Plots for APS poster

Muon Energy Reconstruction at $NO\nu A$

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List of plots

Plots to show for each of the 3 reconstruction methods

- **Reconstruction using track length**
  - Correlation between energy and track length
  - Method: Energy vs Length fit
  - Reco energy vs true energy
  - Energy resolution for this method
- **Reconstruction using summed E**
  - Correlation between energy and deposited energy
  - Reco energy vs true energy
  - Energy resolution for this method
- **Reconstruction using Multiple Scattering**
  - Contour plots → showing sensitivity for un-contained events (docdb 8779)
  - Correlation between energy and scattering angle
  - Reco energy vs true energy
  - Energy resolution for this method

Plot details

The plots on this document correspond to 2 samples:

Reco + Truth cuts
Reco tracks we select as muons
and which match true muon tracks

- Best PID track
- Vertex containment 40 cm
- Track containment 50 cm
- Track hit collection purity ≥ 0.8
- Track hit collection efficiency ≥ 0.8

Reco cuts only:
Reco tracks we select as muons

- Best PID track
- Vertex containment 40 cm
- Track containment 50 cm

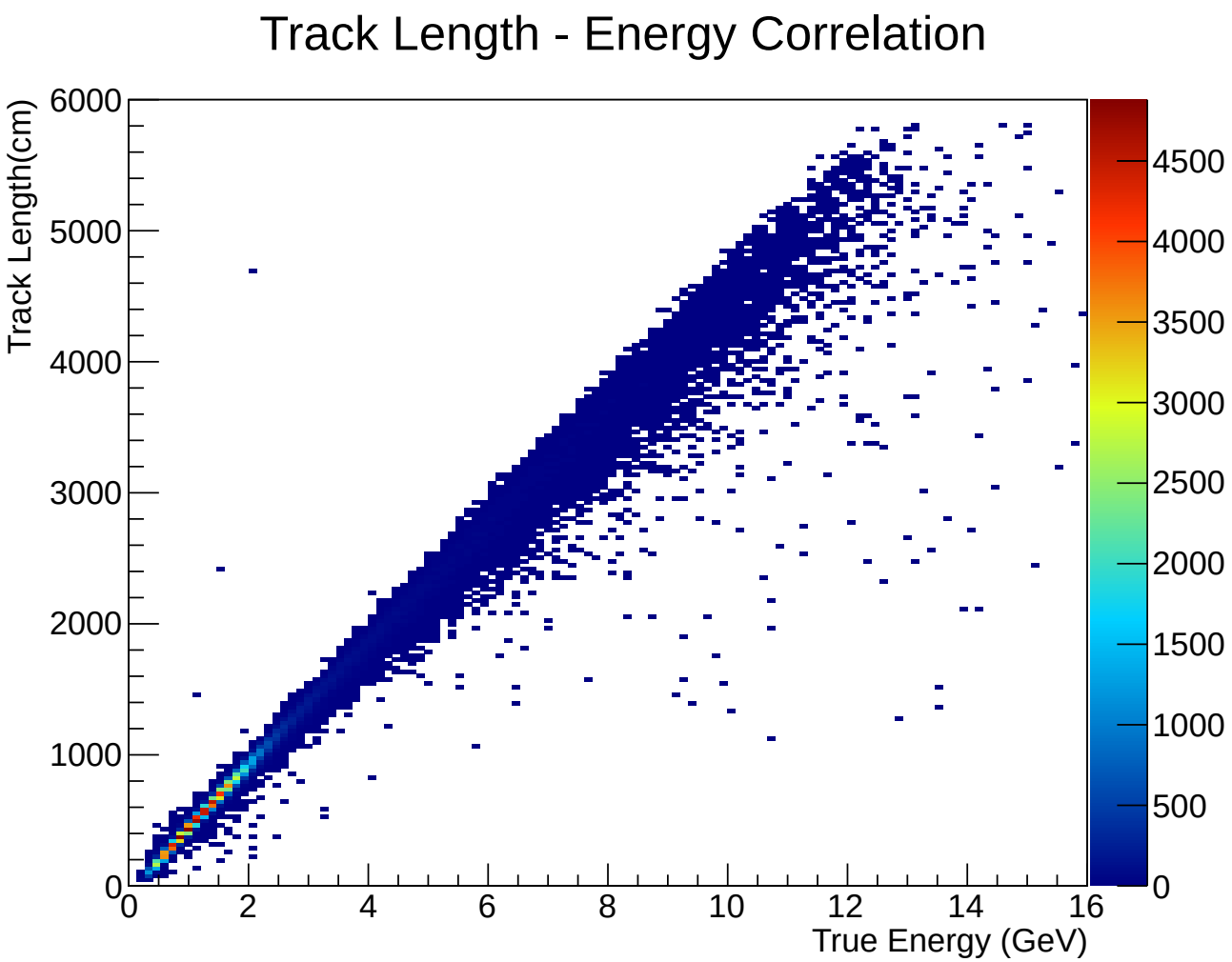
MC used: S12-12-12 fhc nonswap, events with muon hits

★ The purpose of these plots is to show muon energy reconstruction
All plots on this document are **for muons only**, there is no ν information in any of these plots

CORRELATIONS WITH TRUE MUON ENERGY

Reconstruction using Track Length

Correlation between energy and track length

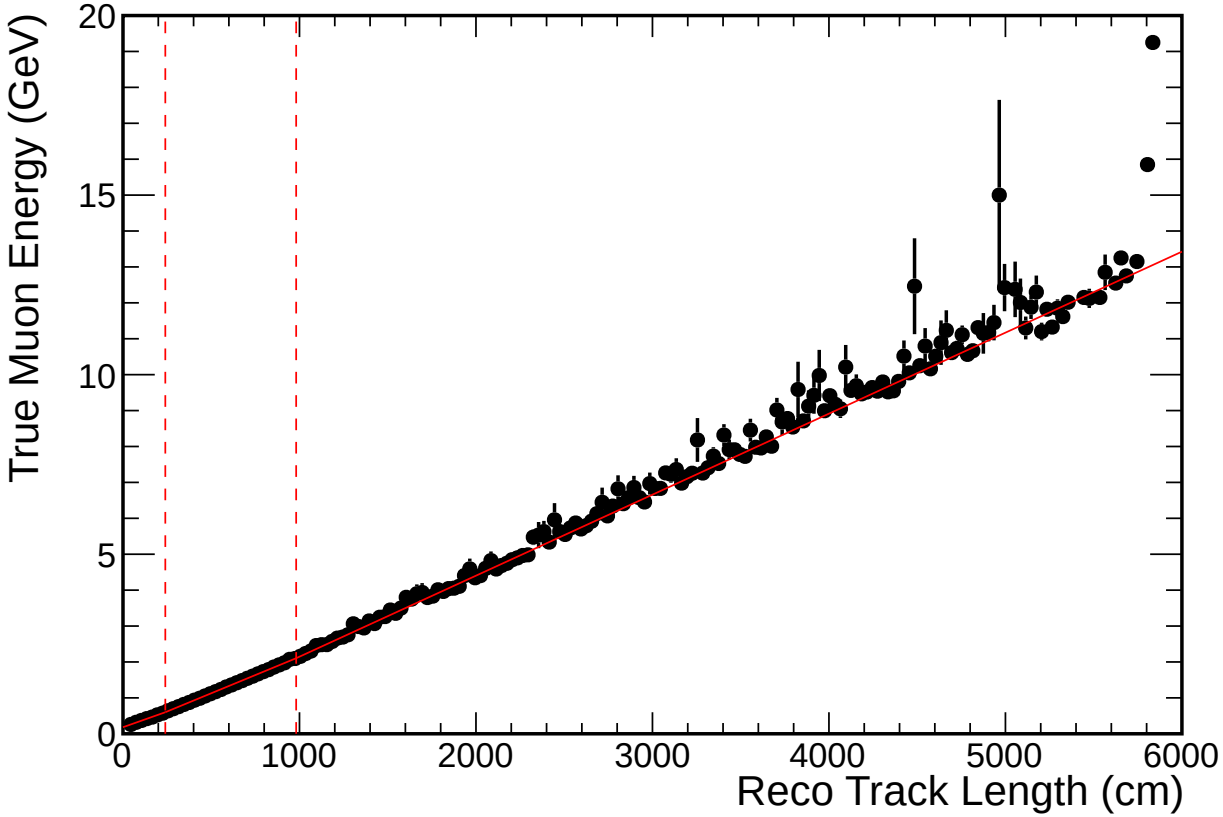


Reco + Truth cuts

Purpose:
Show that there is a correlation between track length and true muon energy

Reconstruction using Track Length

Method: Energy vs Length fit

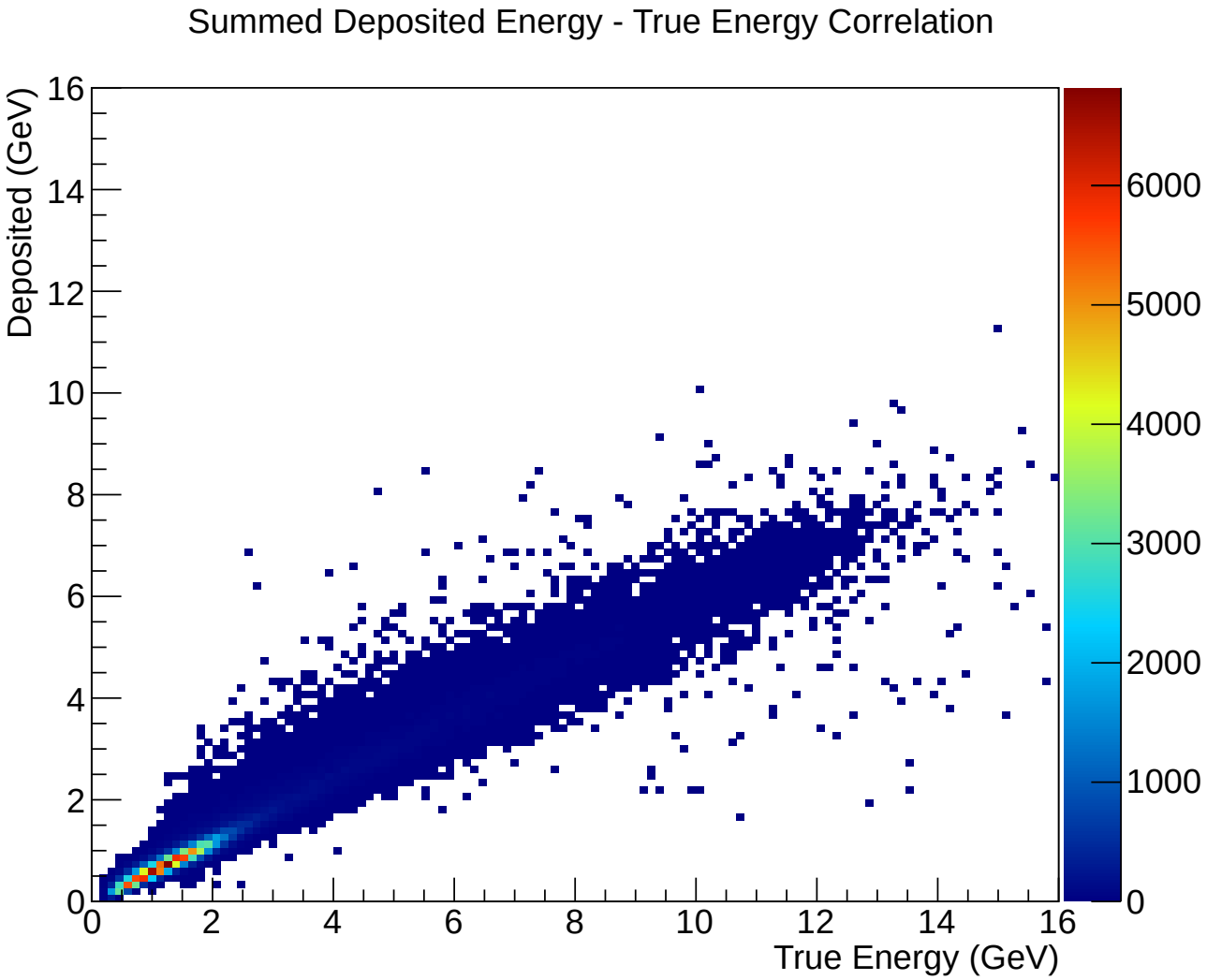


Track length method
from docdb 8485

Purpose:
These 3 line fits are how we use track length information to reconstruct energy

Reconstruction using Summed Energy

Correlation between energy and deposited energy

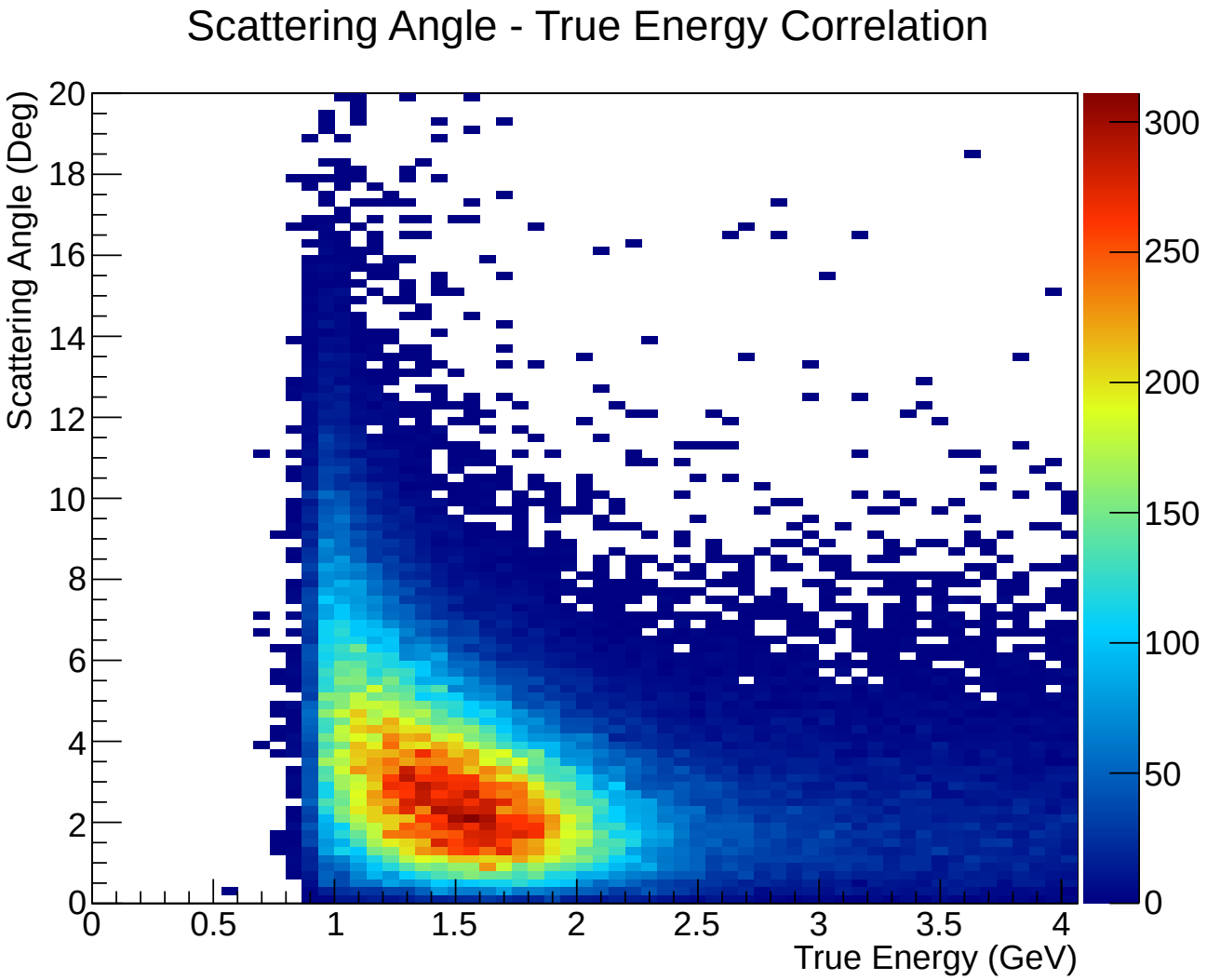


Reco + Truth cuts

Purpose:
Show that there is a correlation between deposited energy and true muon energy

Reconstruction using Multiple Scattering

Correlation between energy and scattering angle

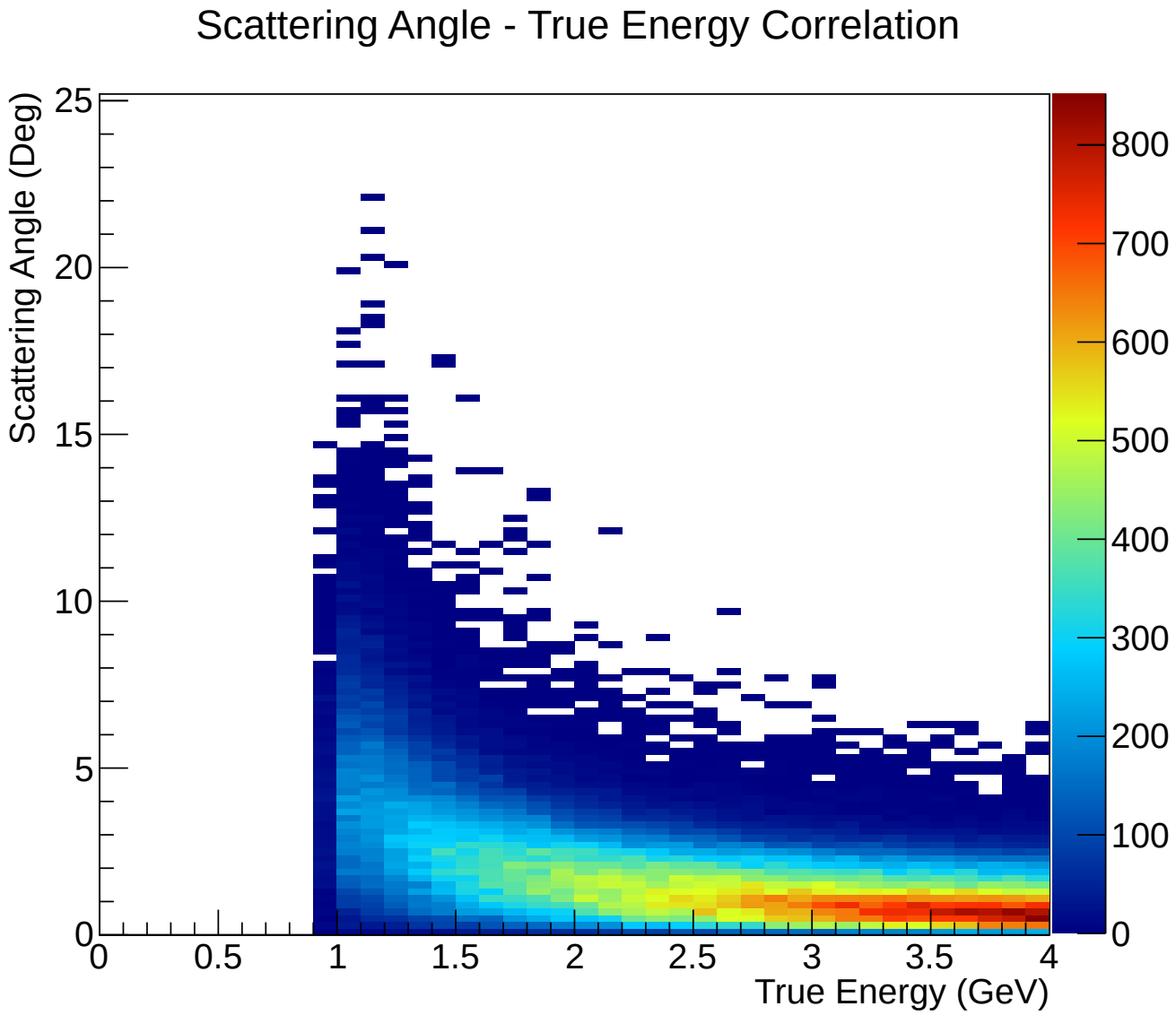


Reco + Truth cuts

Purpose:
Show that there is a correlation between scattering angle and true muon energy

Reconstruction using Multiple Scattering

Correlation between energy and scattering angle



Independent sample:
Single muons in the FD
with uniform energy distribution

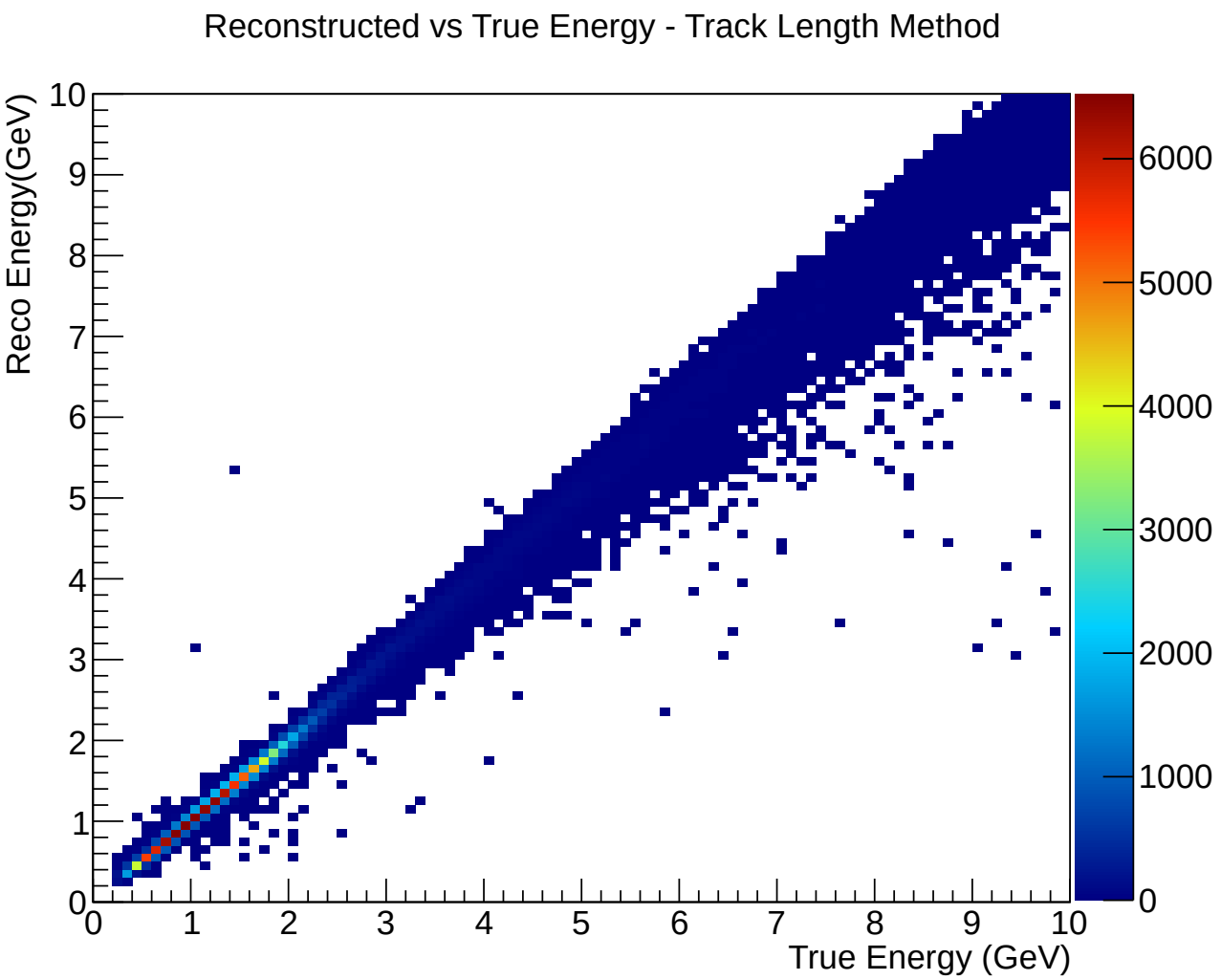
Purpose:
Show that there is a correlation between scattering angle and true muon energy

(Equivalent to the previous one)

MUON ENERGY RECONSTRUCTION

Reconstruction using Track Length

Reco energy vs true energy



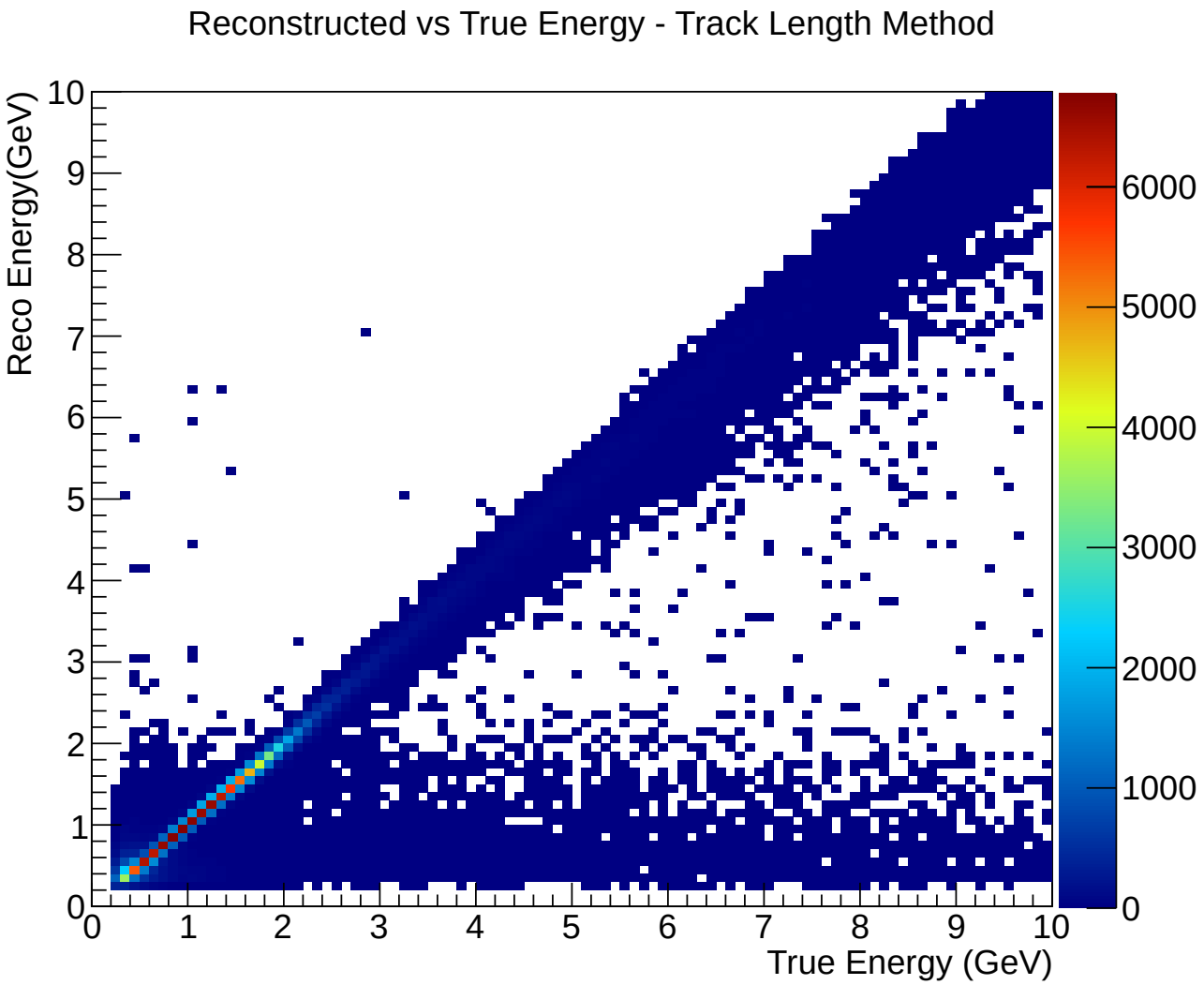
Reco + Truth cuts

Energy reconstruction on NumuEAlg (docdb 8485)

Purpose:
Depict how well we reconstruct muon energy using this method **for well reconstructed muons**

Reconstruction using Track Length

Reco energy vs true energy



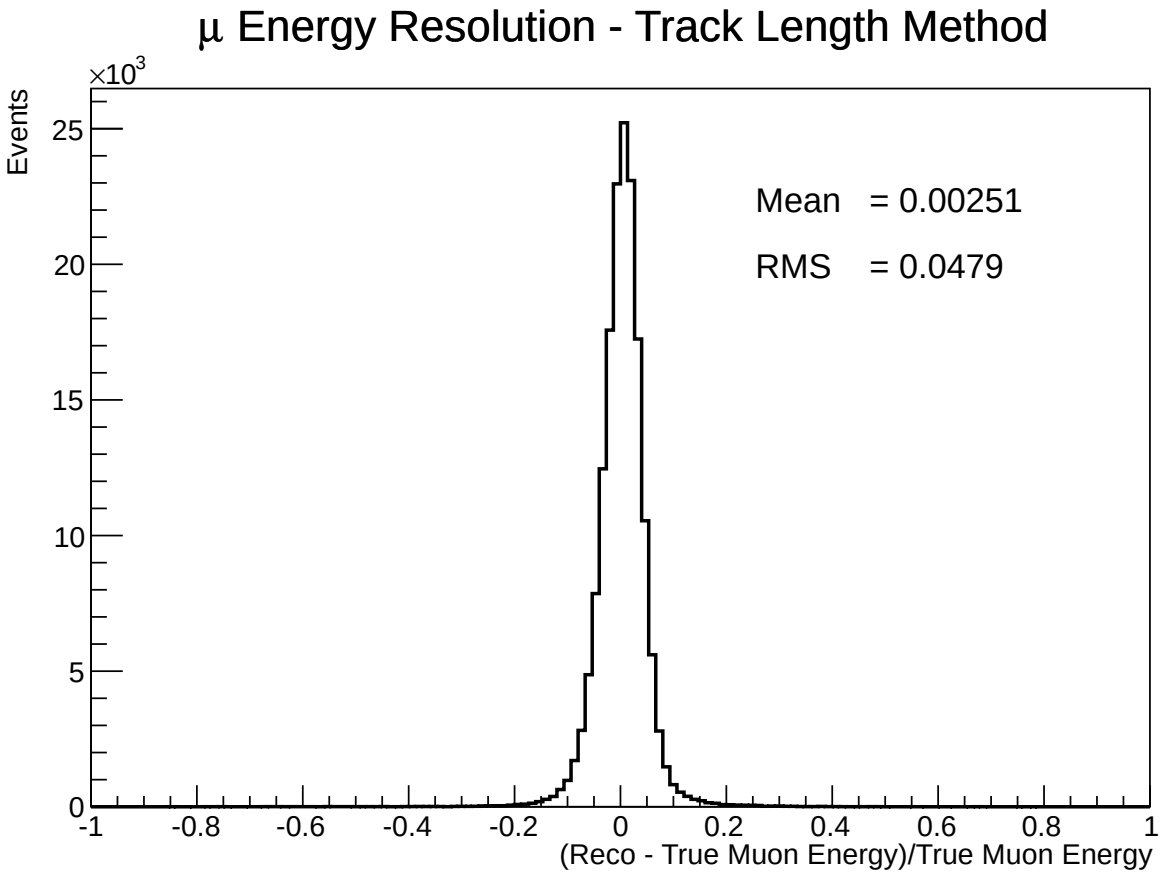
Reco Only cuts

Energy reconstruction on NumuEAlg (docdb 8485)

Purpose:
Depict how well we reconstruct muon energy using this method

Reconstruction using Track Length

Energy resolution



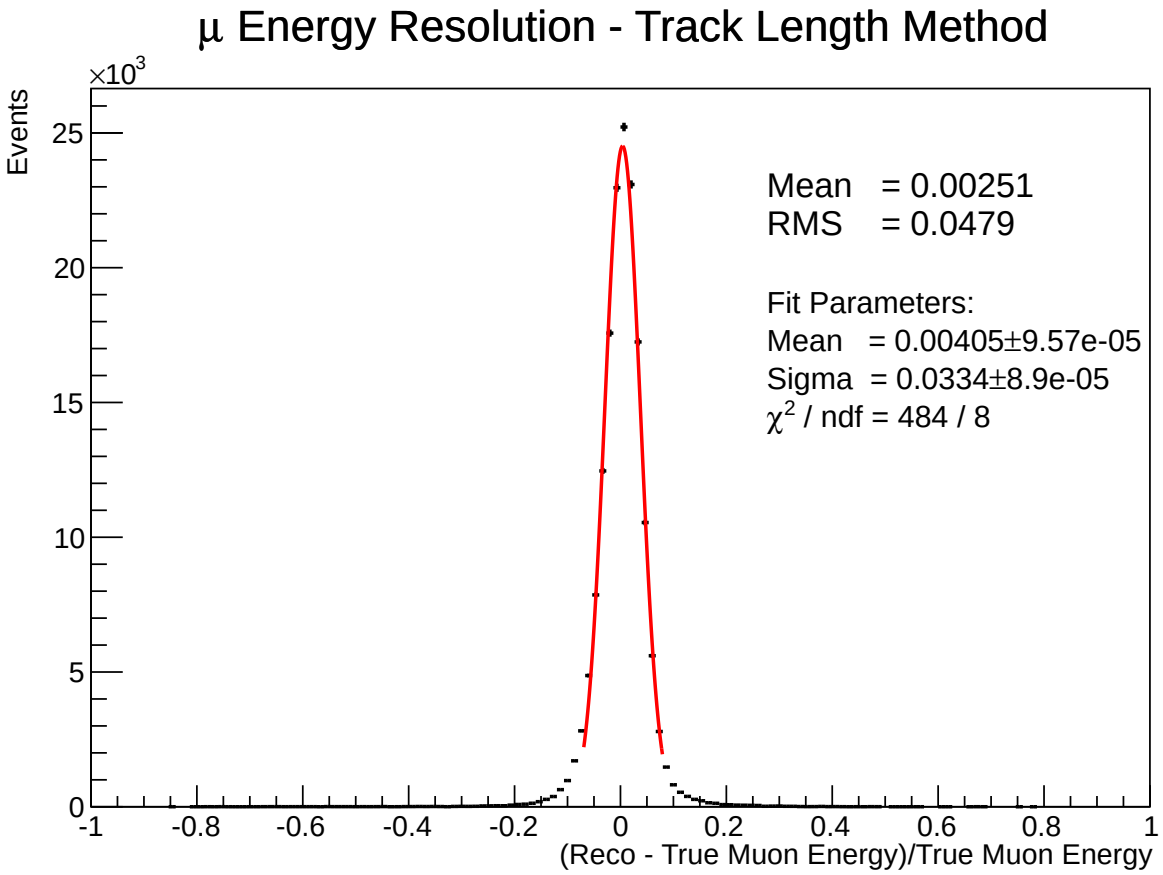
Reco + Truth cuts

Energy reconstruction on NumuEAlg (docdb 8485)

Purpose:
Quantify how well we reconstruct muon energy using this method **for well reconstructed muons**

Reconstruction using Track Length

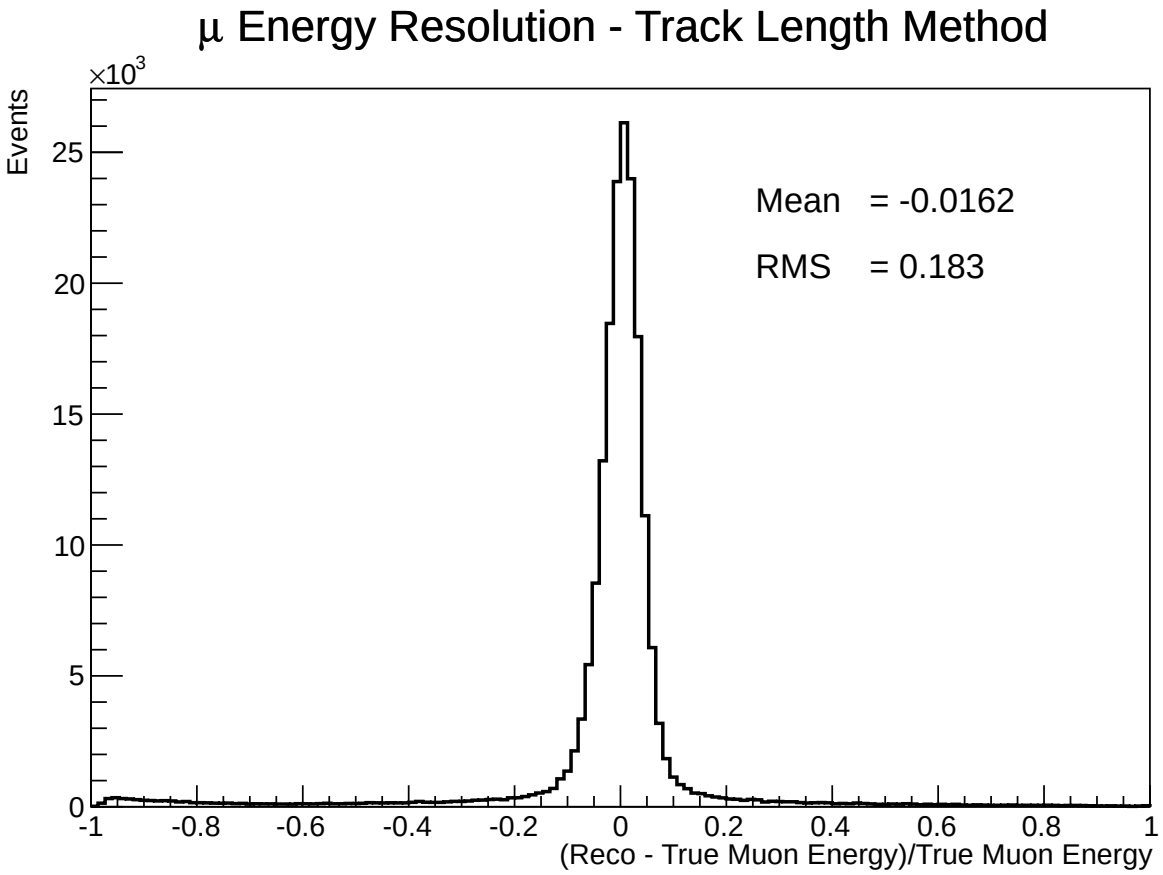
Energy resolution



Same details as previous plot

Reconstruction using Track Length

Energy resolution



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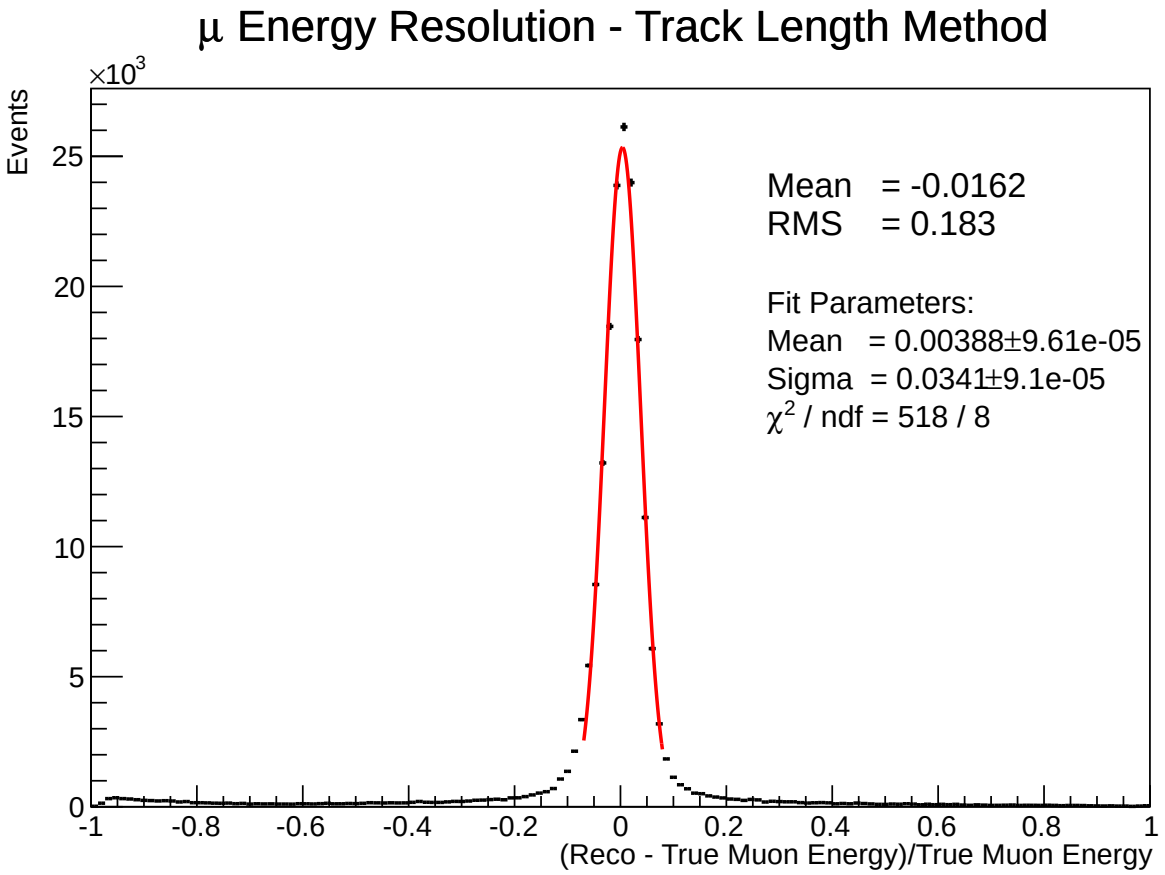
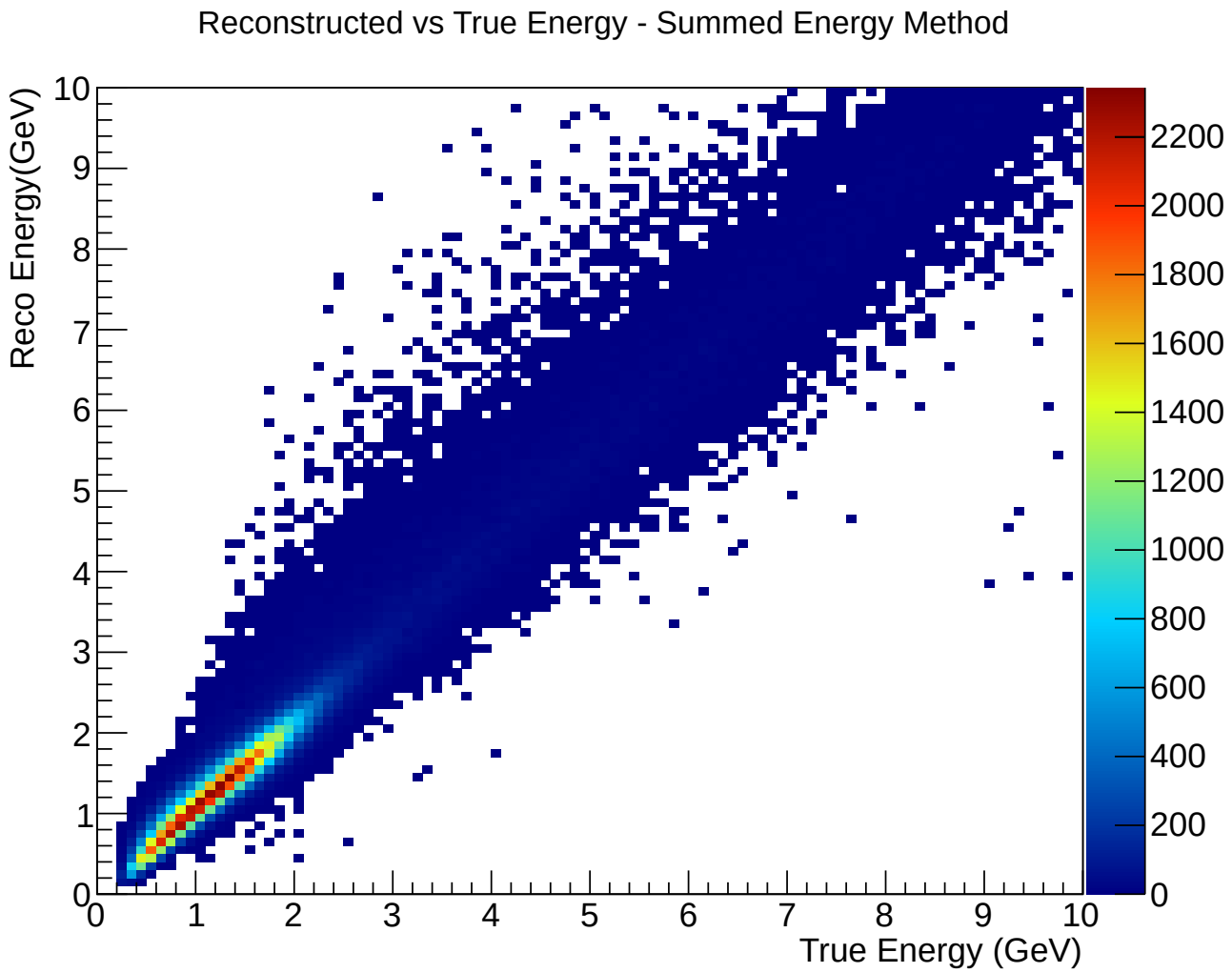
Energy resolution



Same details as previous plot

Reconstruction using Summed Energy

Reco energy vs true energy



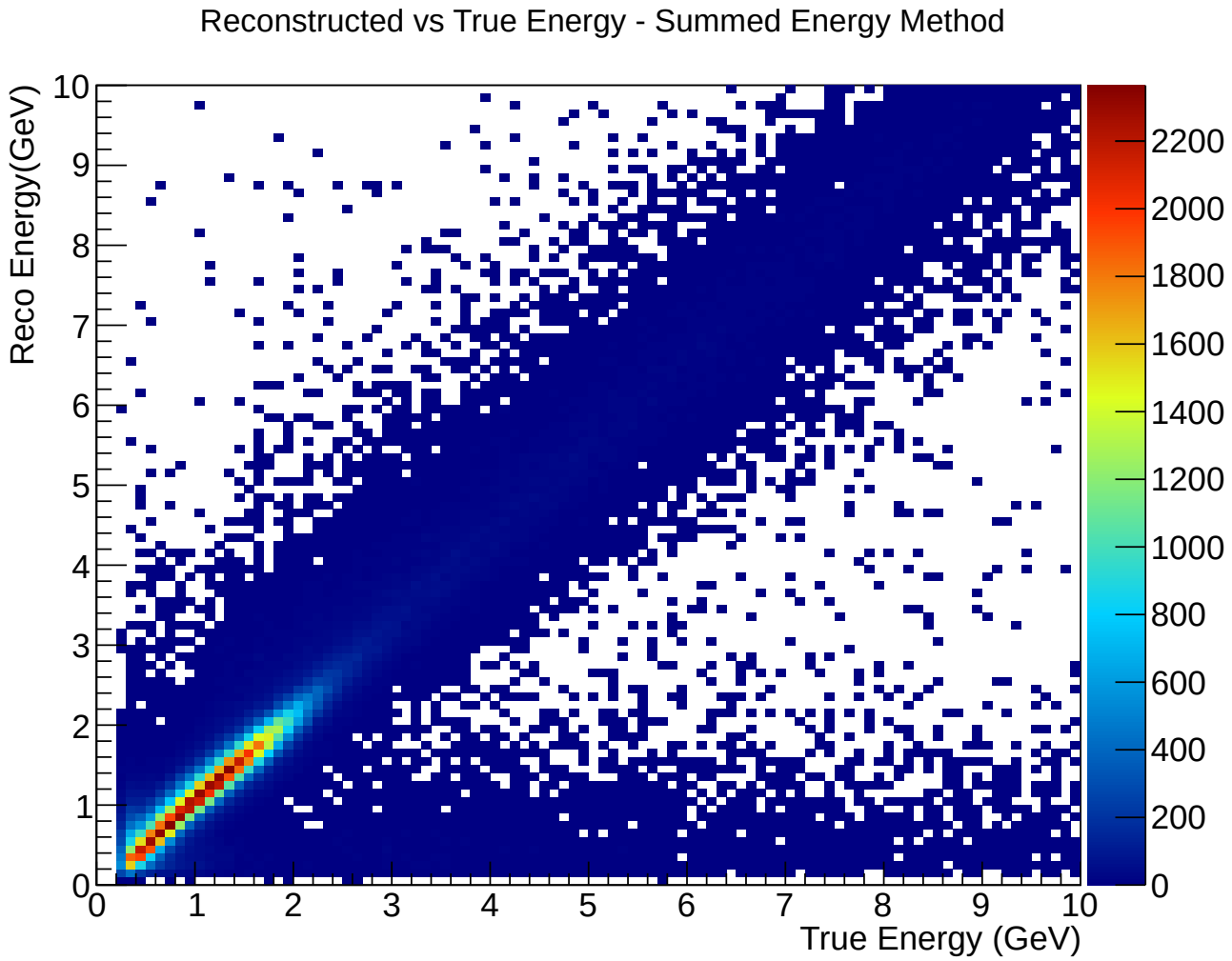
Reco + Truth cuts

Energy reconstruction from NumuEAlg (docdb 8485)

Purpose:
Depict how well we reconstruct muon energy using this method **for well reconstructed muons**

Reconstruction using Summed Energy

Reco energy vs true energy



Reco Only cuts

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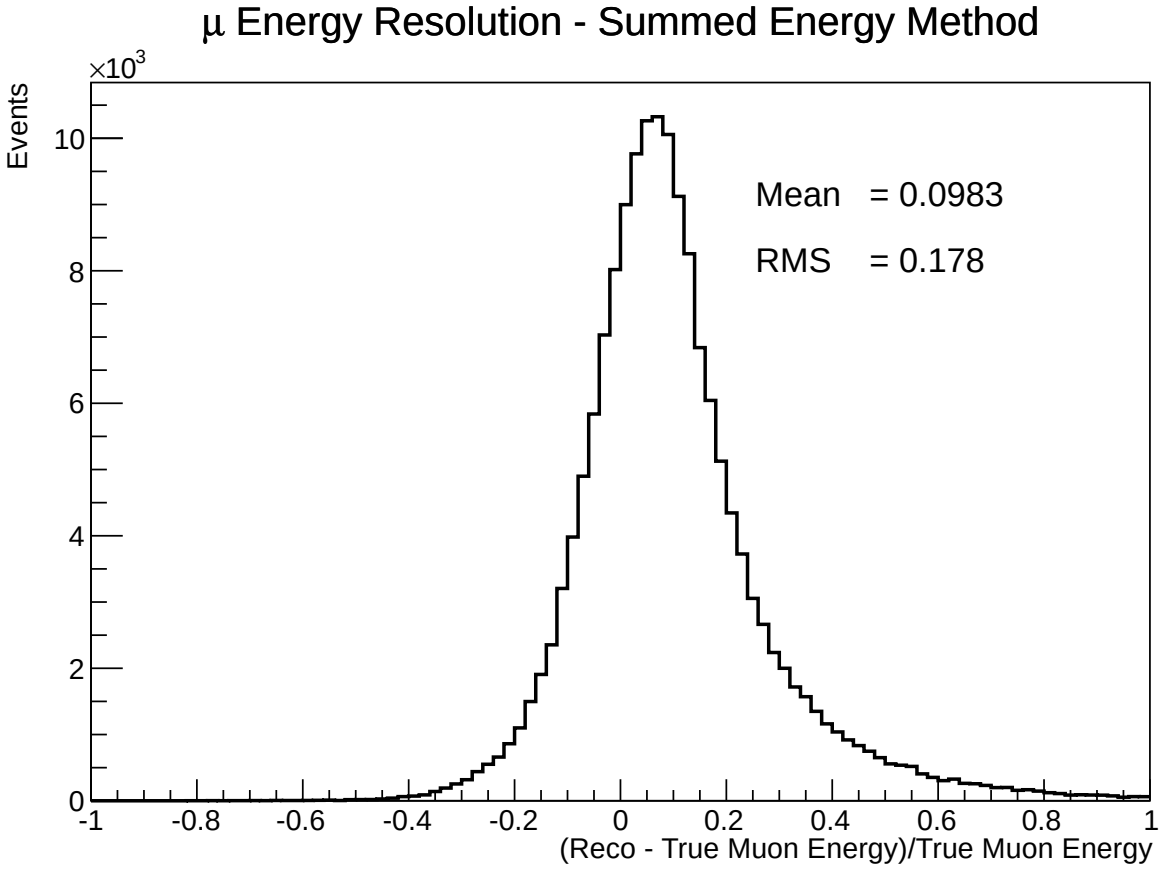
Reconstruction using Summed Energy

Energy resolution for this method



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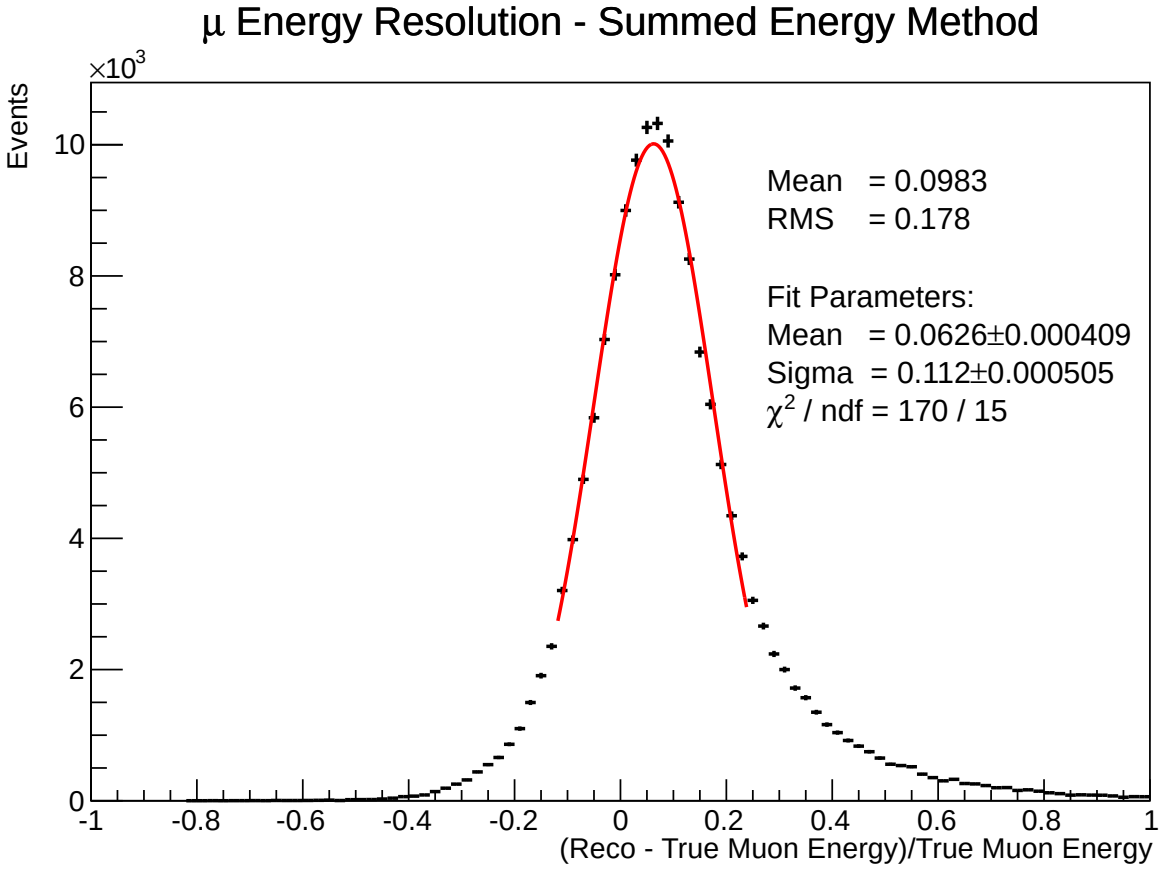

Same details as previous plot

Reconstruction using Summed Energy

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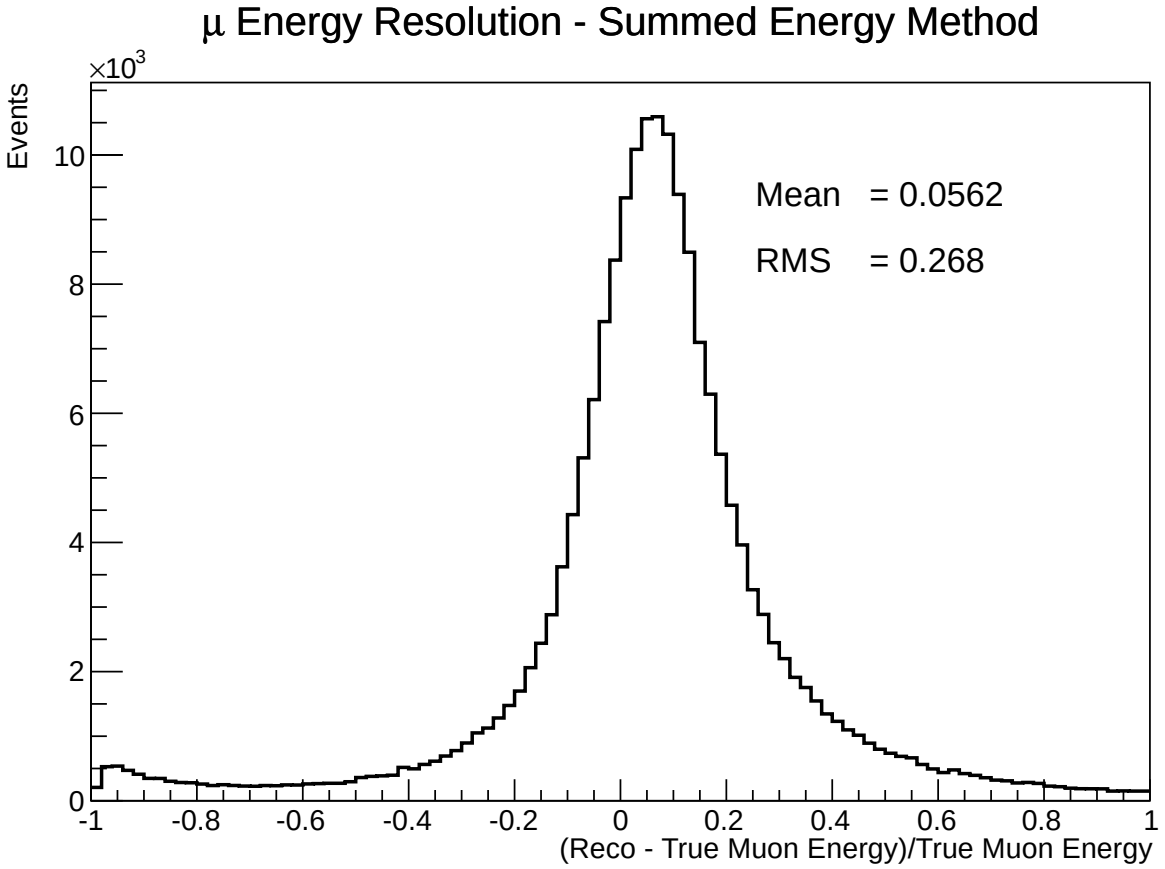

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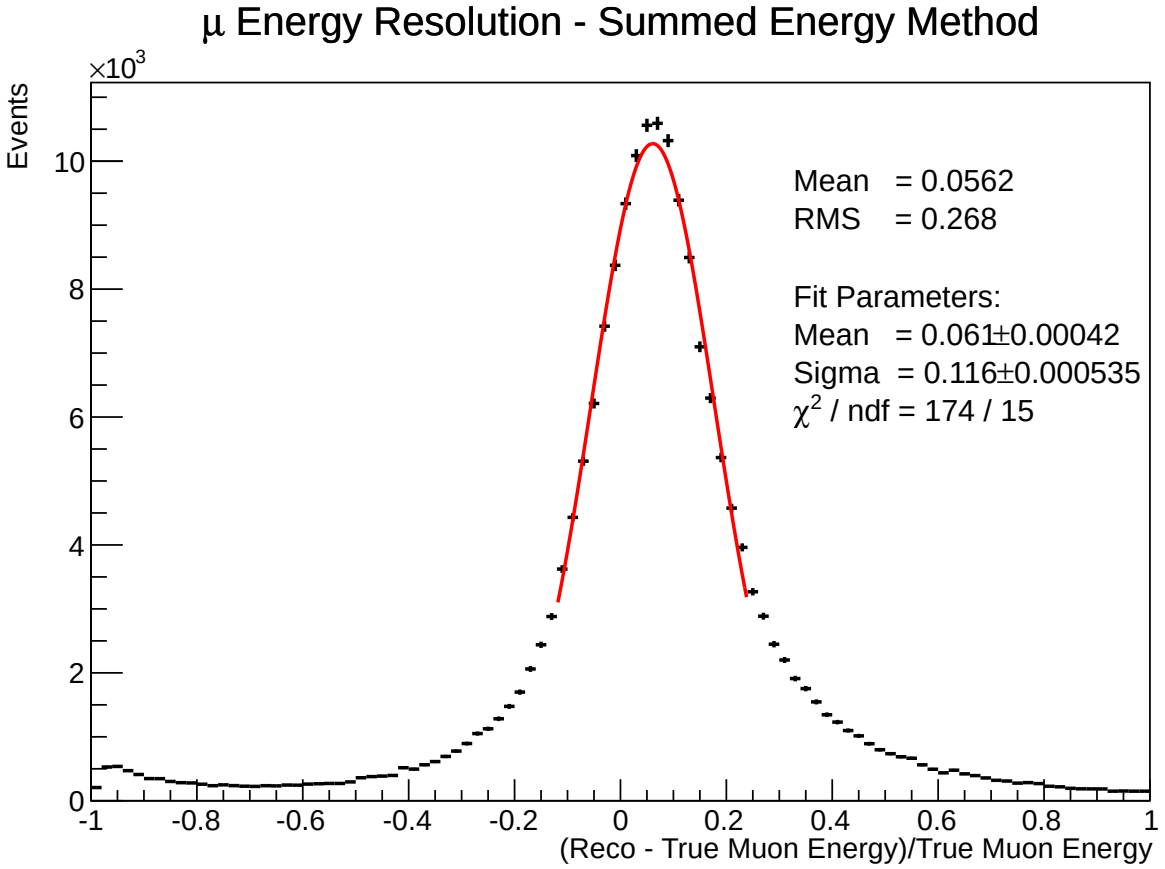
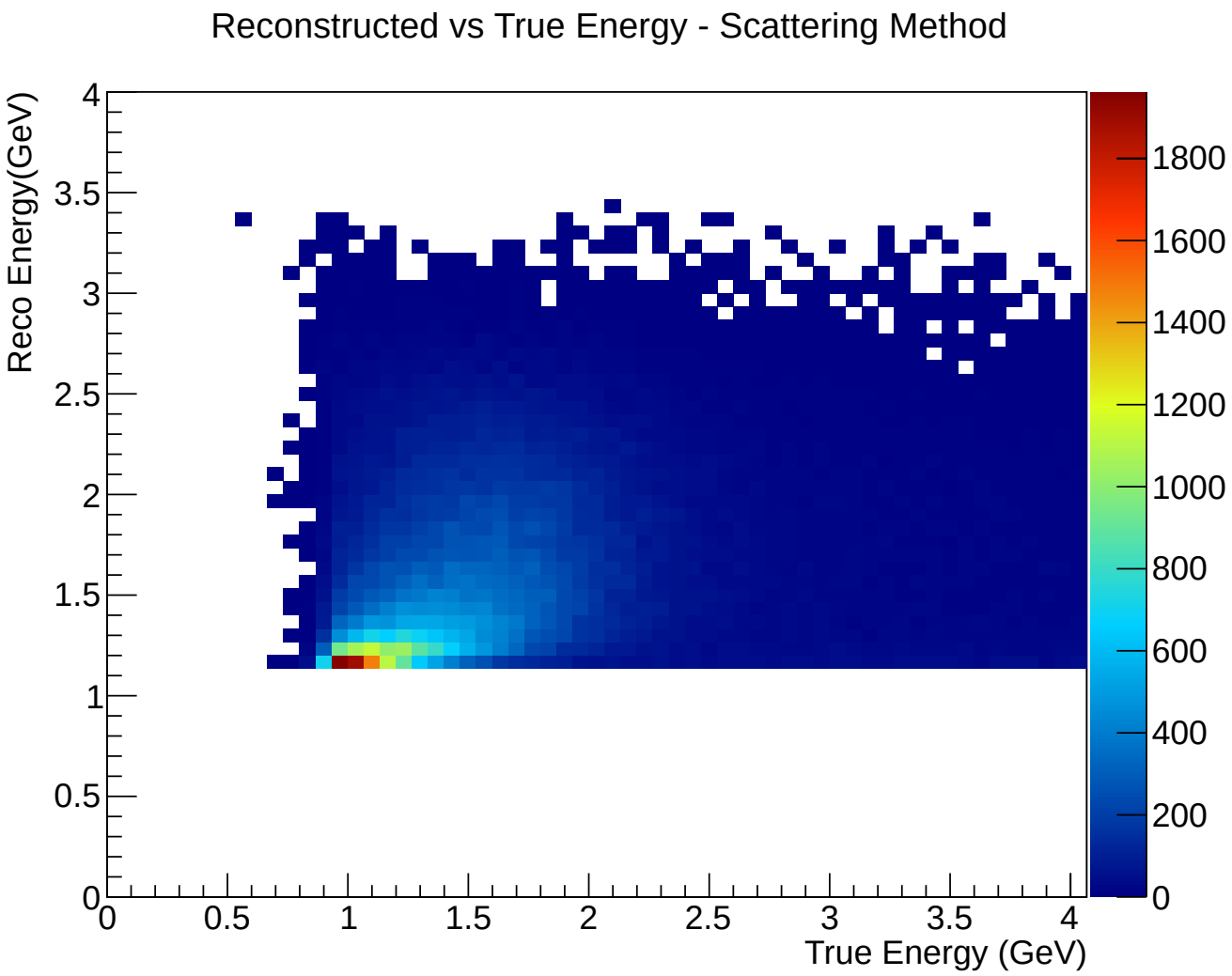


Same details as previous plot

Reconstruction using Multiple Scattering

Reco energy vs true energy



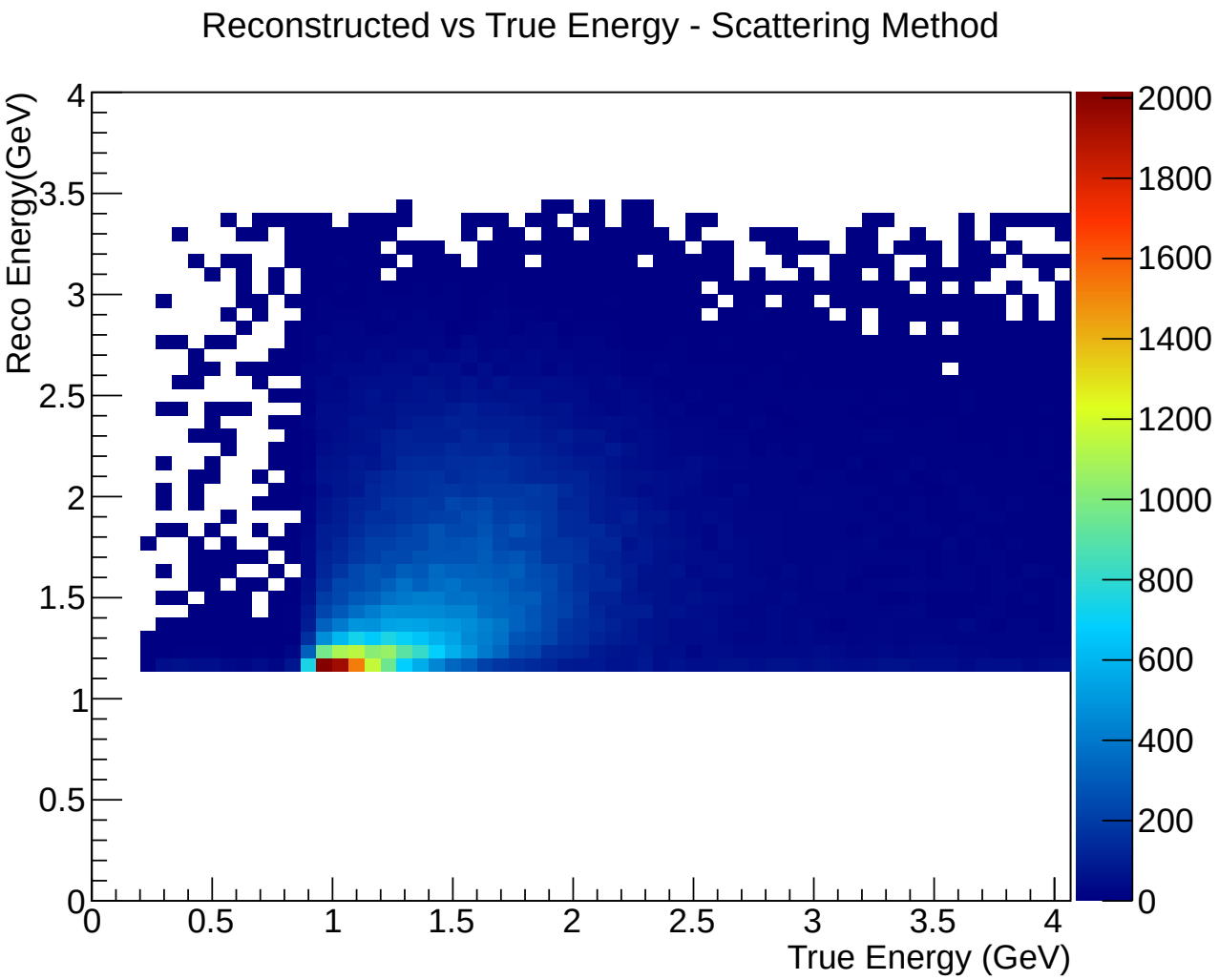
Reco + Truth cuts
Muon True Energy $\leq$ 4GeV

Energy reconstruction from Scattering NN algorithm (docdb 8540)

Purpose:
Depict how well we reconstruct muon energy using this method **for well reconstructed muons**

Reconstruction using Multiple Scattering

Reco energy vs true energy



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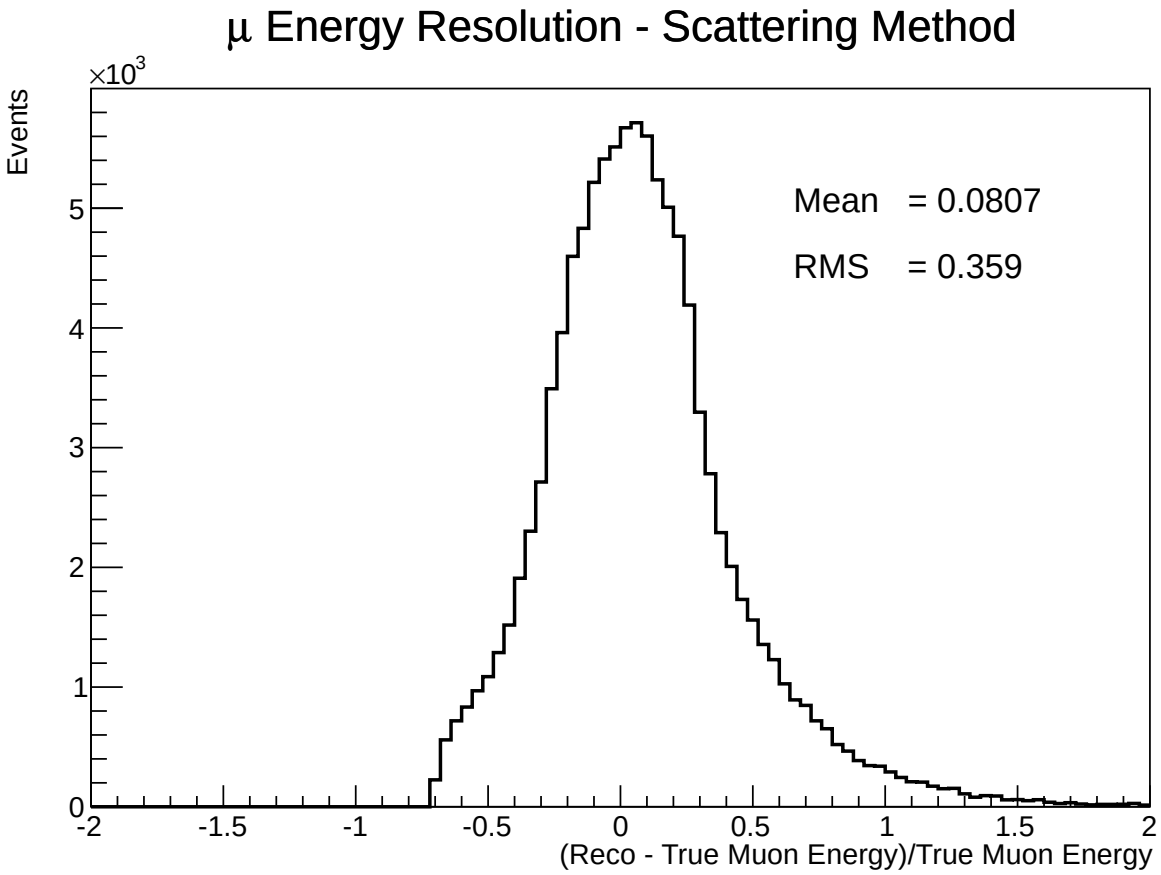

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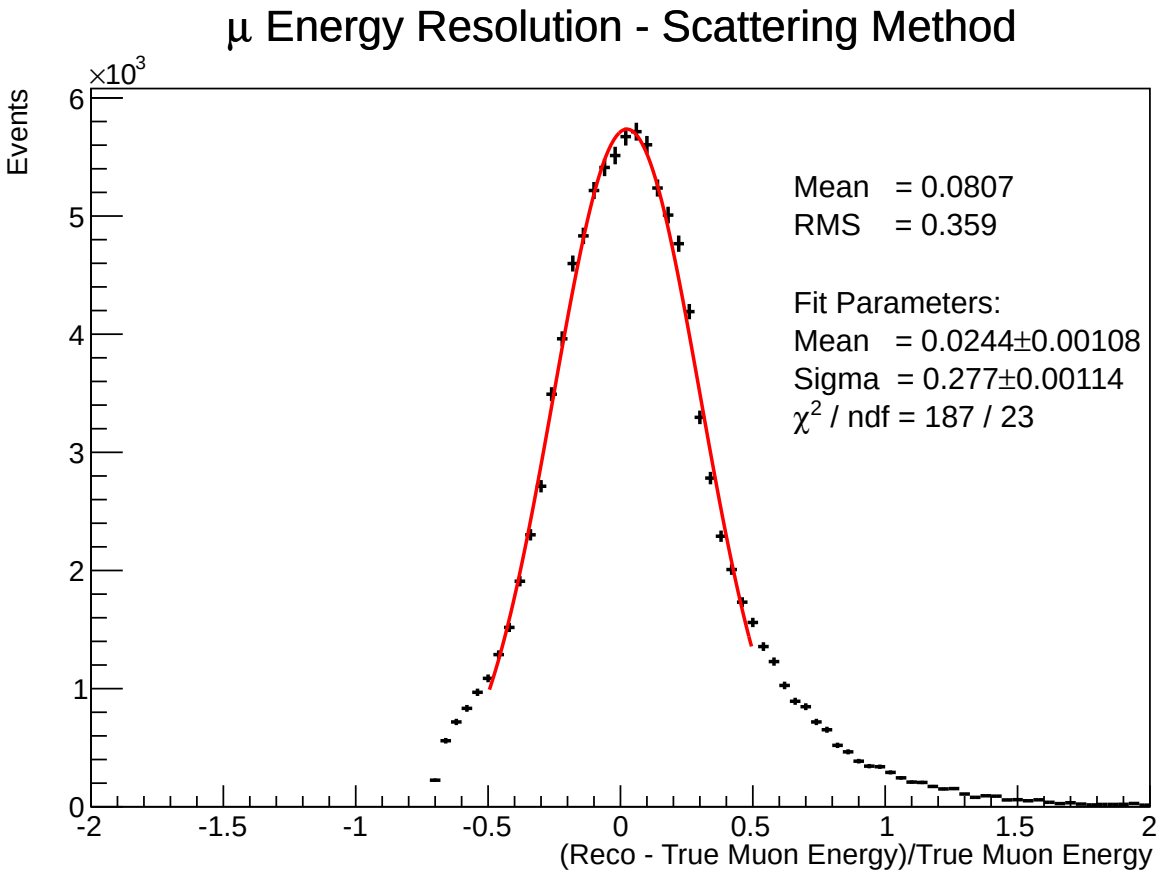

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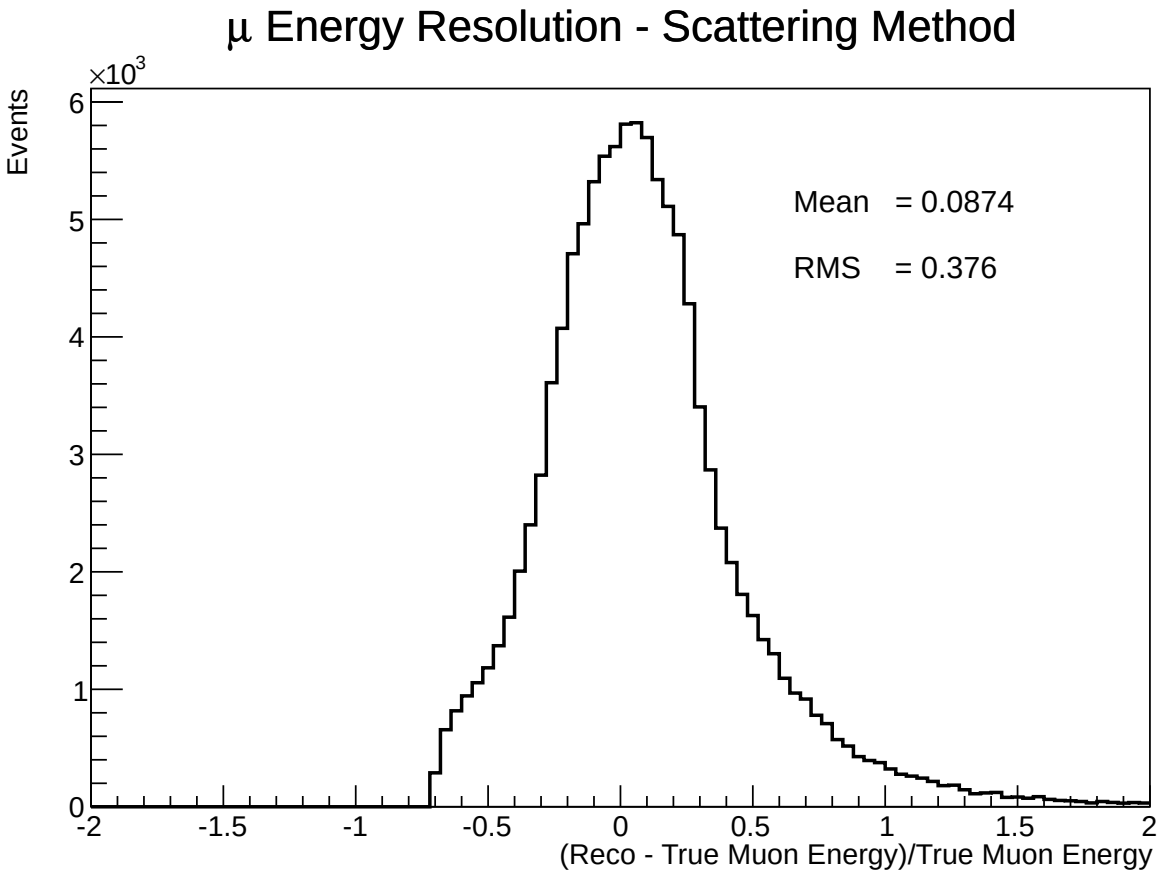

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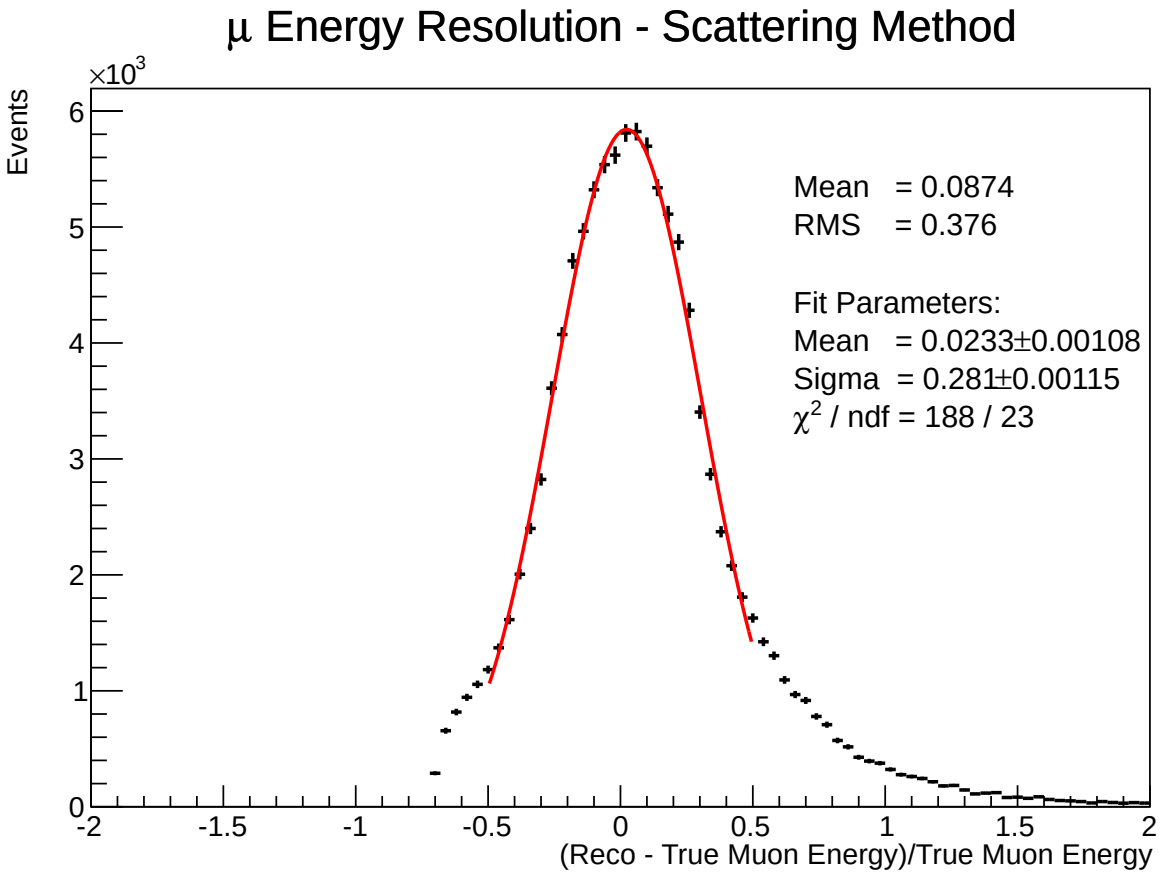

Same details as previous plot