Neutrino flux and detector simulation (FLArE)

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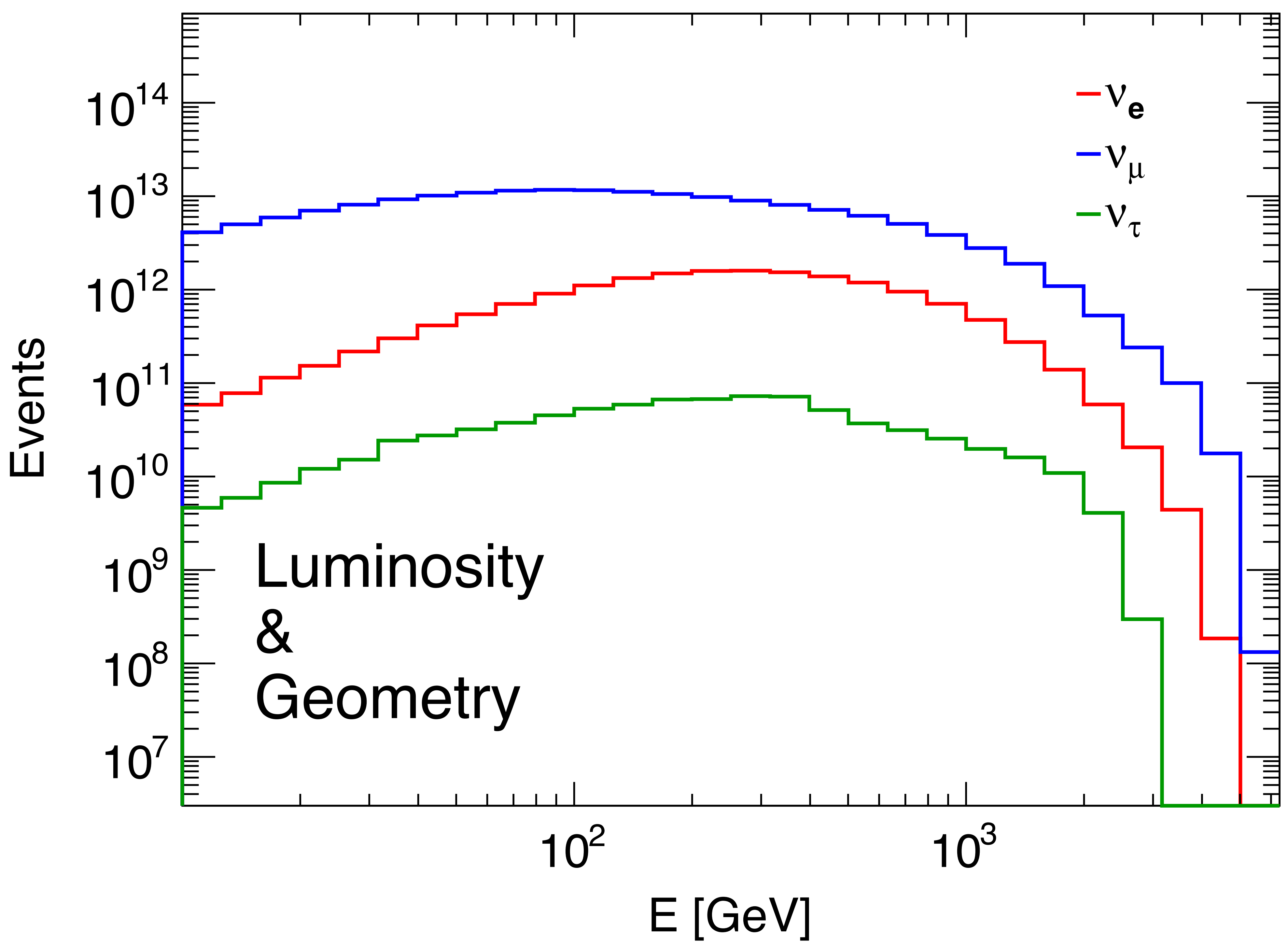
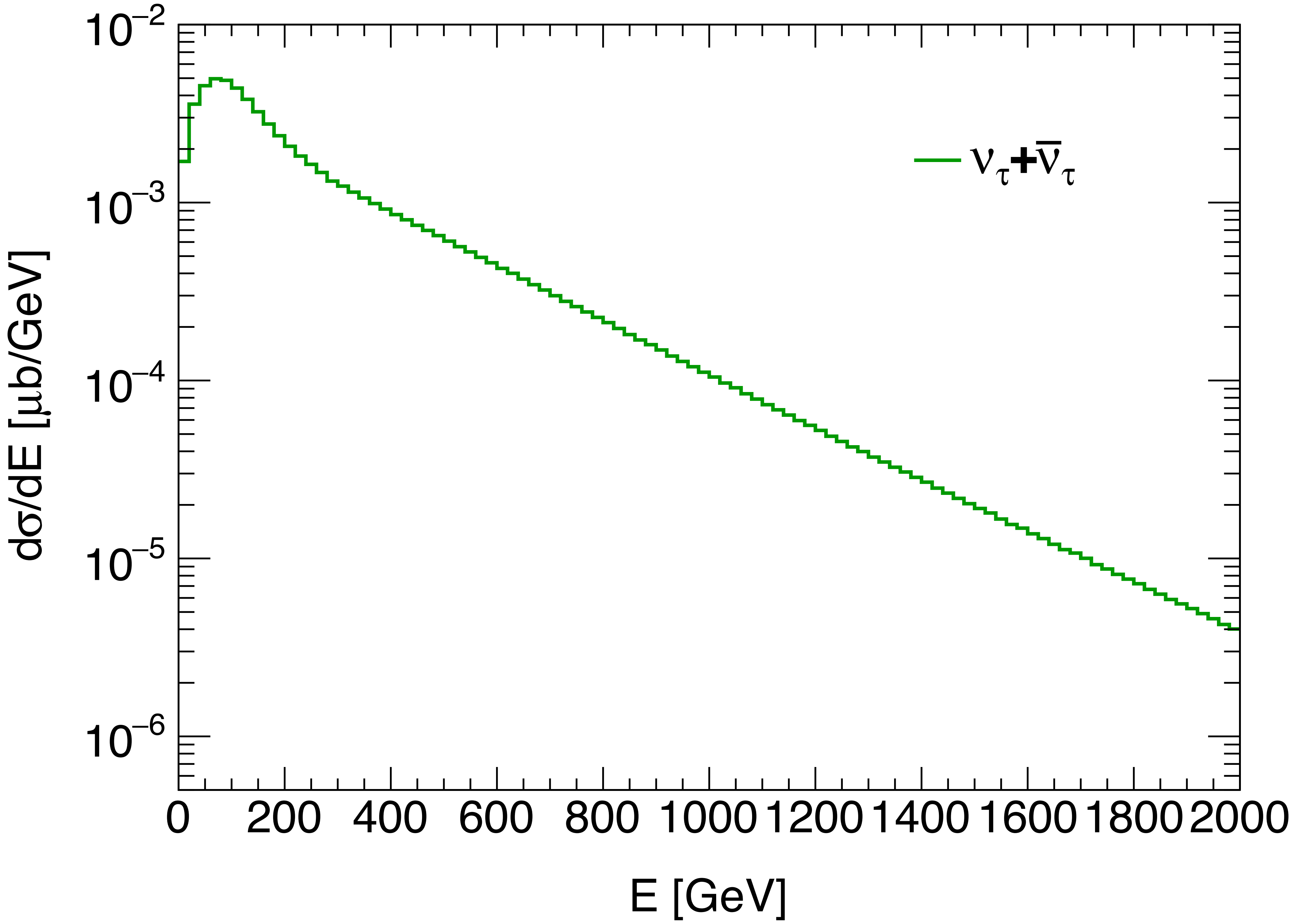
UCIrvine

Neutrino flux



Felix Kling, et. al. 2105.08270
Github

FLArE10, 620m downstream from IP, 3000/fb



Weidong Bai, et. al. 2112.11605
Figure 12, Table 5

eta > 6.9 (radius 1 m at a distance of 480 m from IP)

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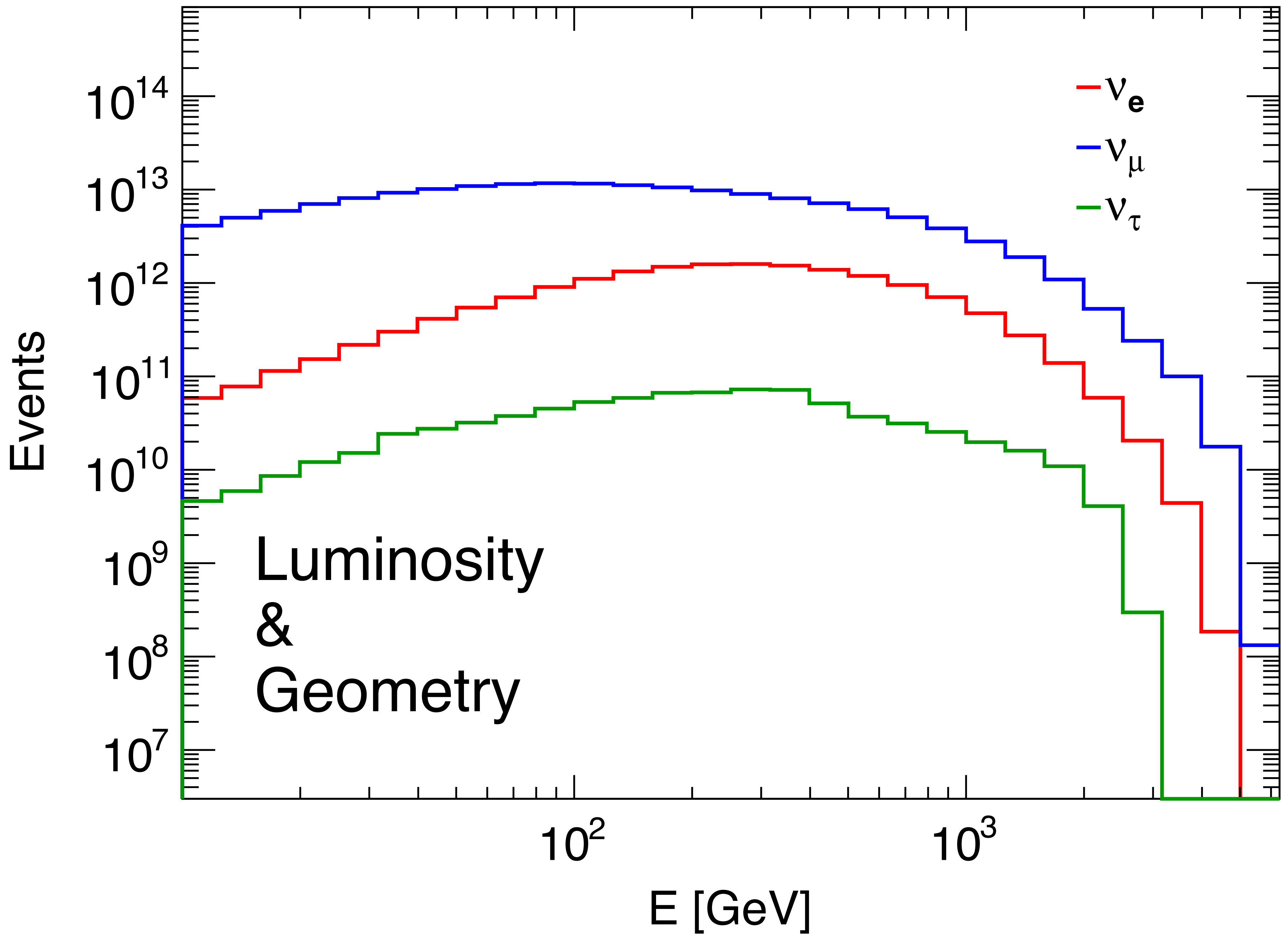
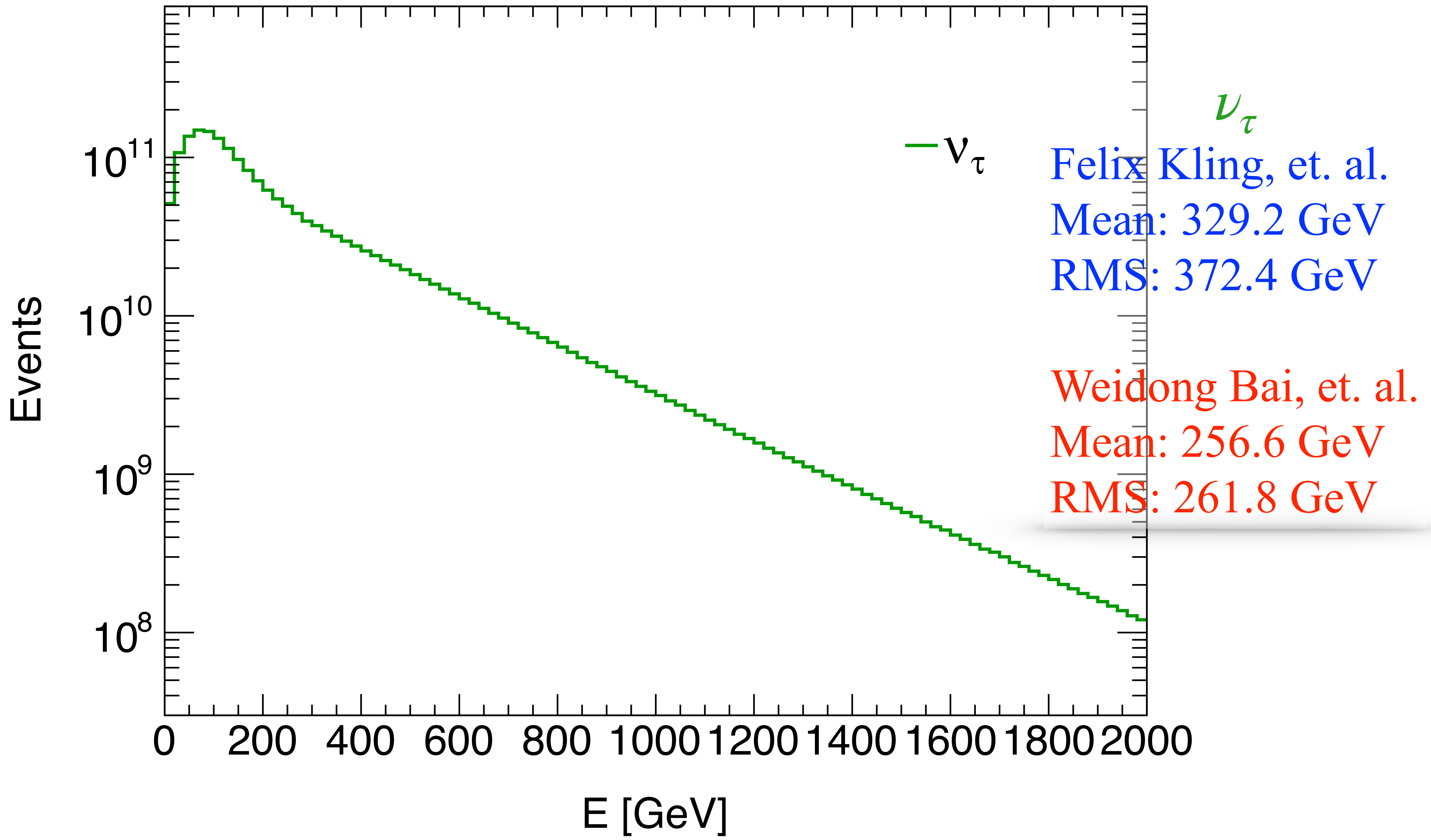
Neutrino flux



x Luminosity / 2



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FLArE10, 620m downstream from IP, 3000/fb

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Figure 12, Table 5

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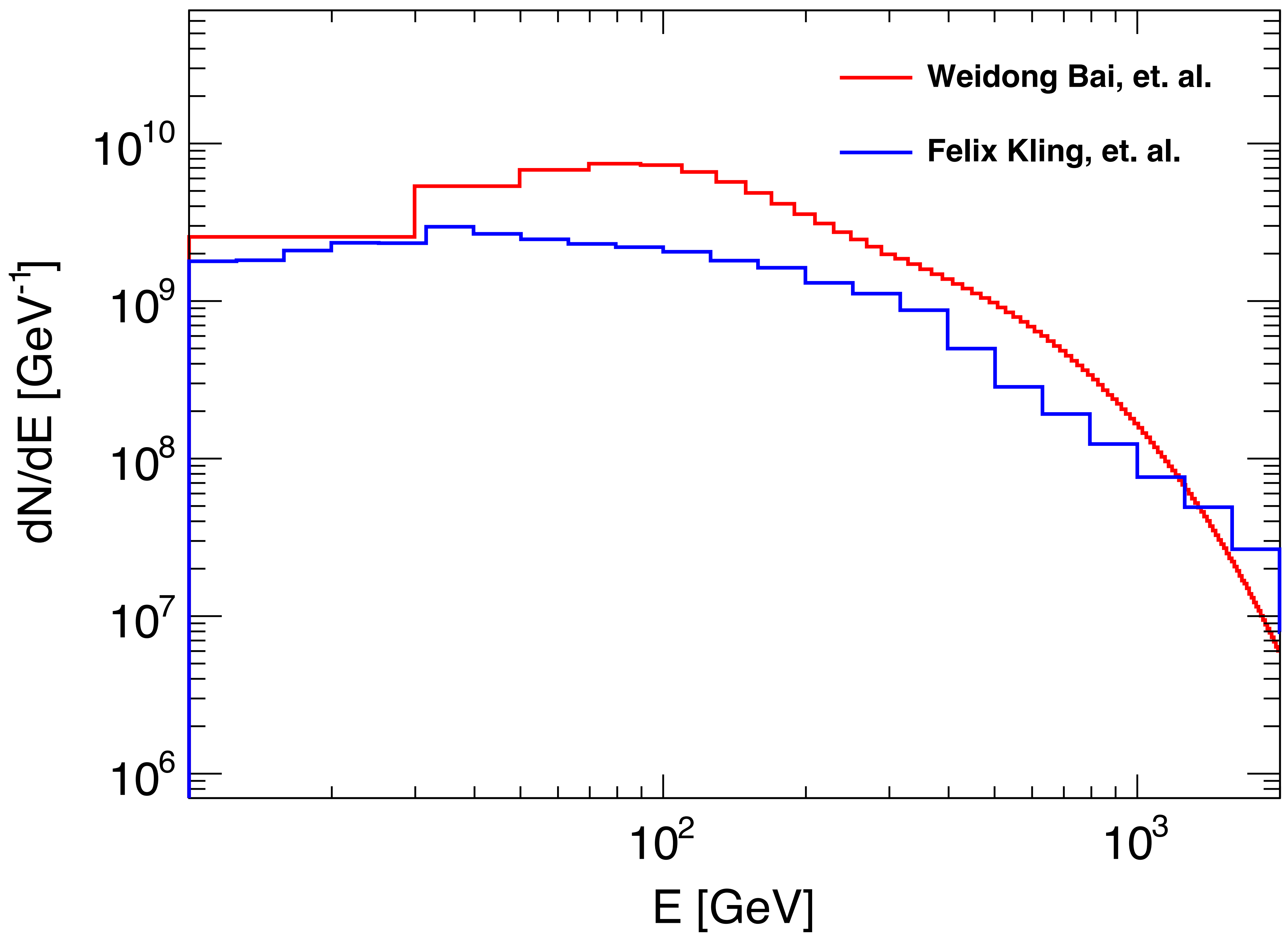
Neutrino flux

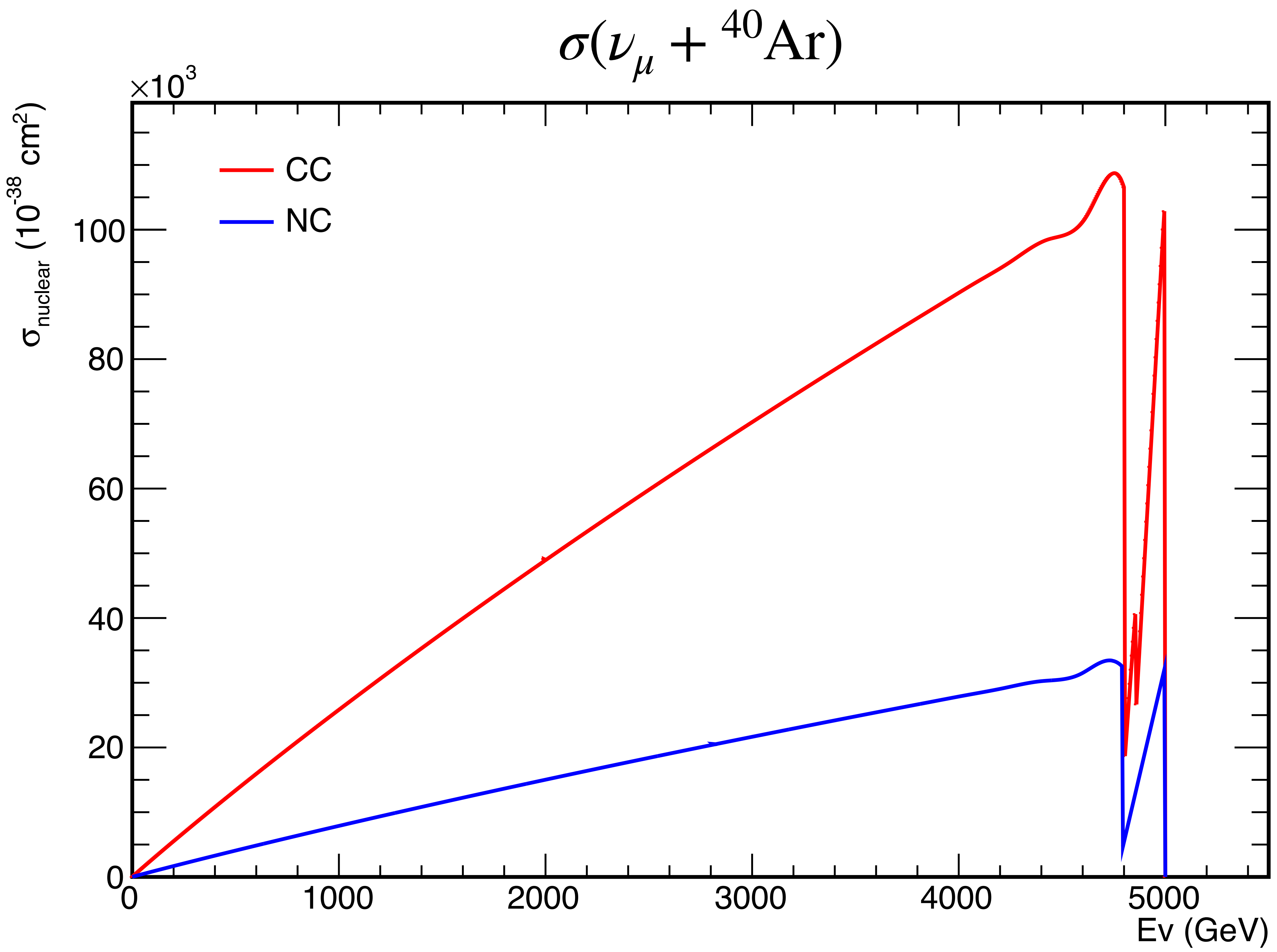


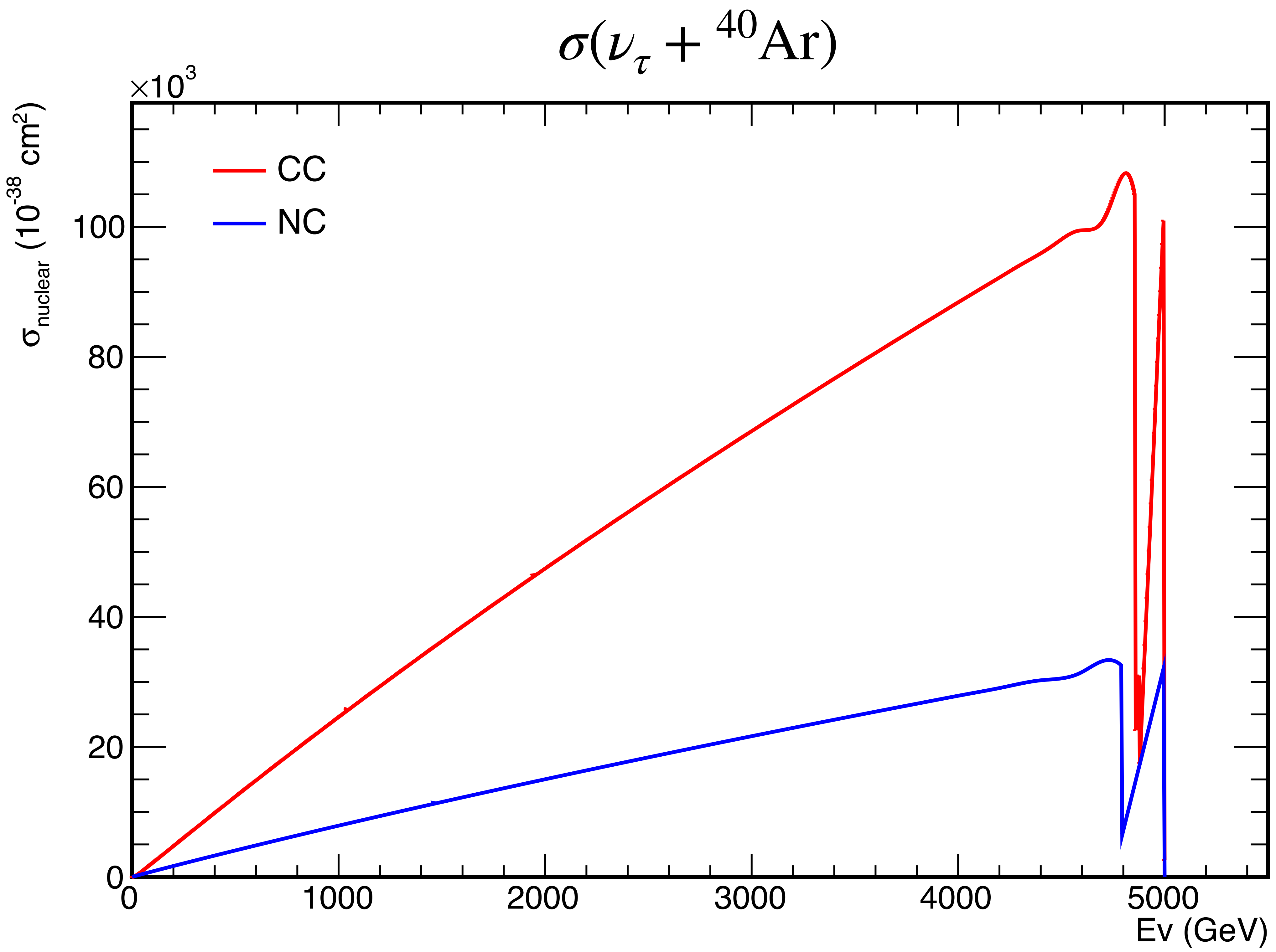
ν_τ spectrum (and rate) from two studies are different

- Different assumptions of pseudorapidity
- Different considerations of ν_τ production mechanism
- Large uncertainty

Cross section (up to 5 TeV) in GENIE

https://scisoft.fnal.gov/scisoft/packages/genie_xsec/v3_00_06/
genie_xsec-3.00.06-noarch-G1802a00000-k250-e5000-resfixfix.tar.bz2





Seems that this cross section is not promising when energy goes too high

Flux drops quickly after 4 TeV, so I don't think it's a big issue for now

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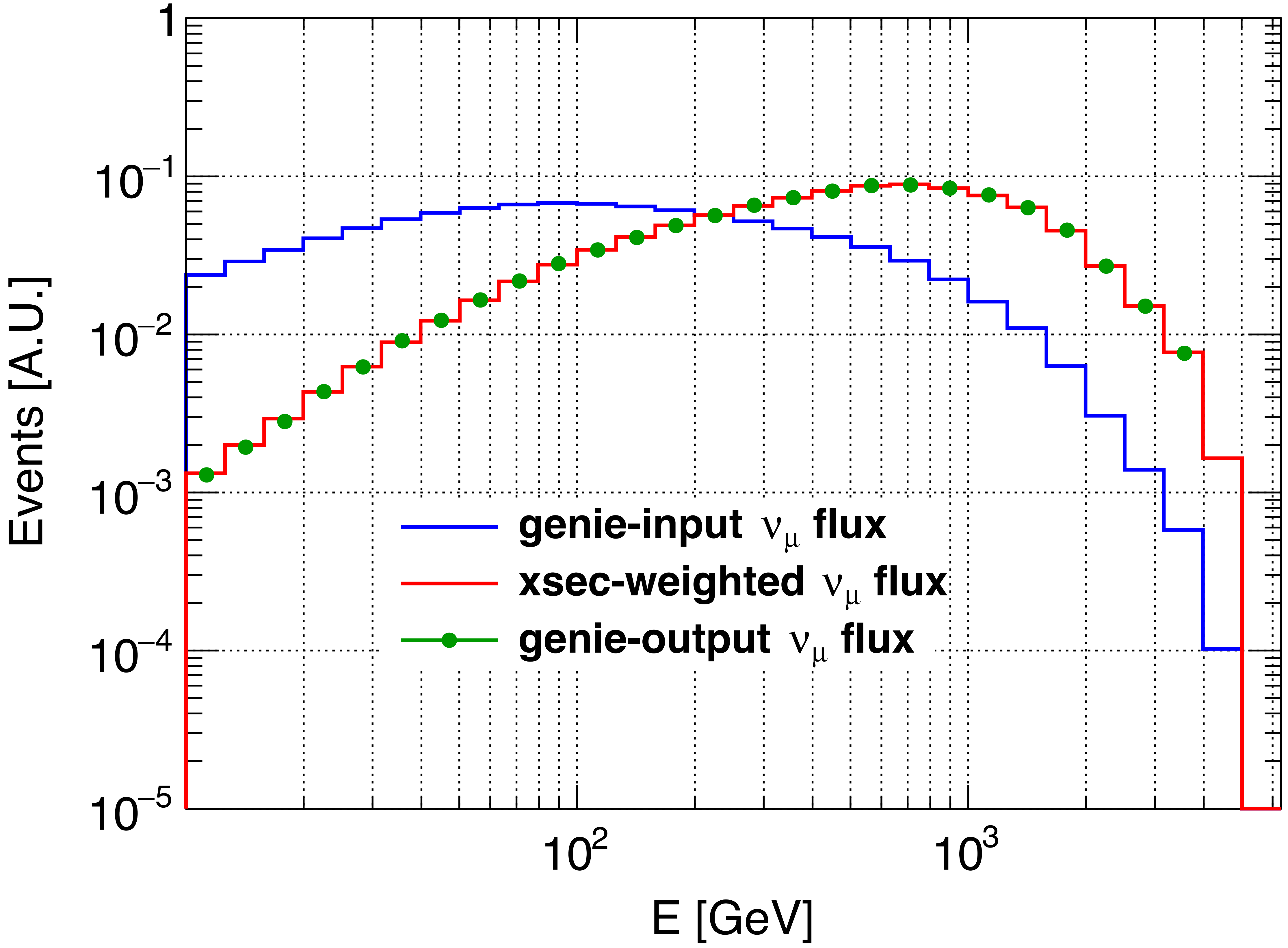
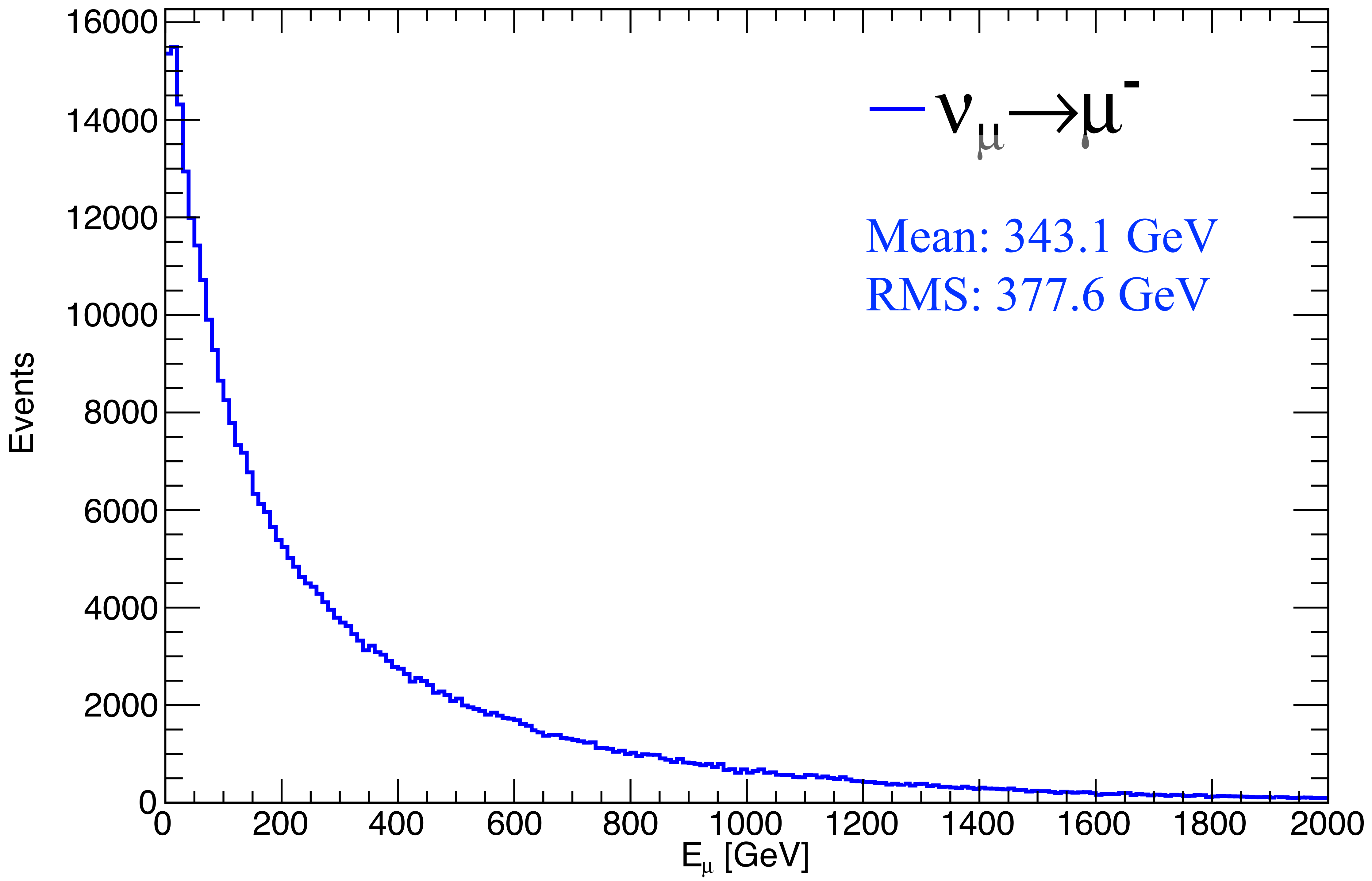
GENIE simulation: ν_μ



Muon energy spectrum $\nu_\mu \to \mu^-$



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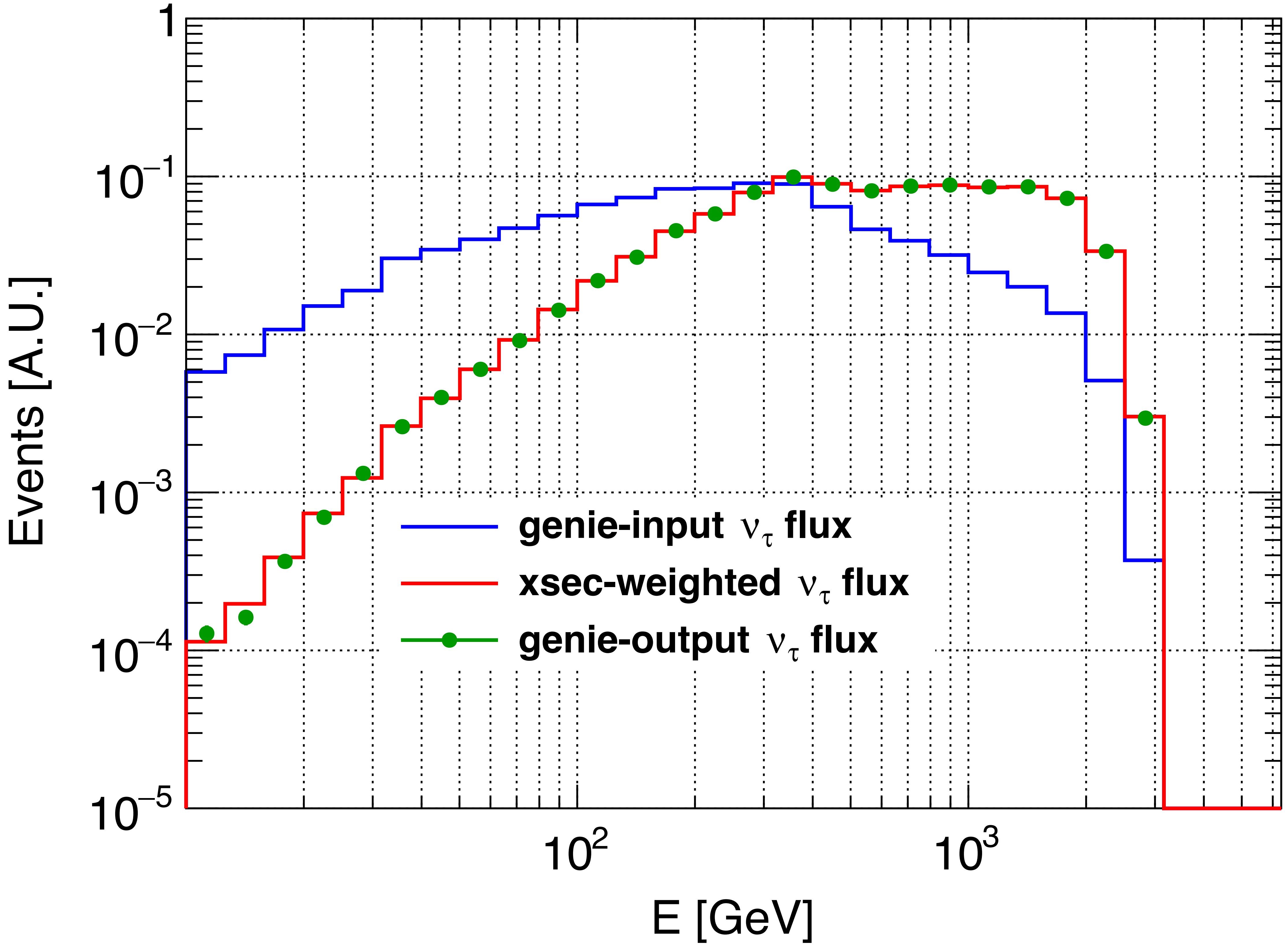
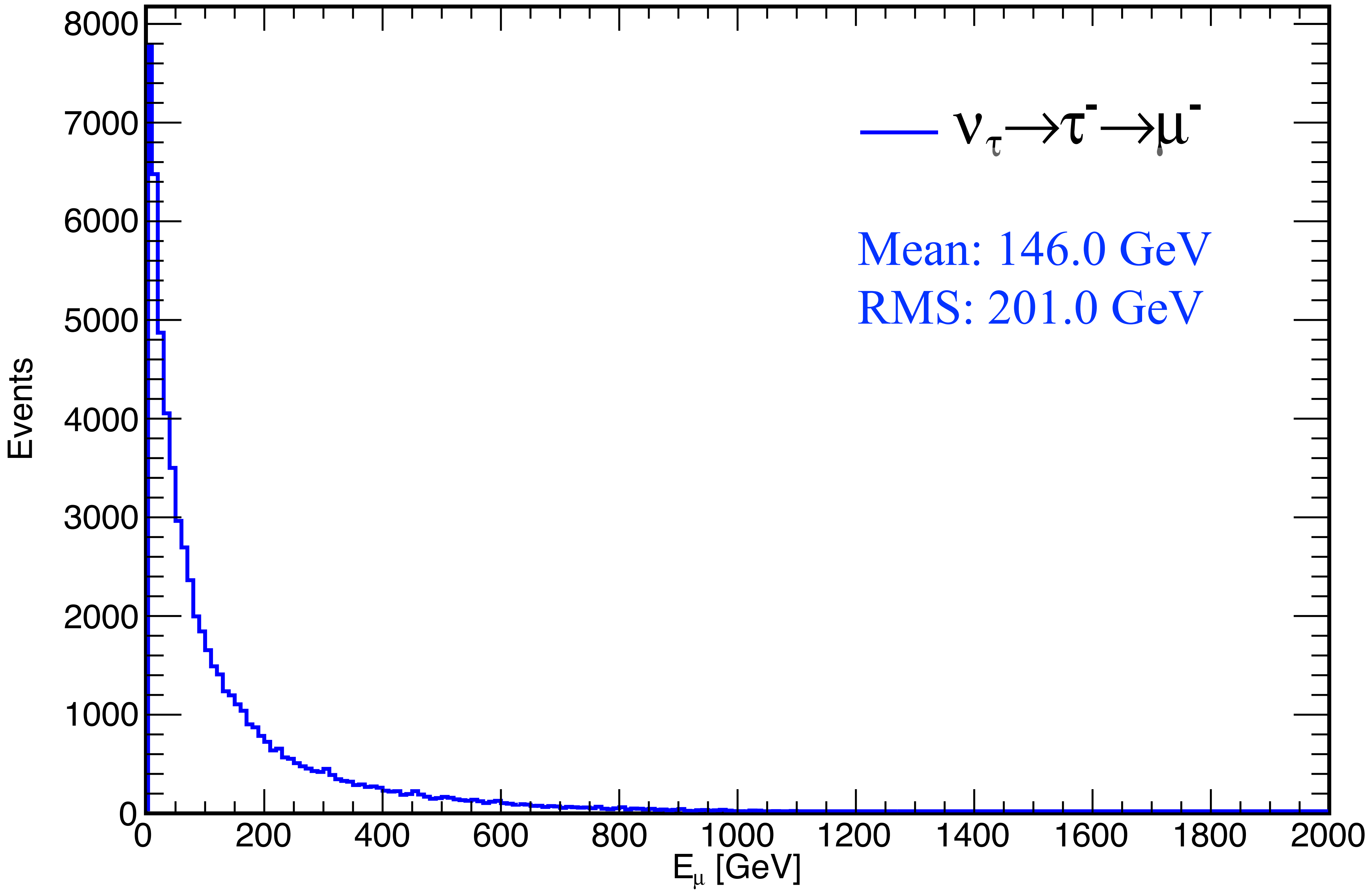
GENIE simulation: ν_τ



Muon energy spectrum $\nu_\tau \to \tau^- \to \mu^-$



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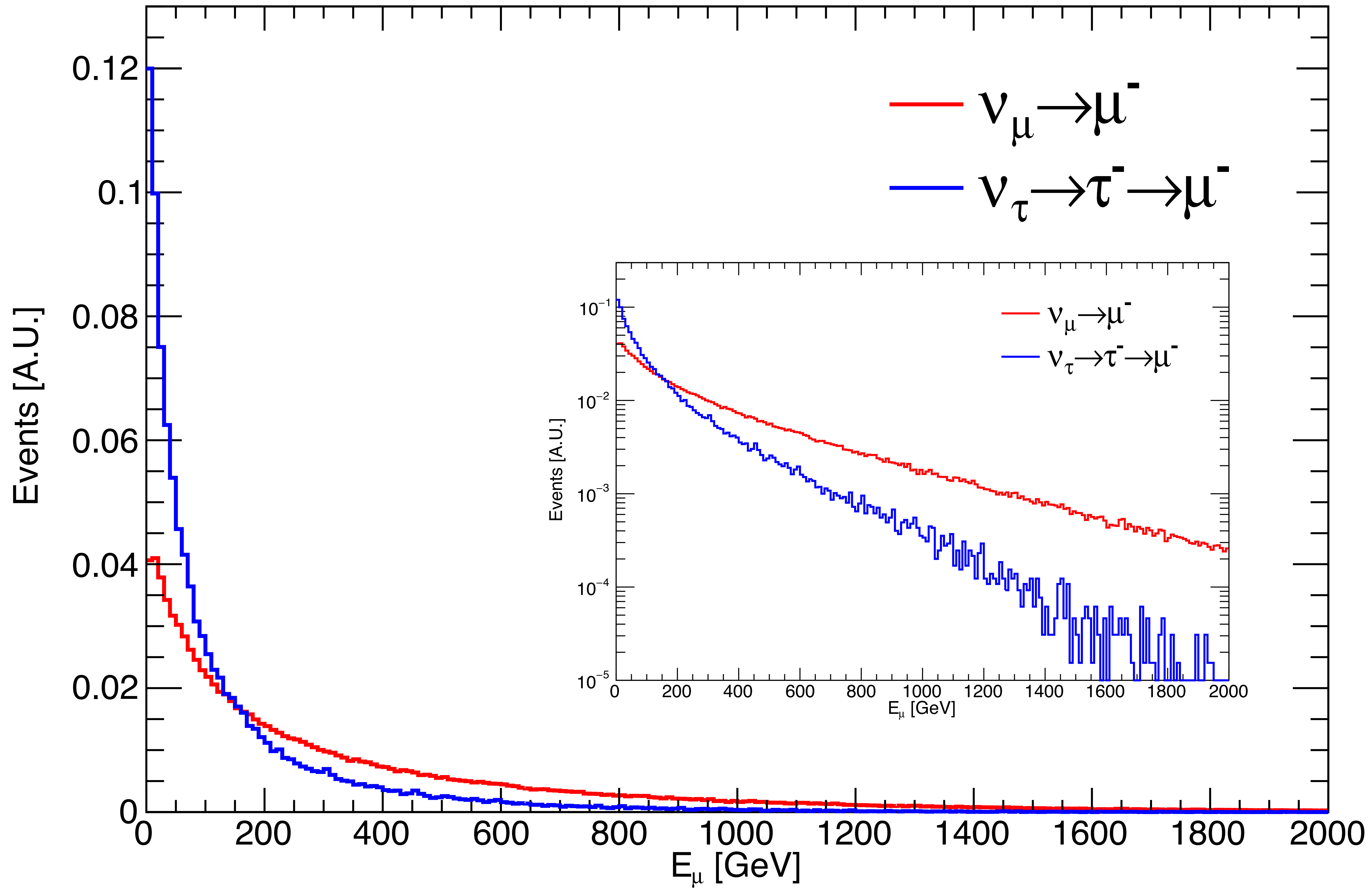
GENIE simulation: muon spectrum



$\nu_\mu \rightarrow \mu^-$
Mean: 343.1 GeV
RMS: 377.6 GeV

$\nu_\tau \rightarrow \tau^- \rightarrow \mu^-$
Mean: 146.0 GeV
RMS: 201.0 GeV

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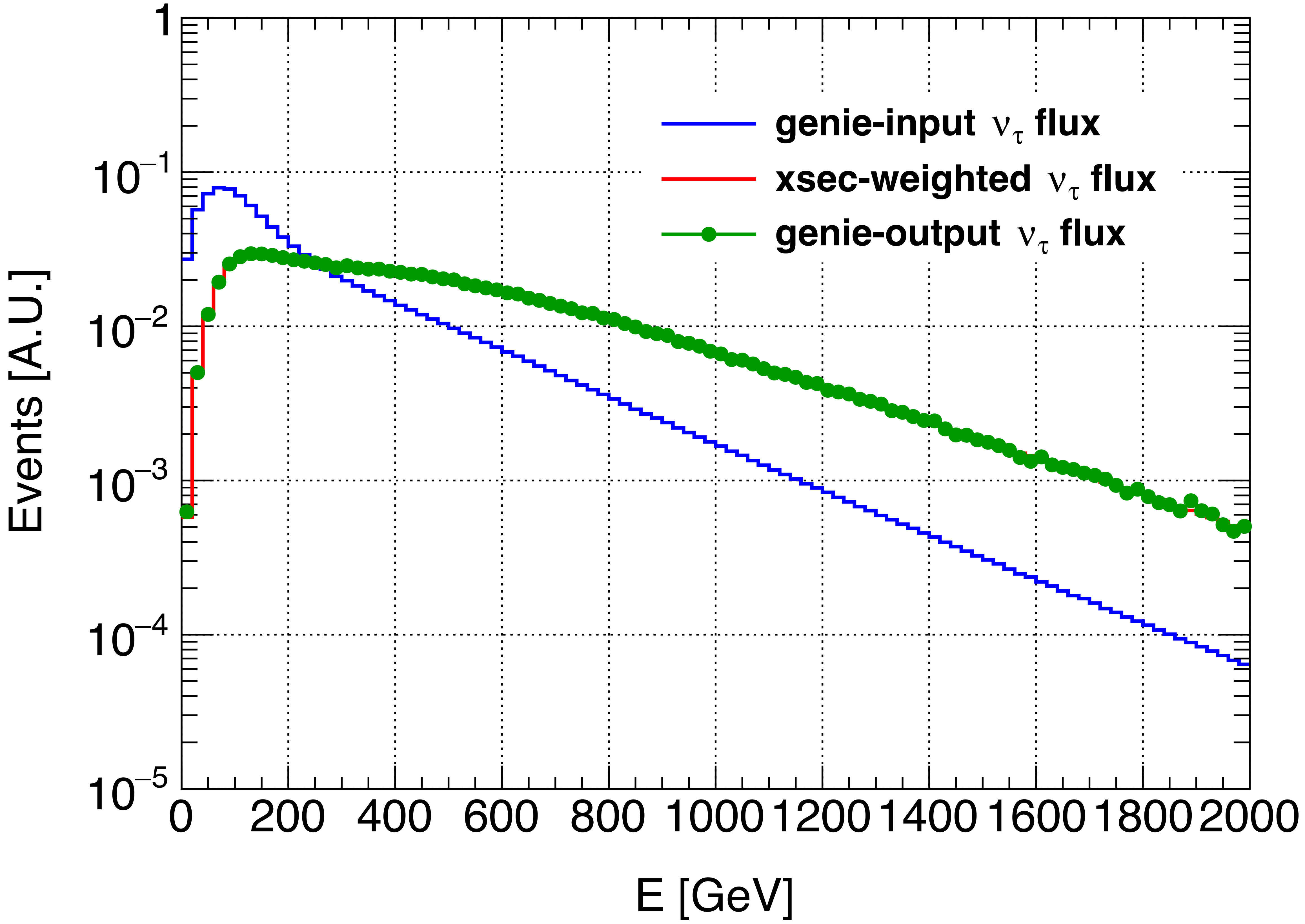
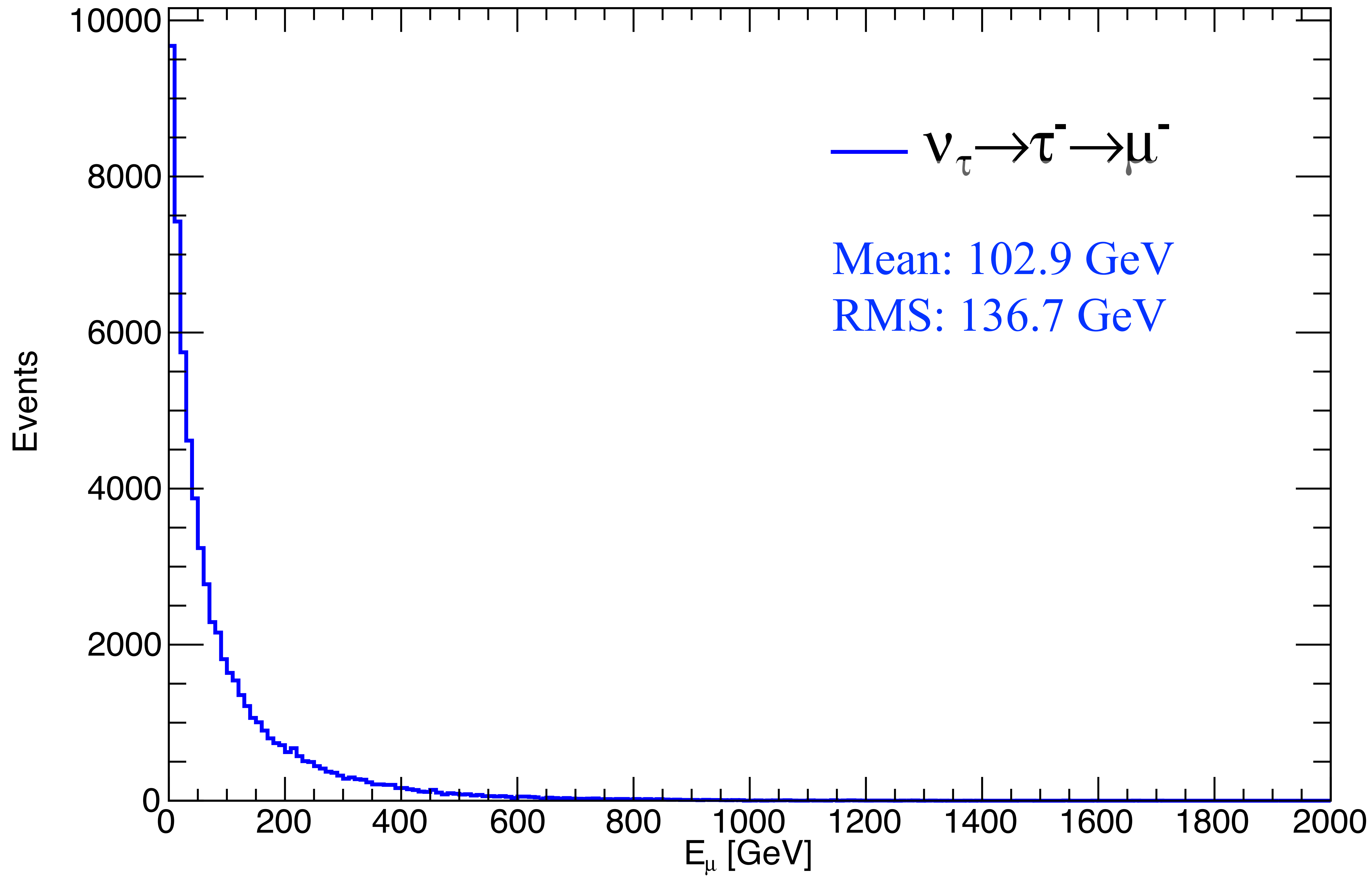
Muon energy spectrum, area normalized

Muon from tau decay is softer

GENIE simulation: ν_τ



Muon energy spectrum $\nu_\tau \to \tau^- \to \mu^-$



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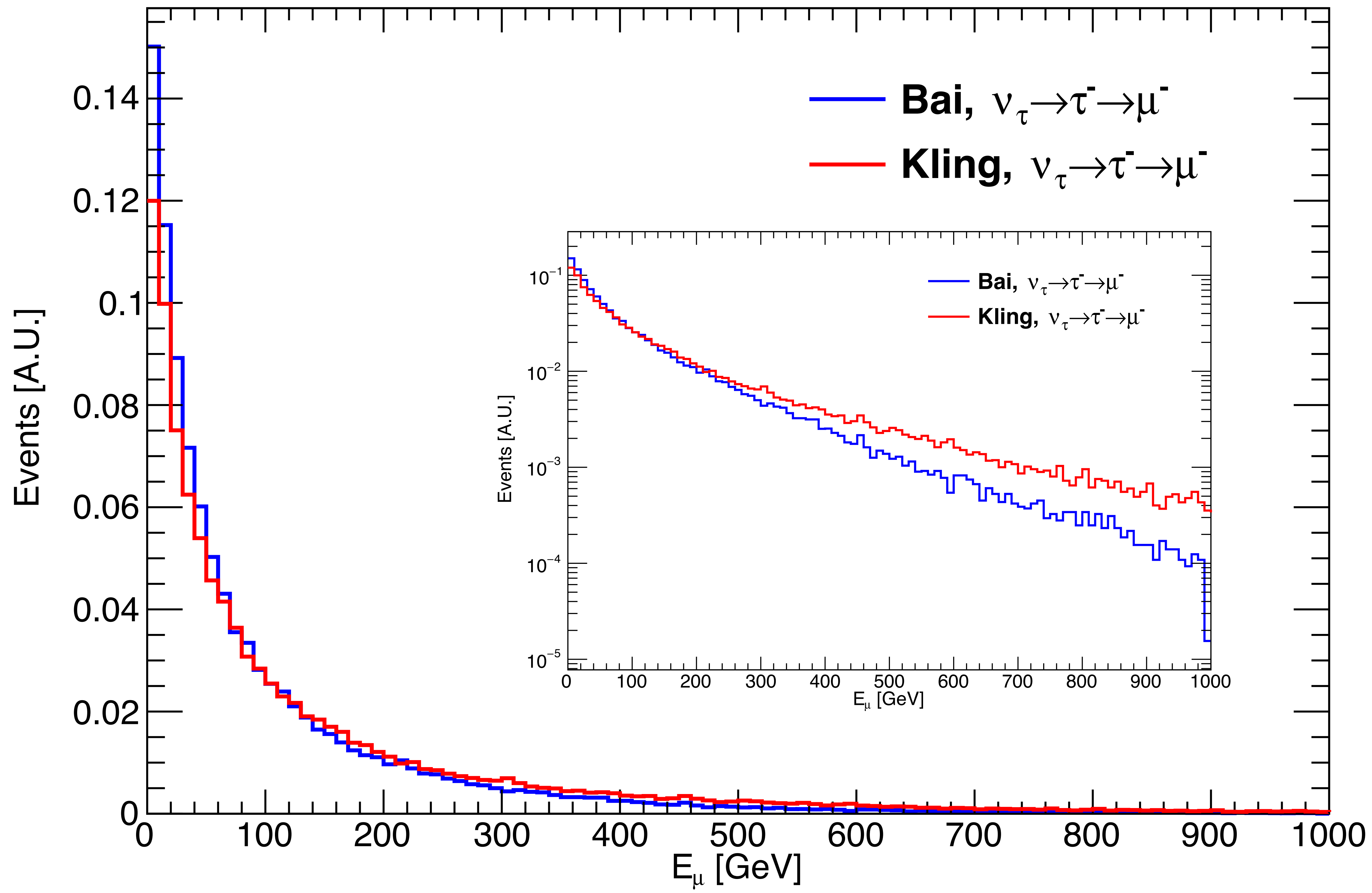
GENIE simulation: muon spectrum



Bai, $\nu_\tau \to \tau^- \to \mu^-$
Mean: 102.9 GeV
RMS: 136.7 GeV

Kling, $\nu_\tau \to \tau^- \to \mu^-$
Mean: 146.0 GeV
RMS: 201.0 GeV

Muon energy spectrum, area normalized

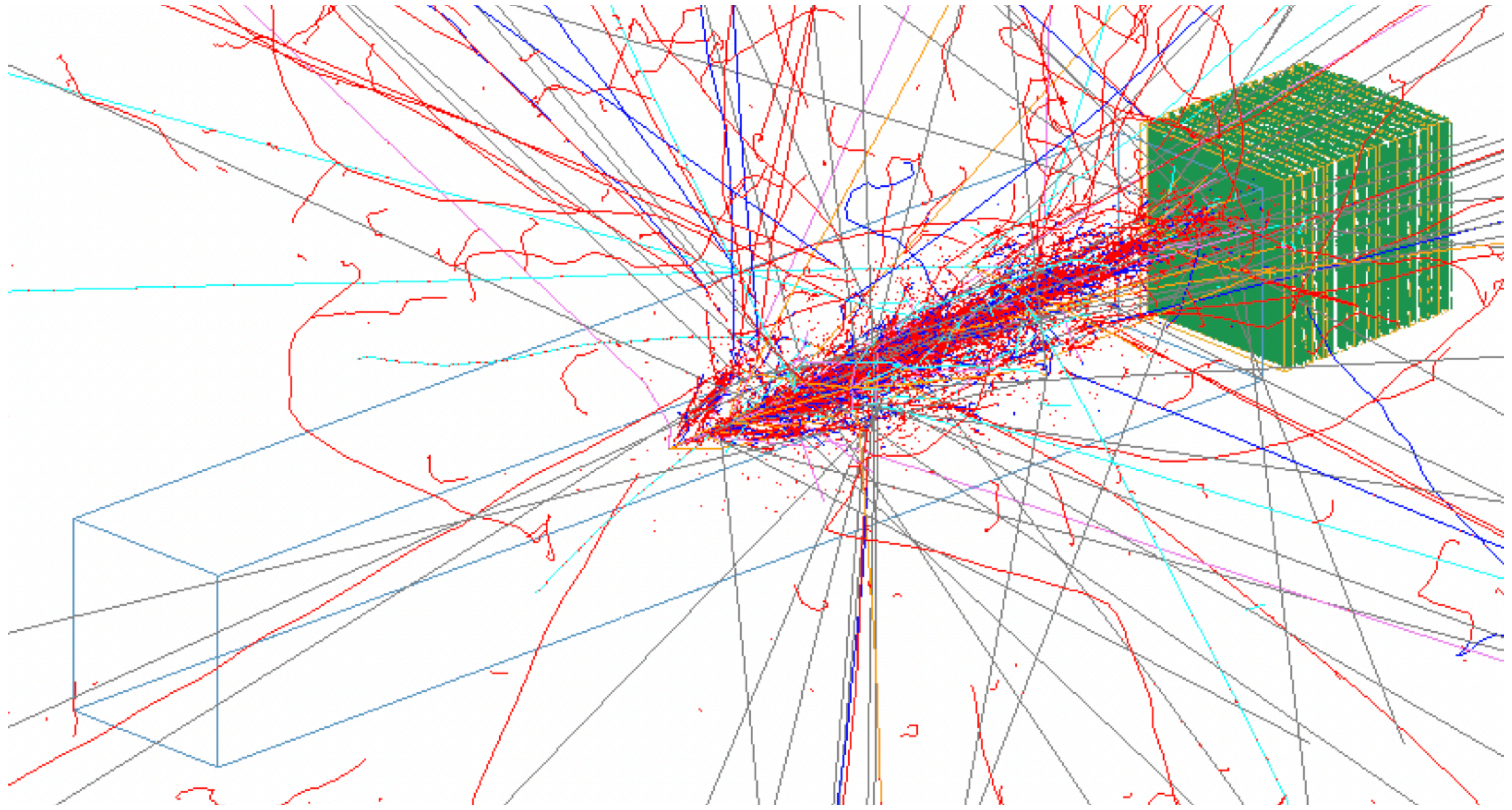
Detector with a Hadron Calorimeter

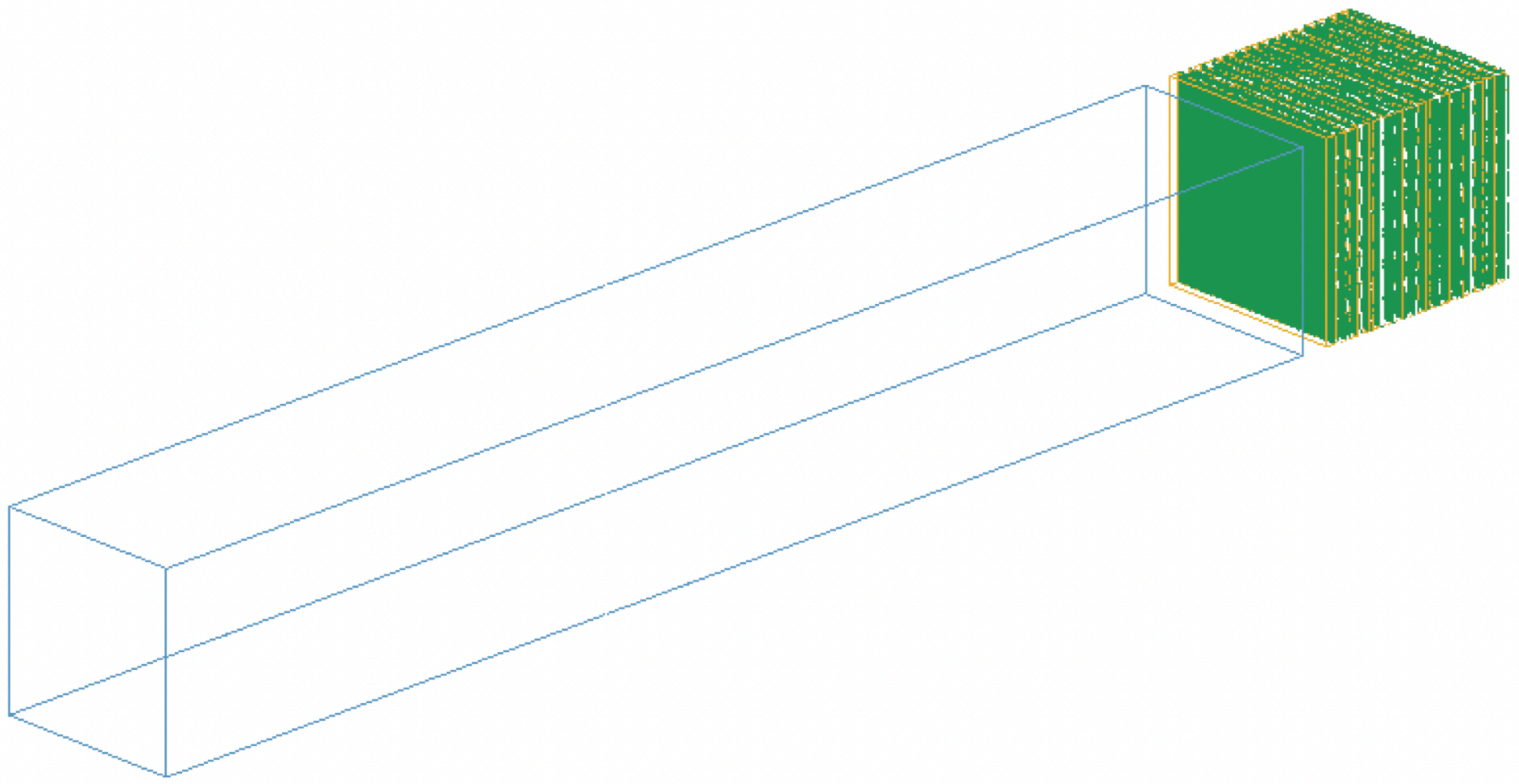
Update

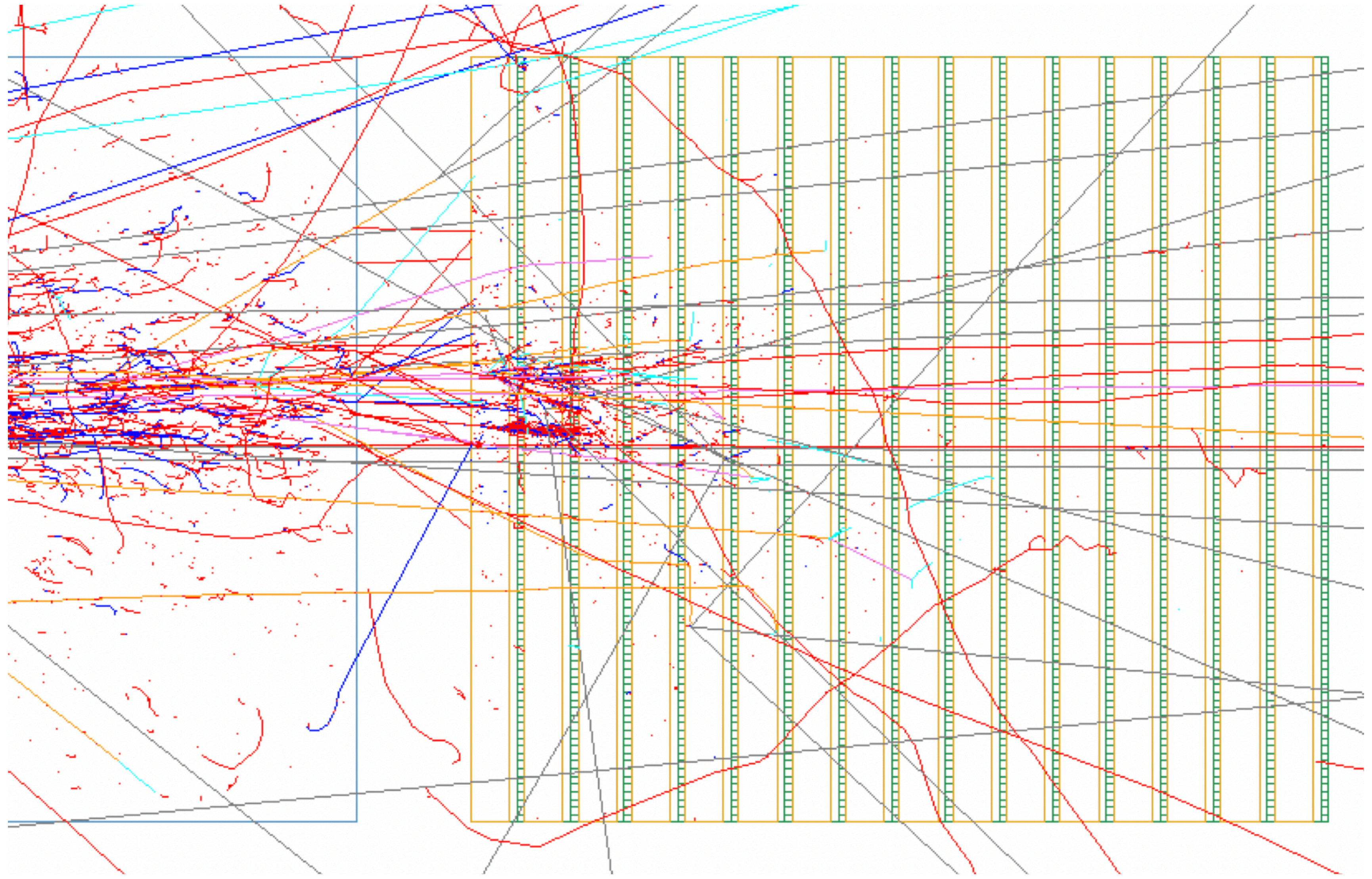
- Support of GENIE input: simulation of neutrino events
- An additional hadron calorimeter downstream
- Event display of deposited energy

Next steps

- Neutrino event simulation in Geant4: 3000 events/2.5 hrs
- Detector optimization







Detector with a Hadron Calorimeter