

2026 SPS TB - HGCROC Readout

September 15, 2026

Friederike Bock



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

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



Overview - Set G

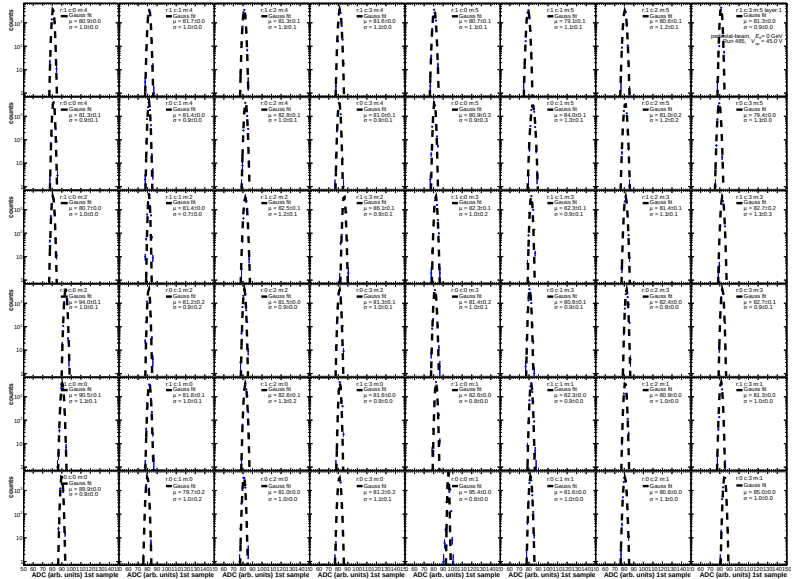
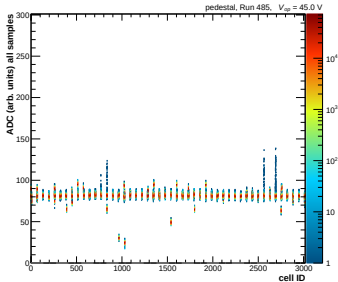
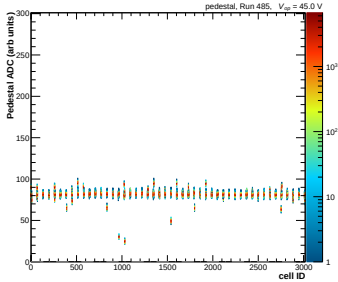
Full Set G

Summing Board V1, $V_{op} = 45$ V, gain settings: RF = 12, CF = 7, CC= 3, CFcomp=1
May 19, 20:22 - May 20, 7:57

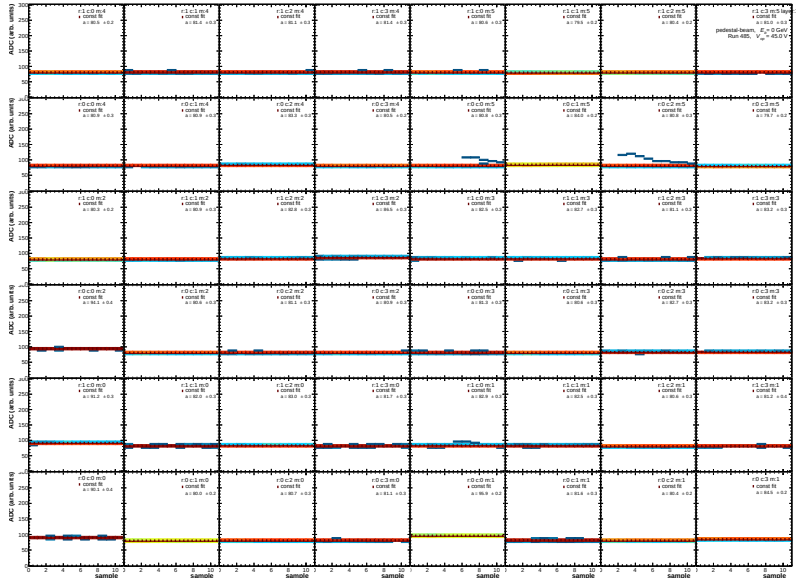
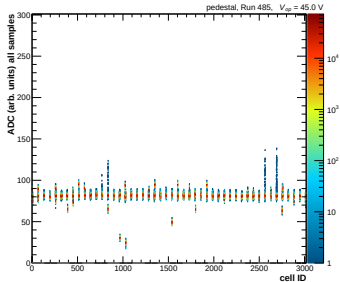
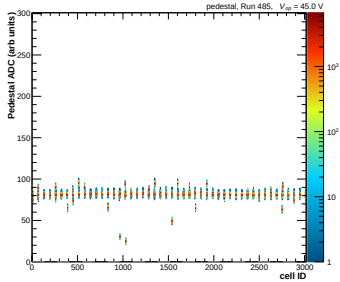
Calibration sets:												
μ table position	ped	(10,-10)	(10,0)	(10,10)	(-10, -10)	(-10,0)	(-10,10)	(0,0)				
1 st	runs	485	486	487	488	489	490	484	491			
	tot events	10K	160K	156K	154K	156K	160K	154K	150K			
μ table position	ped	(10,-10)	(10,0)	(10,10)	(-10, -10)	(-10,0)	(-10,10)	(0,0)				
2 nd	runs	529	531	532	533	534	535	536	530,537			
	tot events	10K	97K	104K	100K	100K	103K	103K	194K			
Electron set:												
E (GeV)	20	30	40	50	80	100						
e ⁻	runs	527	525	523	521	519	517					
	tot events	159K	140K	147K	152K	146K	148K					
e ⁺	runs	528	526	524	522	520	518					
	tot events	155K	135K	147K	156K	151K	148K					
Hadron set:												
E (GeV)	20	30	40	50	60	70	80	90	100	150	200	250
h ⁻	runs	514	512	510	508	506	504	502	500	498	496	494
	tot events	154K	215K	226K	208K	205K	206K	204K	208K	155K	157K	253K
h ⁺	runs	515	513	511	509	507	505	503	501	499	497	495
	tot events	152K	151K	204K	245K	203K	200K	204K	212K	150K	154K	254K

- time:
19.5.2026 20:22 - 20.5.2026 7:57
- $V_{op} = 45$ V, $V_{br} = 38.3$ V
- Gain settings:
 - RF = 12, CF = 7, CC= 3, CFcomp=1
- V1 summing board**
- μ with large scintillator triggers:
 - 7 positions Scan “_1”
 - 7 positions Scan “_2”
- e^- and $h^\pm$ with small scintillators

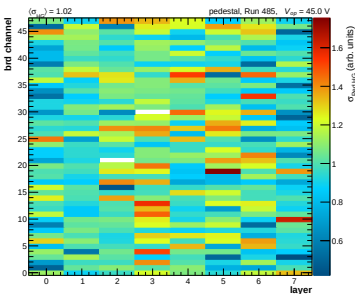
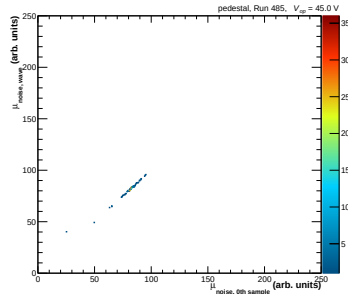
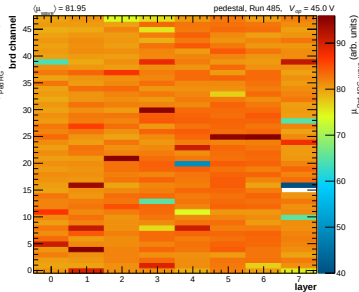
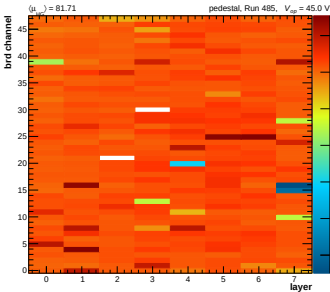
Muon calibration - Set 1: Pedestals



Muon calibration - Set 1: Pedestals

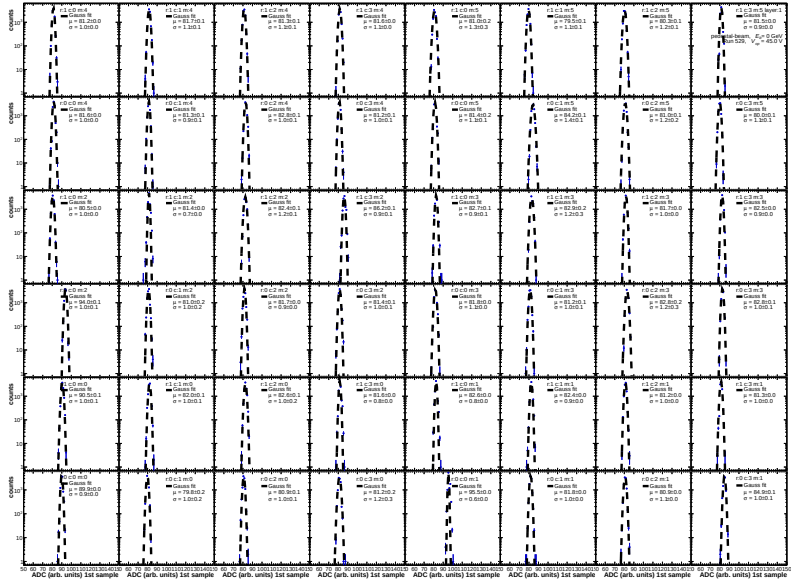
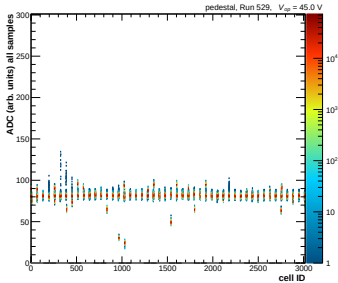
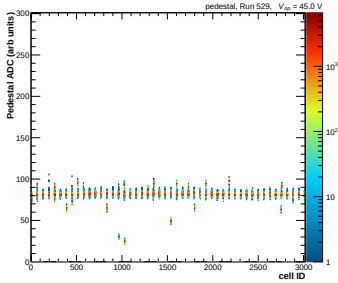


Muon calibration - Set 1: Pedestals

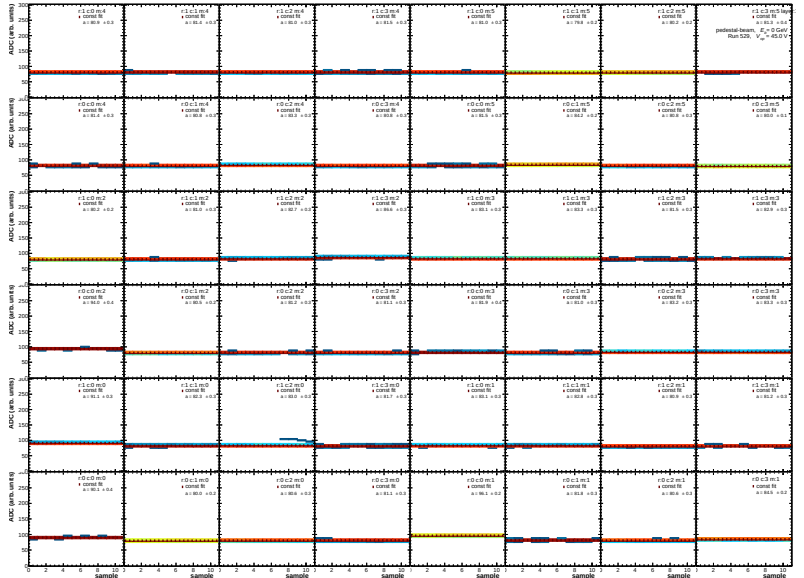
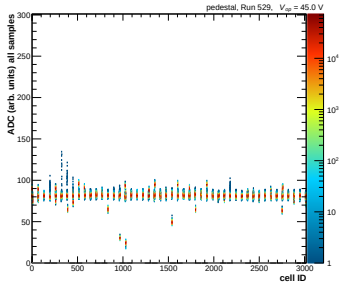
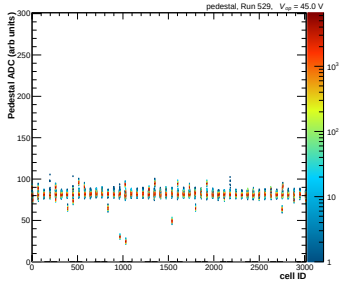


- Pedestal for all readout units set to 80 ADC
- Online calibration verified
- Fitting converges for most cells (2 missing)
- Good correlation between alternative fitting methods for pedestal

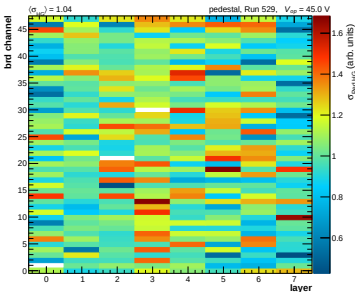
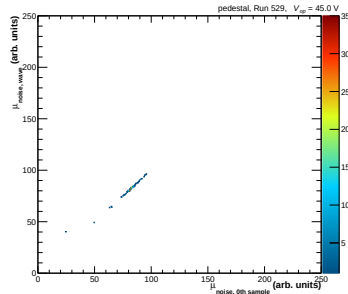
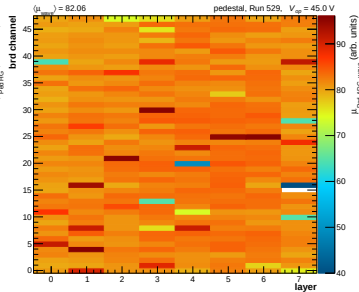
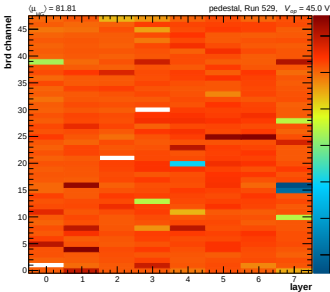
Muon calibration - Set 2: Pedestals



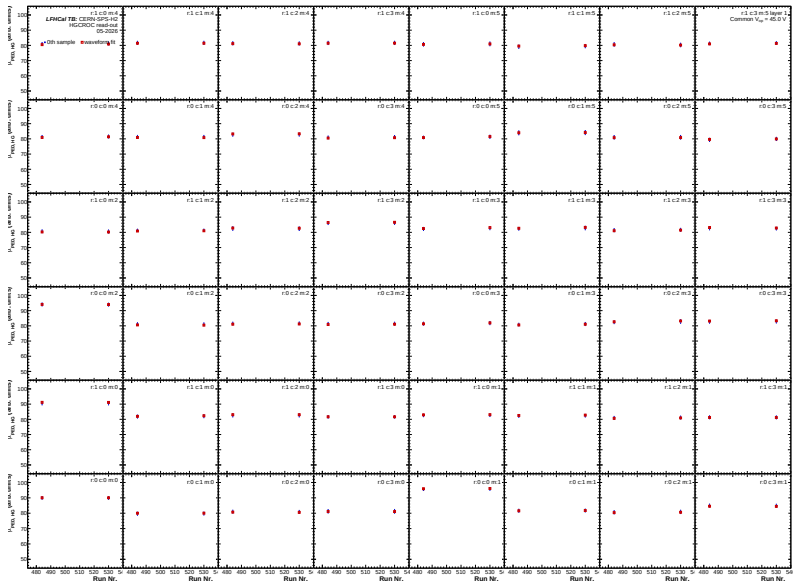
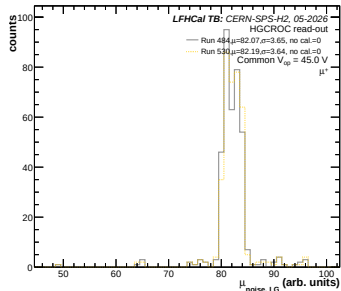
Muon calibration - Set 2: Pedestals



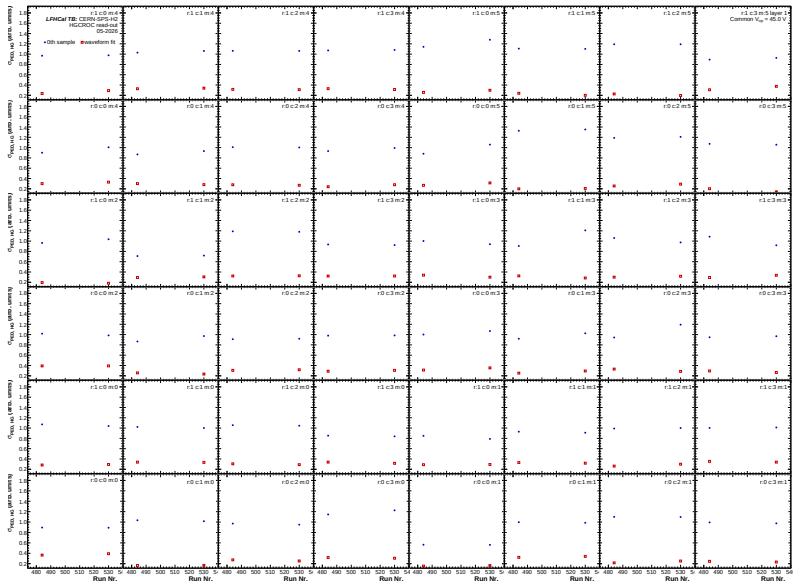
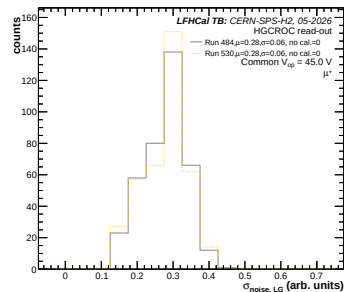
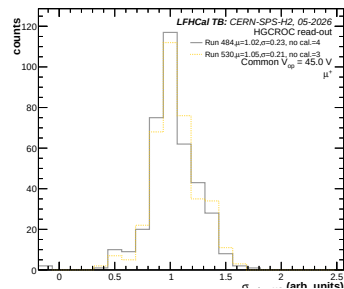
Muon calibration - Set 2: Pedestals



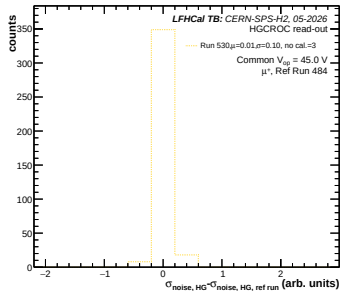
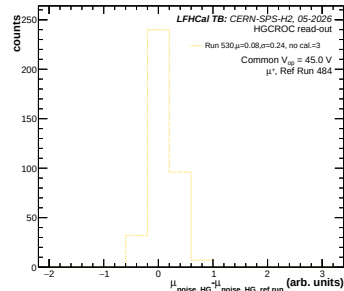
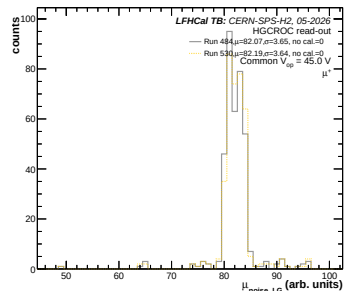
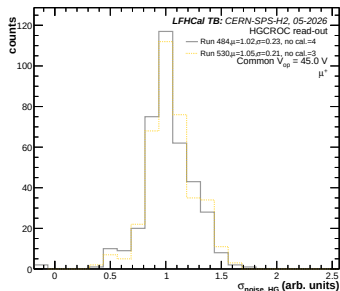
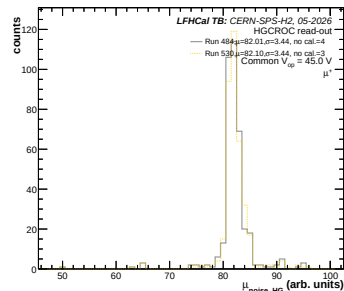
- Pedestal for all readout units set to 80 ADC
- Online calibration verified
- Fitting converges for most cells (3 missing)
- Good correlation between alternative fitting methods for pedestal



Muon calibration - Pedestal Comparison

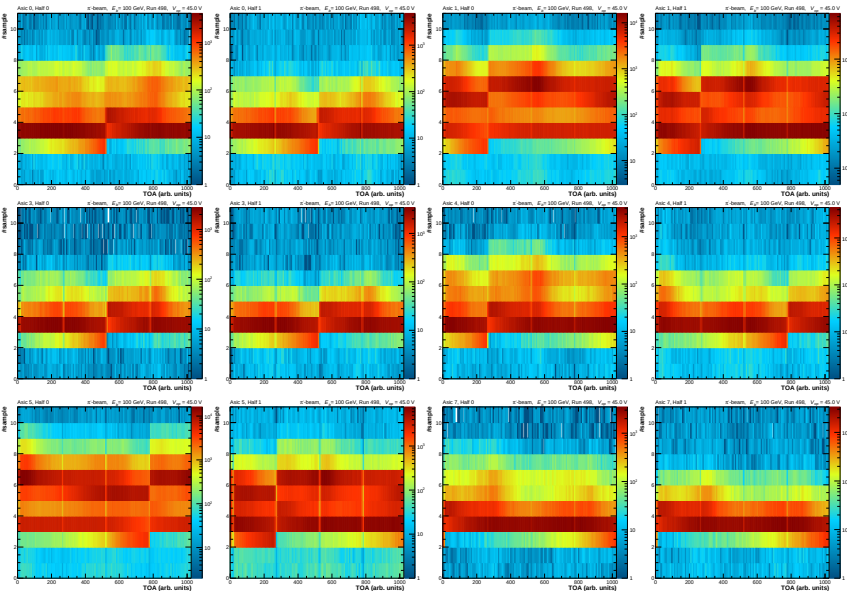


Muon calibration - Pedestal Comparison



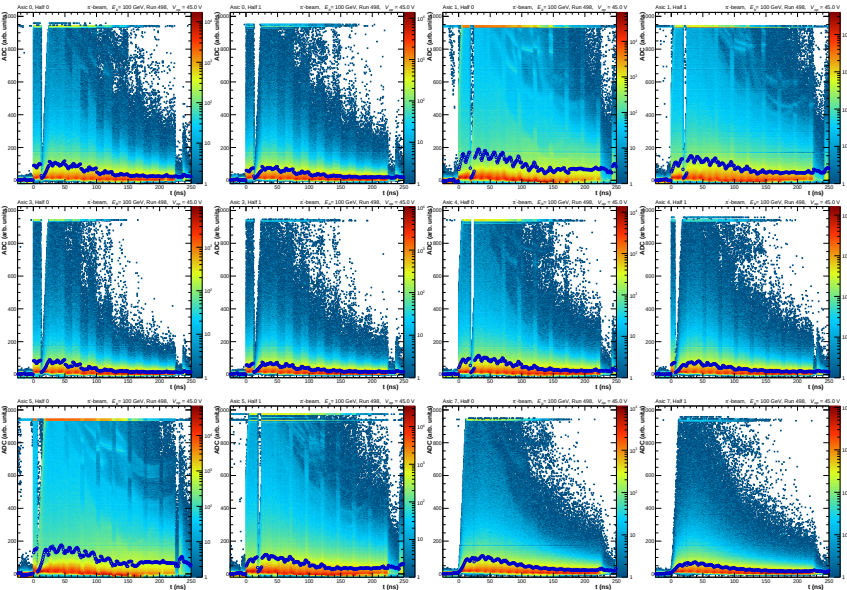
- Very similar pedestal position for both pedestal runs
- Width varies slightly between runs, but within fitting uncertainties
- Either run could be used for corrections

TOA offset calibration



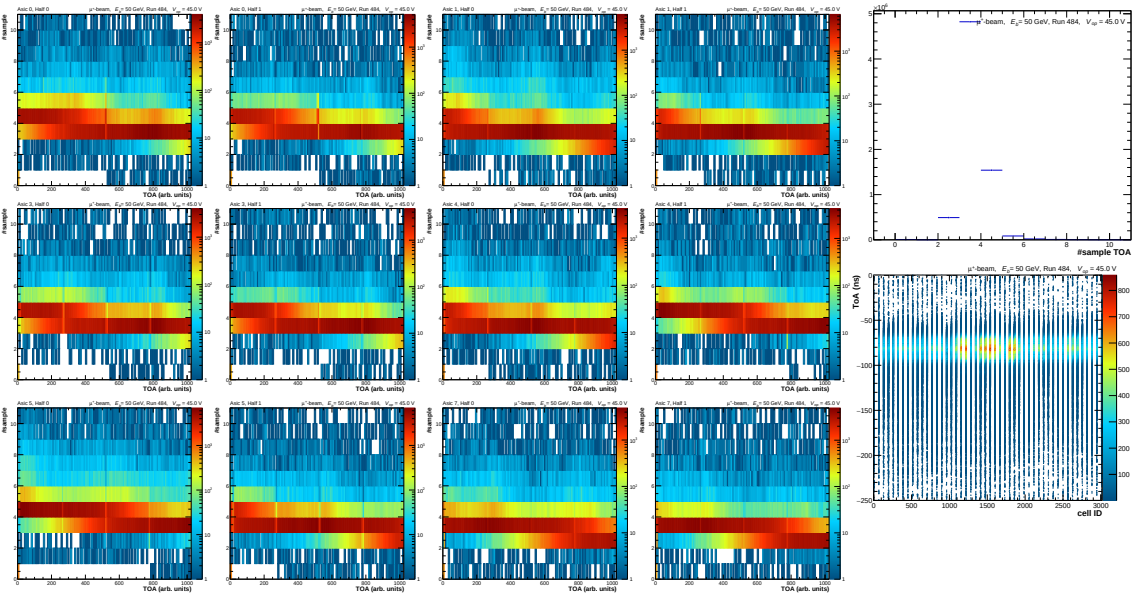
- Estimated using first negative pion run (498) at 100 GeV
- Based on ToA vs nSample plot
- Applied consistently to full set
- [TOA calib offset file]

TOA offset calibration

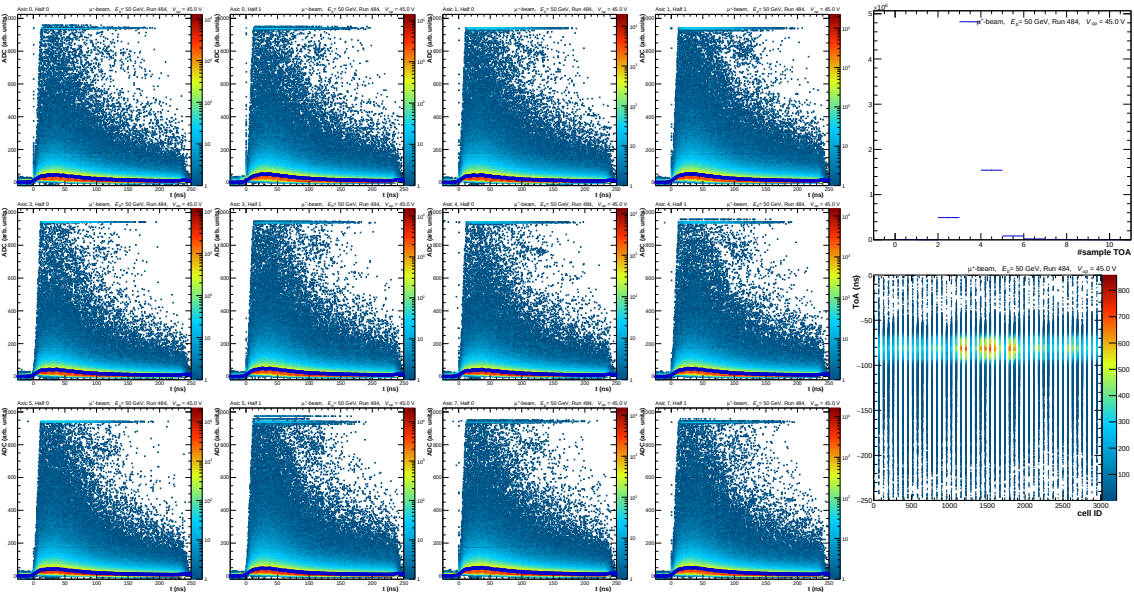


- Estimated using first negative pion run (498) at 100 GeV
- Based on ToA vs nSample plot
- Applied consistently to full set
- [TOA calib offset file]

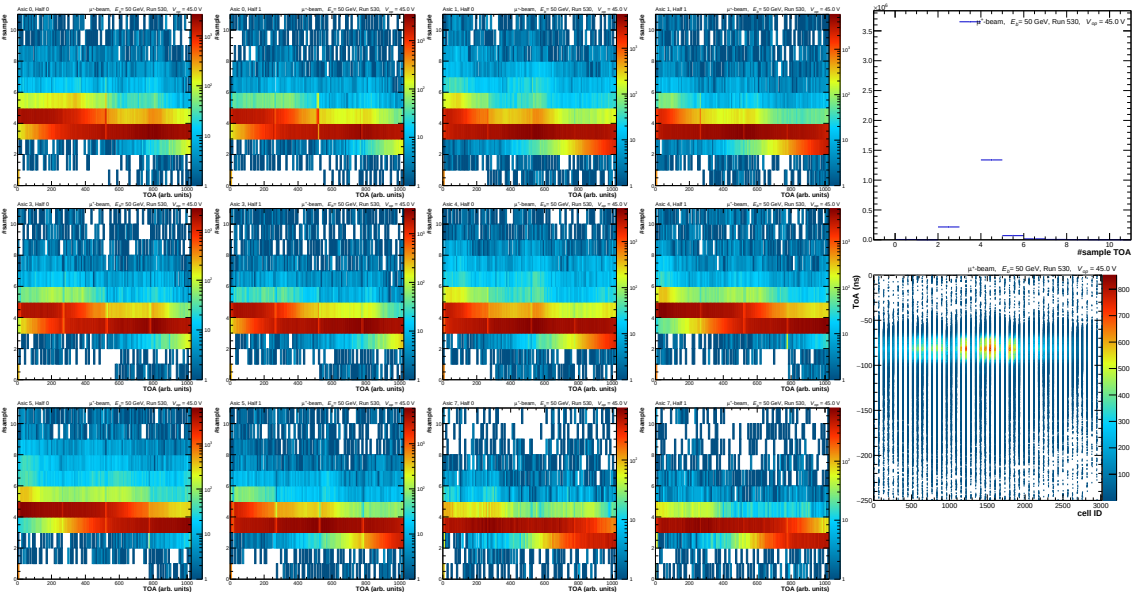
TOA offset calibration - Applied Set 1



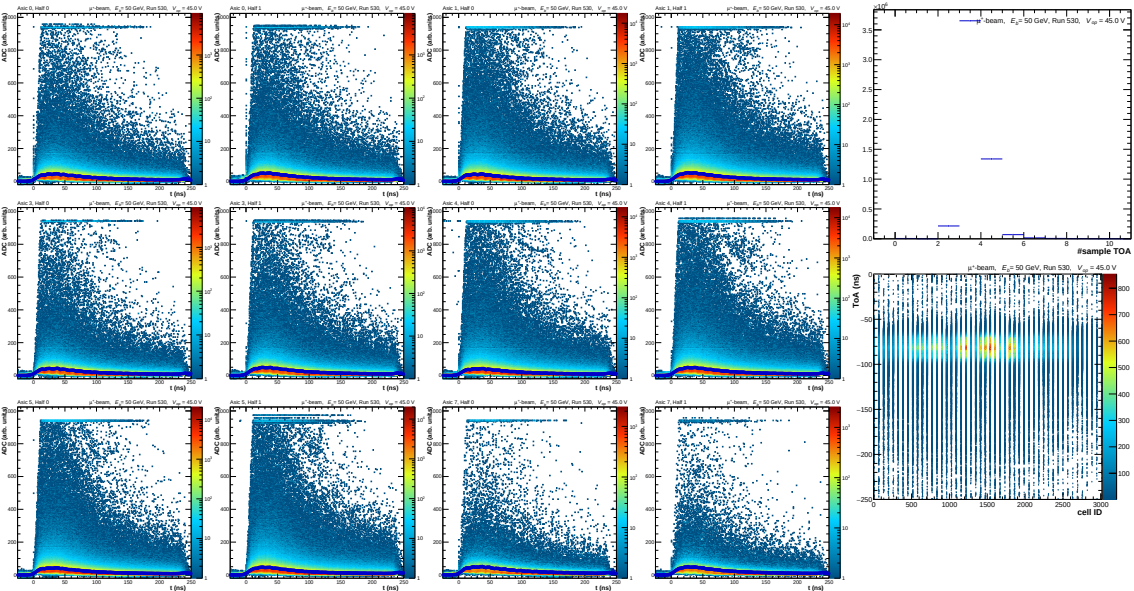
TOA offset calibration - Applied Set 1



TOA offset calibration - Applied Set 2

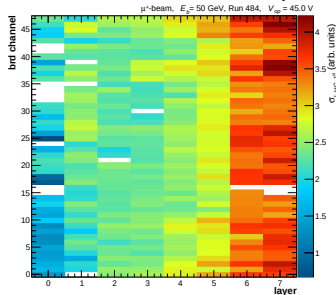
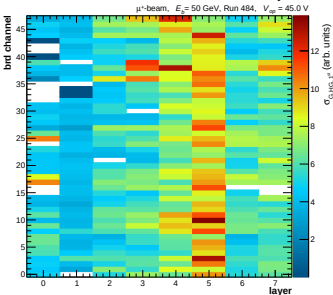
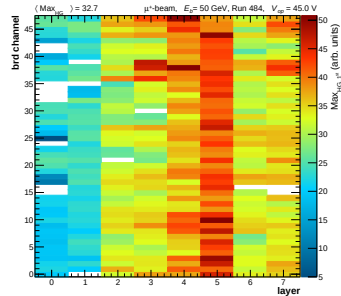
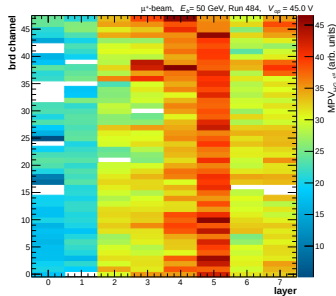
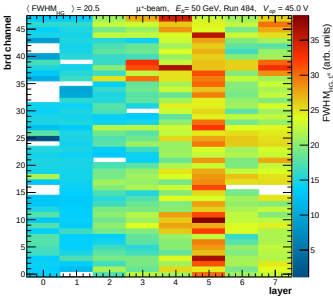


TOA offset calibration - Applied Set 2



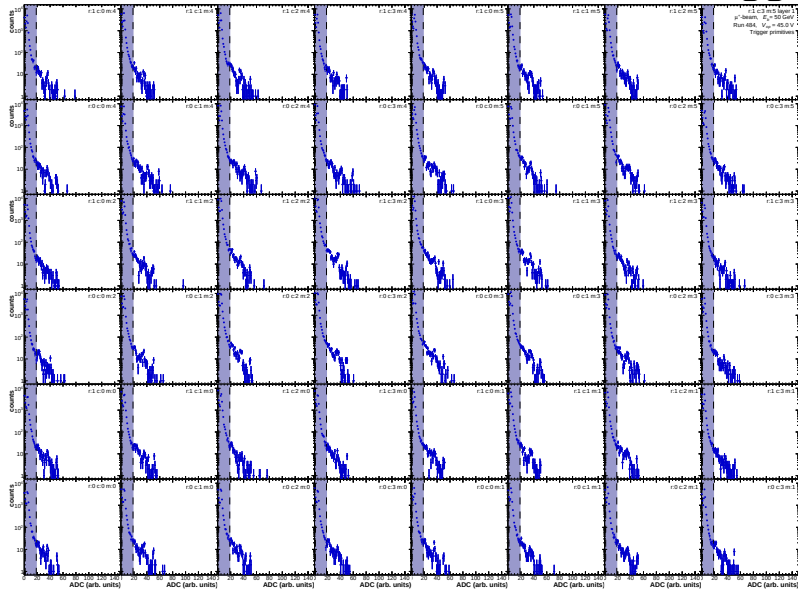


Muon calibration - Set 1: Muons - init (blue)

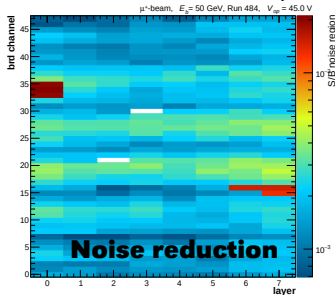
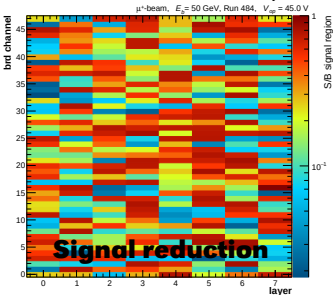
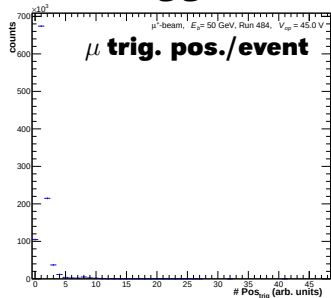
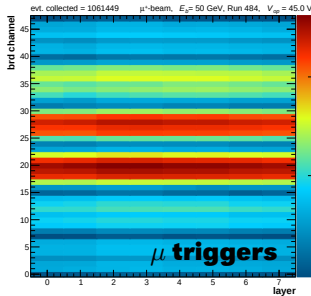
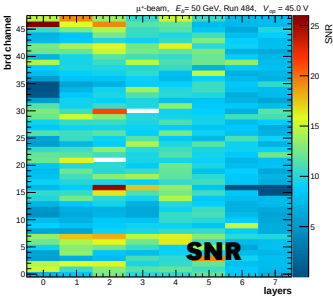


- Initial fit for 45 V & RF=12 quite stable, only few failures
- $\langle Max_{mip} \rangle = 32.7$
- channels with lower statistics not well fitted

Muon calibration - Set 1: Muons - Trigger

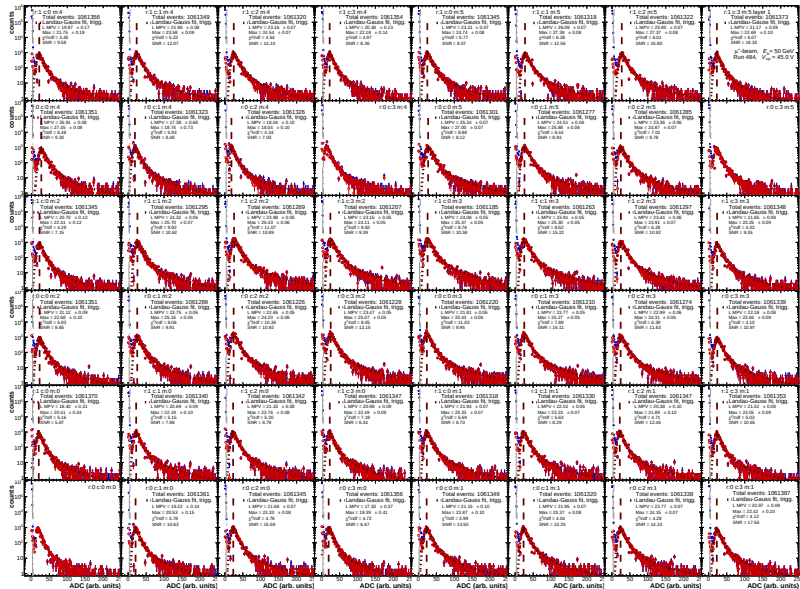


Muon calibration - Set 1: Muons - Trigger

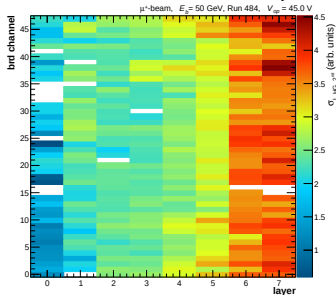
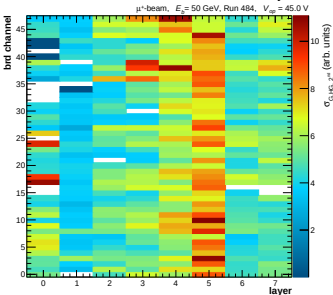
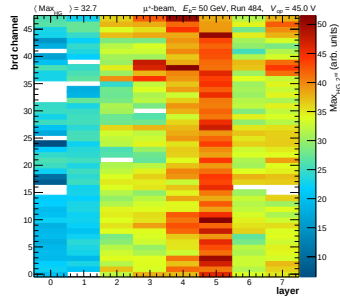
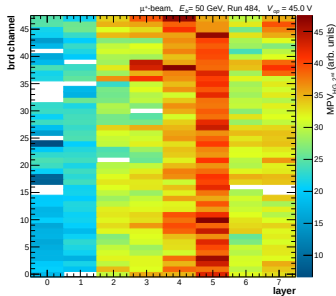
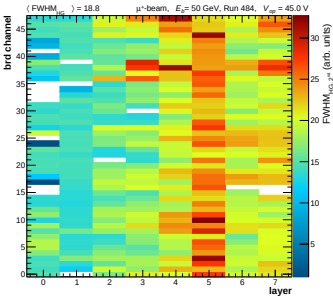


- Trigger evaluation for fixed column and row (all z-segments) if average signal summed over all active cells in $z > 3\sigma_{ped}$
- ⇒ Noise suppression could be improved by increasing $n\sigma_{ped}$
- Clear enhancement in trigger primitives, 0th level muon selection within $0.3\langle Max_{mip} \rangle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

Muon calibration - Set 1: Muons - 0th ite

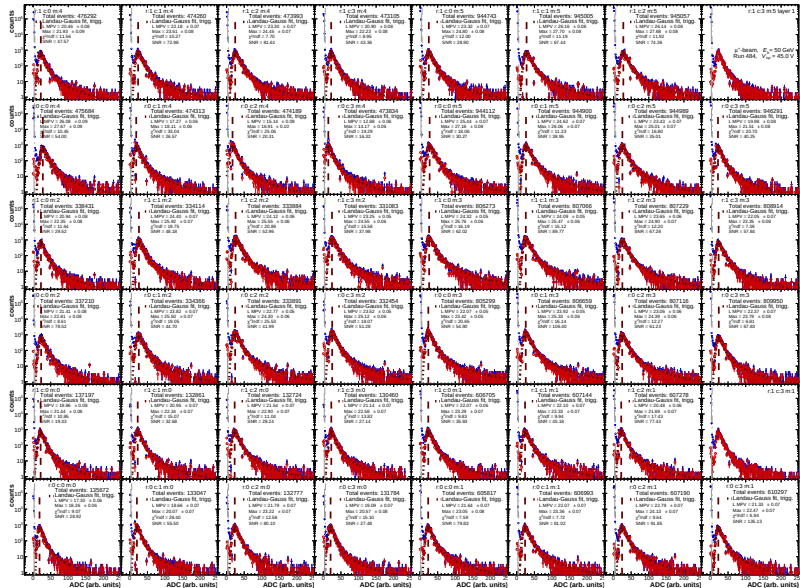


Muon calibration - Set 1: Muons - 0th ite

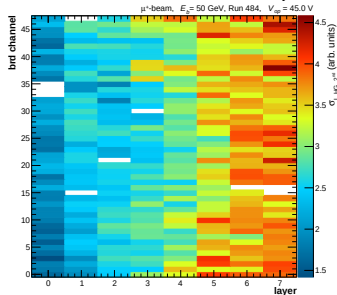
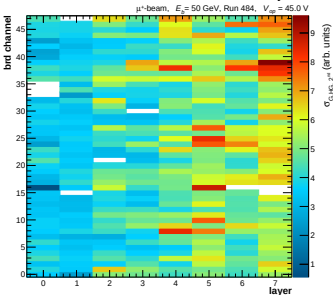
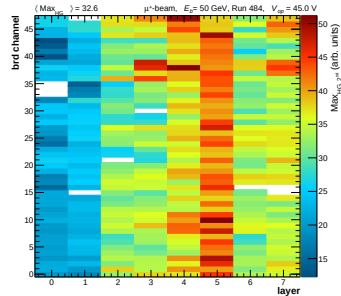
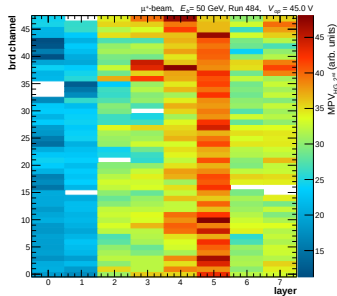
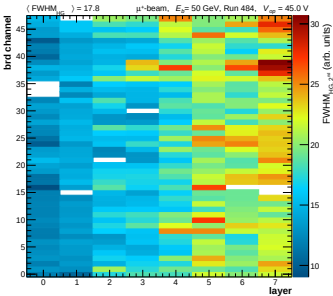


- Large fraction of channels succeeds
- 6 channels identified as bad
- Constrained fit much more in width
- $\langle \text{Max}_{mip} \rangle = 32.7$

Muon calibration - Set 1: Muons - 5th ite

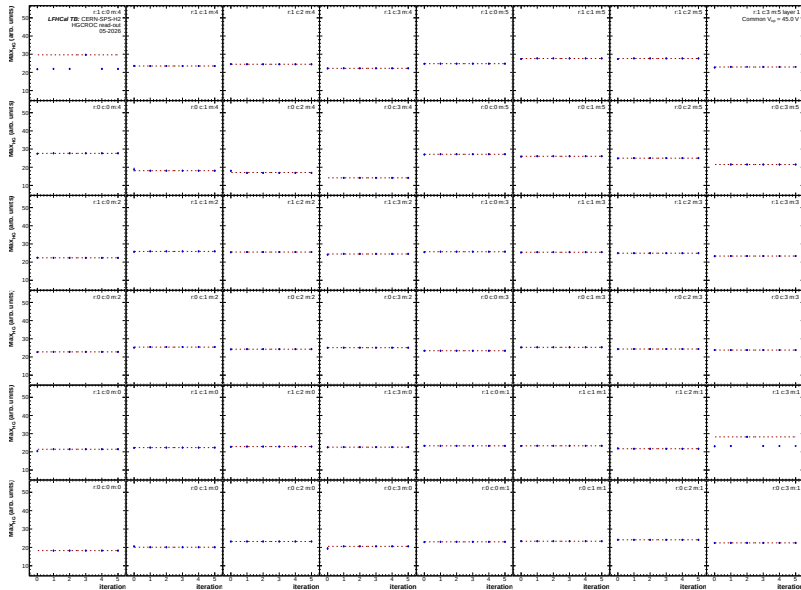


Muon calibration - Set 1: Muons - 5th ite

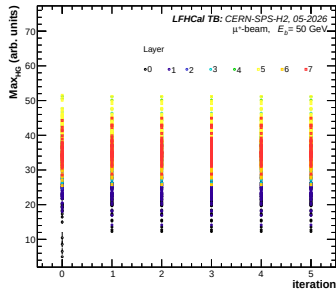
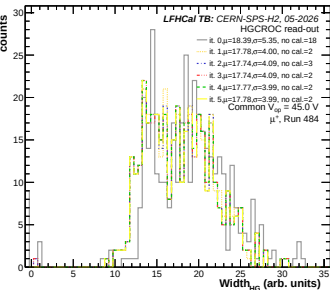
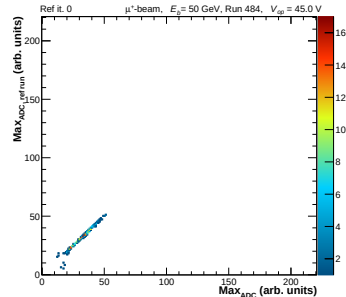
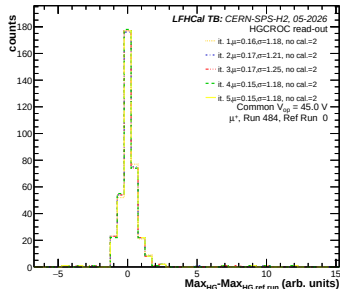
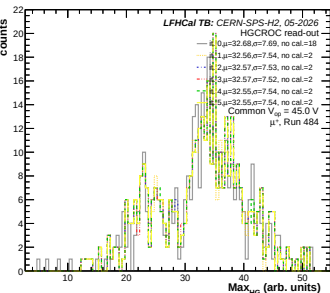


- Nearly all channels "fitable"
- 6 channels identified as bad
- $\langle \text{Max}_{mip} \rangle = 32.6$

Muon calibration - Set 1: Muons - Iterations



Muon calibration - Set 1: Muons - Iterations



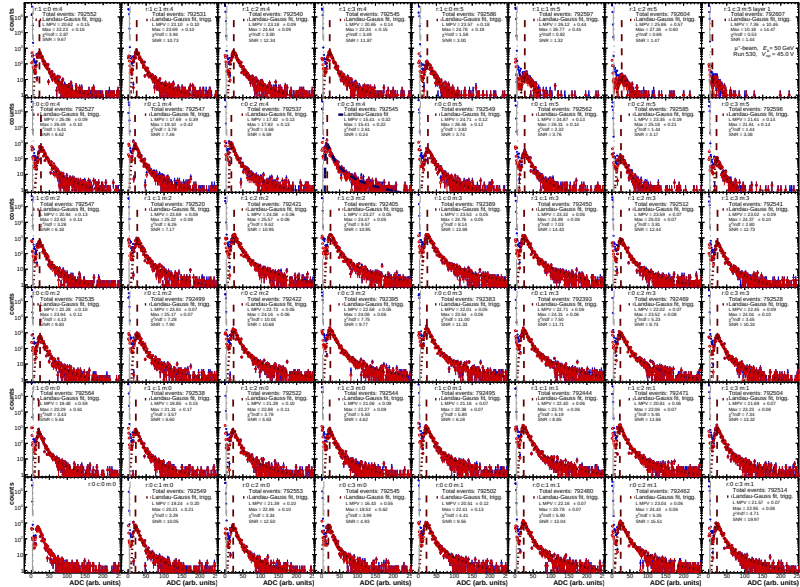
- Reduced mip selection range for trigger primitives

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

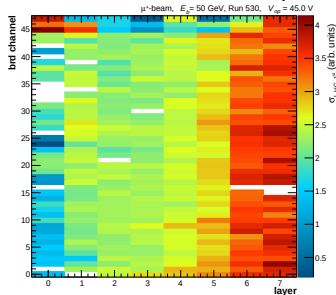
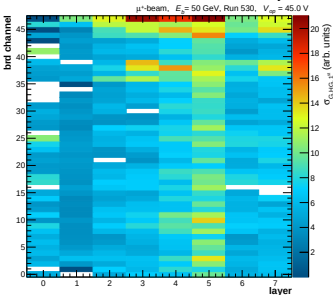
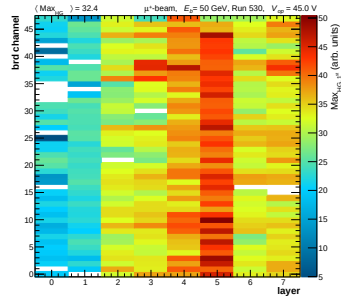
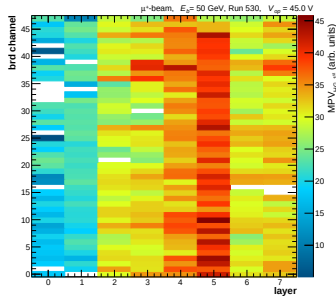
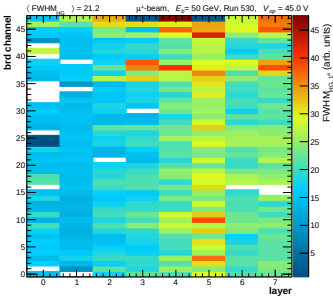
⇒ Further reduction of noise peak

- 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)

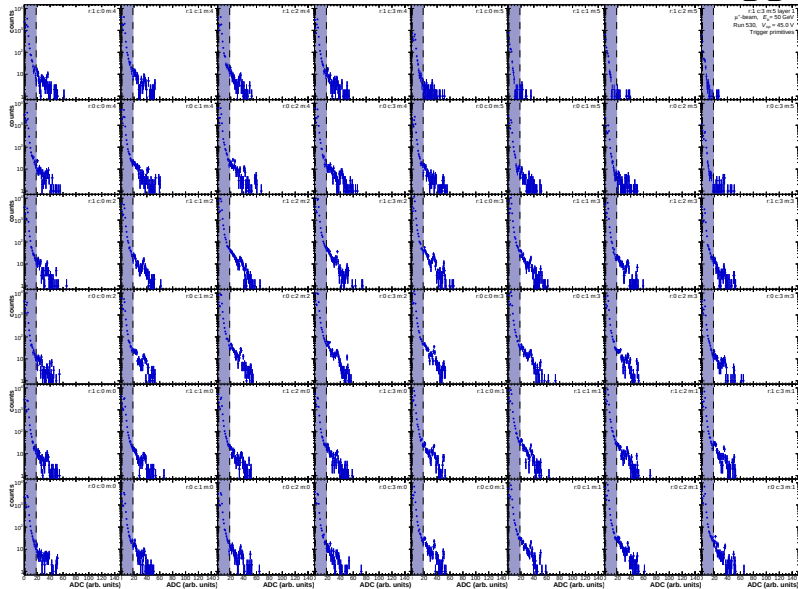


Muon calibration - Set 2: Muons - init (blue)

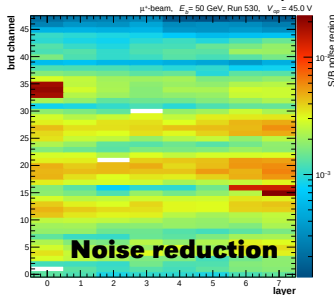
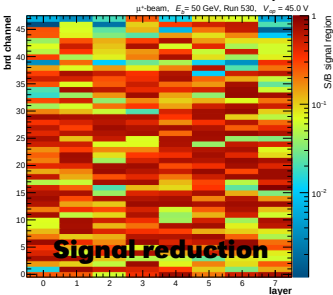
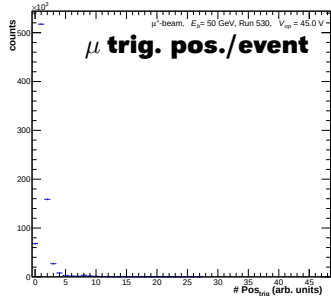
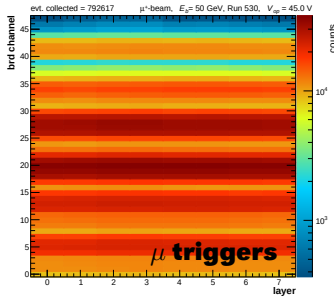
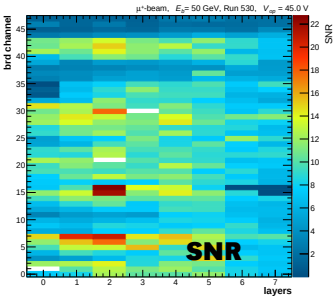


- Initial fit for 45 V & RF=12 quite stable, only few failures
- $\langle \text{Max}_{mip} \rangle = 32.4$
- No strong ch-by-ch variations in individual parameters per layer

Muon calibration - Set 2: Muons - Trigger

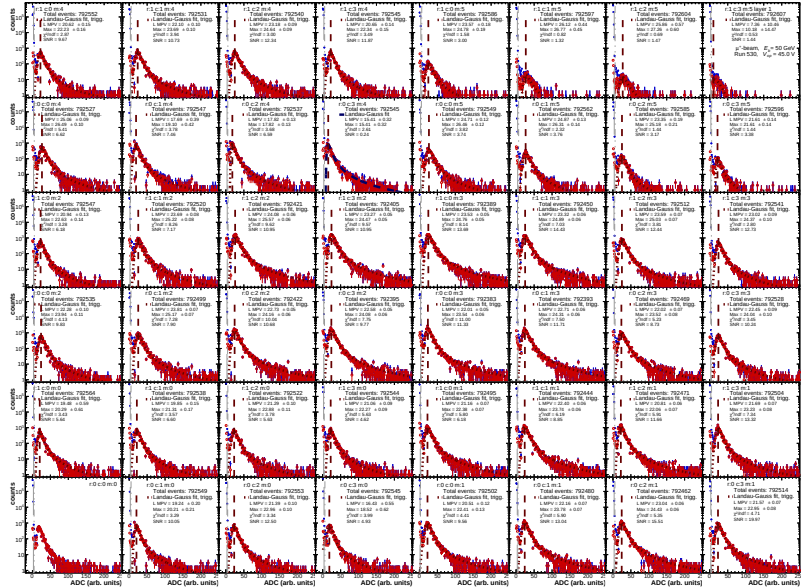


Muon calibration - Set 2: Muons - Trigger

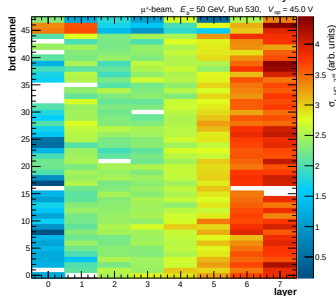
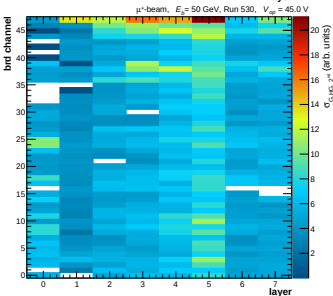
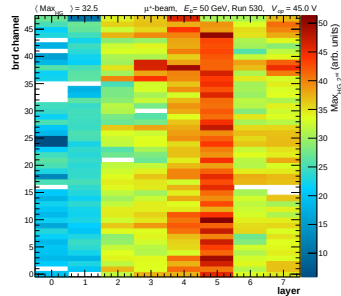
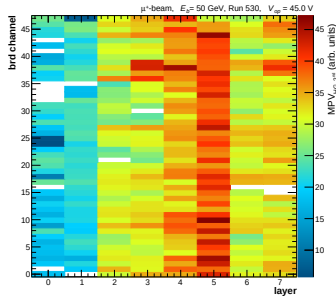
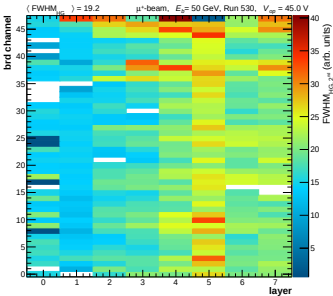


- Trigger evaluation for fixed column and row (all z-segments) if average signal summed over all active cells in $z > 3\sigma_{ped}$
- ⇒ Noise suppression could be improved by increasing $n\sigma_{ped}$
- Clear enhancement in trigger primitives, 0th level muon selection within $0.3\langle Max_{mip} \rangle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

Muon calibration - Set 2: Muons - 0th ite

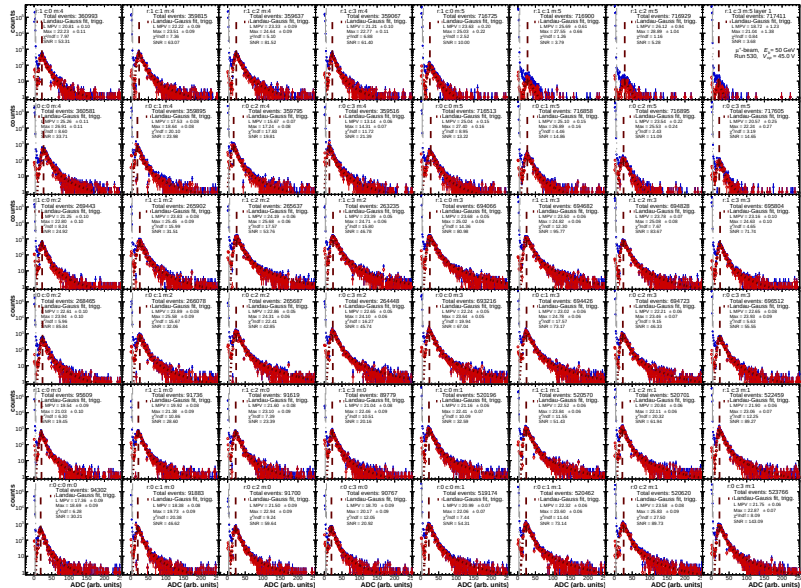


Muon calibration - Set 2: Muons - 0th ite

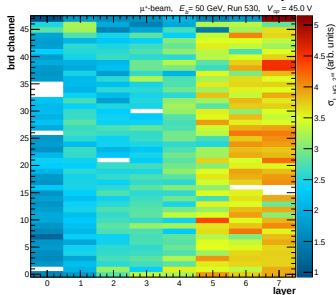
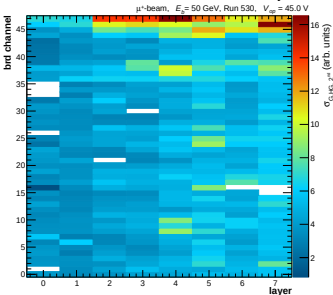
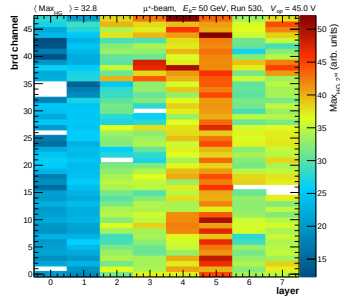
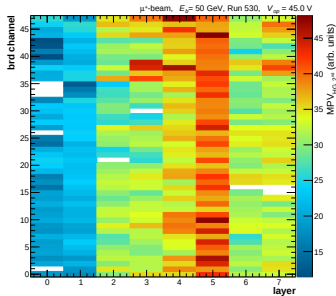
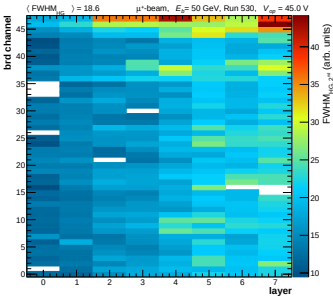


- Only few fit failures
- 6 channels identified as bad
- Constrained fit much more in width
- $\langle \text{Max}_{mip} \rangle = 32.5$

Muon calibration - Set 2: Muons - 5th ite

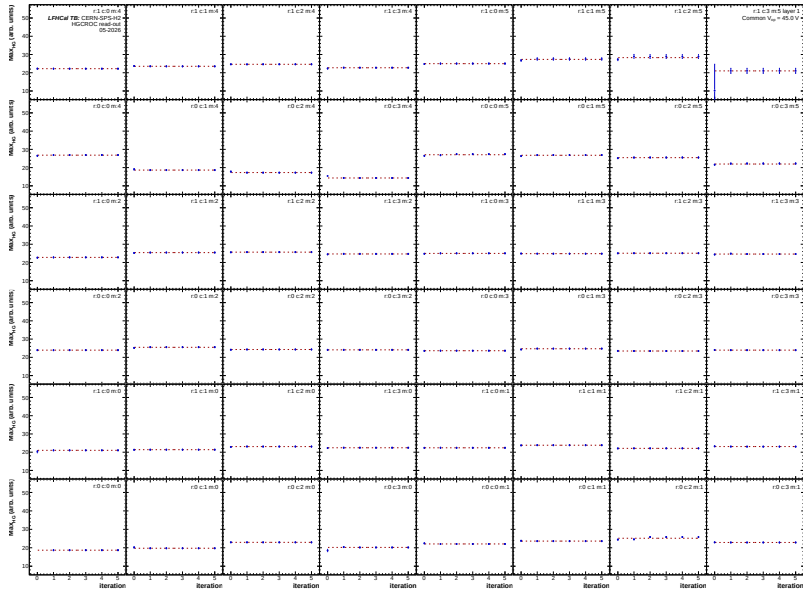


Muon calibration - Set 2: Muons - 5th ite

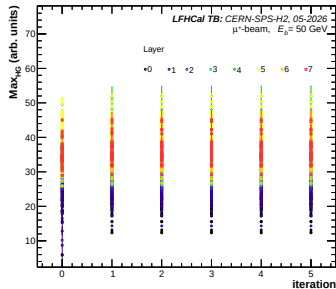
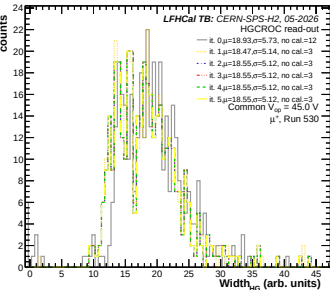
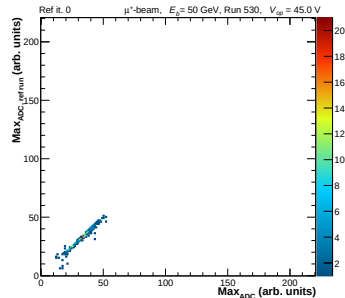
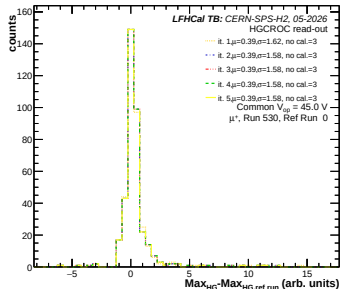
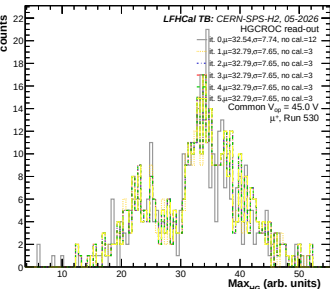


- Nearly all channels "fitable"
- 6 channels identified as bad
- $\langle \text{Max}_{mip} \rangle = 32.8$

Muon calibration - Set 2: Muons - Iterations



Muon calibration - Set 2: Muons - Iterations



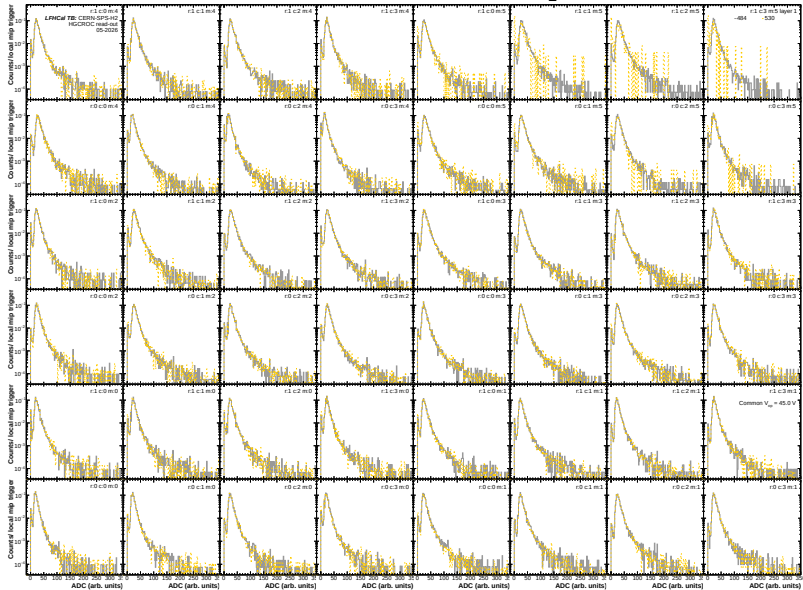
- Reduced mip selection range for trigger primitives

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

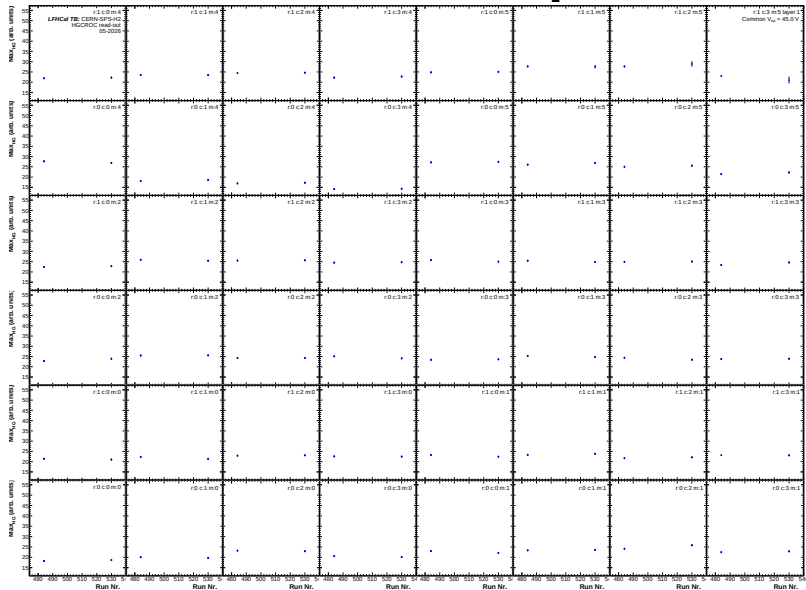
⇒ Further reduction of noise peak

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

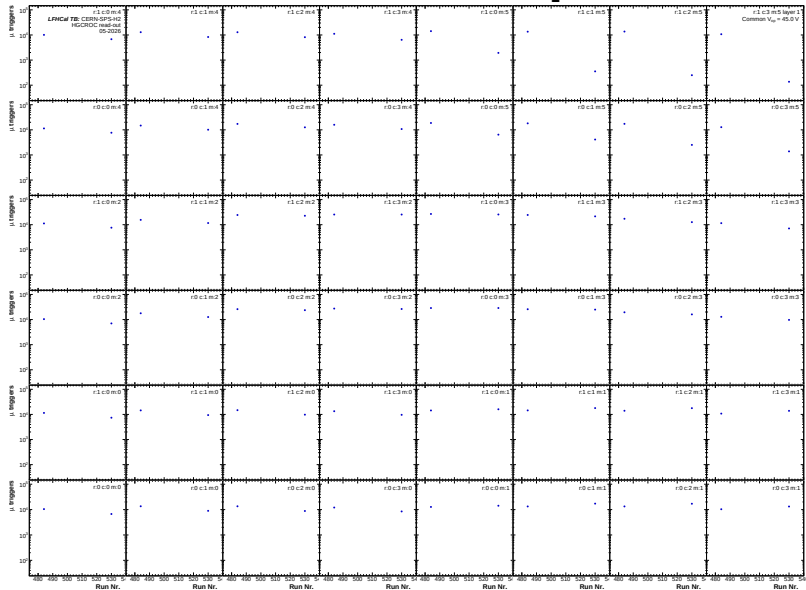
Muon calibration - Comparison Sets



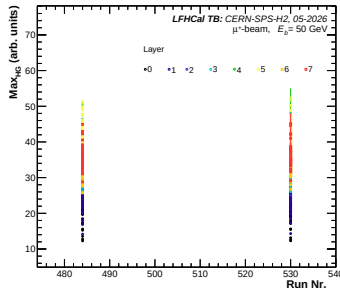
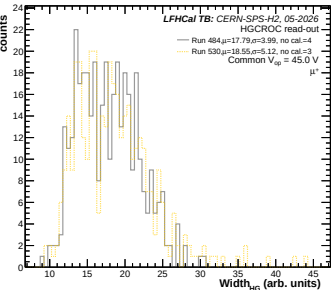
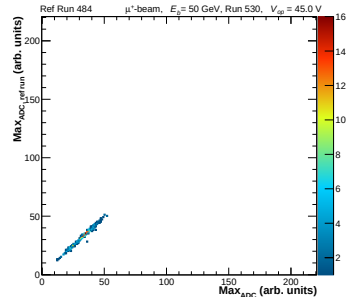
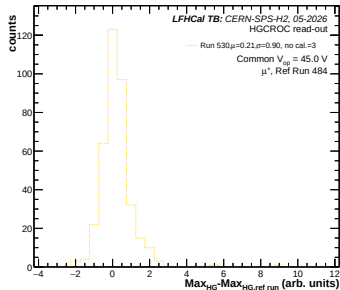
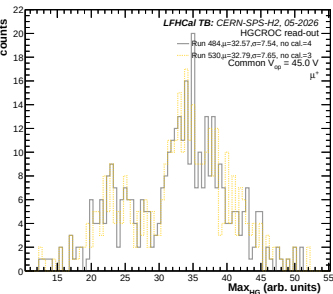
Muon calibration - Comparison Sets



Muon calibration - Comparison Sets



Muon calibration - Comparison Sets



- both sets with approximately equal statistics and positioning
- mip deviations within estimated fitting uncertainties
- very good correlation for same channel
- could use either or merge both

Calibration summary - Set G



Calibration summary

- Besides 6 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 G
- Final calibration based off 'Set_1' (7 beam positions) somewhat arbitrary choice both would be equally ok
 - ▶ Calib file FullSet G 1st [txt-file]
 - ▶ Calib file FullSet G 2nd [txt-file]