Cosmic ray Electron + Positron Flux measurement with DAMPE

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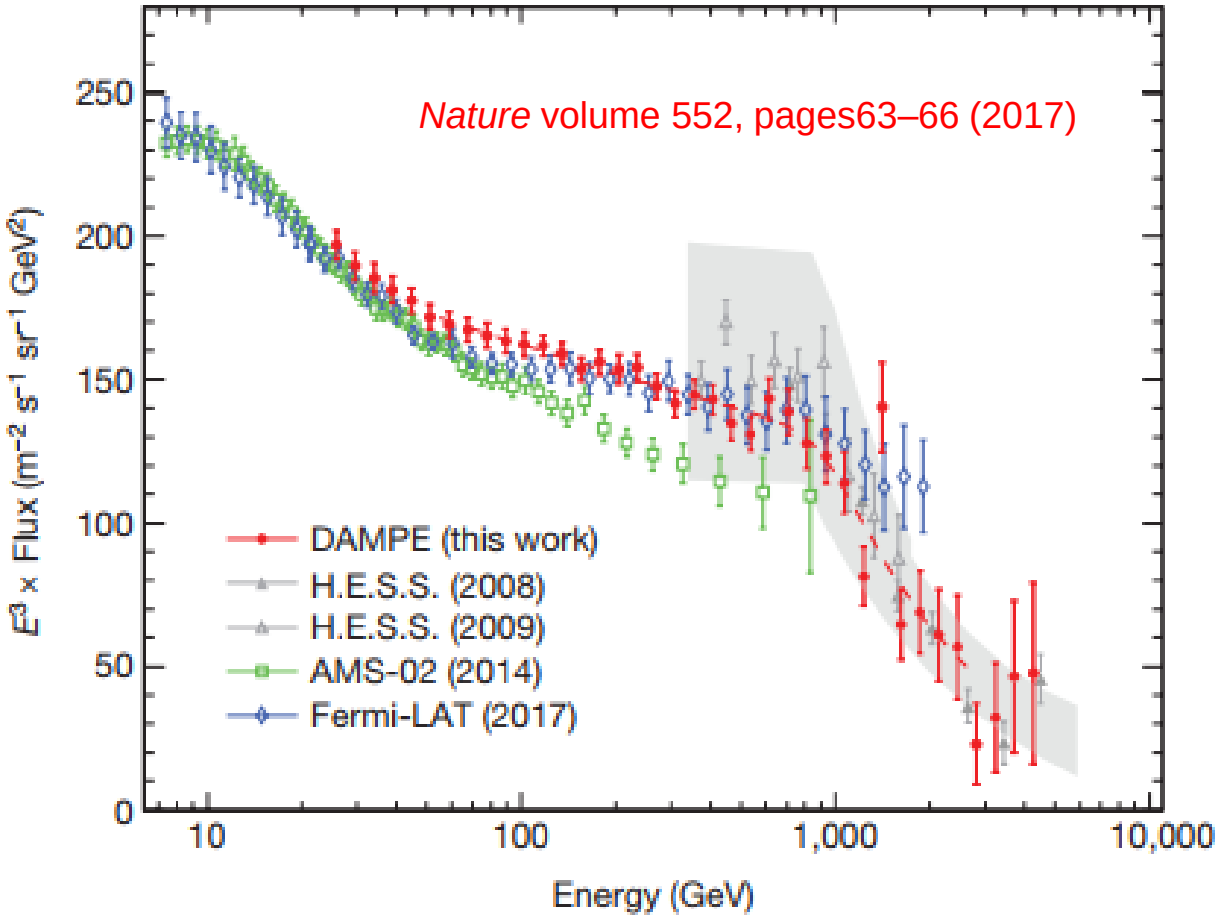
Motivation

Update the cosmic electron + positron flux with 10 years of data (2016.01.01-2025.12.31) mainly using 2017 published analysis method.



Data Sample

- **Flight Data:**
  Data Sample: 10 years (01/01/2016 – 31/12/2025) of data with updated energy reconstruction process
  Live Time: 2.41*10^8 s
  Data in SAA region are excluded
  Data during Sep2017 Solar Flare (20170908~20170913) are excluded

- **MC Simulation:**
  FTFP Electron: 1 GeV – 100 TeV (simu-v6r0p10-reco-v6r0p10)
  FTFP Proton: 10 GeV – 100 TeV (simu-v6r0p18-reco-v6r0p18)
  FLUKA Proton: 10 GeV – 10TeV (simu-v6r0p18-reco-v6r0p18)

Flux Calculation

Flux in $(E, E + \Delta E)$ energy bin:

$$\Phi(E, E + \Delta E) = \frac{N_{sig}(E, E + \Delta E)}{T\ A(E, E + \Delta E)\ \Delta E}$$

$N_{sig}(E, E + \Delta E)$: the number of observed events

$A(E, E + \Delta E)$: effective acceptance

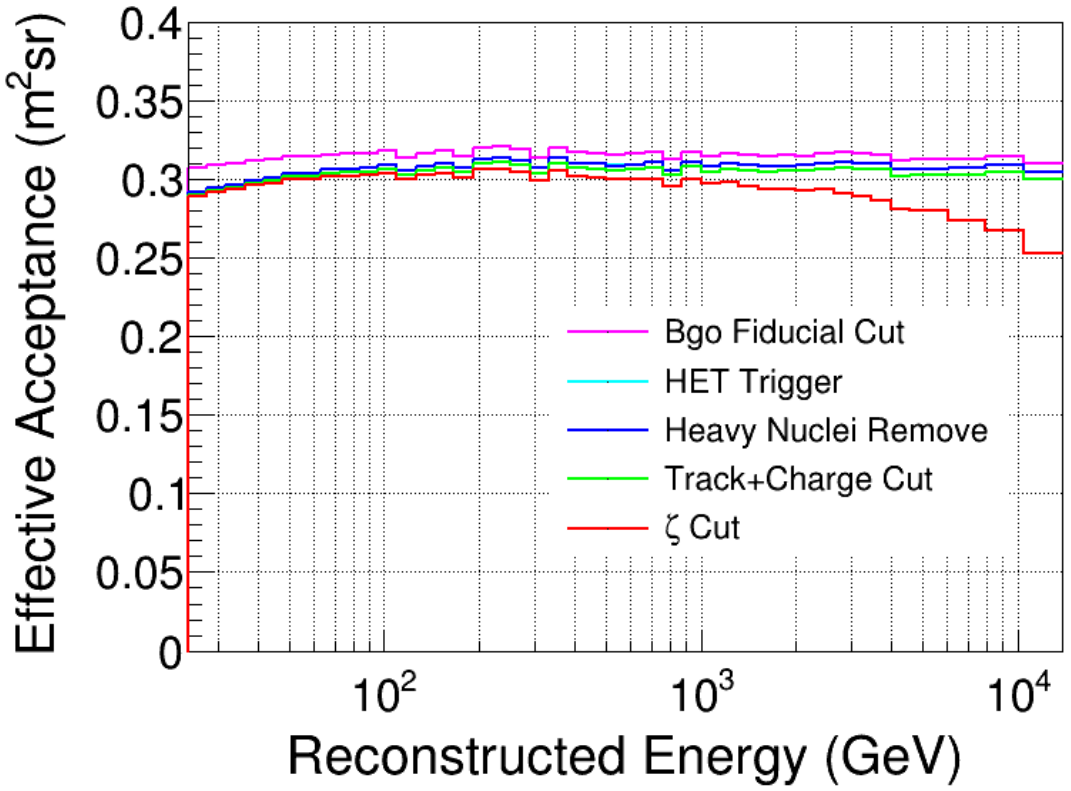
T: effective exposure time

ΔE: energy interval width

Pre-Selections

using analysis method published in 2017

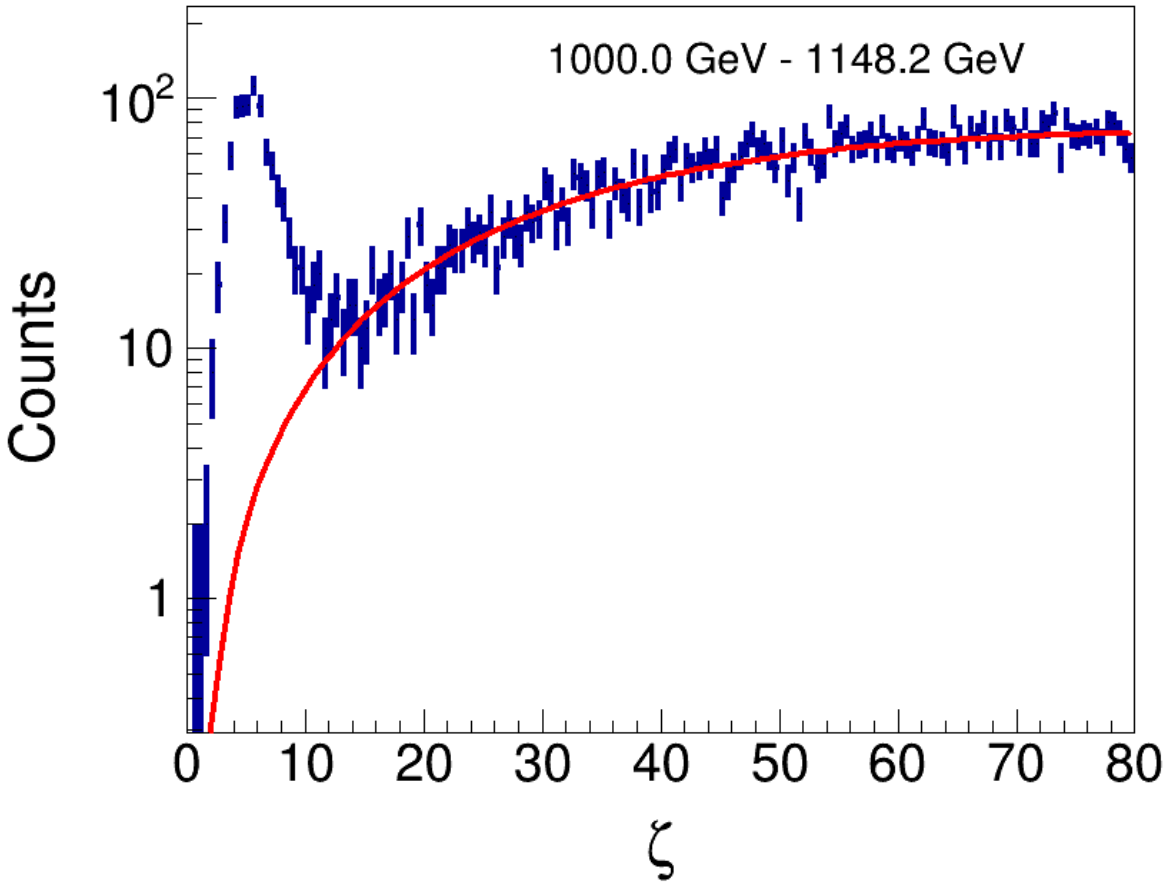
- **BGO Fiducial Cut**
- **HET Trigger (G3)**
- **Heavy Nuclei Remove**
- **Track and Charge Cut (including BGO-Only Events)**
- **Electron/Proton Separation**

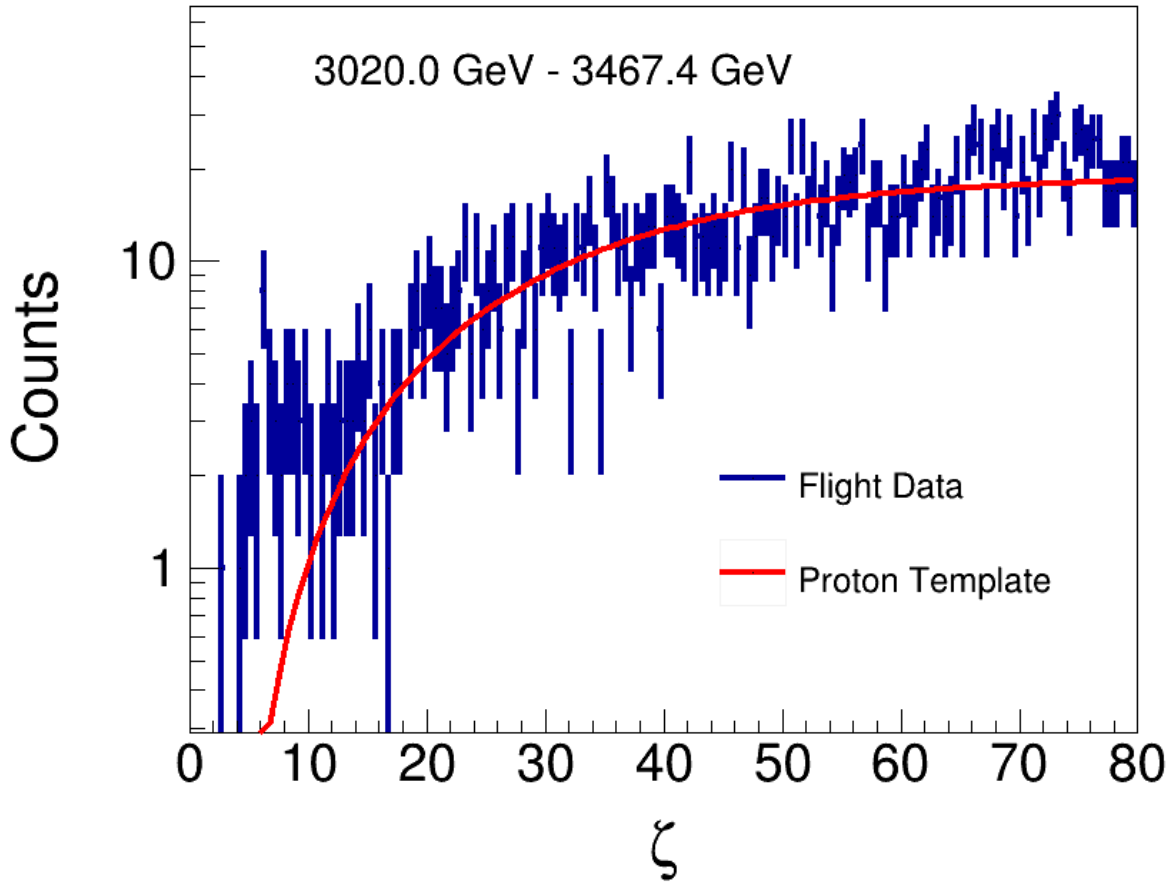


Skip the Details!

Electron/Proton Separation

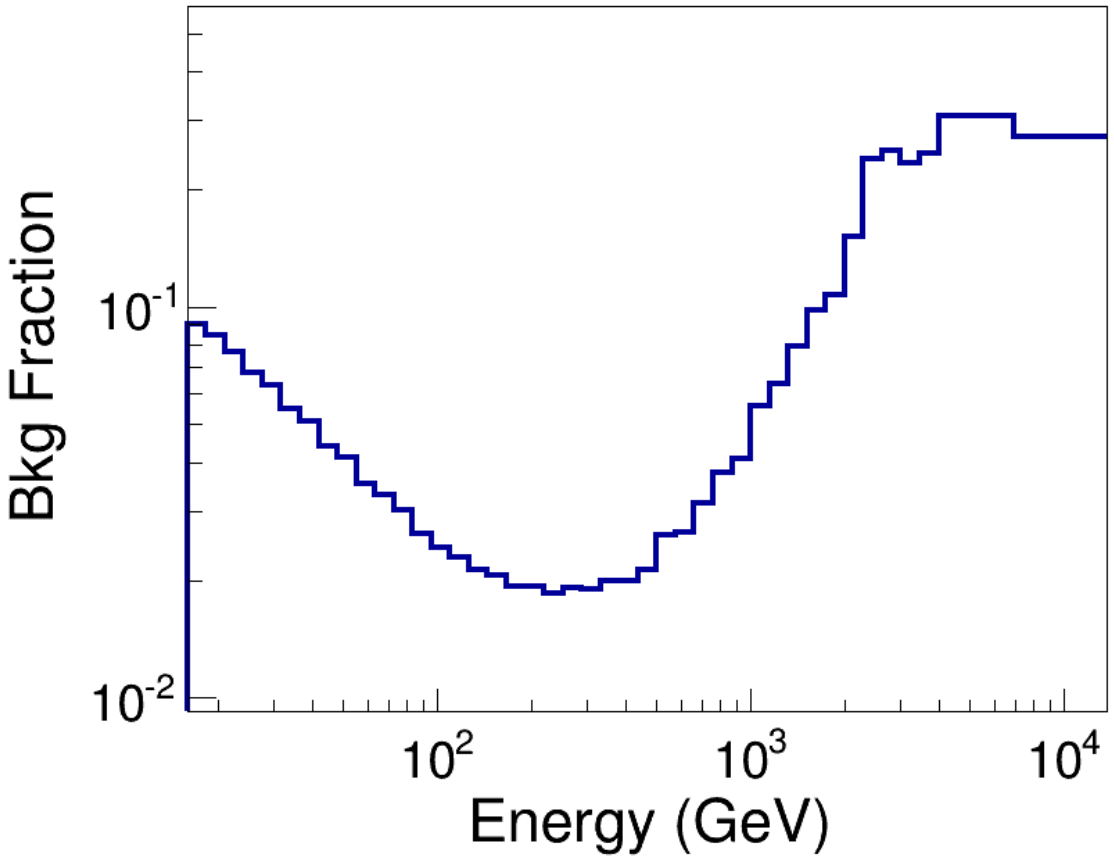
ζ template fitting for particle identification

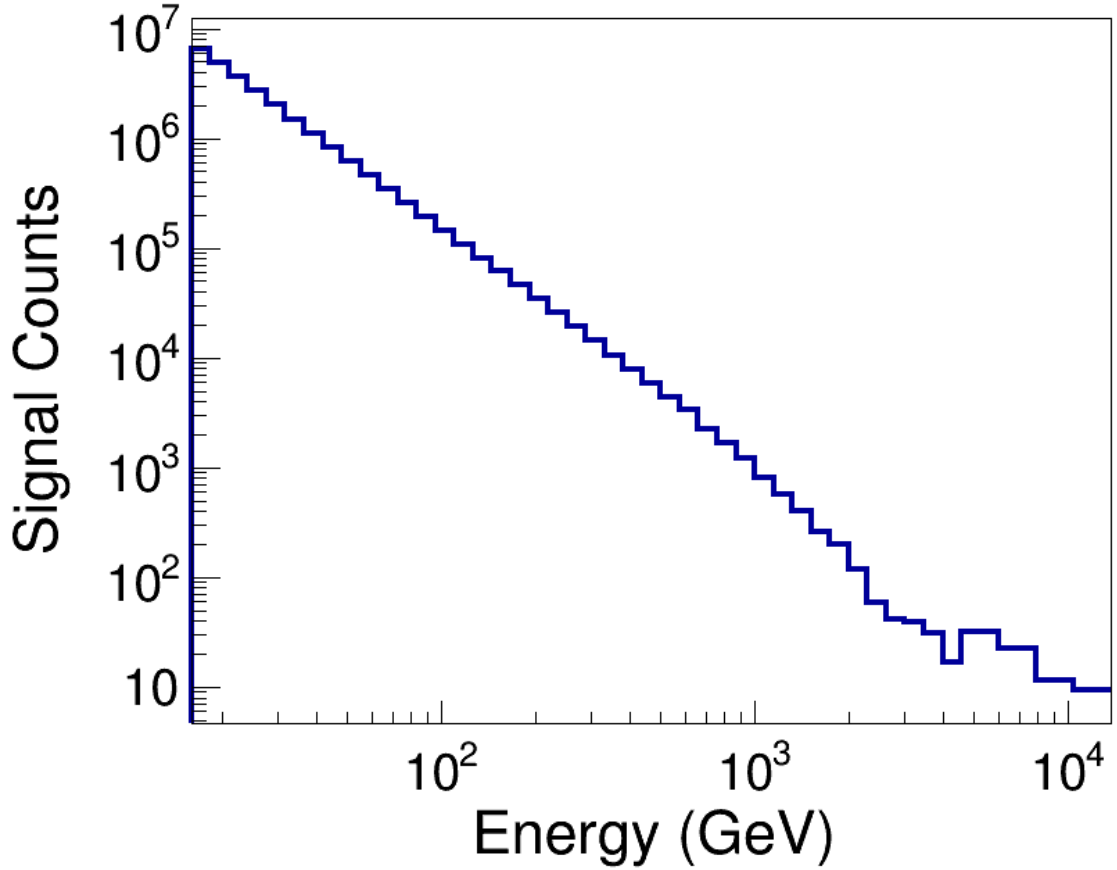




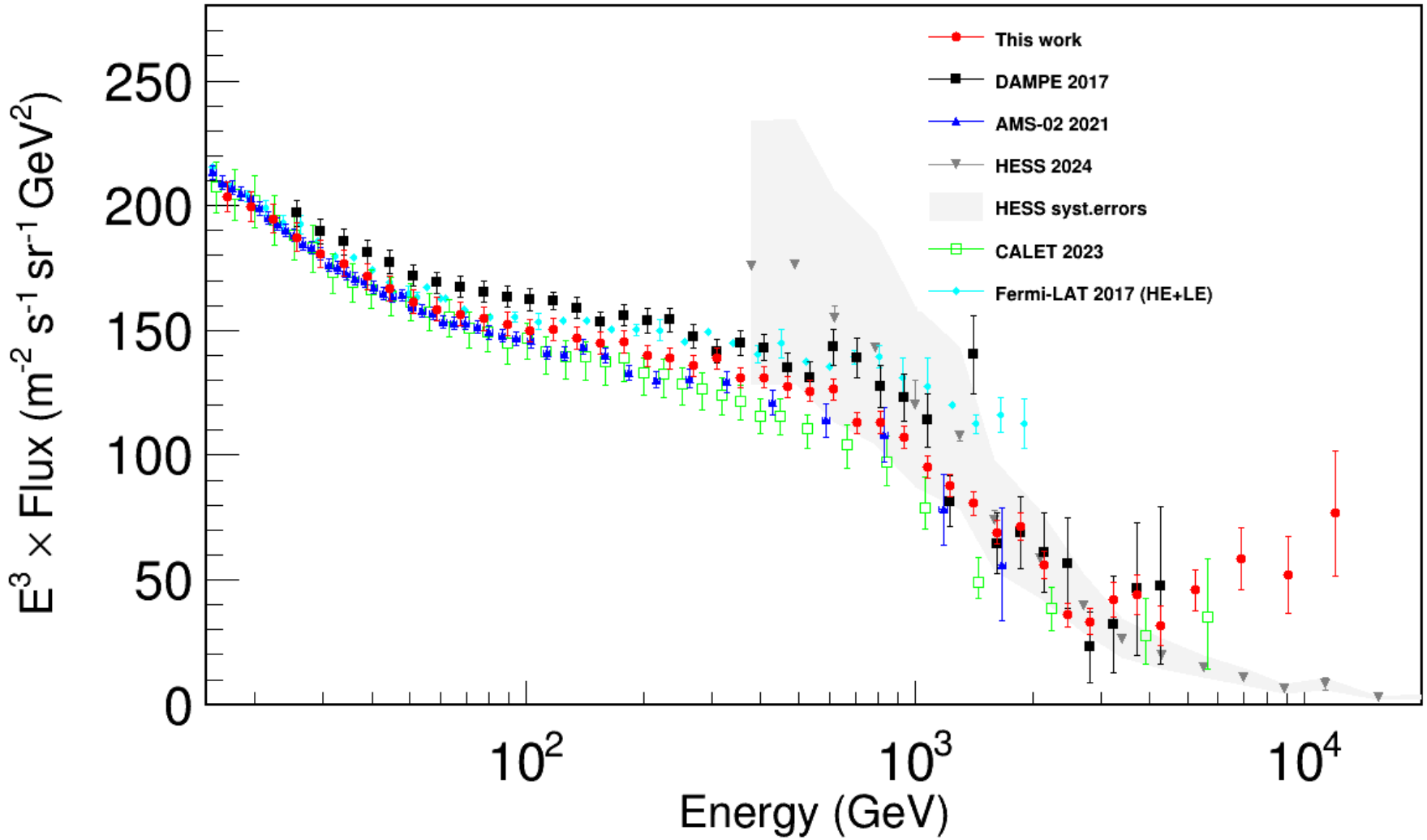
Background Estimation

Traditional ζ Cut

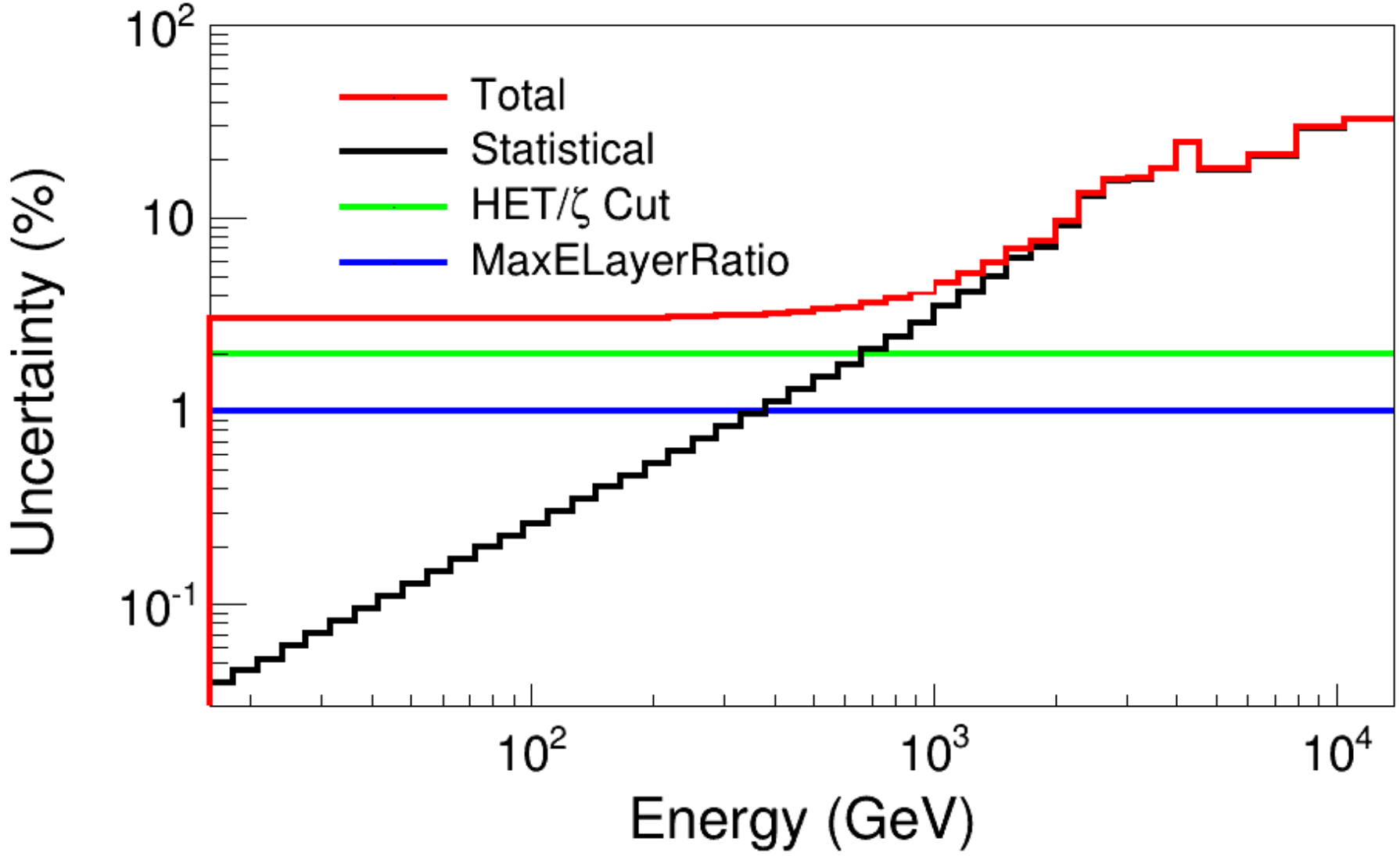




Electron Flux From 17 GeV to 14 TeV

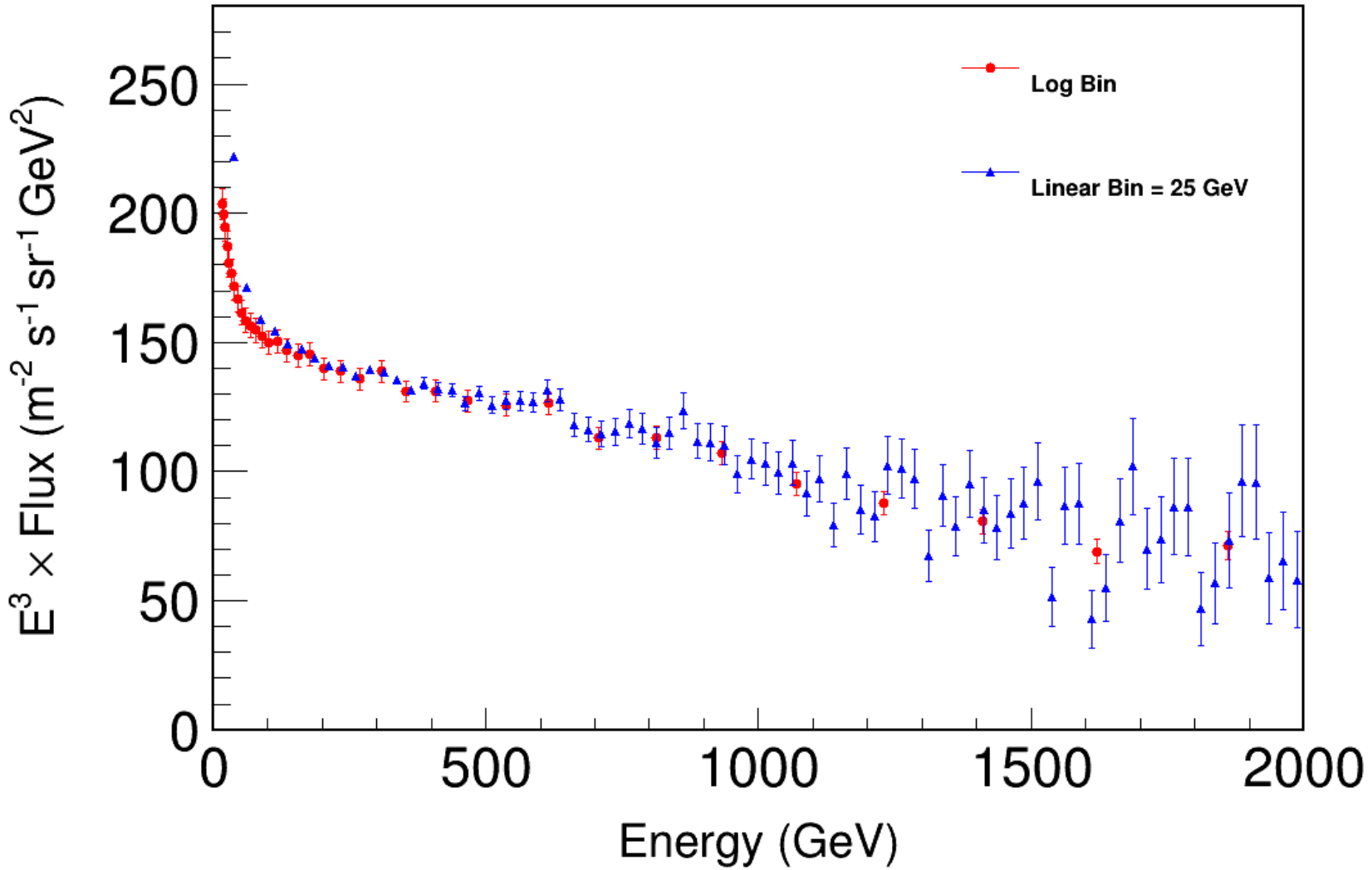


Systematics

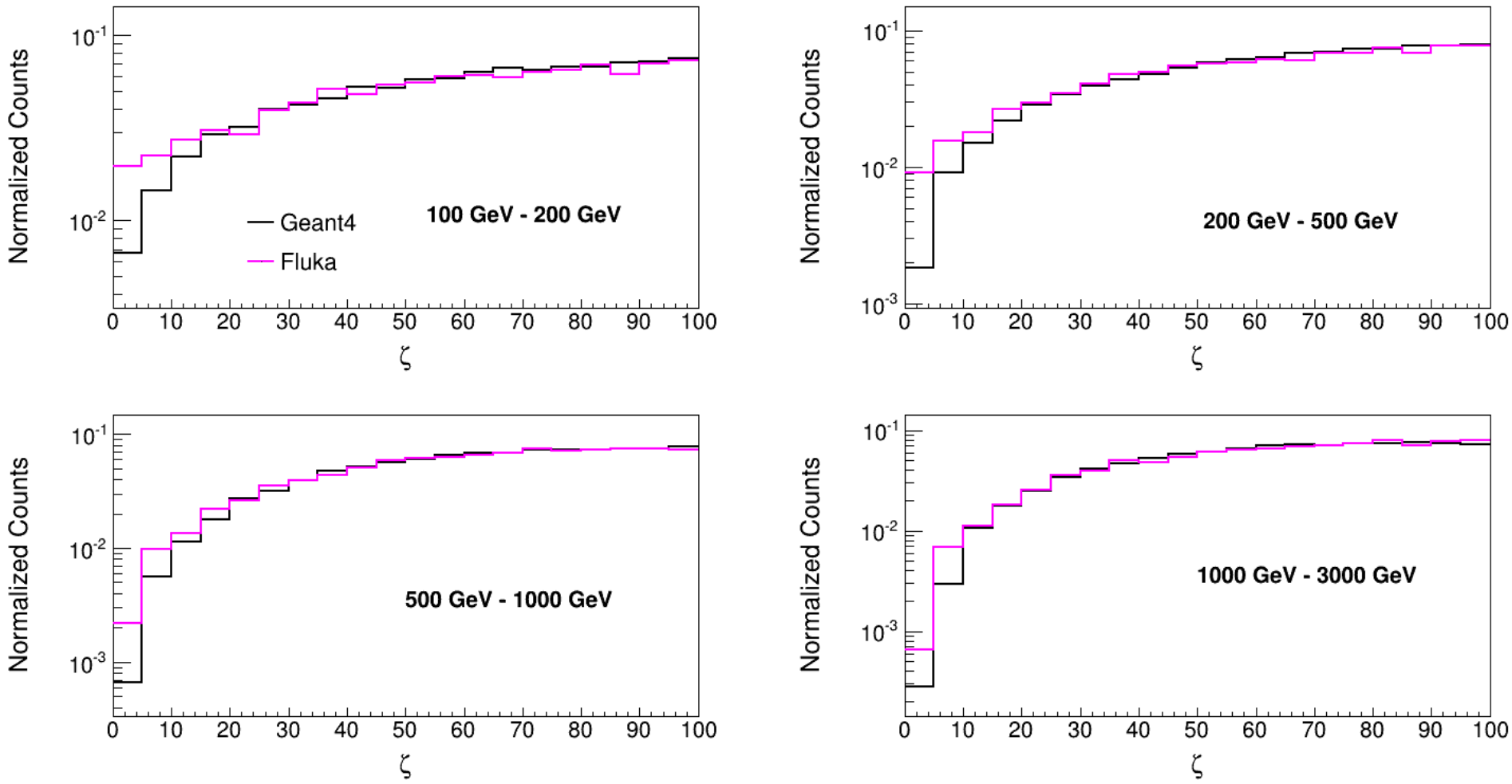


HET: 2% ζ Cut: 2% MaxELayerRatio: 1%

Linear Bin With Statistical Errors

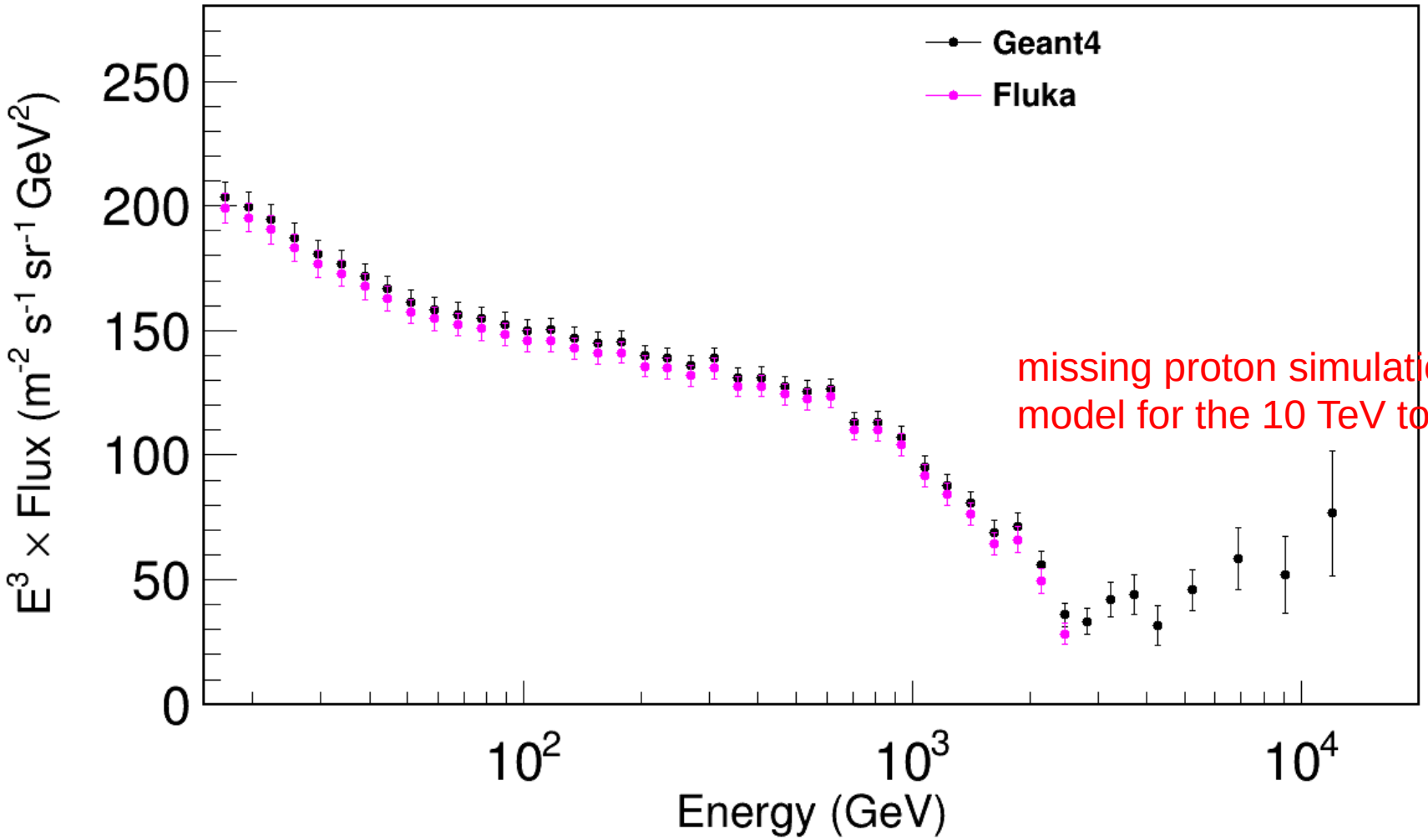


Fluka Vs Geant4



The background estimation in the electron signal region is higher in the Fluka model compared to the Geant4 model.

Electron Flux (Fluka Proton Model)



missing proton simulation in the Fluka model for the 10 TeV to 100 TeV range

The difference in the electron flux caused by the proton model is only in the absolute value, while the spectral shape remains highly consistent.

Summary

- Update the cosmic electron + positron flux with 10 years of data
  - Apply the updated energy reconstruction process
  - Primarily use the analysis method published in 2017
  - Focus on the energy range from 17 GeV to 14 TeV

- Compare the differences between the proton simulations using the Geant4 model and the Fluka model

Thanks!

BackUp

Systematics

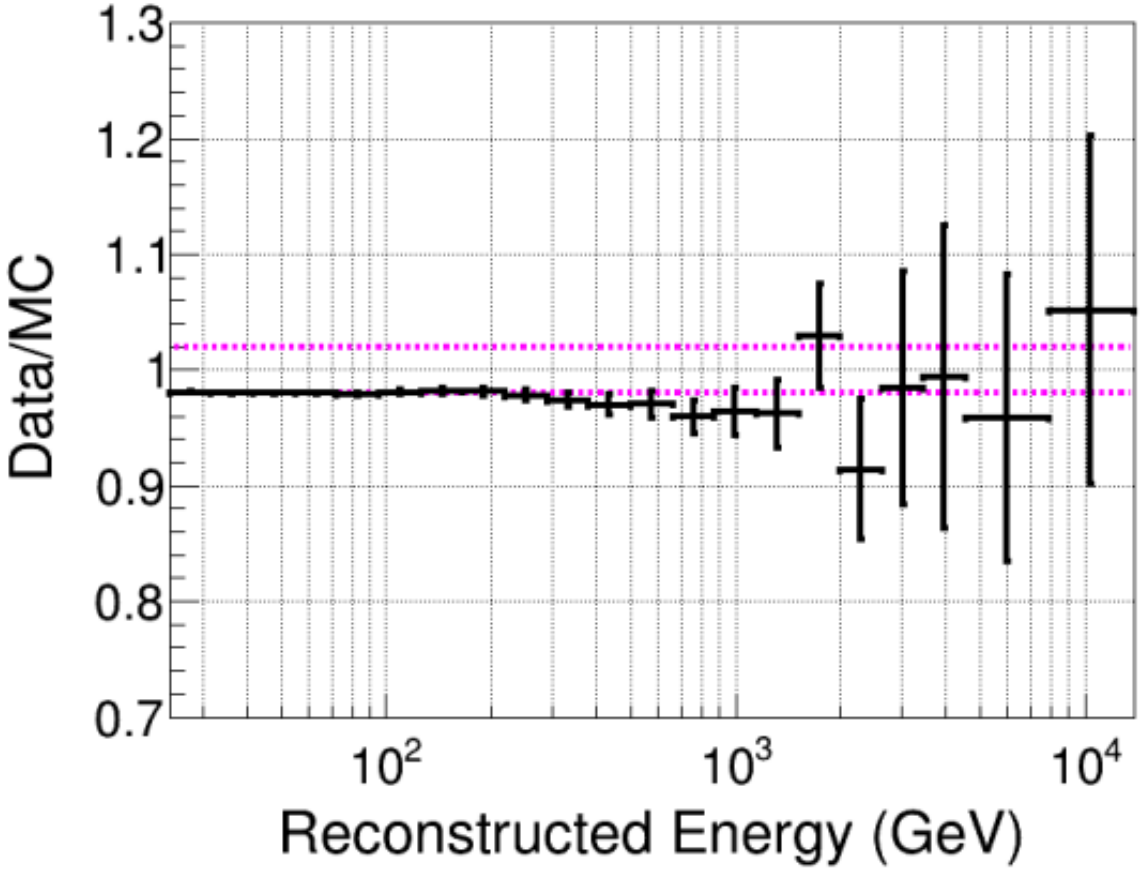


图 6.26　飞行数据和模拟数据电子样本的 ζ 选择效率差异随能量的变化

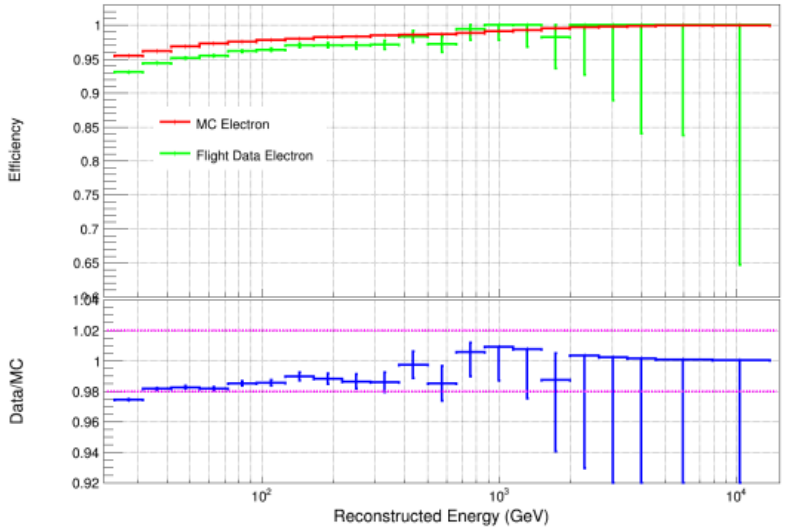


图 6.22　飞行数据电子样本和模拟电子样本的高能触发效率

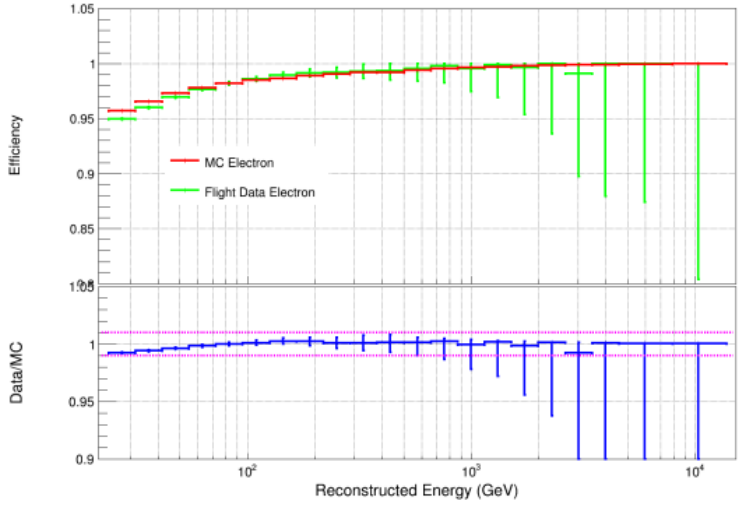


图 6.20　飞行数据电子样本和模拟电子样本的 MaxELayerRatio 效率差异

Electron Flux