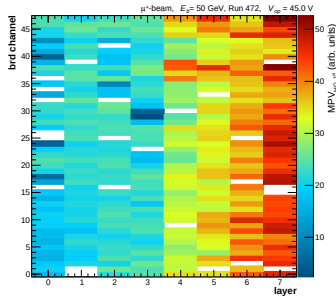
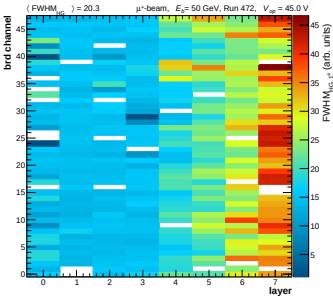
$$0.8 \langle Max_{mip} \rangle < trigg_{prim} < 2.5 \langle Max_{mip} \rangle$$

⇒ 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

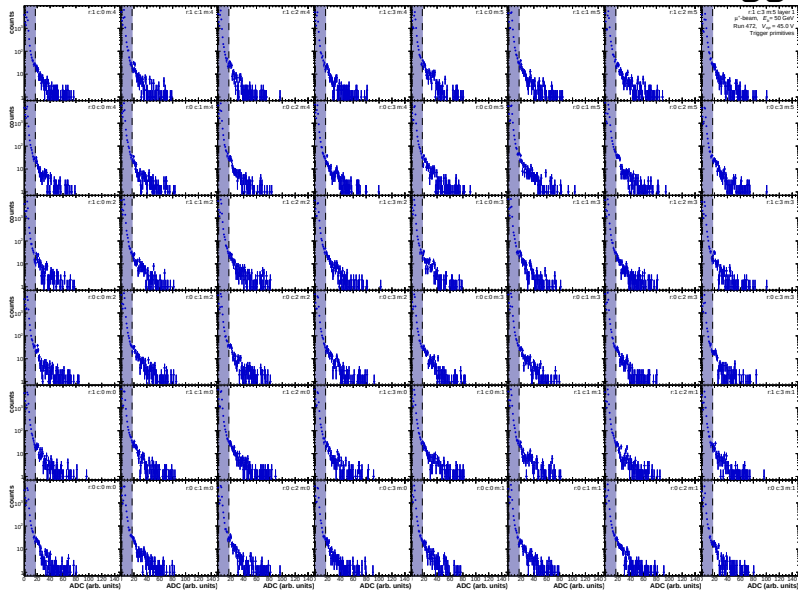


Muon calibration - Set 2: Muons - init (blue)

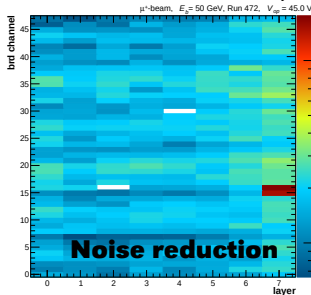
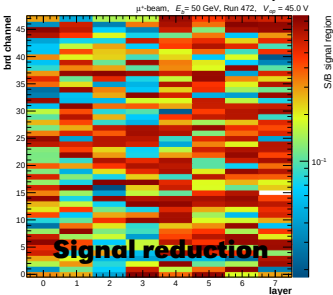
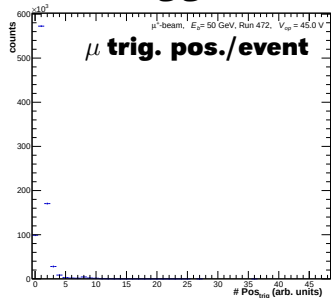
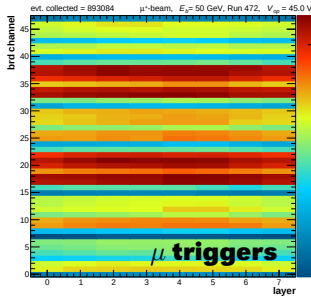
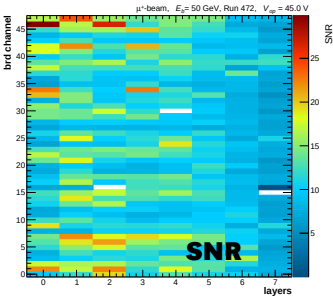


- Initial fit for 45 V & RF=12 quite stable, only few failures
- $\langle \text{Max}_{\text{HC}} \rangle = 31.6$
- No strong ch-by-ch variations in individual parameters per layer

Muon calibration - Set 2: Muons - Trigger

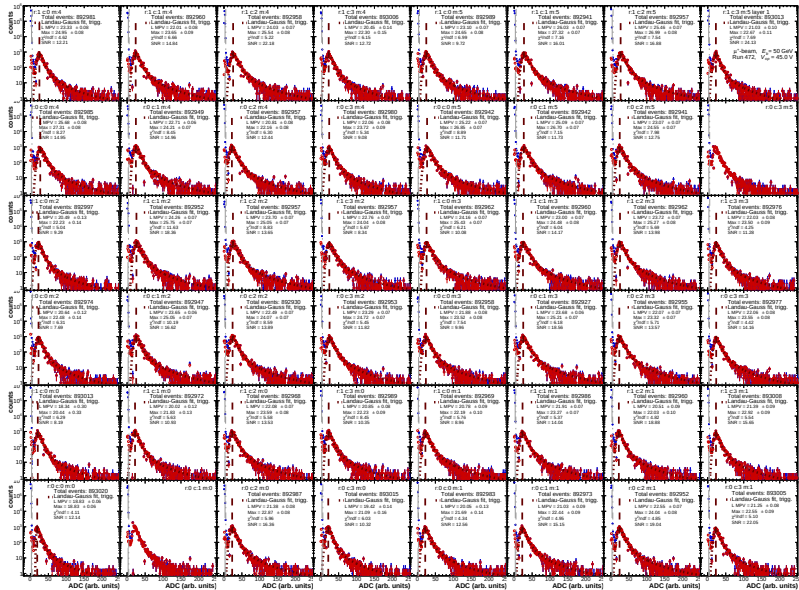


Muon calibration - Set 2: Muons - Trigger

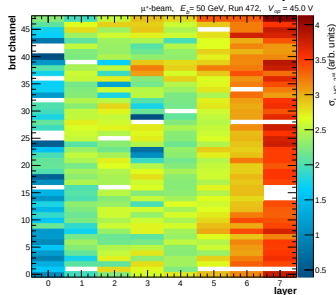
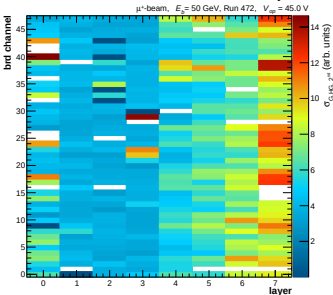
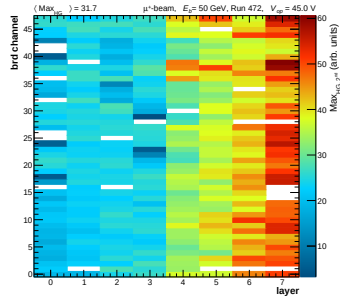
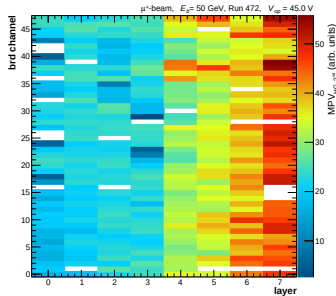
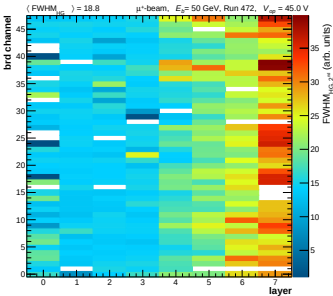


- Trigger evaluation for fixed column and row (all z-segments) if average signal summed over all active cells in $z > 3\sigma_{ped}$
- ⇒ Noise suppression could be improved by increasing $n\sigma_{ped}$
- Clear enhancement in trigger primitives, 0th level muon selection within $0.3\langle Max_{mip} \rangle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

Muon calibration - Set 2: Muons - 0th ite



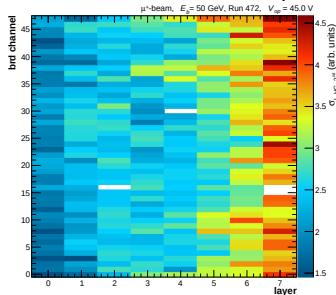
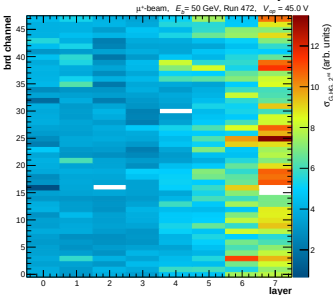
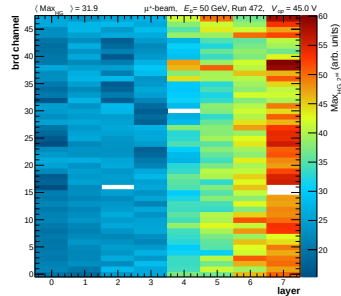
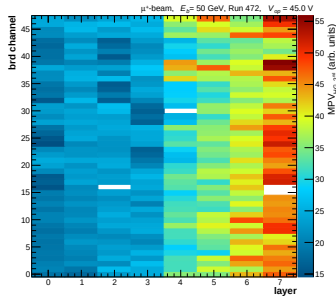
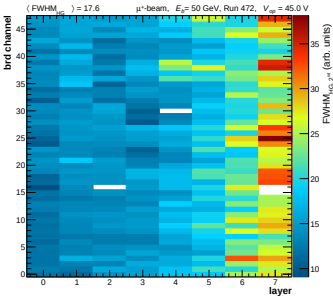
Muon calibration - Set 2: Muons - 0th ite



- Only few fit failures
- 2 channels identified as bad
- Constrained fit much more in width
- $\langle \text{Max}_{mip} \rangle = 31.7$

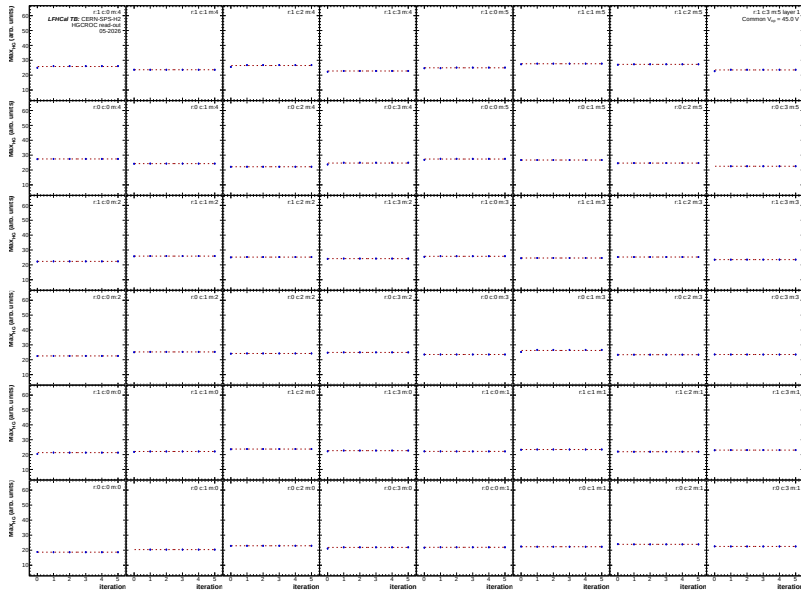


Muon calibration - Set 2: Muons - 5th ite

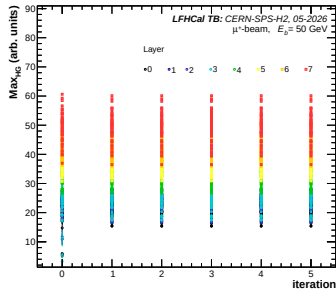
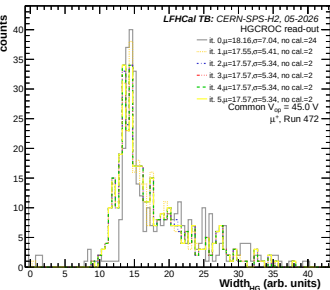
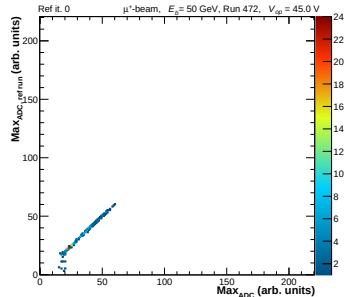
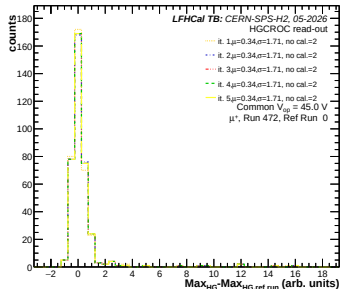
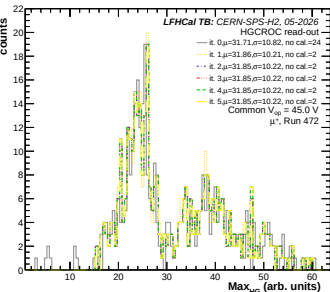


- Nearly all channels "fitable"
- 2 channels identified as bad
- $\langle \text{Max}_{mip} \rangle = 31.9$

Muon calibration - Set 2: Muons - Iterations



Muon calibration - Set 2: Muons - Iterations



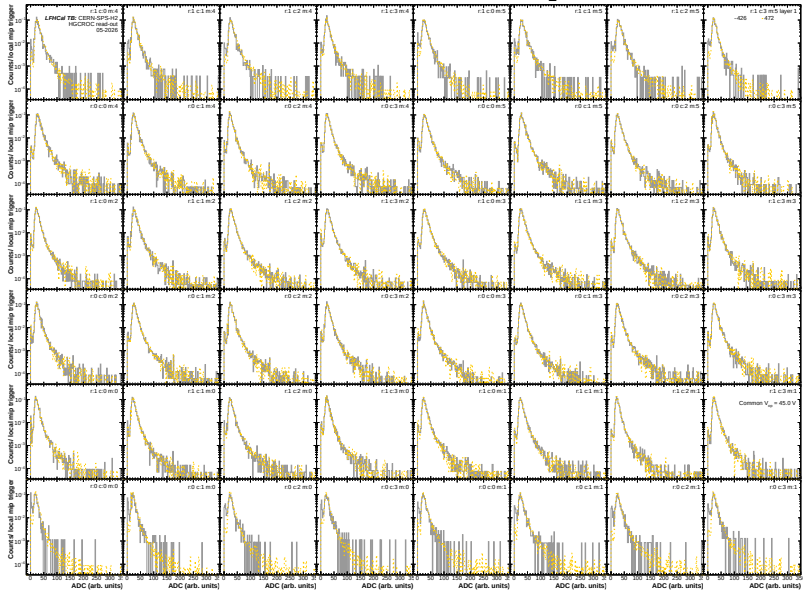
- Reduced mip selection range for trigger primitives

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

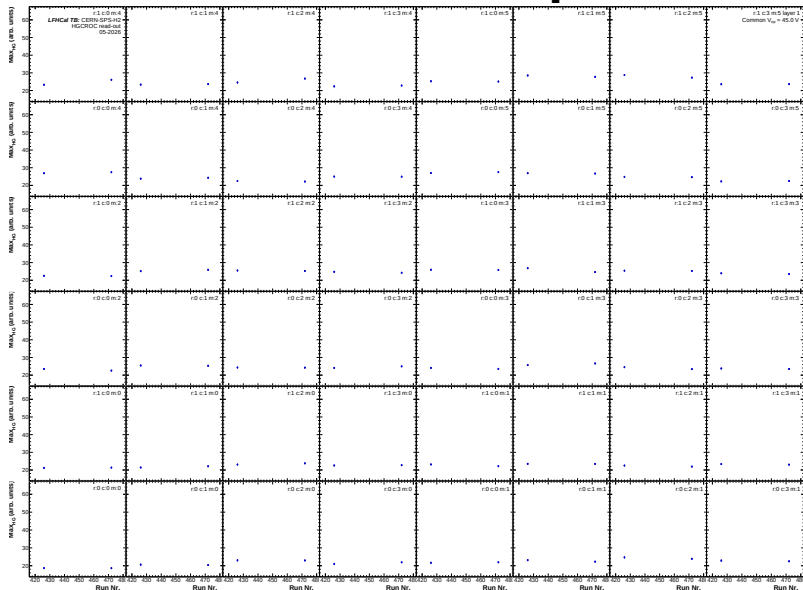
⇒ Further reduction of noise peak

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

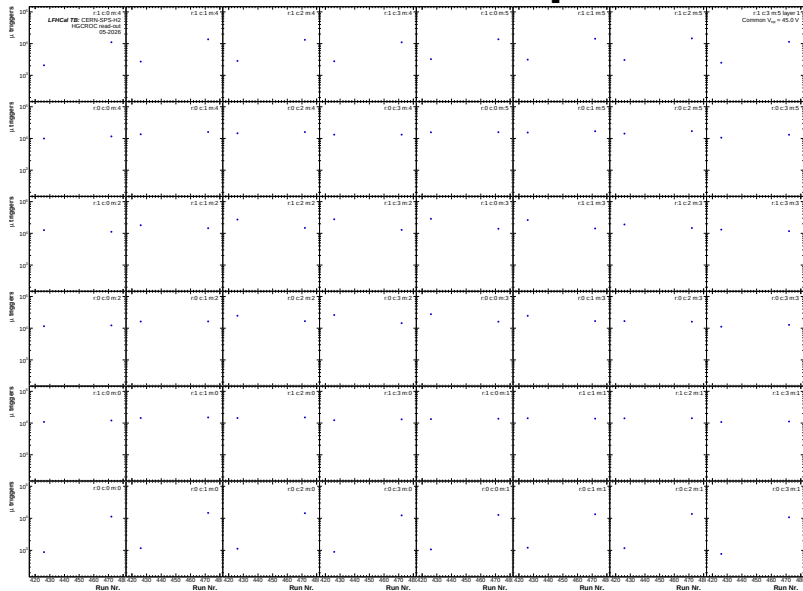
Muon calibration - Comparison Sets



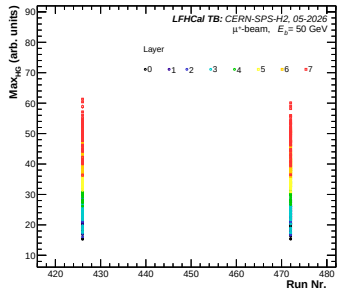
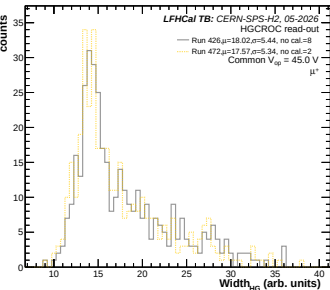
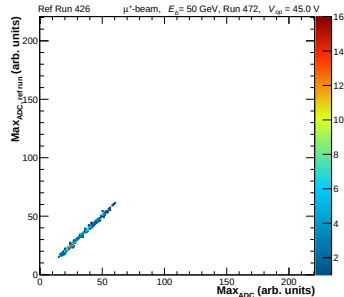
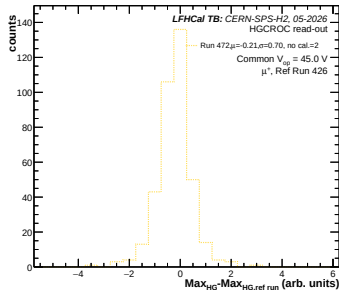
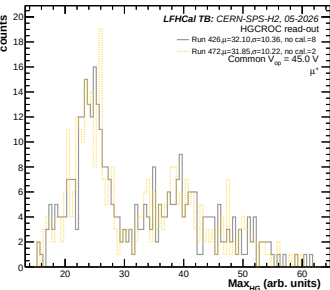
Muon calibration - Comparison Sets



Muon calibration - Comparison Sets



Muon calibration - Comparison Sets



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

Calibration summary - Set F



Calibration summary

- Besides 2 bad channels identified in this data set no further channels found problematic
- ToA offset calibration estimated on 100 GeV h^- run (pion) run valid for all runs of set F
- Final calibration based off 'Set_2' (6 beam positions) due to higher statistics & better coverage
 - ▶ Calib file FullSet F 1st [txt-file]
 - ▶ Calib file FullSet F 2nd [txt-file]