Muons and Detector Systematics

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UW
IceCube Collaboration Meeting
Spring 2009

No End To Trouble

Depth

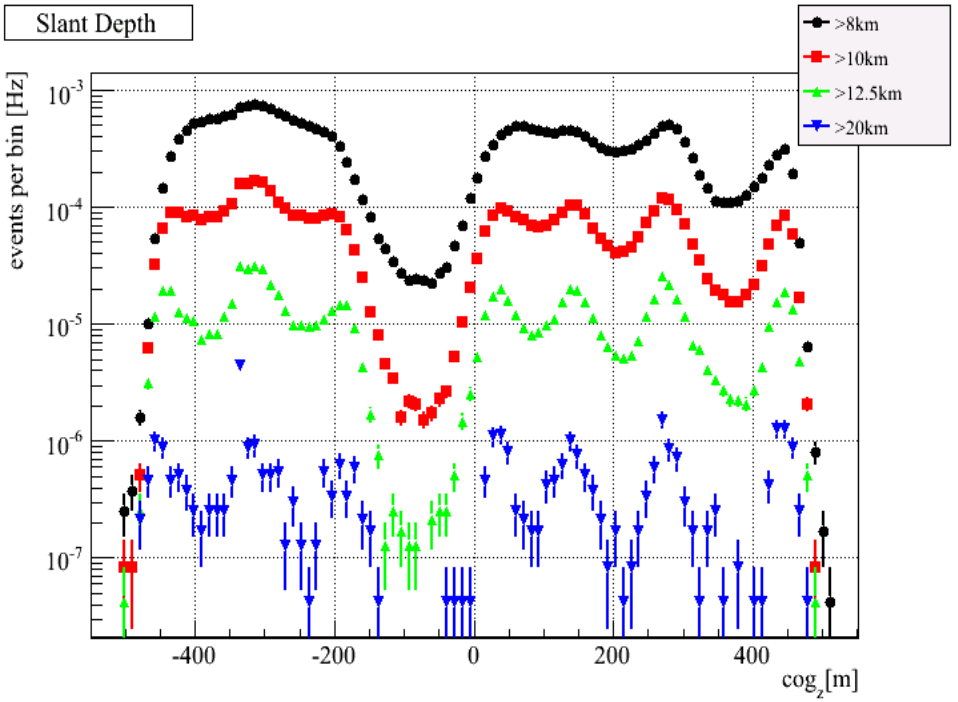
Hit Maker

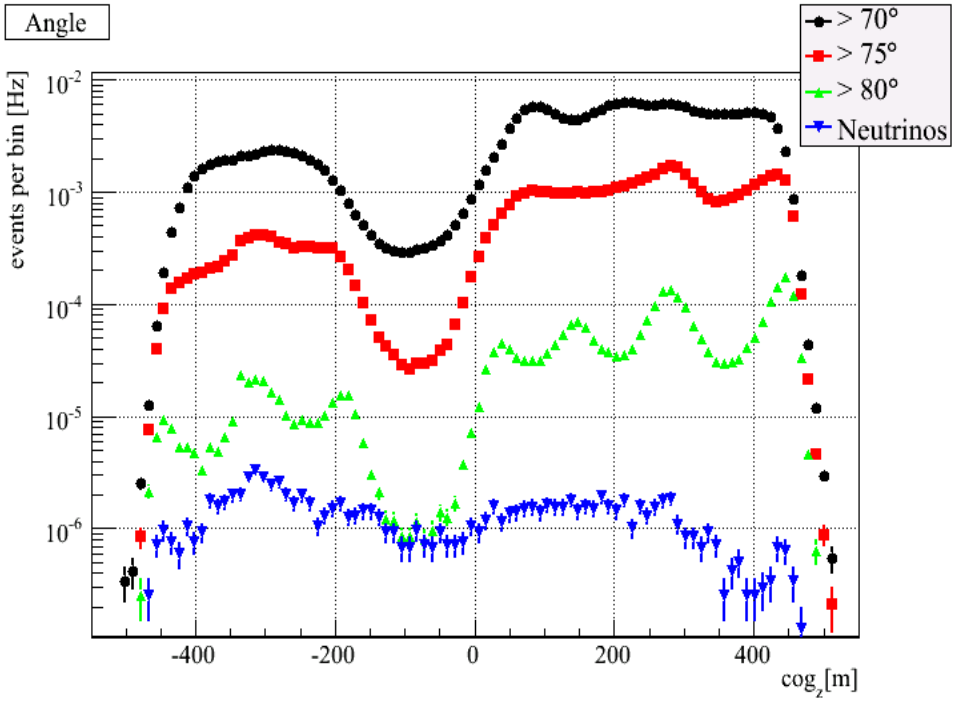
Early Pulses

Droop Correction

And Probably a Whole Lot More

Horizontal Muons





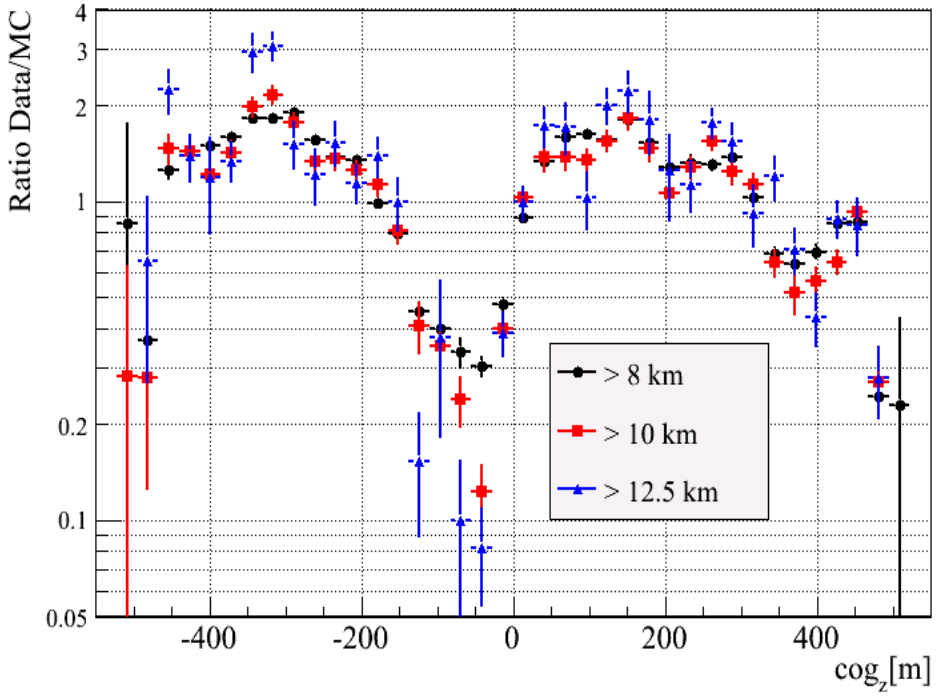
Slant Depth

Distance from surface to detector:

$cog_z/\cos\theta$

Zenith Angle

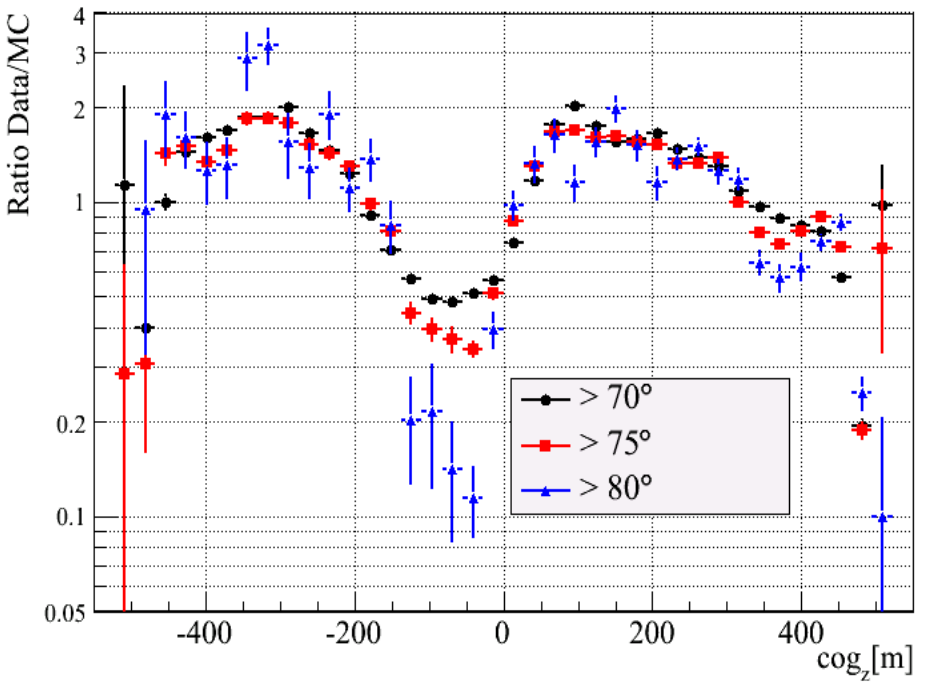
Horizontal Muons



Slant Depth

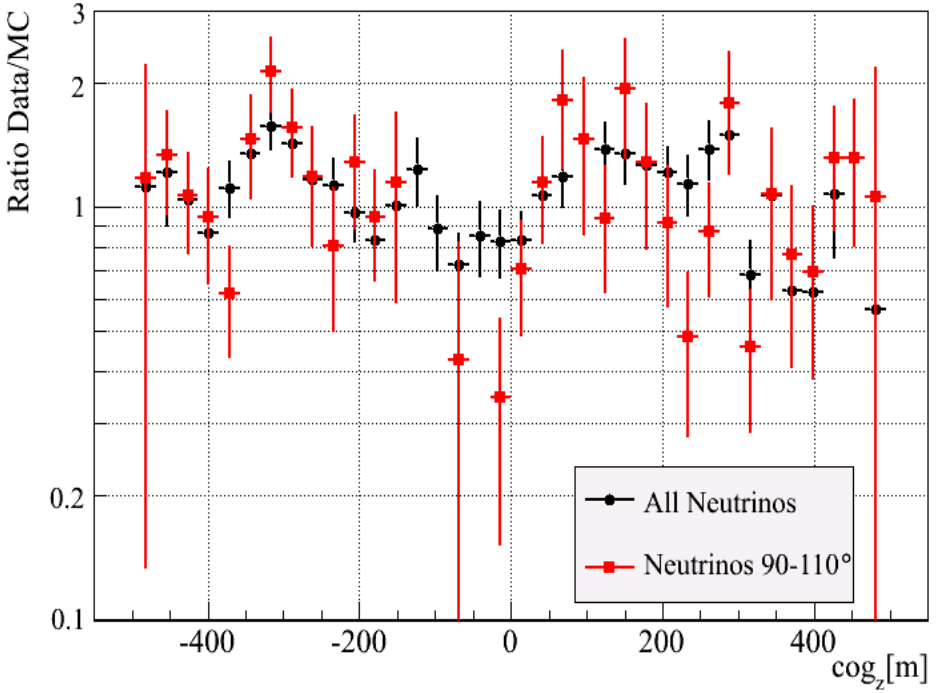
Distance from surface to detector:

$cog_z/\cos\theta$

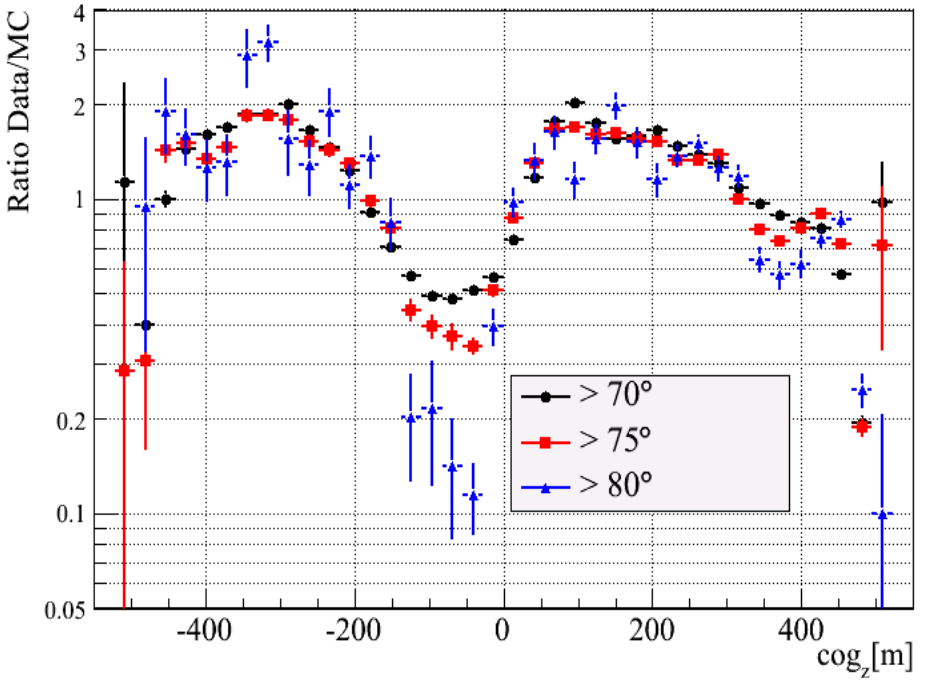


Zenith Angle

Above and Below the Horizon

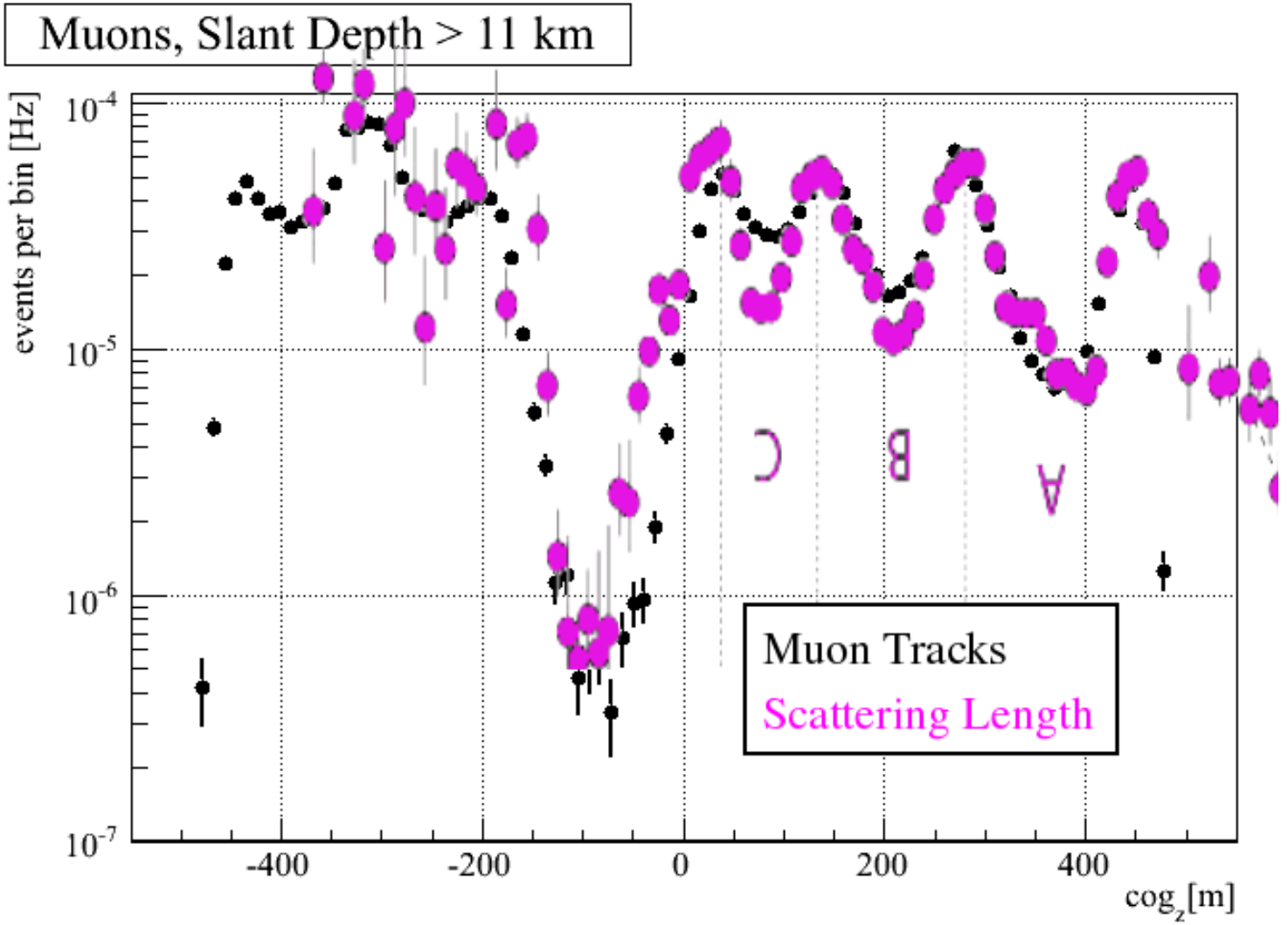


Neutrinos

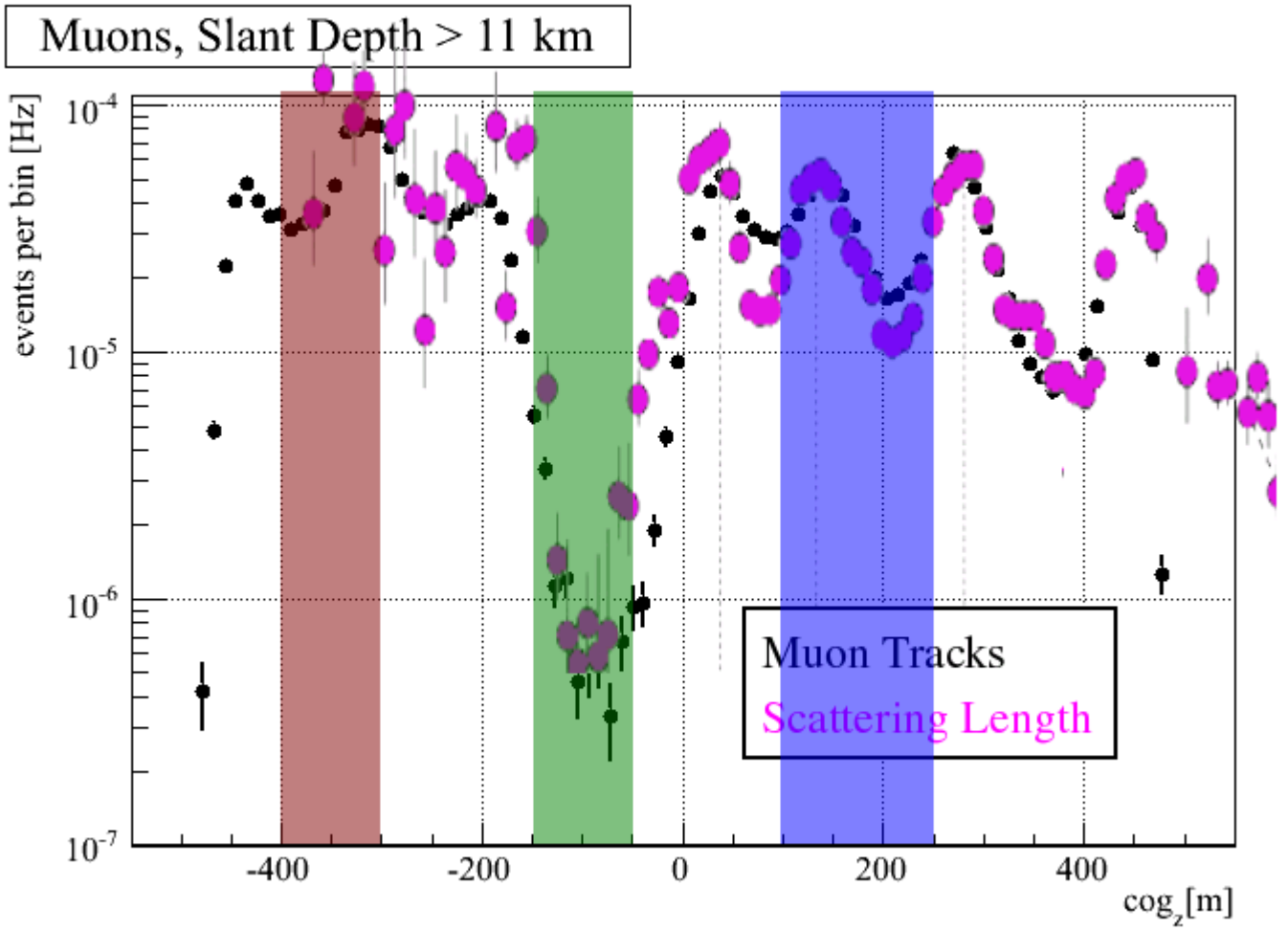


Muons

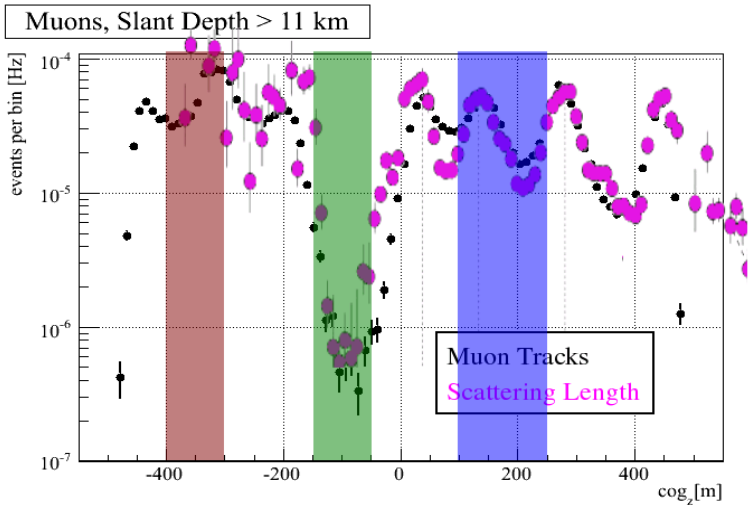
Dust Layers

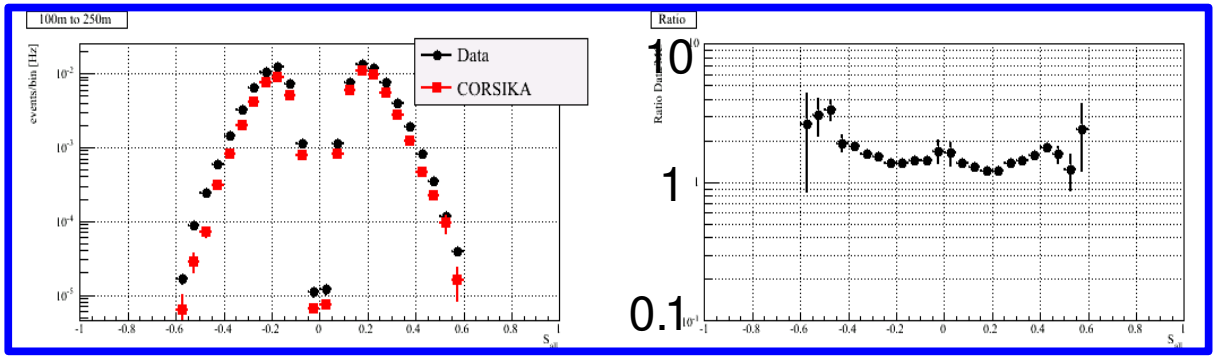

Muons, Slant Depth > 11 km
events per bin [Hz]
10^{-4}
10^{-5}
10^{-6}
10^{-7}
-400
-200
0
200
400
cog_z [m]
C
B
A
Muon Tracks
Scattering Length

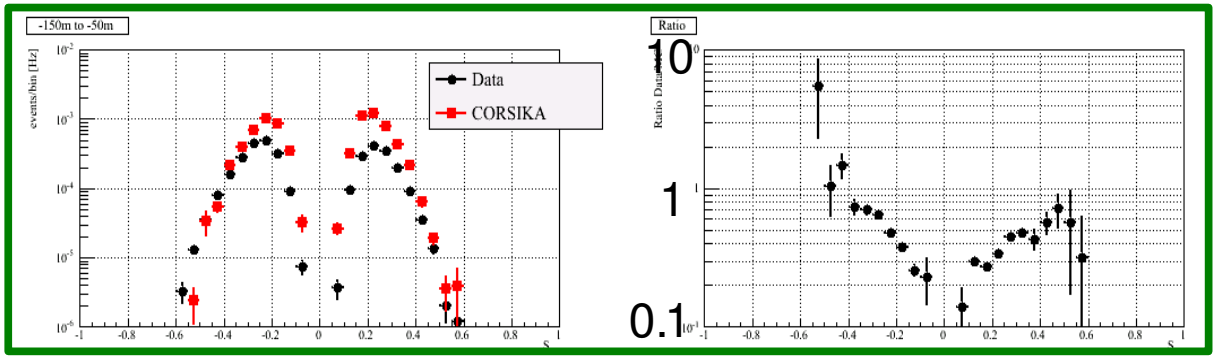
3 Layers

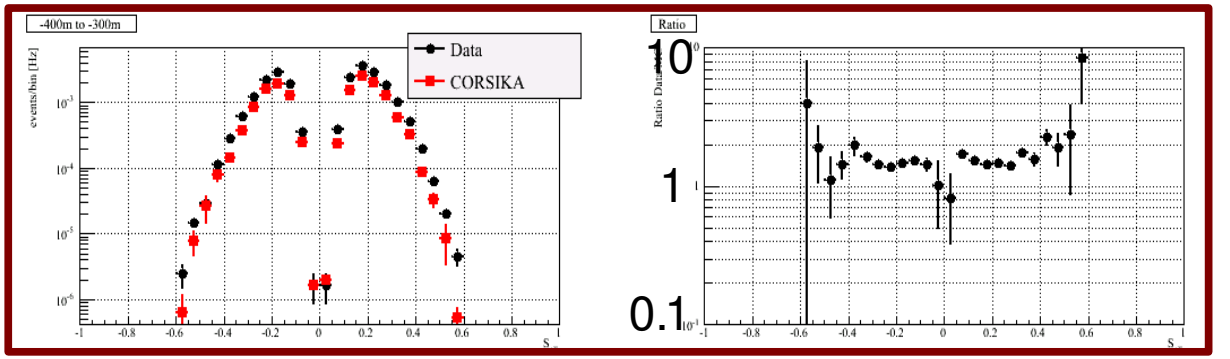

Muons, Slant Depth > 11 km
events per bin [Hz]
10^{-4}
10^{-5}
10^{-6}
10^{-7}
-400
-200
0
200
400
cog_z [m]
Muon Tracks
Scattering Length

Smoothness

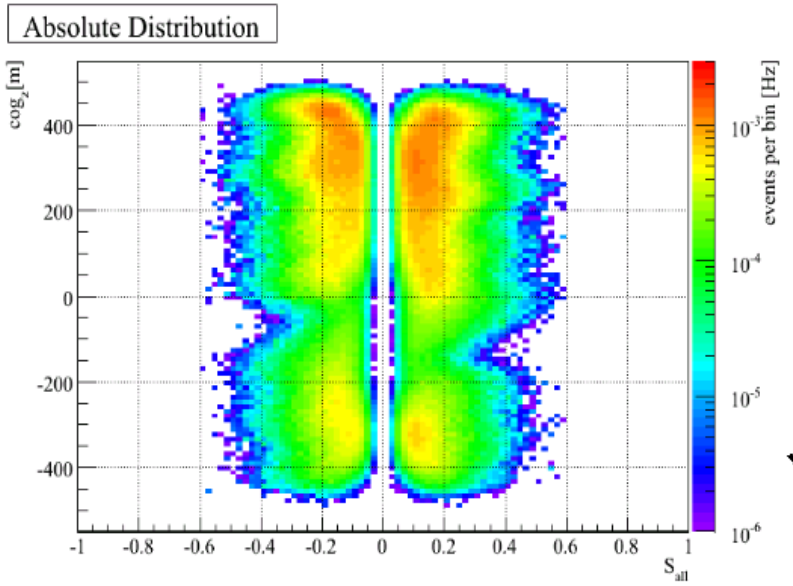

Muons, Slant Depth > 11 km
events per bin [Hz]
cog_z [m]
Muon Tracks
Scattering Length

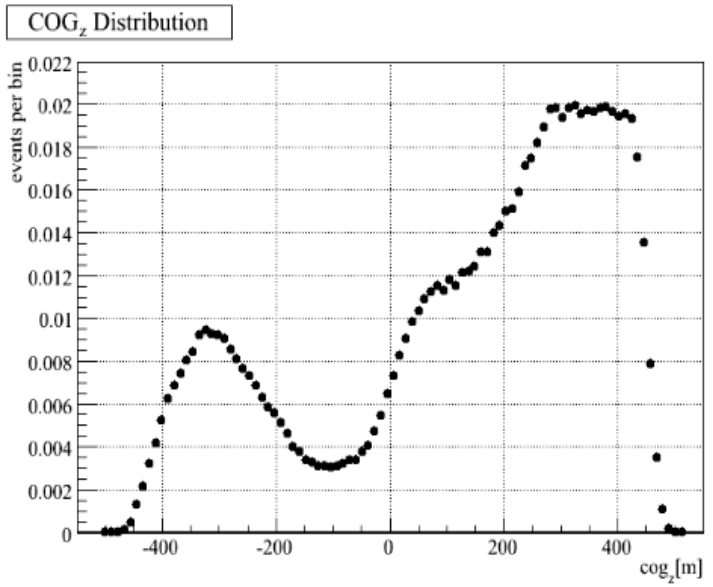

100m to 250m
Data
CORSIKA
Ratio

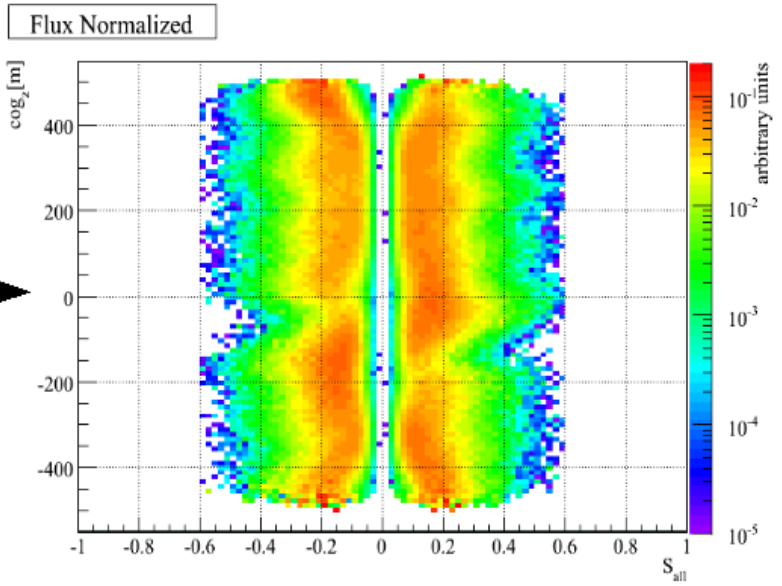

-150m to -50m
Data
CORSIKA
Ratio


-400m to -300m
Data
CORSIKA
Ratio

Flux-Normalized Distribution

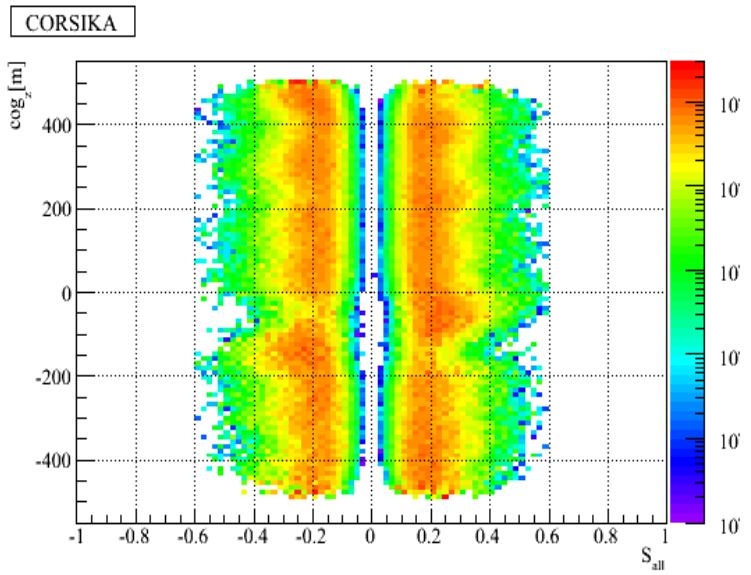


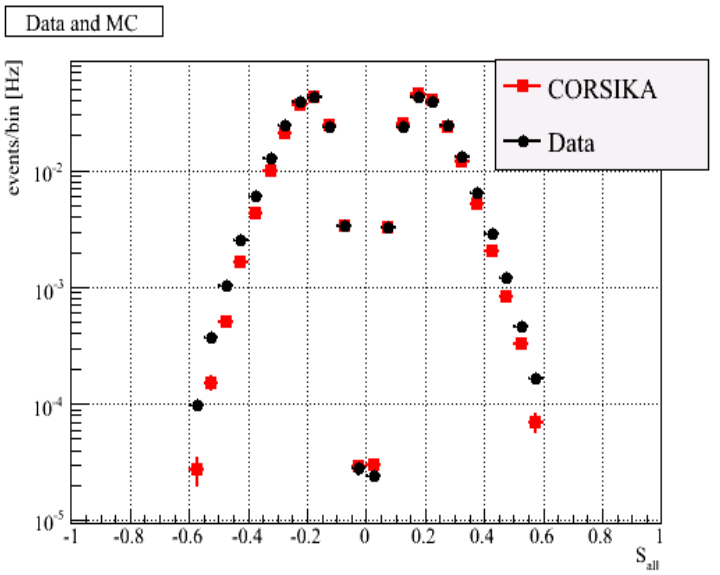




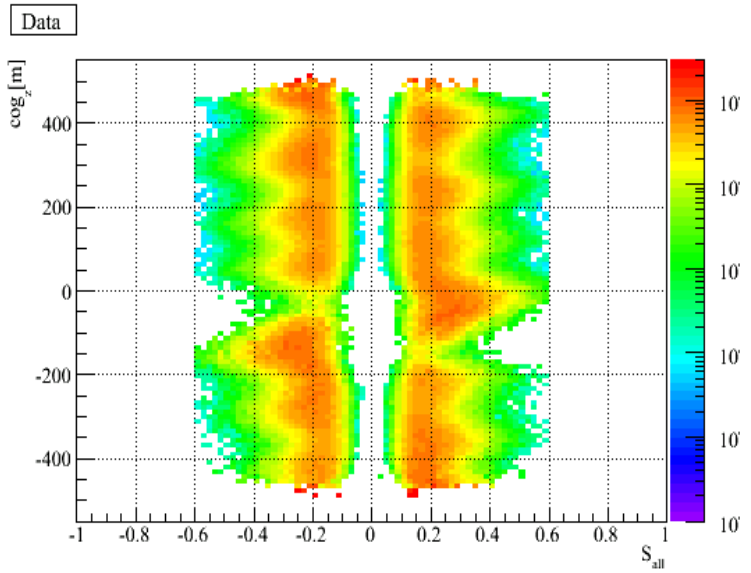
Smoothness

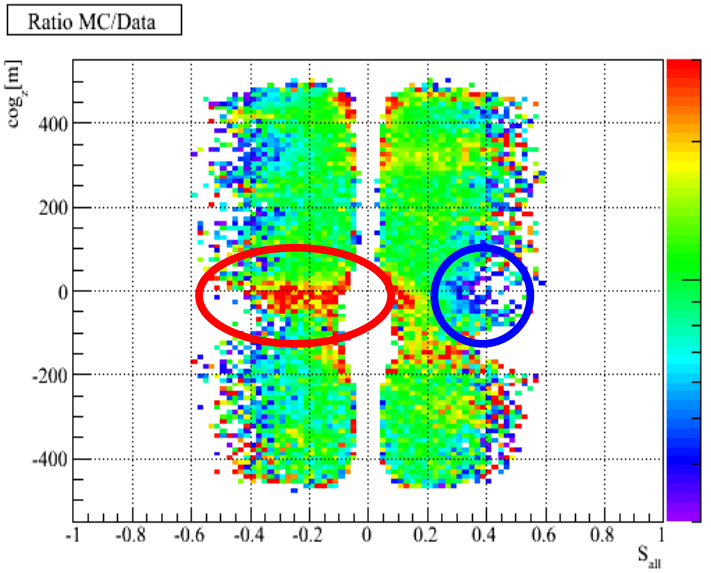
MC





Data

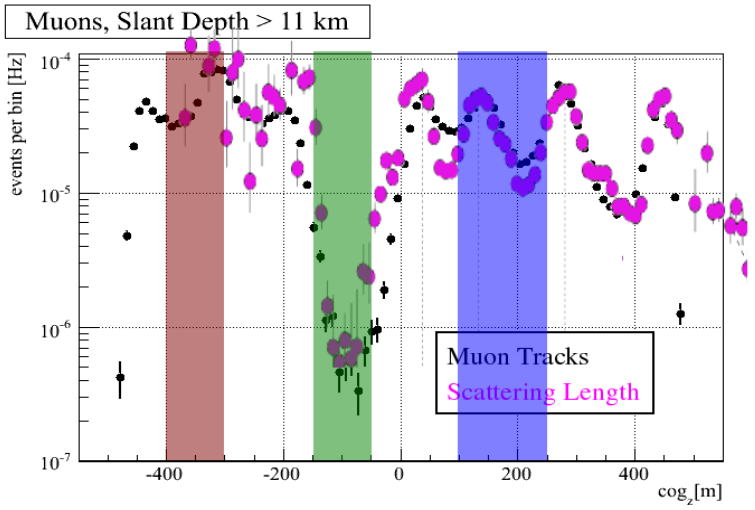


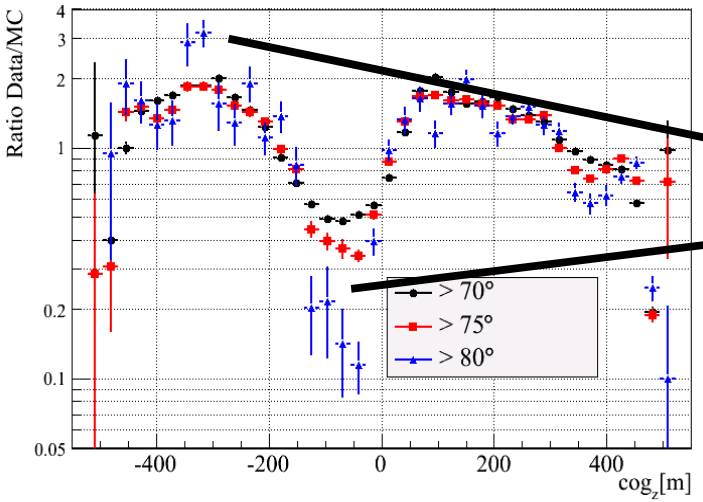


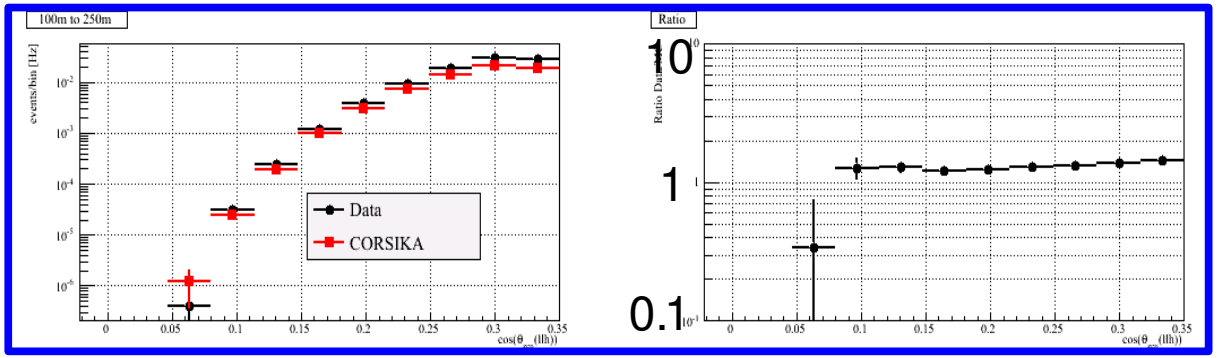
MC/Data

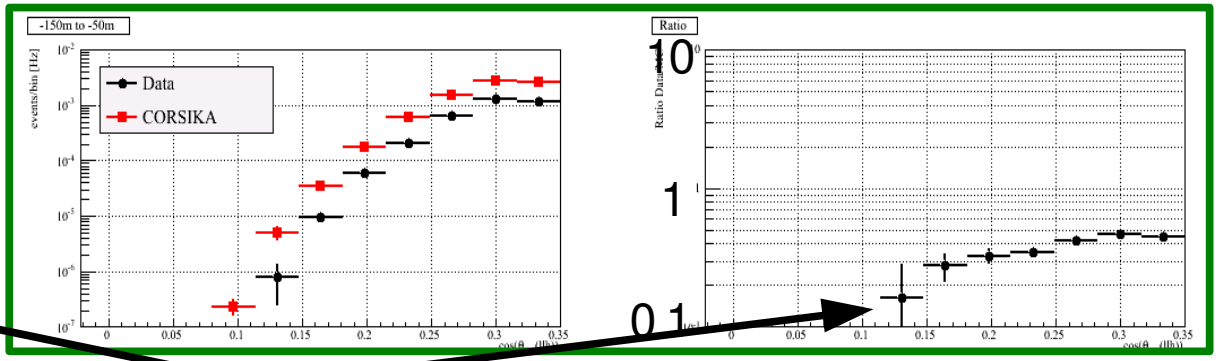
Data Excess Data Deficit

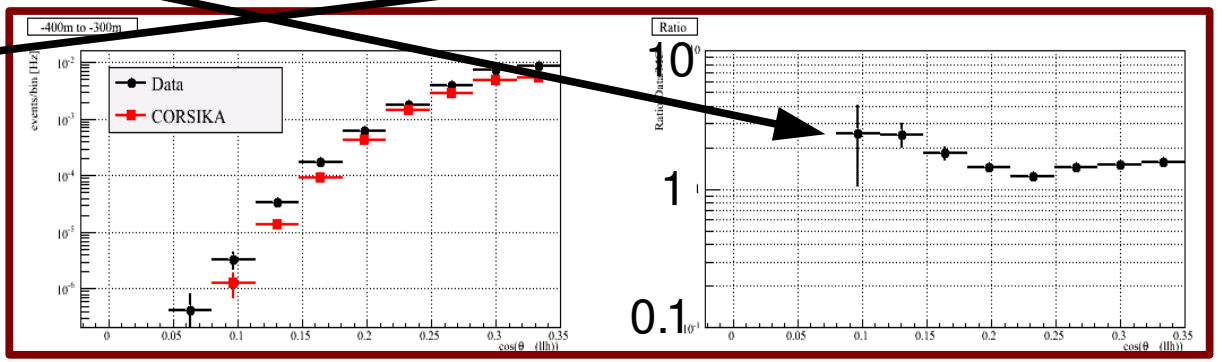
Zenith Angle





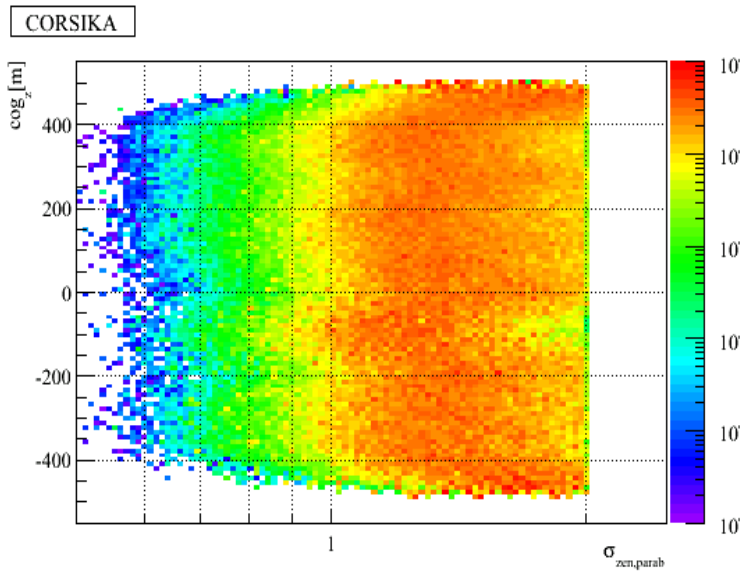


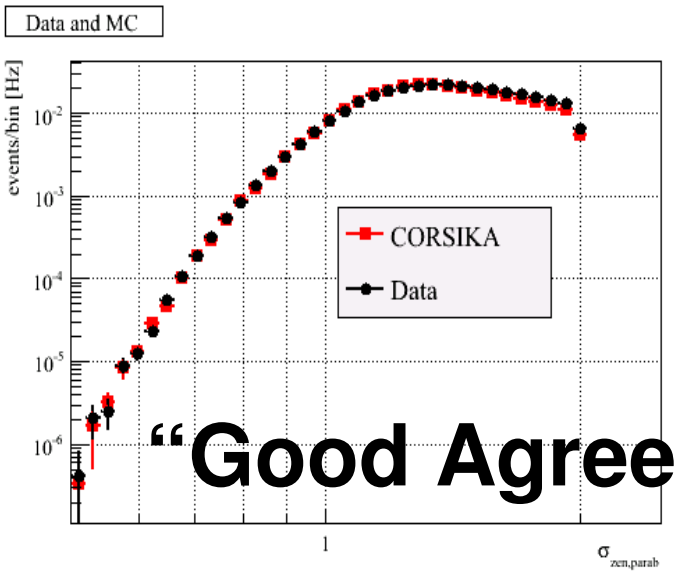




Paraboloid Sigma

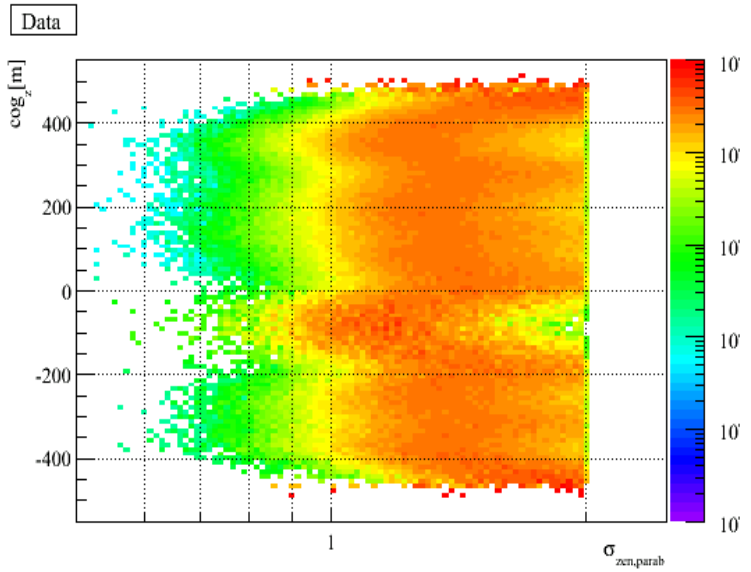
MC

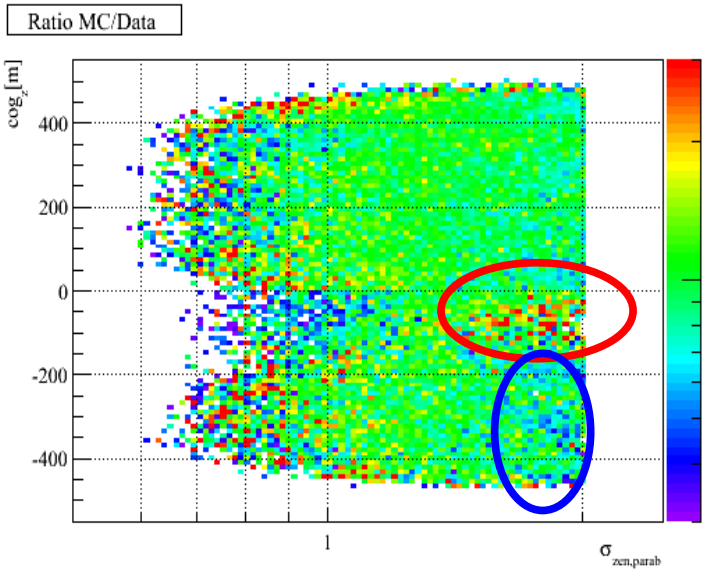




“Good Agreement!”

Data



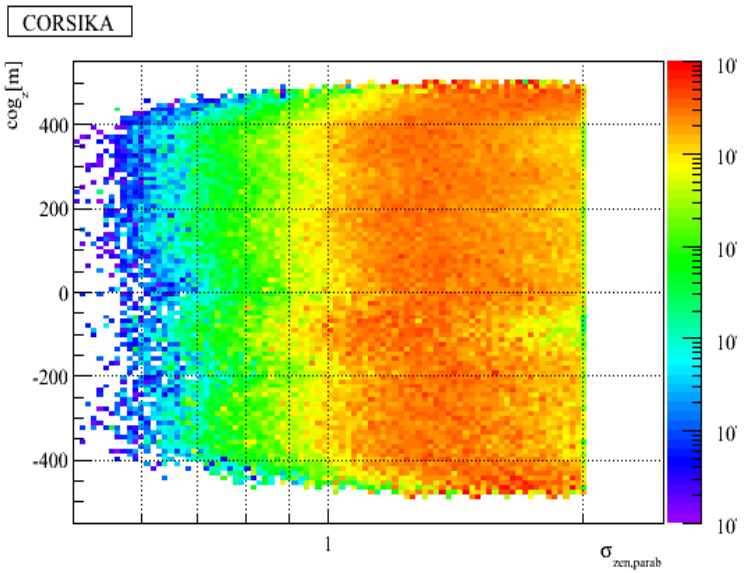


MC/Data

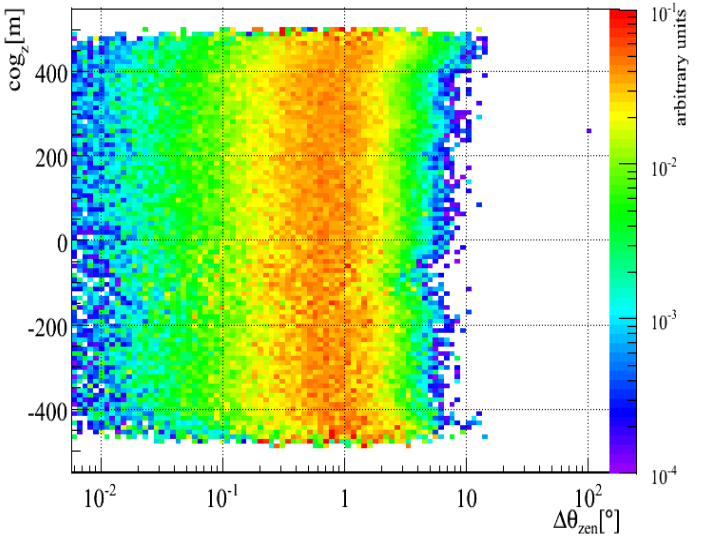
Data Excess Data Deficit

Paraboloid Sigma

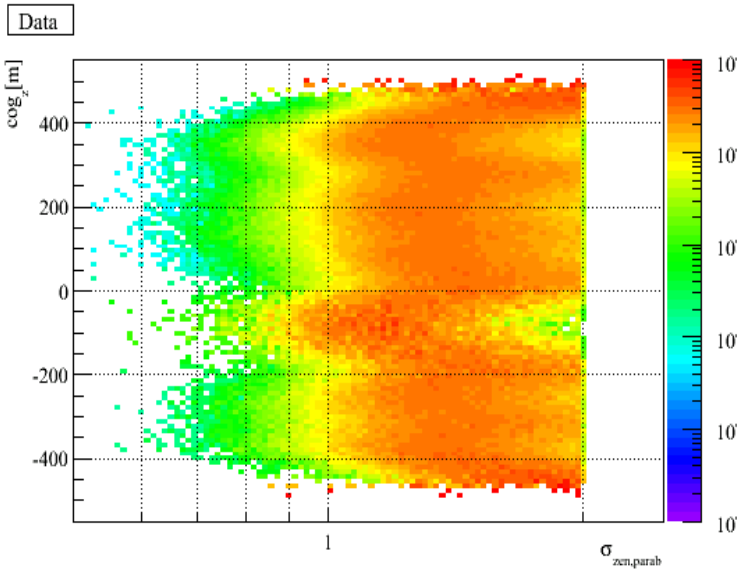
MC

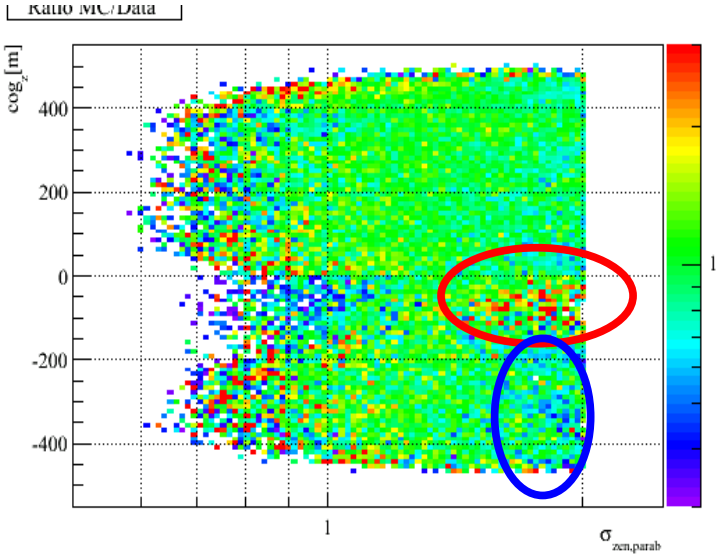


abs(True Zenith-LLH Zenith)



Data

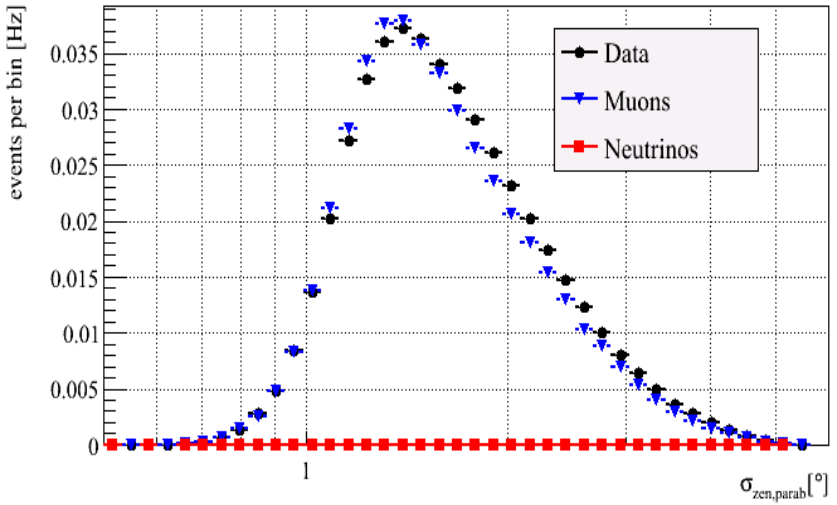


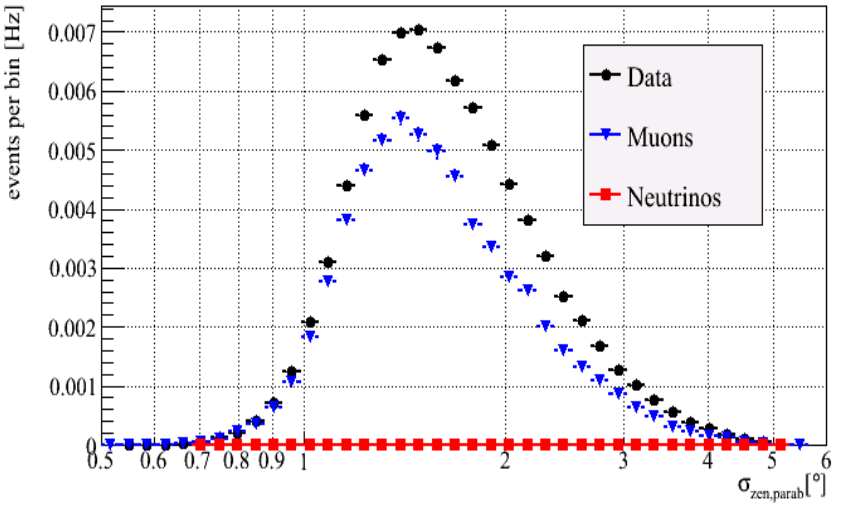


MC/Data

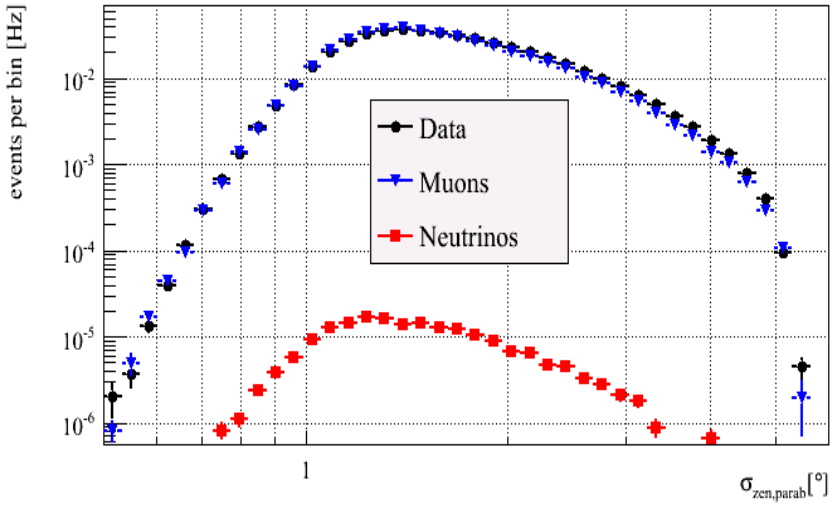
Data Excess Data Deficit

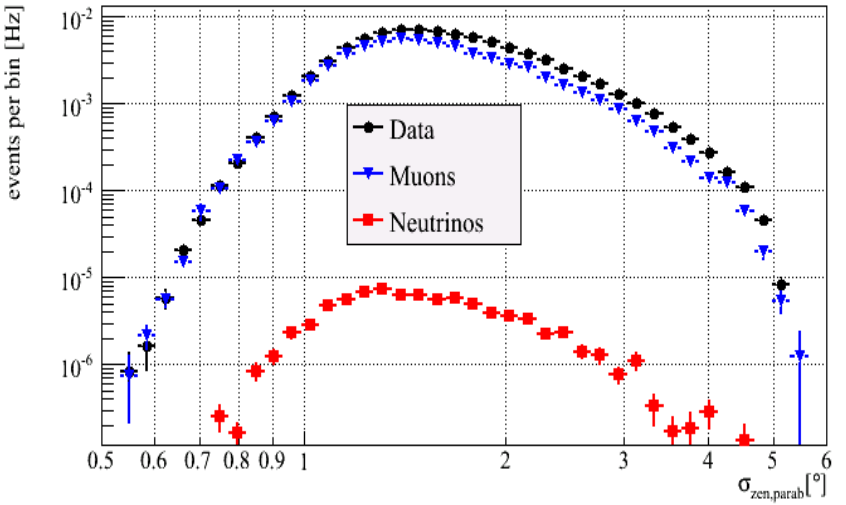
IC22 Horizontal Muons, After Quality Cut





lin





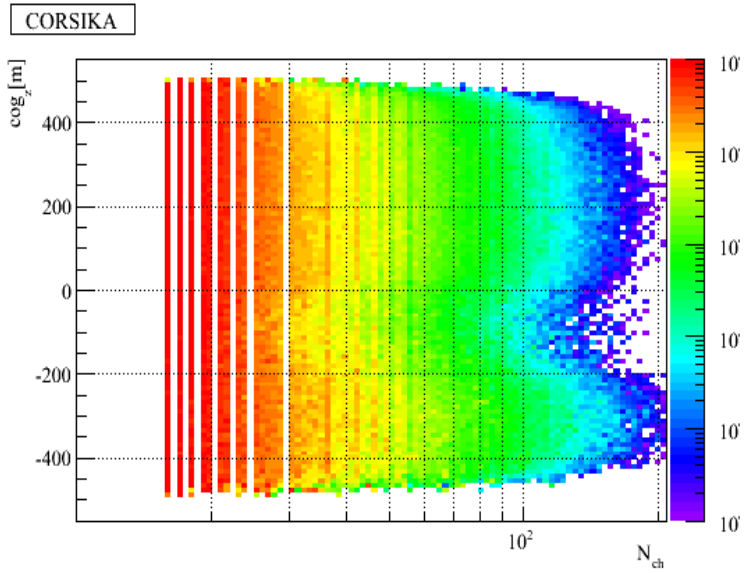
log

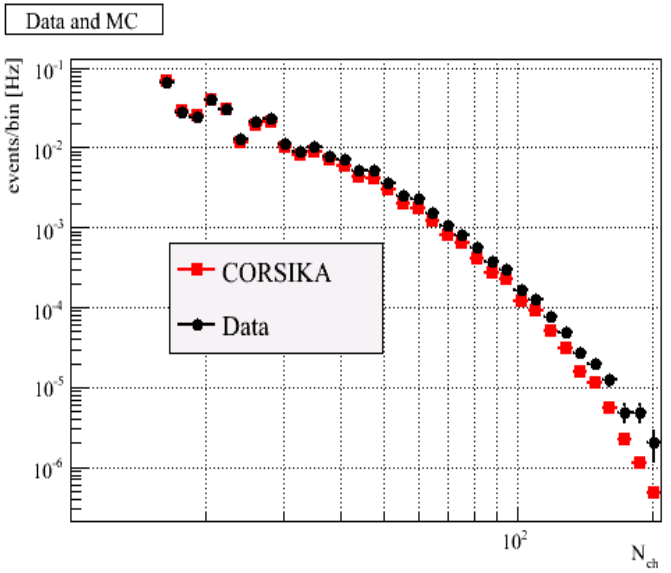
All

Below Dust Layer

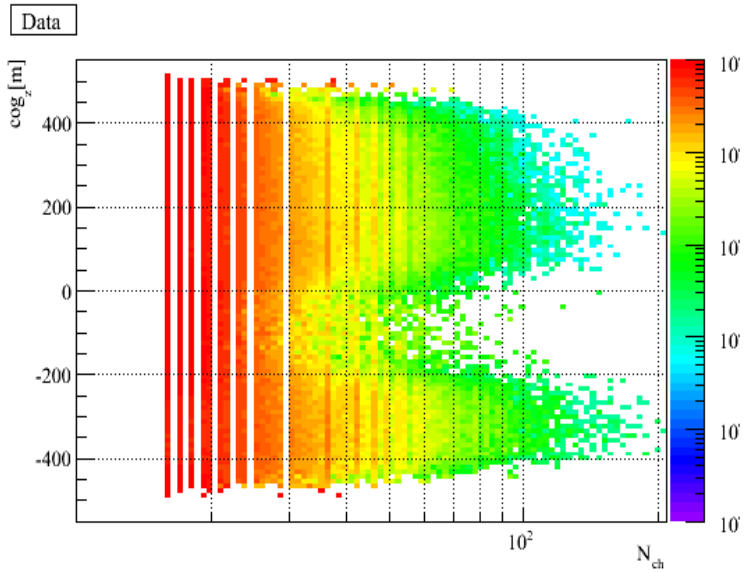
$N_{Channel}$

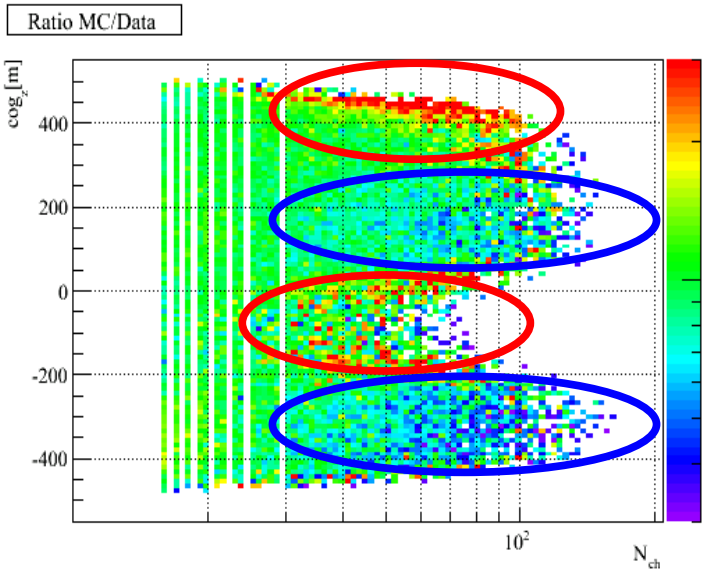
MC





Data



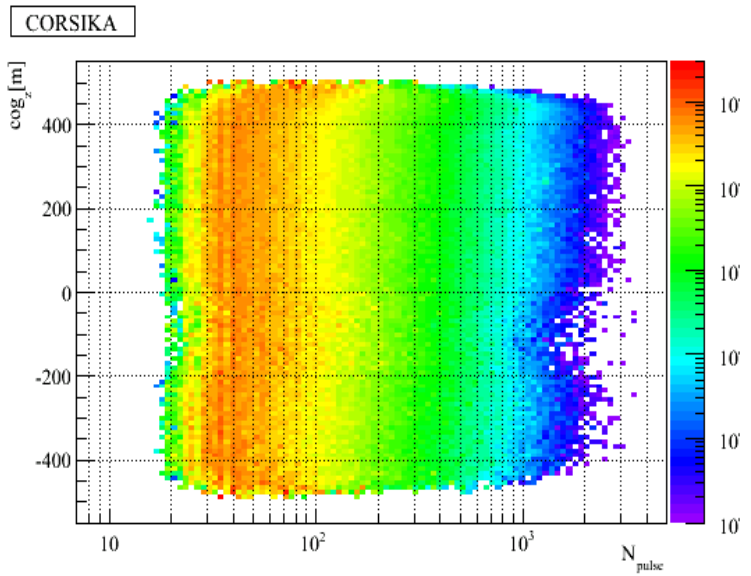


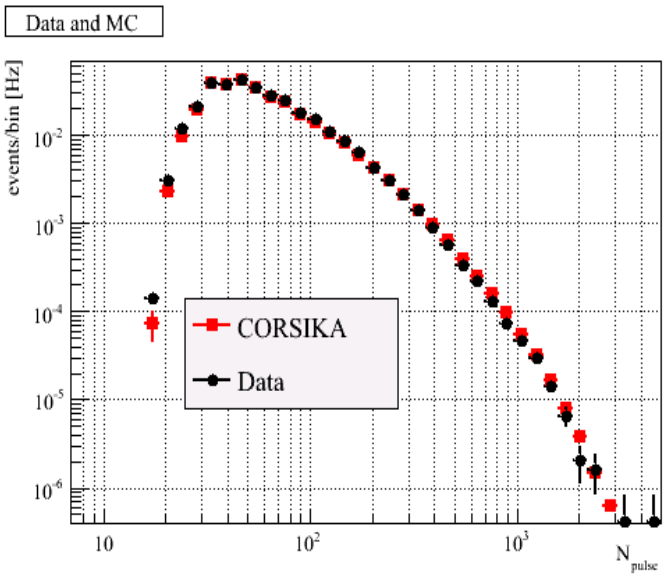
MC/Data

Data Excess Data Deficit

N_{Pulse}

MC





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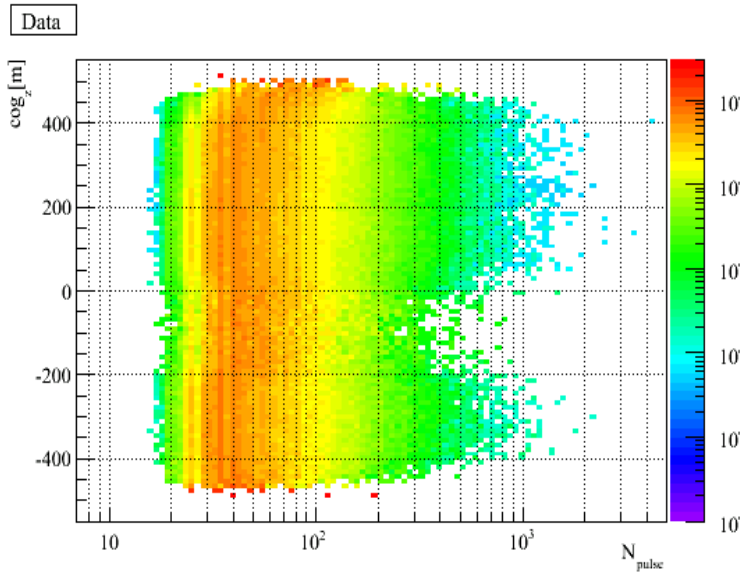
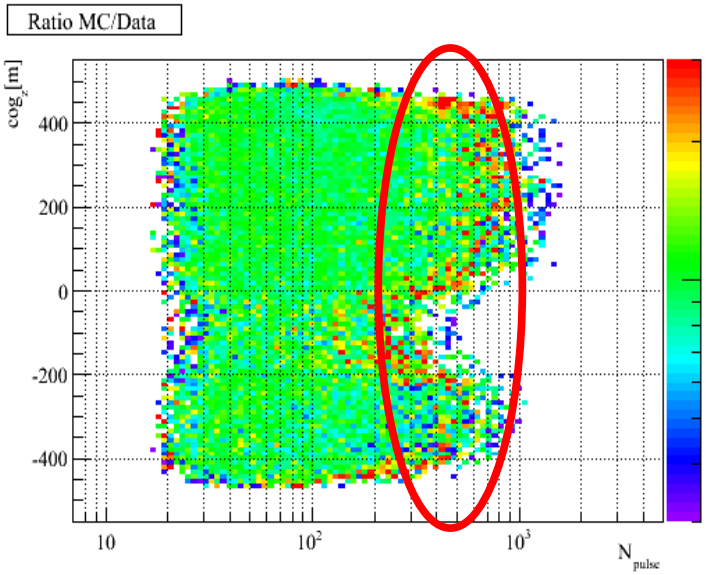


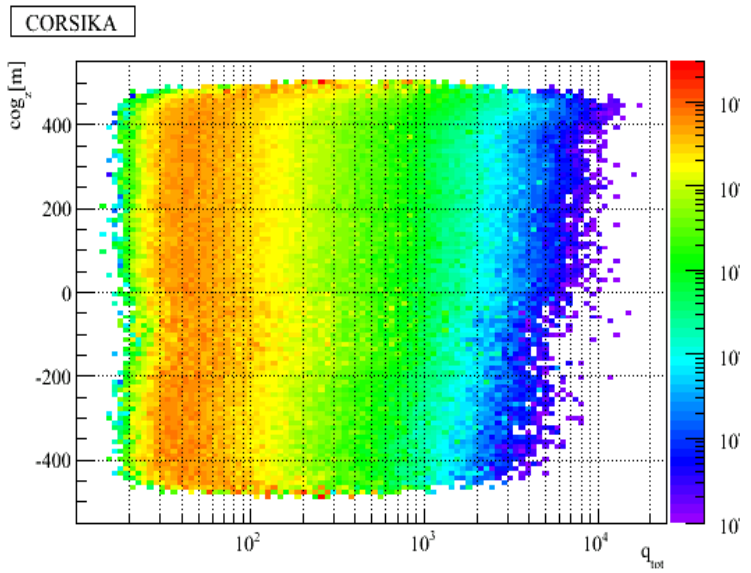


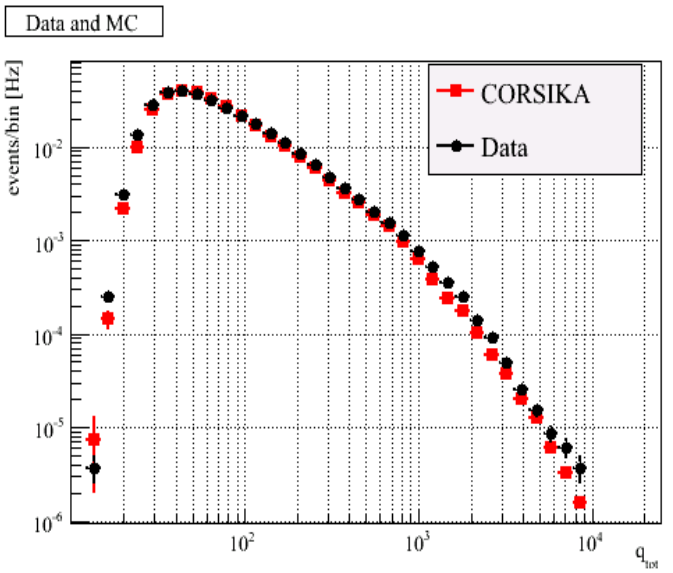
MC/Data

(Slight) Data Excess

Q_{tot}

MC





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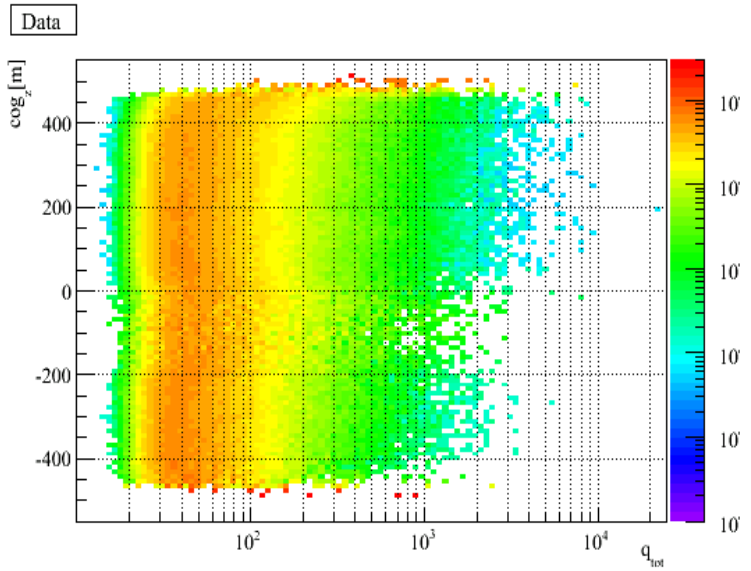
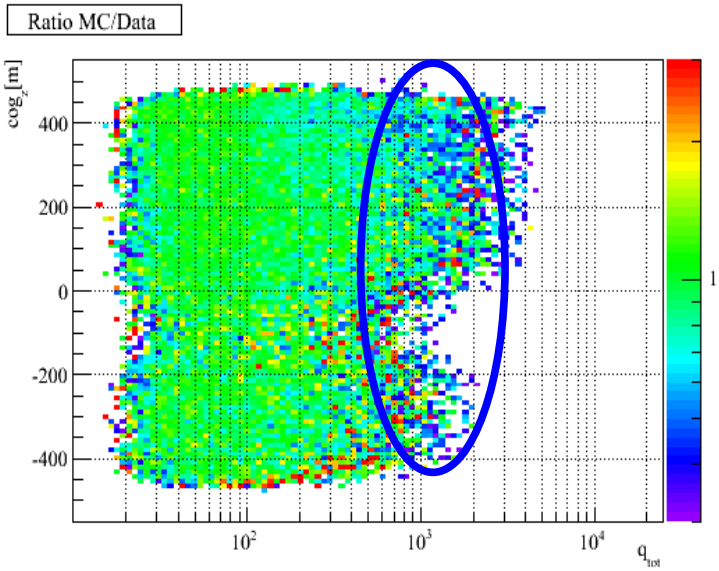
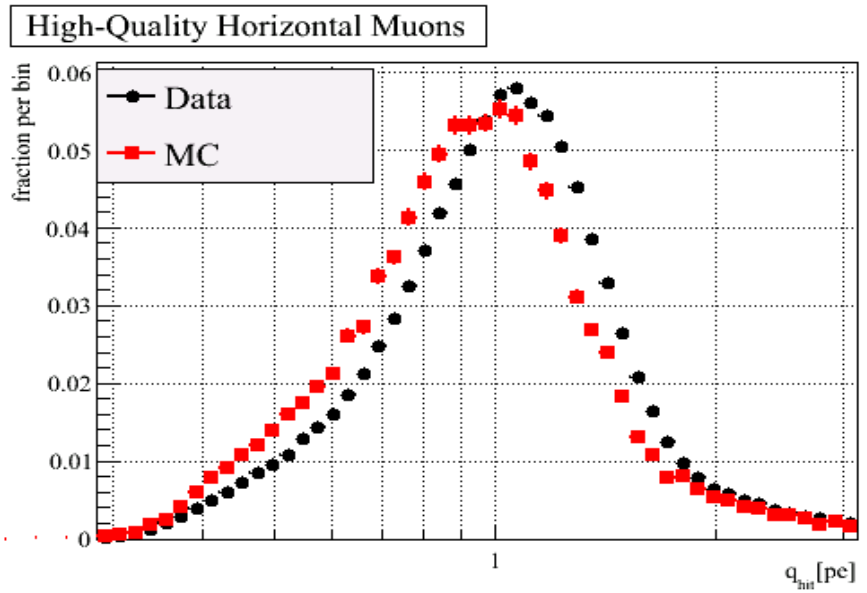


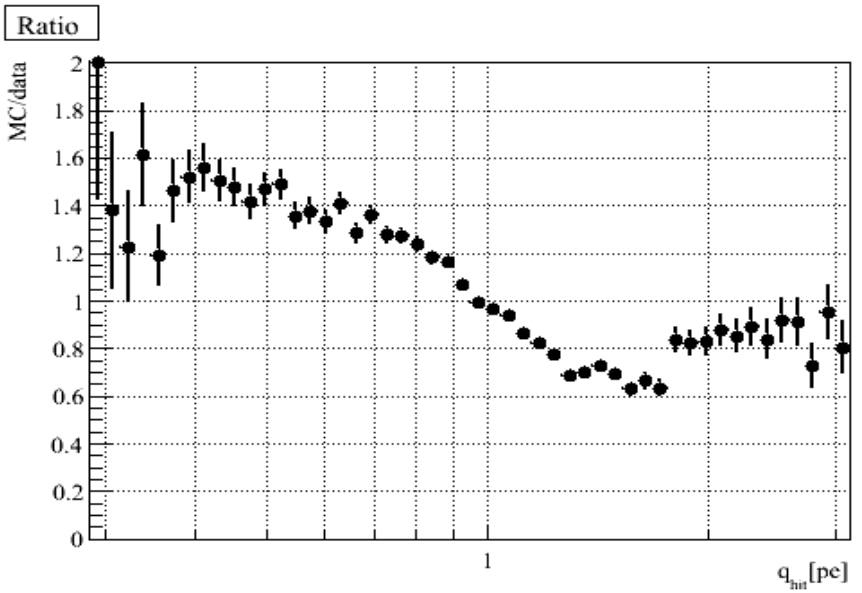


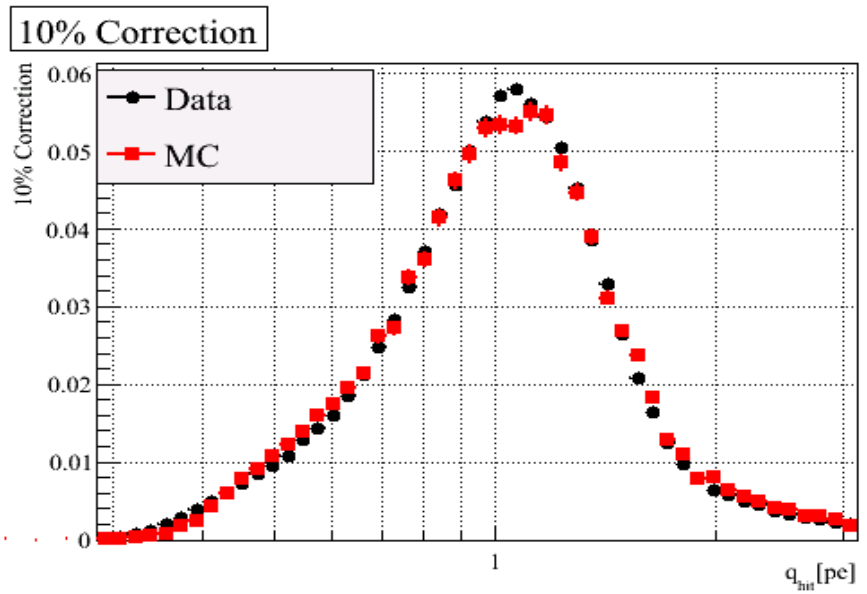
MC/Data

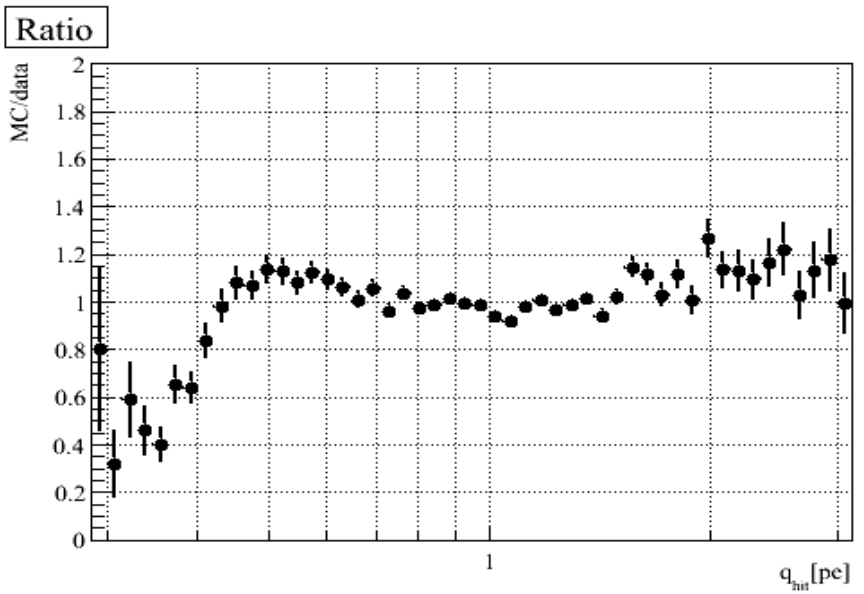
Data Deficit

Charge of Individual Pulses

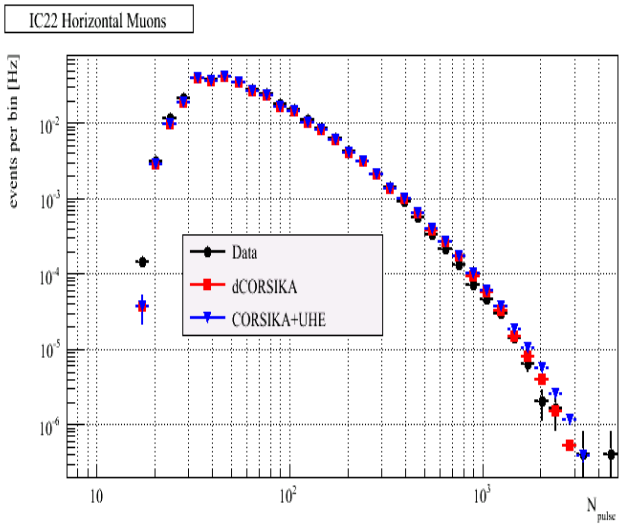


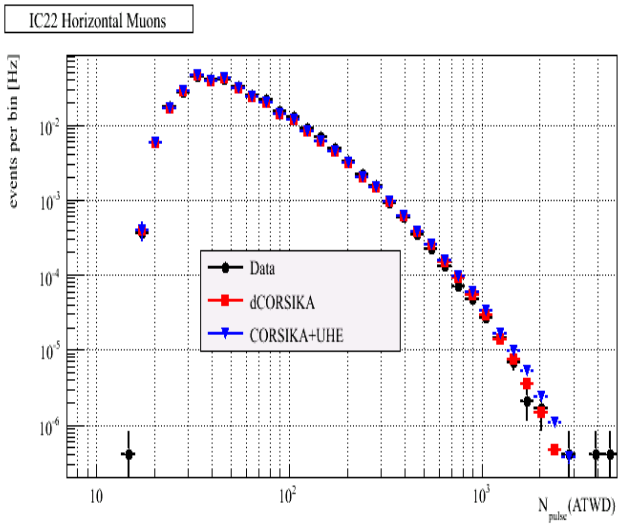


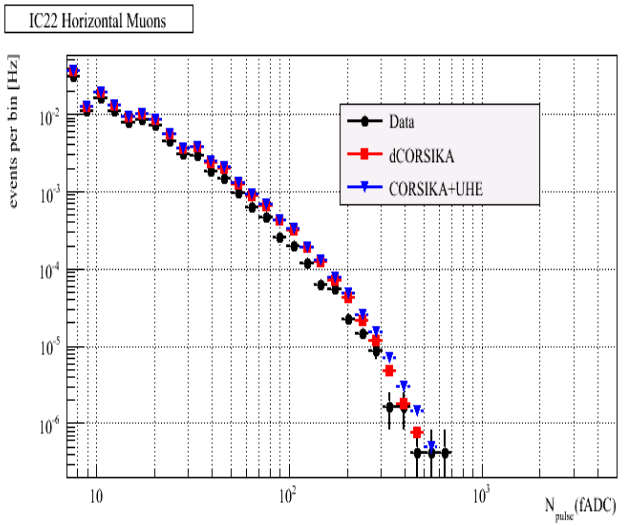


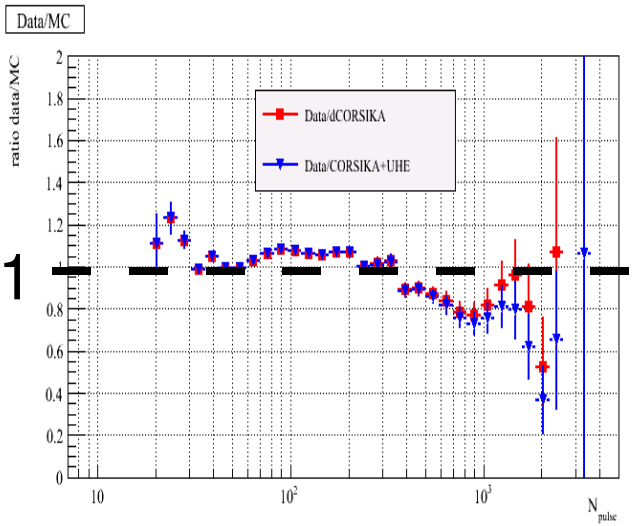


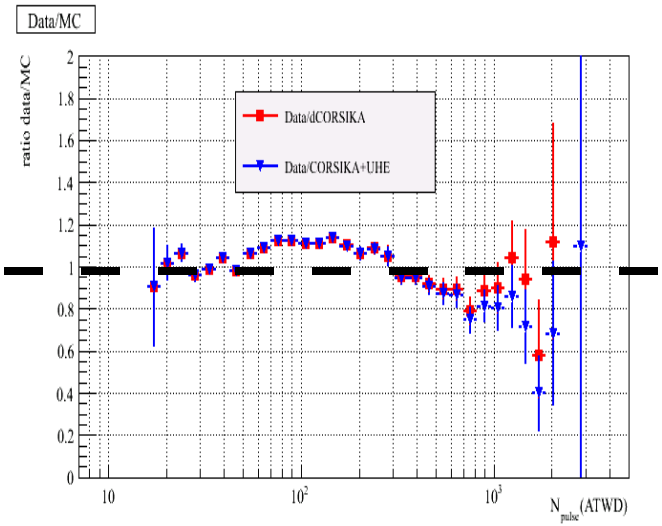
IC22: Pulses

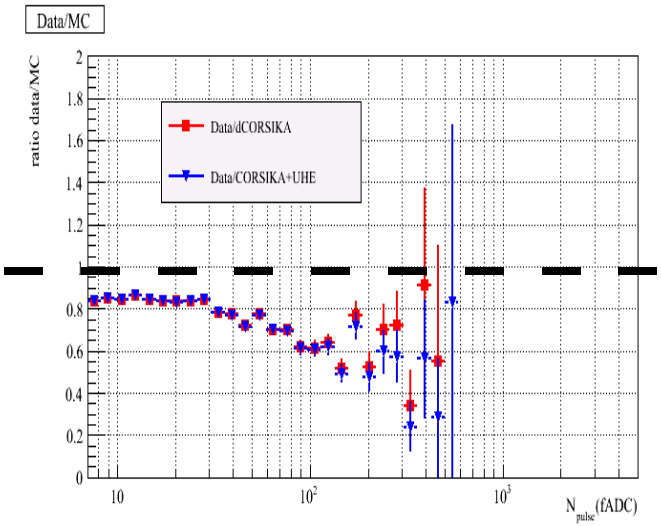








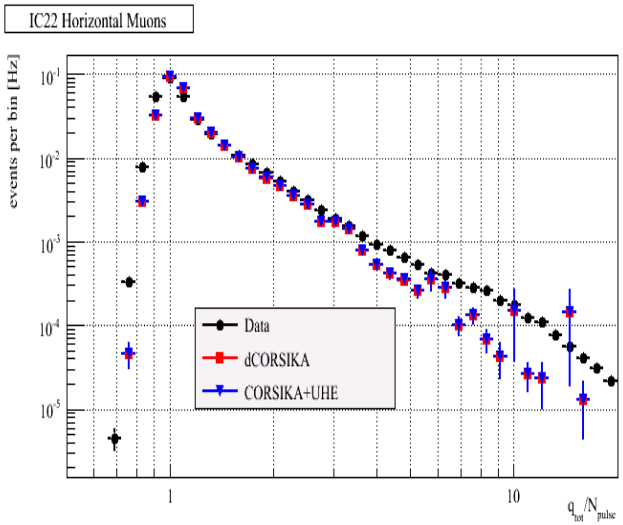


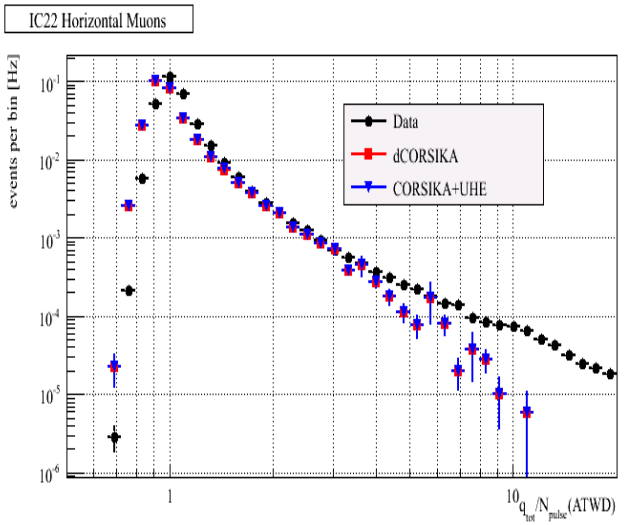


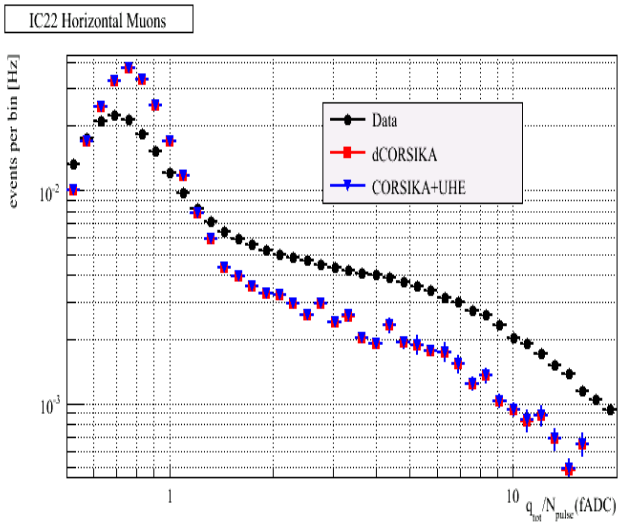
All ATWD fADC

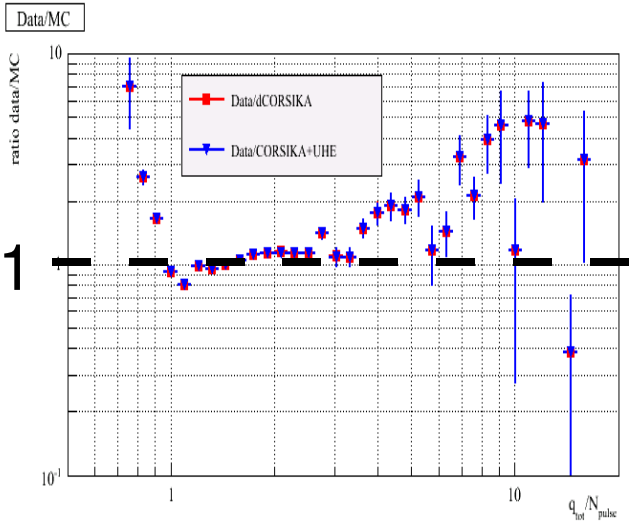
Horizontal Muons below 70°, Zero Misreconstructed

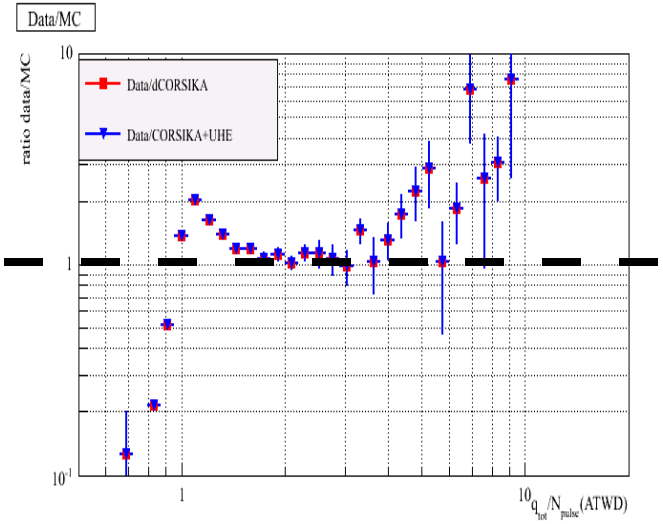
IC22: Total Charge/Pulses

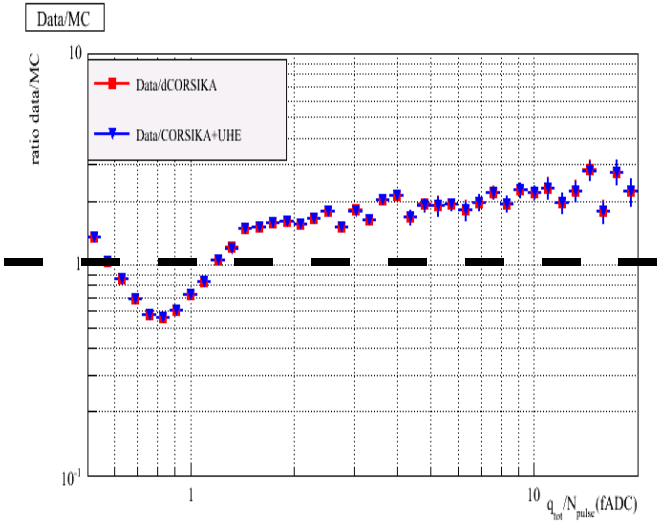












1

All

(1.1 corrected)

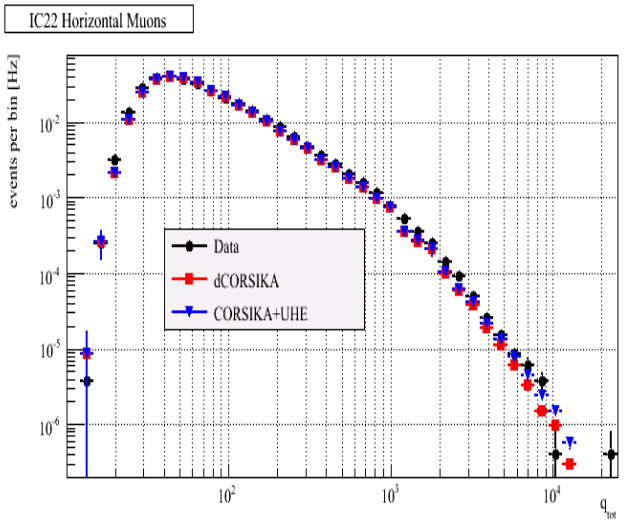
ATWD

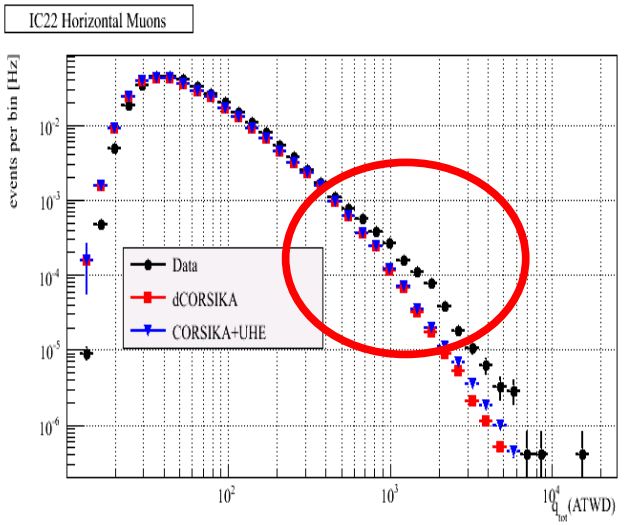
(uncorrected)

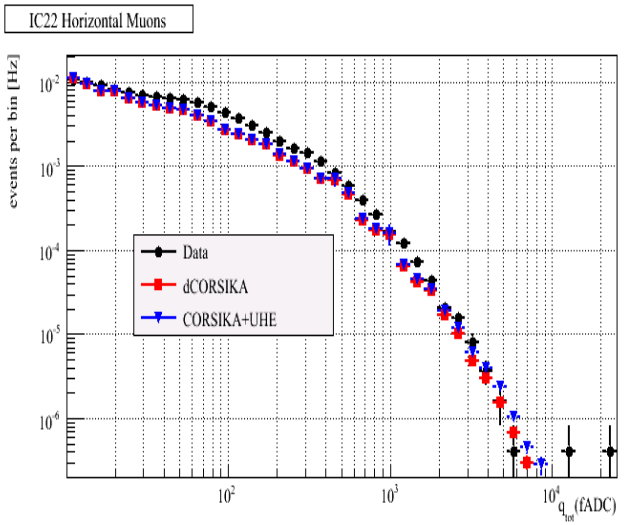
fADC

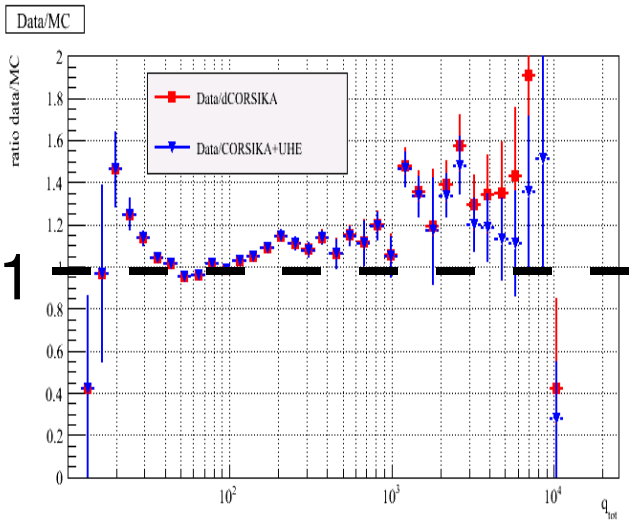
(uncorrected)

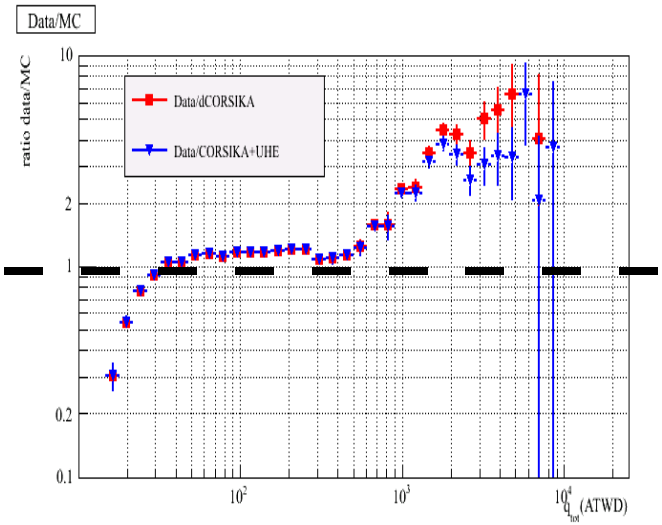
IC22: Total Charge

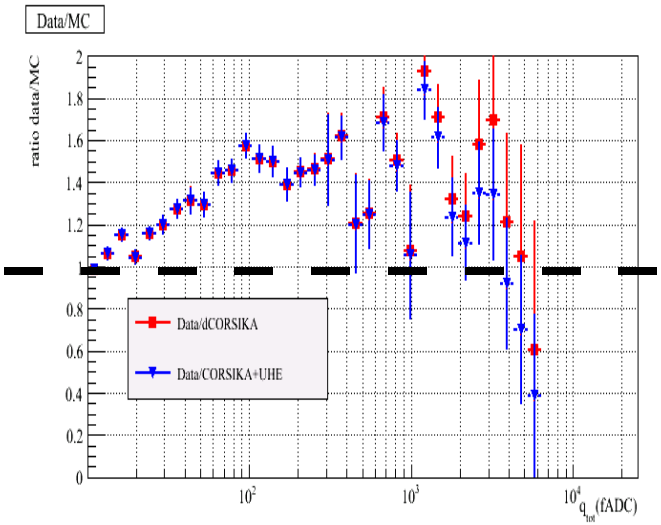












1

All

(1.1 corrected)

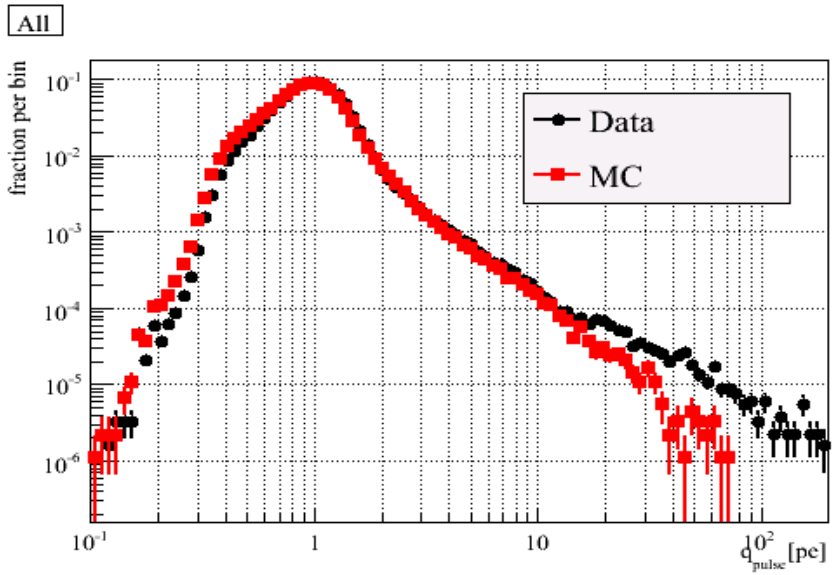
ATWD

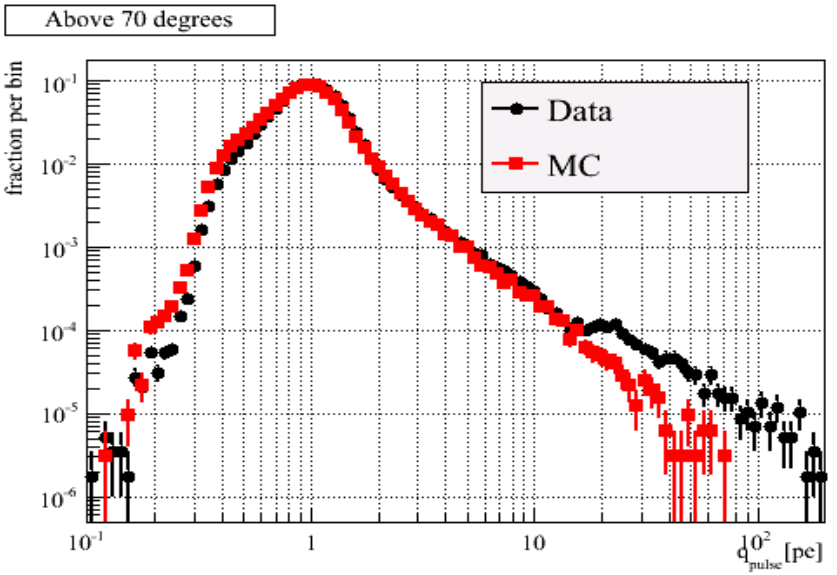
(uncorrected)

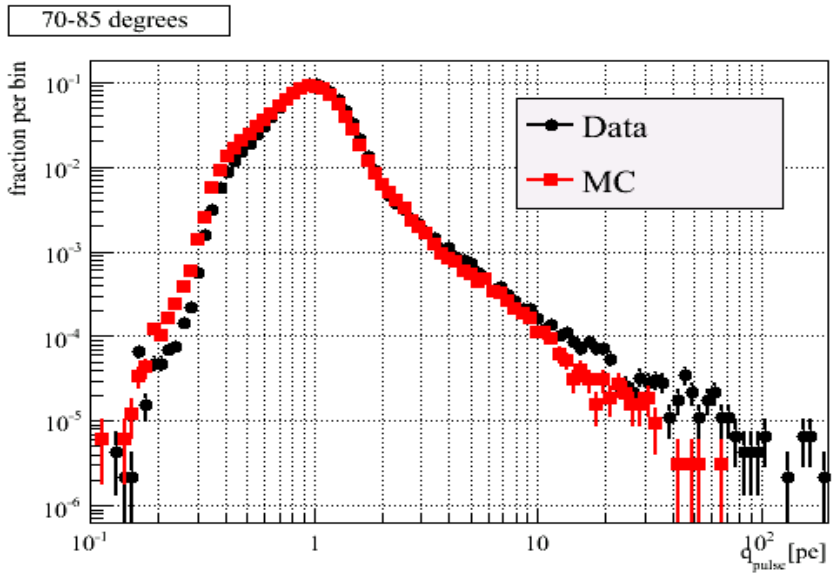
fADC

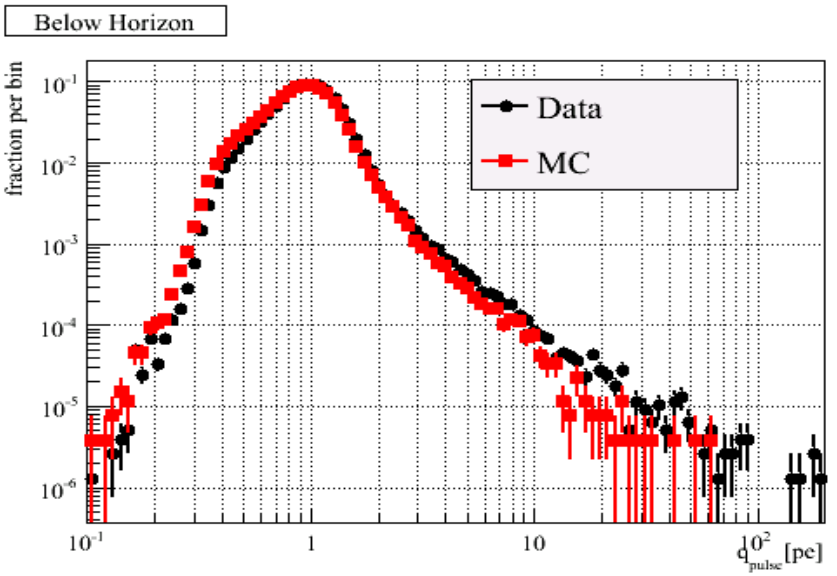
(uncorrected)

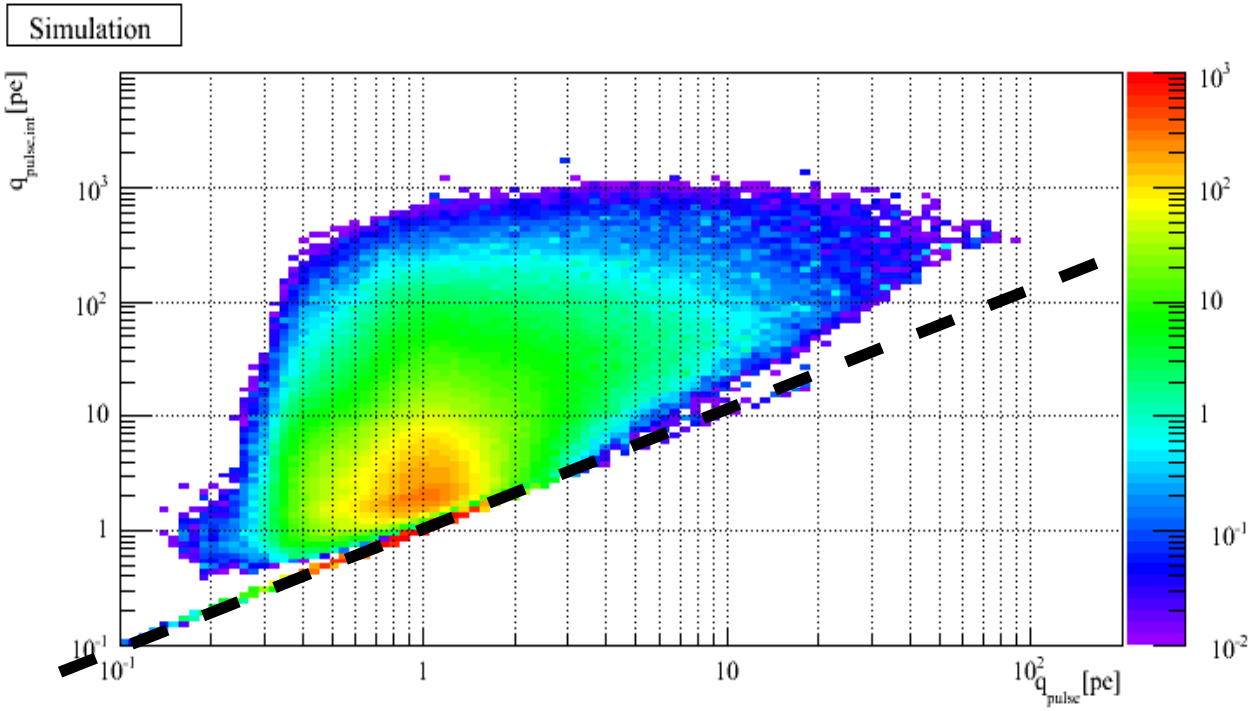
First Pulse in Each DOM (IC40)











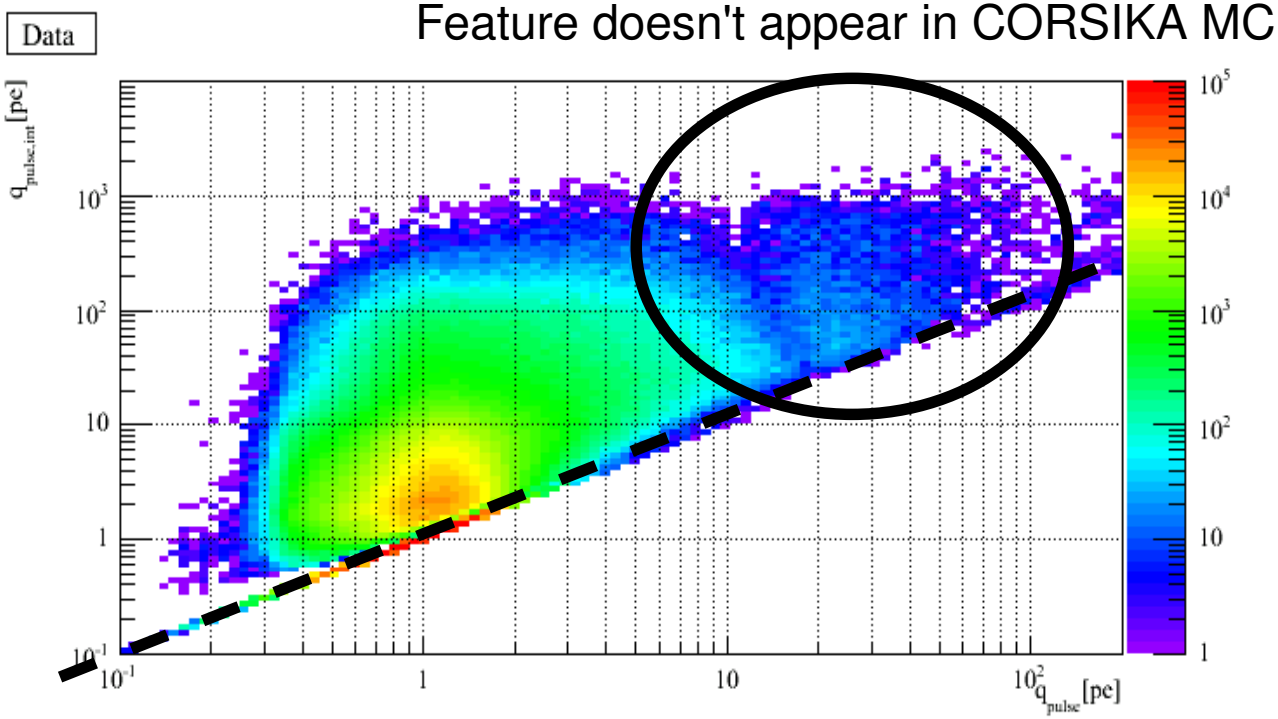
IC22, μ Filter

All Pulses

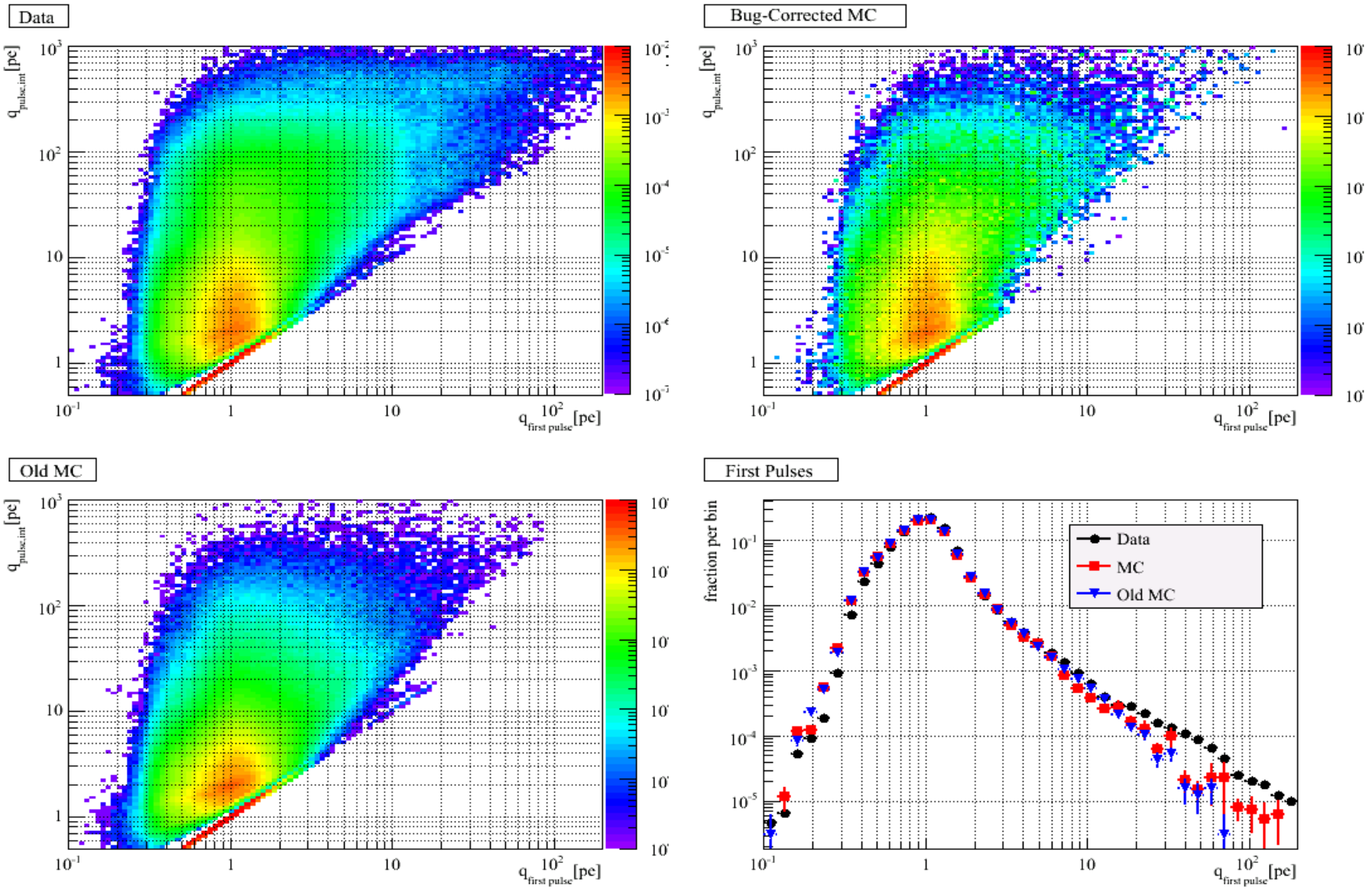
Charge

First Pulse

Feature doesn't appear in CORSIKA MC



IC 40 Muon Filter, above 70°



We still don't understand the detector

It is essential to look at atmospheric muons!