Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

Calorimeter for ILC

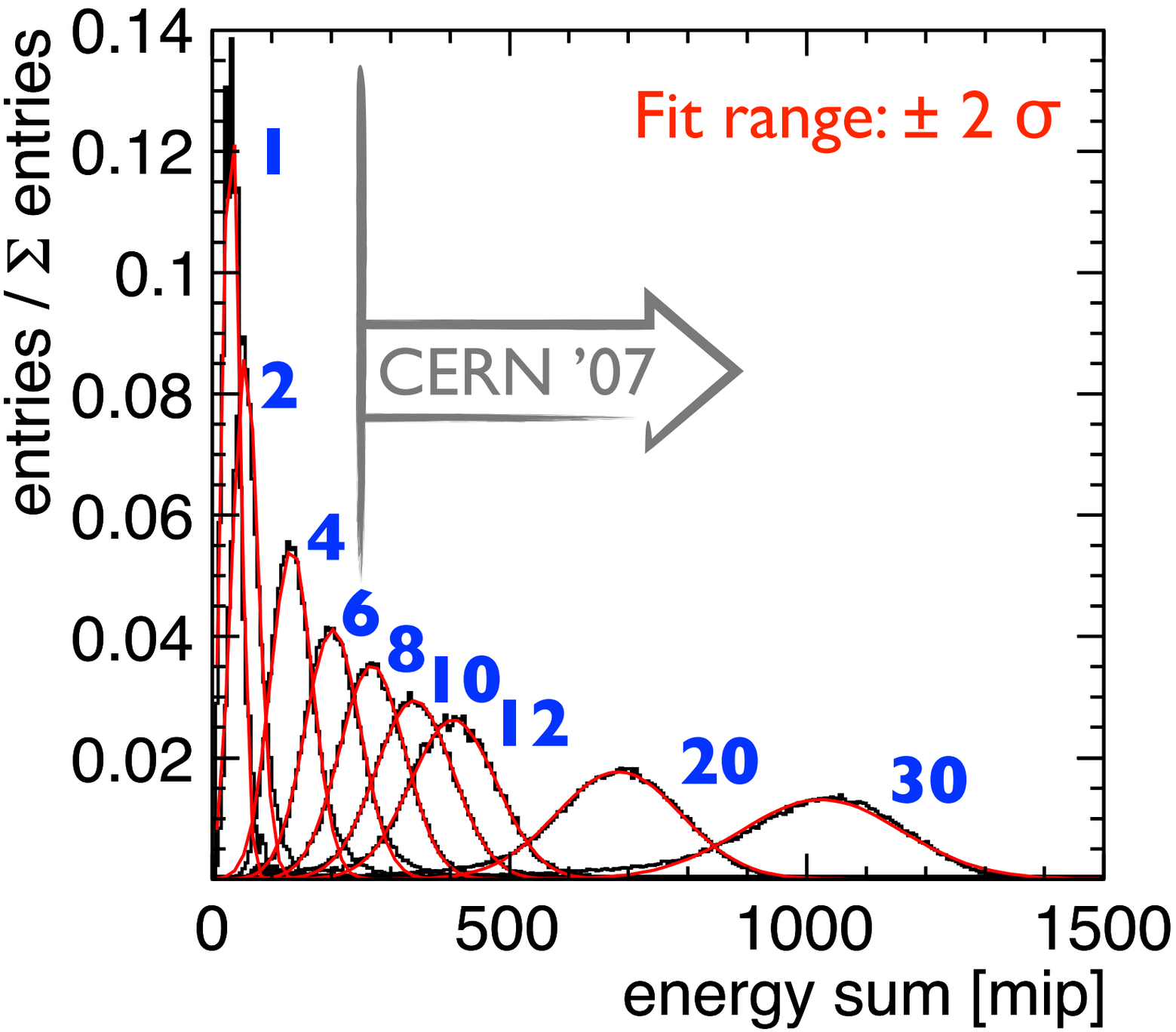
Pions at the Low-energy Frontier

Nils Feege

University of Hamburg

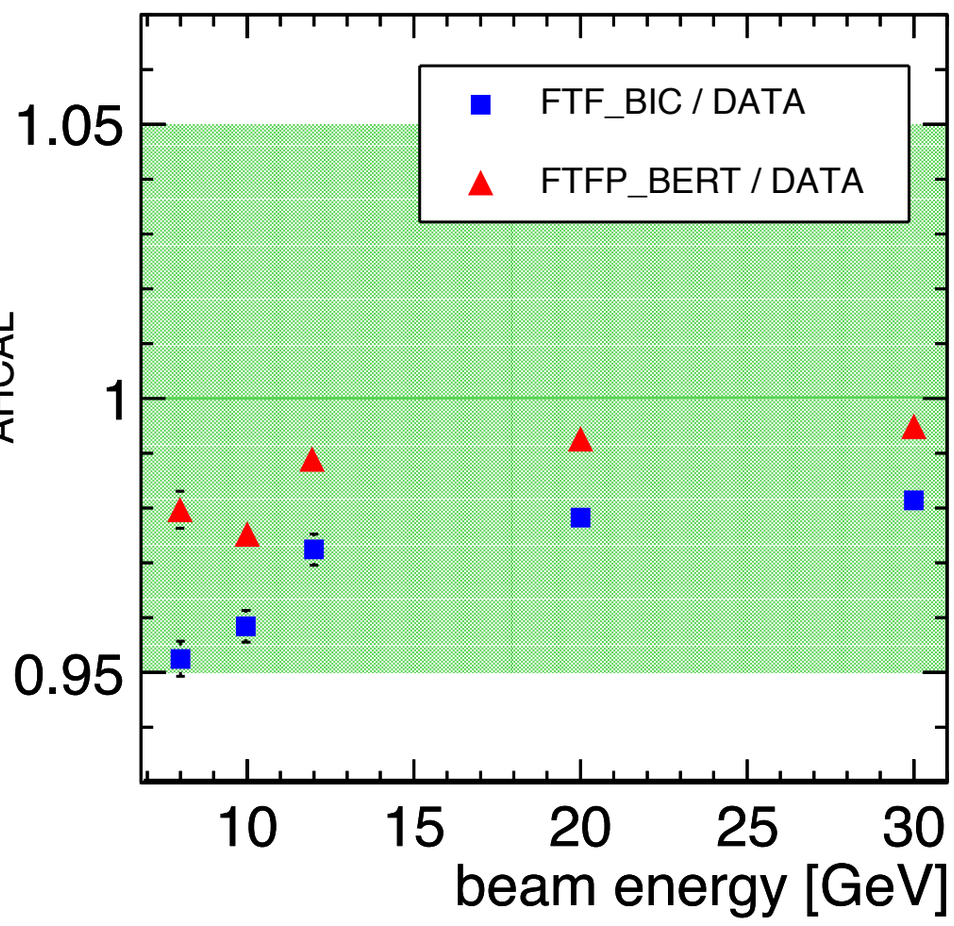
AHCAL Main Meeting, DESY, 20 January 2011

Fermilab π Data ('08 - '09)

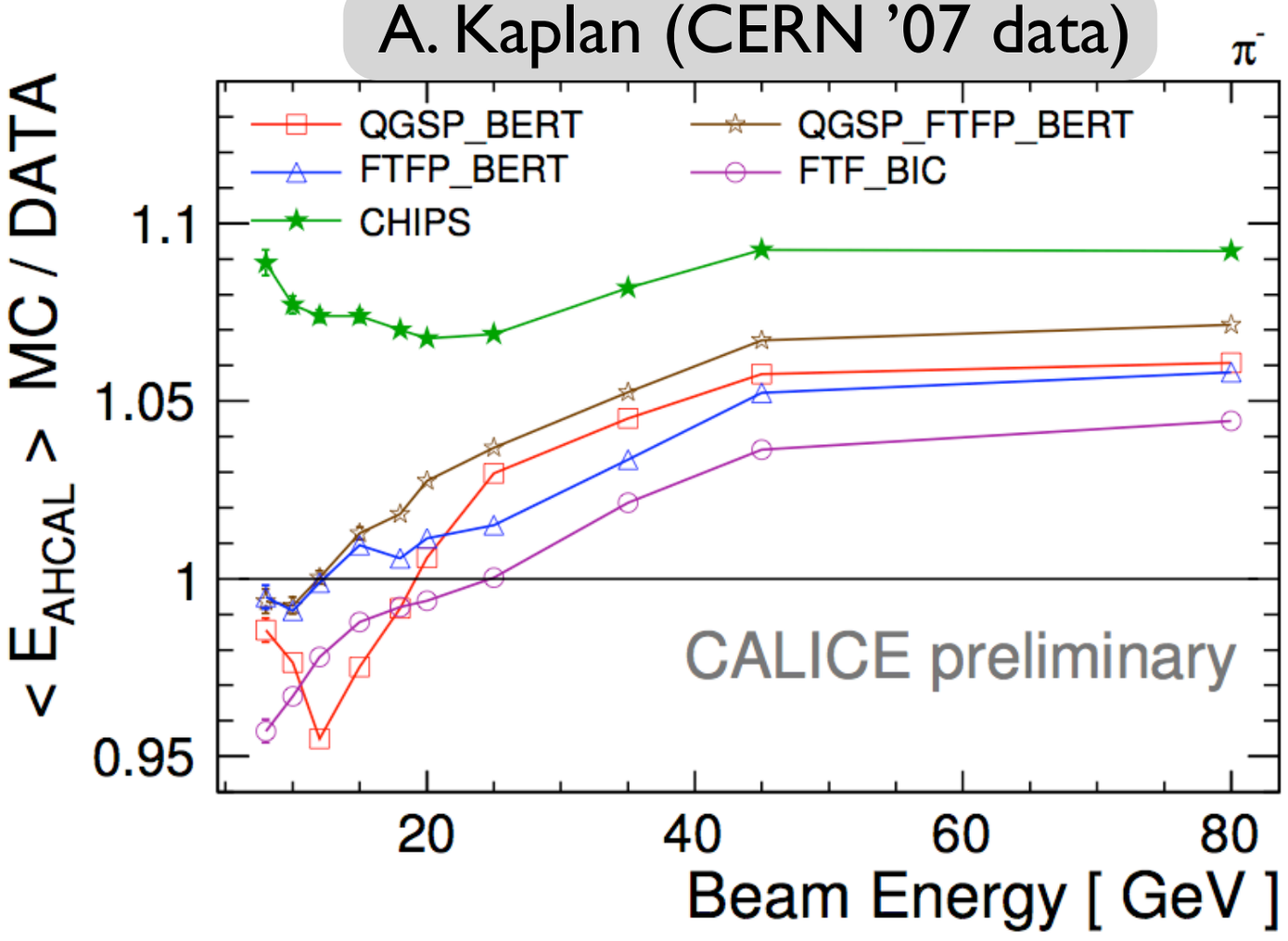


data taken w/o ECAL

Energy Sum MC / DATA

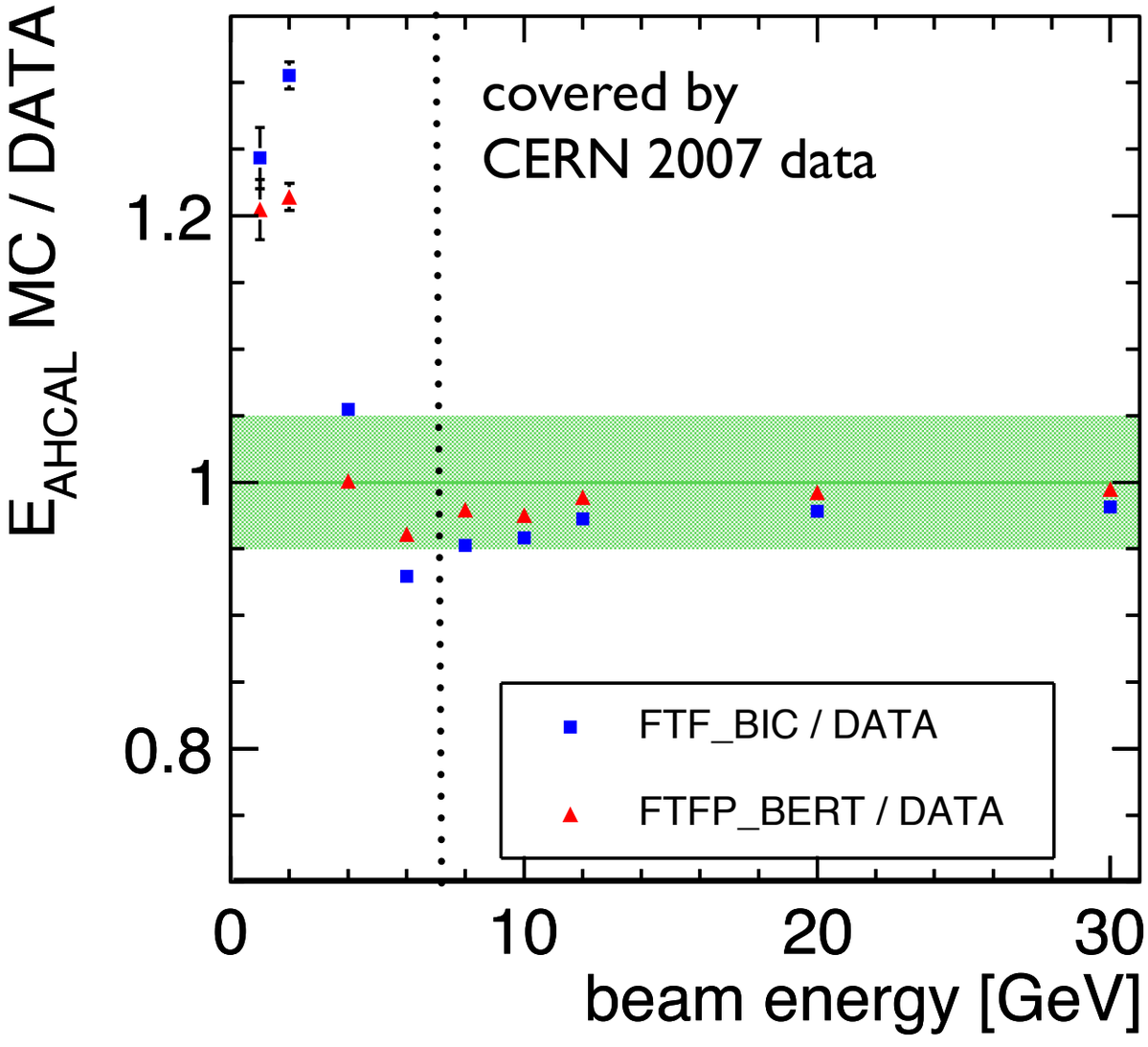


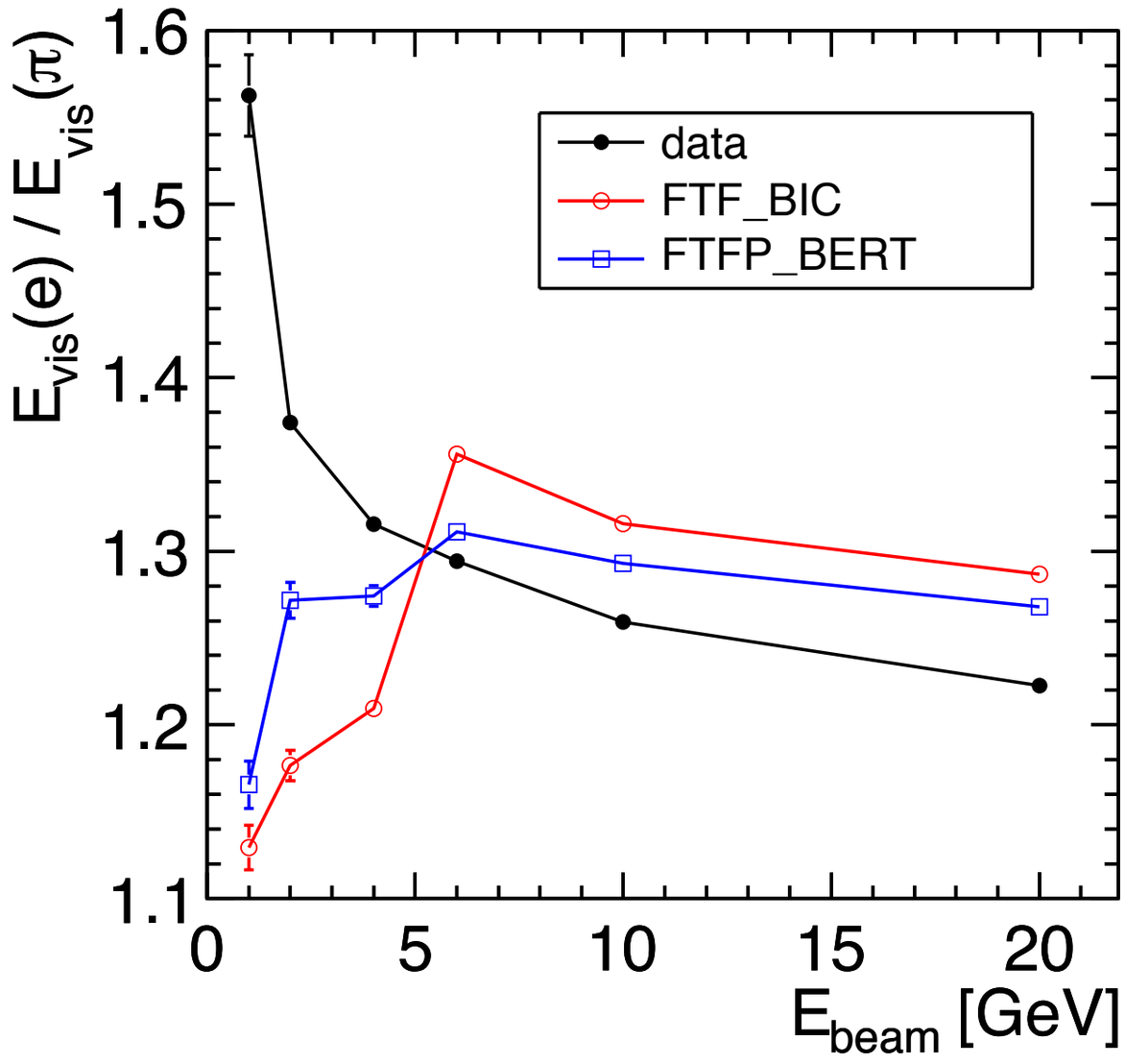
A. Kaplan (CERN '07 data)



Trends for FTF_BIC and FTFP_BERT agree -
MC / DATA ratio decreases with energy

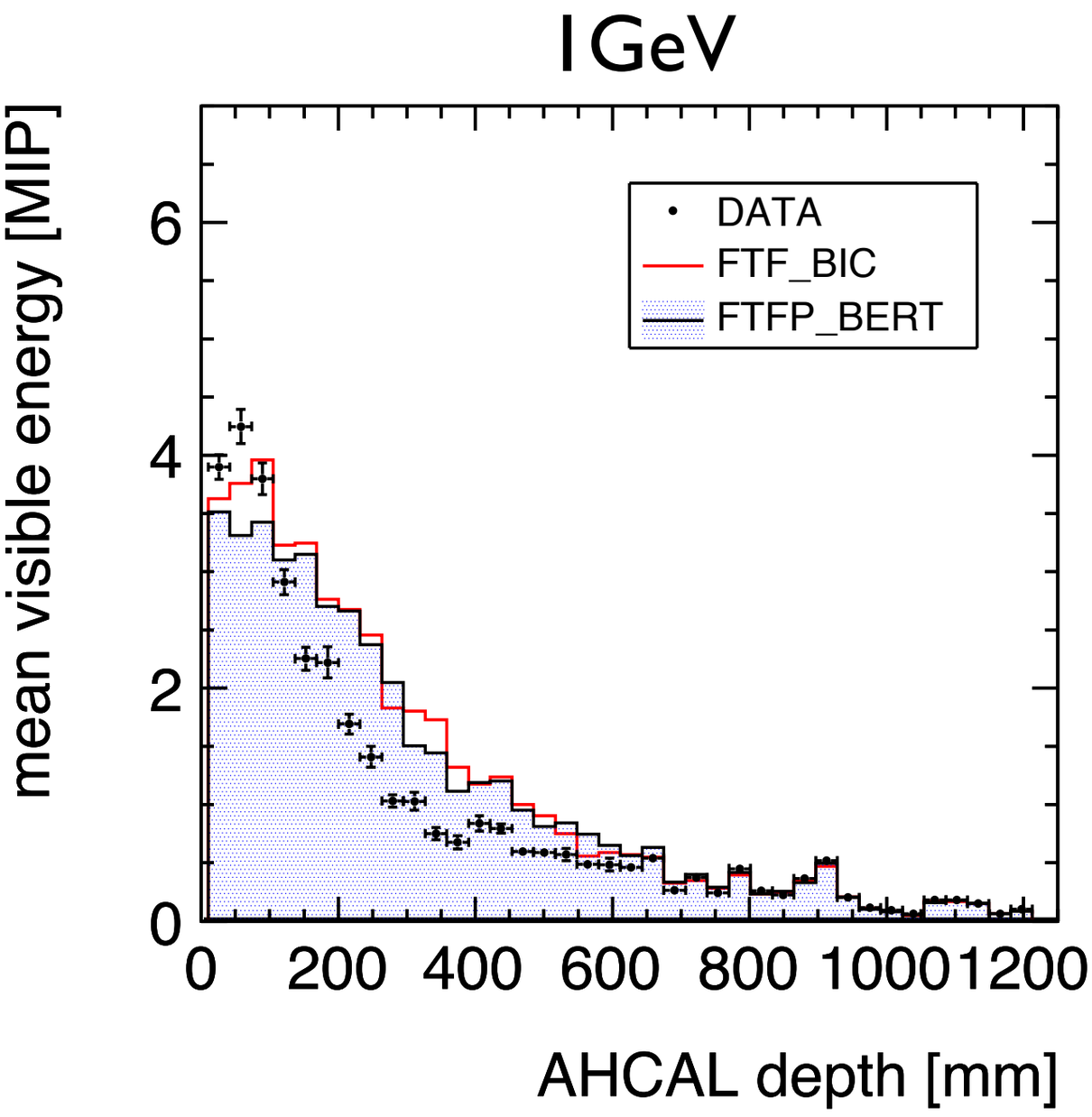
Exploring the Lower Energies

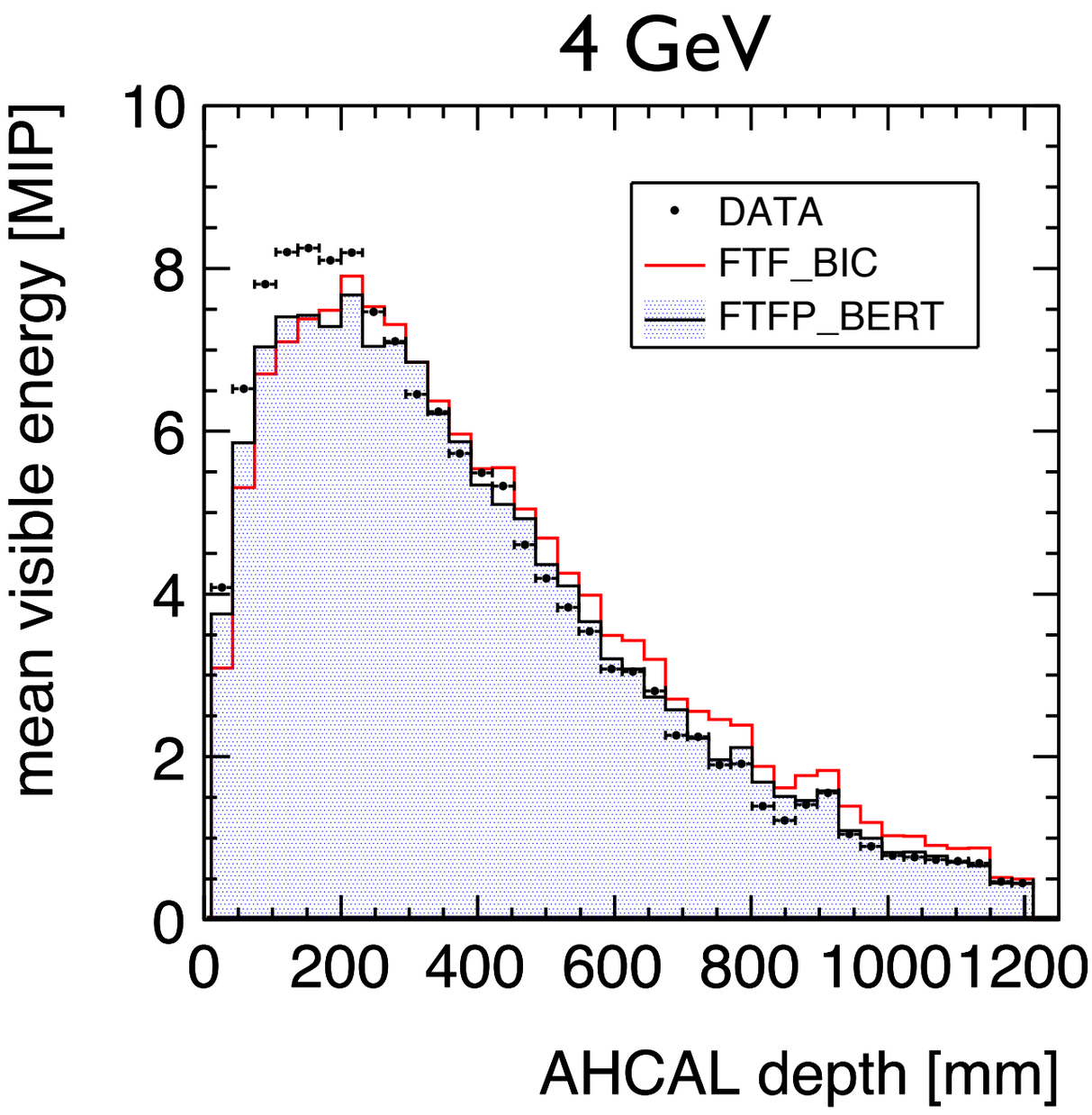




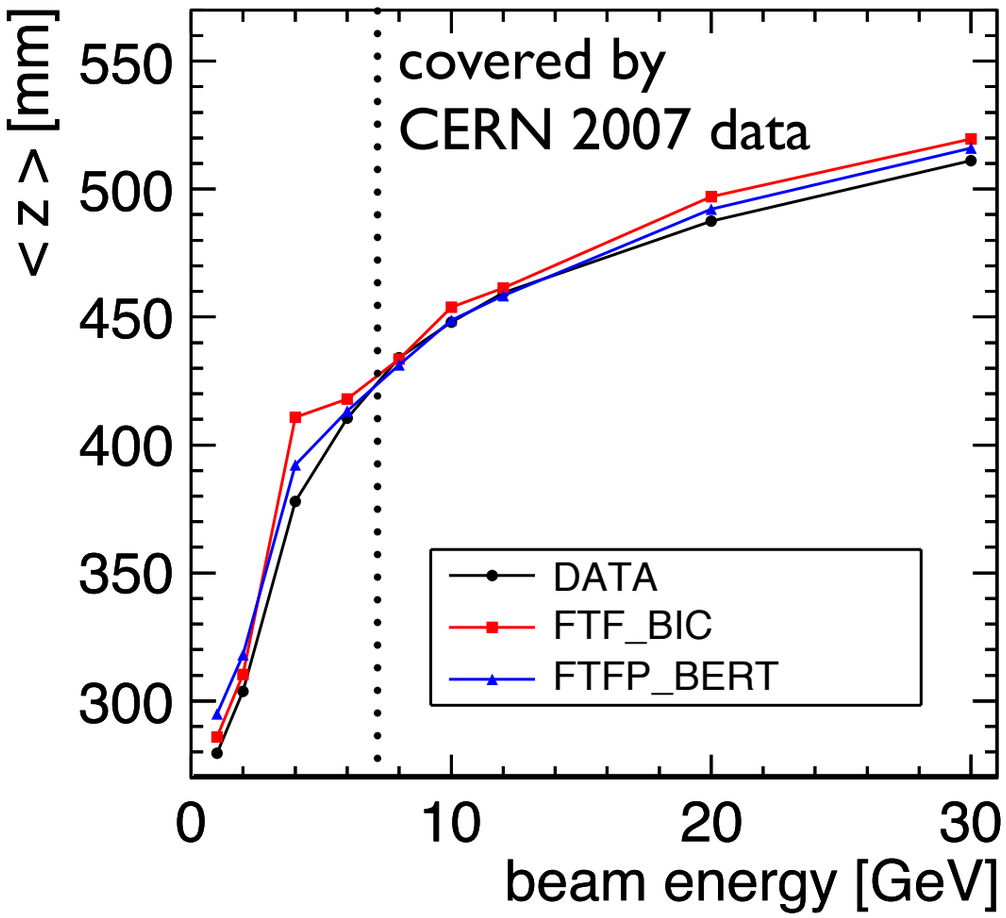
Below 6 GeV: MC / DATA relation changes

Longitudinal Profiles





Mean Shower Length < z >



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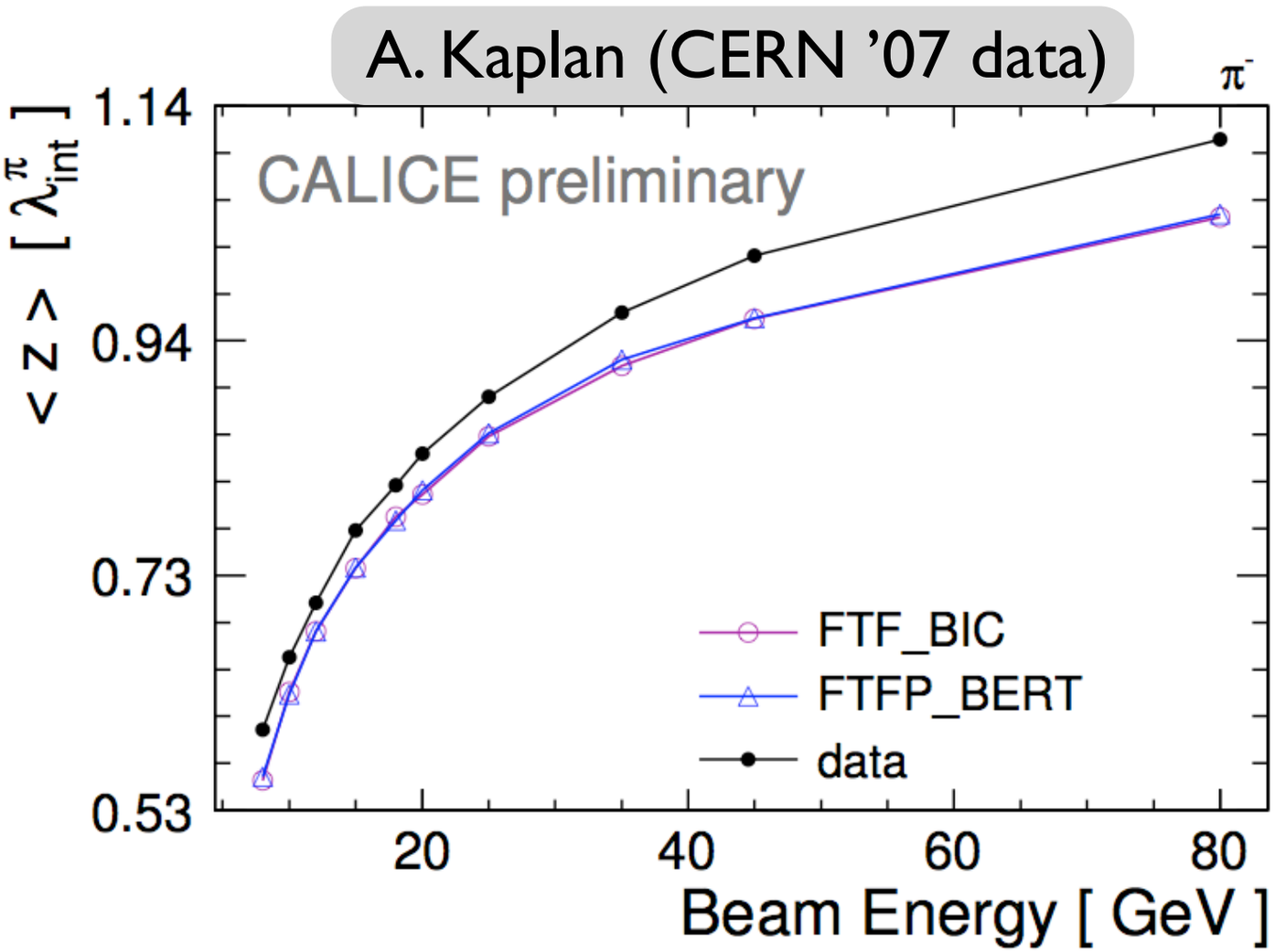
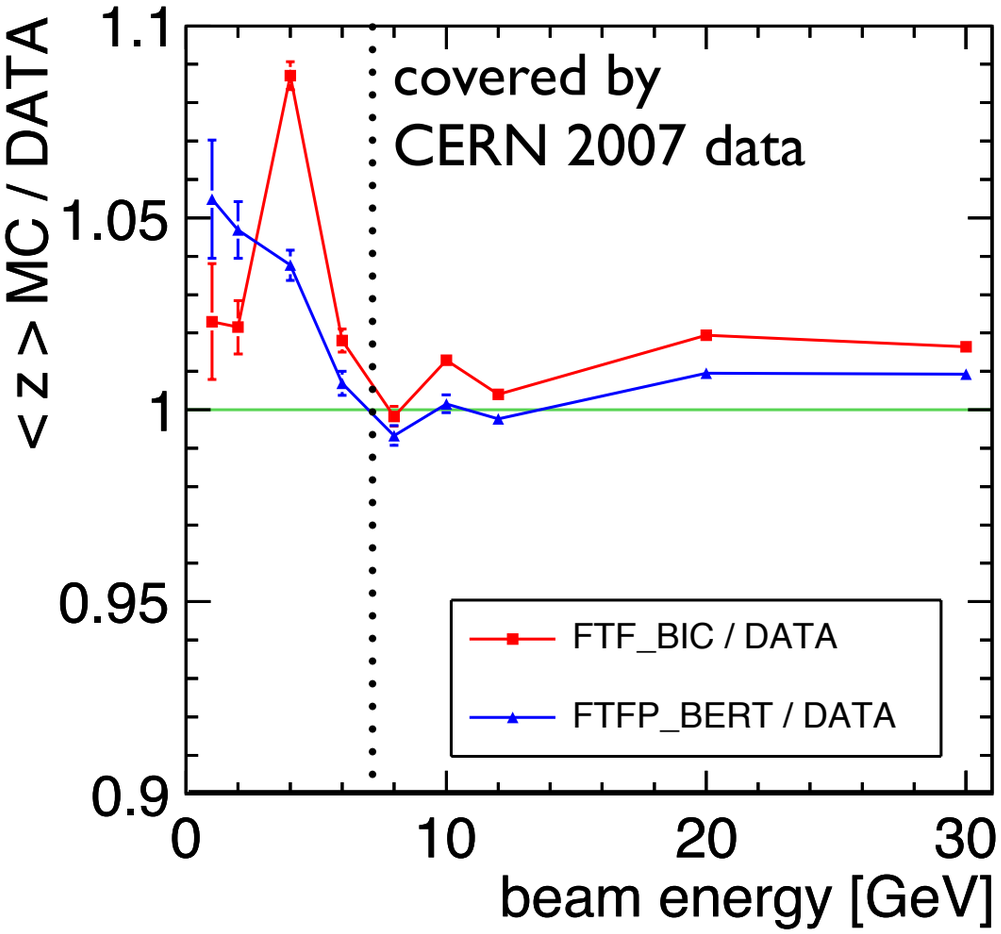


from **calorimeter start**

from **1st hard interaction**

Mean Shower Length < z >



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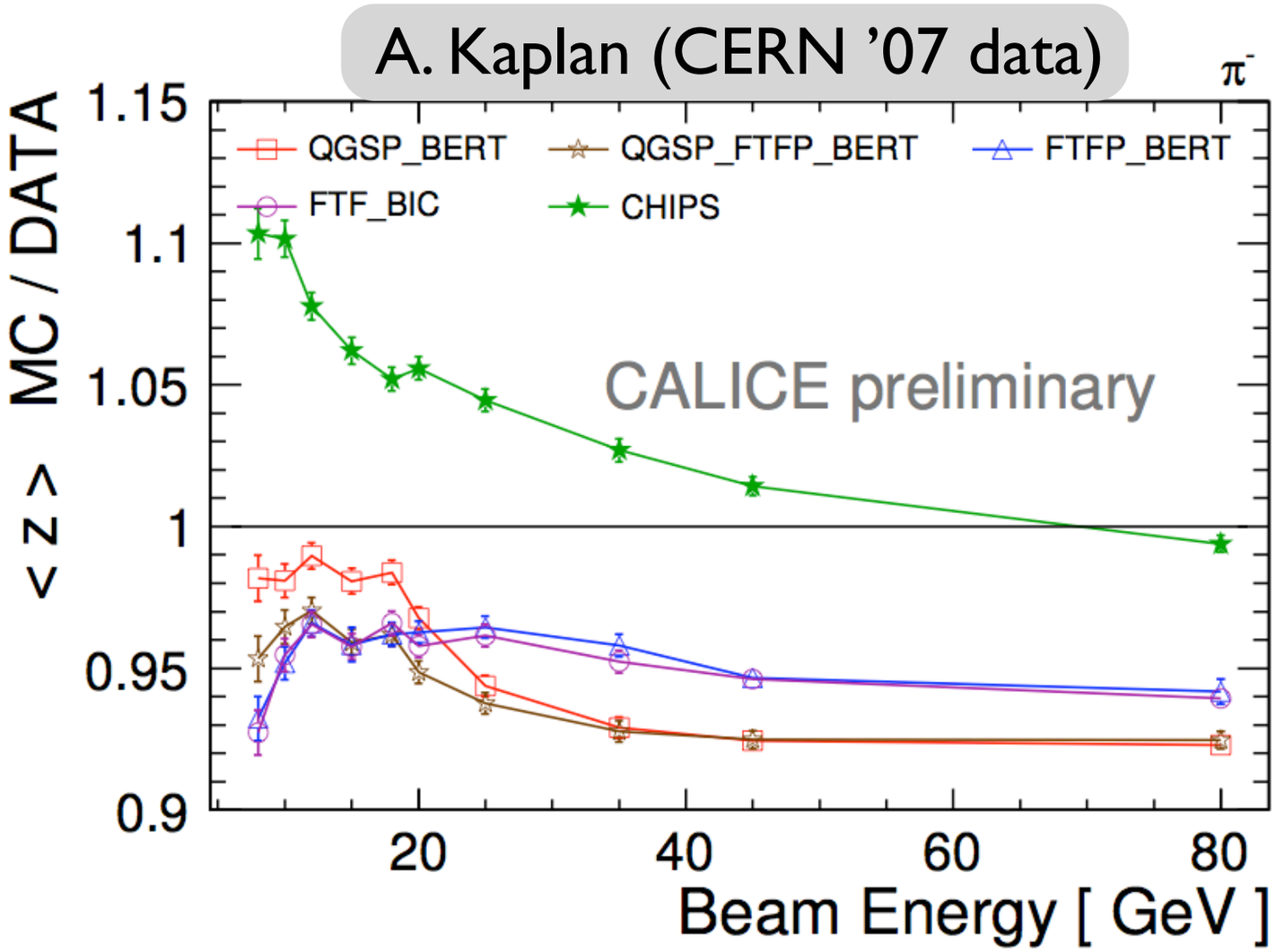
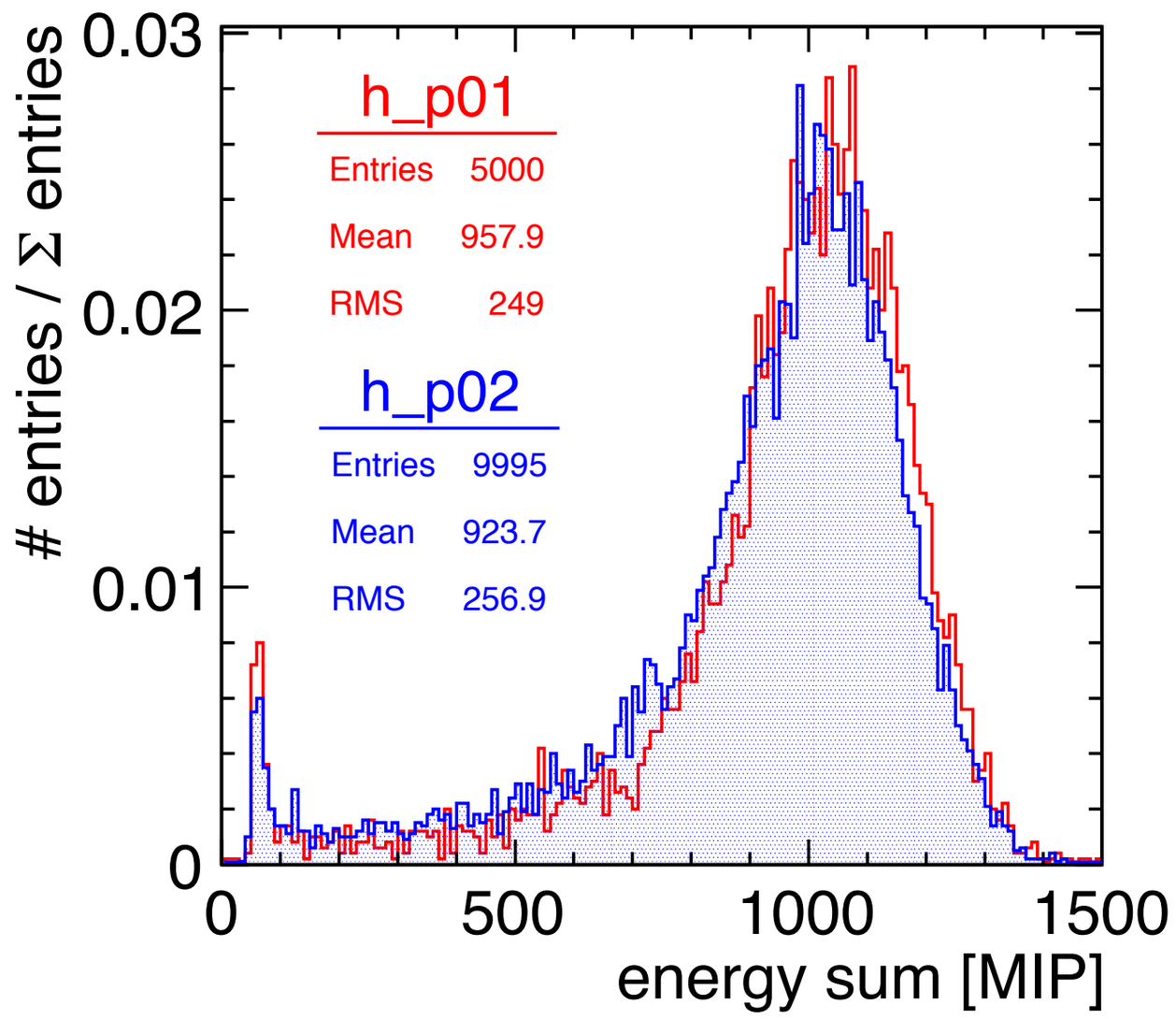


from **calorimeter start**

from **1st hard interaction**

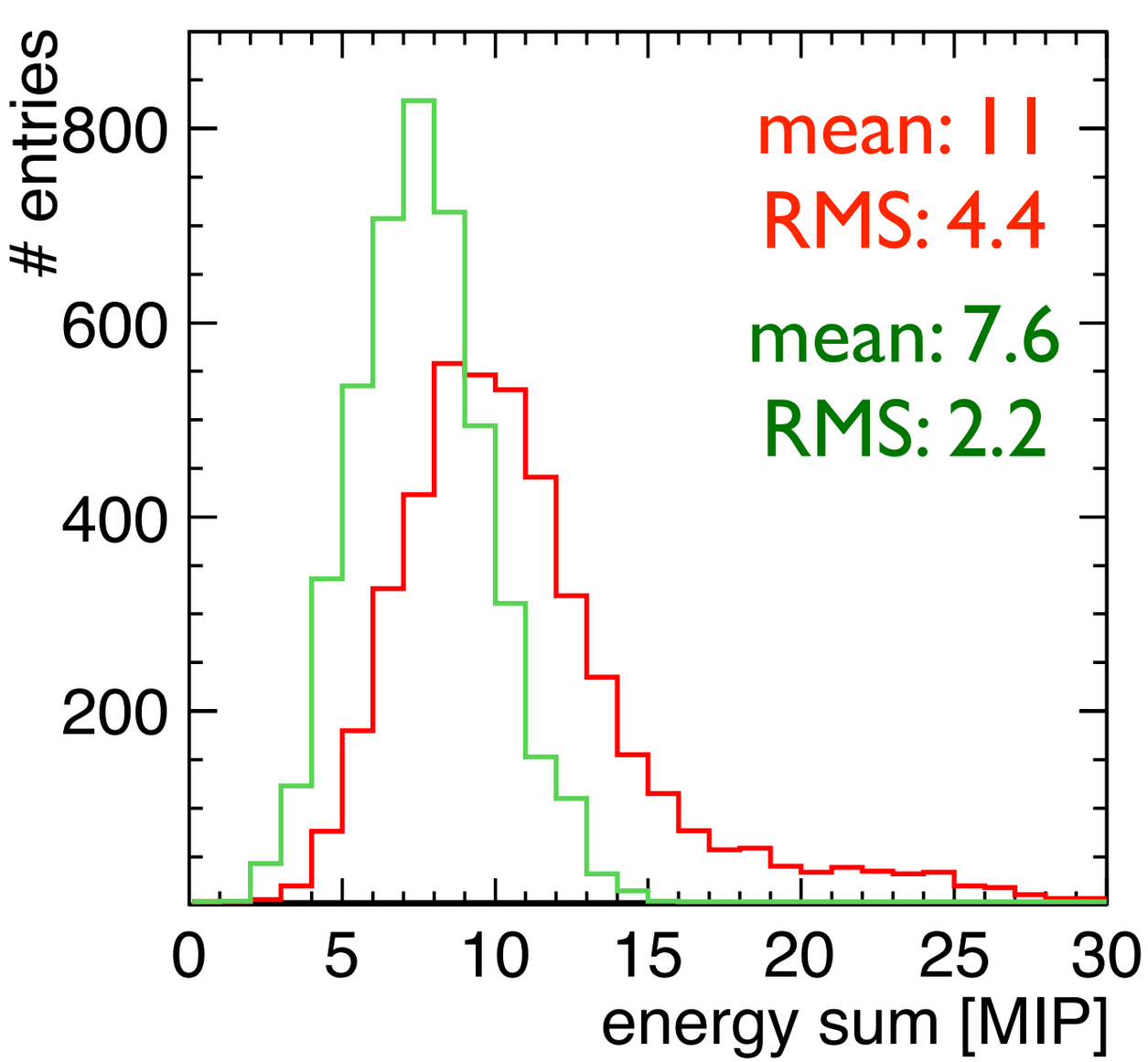
Differences Alex' - My Analysis

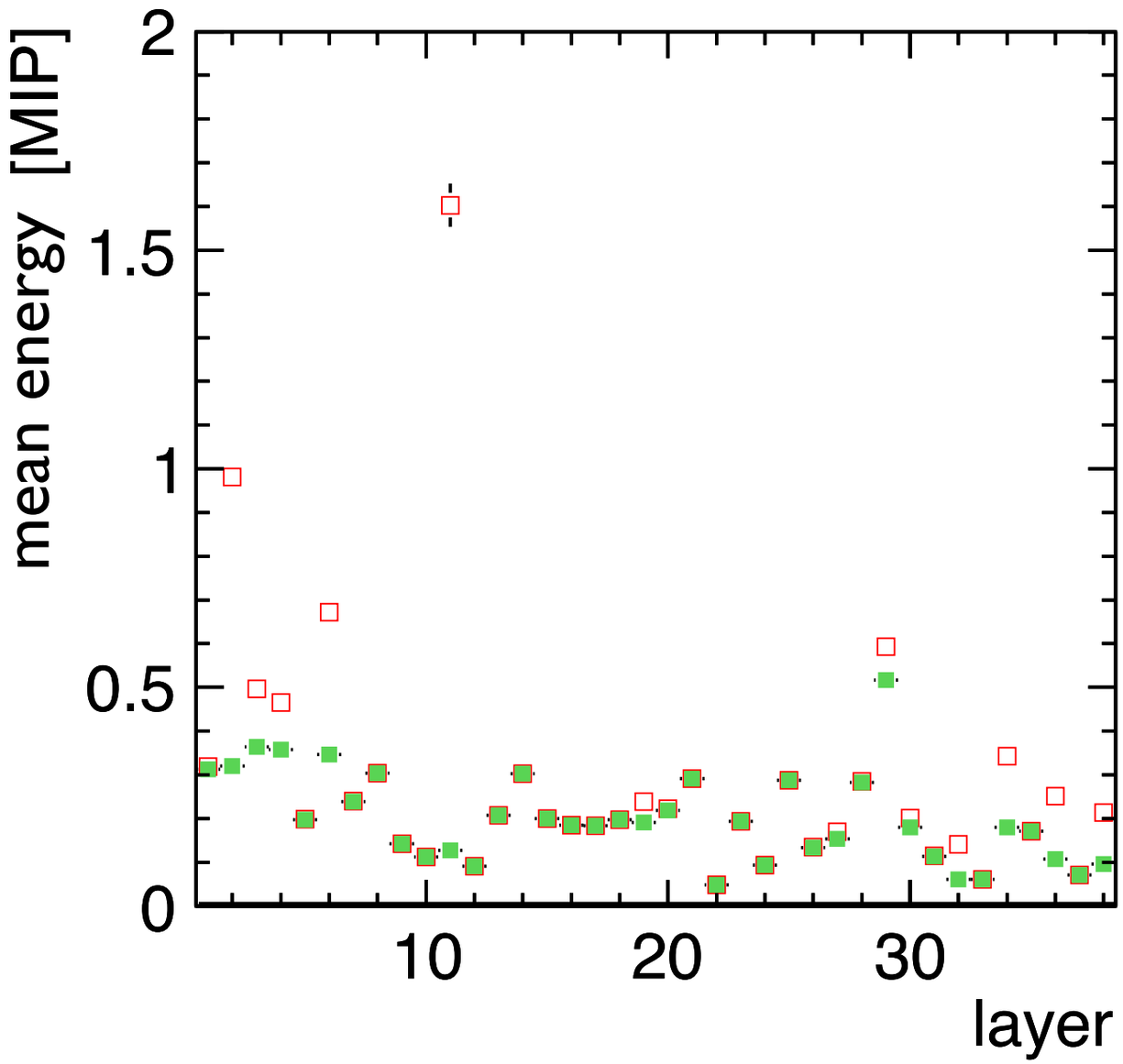
Geant4.9.3.p02	Geant4.9.3.p01
805 keV/MIP	816 keV/MIP
calibration	
remove noisy cells	-
event selection	
Me	Alex



G4.9.3.p01 → G4.9.3.p02
FTF_BIC mean changes by ~4 %

Noise Above 0.5 MIP

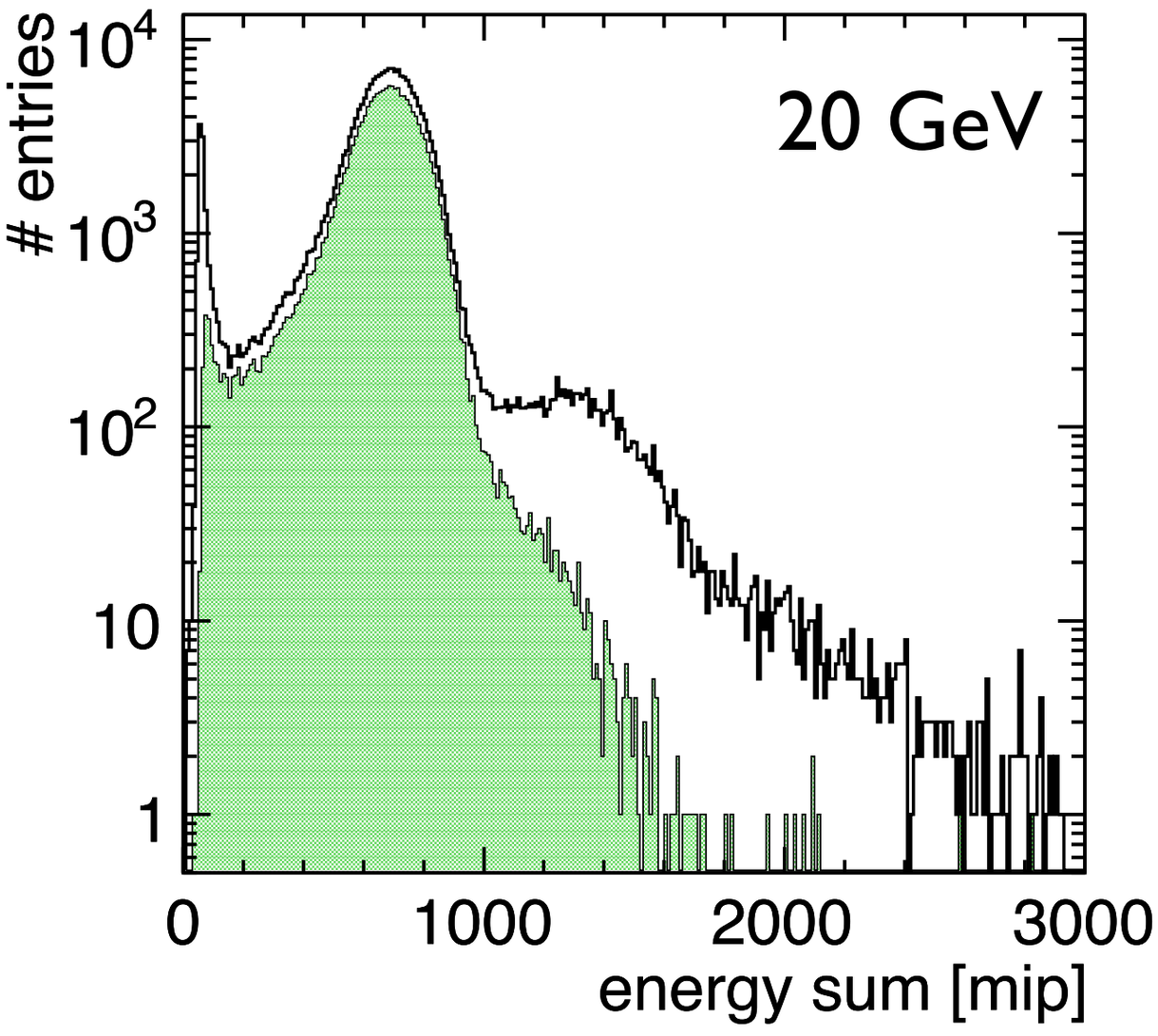


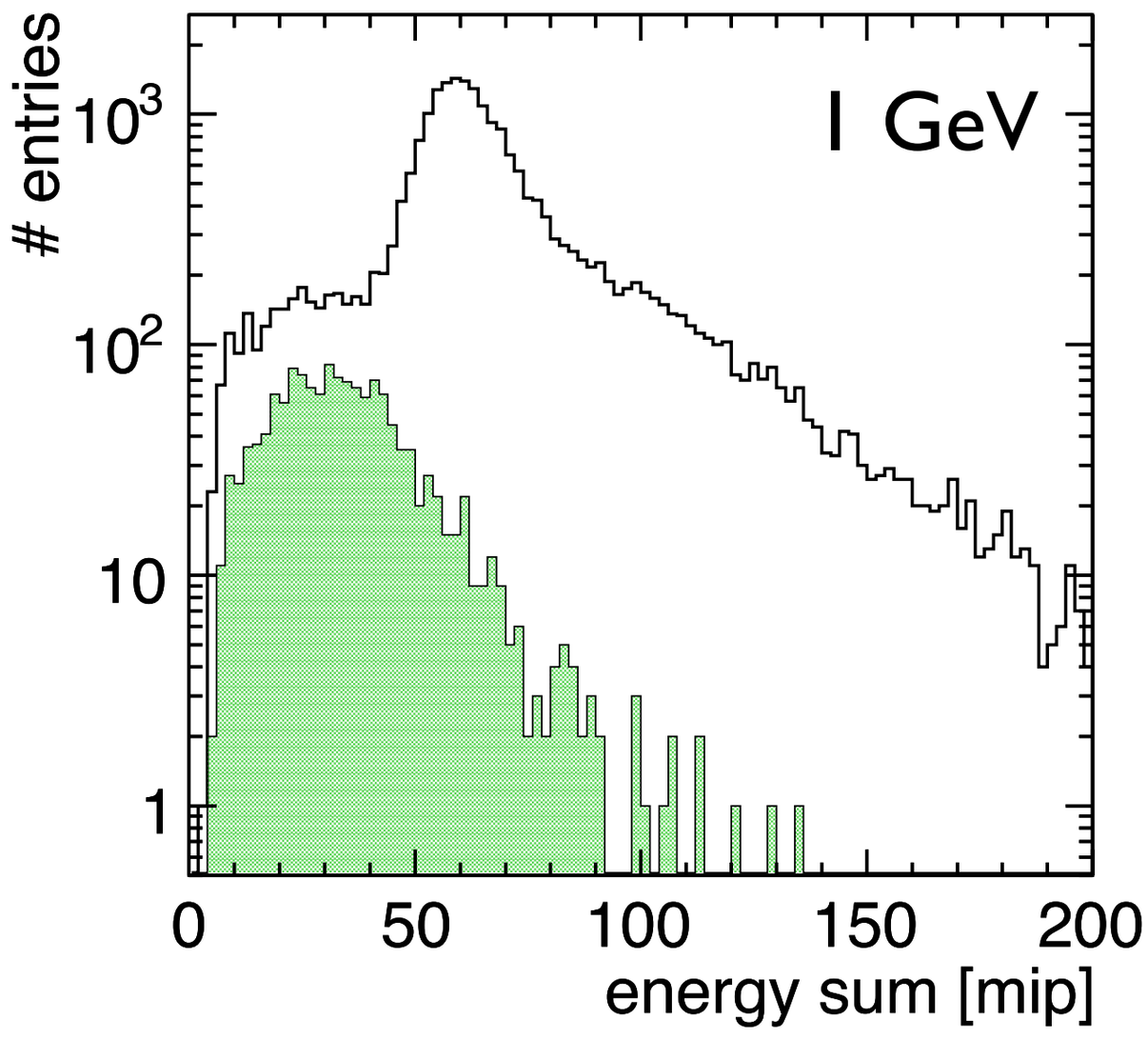


w/o dead cells (2.9%)

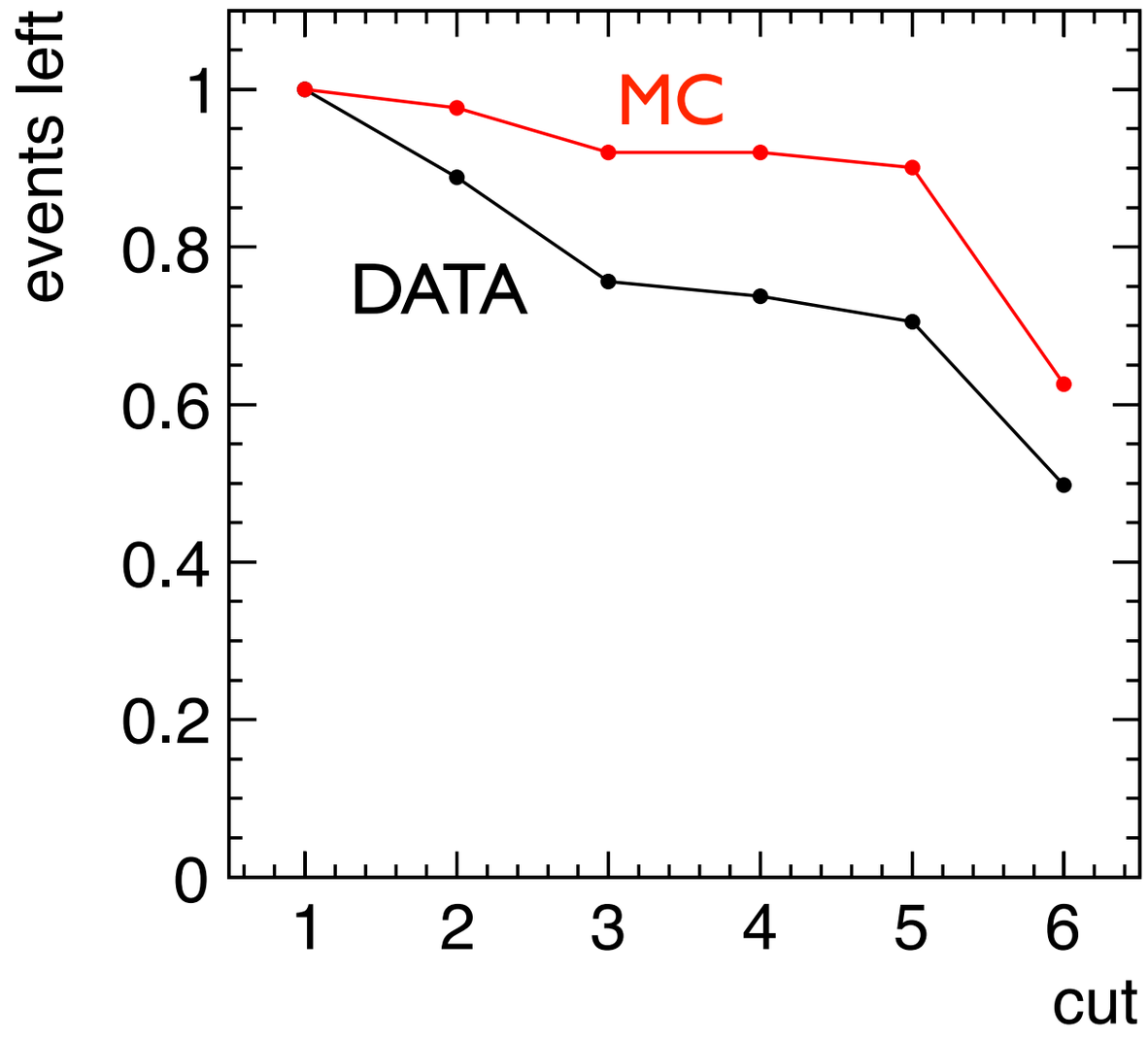
w/o dead **or noisy** cells (3.8%)

π Event Selection





Events After Cuts - 20 GeV



(1) 10x10 scintillator coincidence

(2) no signal in veto wall
(remove trash)

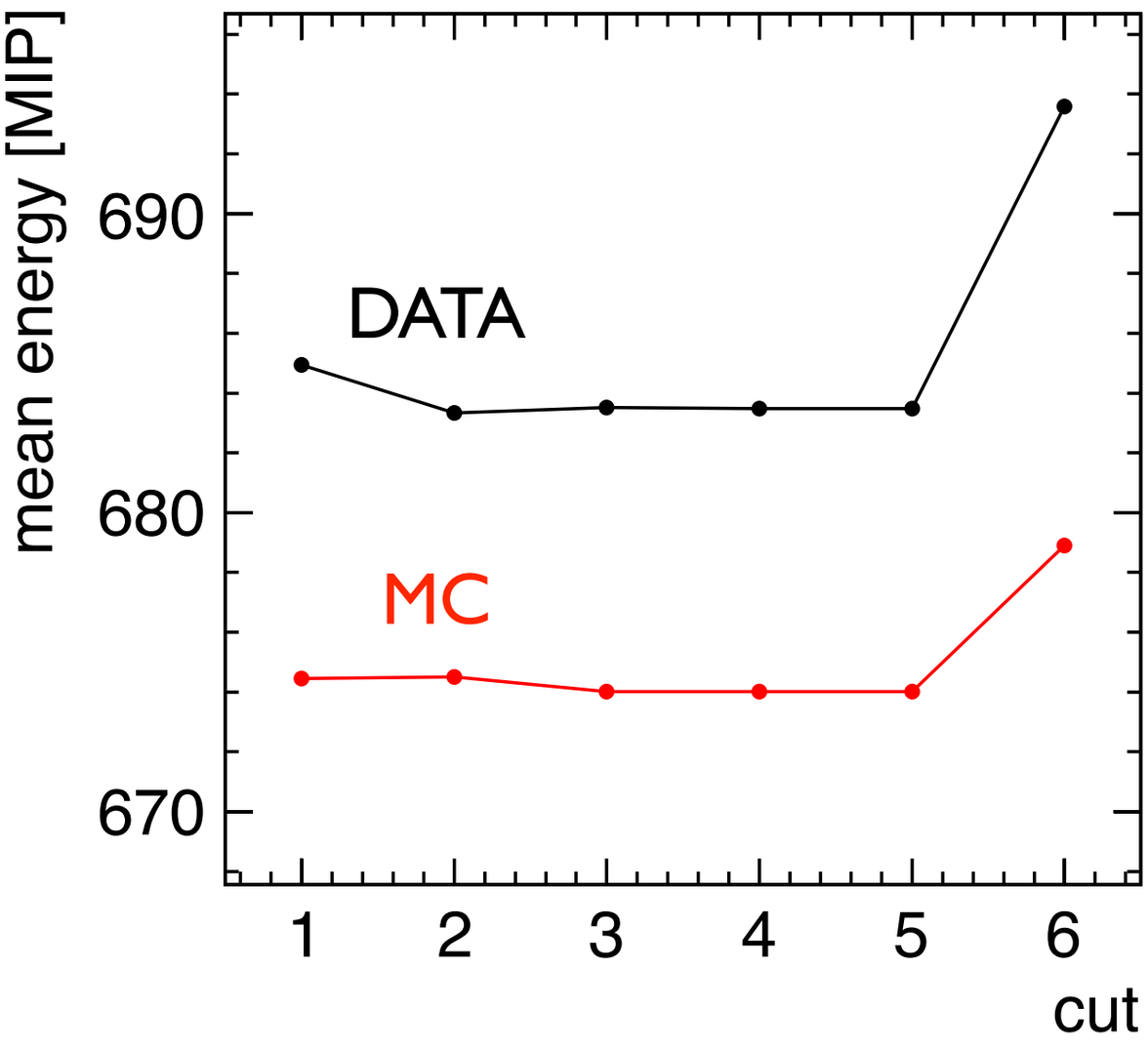
(3) multiplicity counter < 4000 ADC
(remove multi-particle events)

(4) outer Čerenkov off
(remove electrons)

(5) shower start in AHCAL
(remove muons)

(6) shower start before layer 11

Cut Effects on MC - 20 GeV



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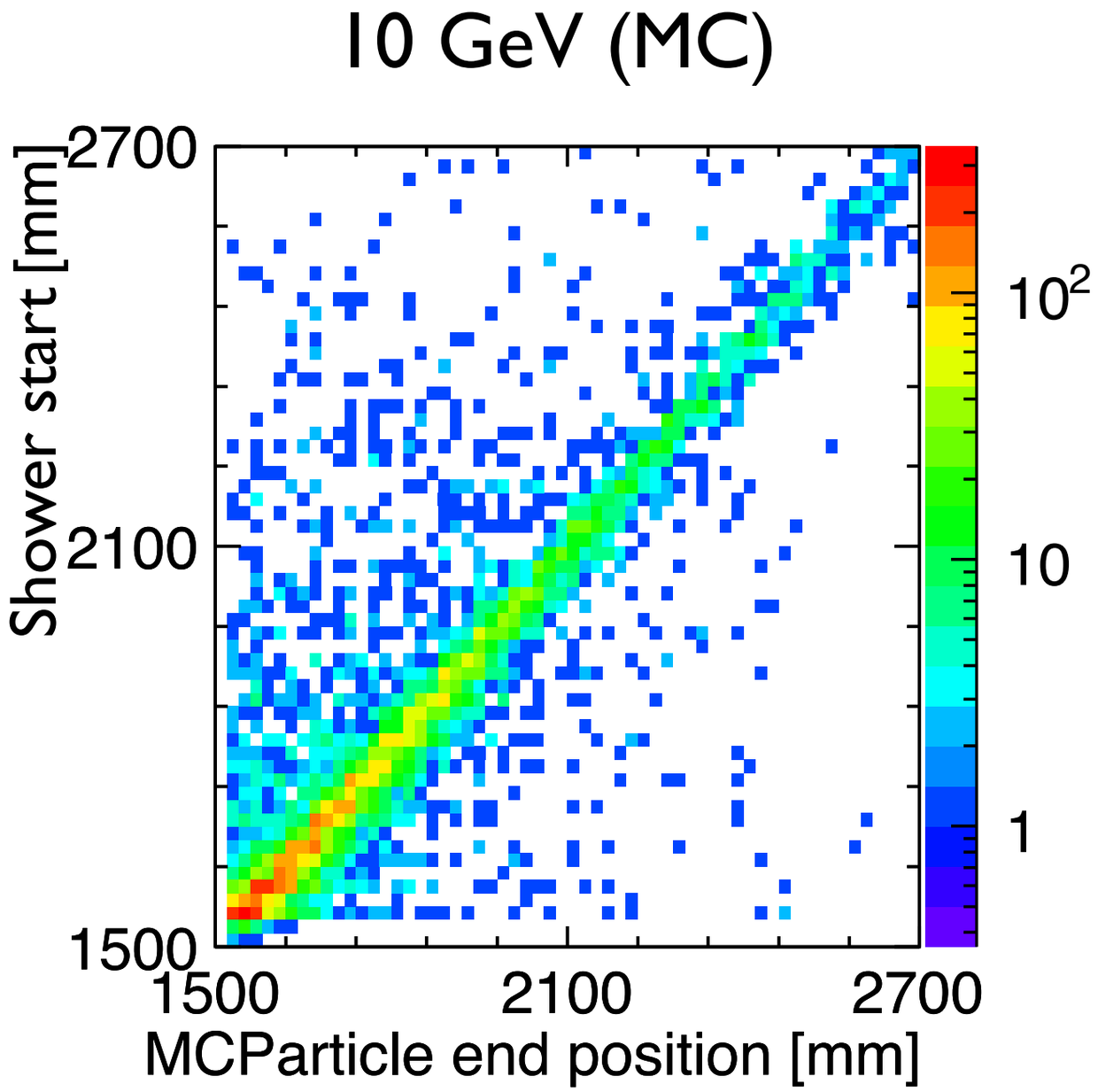
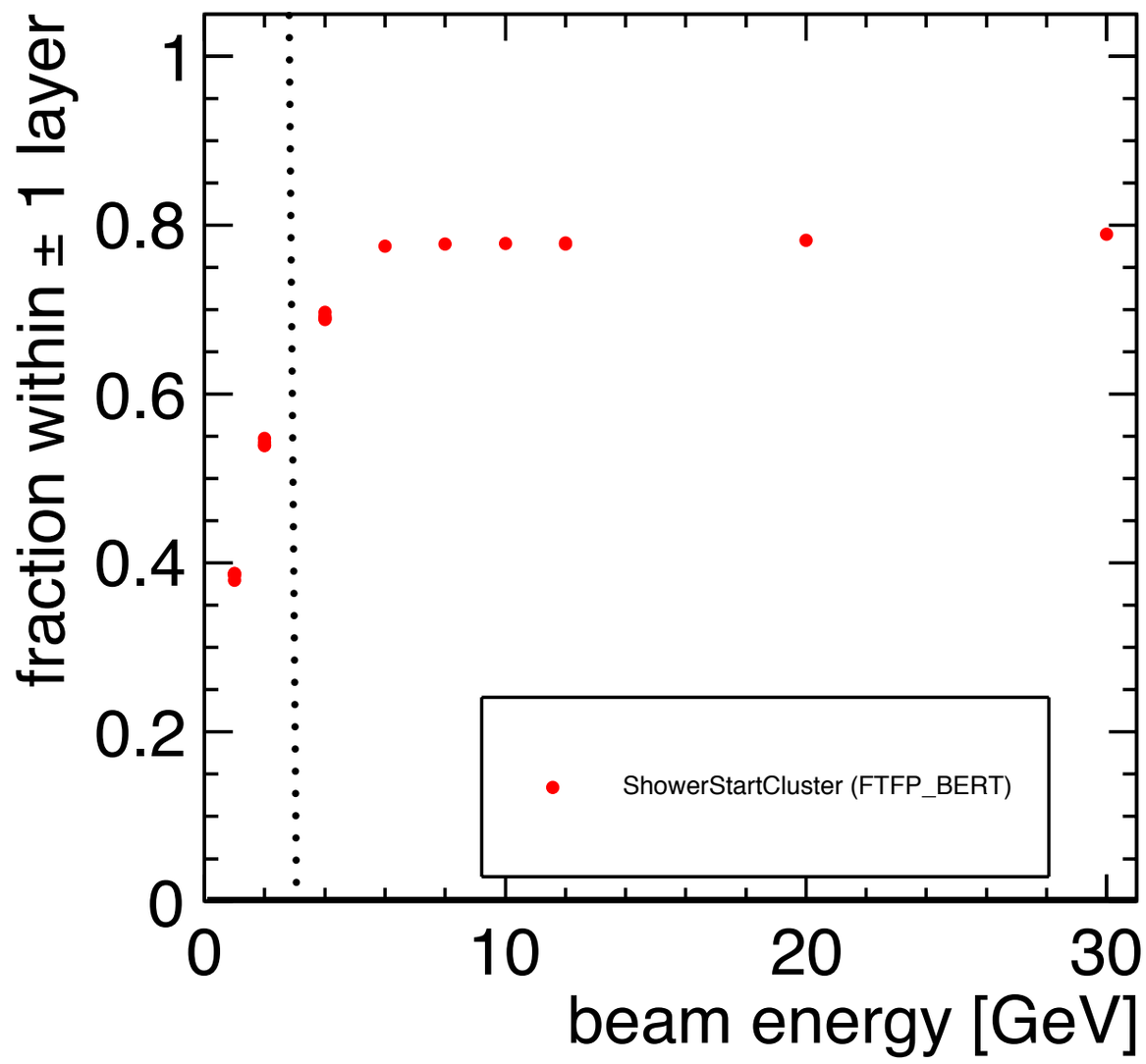
Shower Start Finder: Performance

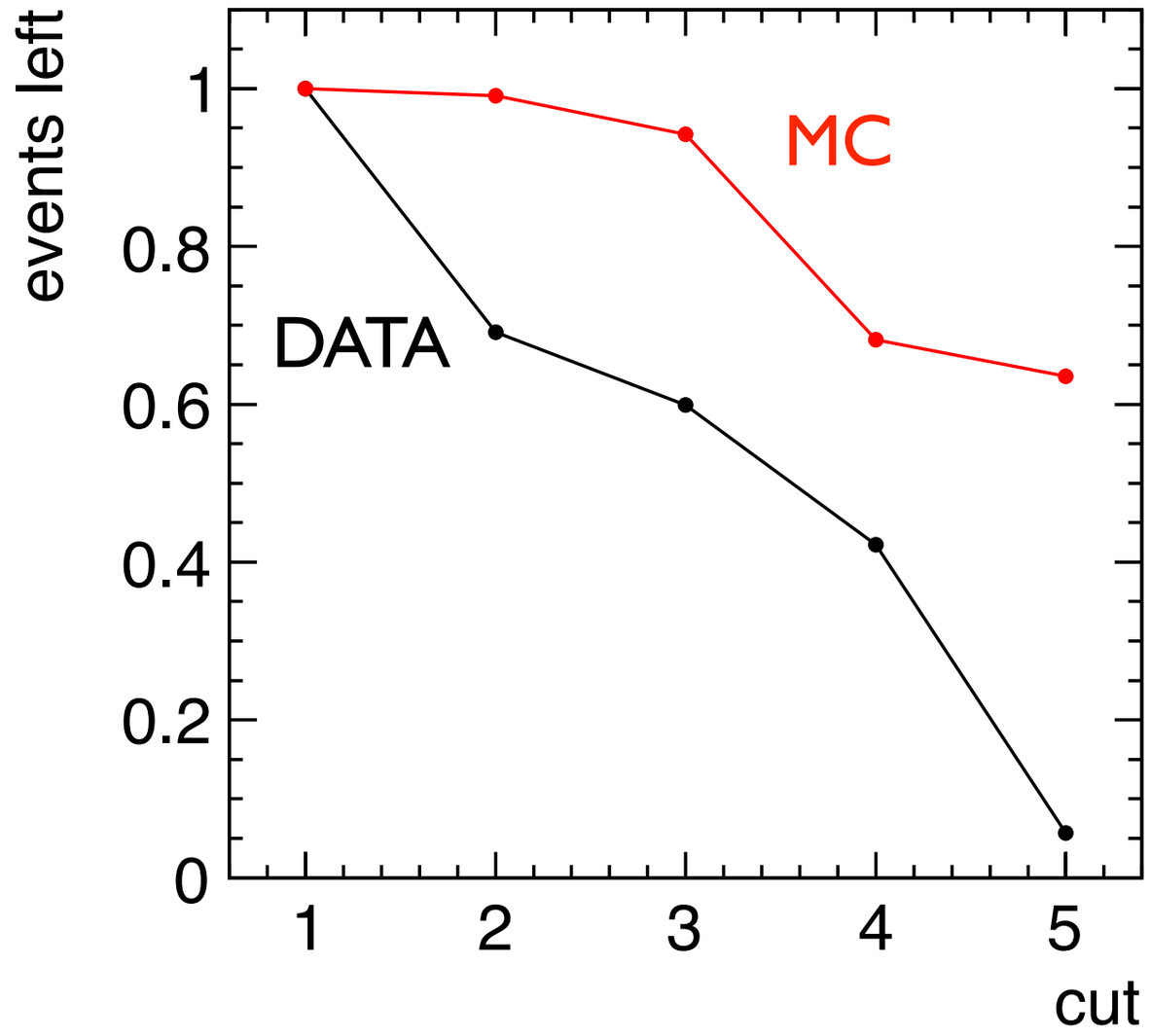
Processor developed by B. Lutz





Muon rejection efficiency:
> 80 % for all energies

Events After Cuts - 1 GeV



(1) 10x10 scintillator coincidence

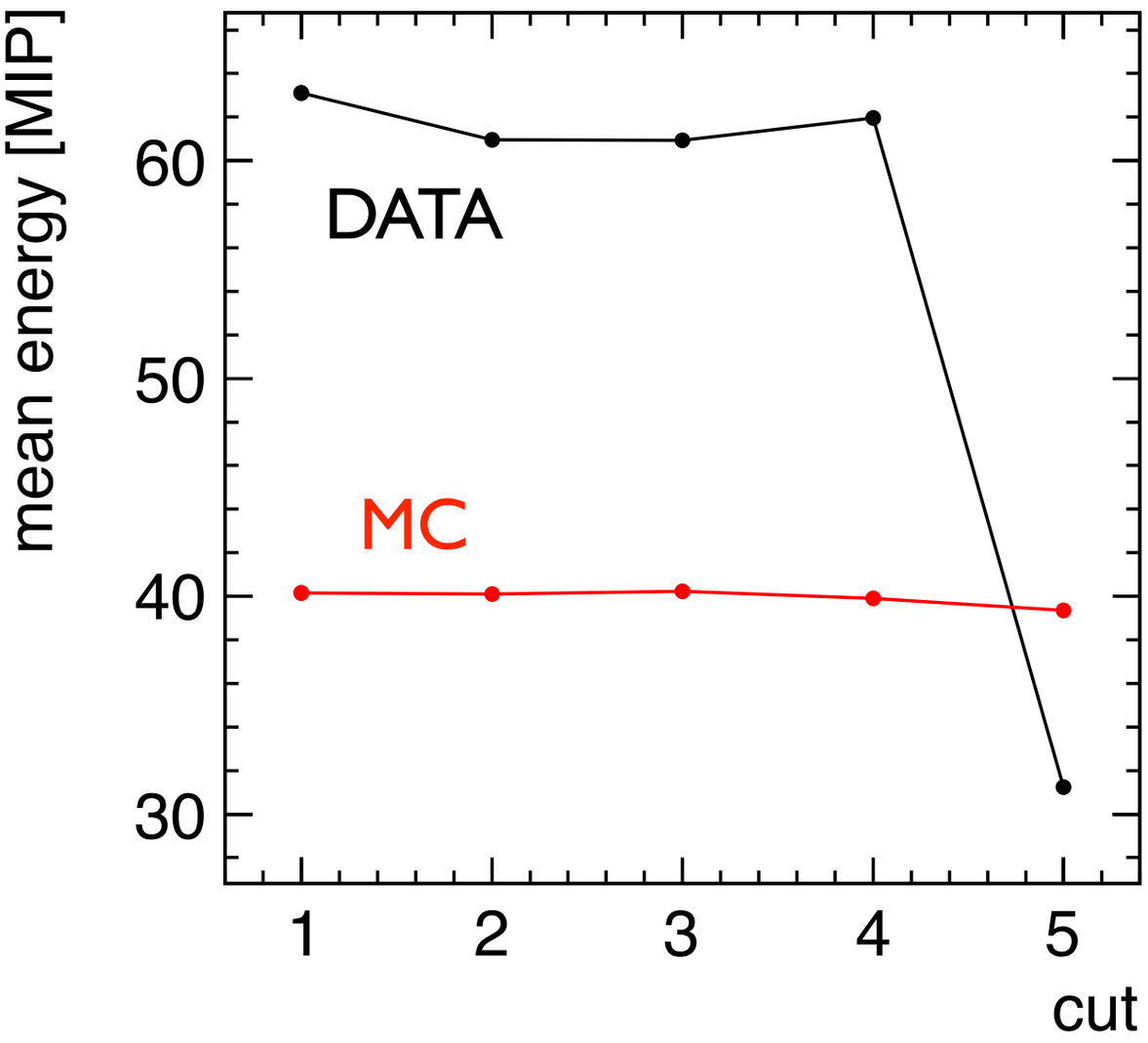
(2) no signal in veto wall
(remove trash)

(3) multiplicity counter < 4000 ADC
(remove multi-particle events)

(4) energy (1st layer) ≥ 1 MIP
(remove empty events)

(5) energy (layer 29 - 38) < 4 MIP
(remove muons)

Cut Effects on MC - 1 GeV



(1) 10x10 scintillator coincidence

(2) no signal in veto wall (remove trash)

(3) multiplicity counter < 4000 ADC (remove multi-particle events)

(4) energy (1st layer) ≥ 1 MIP (remove empty events)

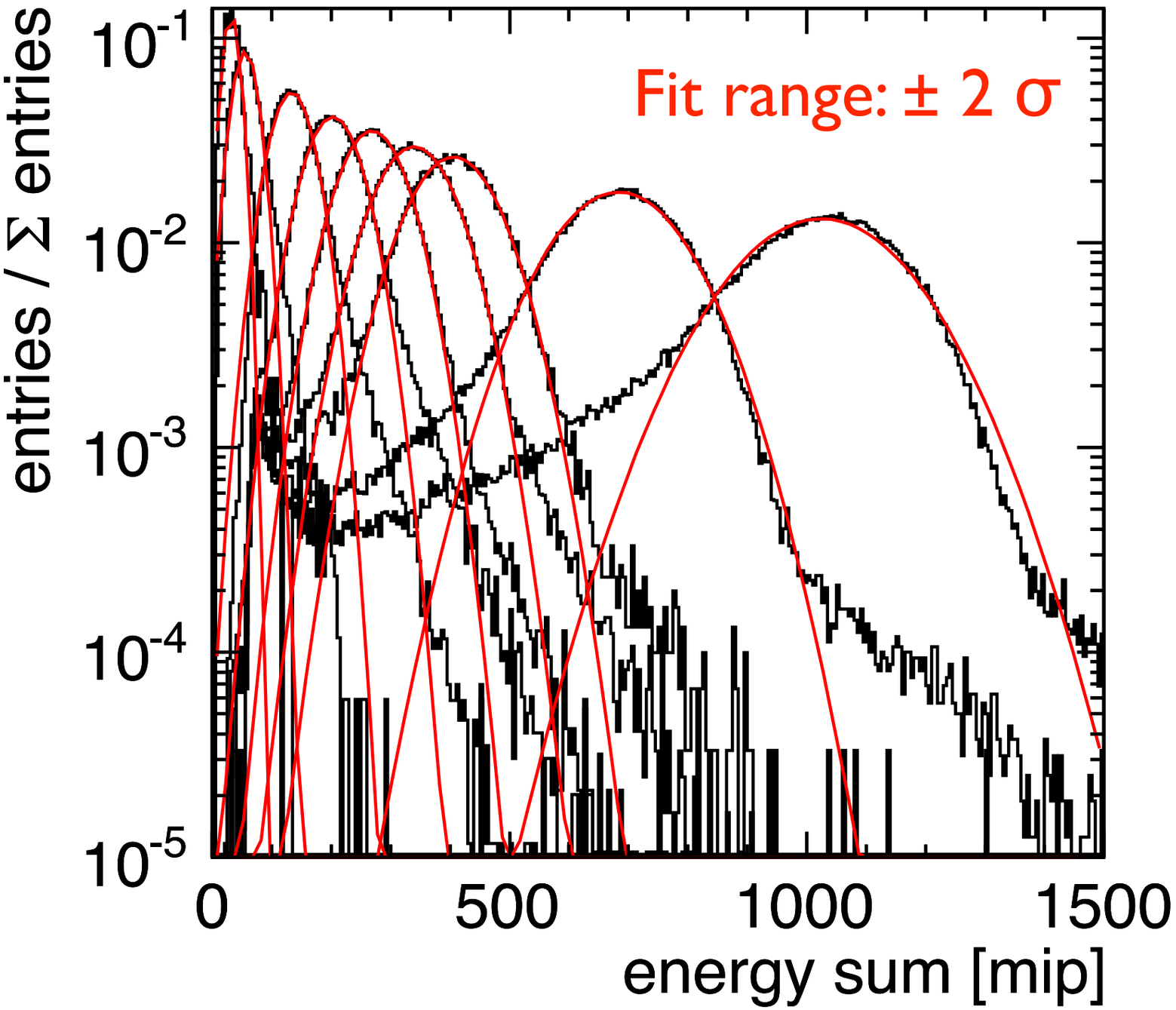
(5) energy (layer 29 - 38) < 4 MIP (remove muons)

Summary

- 8 GeV - 30 GeV: MC / DATA relation trends agree with CERN 2007 analysis (A. Kaplan)
- 1 GeV - 6 GeV: Data ready to challenge MC models in new energy range

BACKUP - SLIDES

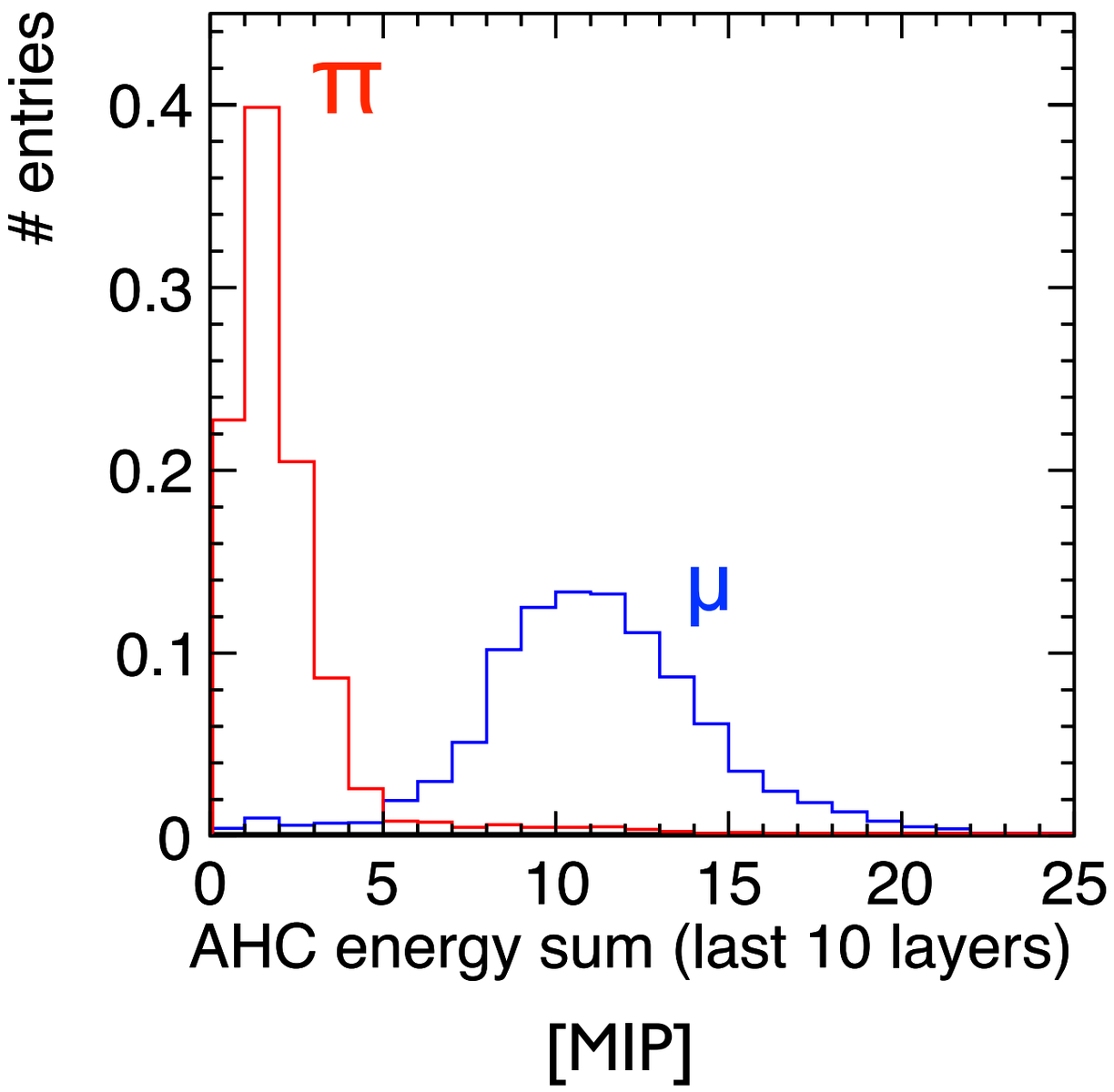
Fermilab π Data ('08 - '09)

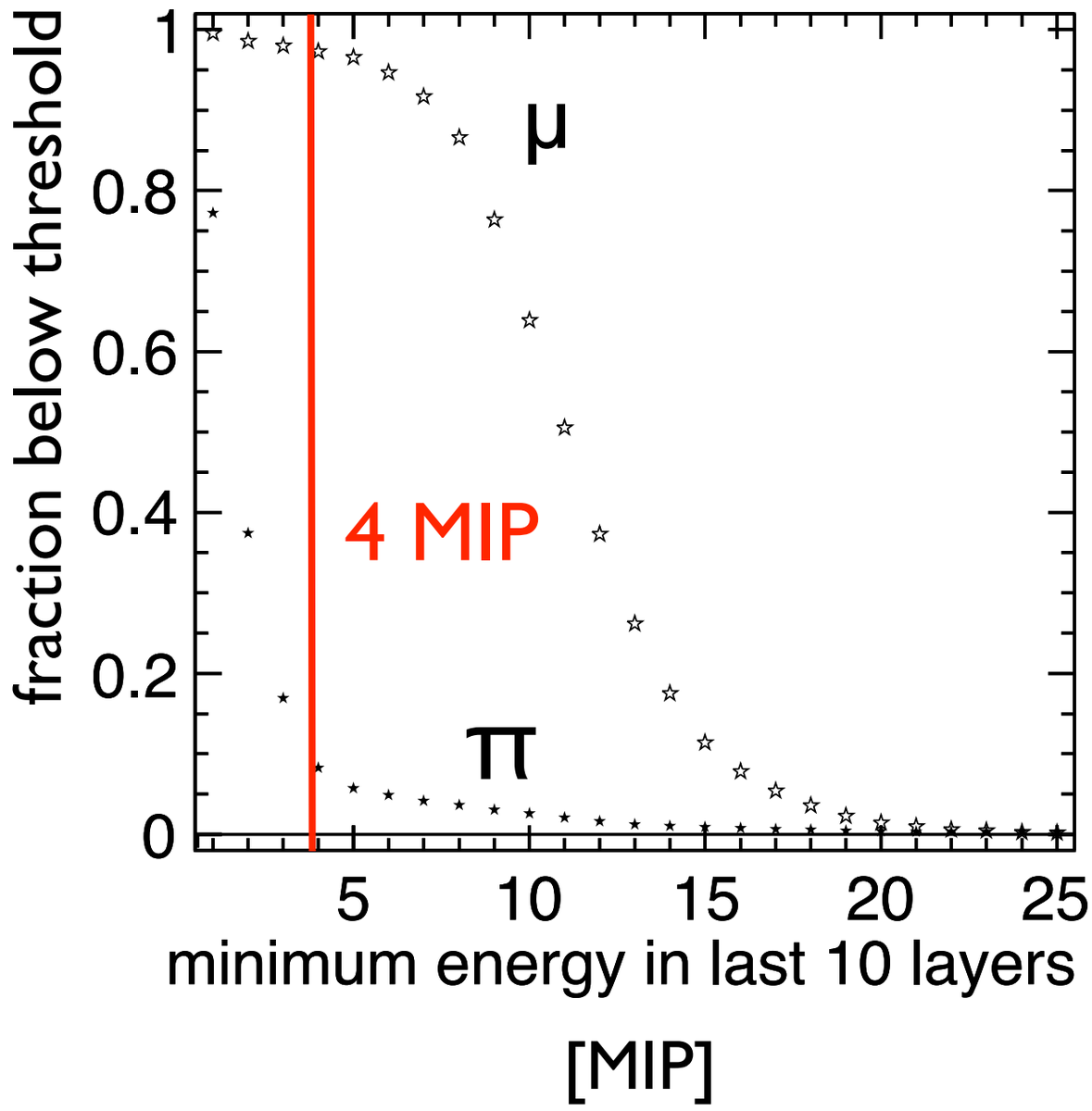


Muon Rejection At 1 GeV

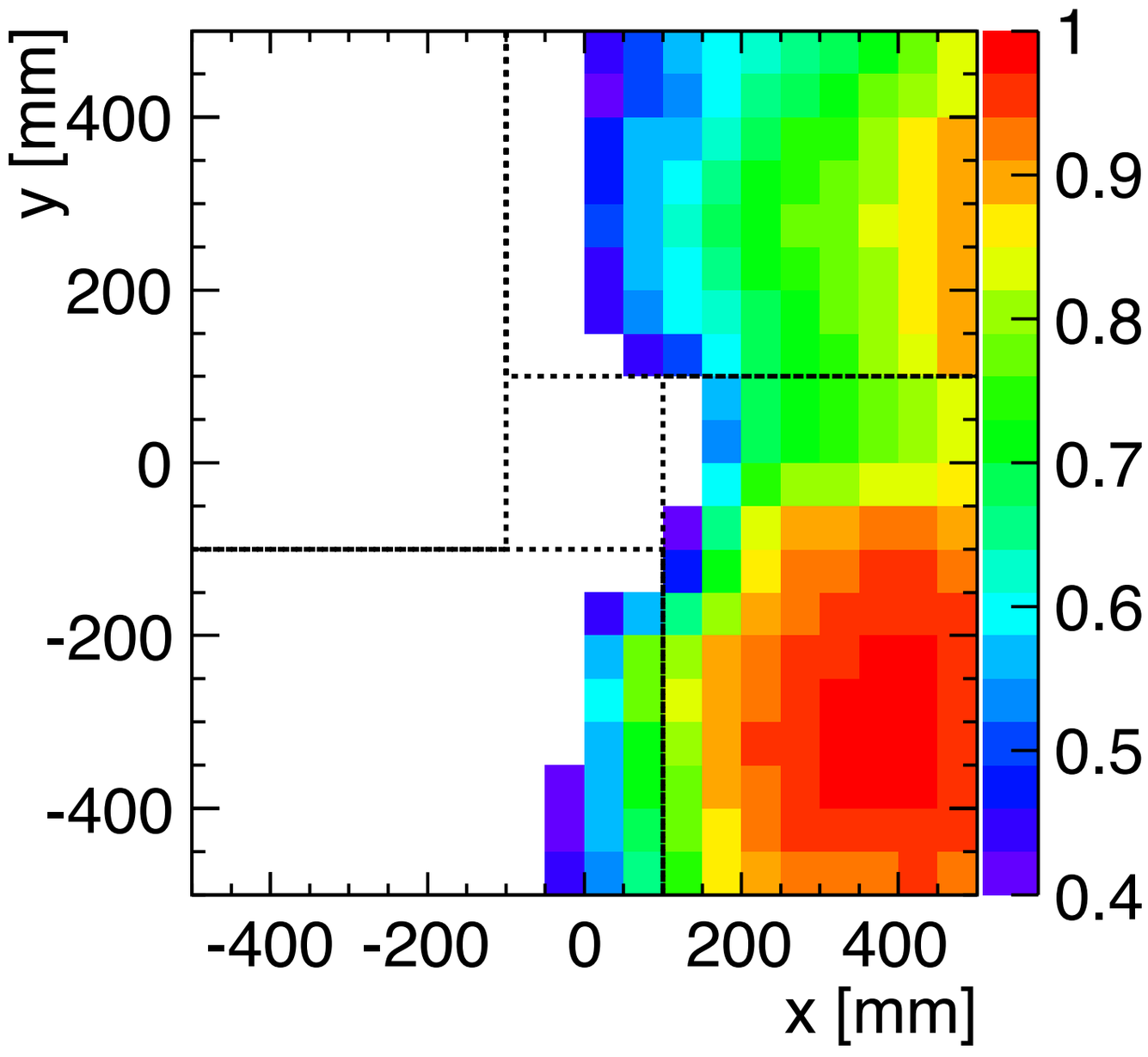
π purity > 98 %

π efficiency > 85 %

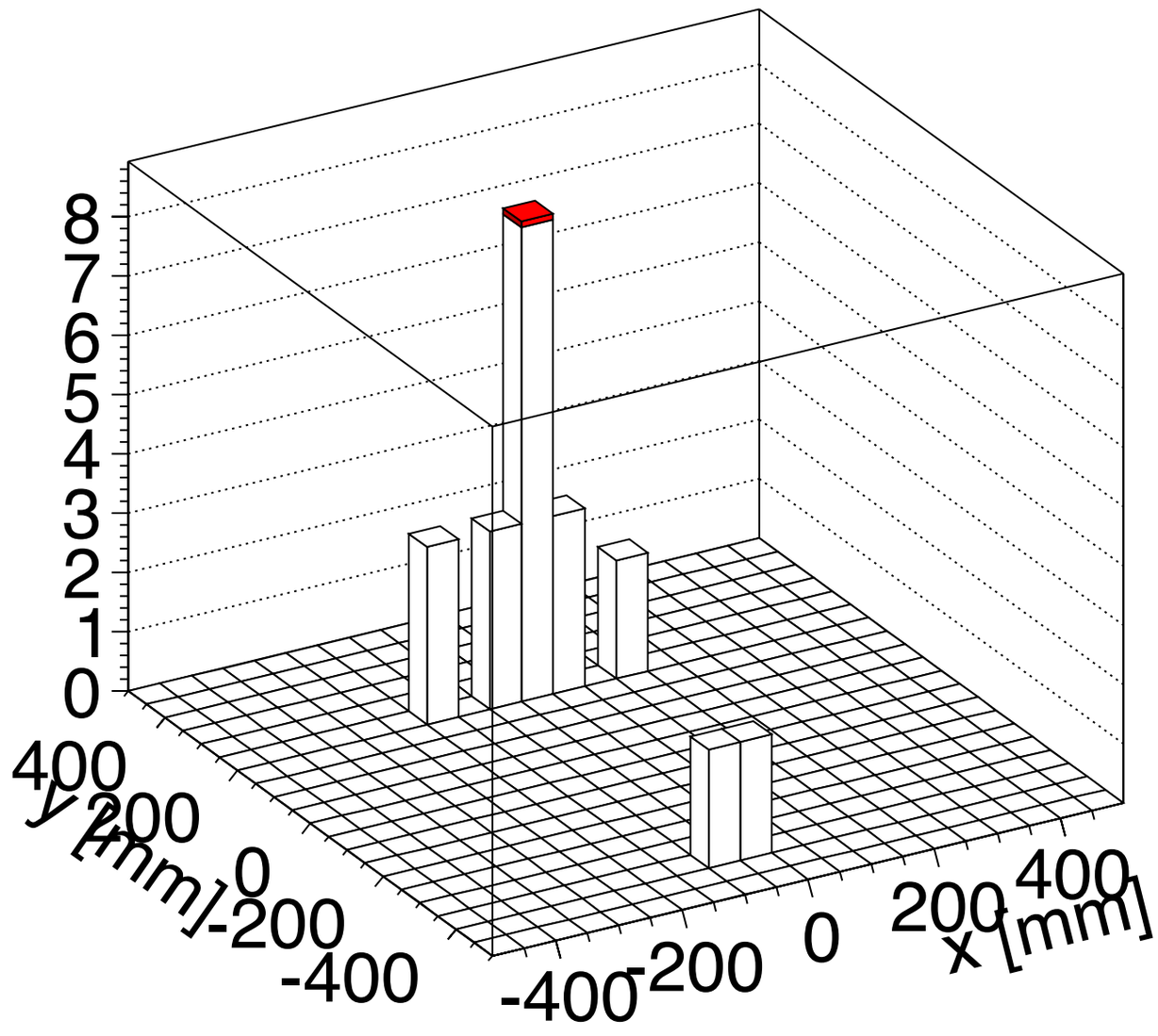




Veto Wall Efficiency



TCMT Muon Tracker



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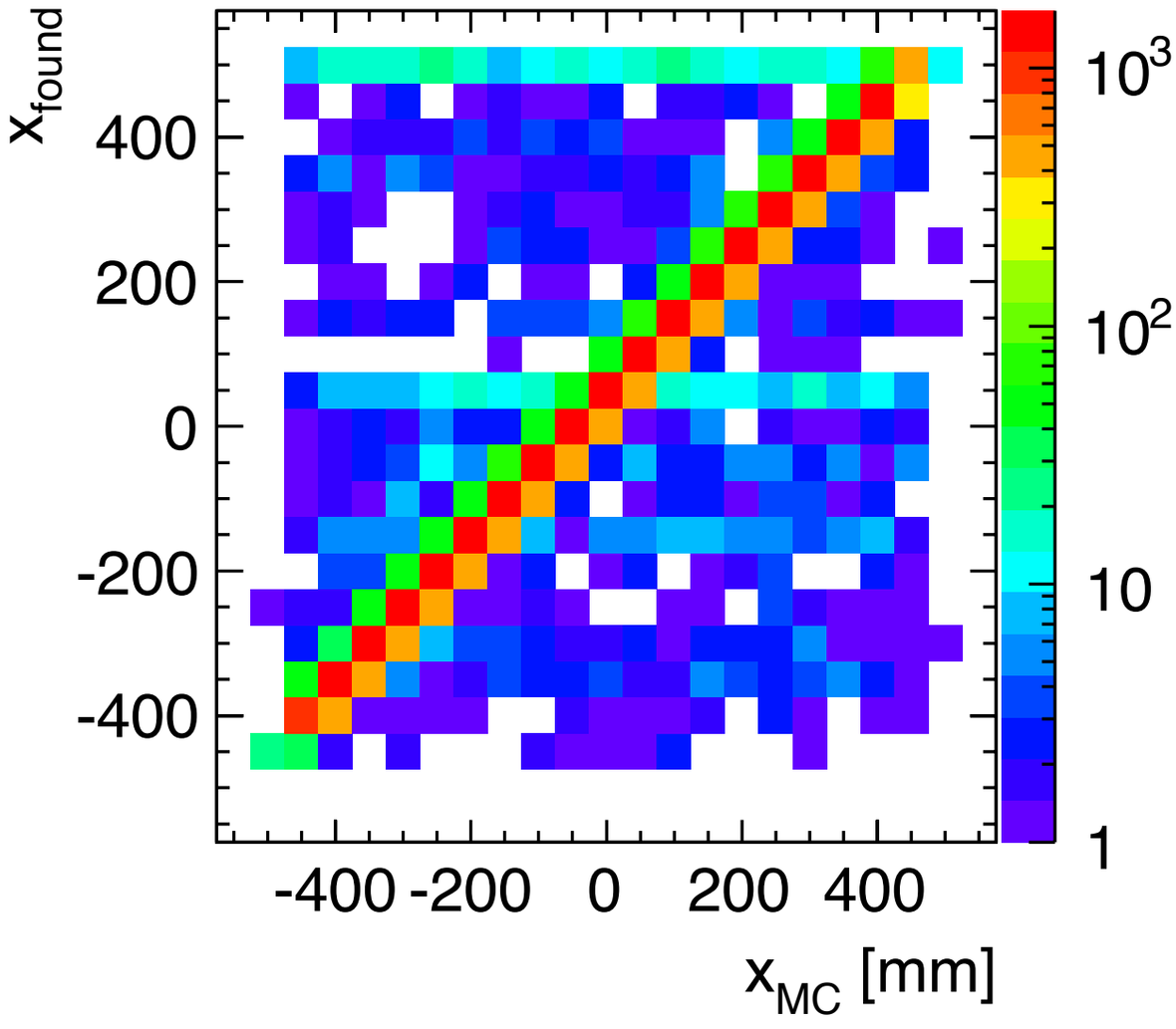
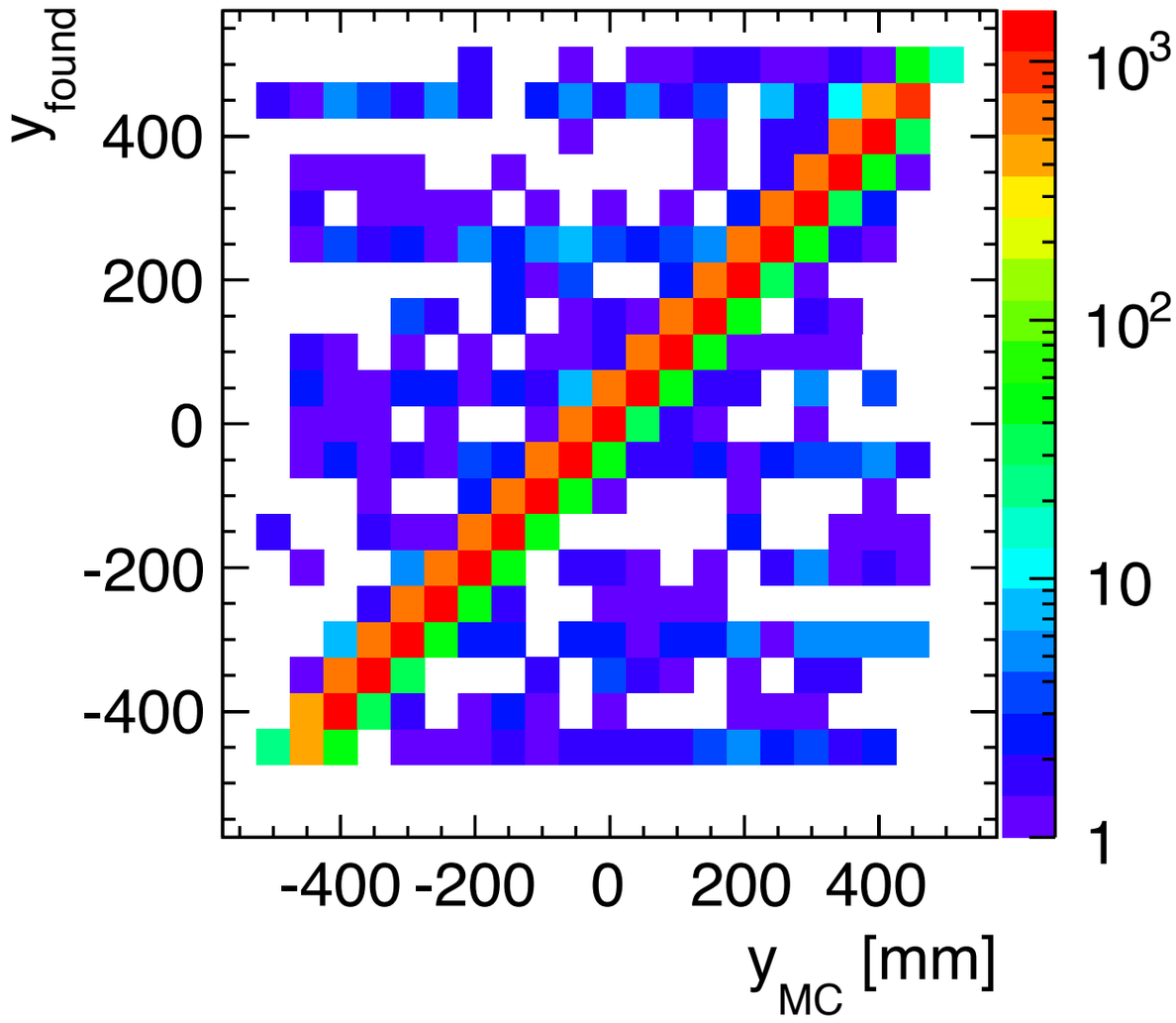




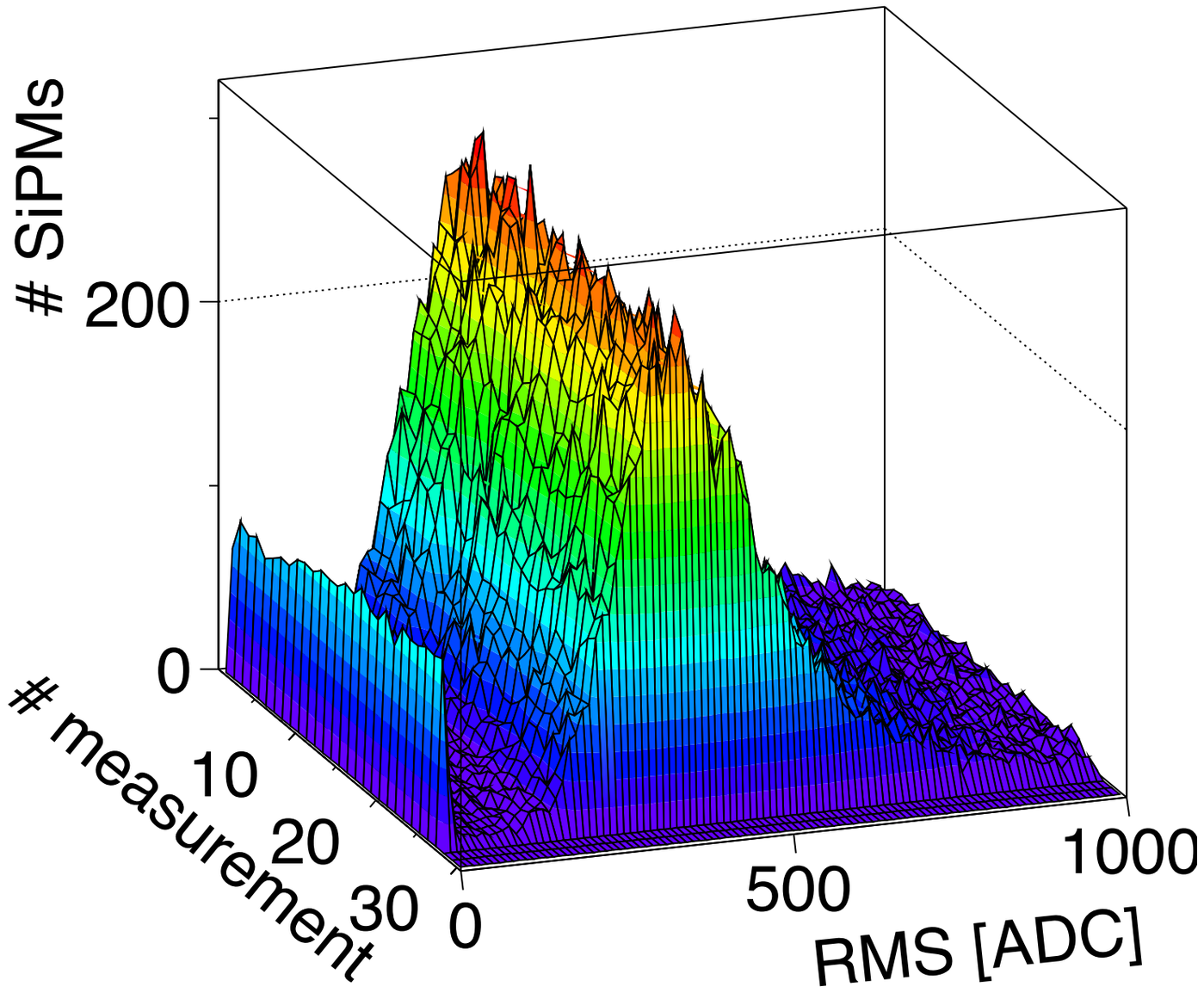
Bad Cell Statistics

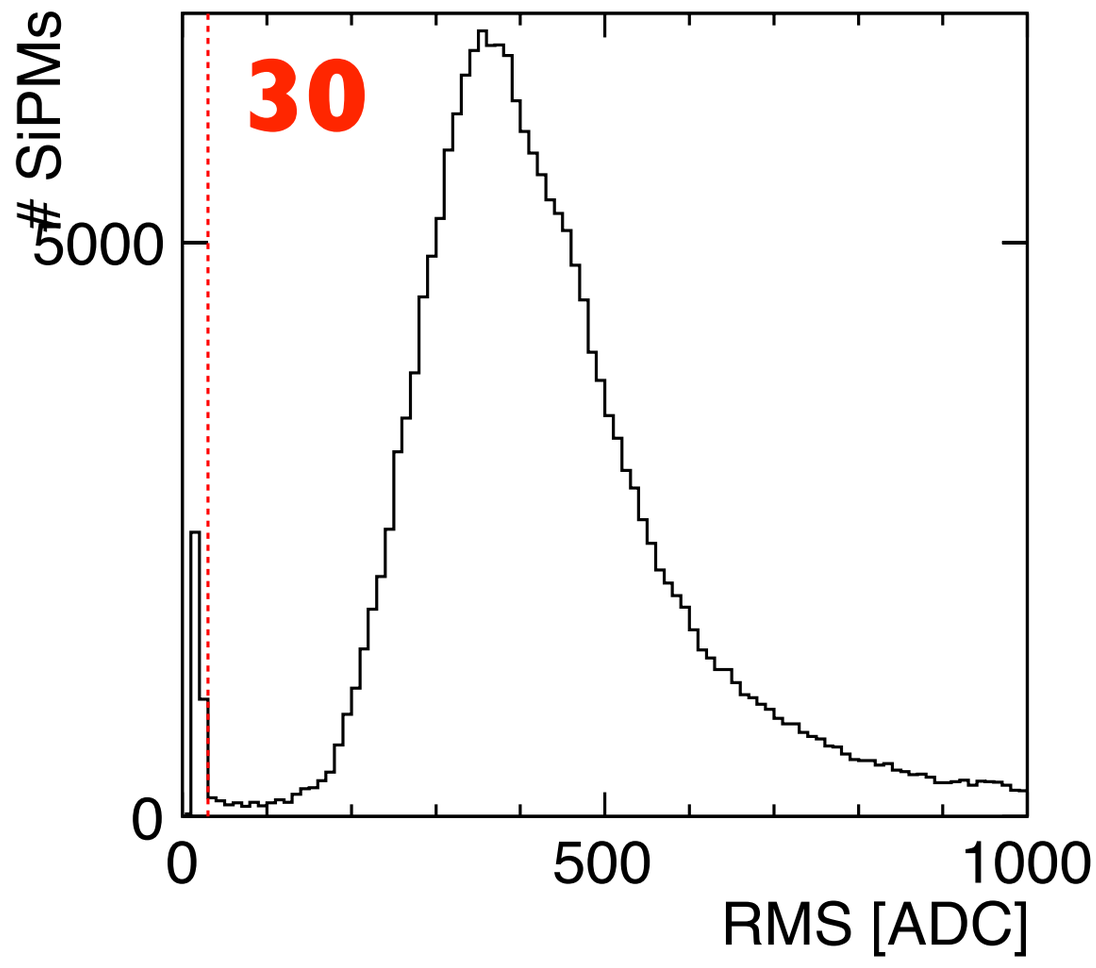
dead cells (DB)	**218 (2.9%)**
LED: RMS < 30	+ 11
noise: RMS > 140	+ 15
noise: mean outside -3 … +3	+ 31
noise: rate > 0.1	+ 6
noise: >1 peaks	+ 11
TOTAL	**292 (3.8 %)**

LED: Dead Cells

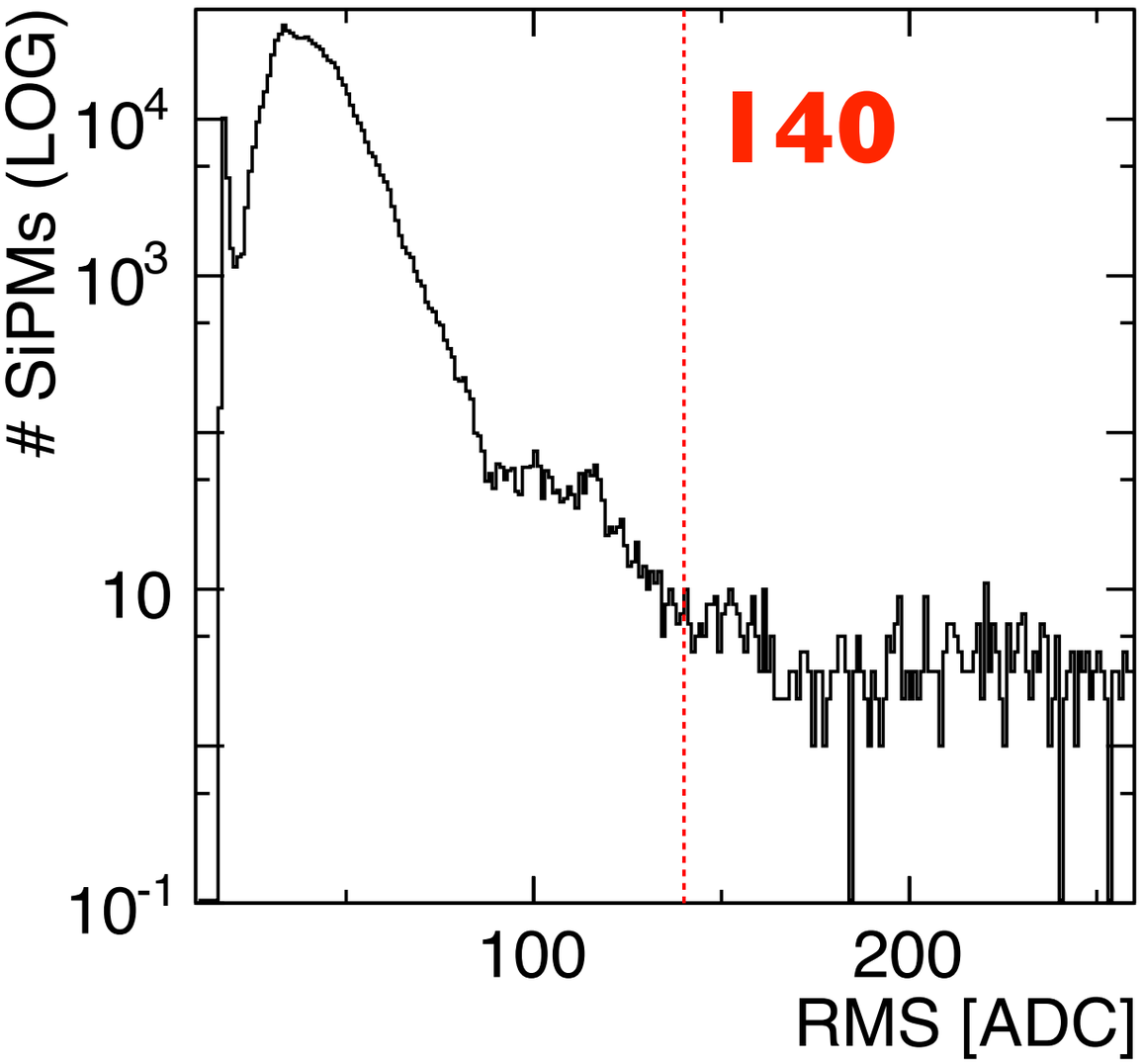
"*standard*" definition: RMS < 20 (noise) → dead

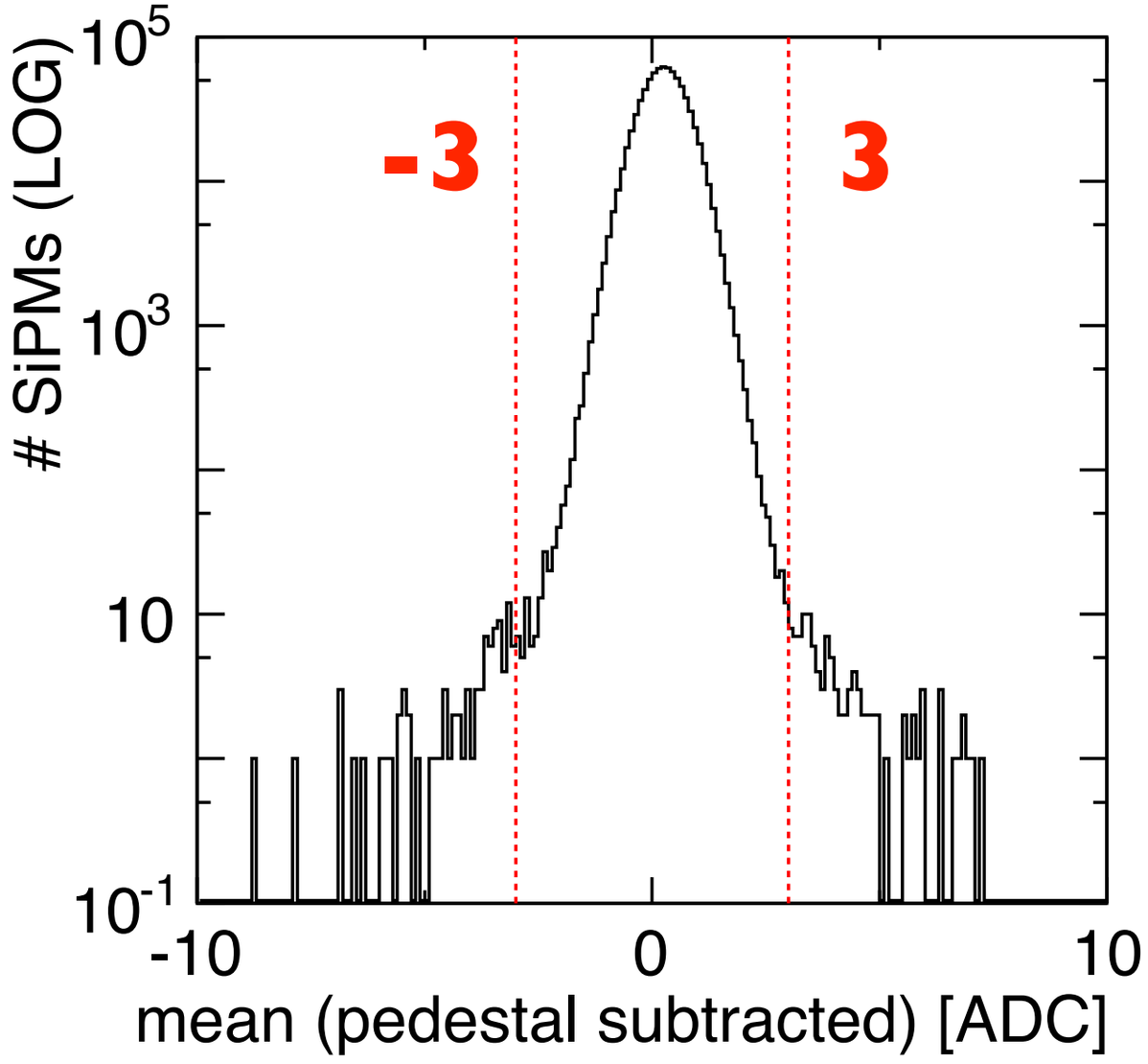
here: RMS < 30 (LED) → dead



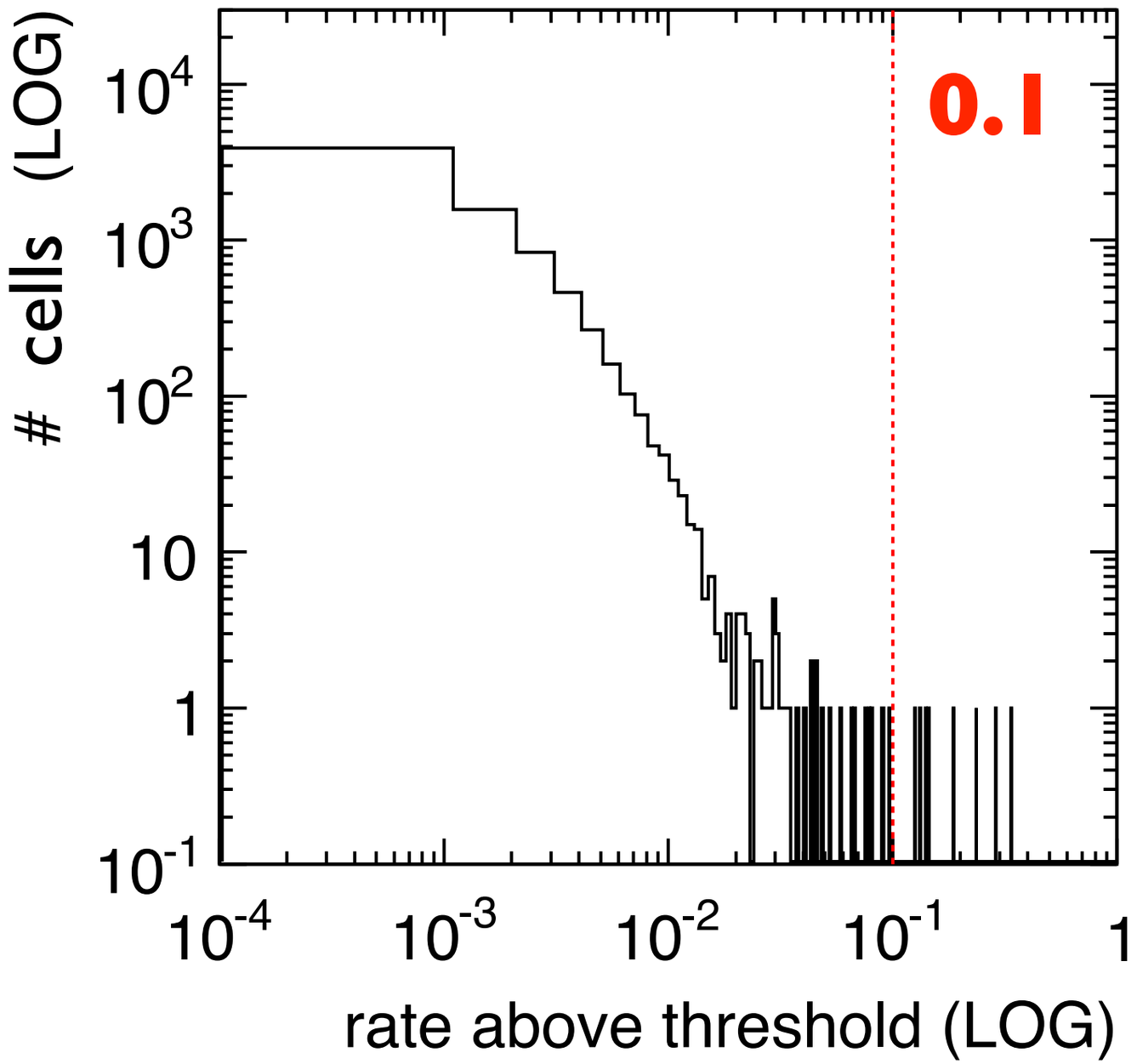


Noisy Cells


140
SiPMs (LOG)
10^4
10^3
10
10^{-1}
100
200
RMS [ADC]

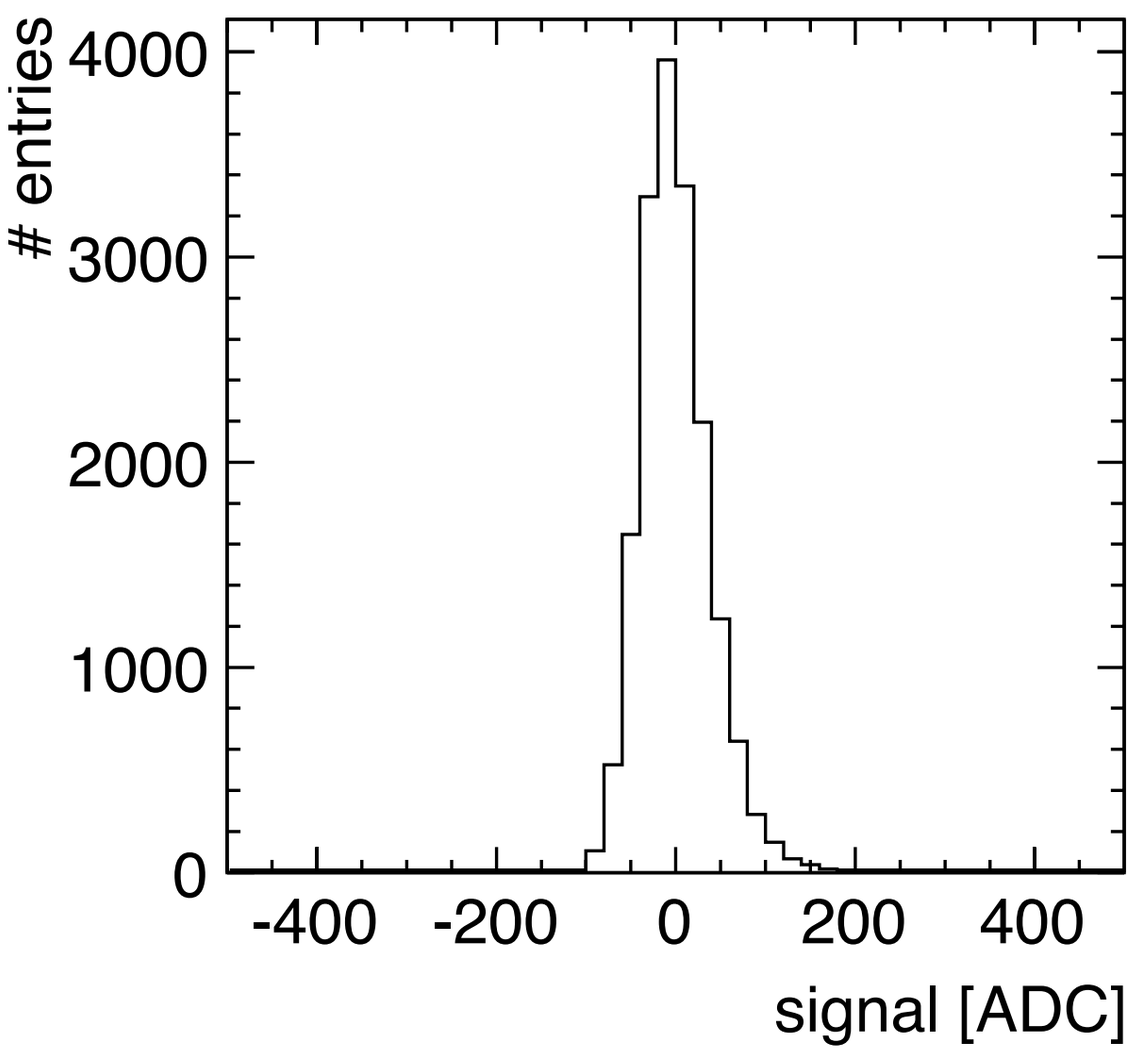

-3
3
SiPMs (LOG)
10^5
10^3
10
10^{-1}
-10
0
10
mean (pedestal subtracted) [ADC]

Noise Rate > 0.5 MIP

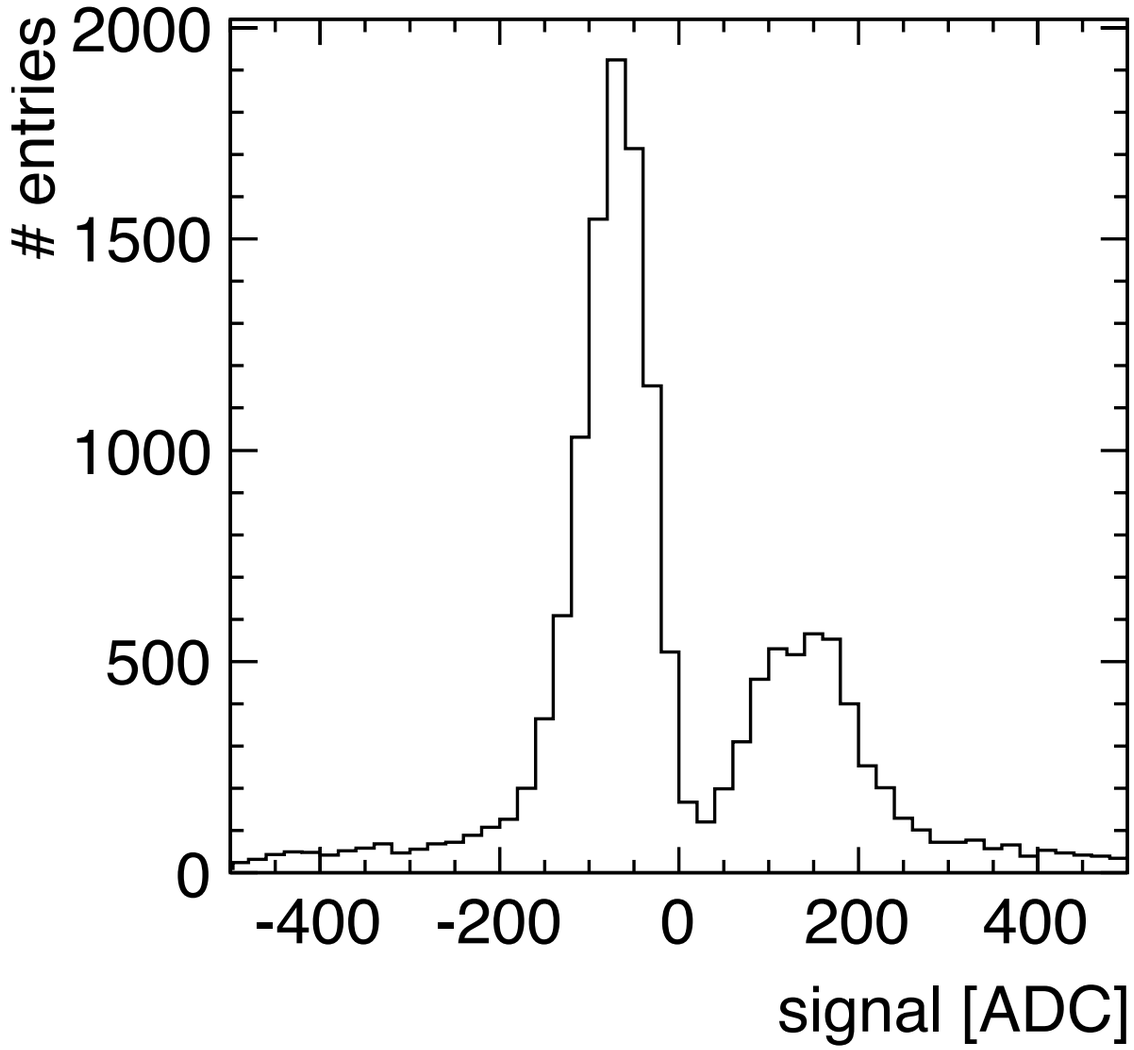


Instable Cells

good cell



bad cell



peak finder (ROOT:TSpectrum) → spot multiple peaks