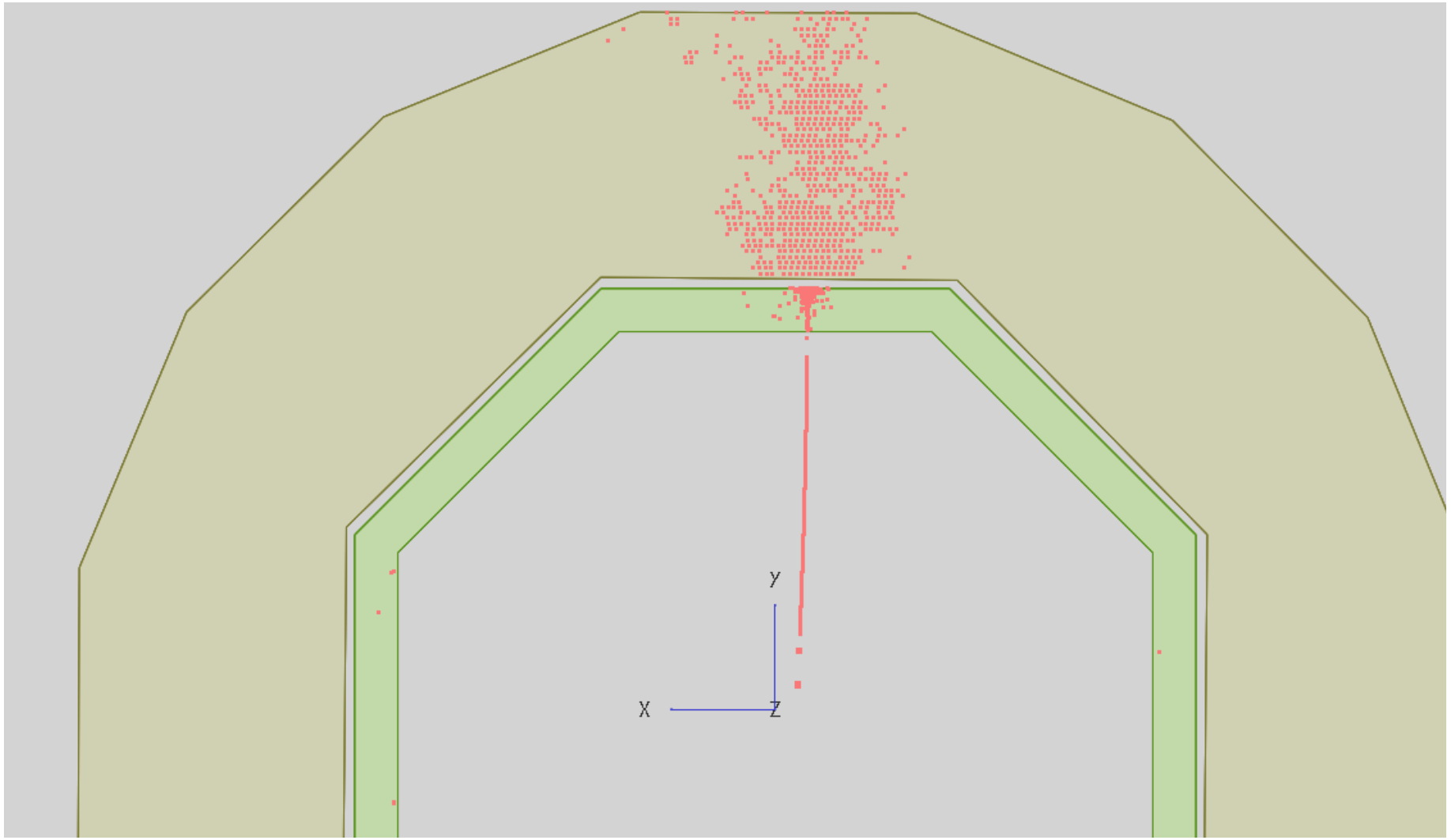
Pion showers in the ECAL + HCAL system

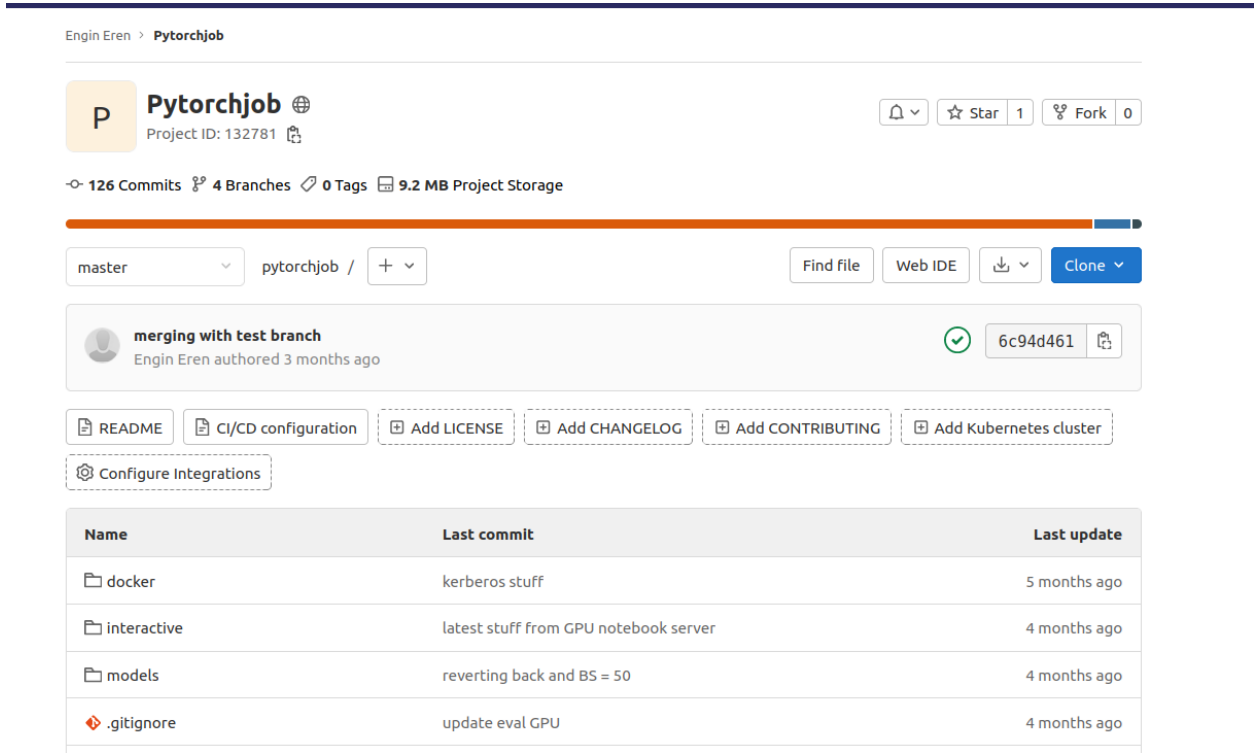


Combined dataset is ready with 3 single point energies (40, 50 and 60 GeV)

Generative Model is WGAN with 3 critics

We jointly update **both** generators ECAL and HCAL generators

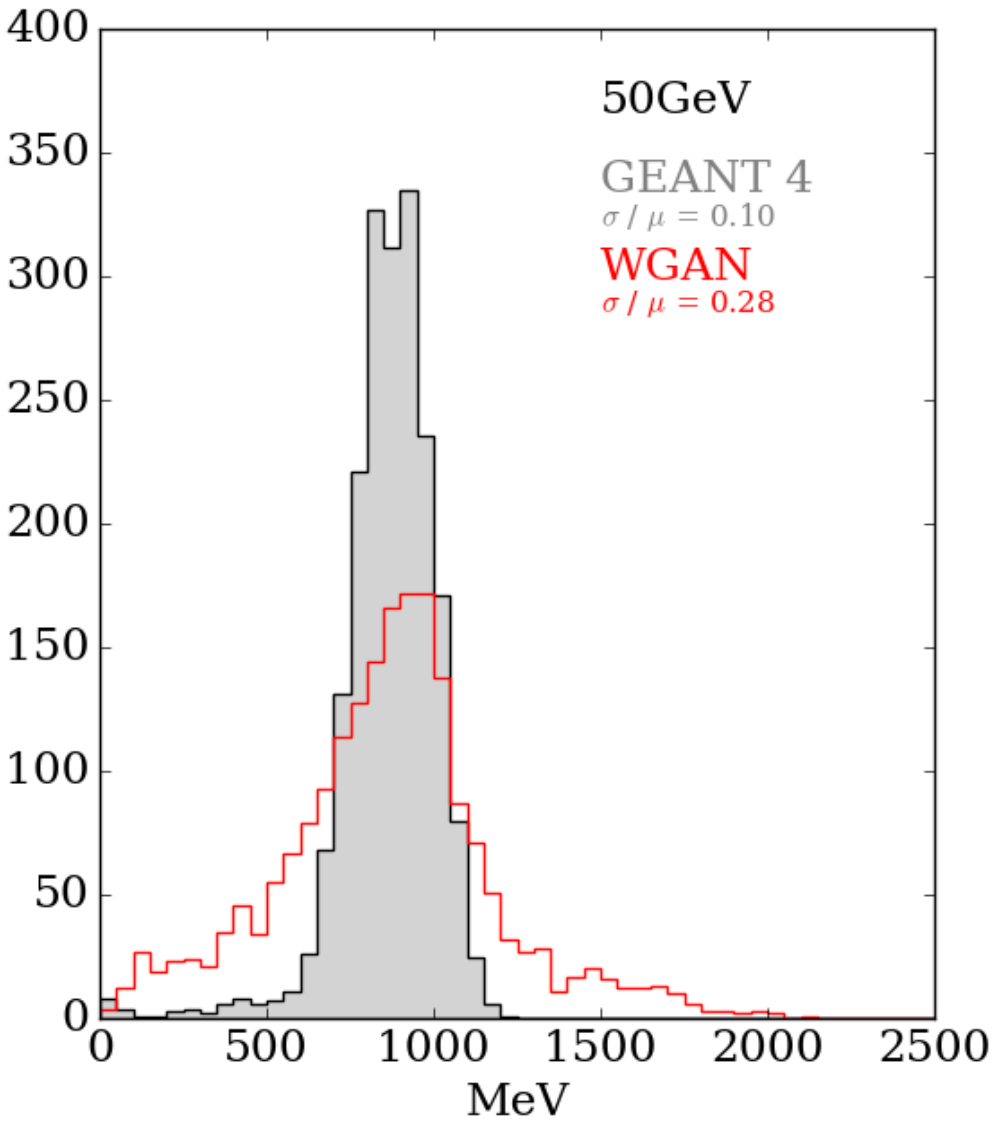
1) Critic and generator for ECAL
2) Critic and generator for HCAL
3) One critic to look at ECAL + HCAL and update both models

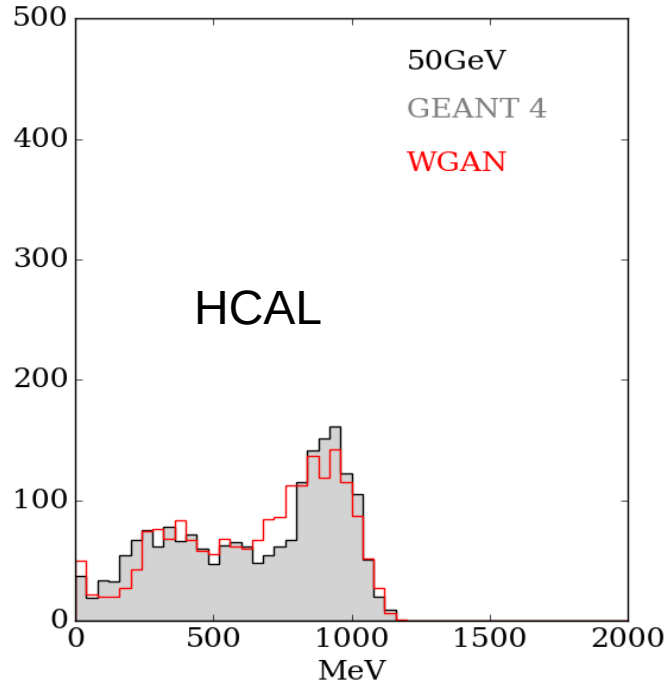


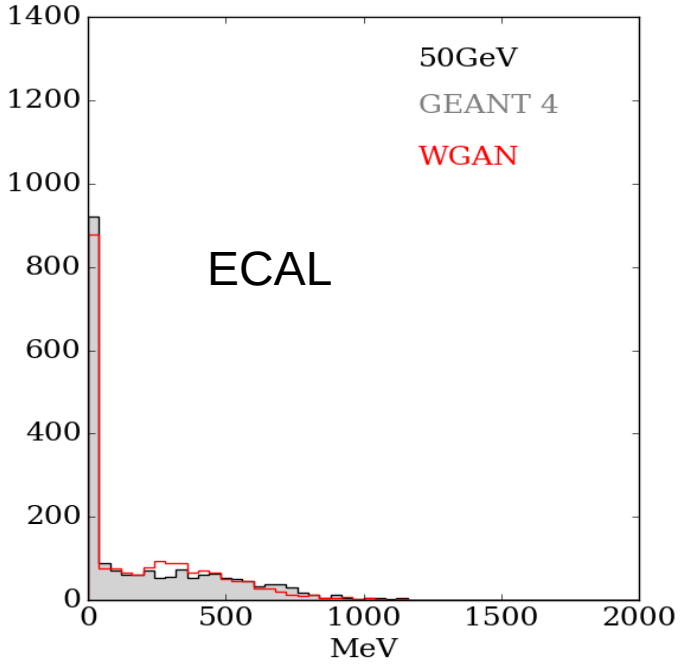
https://gitlab.cern.ch/eneren/pytorchjob

Some results (Energy-sum)

ECAL + HCAL

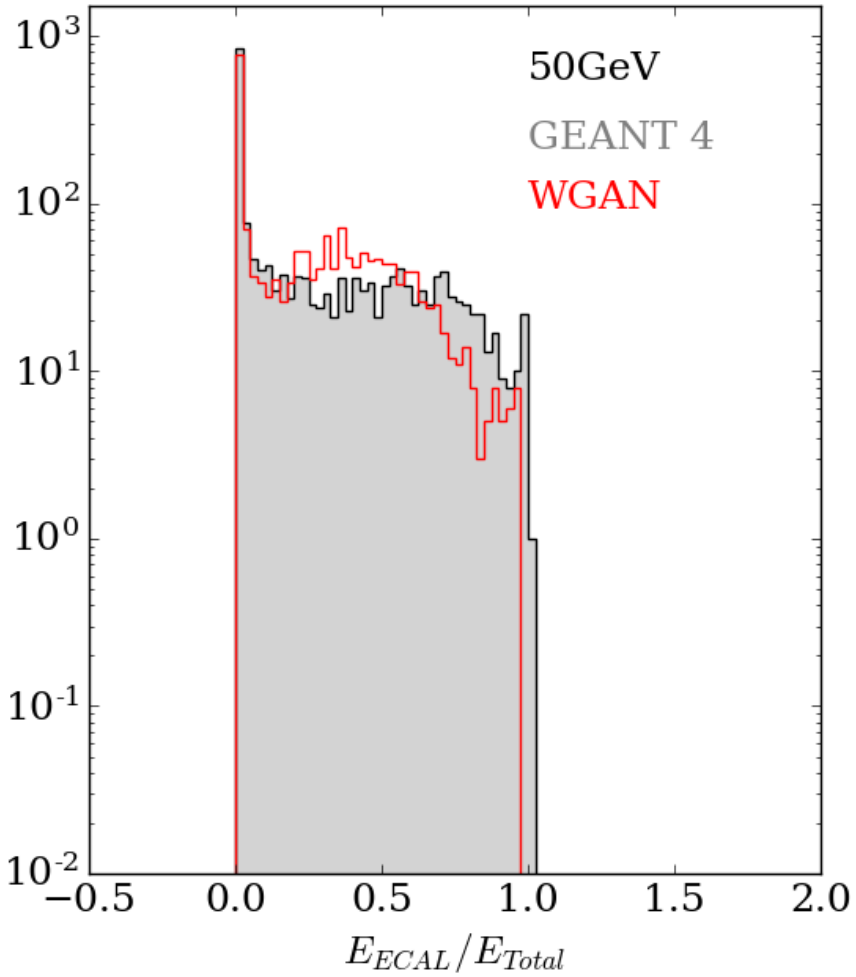


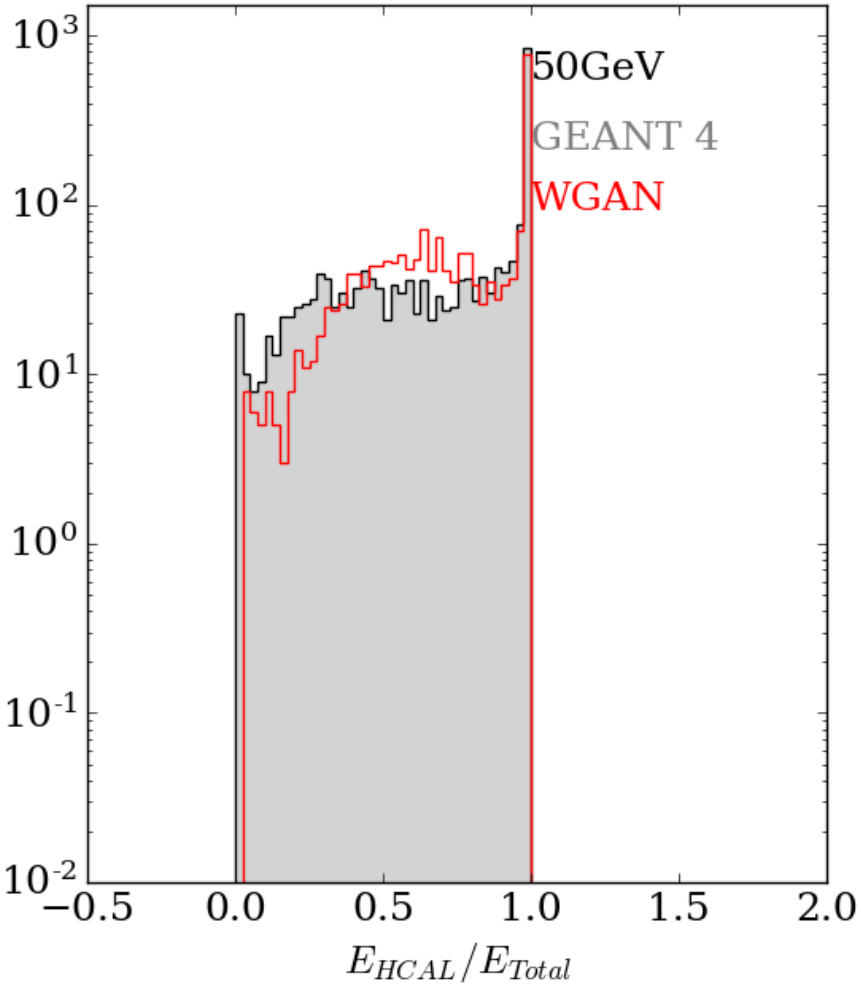




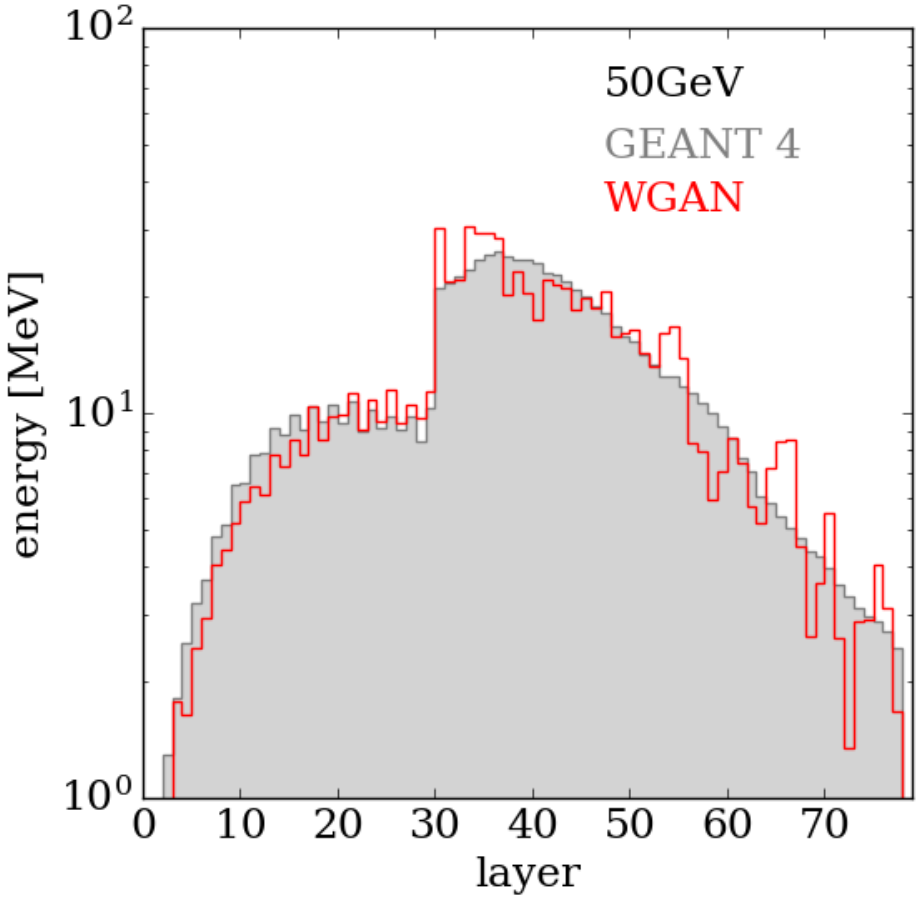
Some results

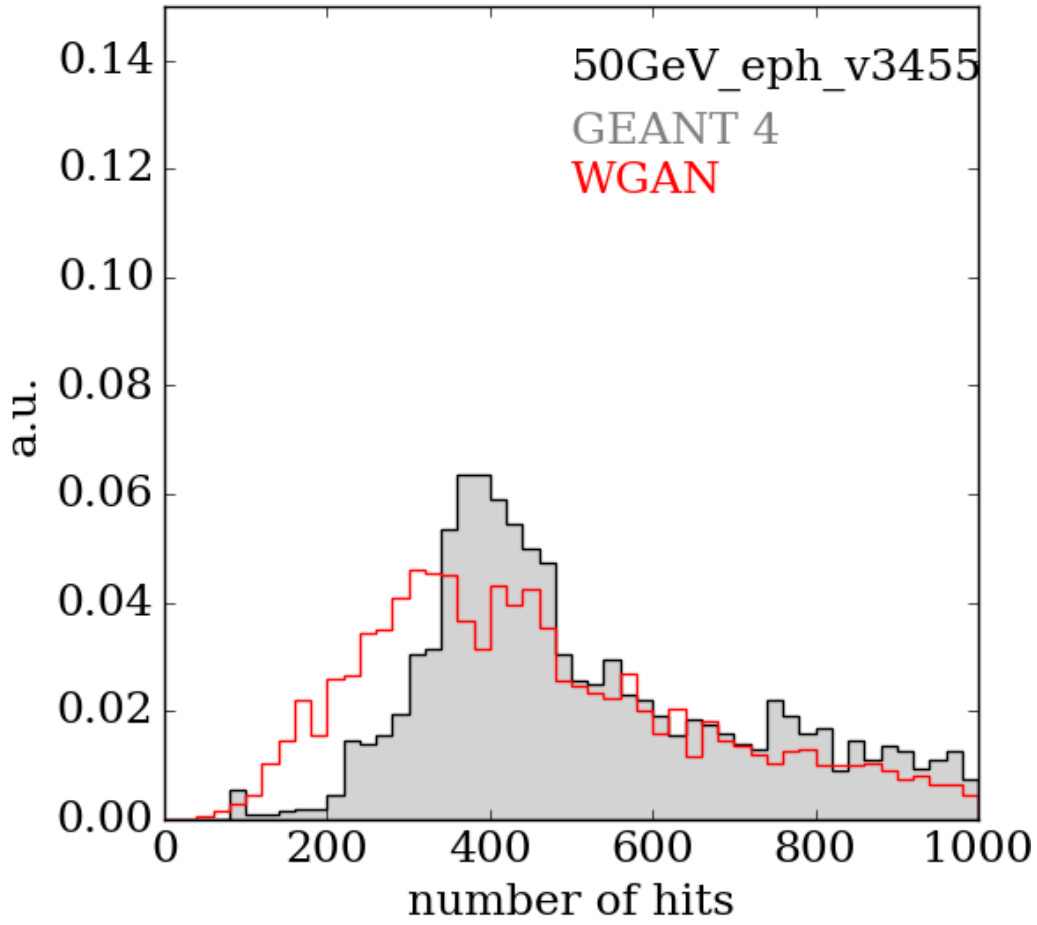
Fraction of energy in ECAL and HCAL





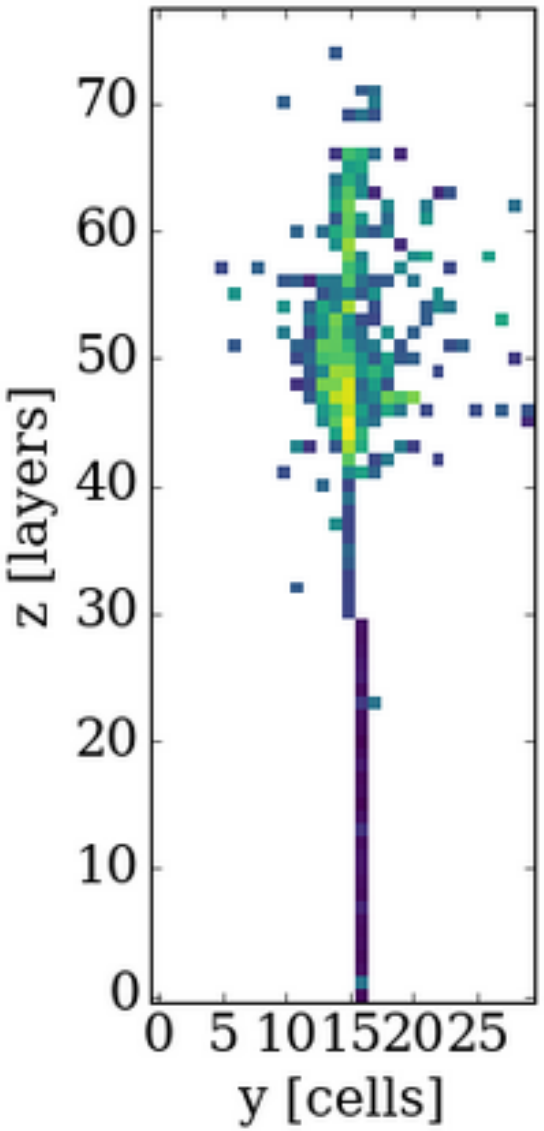
Some results



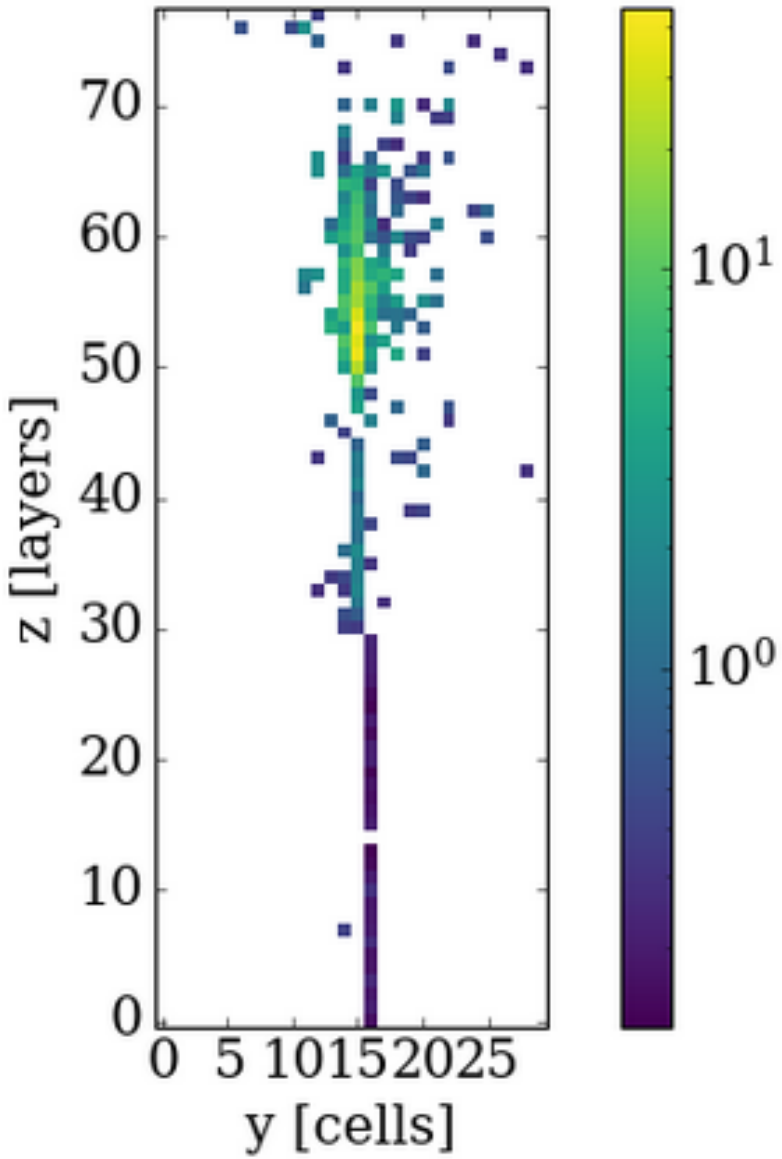


Some example images

REAL

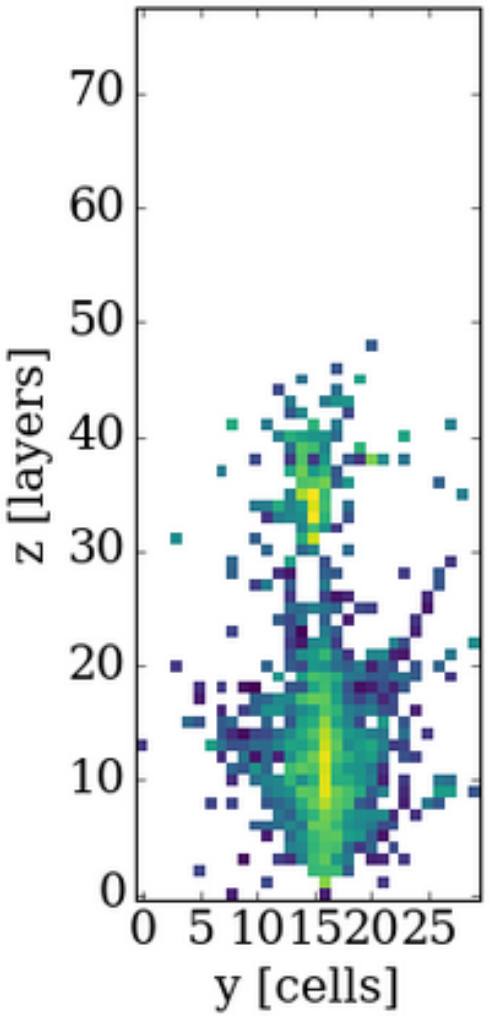


FAKE

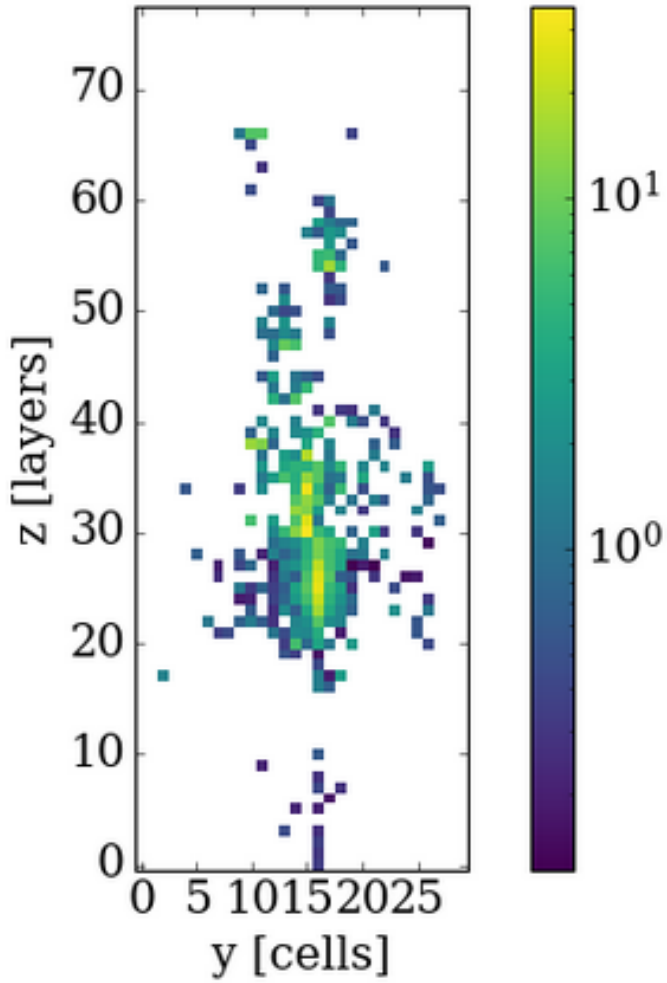


Some example images

REAL



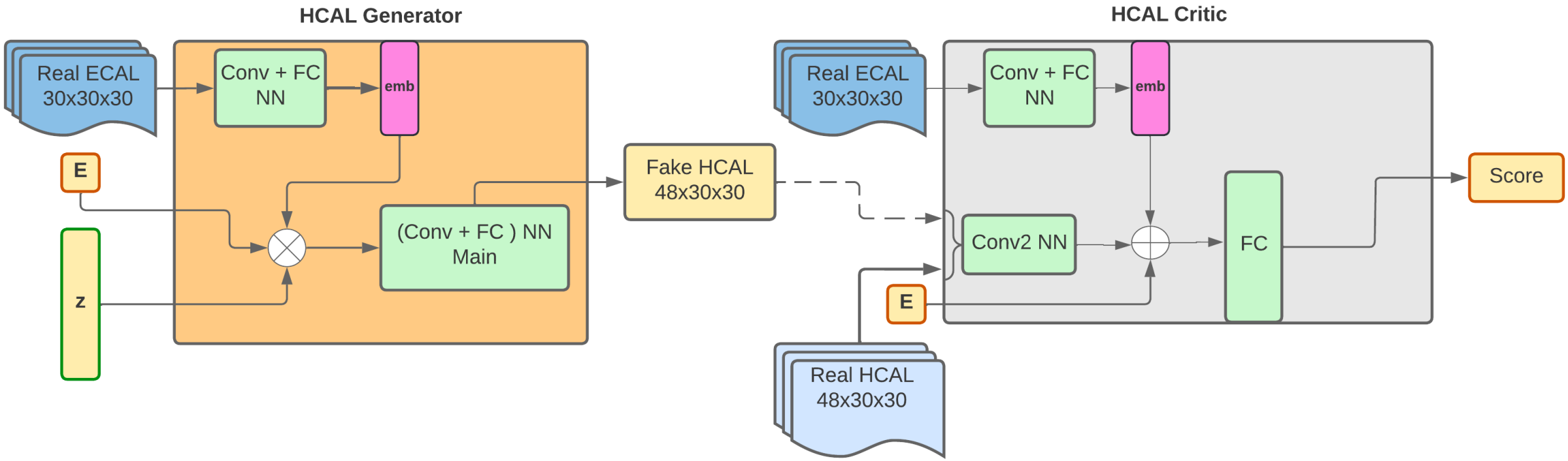
FAKE



Thank you

Pion showers in the ECAL + HCAL system

During the training:



During the total inference:

$$G_{ECAL}(z, E) + G_{HCAL}[G_{ECAL}(z, E), z, E]$$

Summary of pion showers in the ECAL + HCAL system

Case 1: Everywhere Real ECAL

....

Critic:

1. REAL: Real ECAL + Real HCAL
2. FAKE: Real ECAL + Fake HCAL

Generator:

- Real ECAL + Fake HCAL

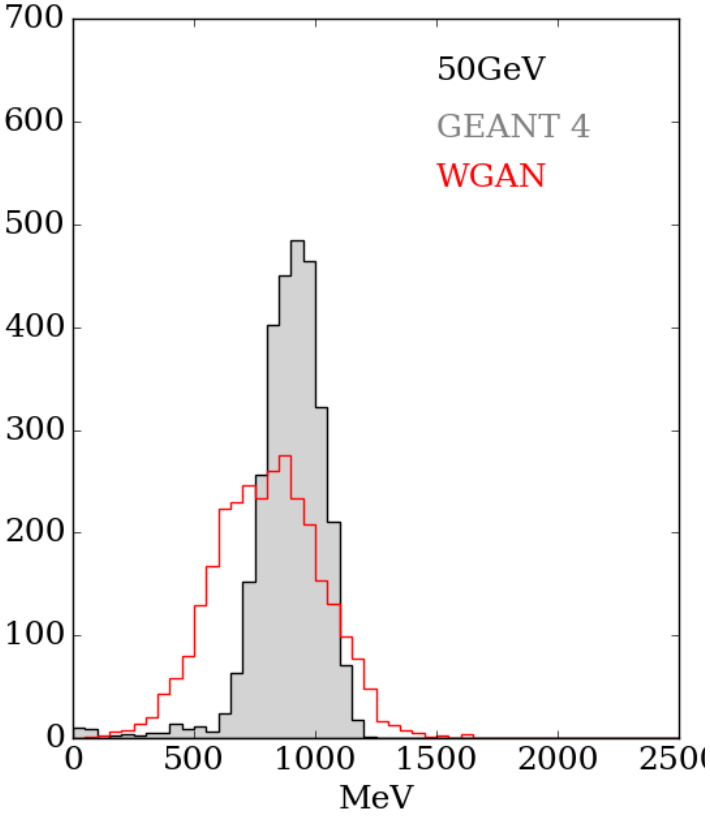
Use **Fake ECAL** during the **inference**

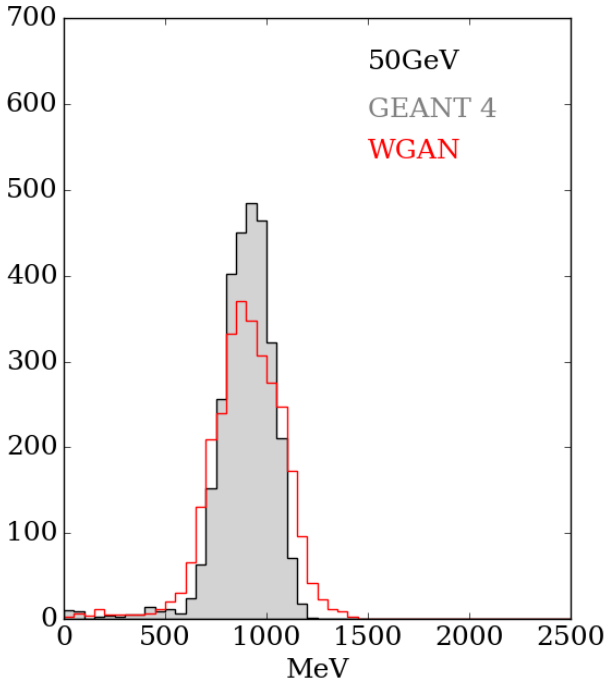
Use **real ECAL** during **the inference**

$$G_{ECAL}(z,E)+G_{HCAL}[G_{ECAL}(z,E),z,E]$$

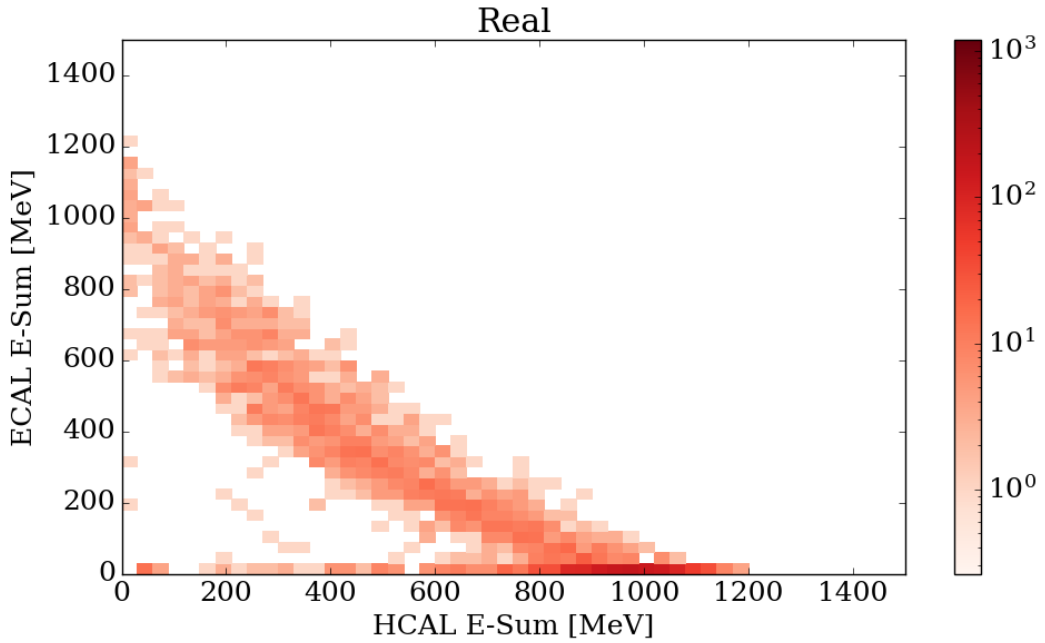
Real ECAL

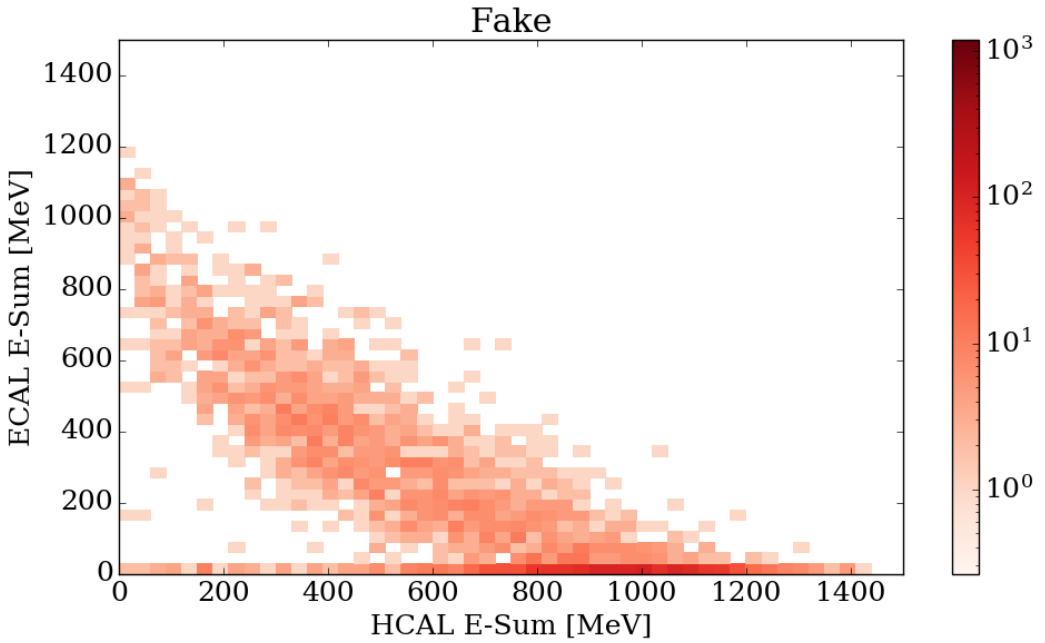
Real ECAL

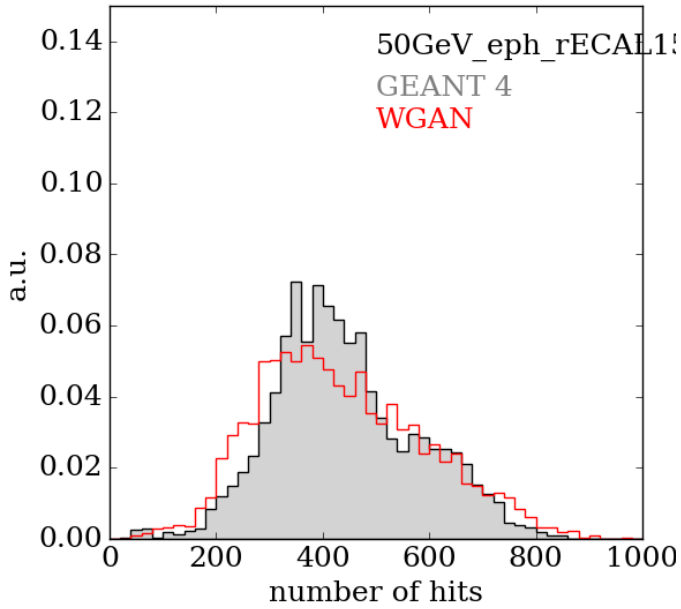


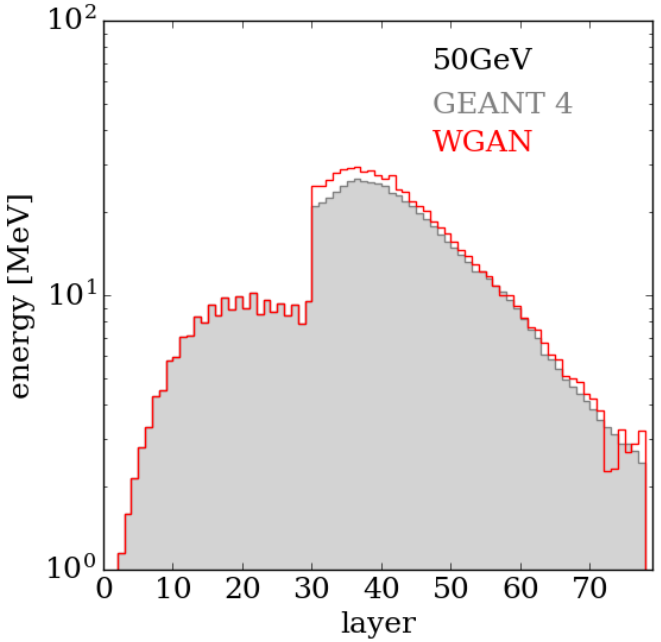


Pion showers in the ECAL + HCAL system









Summary of pion showers in the ECAL + HCAL system

Case 1: Everywhere Real ECAL ✔?

....
Critic:
1. REAL: Real ECAL + Real HCAL
2. FAKE: Real ECAL + Fake HCAL
Generator:
- Real ECAL + Fake HCAL

Case 2: Fake ECAL only in generator ✗

....
Critic:
1. REAL: Real ECAL + Real HCAL
2. FAKE: Real ECAL + Fake HCAL
Generator:
- Fake ECAL + Fake HCAL

Case 3: Fake ECAL in both ✗

....
Critic:
1. REAL: Real ECAL + Real HCAL
2. FAKE: Fake ECAL + Fake HCAL
Generator:
- Fake ECAL + Fake HCAL

Case 4: Fake ECAL everywhere ✗

....
Critic:
1. REAL: Fake ECAL + Real HCAL
2. FAKE: Fake ECAL + Fake HCAL
Generator:
- Fake ECAL + Fake HCAL

Summary of pion showers in the ECAL + HCAL system

Case 1: Everywhere Real ECAL

....

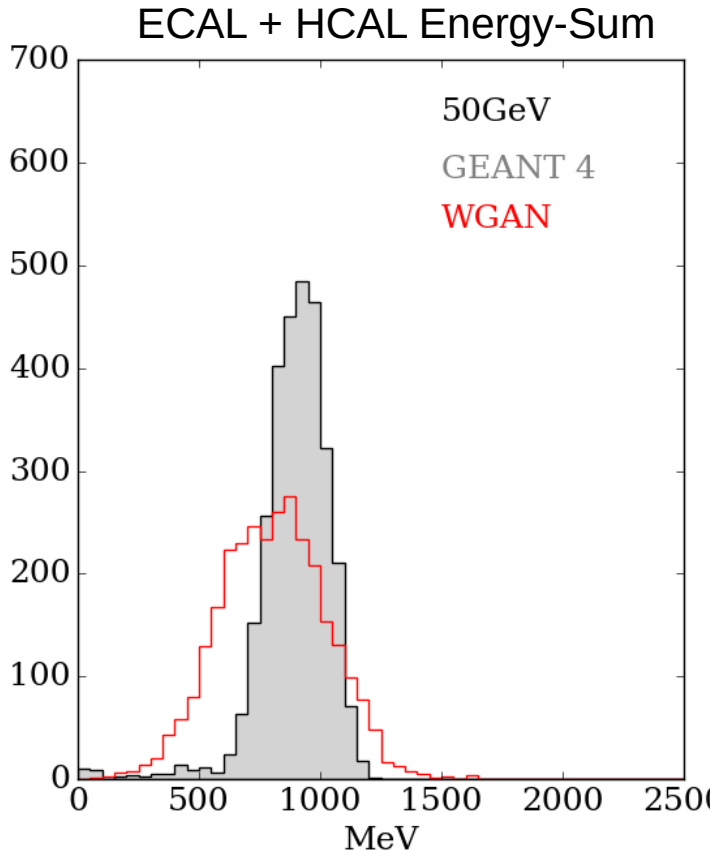
Critic:

1. REAL: Real ECAL + Real HCAL
2. FAKE: Real ECAL + Fake HCAL

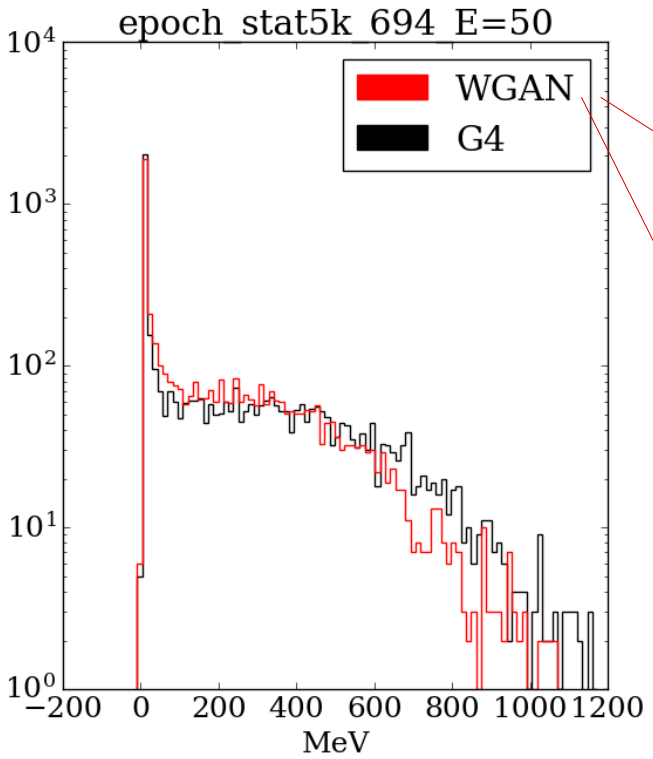
Generator:

- Real ECAL + Fake HCAL

Use **Fake ECAL** during the **inference**



ECAL-only generator
(Pre-trained model)

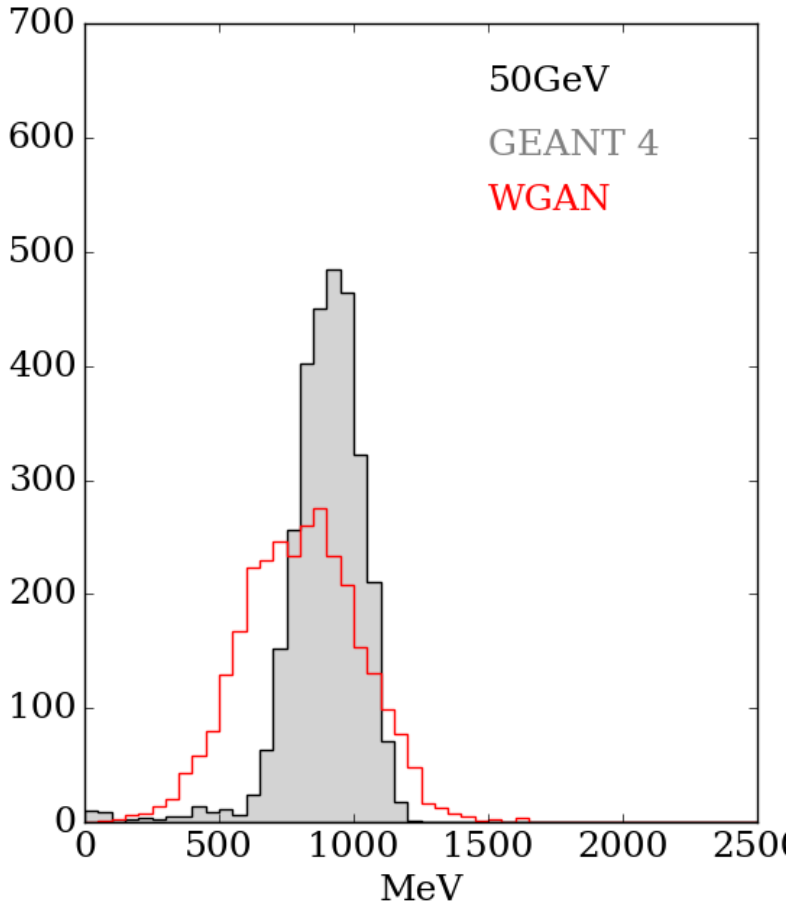


$$G_{ECAL}(z,E)+G_{HCAL}[G_{ECAL}(z,E),z,E]$$

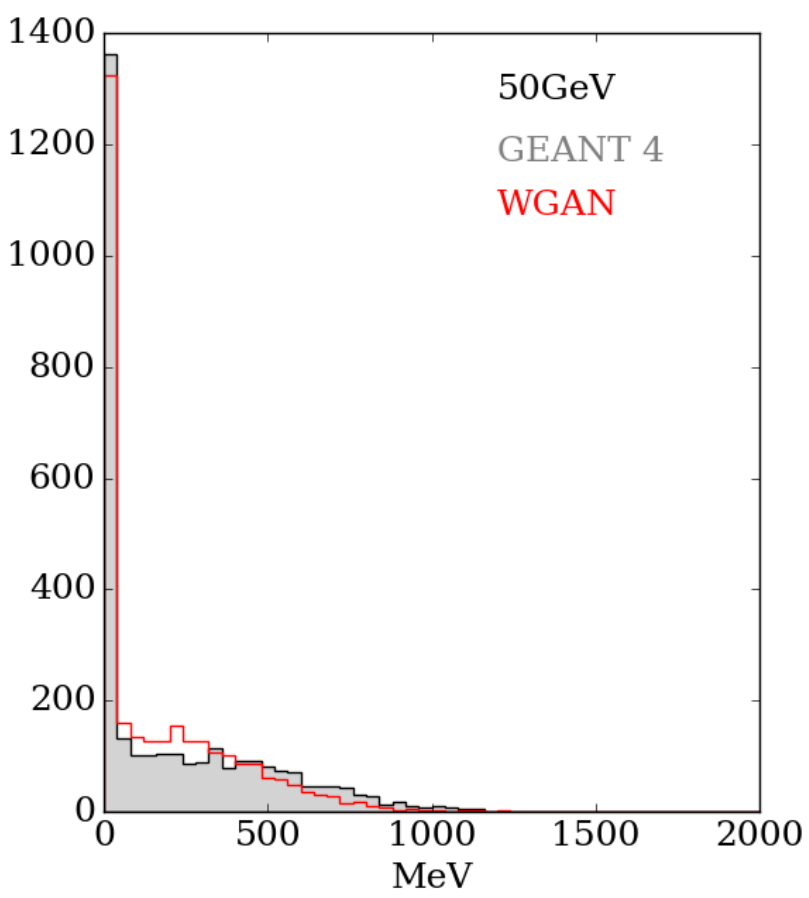
Pion showers in the ECAL + HCAL system

Some preliminary results with current best epoch
Cell energies > 0.25 MeV

Total Energy Sum



ECAL



HCAL