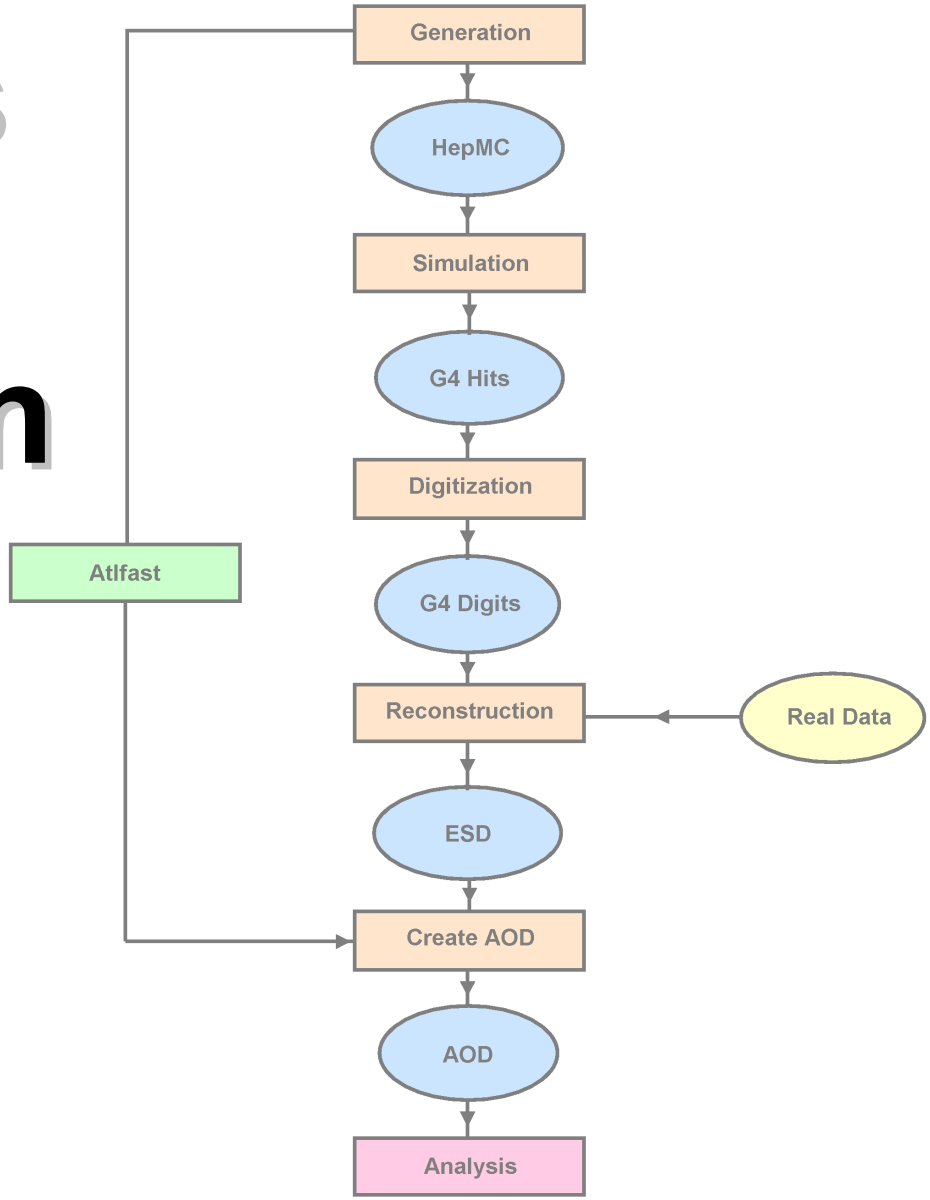
MinimumBias

Full Simulation

what ATLAS

can see



Overview

- Generators: PHOJET and PYTHIA in ATHENA
- Full Chain: a short summary
- The truth
- What can ATLAS see from MinimumBias?
- Summary

PHOJET and PYTHIA in ATHENA

In the p_t-region of soft scattering where MinimumBias takes place, perturbative QCD has **two serious problems:**

1) at $\mathbf{p_t \leq 2GeV}$ the parton cross-section exceeds the proton cross-section.

2) for $\mathbf{p_t \rightarrow 0}$ the differential cross-section diverges.

To simulate MinimumBias there are **two different approaches:**

1) fixing QCD by additional terms, to prevent the divergence (**PYTHIA**)

2) using a different model at $\mathbf{p_t \sim 2GeV}$ (**PHOJET**)

PHOJET and PYTHIA in ATHENA

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2) using a different model (DPM) at $\mathbf{p_t \sim 2GeV}$ (**PHOJET**)

Generator: The question of truth

Truth is hard to find in ATHENA, tools like CBNT fail!

I implemented histogramming in the generator interface to get the truth.

Problem: both Generators have different stable particles.
==> hard to compare the truth!

In ATHENA there are two different definitions of truth:
MC – Truth: Generated particles
Geant – Truth: Particle-detector-interaction

In this talk I will only look at MC – Truth.

For my diploma thesis I am working to obtain Geant - Truth.

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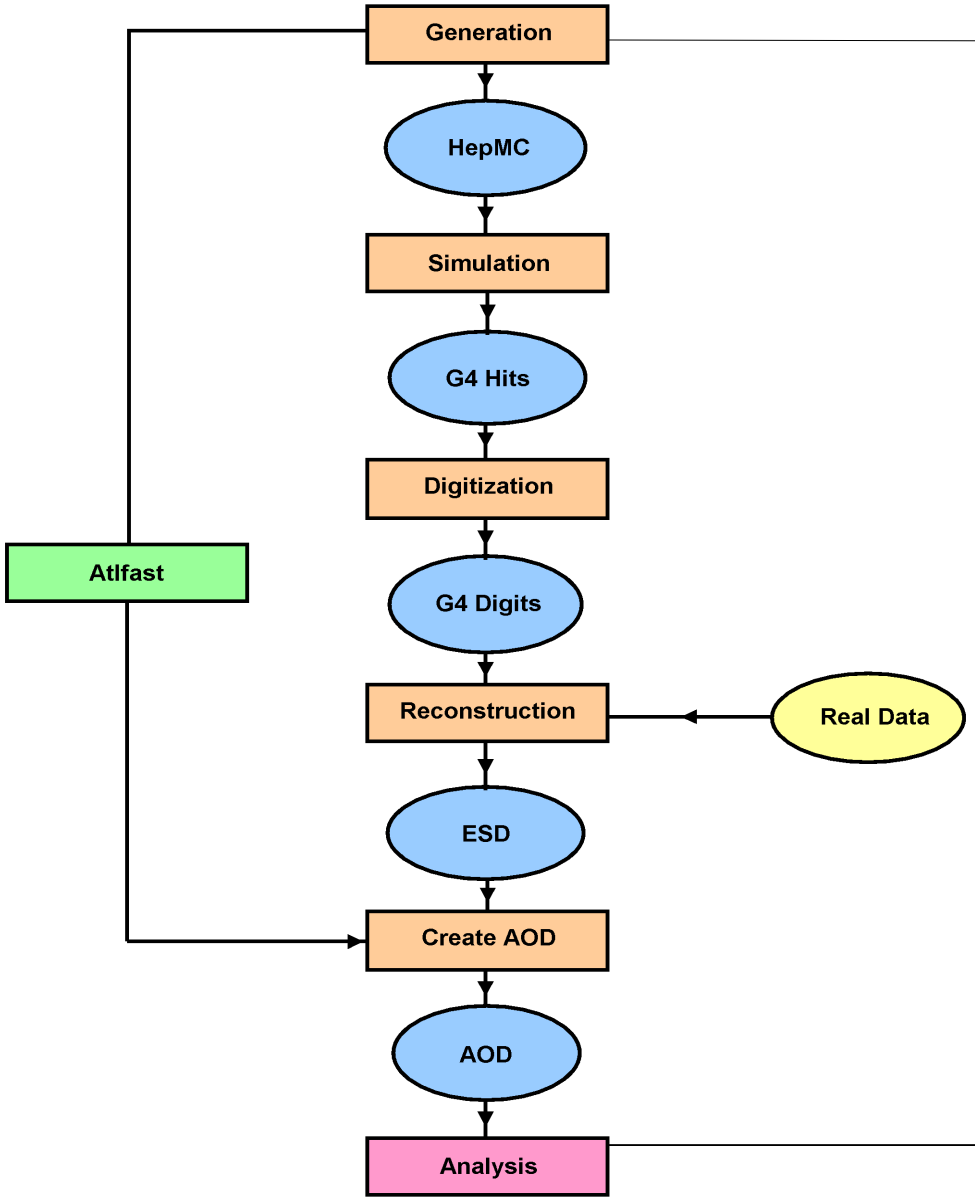
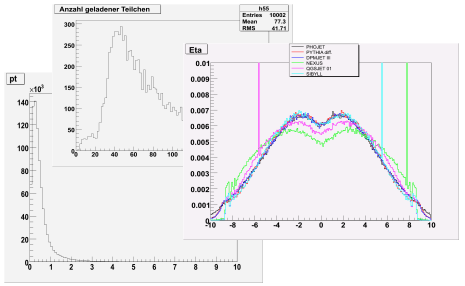
Full Chain



PYTHIA and PHOJET

Root n-tuples

Truth information



comparison

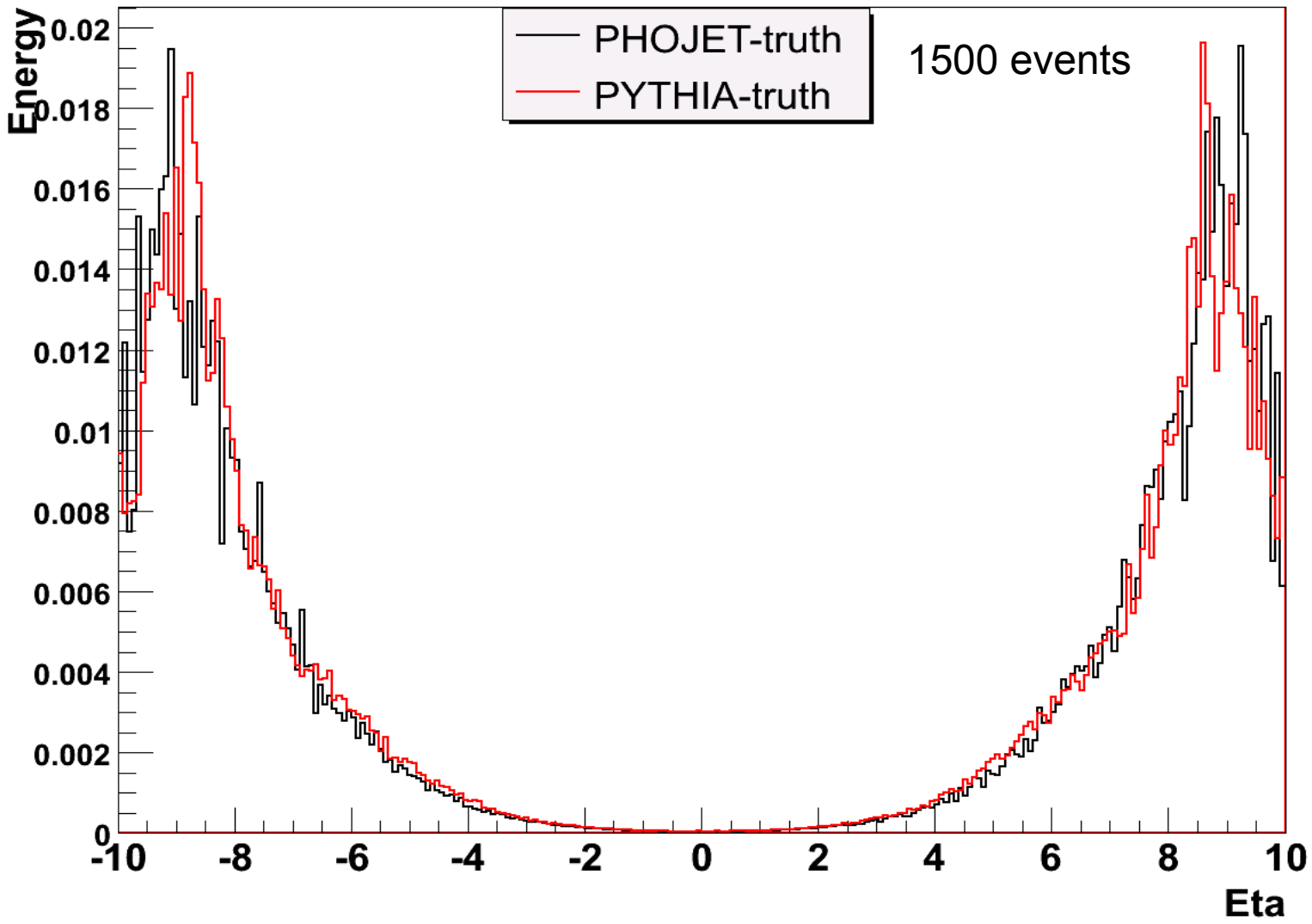
Reconstructed information

Root n-tuples

User Analysis

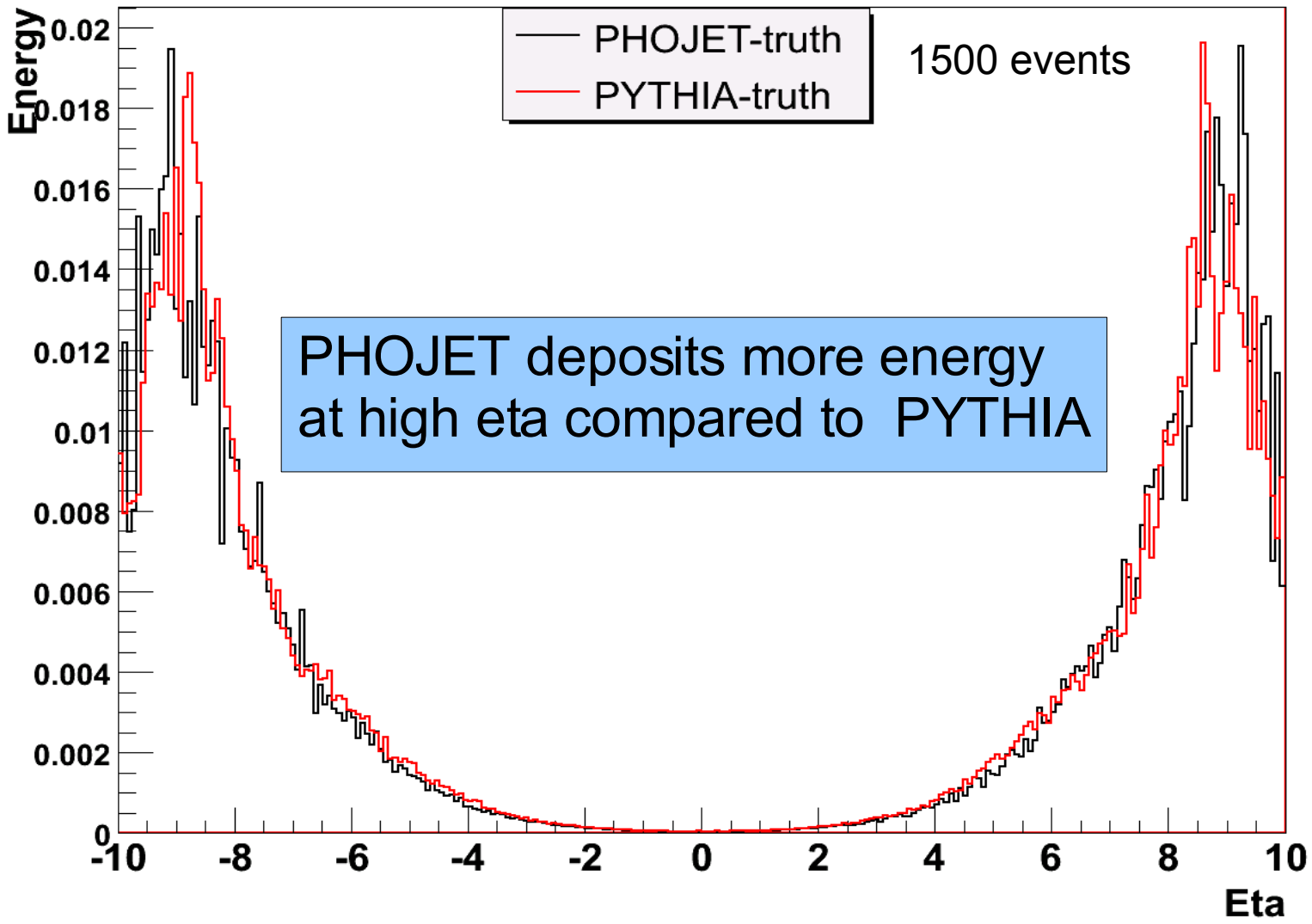
The truth

Eta weighted by energy



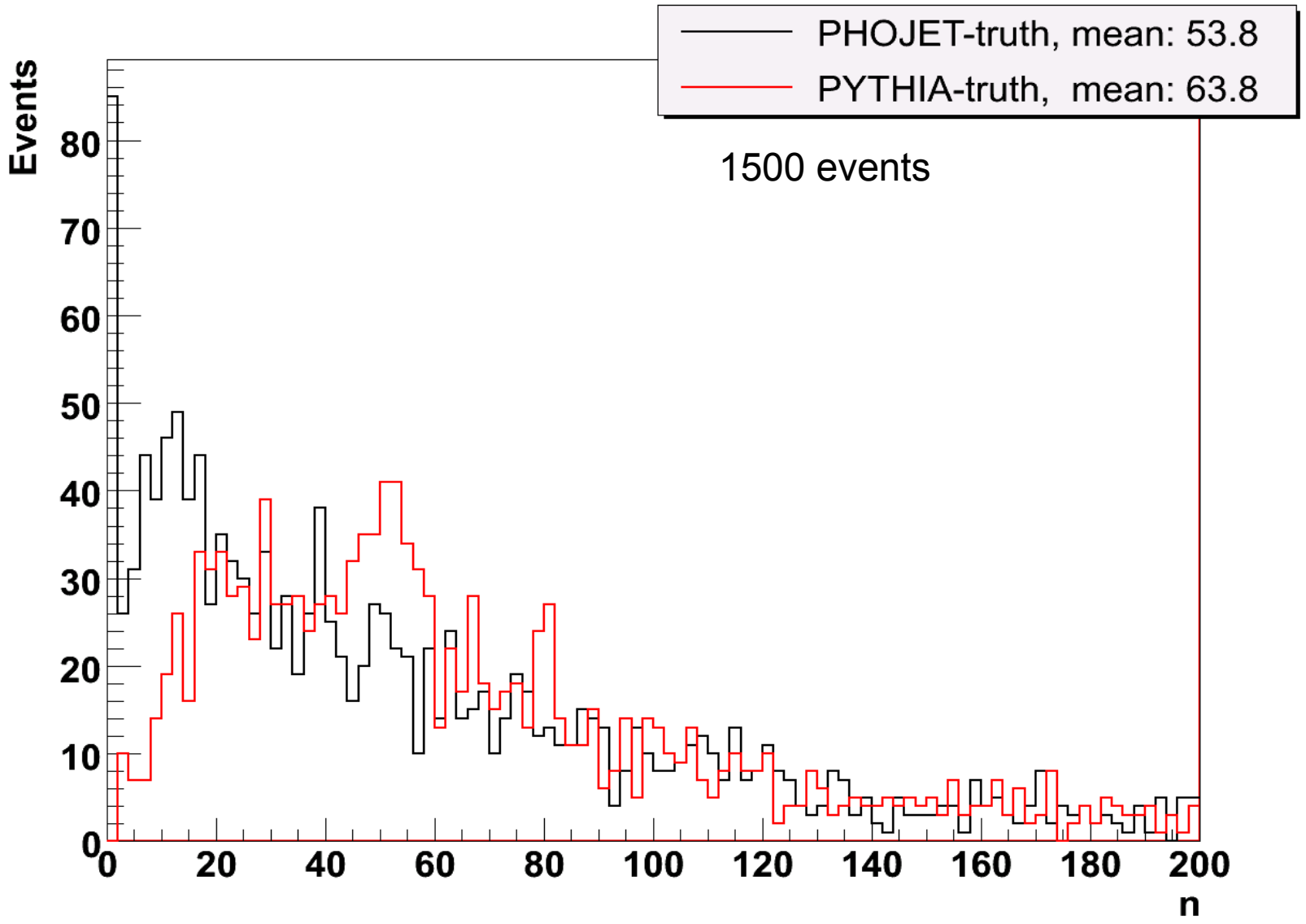
The truth

Eta weighted by energy



The truth

Charged particle multiplicity



The truth

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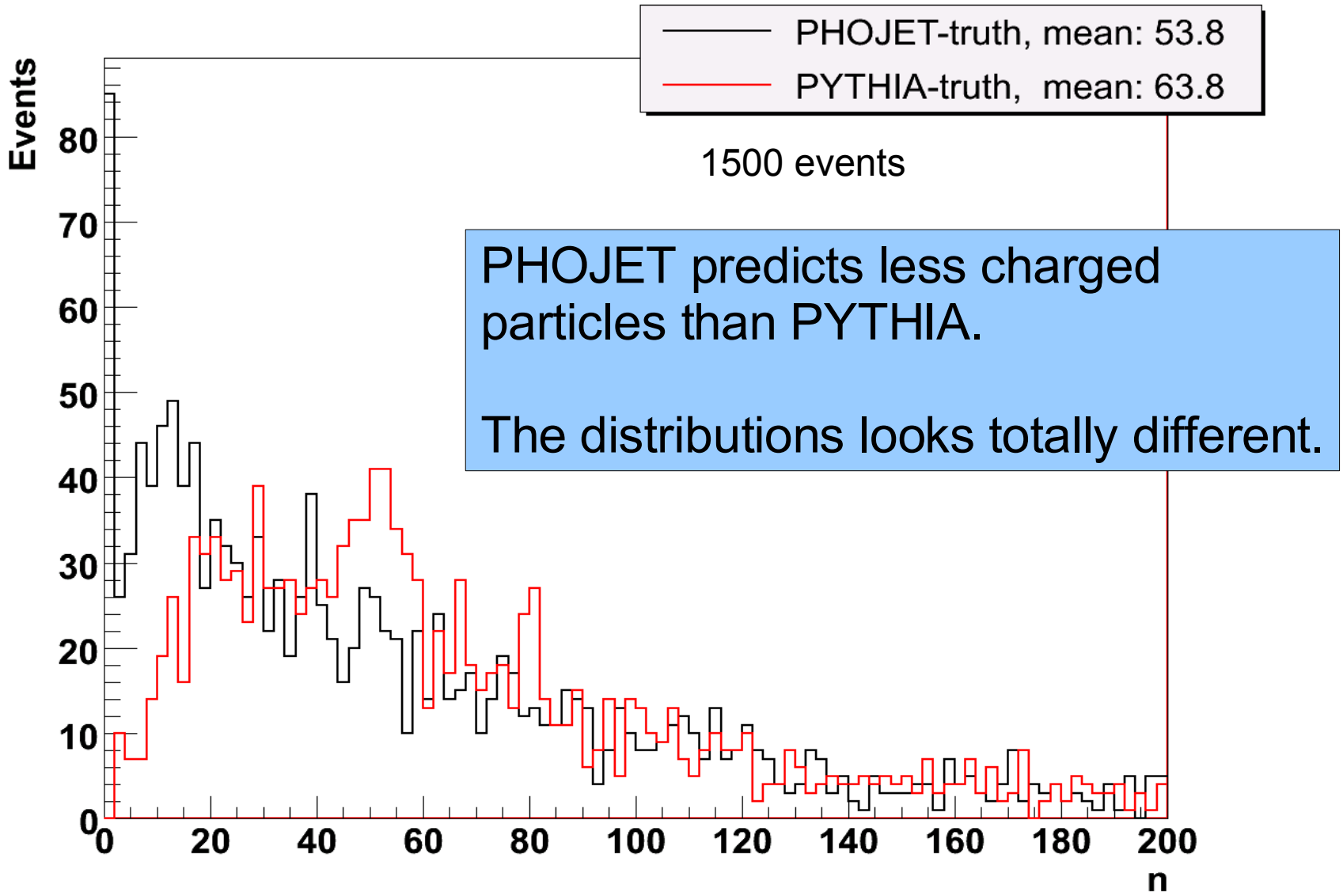
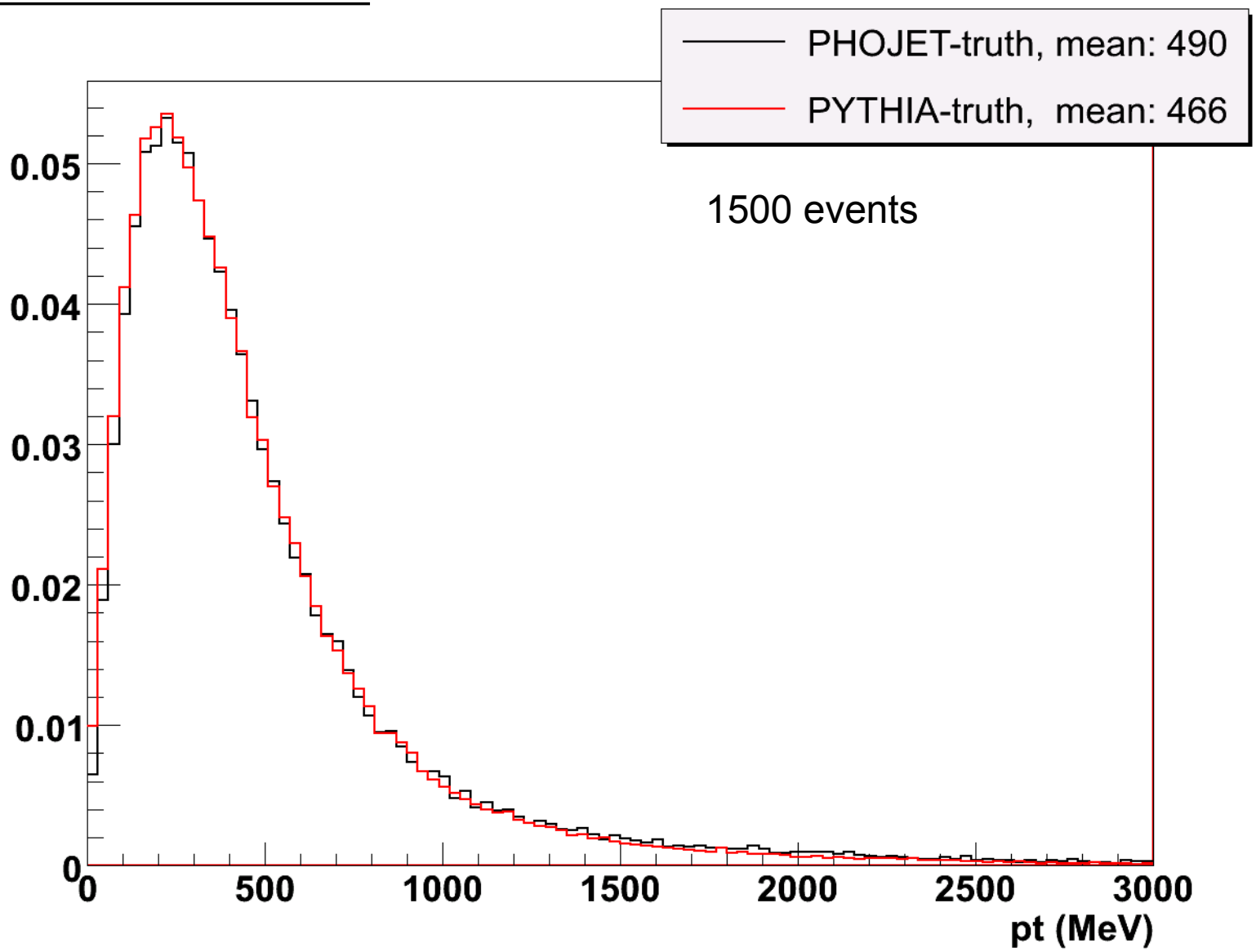


PHOJET predicts less charged particles than PYTHIA.

The distributions looks totally different.

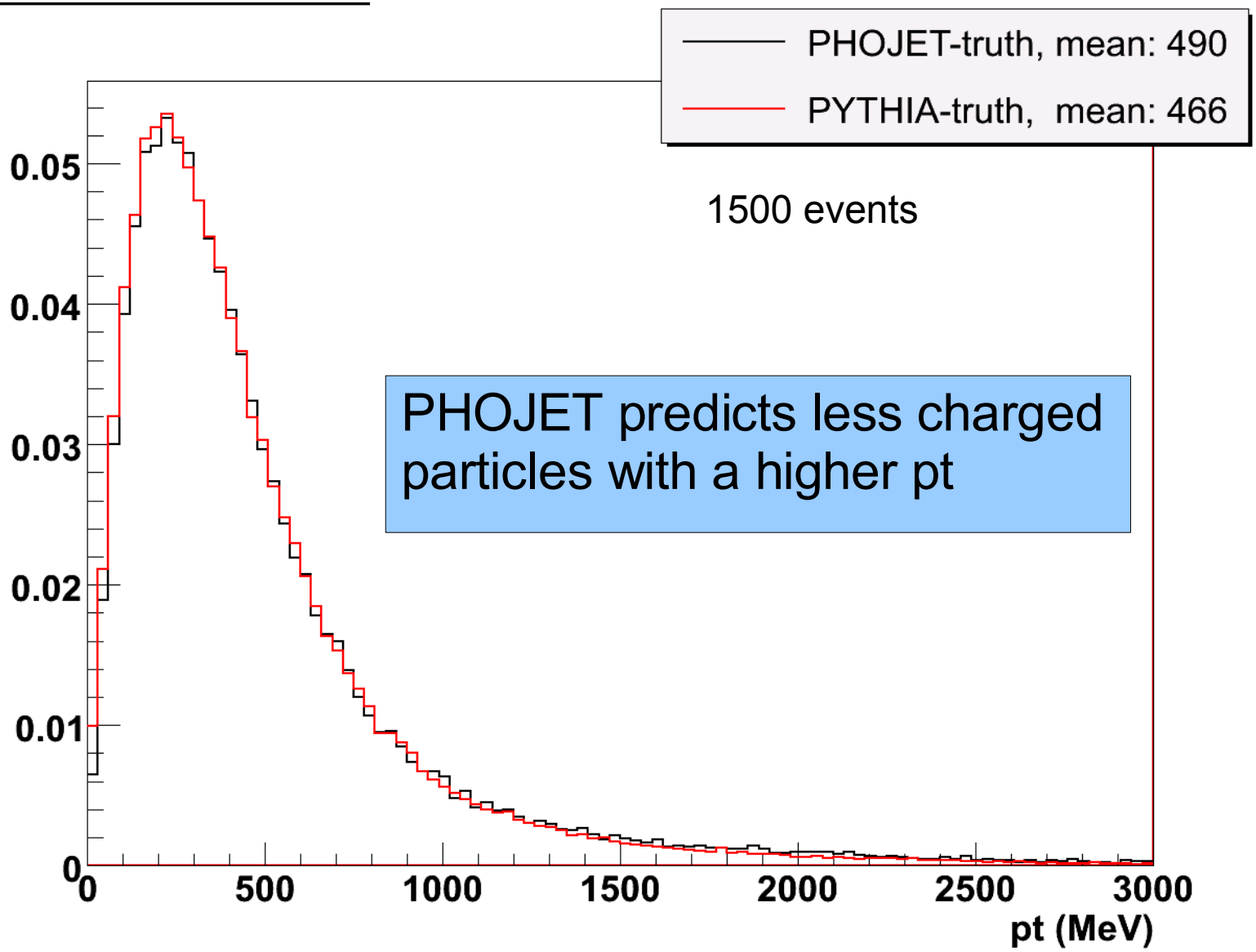
The truth

Transversal momentum



The truth

Transversal momentum



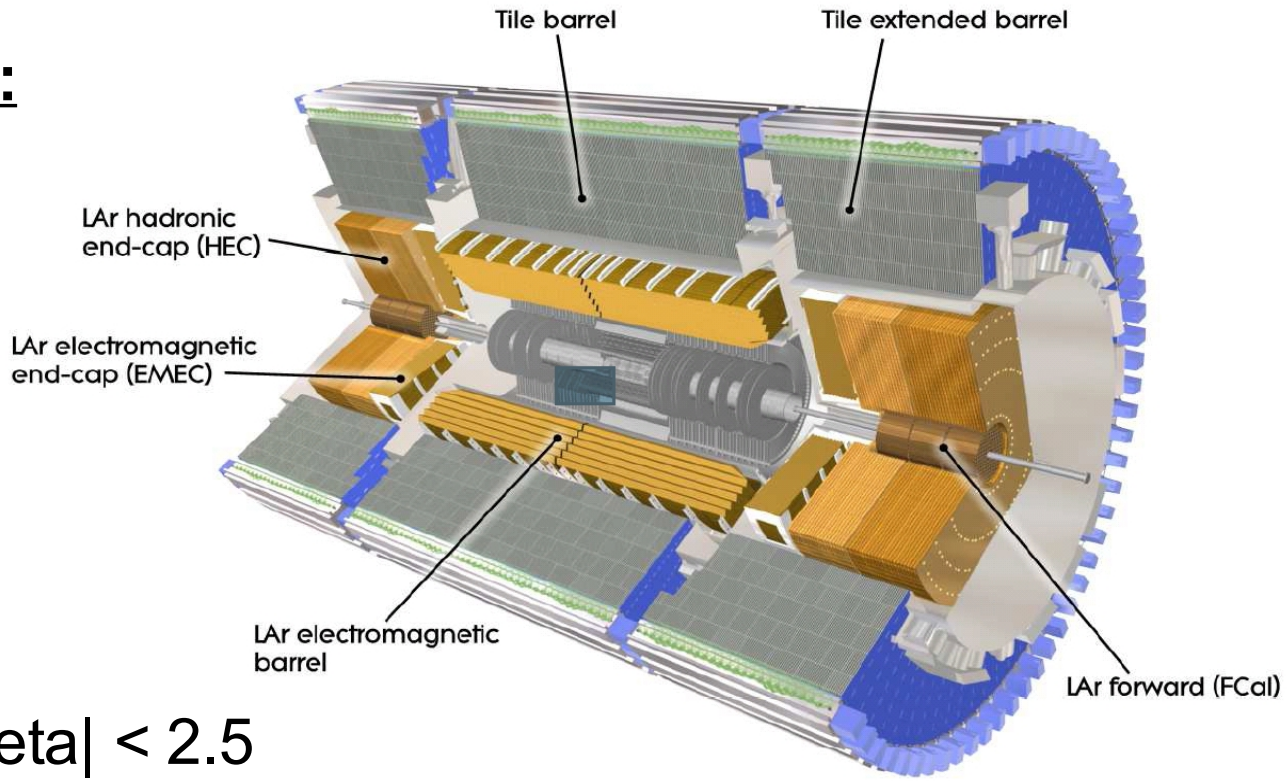
PHOJET predicts less charged particles with a higher pt

The truth

- Most energy of MinimumBias events is deposit at high eta range.
- PHOJET produced more particles towards high eta region
- and predicts less charged particles with higher transverse momentum compared to PYTHIA.
- The charged particle distributions have a totally different shape.

What ATLAS can see

The ATLAS calorimeter:



Cuts: p_t > 500 MeV
e > 500 MeV

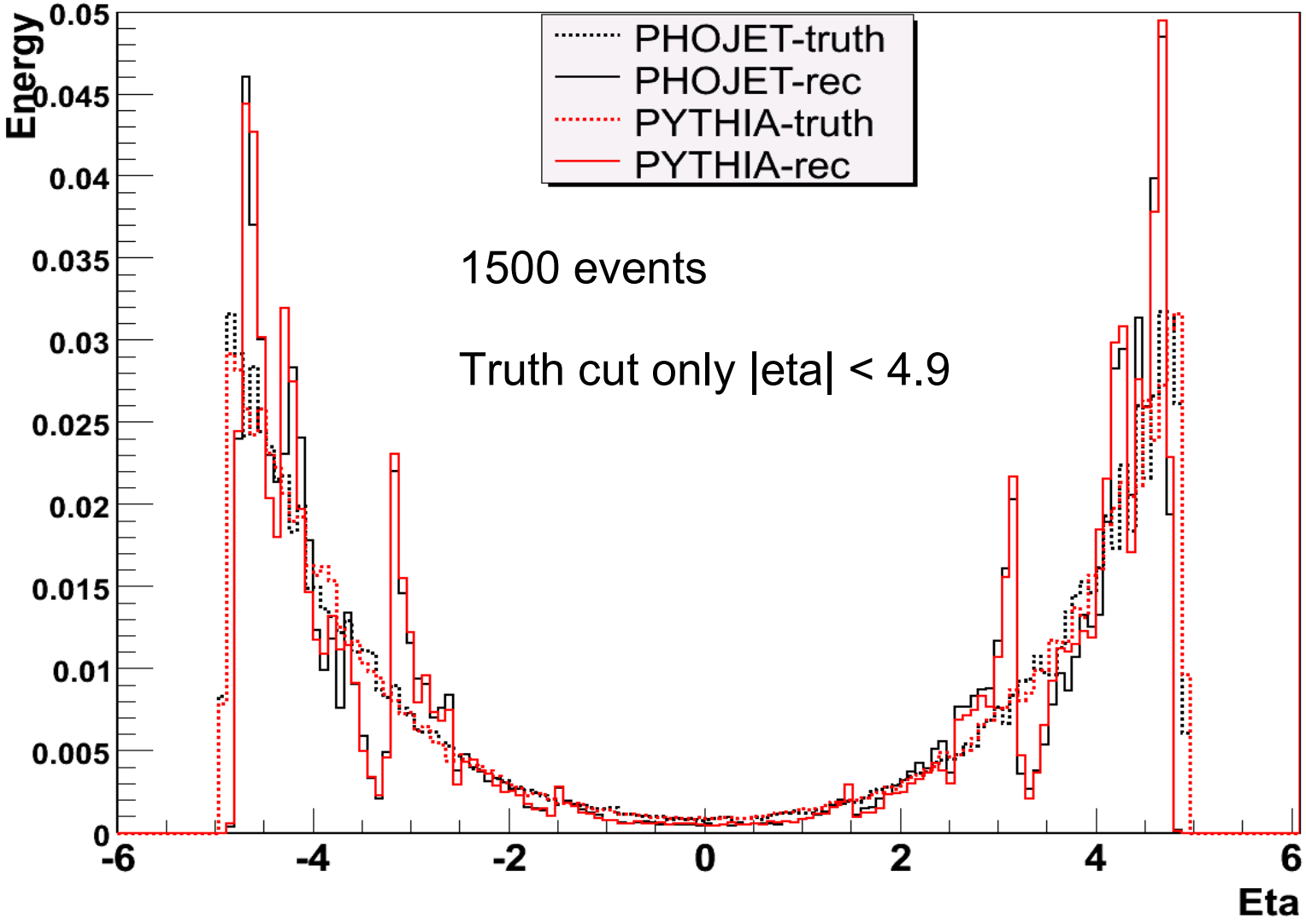
Track reconstruction: |eta| < 2.5

Hadronic calorimeter:
Barrel: |eta| < 1.7
Endcap: 1.5 < |eta| < 3.2
Forward: 3.1 < |eta| < 4.9

Electromagnetic calorimeter:
Barrel: |eta| < 3.2
Forward: 3.1 < |eta| < 4.9

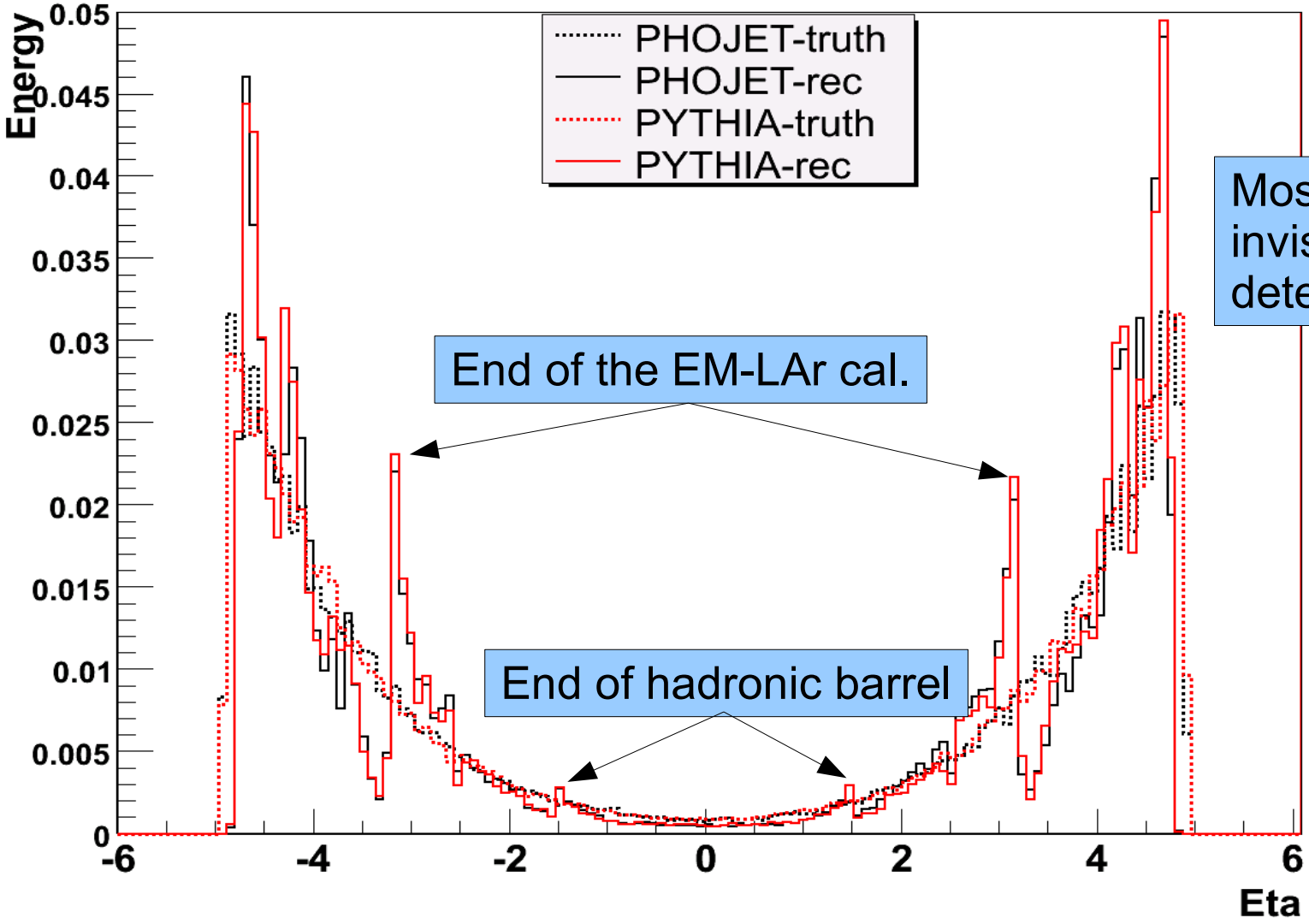
What ATLAS can see

Eta weighted by energy



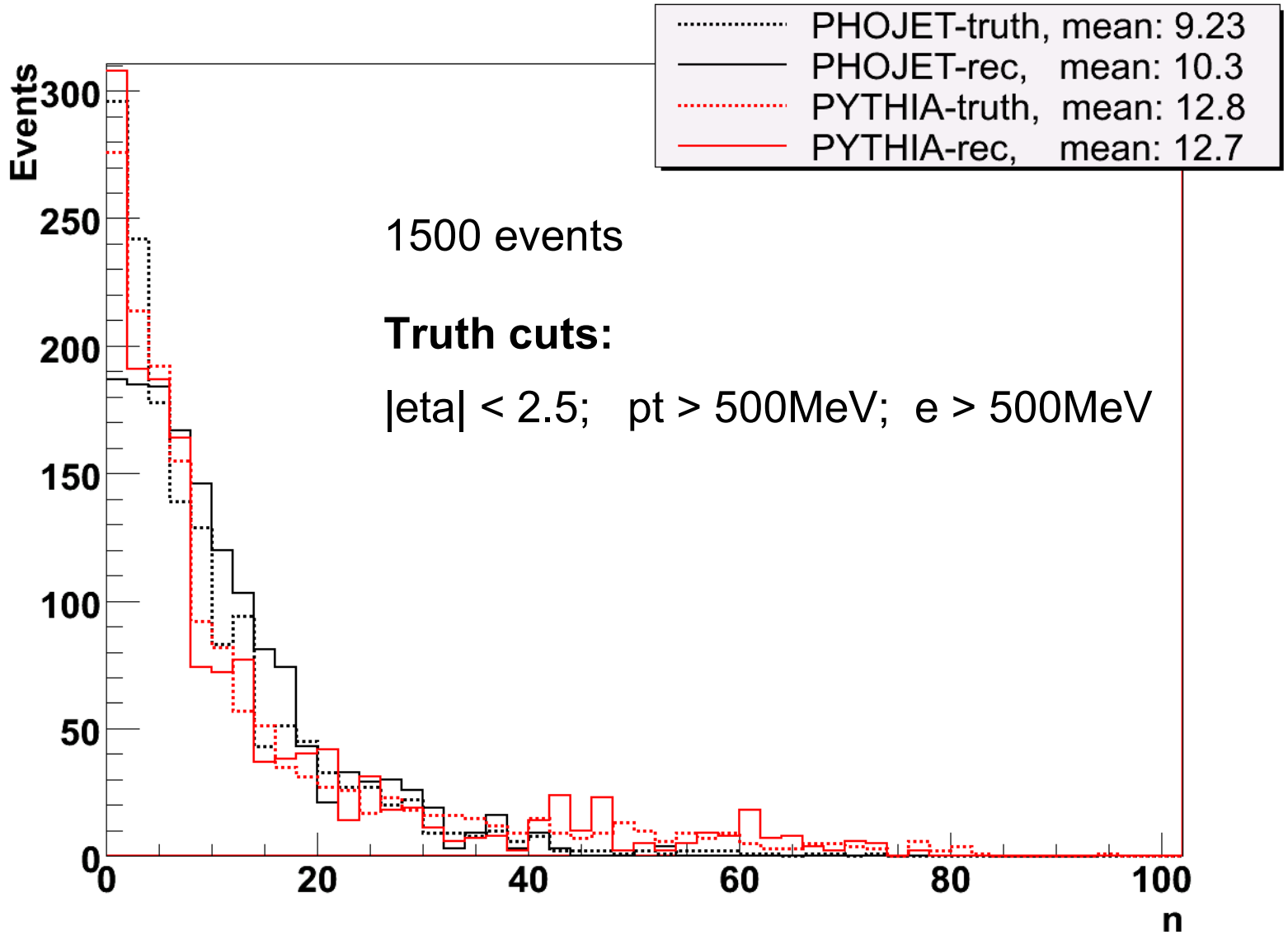
What ATLAS can see

Eta weighted by energy



What ATLAS can see

Charged particle multiplicity



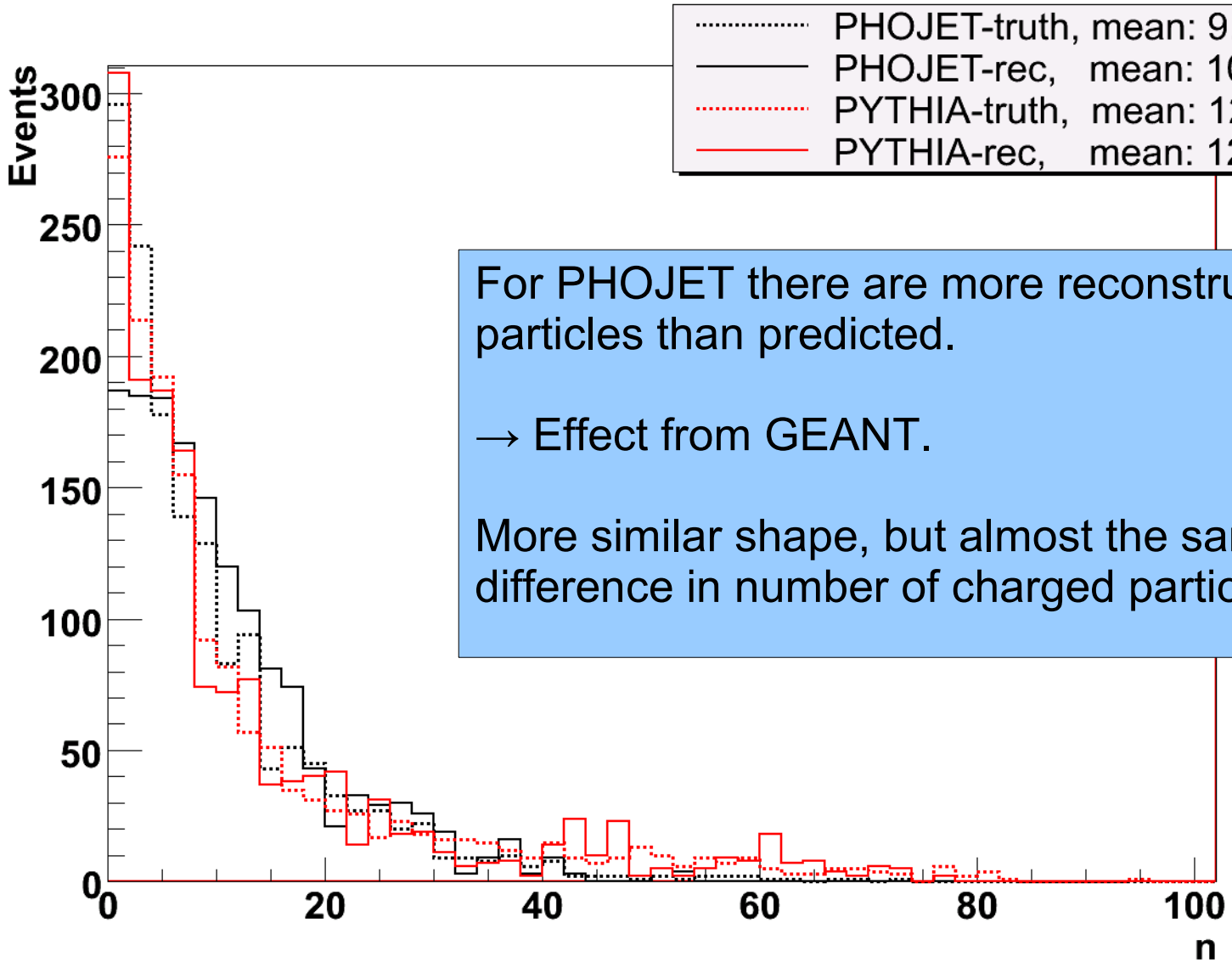
1500 events

Truth cuts:

|eta| < 2.5; pt > 500MeV; e > 500MeV

What ATLAS can see

Charged particle multiplicity



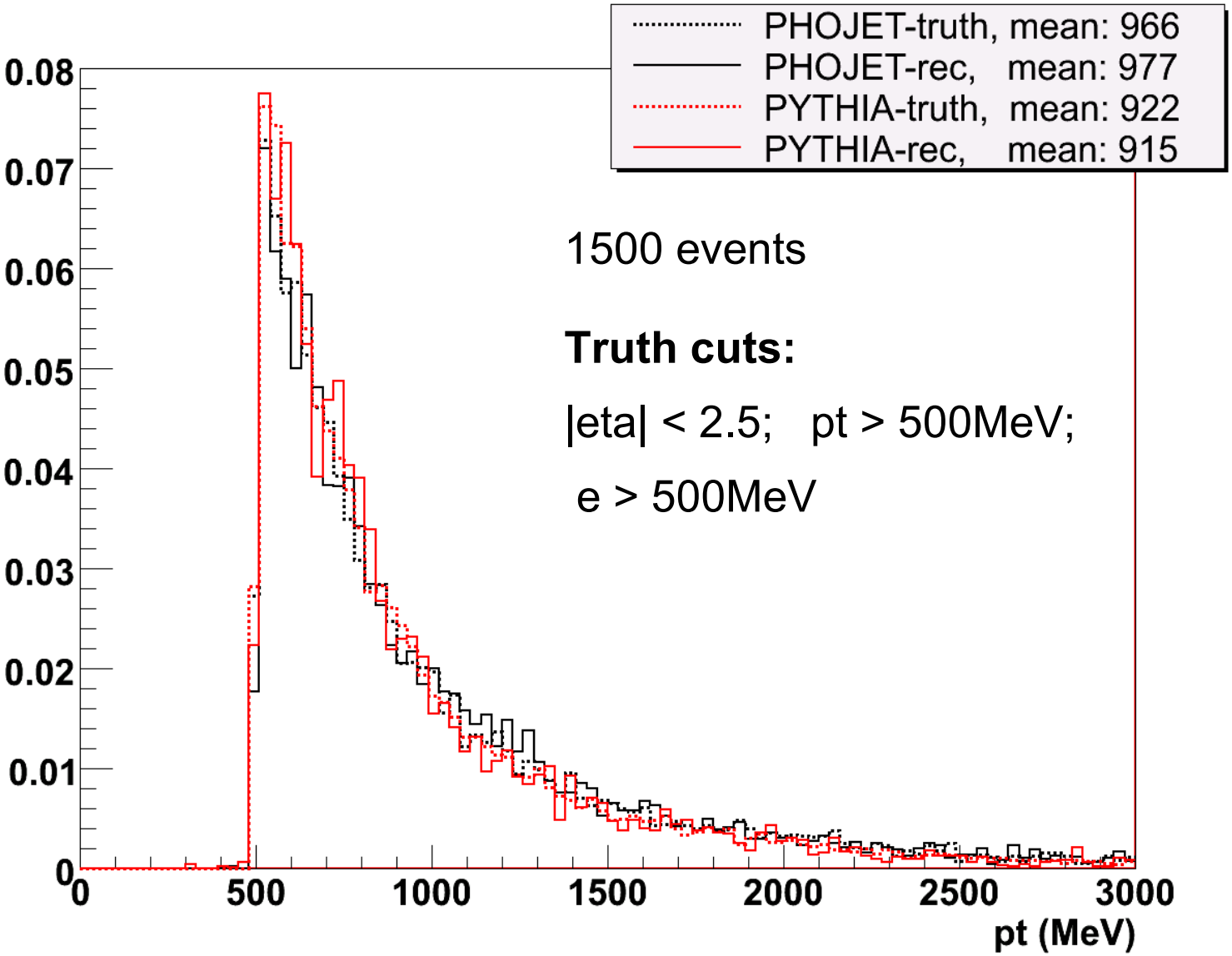
For PHOJET there are more reconstructed particles than predicted.

→ Effect from GEANT.

More similar shape, but almost the same difference in number of charged particles.

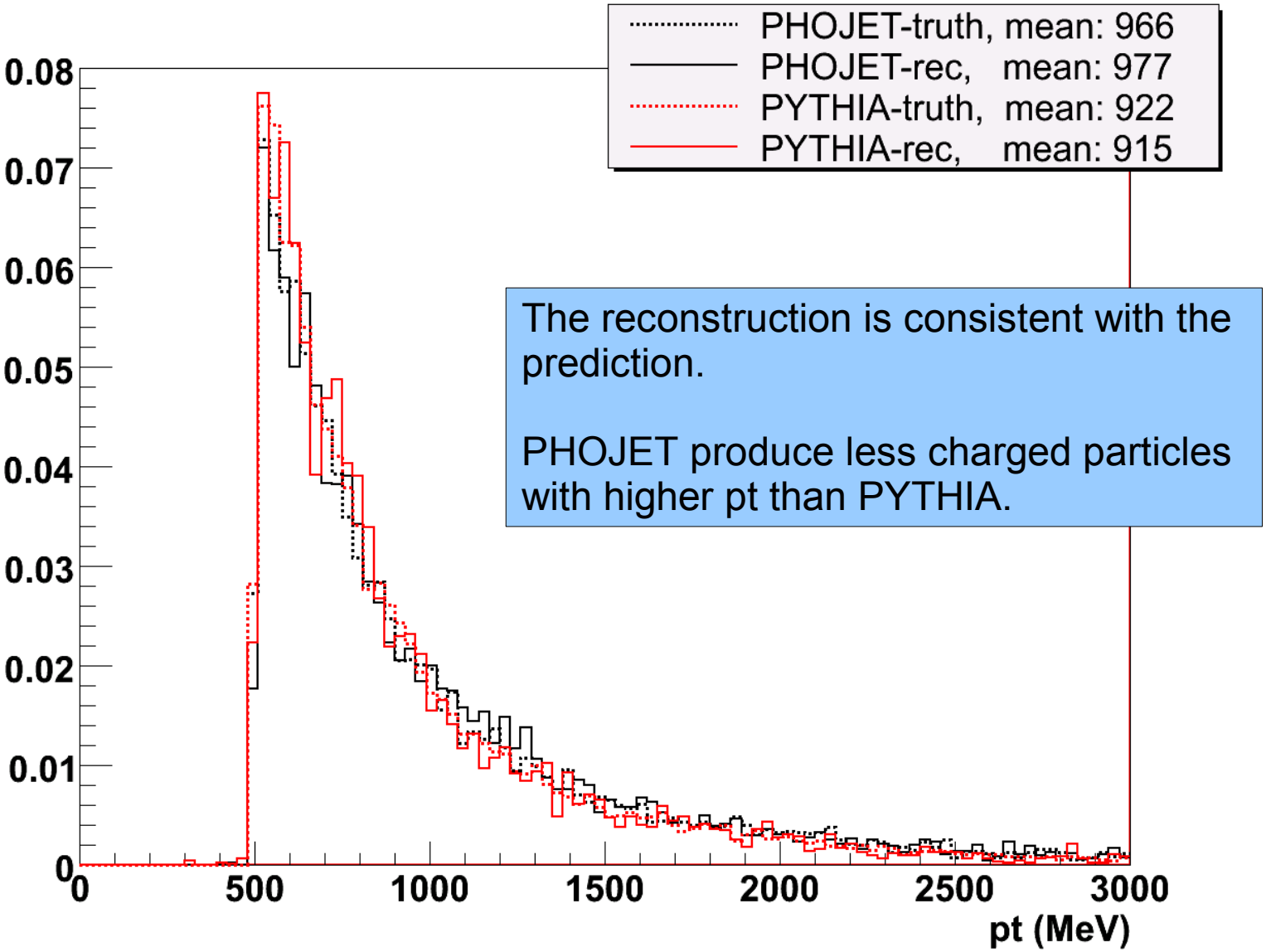
What ATLAS can see

Transverse momentum



What ATLAS can see

Transverse momentum



The reconstruction is consistent with the prediction.

PHOJET produce less charged particles with higher pt than PYTHIA.

Summary

- The biggest part of MinimumBias events is invisible for the ATLAS detector.
- But the differences of both generators can still be seen.
- Overall, PHOJET predicts less charged particles with higher pt compared to PYTHIA.
- To make more reasonable predictions I have to go to higher statistics and I need the truth information from GEANT.

THANK YOU!