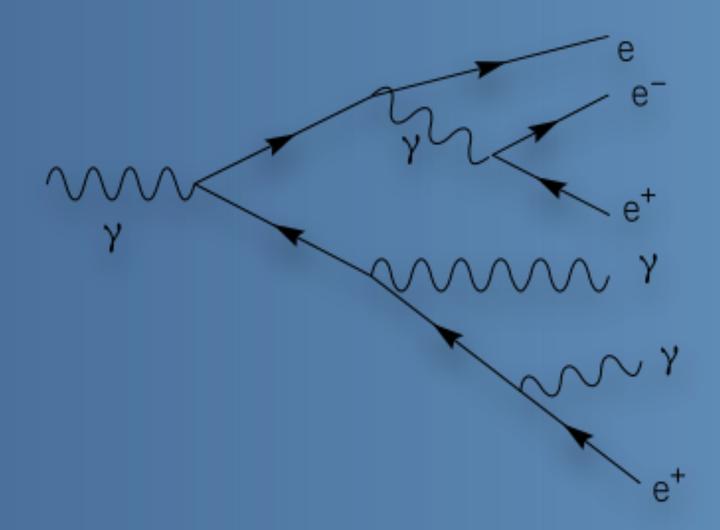
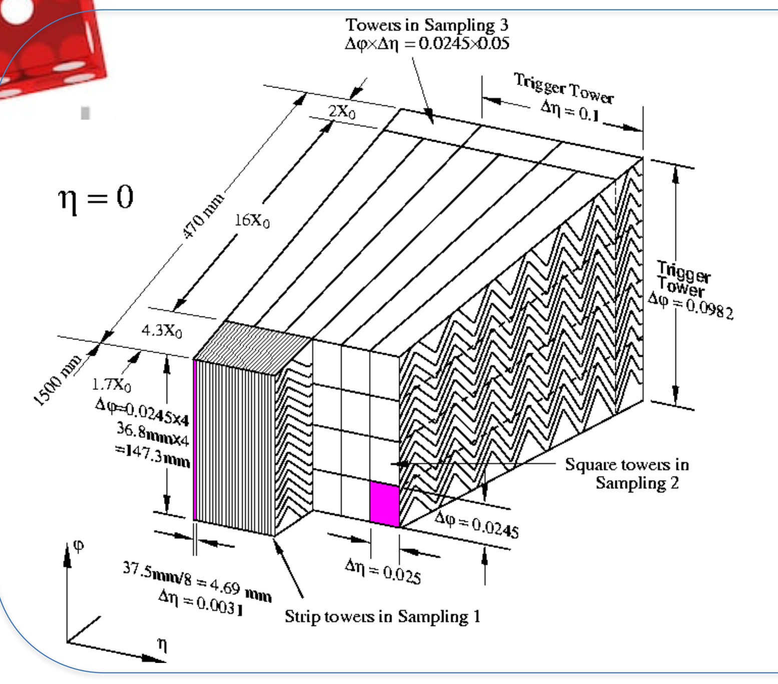
Poster Session RJP – Paris - November, 2019

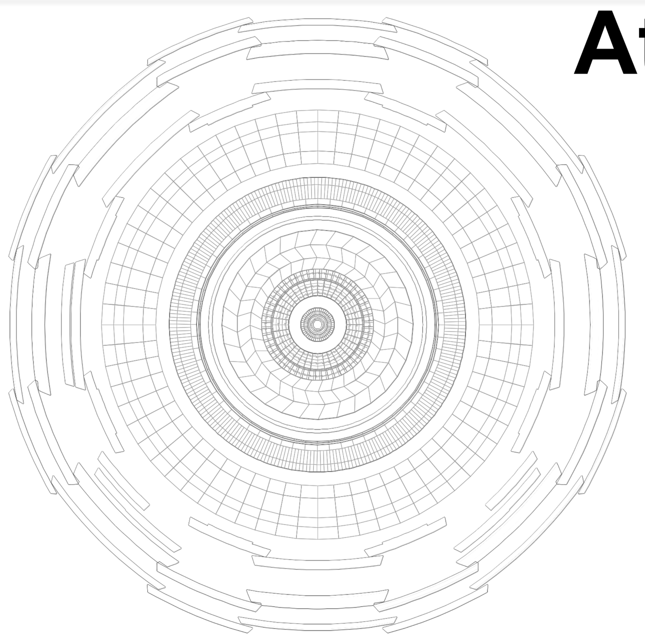
Generative Adversarial Networks for fast shower simulation in ATLAS



Current human designed fast simulation methods fulfil need for large scale simulations at the cost of accuracy. Lightning fast neural nets could learn to generate the physics instead. A 2-vs-1 competition between neural networks is studied for EM shower simulation.

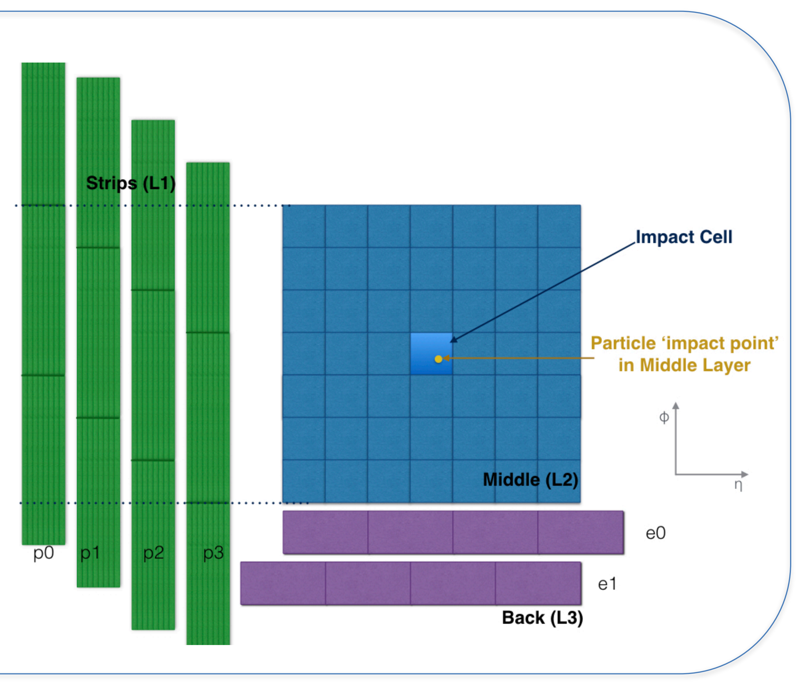
Atlas EM Calorimeter



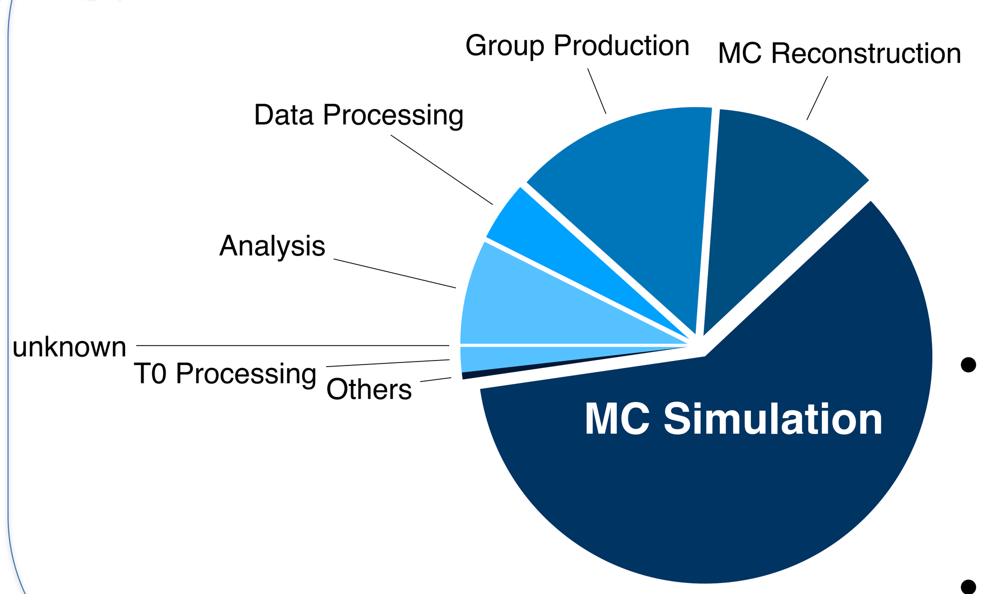


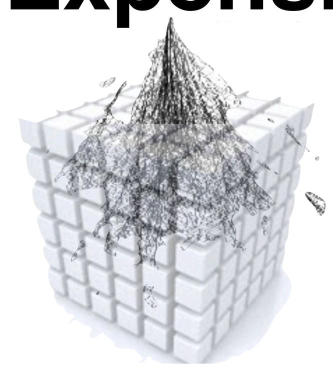
Alignment Configurations :

- 2- periodic in η
- 4-periodic in ϕ



Showers Computationally Expensive

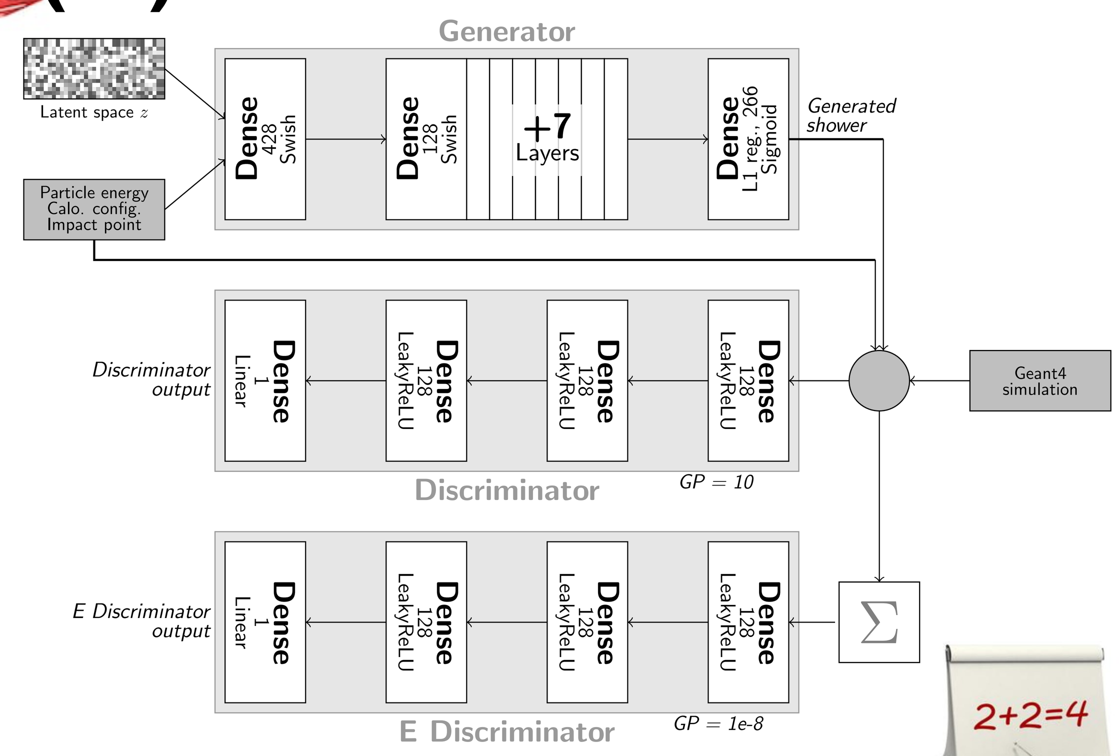


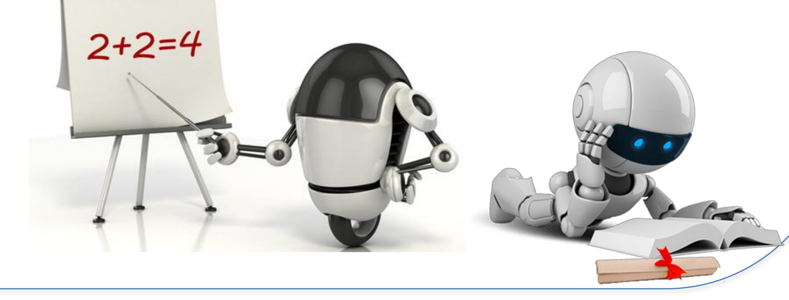


- Cascade quantum simulations are expensive for Geant4
- Only final shower image is recorded

(W) Generative Adversarial Networks

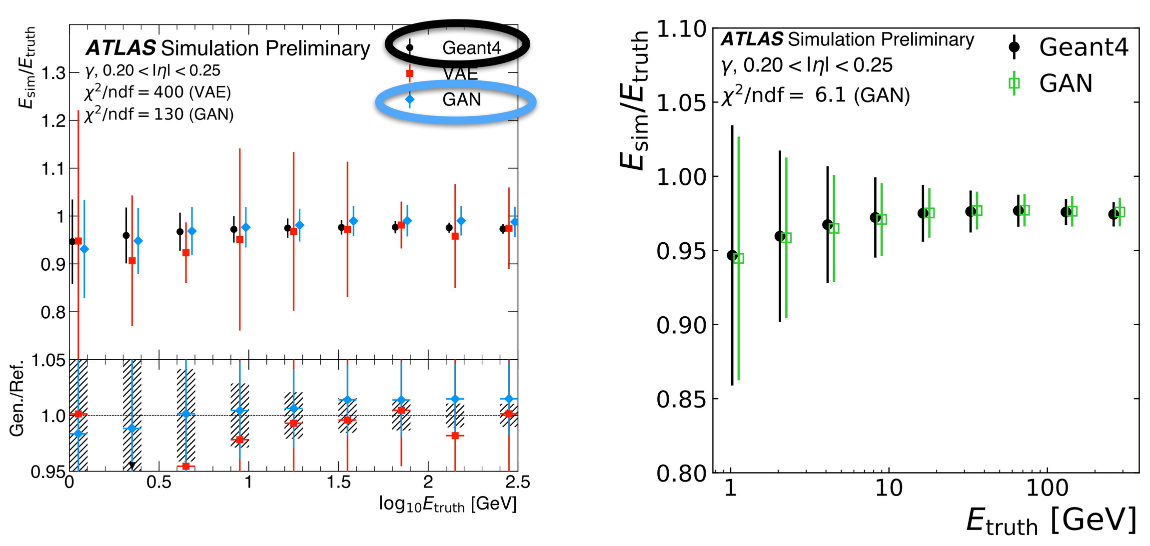
Gulrajani et al. 2017





Let AI supervise AI

Why we need the third network



Bars = standard deviation not error

Look at single photon showers at {1,2,4,8,16, 32, 65, 131, 262} GeV

Assume **Geant4** is ideal

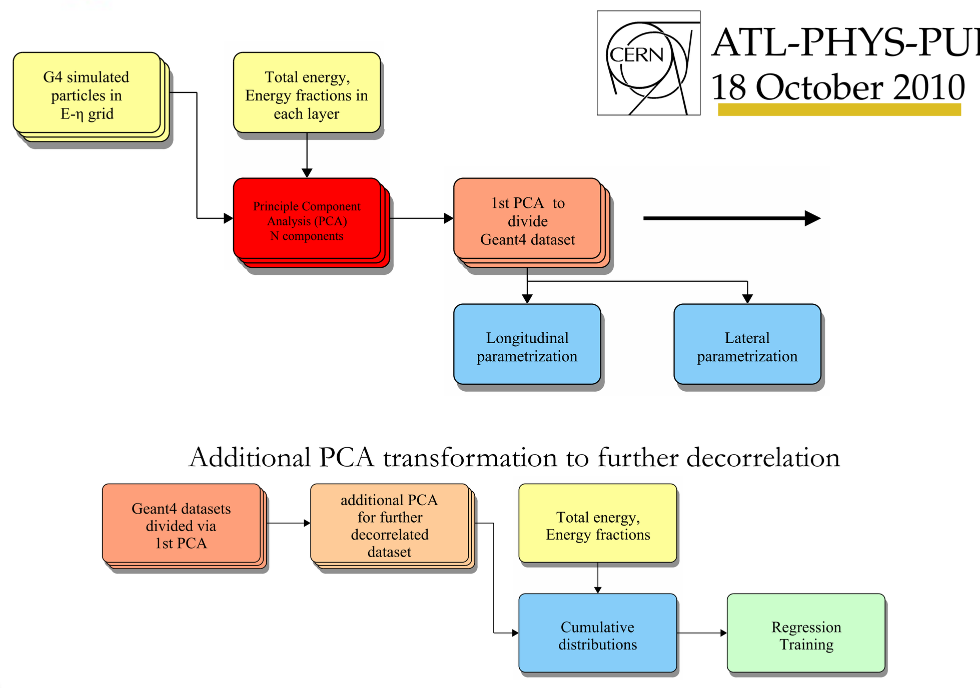
Additional Critic helps reproduce resolution of the detector
σE/E ~ 10% √E very well

Graeme Stewart (CERN), Aishik Ghosh, David Rousseau (LAL, Orsay), Kyle Cranmer (NYU), Stefan Gadatsch, Tobias Golling, Dalila Salamani (UniGe), Gilles Louppe (ULiège)

PUB Note: *ATL-SOFT-PUB-2018-001* SIM-2019-004

Baseline: FastCaloSim

ATL-PHYS-PUB-2010-013
18 October 2010

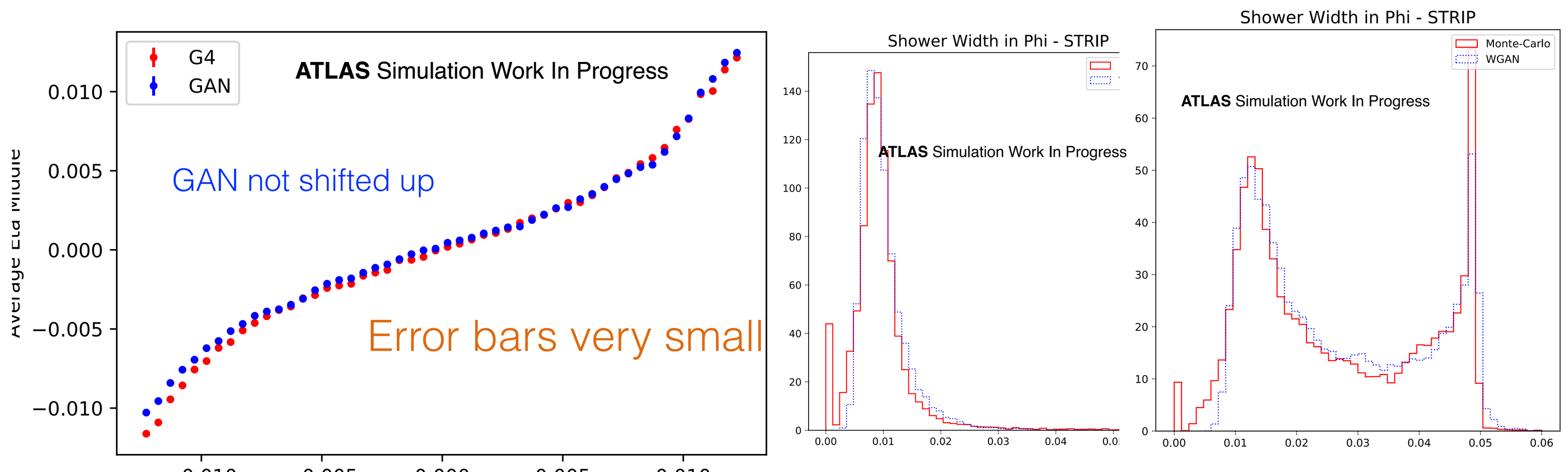


Actively developed and improved by team of physicists for decade

Done separately for each η slices, energy

additional interpolation mechanism

Detector Geometry Features



Particle Position

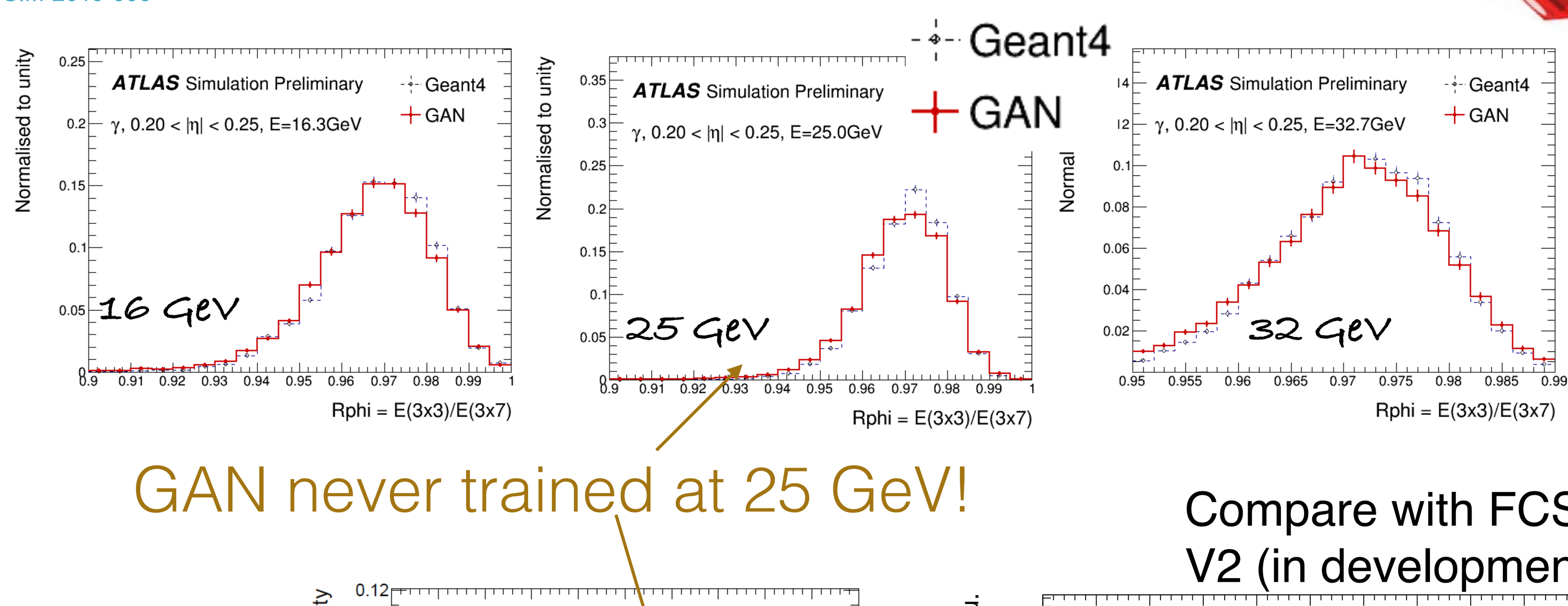
Calorimeter layer alignments

Conditional GAN:
2 continuous conditions,
72 discrete conditional combinations at training

GAN looks good! Next, expand to entire calorimeter

Plug into ATLAS C++ Software

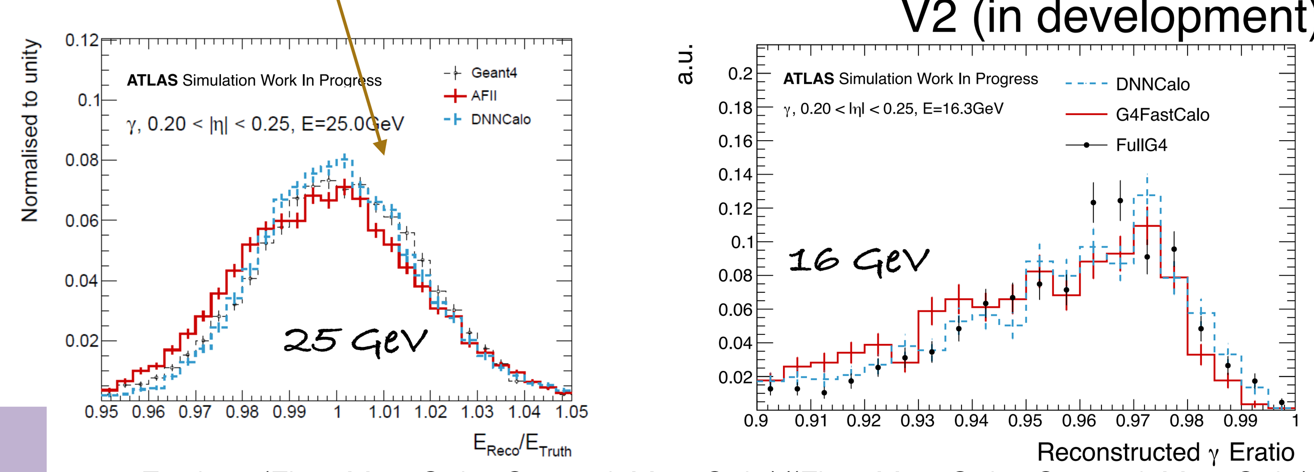
SIM-2019-006



GAN never trained at 25 GeV!

Compare with ATLAS Fast II

Compare with FCS V2 (in development)



Eratio = (First_Max_Strip -Second_Max_Strip)/(First_Max_Strip+Second_Max_Strip)

Aishik Ghosh (LAL, Orsay)