

Summary of my work at the 2018 Tokyo Analysis Workshop

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DER FORSCHUNG | DER LEHRE | DER BILDUNG



:)

If your're not okay with pictures, let me know before my last slide in order to not show them or afterwards in order to delete them!

Overview

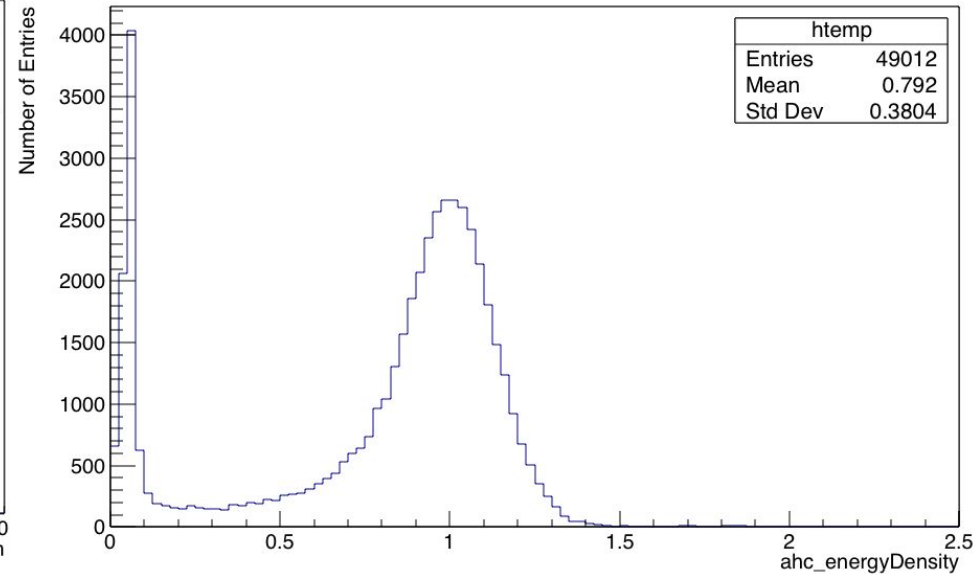
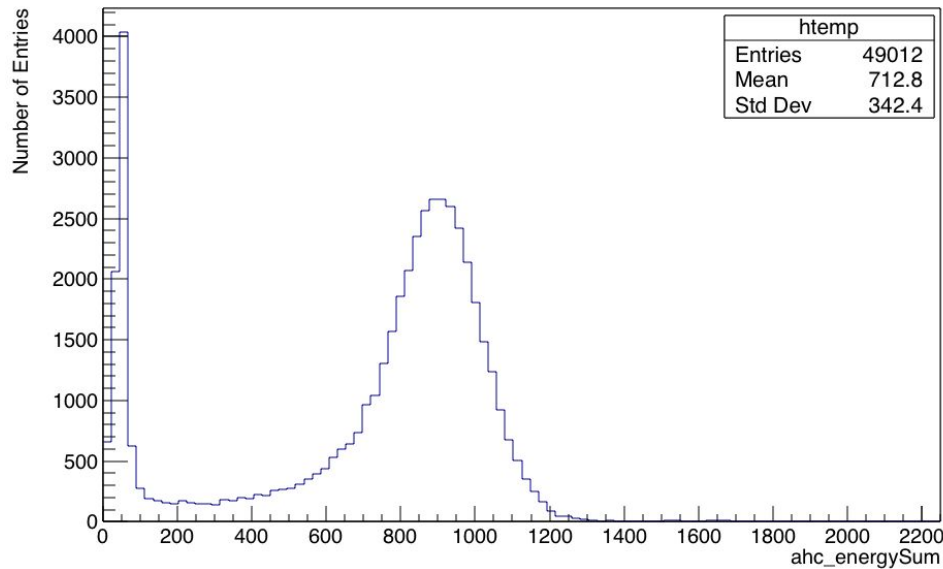
- 2 main tasks
 - RootTreeWriter
 - Archaeology
 - Fixing of different variables
 - Documentation on Confluence
 - Processor/engine implementation now in Vladimir's hands
 - Simulation Studies
 - Fixing of several issues
 - Muon studies
 - Adaptation of the "MIP2GeV conversion factor"
 - Pion studies

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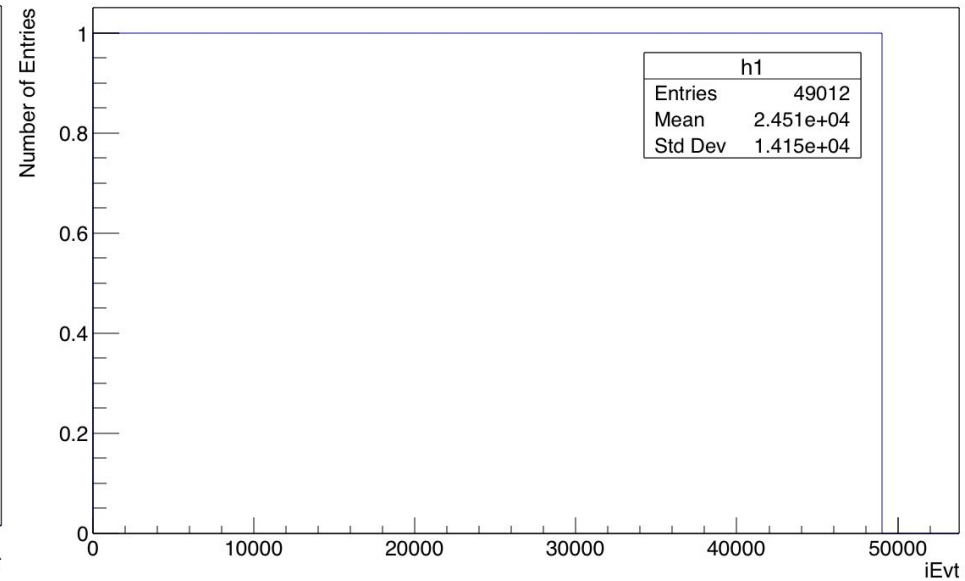
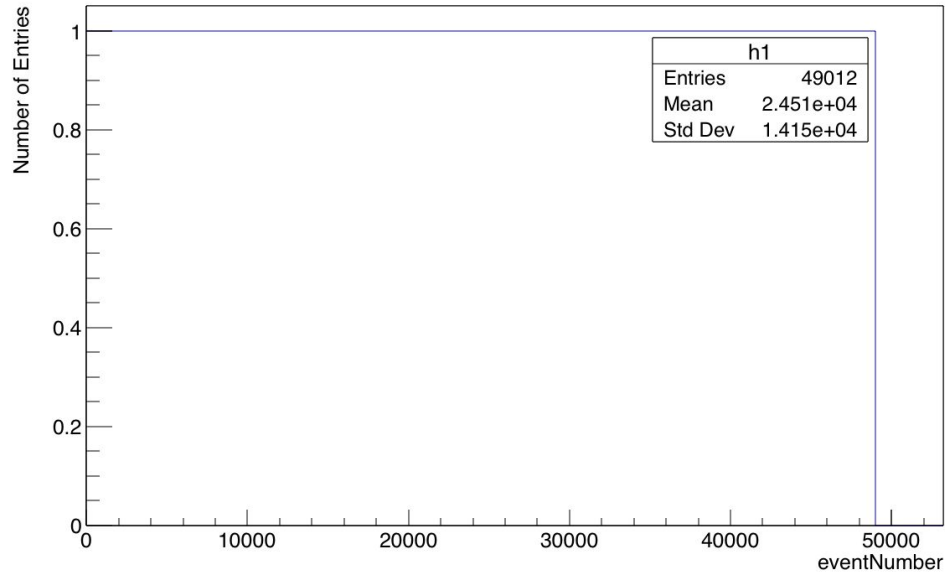
RootTreeWriter

- RootTreeWriter: Processor with several engines converting reconstructed slcio data into root trees, but also calculating several variables
 - Ongoing adaptation: Calculations done on slcio level, RootTreeWriter only as converter (Vladimir)
- First step: Archaeology to find exact definitions of several variables and try to document everything
- Second step: Adapt variables which don't represent what they are expected to be

- Now actually looks like $\text{energySum}/\text{cellSize}^2$



- Now counts events instead of hits, starts at 1

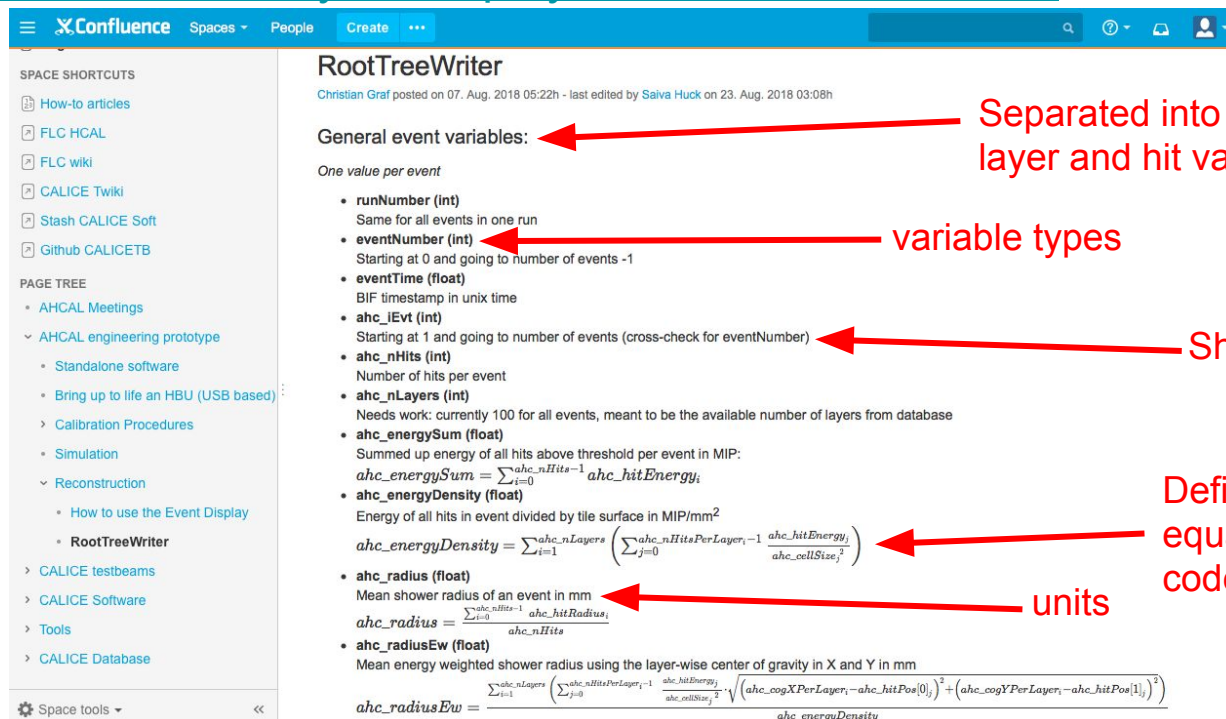


Variables fixed

- energyDensity and all variables dependent on this
 - radiusEw!
 - iEvt
 - eventNumber and all variables dependent on this
 - all per layer-variables
 - cellSize in mm instead of cm
- ⇒ All variables now represent what they are expected to be
- ⇒ RootTreeWriter is in a place where it can temporarily stay

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- <https://confluence.desy.de/display/Calice/RootTreeWriter>



RootTreeWriter
 Christian Graf posted on 07. Aug. 2018 05:22h - last edited by Saiva Huck on 23. Aug. 2018 03:08h

General event variables:

One value per event

- runNumber (int)**
Same for all events in one run
- eventNumber (int)**
Starting at 0 and going to number of events -1
- eventTime (float)**
BIF timestamp in unix time
- ahc_iEvt (int)**
Starting at 1 and going to number of events (cross-check for eventNumber)
- ahc_nHits (int)**
Number of hits per event
- ahc_nLayers (int)**
Needs work: currently 100 for all events, meant to be the available number of layers from database
- ahc_energySum (float)**
Summed up energy of all hits above threshold per event in MIP:

$$ahc_energySum = \sum_{i=0}^{ahc_nHits-1} ahc_hitEnergy_i$$
- ahc_energyDensity (float)**
Energy of all hits in event divided by tile surface in MIP/mm²

$$ahc_energyDensity = \sum_{i=1}^{ahc_nLayers} \left(\sum_{j=0}^{ahc_nHitsPerLayer_i-1} \frac{ahc_hitEnergy_j}{ahc_cellSize_j^2} \right)$$
- ahc_radius (float)**
Mean shower radius of an event in mm

$$ahc_radius = \frac{\sum_{i=0}^{ahc_nHits-1} ahc_hitRadius_i}{ahc_nHits}$$
- ahc_radiusEw (float)**
Mean energy weighted shower radius using the layer-wise center of gravity in X and Y in mm

$$ahc_radiusEw = \frac{\sum_{i=1}^{ahc_nLayers} \left(\sum_{j=0}^{ahc_nHitsPerLayer_i-1} \frac{ahc_hitEnergy_j}{ahc_cellSize_j^2} \sqrt{(ahc_cogXPerLayer_i - ahc_hitPos[0]_j)^2 + (ahc_cogYPerLayer_i - ahc_hitPos[1]_j)^2} \right)}{ahc_energyDensity}$$

Separated into event, layer and hit variables

variable types

Short explanations

Definitions in the form of equations used in the code

units

- 2 main tasks

- RootTreeWriter

- Archaeology
 - Fixing of different variables
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 - Processor/engine implementation now in Vladimir's hands

- Simulation Studies

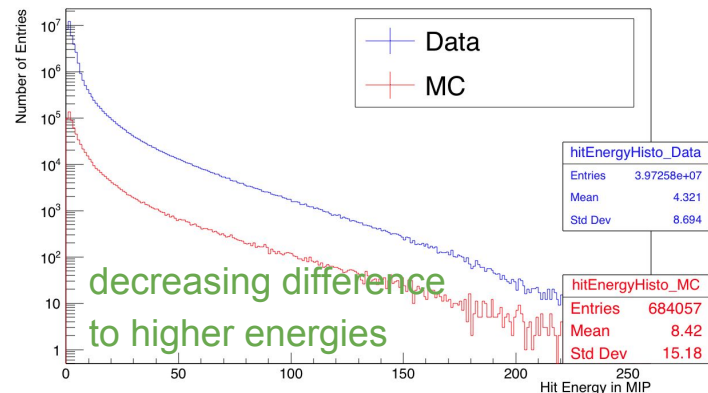
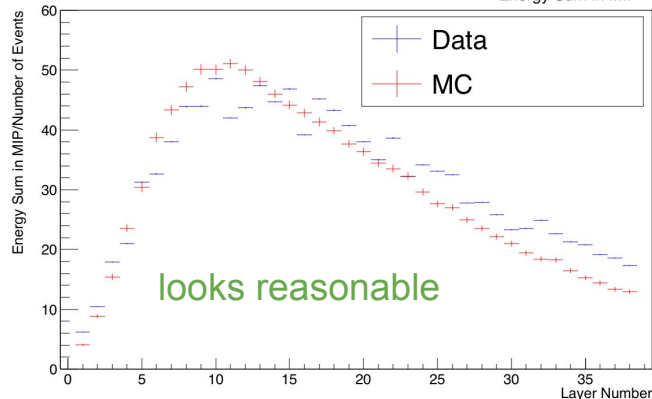
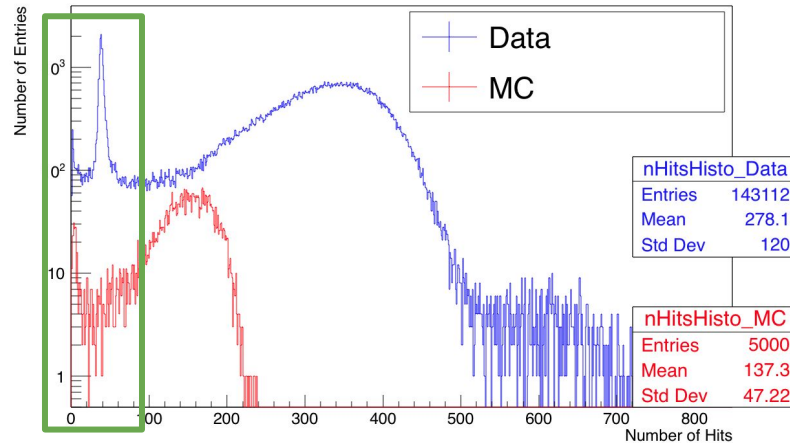
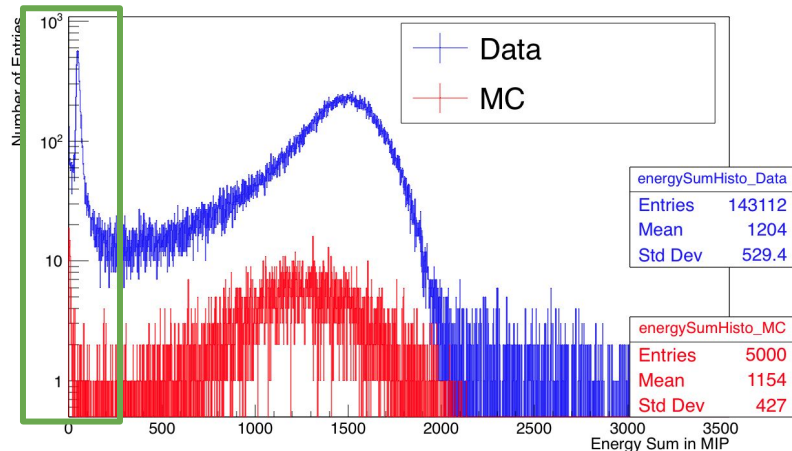
- Fixing of several issues
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Simulation Story
→ May data

Simulation Story

- No MIP peak in simulated pion data

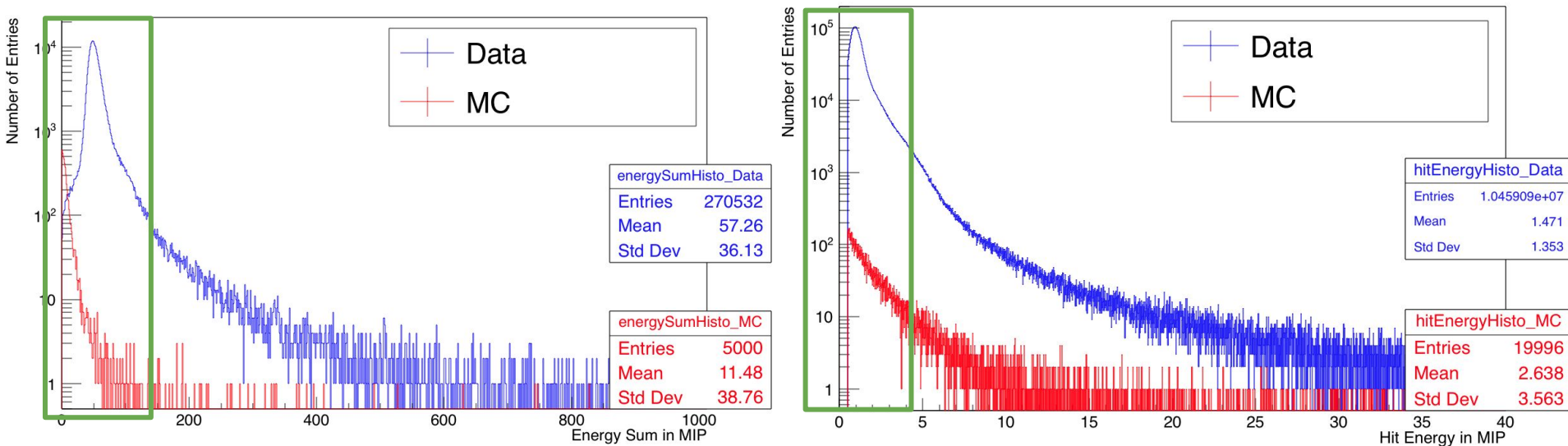
No MIP peak in simulated pions



Simulation Story

- No MIP peak in simulated pion data: **check muon simulations**
- Also no MIP peak in simulated muon data

No MIP peak in simulated muons

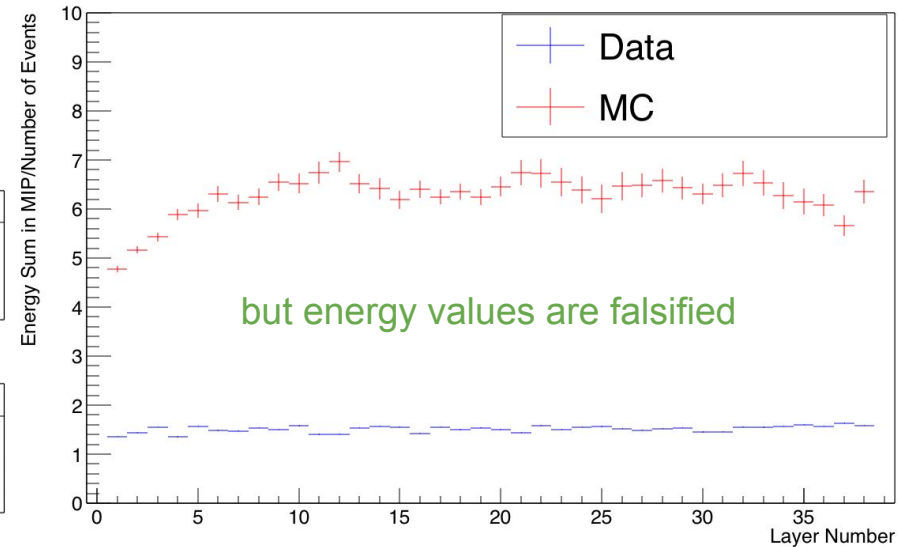
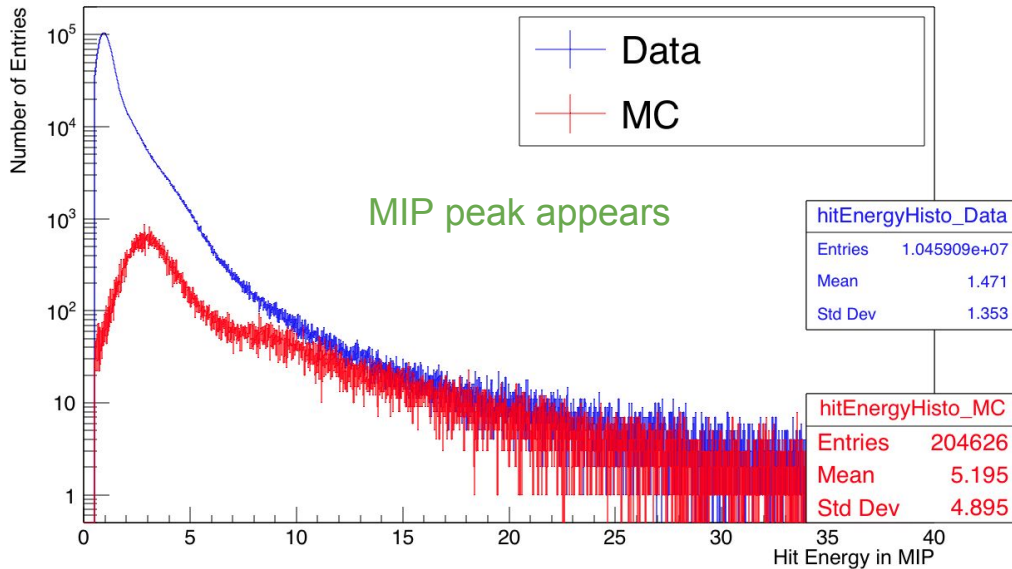


⇒ We must be losing low-energy hits!

Simulation Story

- No MIP peak in simulated pion data: **check muon simulations**
- Also no MIP peak in simulated muon data: **is the peak shifted by the “MIP2GeV conversion” factor or cut off by thresholds?**

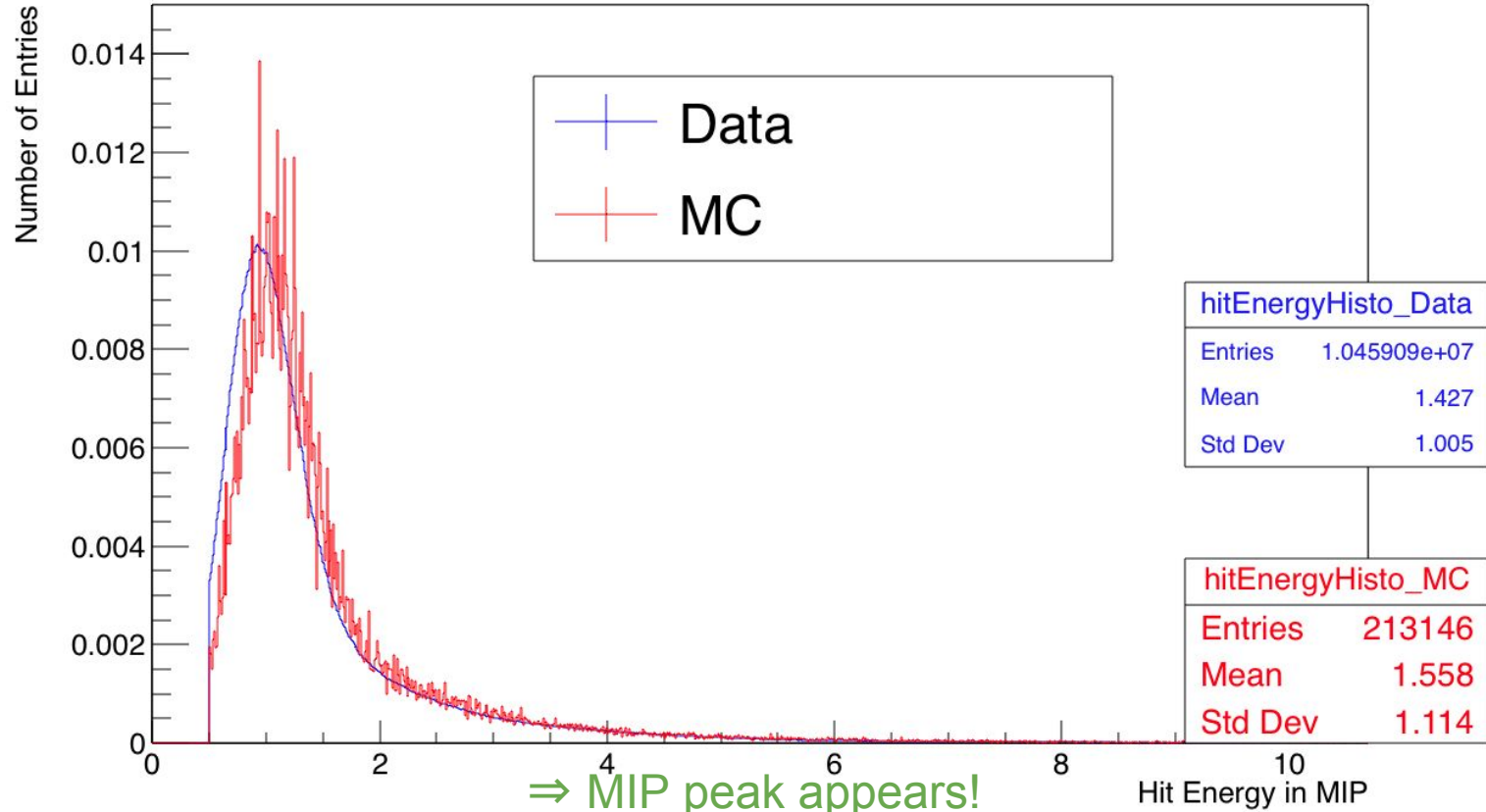
MIP2GeV adaptation



Simulation Story

- No MIP peak in simulated pion data: **check muon simulations**
- Also no MIP peak in simulated muon data: **no difference from threshold changes, “MIP2GeV conversion” is not the problem**
- Pedestal subtraction as simulation killer: **not added pedestal is subtracted for simulation data during reconstruction**

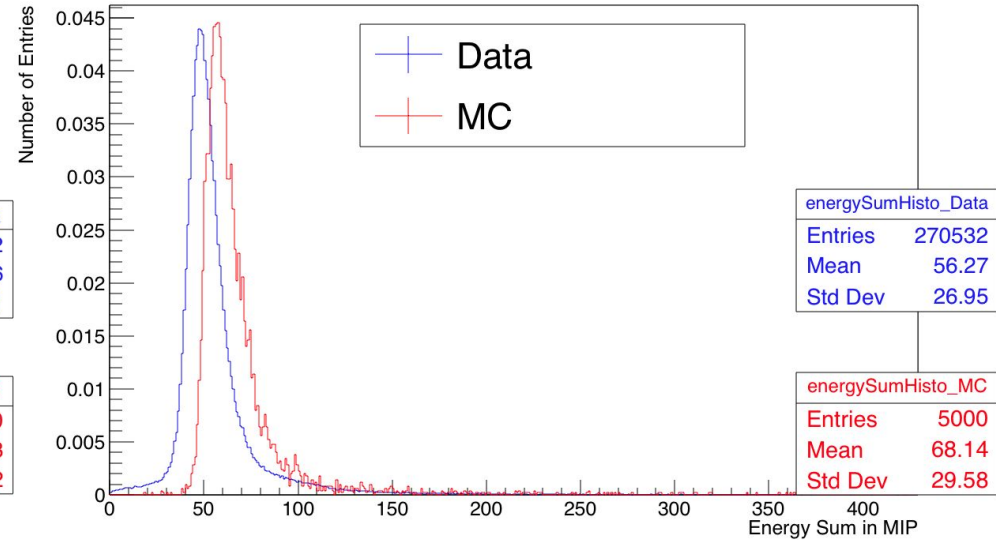
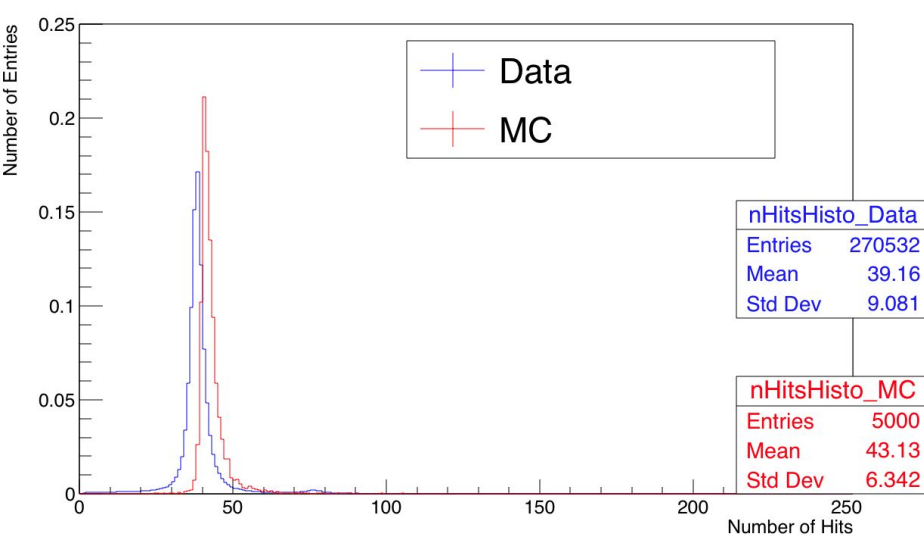
Removed pedestal subtraction



Simulation Story

- No MIP peak in simulated pion data: ✓
- Also no MIP peak in simulated muon data: ✓
- Pedestal subtraction as simulation killer: ✓
- nHits and energySum shifted to higher values

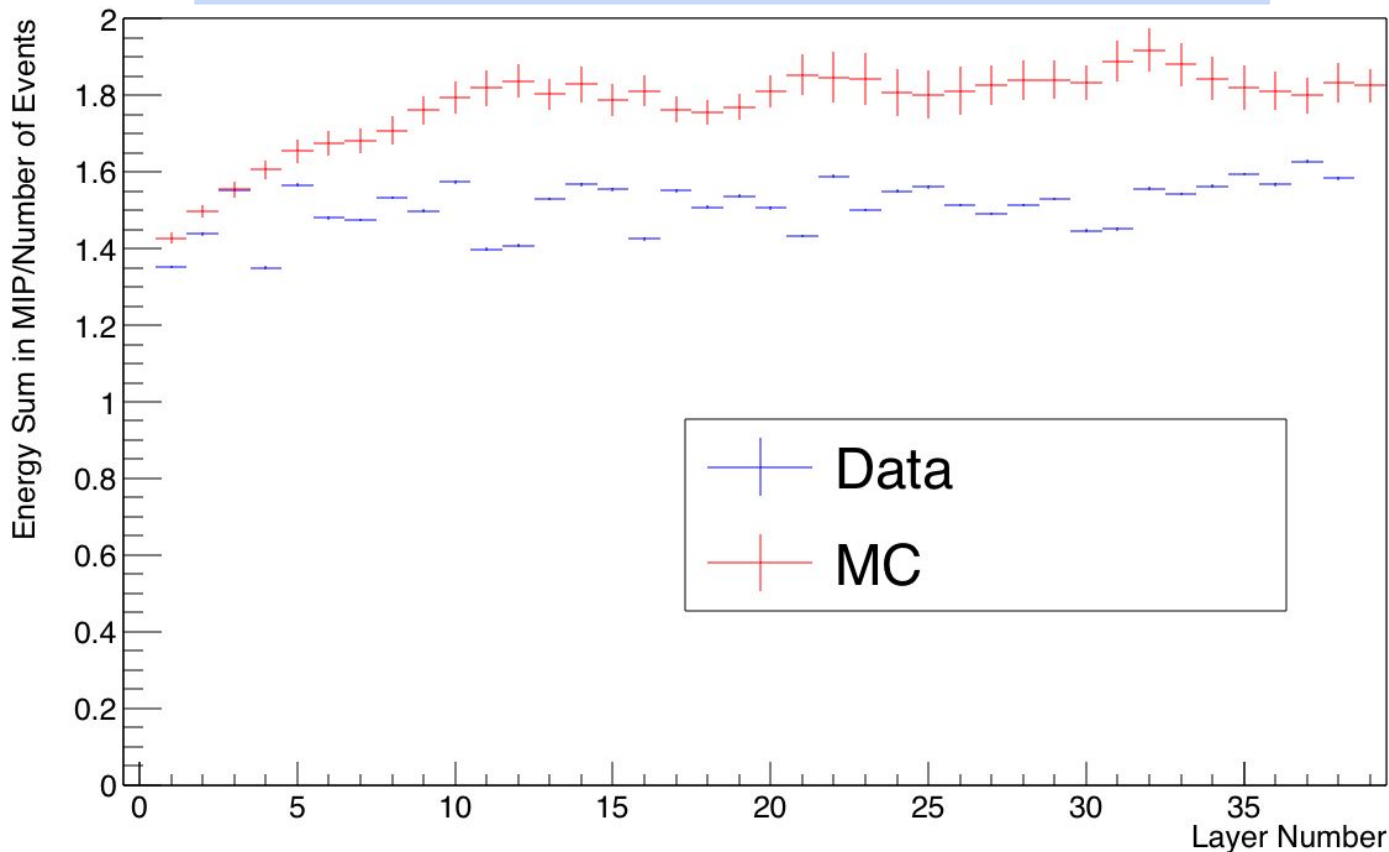
Distributions shifted



Simulation Story

- No MIP peak in simulated pion data: ✓
- Also no MIP peak in simulated muon data: ✓
- Pedestal subtraction as simulation killer: ✓
- nHits and energySum shifted to higher values: **check layer profiles**

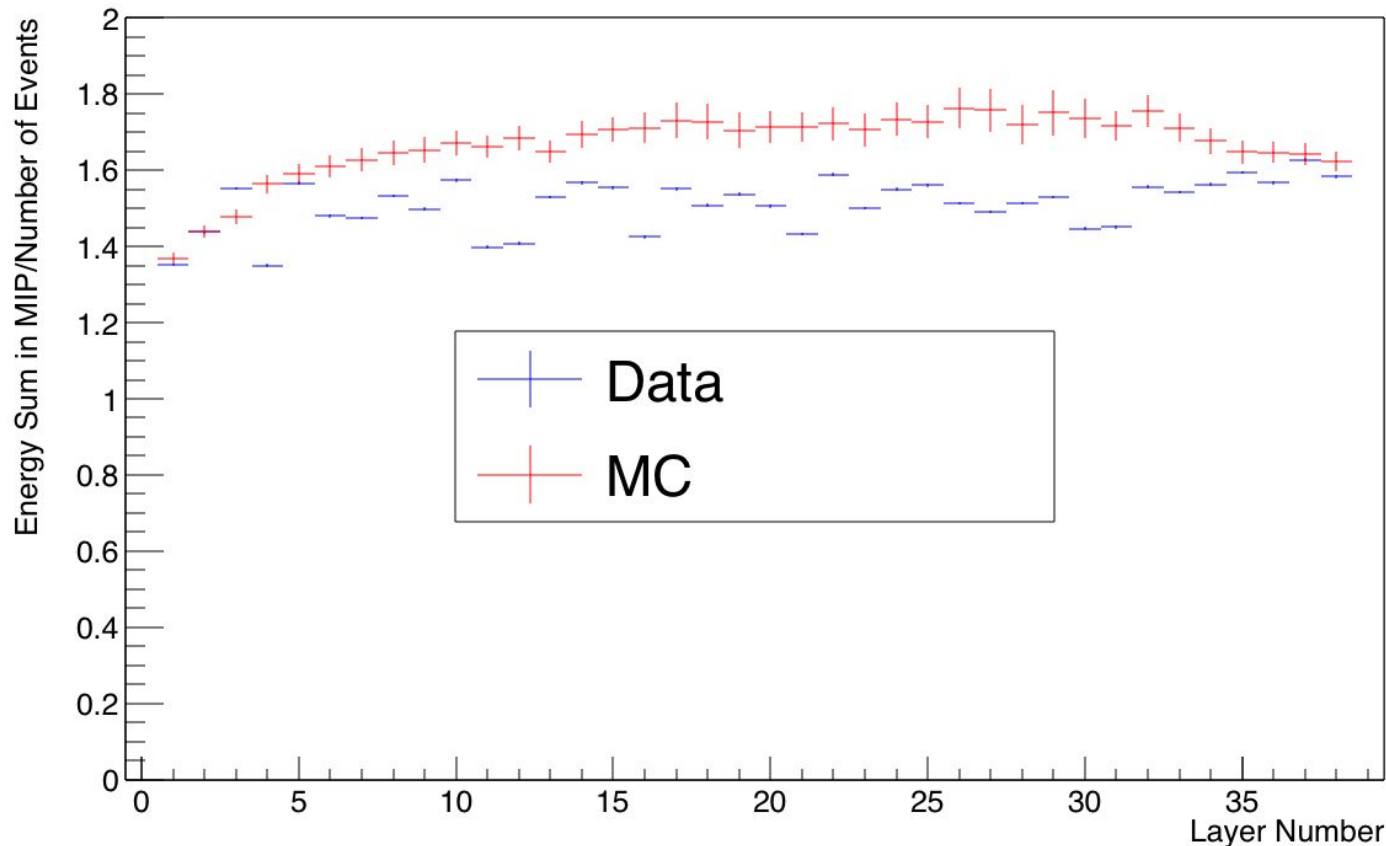
Additional layers in simulation



Simulation Story

- No MIP peak in simulated pion data: ✓
- Also no MIP peak in simulated muon data: ✓
- Pedestal subtraction as simulation killer: ✓
- nHits and energySum shifted to higher values: **check layer profiles**
- Simulated layer profiles have additional layers

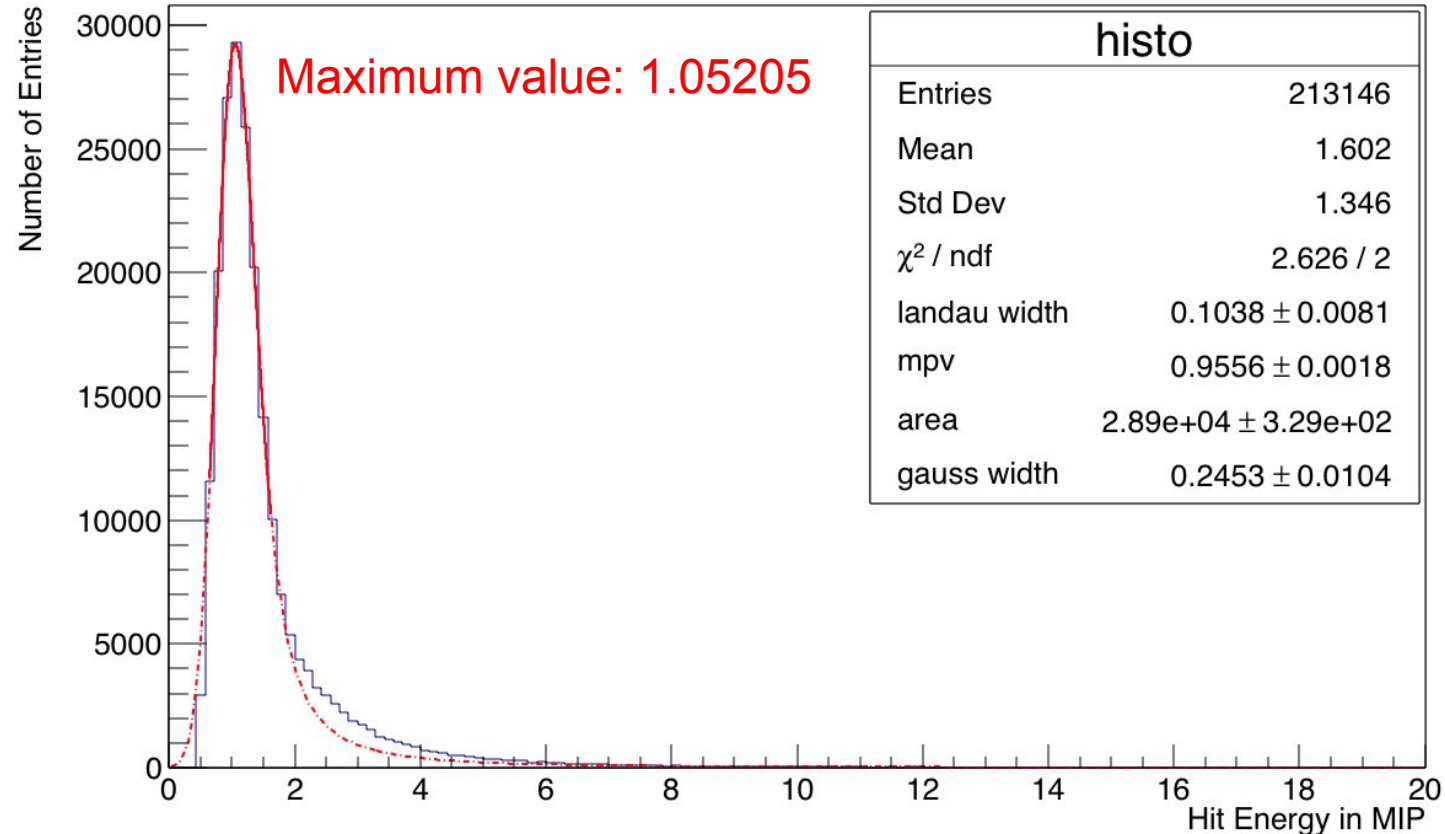
Fixed layer number in simulation



Simulation Story

- No MIP peak in simulated pion data: ✓
- Also no MIP peak in simulated muon data: ✓
- Pedestal subtraction as simulation killer: ✓
- nHits and energySum shifted to higher values: improved
- Simulated layer profiles have additional layers: ✓
- MIP peak not exactly at 1 MIP

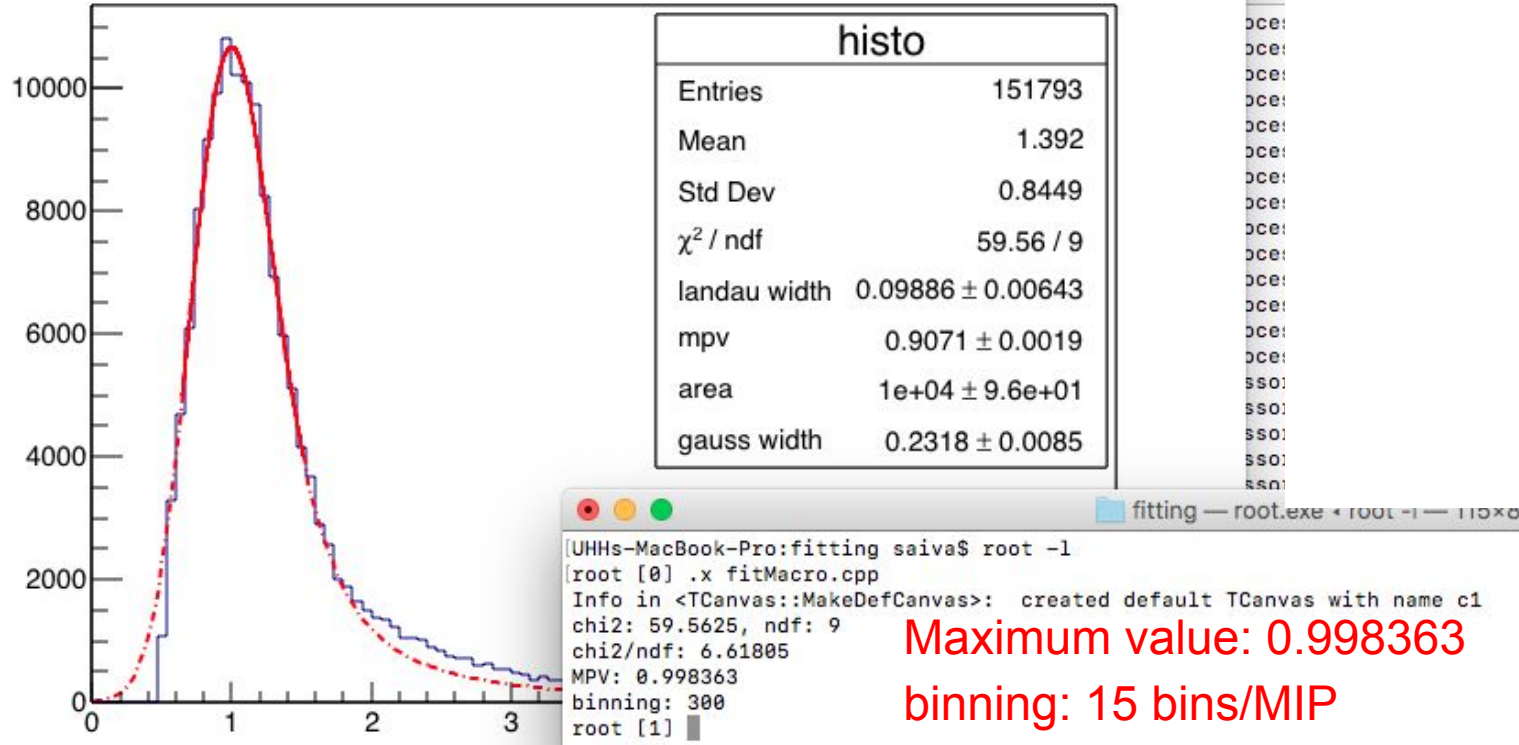
MIP peak at > 1



Simulation Story

- No MIP peak in simulated pion data: ✓
- Also no MIP peak in simulated muon data: ✓
- Pedestal subtraction as simulation killer: ✓
- nHits and energySum shifted to higher values
- Simulated layer profiles have additional layers: ✓
- MIP peak not exactly at 1 MIP: adapt “MIP2GeV conversion” factor using Landau-Gauss fit used for MIP calibration

MIP peak very close to 1



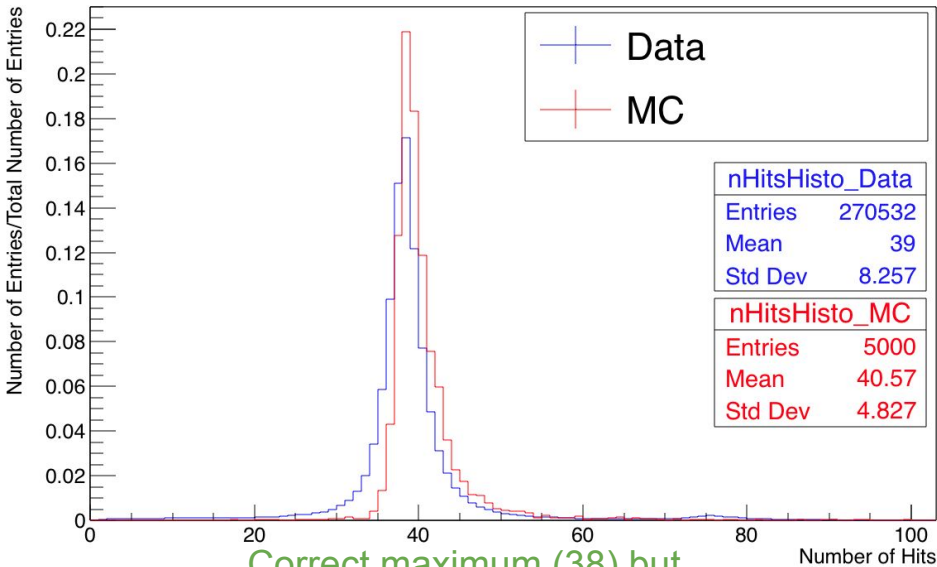
Maximum value: 0.998363
 binning: 15 bins/MIP

⇒ Deviations below 1% for different fits, binnings and energies

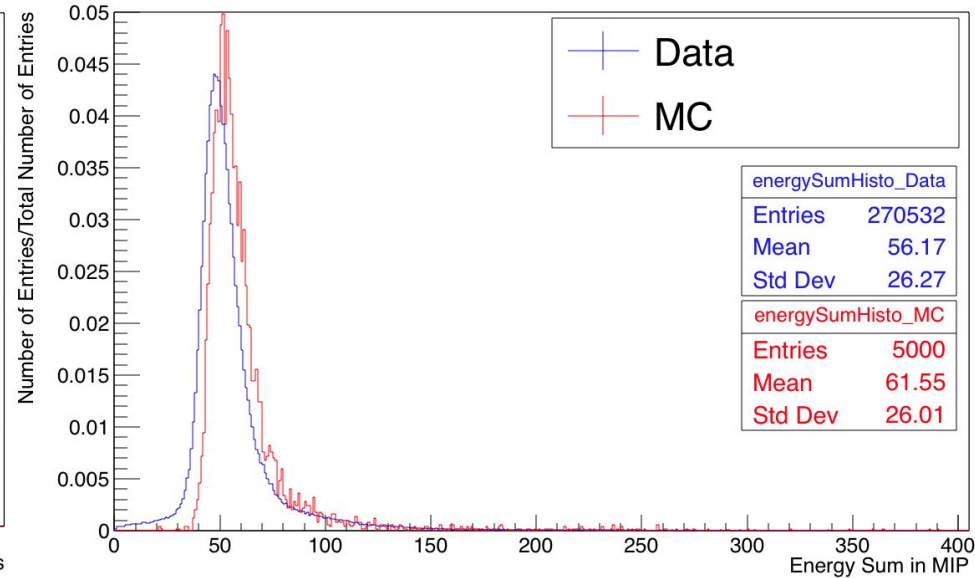
Simulation Story

- No MIP peak in simulated pion data: ✓
- Also no MIP peak in simulated muon data: ✓
- Pedestal subtraction as simulation killer: ✓
- nHits and energySum shifted to higher values
- Simulated layer profiles have additional layers: ✓
- MIP peak not exactly at 1 MIP: ✓
- Rise in layer profiles for simulated data

Shifted distributions

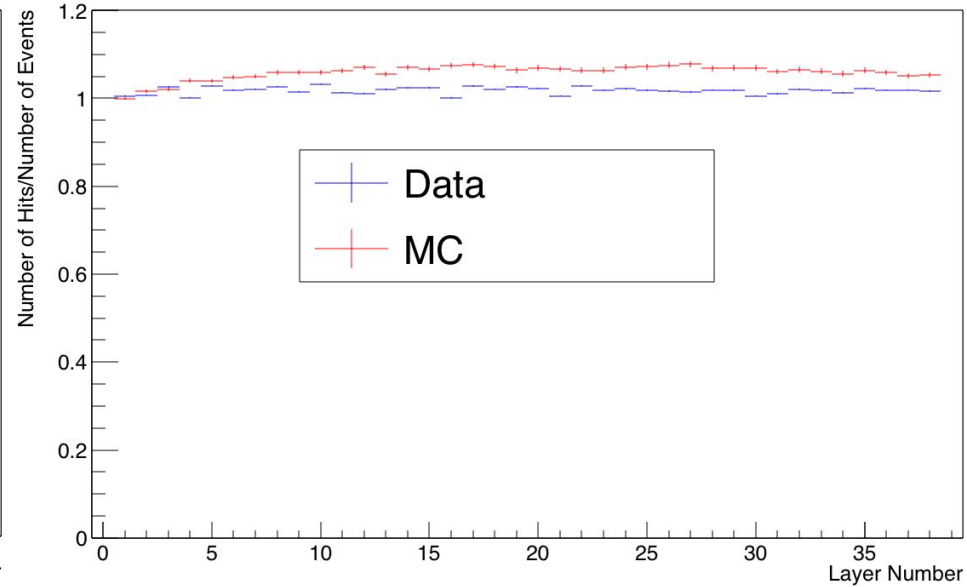
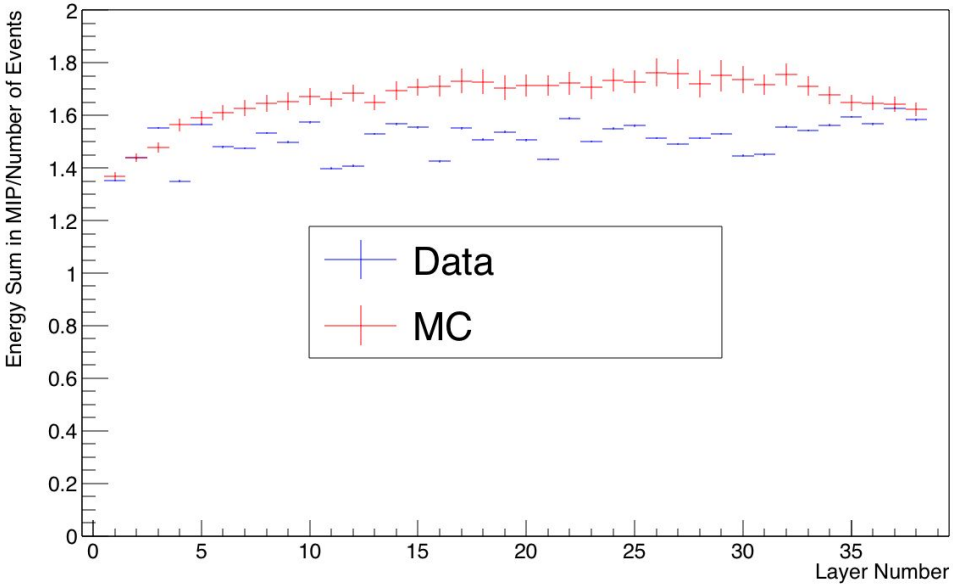


Correct maximum (38) but
 whole distribution shifted to
 higher numbers



Entire peak shifted to higher
 energies

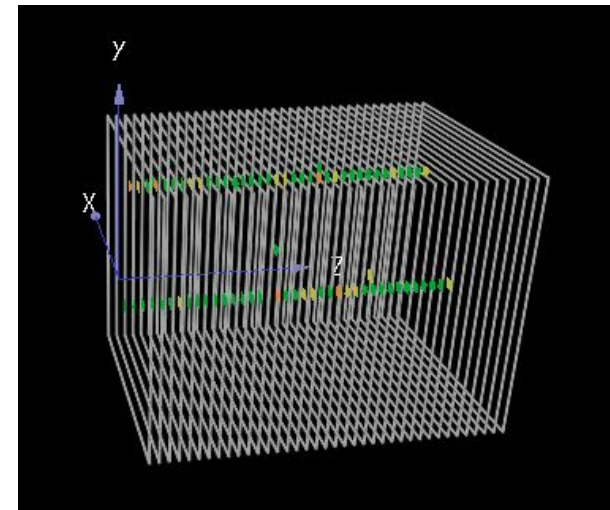
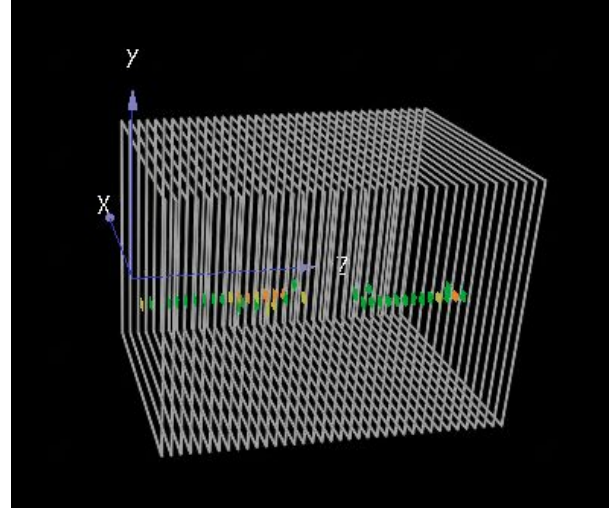
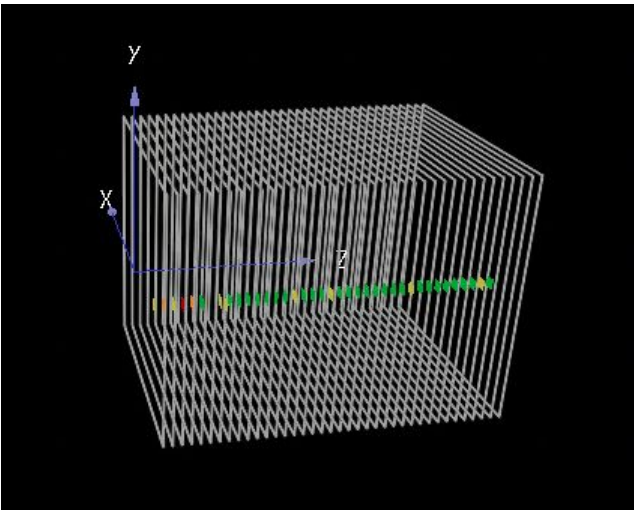
Rise in layer profiles



Simulation Story

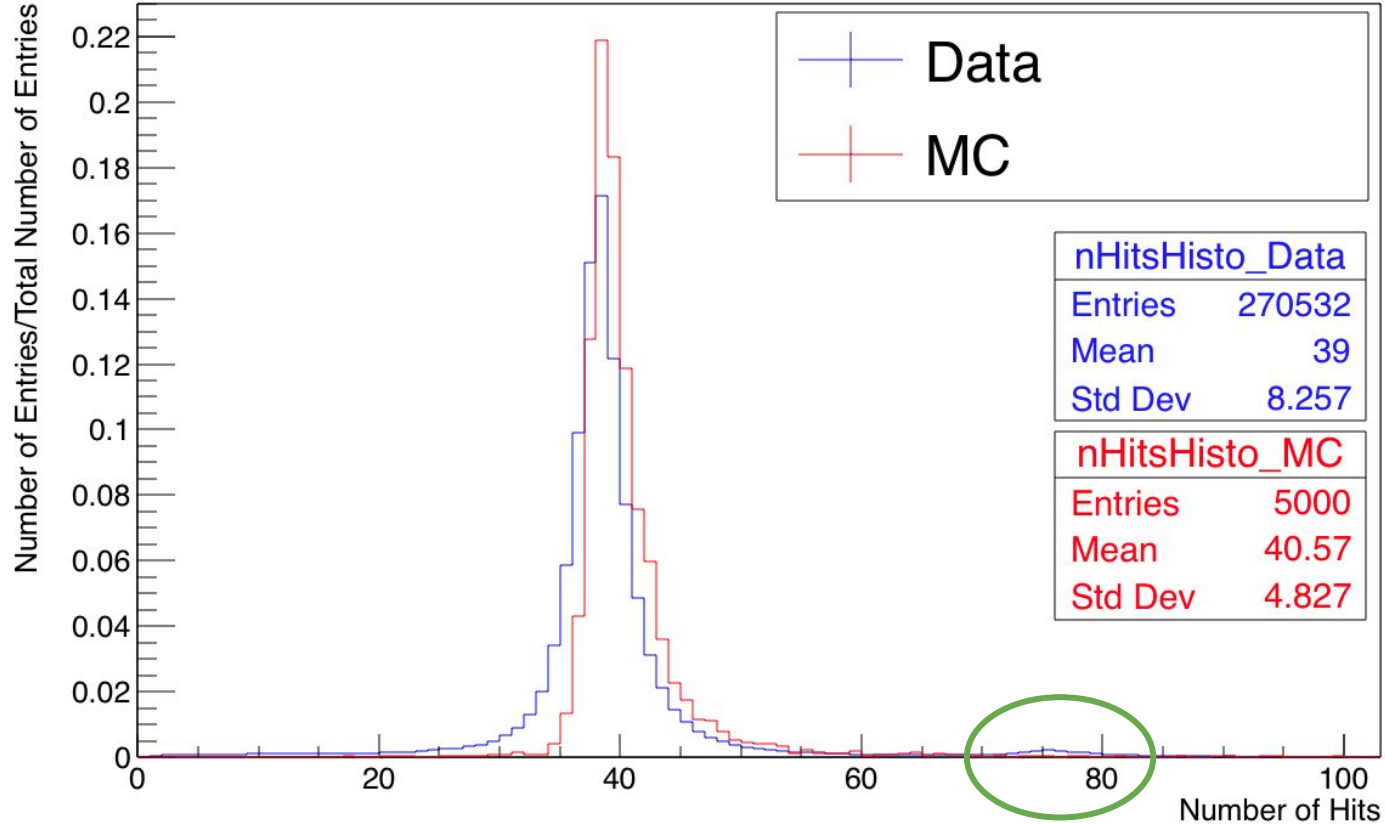
- No MIP peak in simulated pion data: ✓
- Also no MIP peak in simulated muon data: ✓
- Pedestal subtraction as simulation killer: ✓
- nHits and energySum shifted to higher values: ?
- Simulated layer profiles have additional layers: ✓
- MIP peak not exactly at 1 MIP: ✓
- Rise in layer profiles for simulated data: ?

Muon data event displays

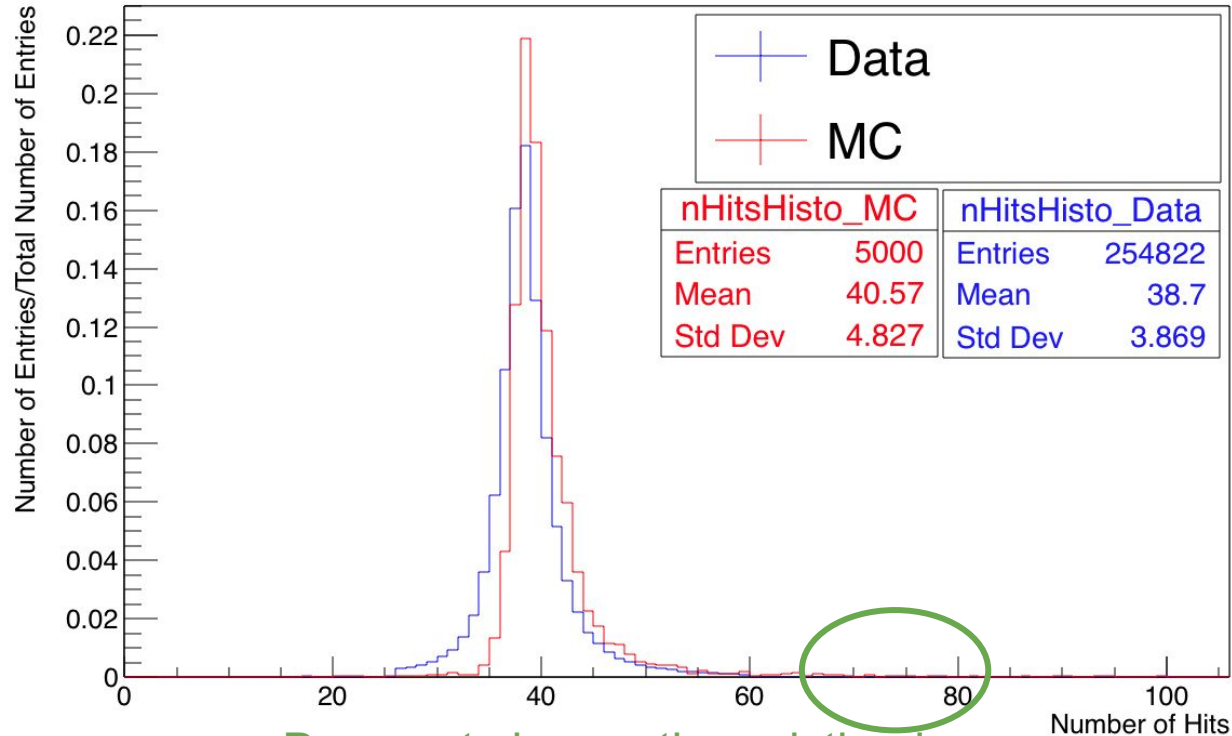


⇒ Ideas for data nHits cuts

double-muon events



$$n\text{Hits} < 60 \ \&\& \ n\text{Hits} > 25$$



⇒ Does not change the existing issues

⇒ Not at all optimized yet!

Simulation Story

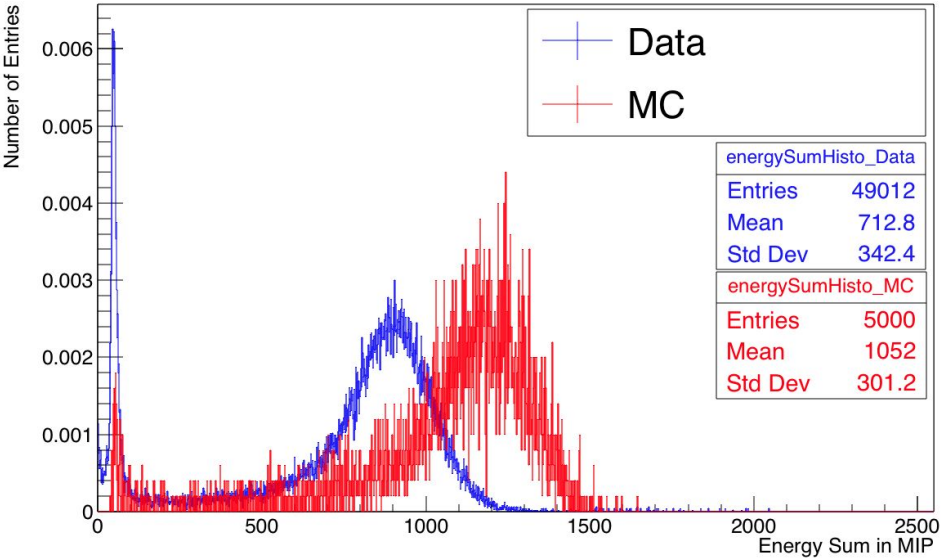
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⇒ **To be continued**

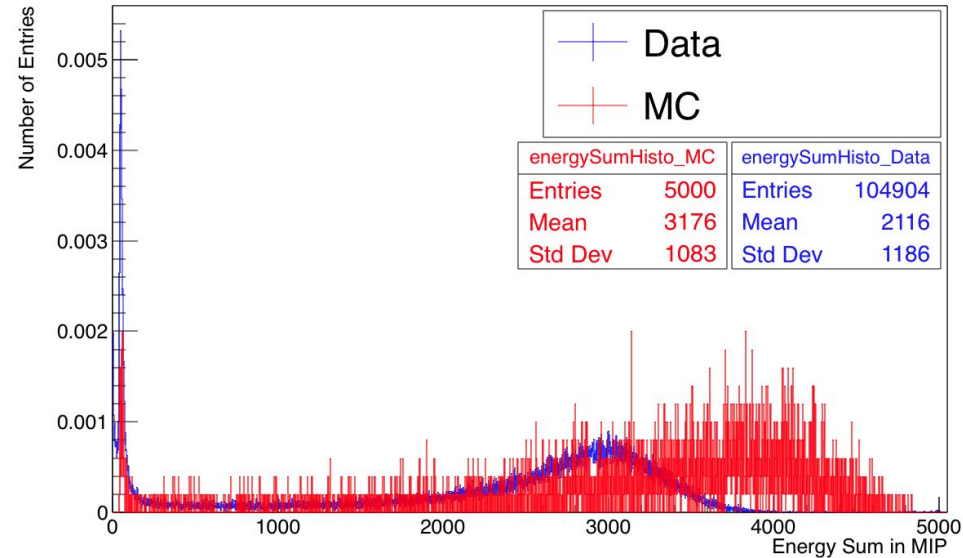
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 - Pion studies → 10, 30, 50, 80, 100, 120 GeV

energySum

30 GeV

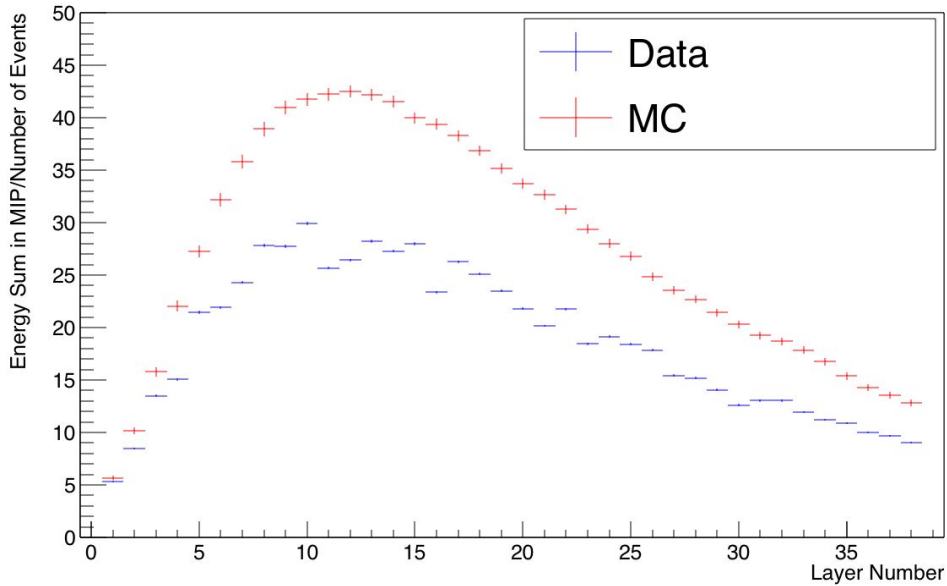


100 GeV

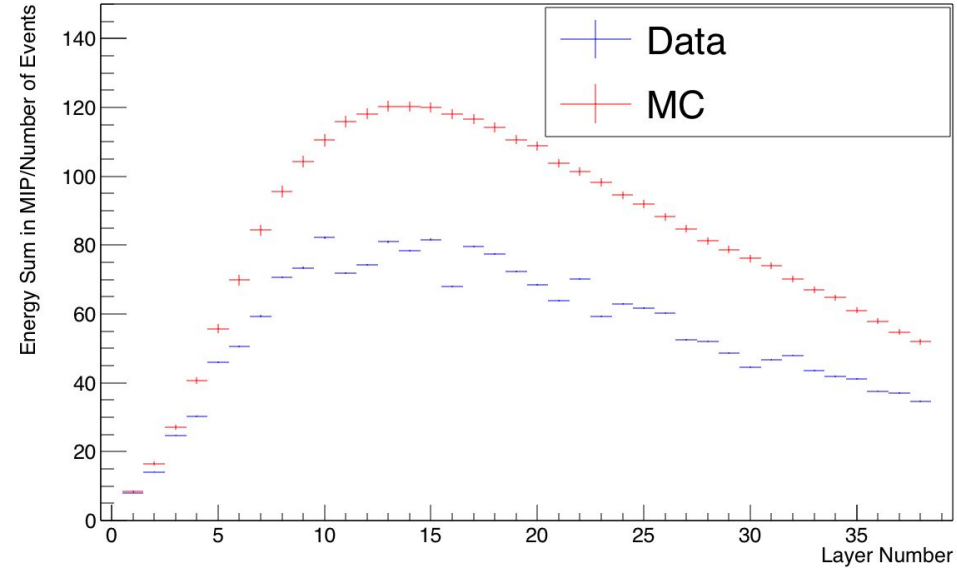


shower profile

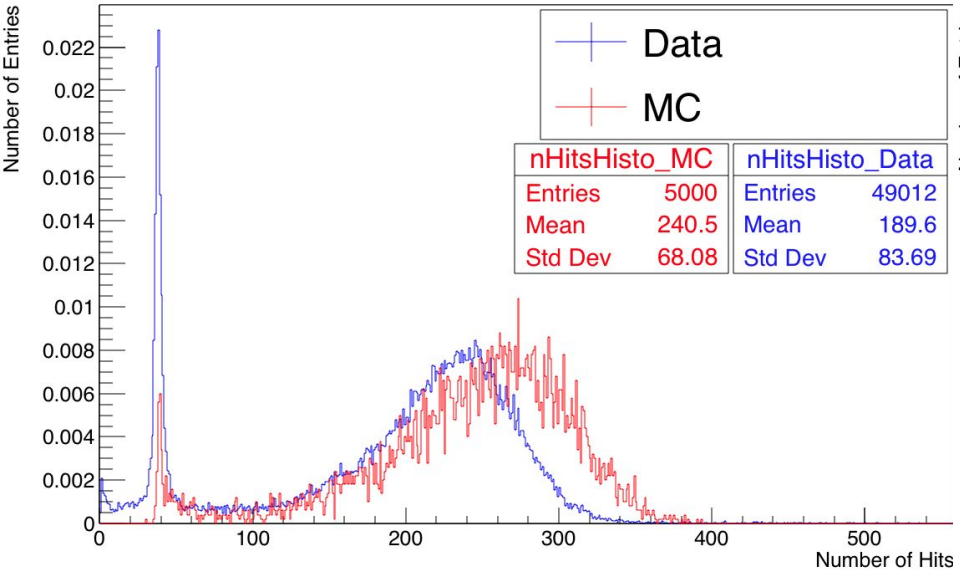
30 GeV



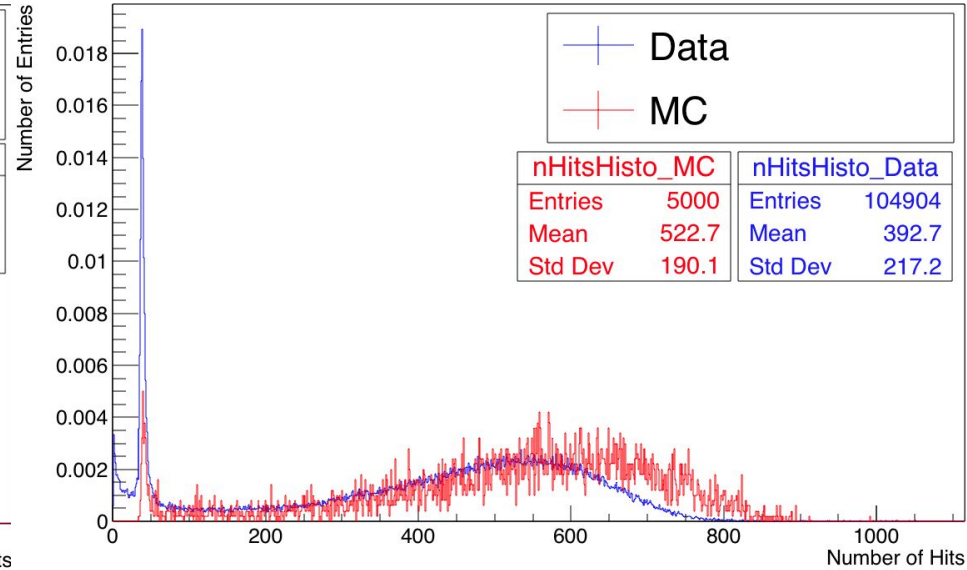
100 GeV



30 GeV

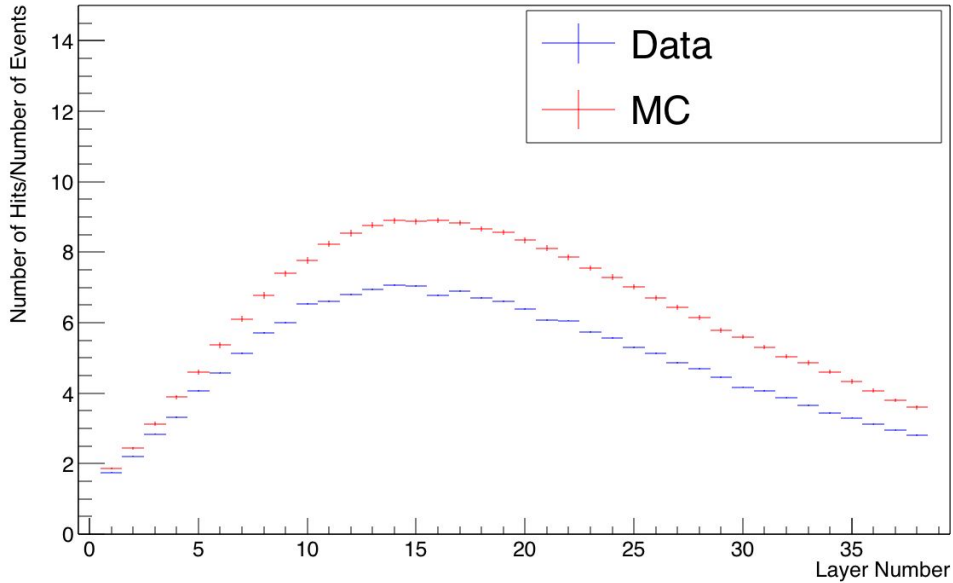


100 GeV

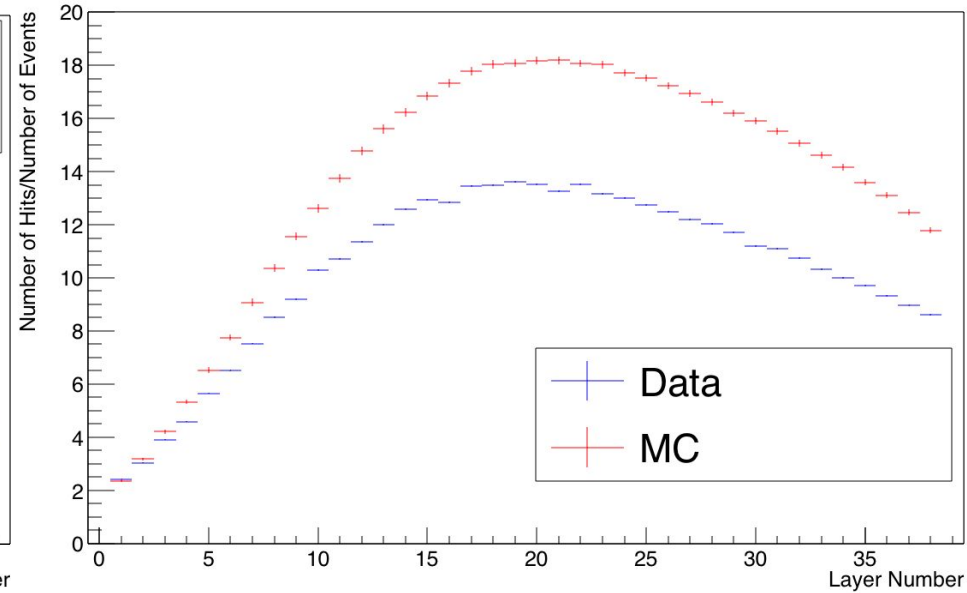


nHits profile

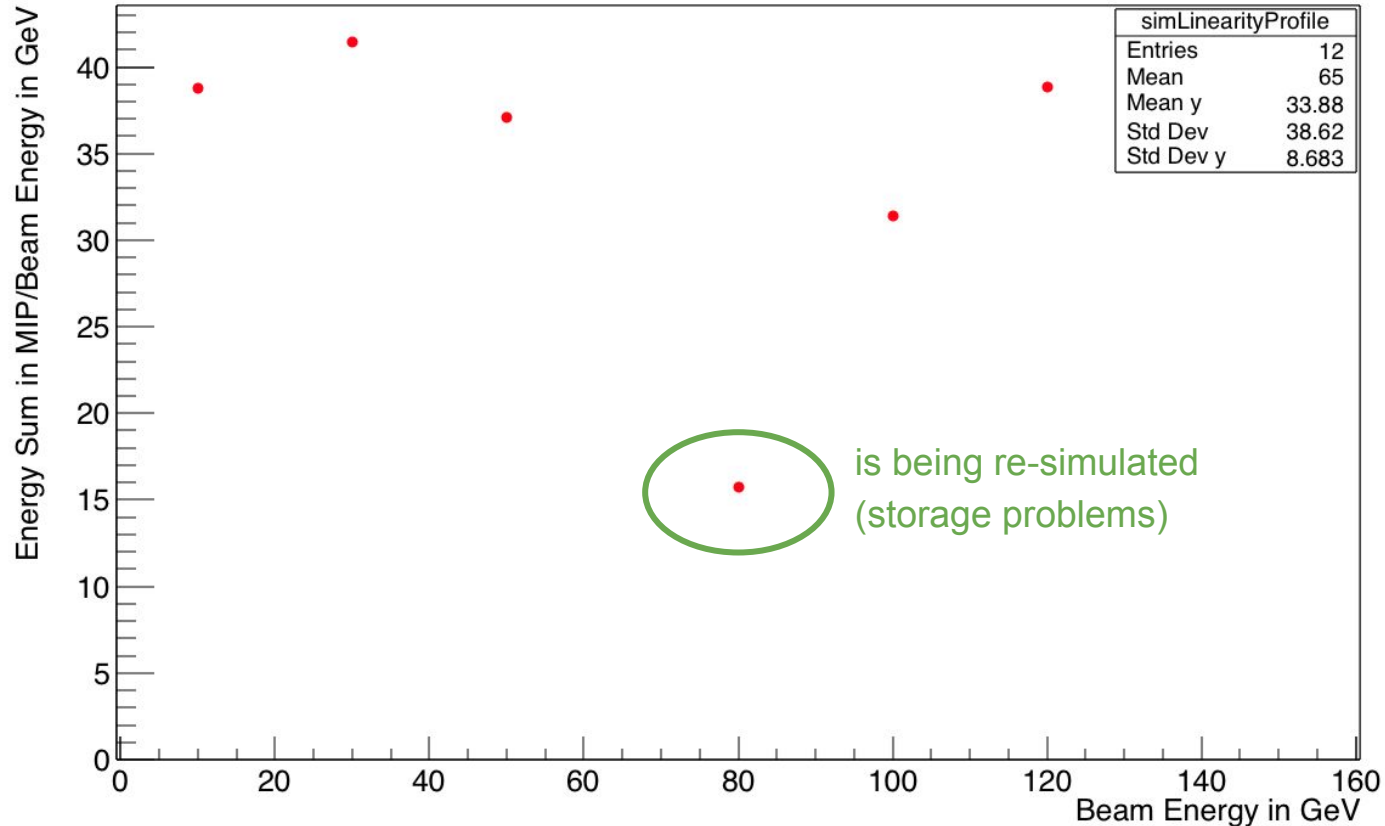
30 GeV



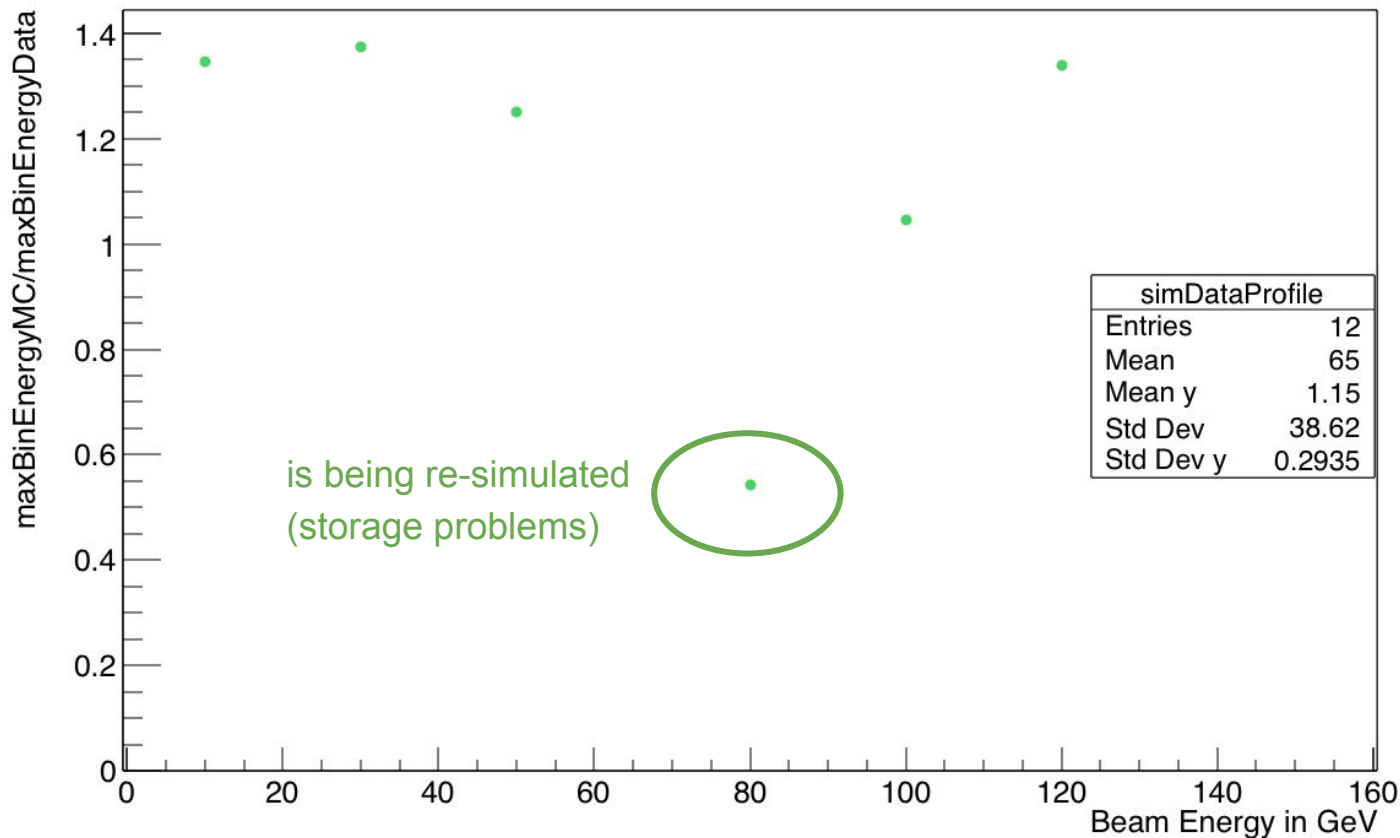
100 GeV



First look at simulated pions



First look at simulated pions

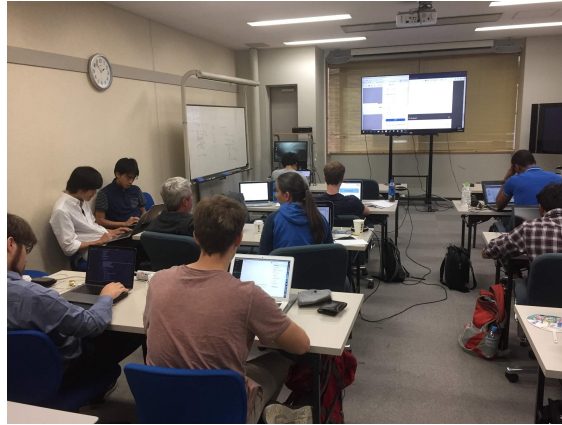


- Done:
 - RootTreeWriter is in a reasonable state for being left as it is temporarily
 - RootTreeWriter documentation is complete
 - Many simulation bugs are fixed and May simulation is working reasonably well for current status
 - Simulation MIP peak is very close to 1
- Ongoing:
 - Pion simulation studies
 - Different detector positions for simulated muons
 - Clean-up of data for comparison to simulation
- Future steps:
 - Investigate the shift to larger values and rise with increasing layer number in simulation
 - Higher statistics for everything
 - June data simulation studies
 - Repeat studies for new calibration constants

Thank you to all!

- Thank you for the very instructive, productive and also fun workshop!
- Thanks to everyone for the help, especially Christian!
- Thank you for including us master students as a real part of the team!

Thank you to all!



August 2018

Thank you for your attention!

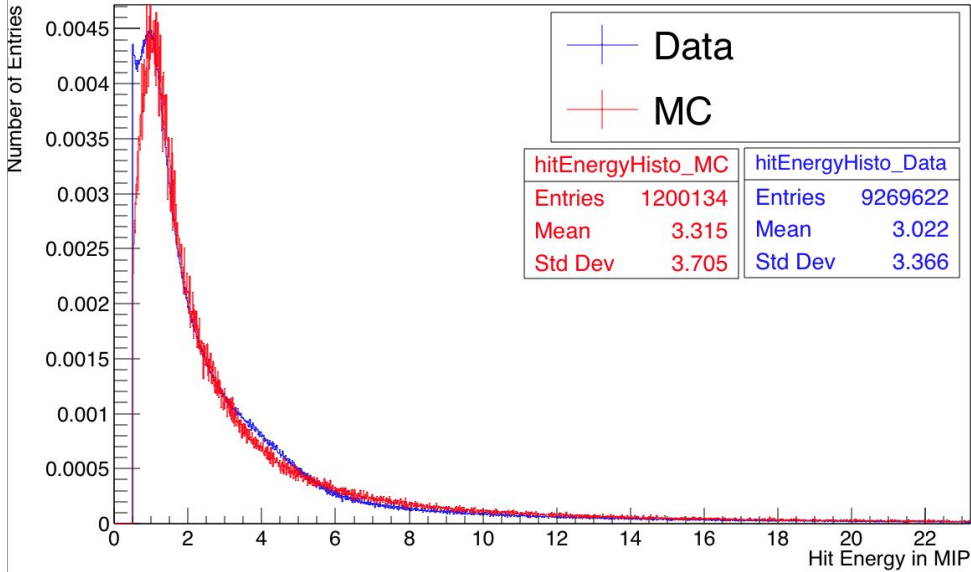


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Backup

30 GeV



100 GeV

