AI for Data Analysis and Preservation

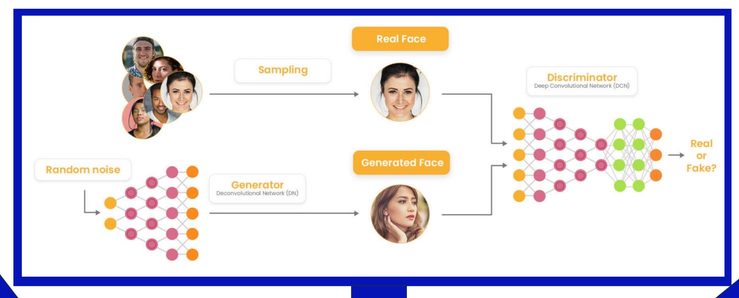
Tommaso Vittorini on behalf on A(i)DAPT working group
tommaso.vittorini@ge.infn.it

A(i)DAPT
AI for Data Analysis and PreservaTion

Can AI support NP/HEP experiments and allow to extract physics form data in a more efficient way?

Develop AI-supported procedures to:
- Unfold detector effects
- Accurately fit data in multi-D space
- Generate synthetic data with same properties as real data

Generative Adversarial Networks (GANs)



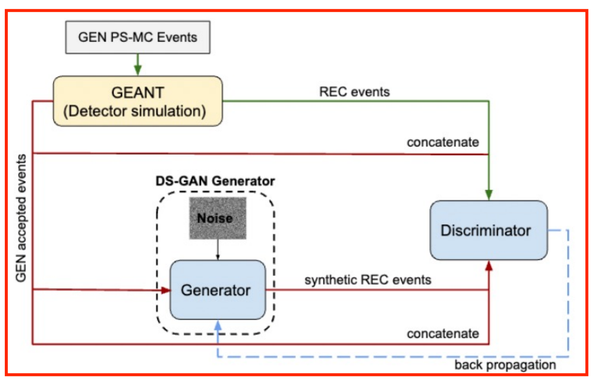
Recover CLAS resoution

Reaction definition

- CLAS g11 2π photoproduction pseudodata with $E_\gamma = (3-4)GeV$
- Focus on $\gamma p \to p\pi^+(\pi^-)$
- Multi-pion background
- Dominant processes:

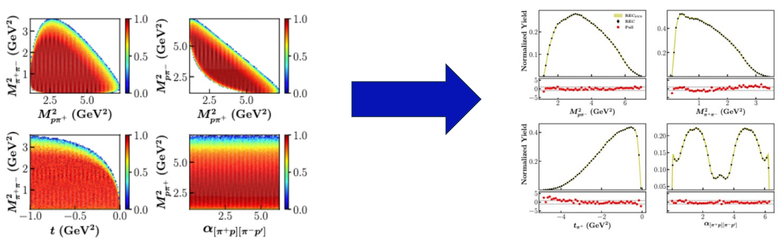
$$\gamma p \to p\rho^0 \to p\pi^+(\pi^-)$$
$$\gamma p \to \Delta^{++}\pi^- \to p\pi^+(\pi^-)$$

Detector-simulation GAN

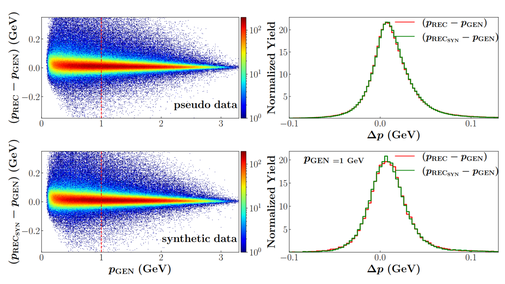


- Train the DS-GAN to apply detector smearing on vertex-level events

Phase space training dataset



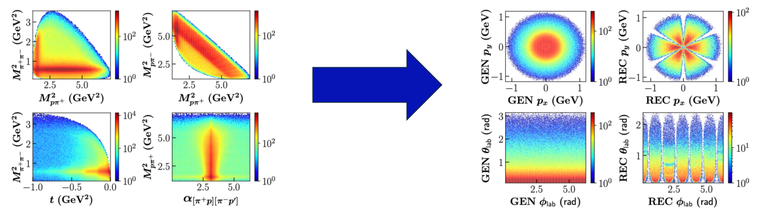
CLAS Resolution closure test



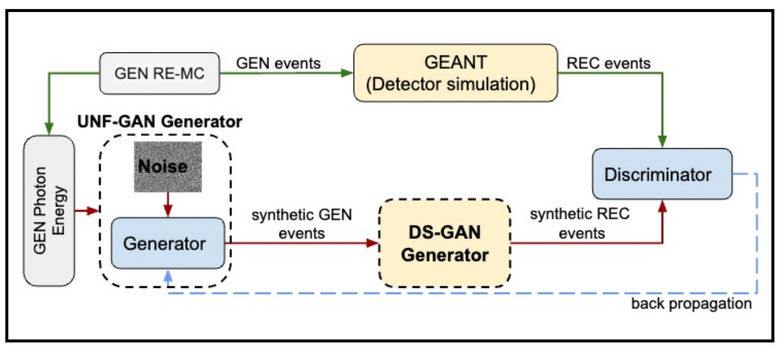
Recover vertex level distributions

Training dataset

- Vertex-level data generated through MC simulation including the most dominant processes
- Detector effects added through a MC detector proxy (GSIM-GEANT)

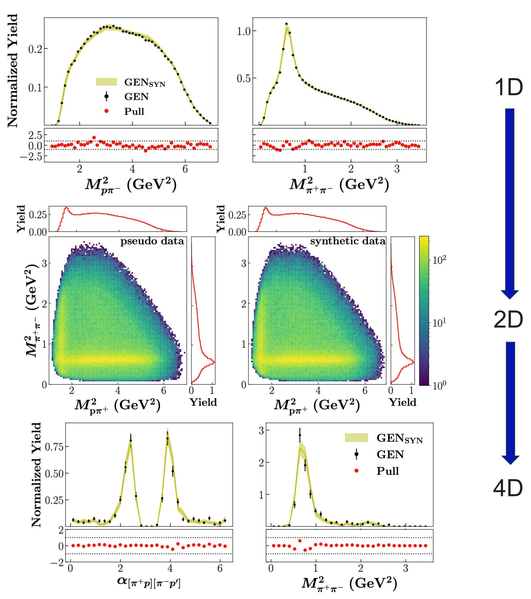


Unfolding GAN



- Train the unfolding GAN to recover vertex-level distribution

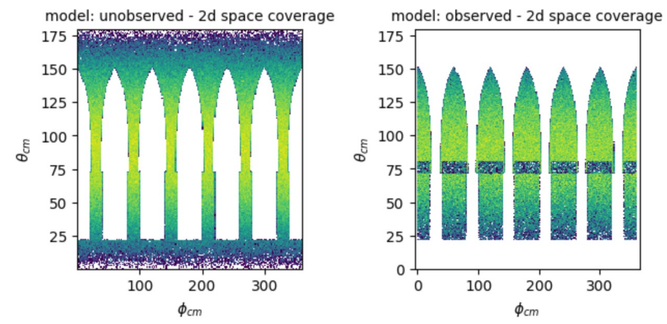
Unfolding GAN results



Work in progress and outlook

Acceptance

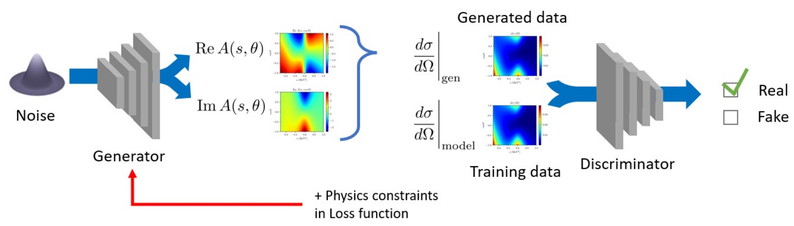
- $\gamma p \to \Delta^+(1232) \to p\pi^0$ model
- Topologies dinstiction:
  - T0: $\gamma p \to unmeasured$
  - T1: $\gamma p \to p(\pi^0)$
  - T2: $\gamma p \to (p)\pi^0$
  - T3: $\gamma p \to p\pi^0$



- Build a single GAN which is able to generate events in the full phase space

Amplitude extraction

- $\pi^+\pi^- \to \pi^+\pi^-$ scattering model



- Amplitute extraction from experimental data cross-section