GANS FOR ETHER

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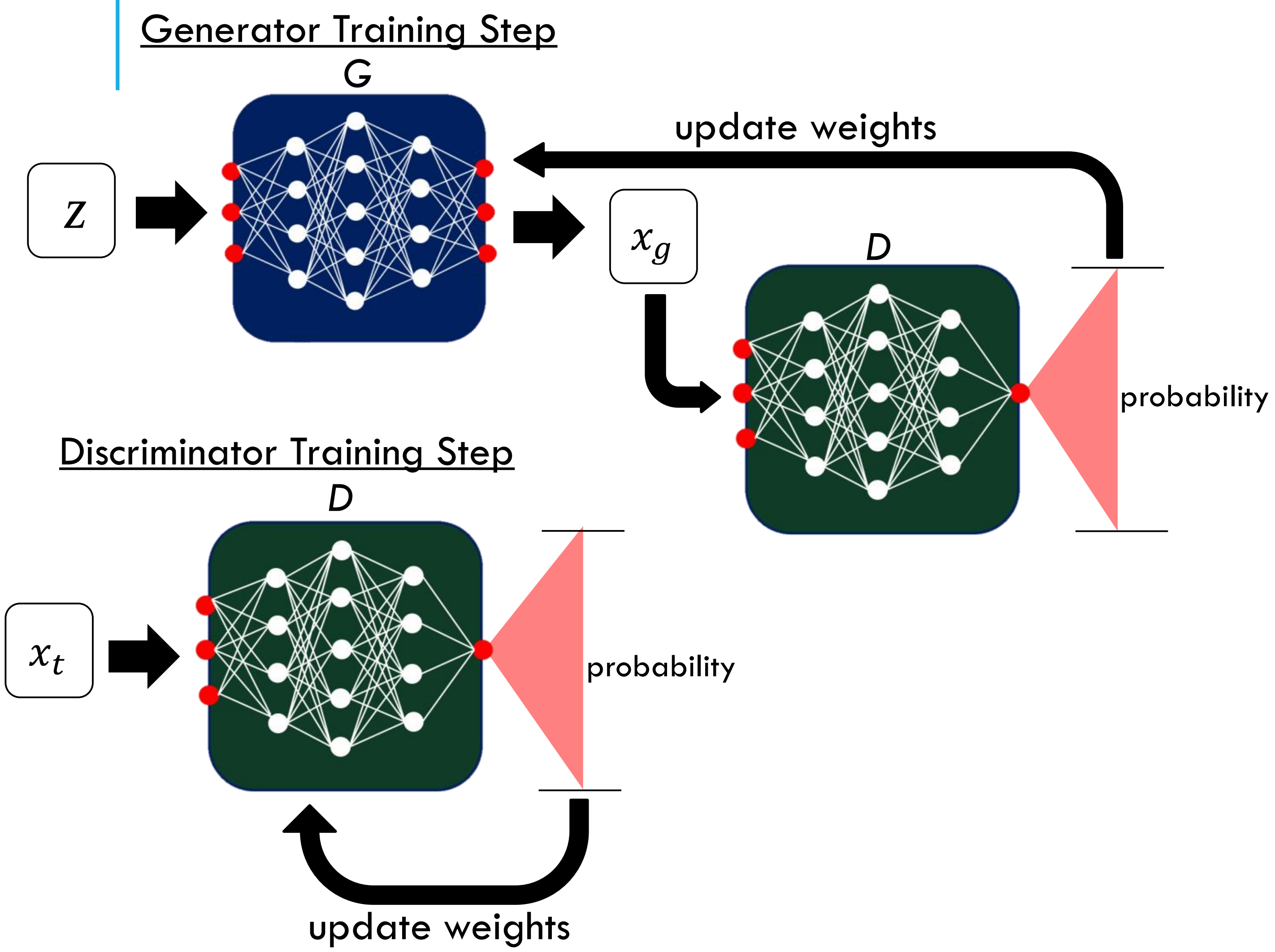
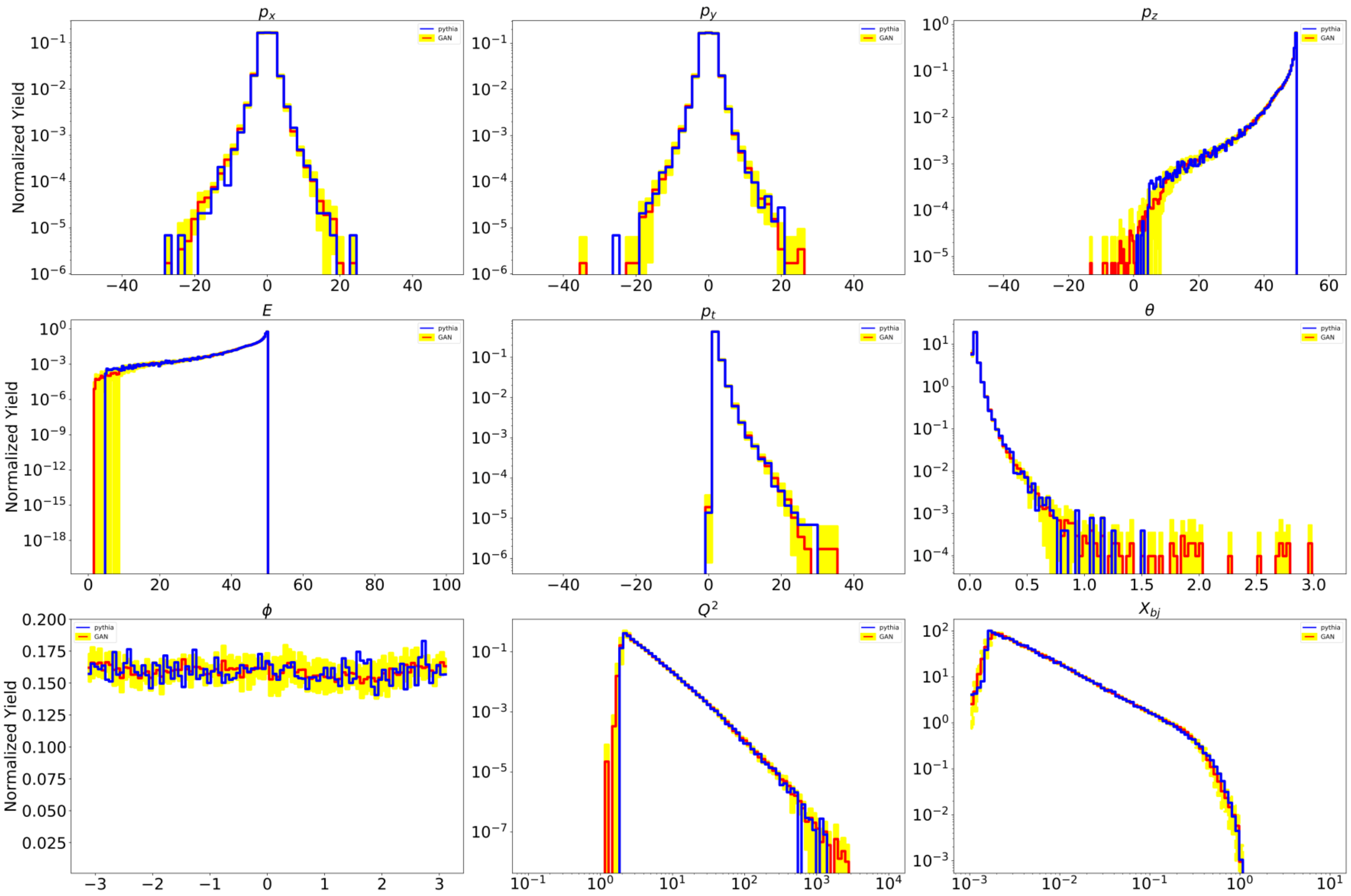
Generative Adversarial Networks (GANs)



- Unsupervised model
  - Generator, *G*
  - Discriminator, *D*
- Adversarial training allows Generator to learn the underlying distribution of the training set
  - x_t is only involved in *D* training step
- Currently, for ETHER, x_t = features generated from PYTHIA

THE INCLUSIVE CASE

- Consider only the scattered electron
- From p_x, p_y, p_z generated from PYTHIA the following additional features are calculated:
  - $\ln(Beam\ Energy\ -\ p_z)$
  - $p_x p_y$
  - $p_x p_z$
  - p_t
  - E
  - $p_z p_t$
- Q^2 and xBj are calculated outside of the GAN framework and used to evaluate the generator's performance



PYTHIA

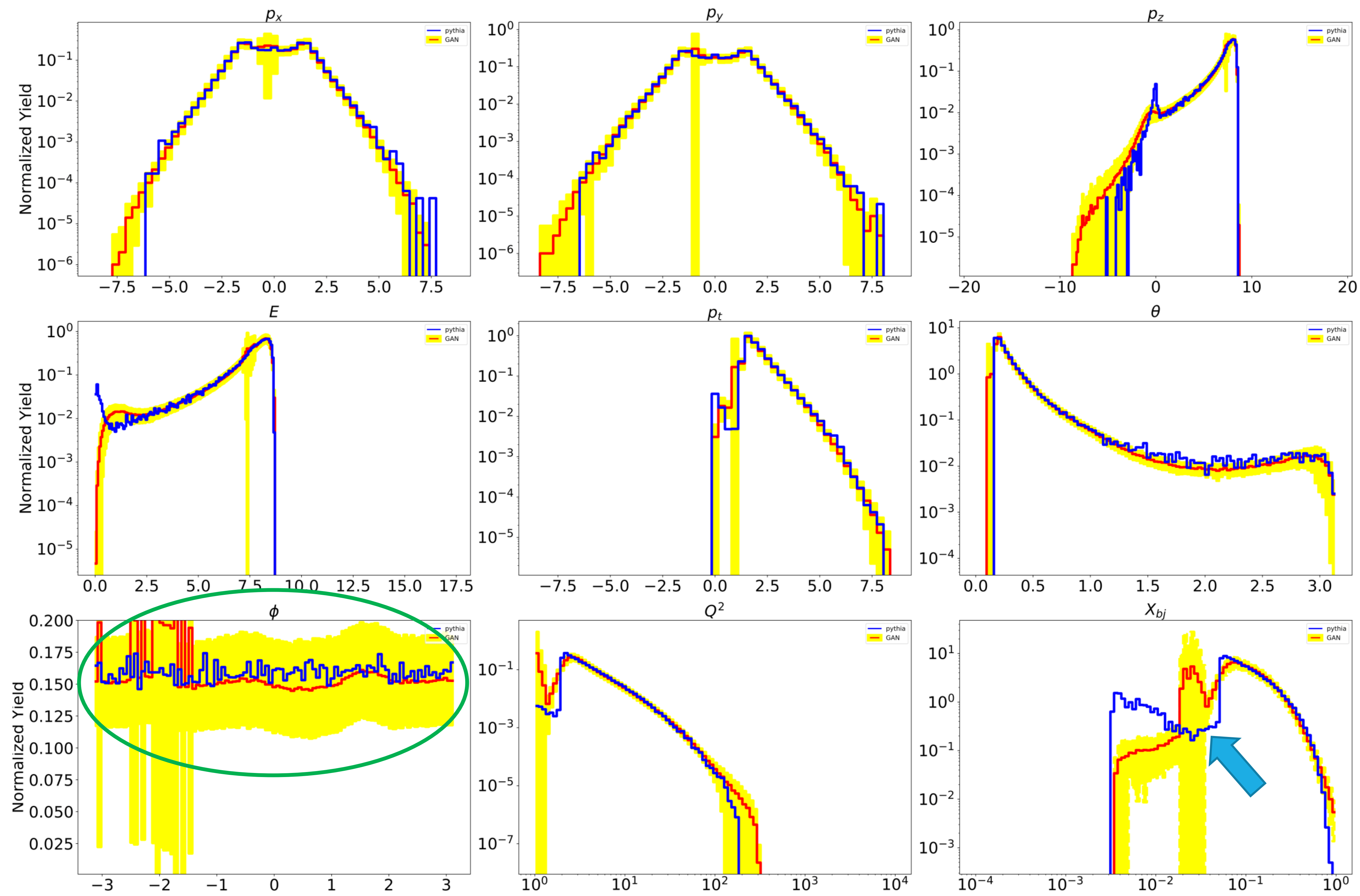
GAN

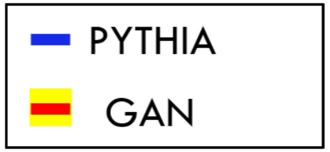
- Training set: 100,000 events
- Training steps:
- Bootstrapping procedure used to obtain error bands on generator

2 PARTICLES

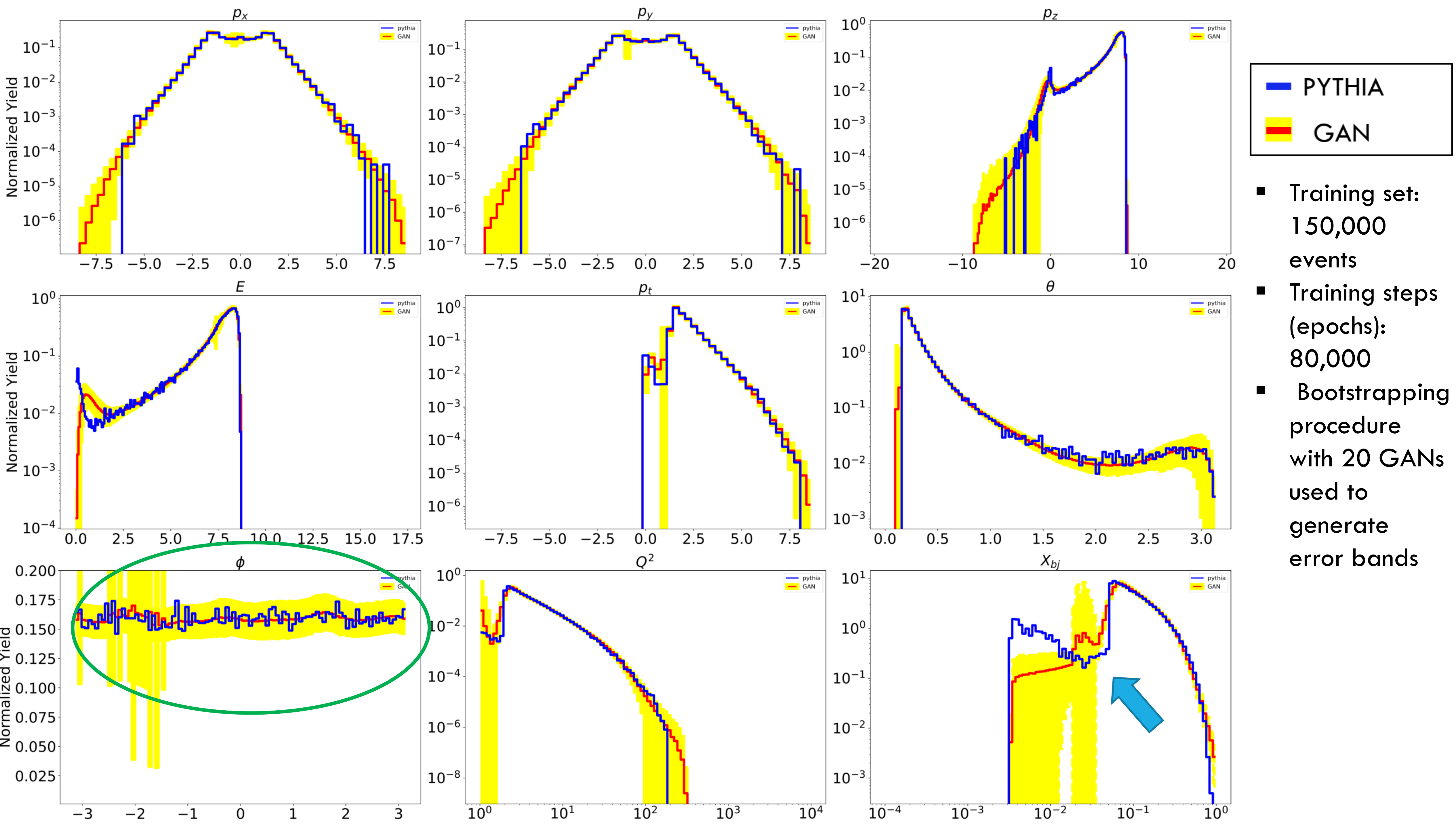
- Consider two particles, the scattered $e^-$and a π^+
- Extending the techniques from the inclusive case, the same features are generated from PYTHIA for each particle:
  - $\ln(Beam\ Energy\ -\ p_z)$
  - $p_x p_y$
  - $p_x p_z$
  - p_t
  - E
  - $p_z p_t$

  For a total of 20 features
  - $Q^2$and xBj are calculated outside of the GAN framework and used to evaluate the generator's performance

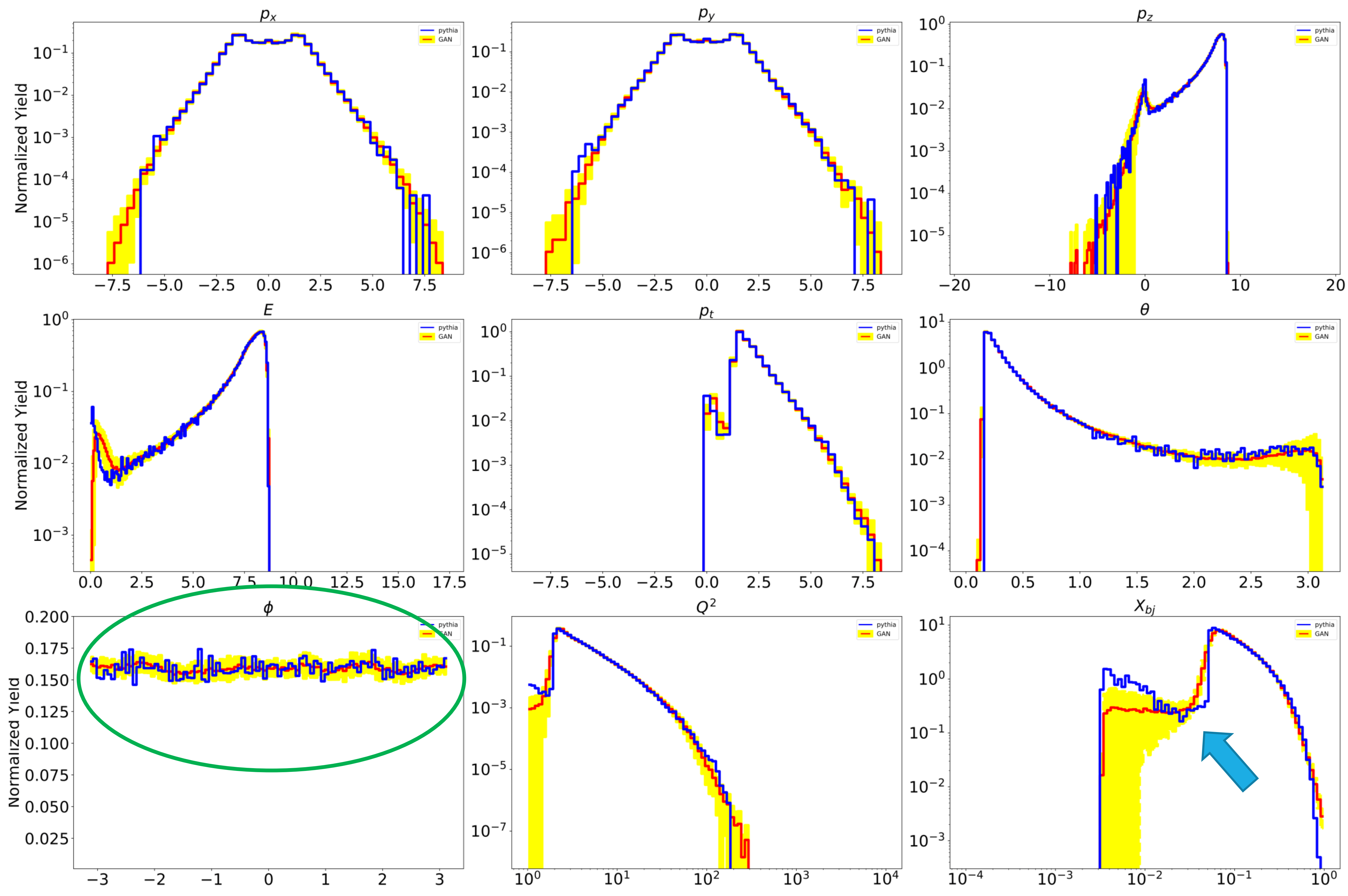


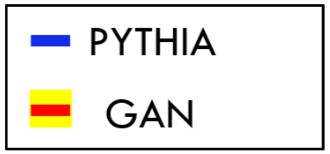


- Training set: 150,000 events
- Training steps (epochs): 10,000
- Bootstrapping procedure with 20 GANs used to generate error bands



- Training set: 150,000 events
- Training steps (epochs): 80,000
- Bootstrapping procedure with 20 GANs used to generate error bands





- Training set: 150,000 events
- Training steps (epochs): 160,000
- Bootstrapping procedure with 20 GANs used to generate error bands