HADRON IDENTIFICATION IN SIDIS RECONSTRUCTION

SIDIS PWG | ePIC collaboration

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STUDY OF EPIC PID PERFORMANCE

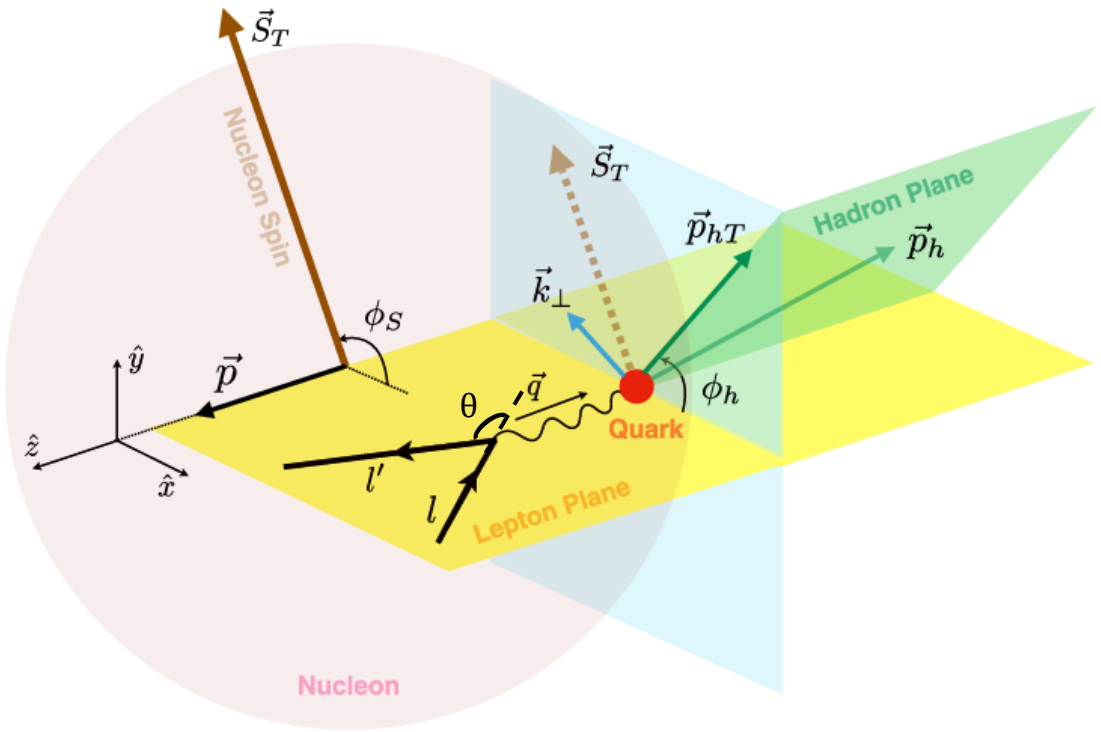
Goal: Assess hadron reconstruction and **PID** capabilities at **ePIC** for **pions**, **kaons** and **protons** as a function of $Q^2, x_B, z, P_{hT}, P_h, \eta$.

Data sample	Generator	Energy	Scale	Cut	Acceptance	Event analyzed
24.05.0	Pythia6.4	18×275 GeV	$Q^2 < 1$ GeV^2	$-3.7 < \eta < 3.7$	49.71%	3×10^4
24.06.0	Pythia8	18×275 GeV	$Q^2 > 1$ GeV^2	$-3.5 < \eta < 3.5$ $y < 0.95$	47.24%	5×10^4
24.08.1	Pythia8	18×275 GeV	$Q^2 > 1$ GeV^2	$-3.5 < \eta < 3.5$ $y < 0.95$	48.37%	5×10^4

PID systems: tracking system, pfRICH, hpDIRC, ToF and dRICH (only Look-Up tables).

→ **NB:** Calorimeters not included in the simulation → **scattered electron information loss**

RECONSTRUCTION OF KINEMATIC VARIABLES



DIS variables (**Double Angle** method) and **SIDIS** variables:

$$y = \frac{tan\frac{\Phi_h}{2}}{tan\frac{\Phi_h}{2} + tan\frac{\theta}{2}} \qquad z = \frac{P \cdot P_h}{P \cdot q}$$

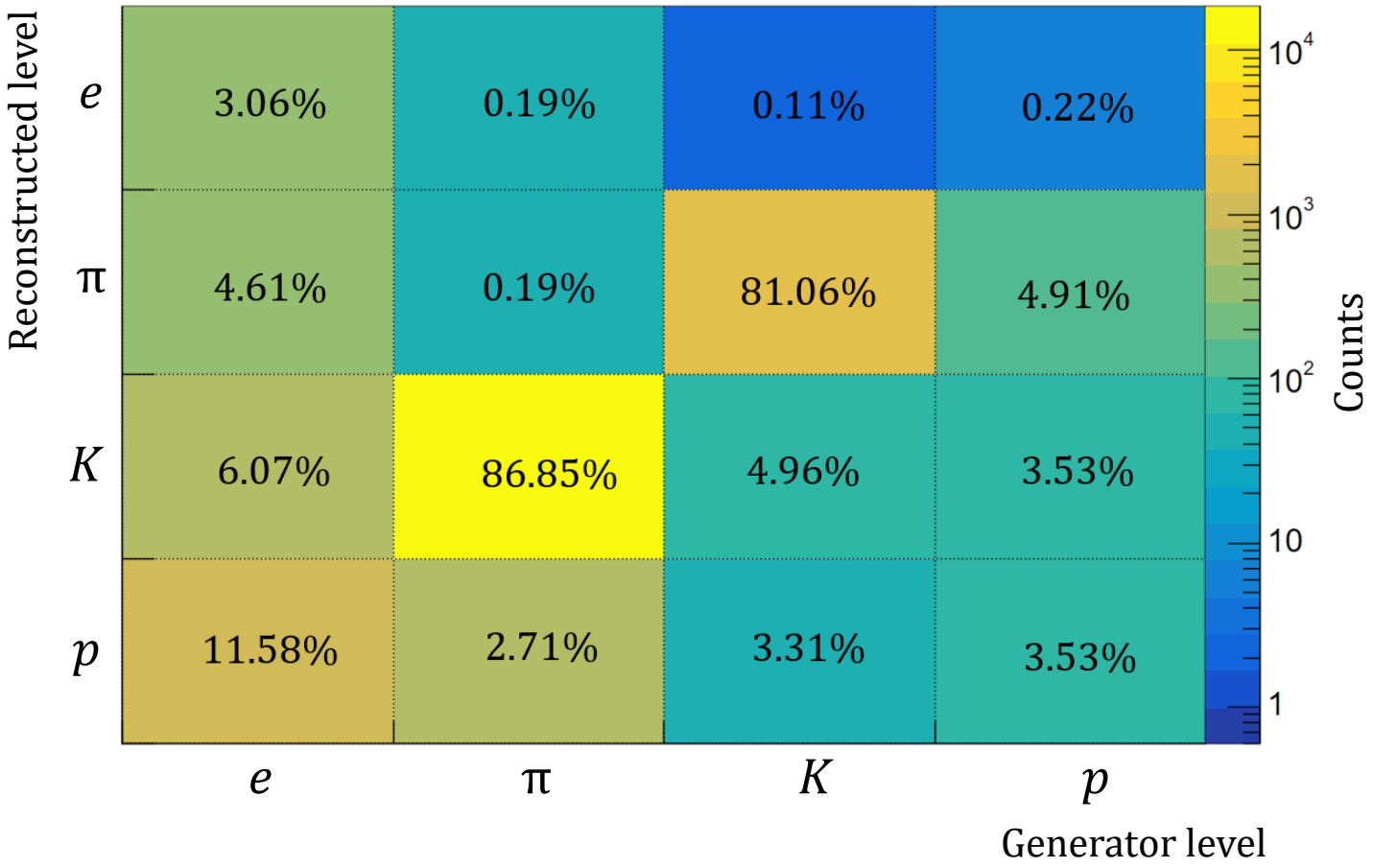
$$Q^2 = 4E_0^2 cot\frac{\theta}{2}(1-y) \qquad \vec{P}_{hT} = \vec{P}_h - \frac{\vec{P}_h \cdot \vec{q}}{|\vec{q}|}\hat{q}$$

$$x_B = \frac{Q^2}{4E_0E_p y}$$

$E_0 =$ energy of the electron beam $\quad \theta =$ scattered electron

$E_p =$ energy of the proton beam $\quad \Phi_h =$ identified hadron

PARTICLE IDENTIFICATION

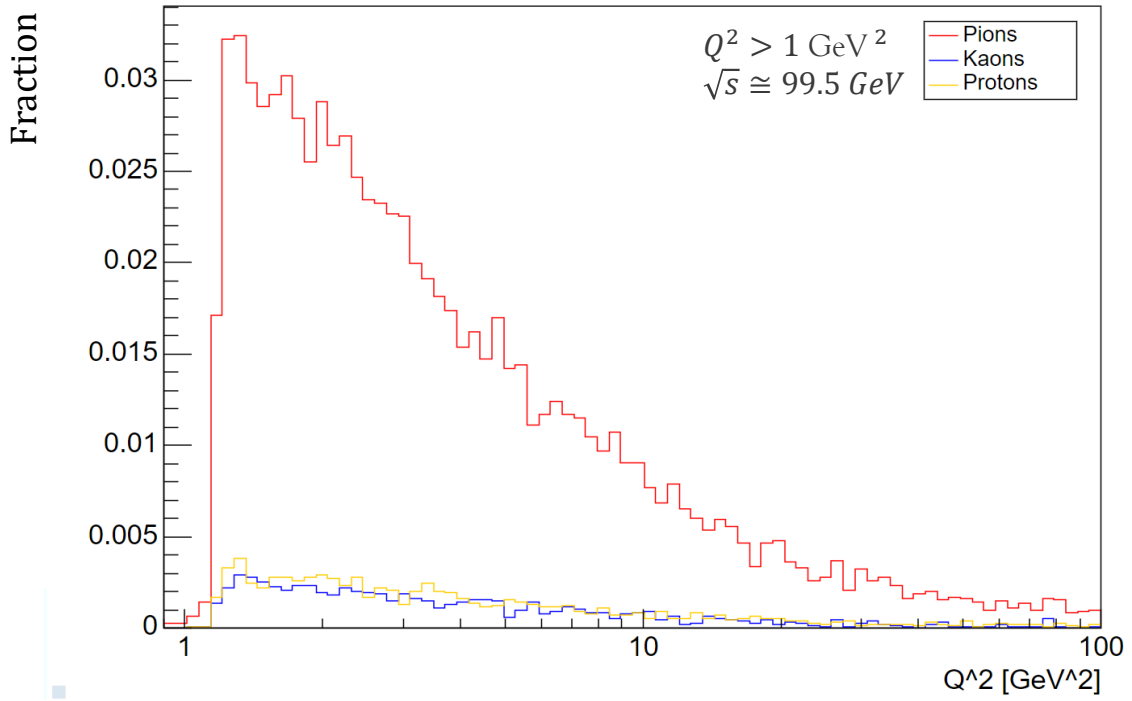


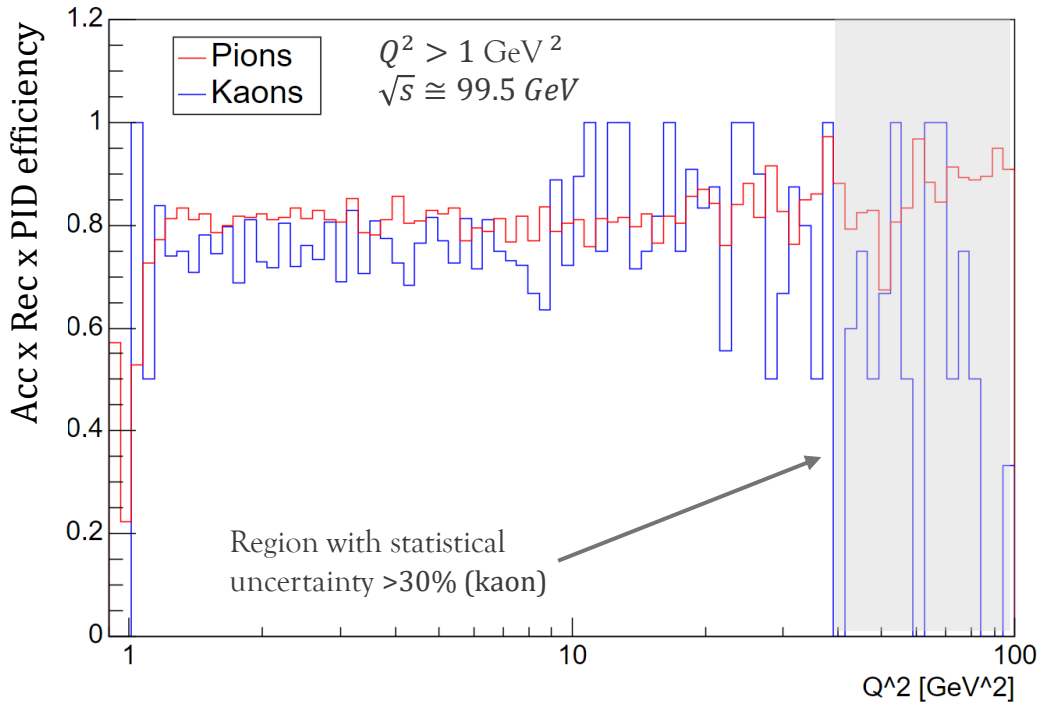
- **Shown:** Acceptance x reconstruction efficiency x PID efficiency.
- Around **86.85%** of pions and **81.06%** of kaons are correctly identified.
- **Most of the generated protons are not identified!**
- The **12.44%** of the total particles are **not identified** (not in table).
- **No** improvement from the **24.06.0.**

PRODUCTION AND EFFICIENCY VS Q^2

Fraction = fraction of a given particle species in a given Q^2 bin relative to the total reconstructed charged particles.
Perfect PID via Monte Carlo ID.

Efficiency = Reconstructed and correctly identified particles in acceptance / generated particles in the acceptance.

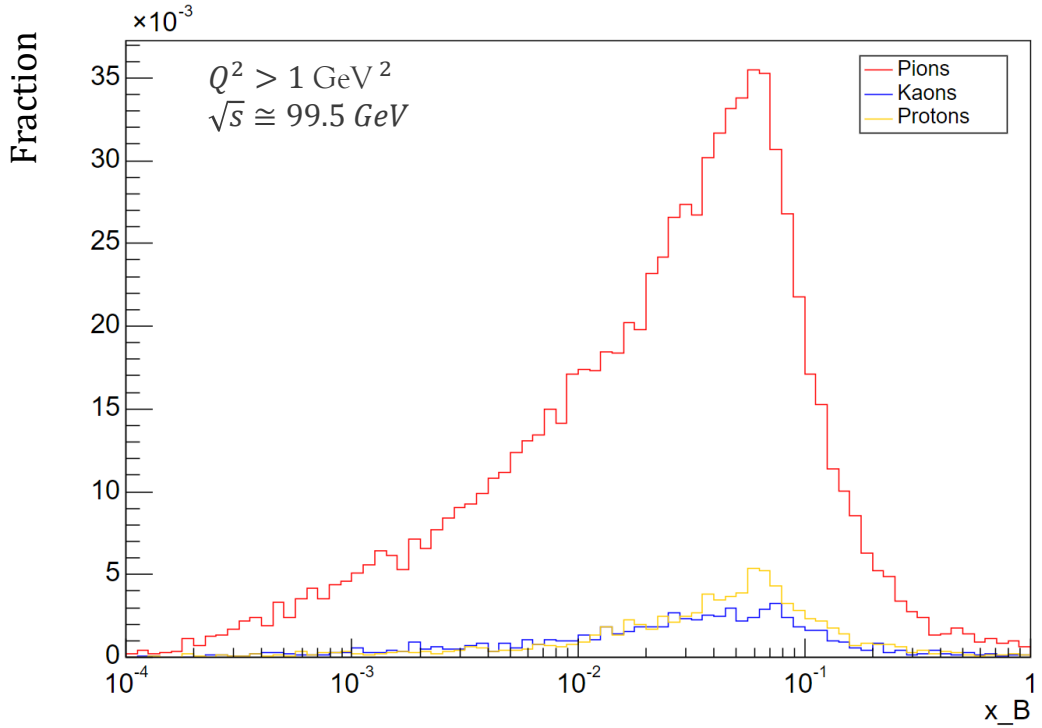


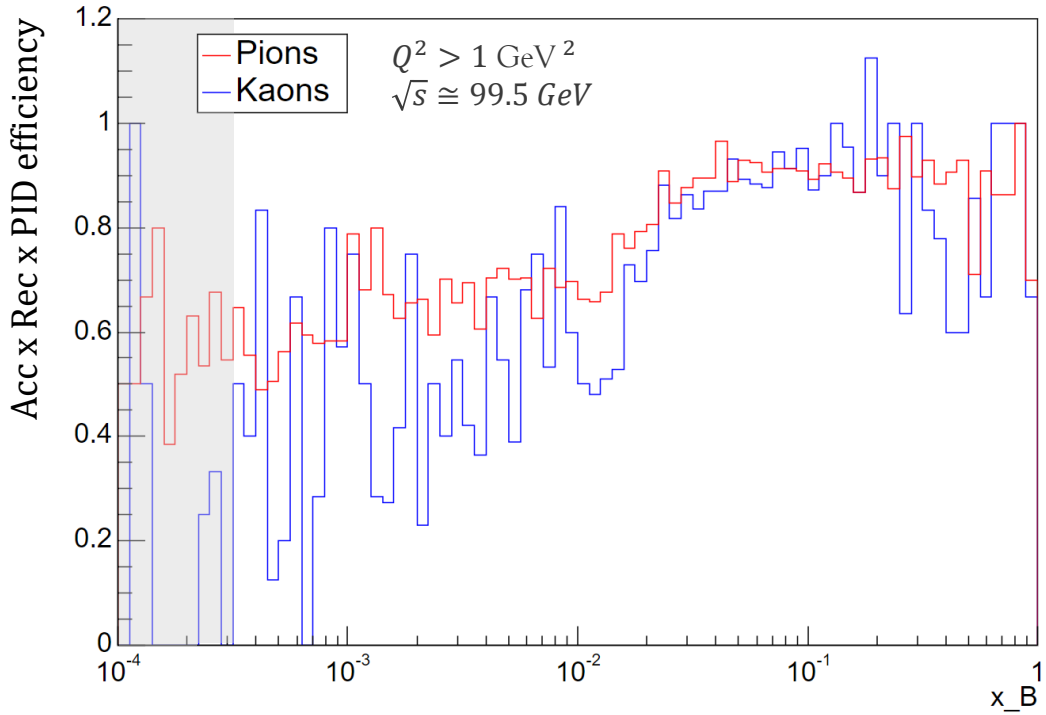


PRODUCTION AND EFFICIENCY VS x_B

Fraction which display a peak in the production slightly before x_B~0.06, which is near the region of interest for the TMD calculations.

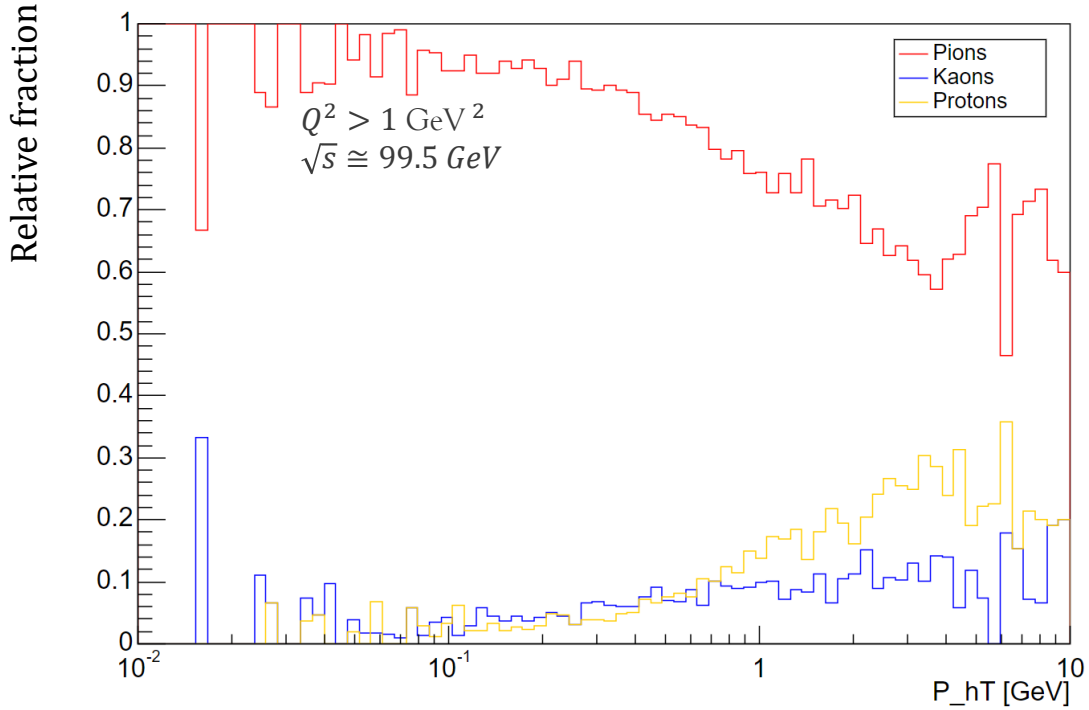
The **efficiencies** increase with the increase of the momentum, with a saturation aroud the **90%** for both species at $0.03 < x_B < 0.2$.



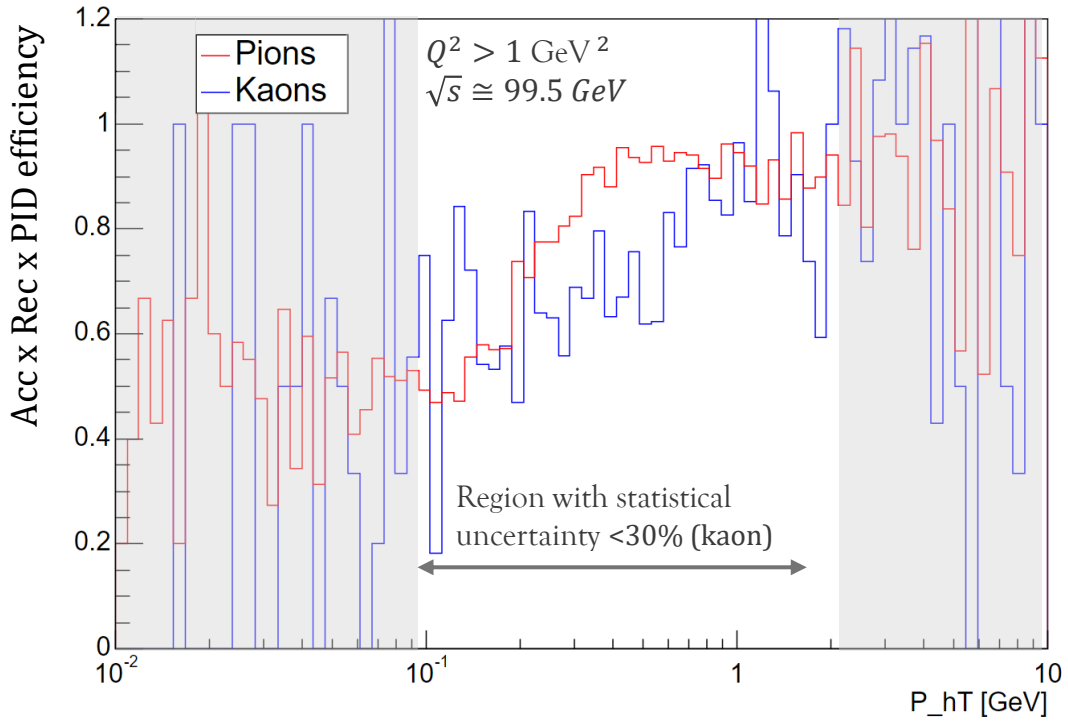


PRODUCTION AND EFFICIENCY VS P_{hT}

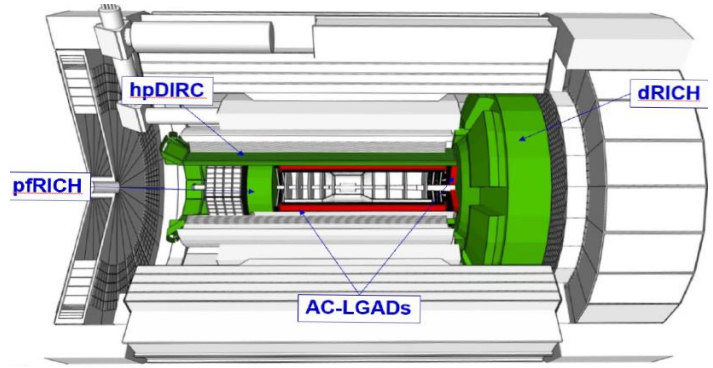
Relative fraction = fraction of a given particle species in a given P_{hT} bin, where each bin is normalized at 1.
Perfect PID via Monte Carlo ID.

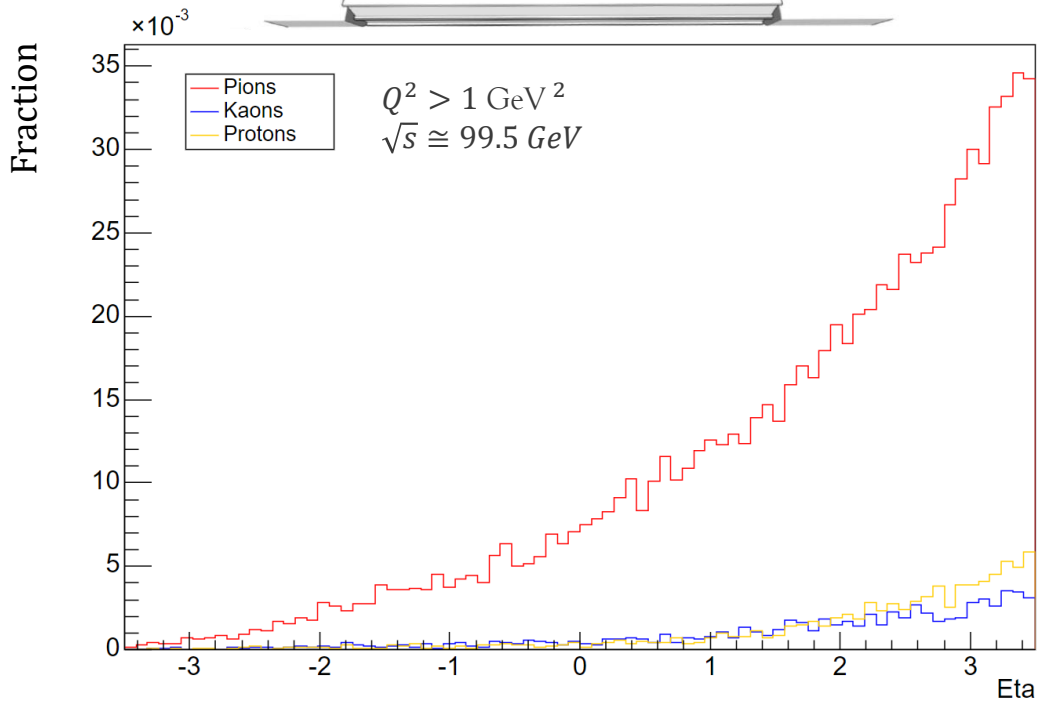


Efficiency around **50%** near 0.1 GeV with peak about to **90%** at 0.3 GeV for the pion and 0.5 GeV for the kaon.

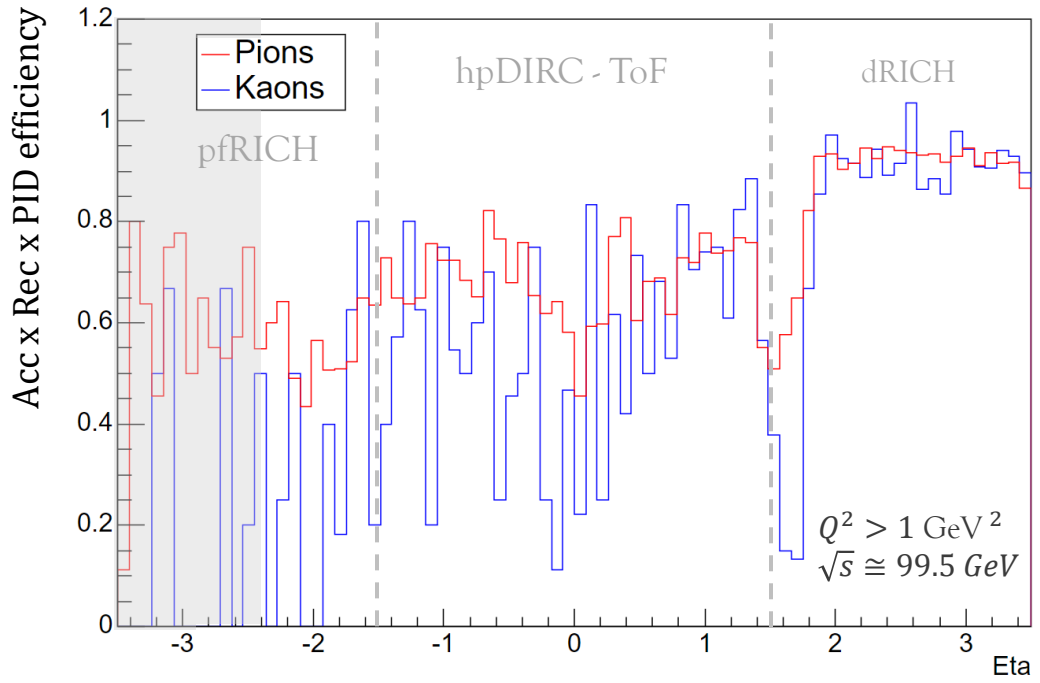


PRODUCTION AND EFFICIENCY VS η





The **efficiency** is peaked in the **dRICH** region (> **90%** for η > 1.8).
The **pfRICH** sector has the least developed LUT and suffers large statistical fluctiations.

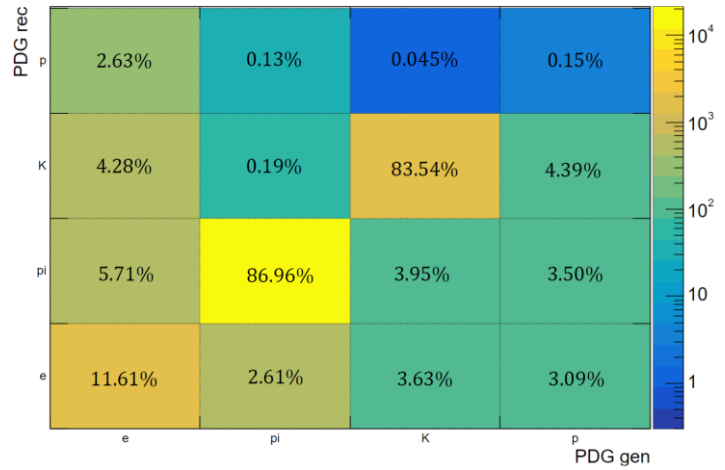


SUMMARY

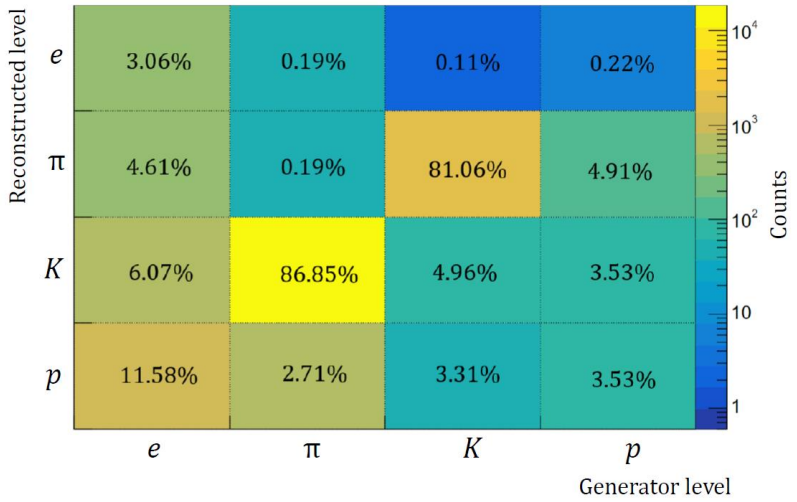
Resulting from this work:

- New assessement of **PID performance**.
- Suggestions on priorities for future improvement for **ePIC simulations**.
- No improvements in the PID in the **24.08.1** campaing (same performance of the **24.06.0**).

24.06.0

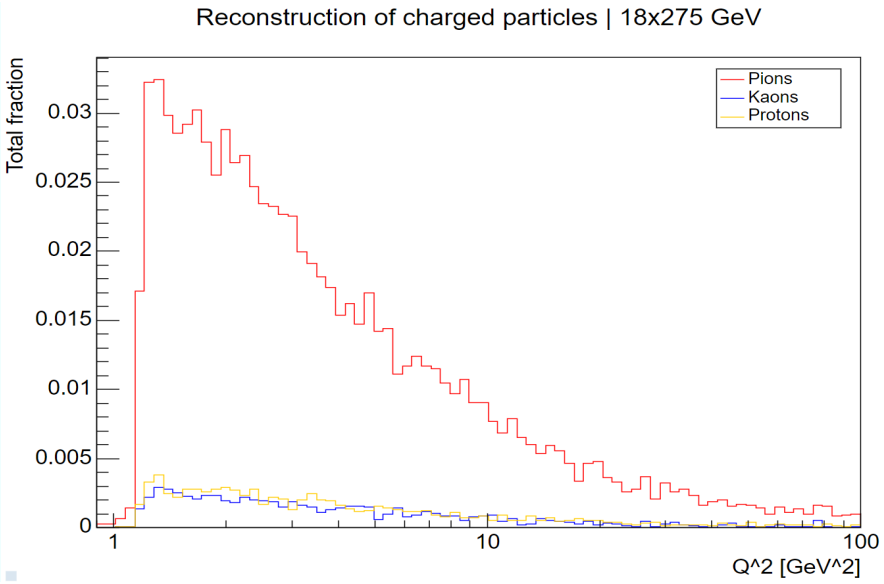


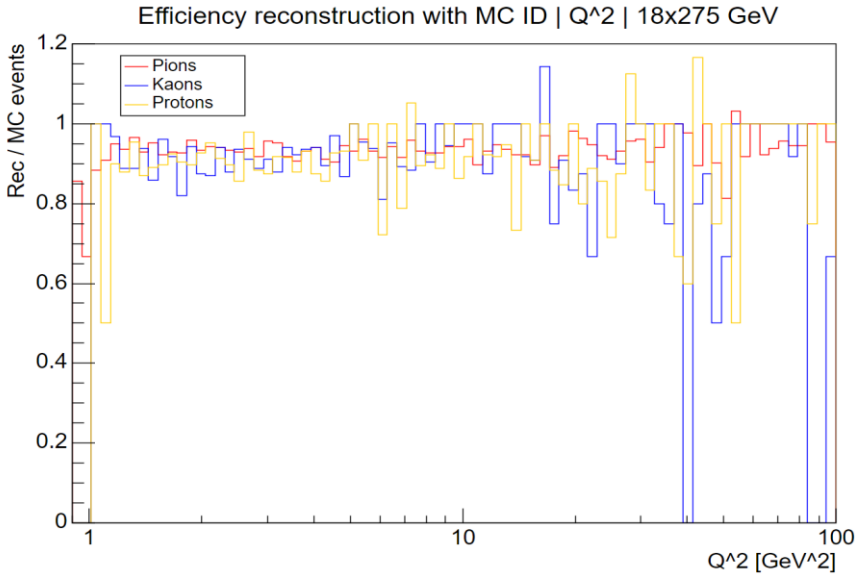
24.08.1

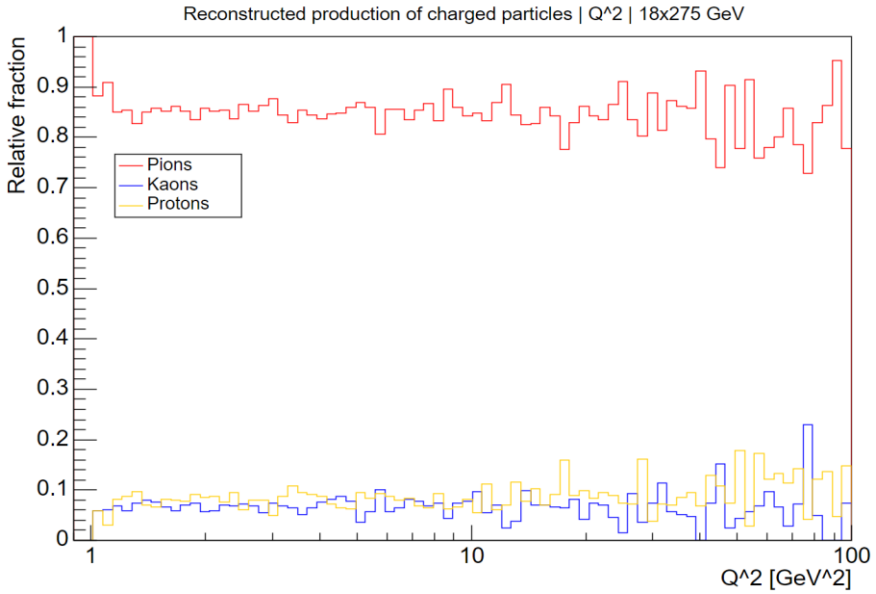


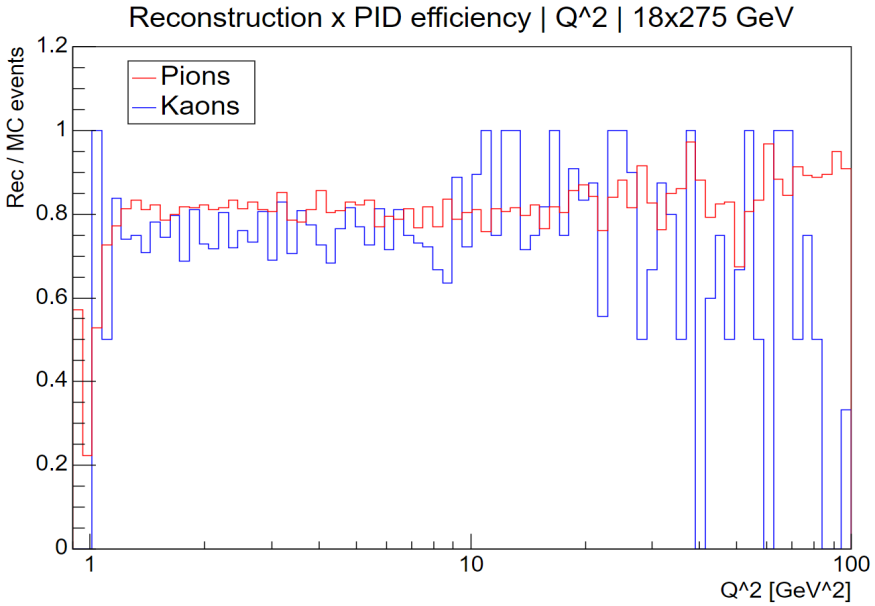
THANKS FOR YOUR ATTENTION

PRODUCTION & EFFICIENCY OVER Q^2

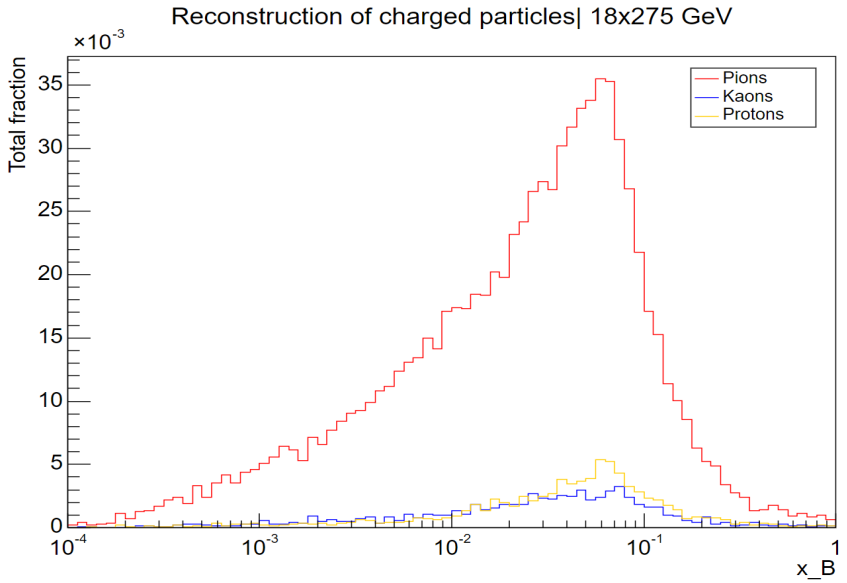


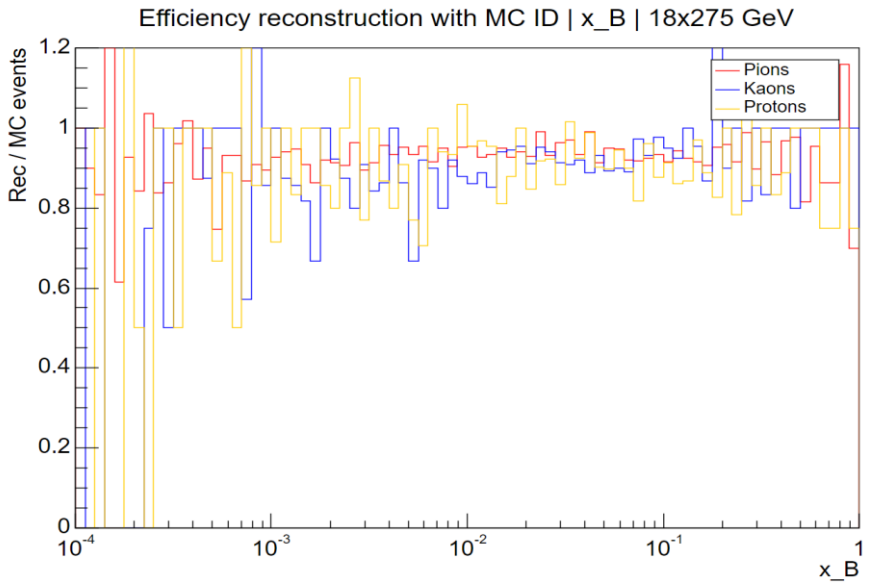


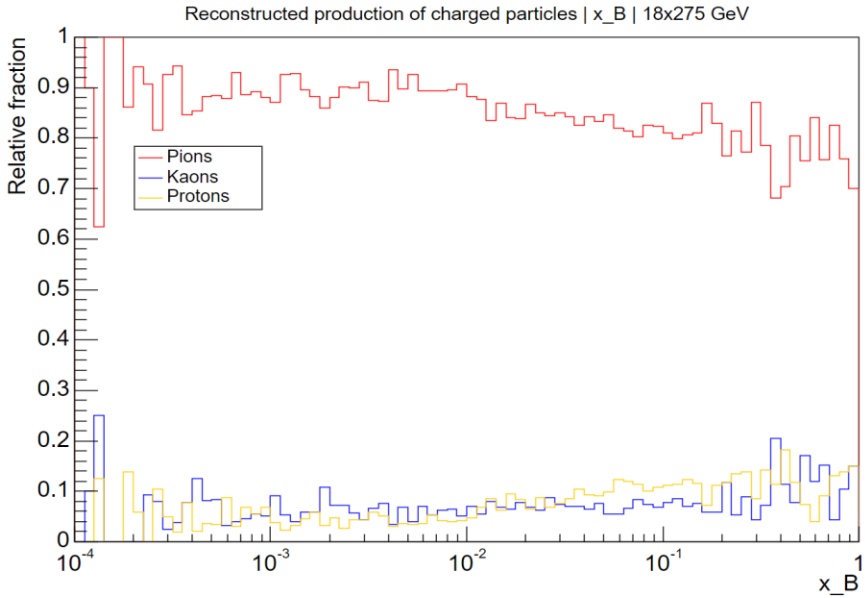


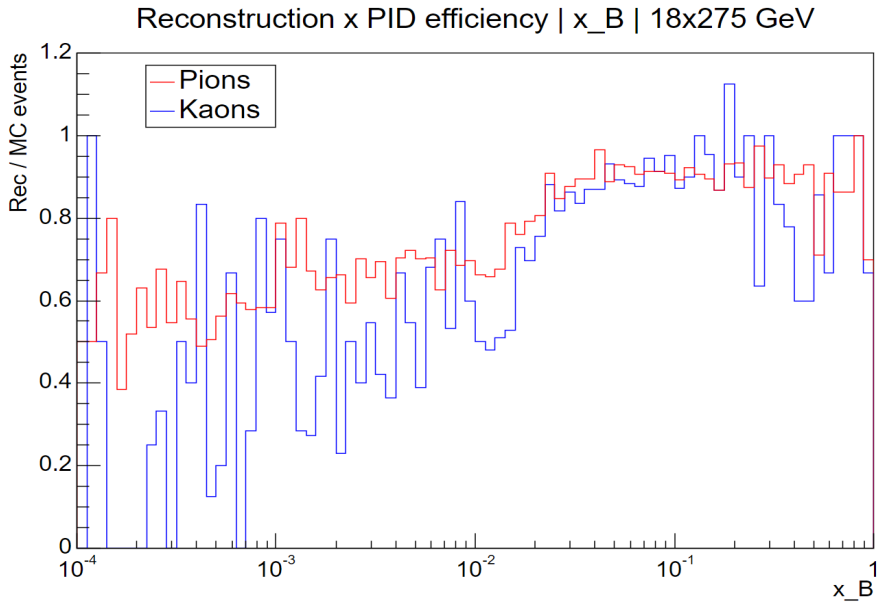


PRODUCTION & EFFICIENCY OVER x_B

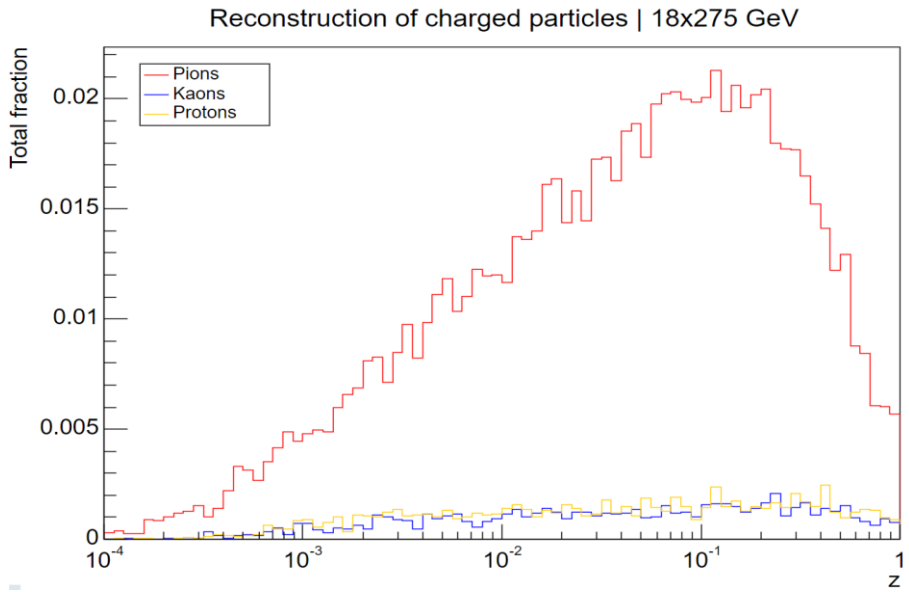


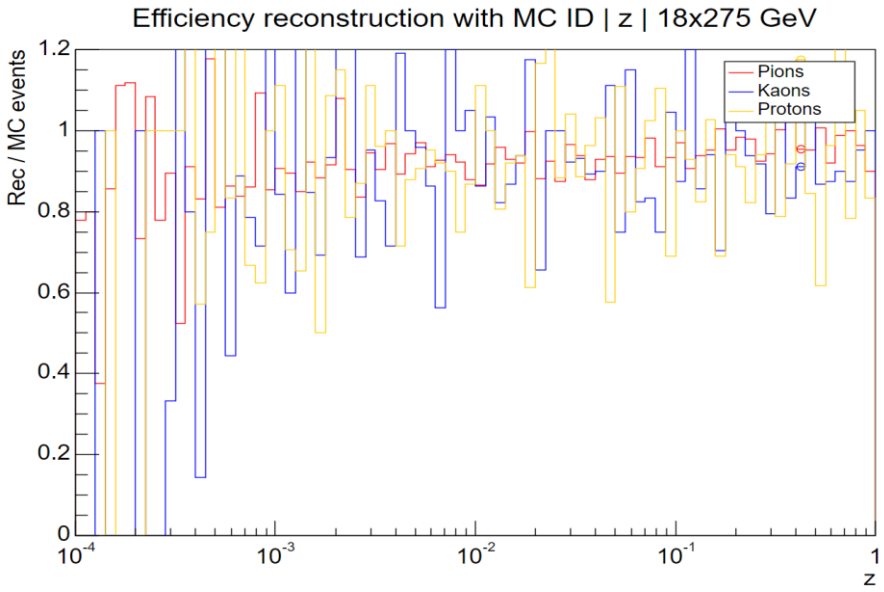


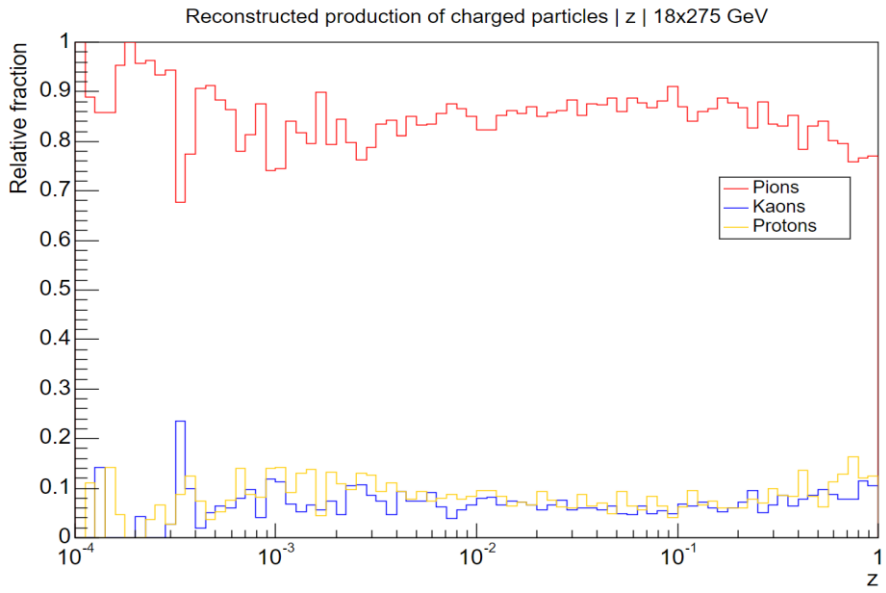


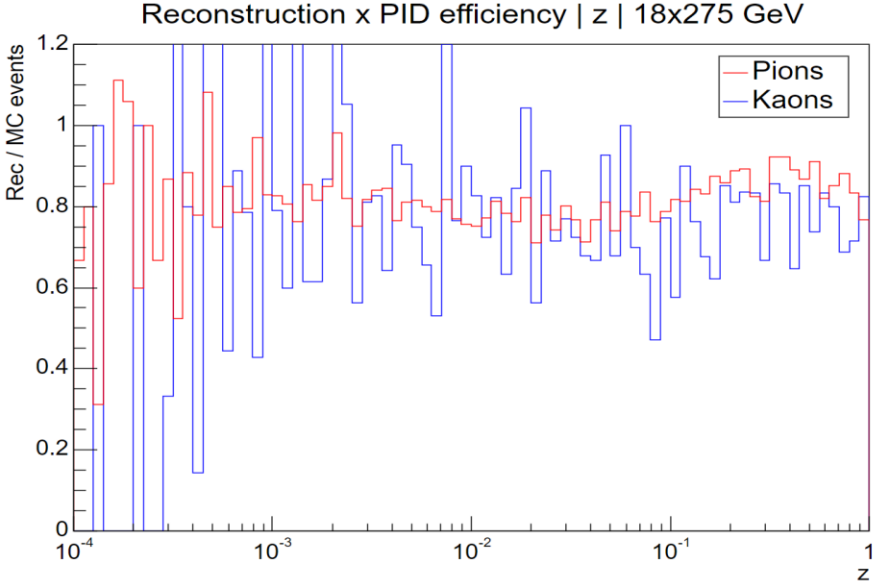


PRODUCTION & EFFICIENCY OVER *z*

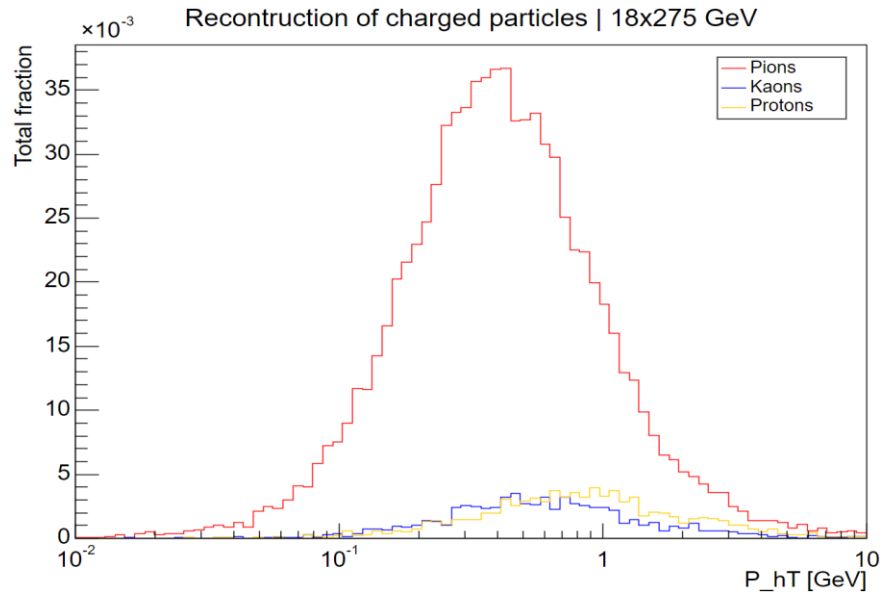


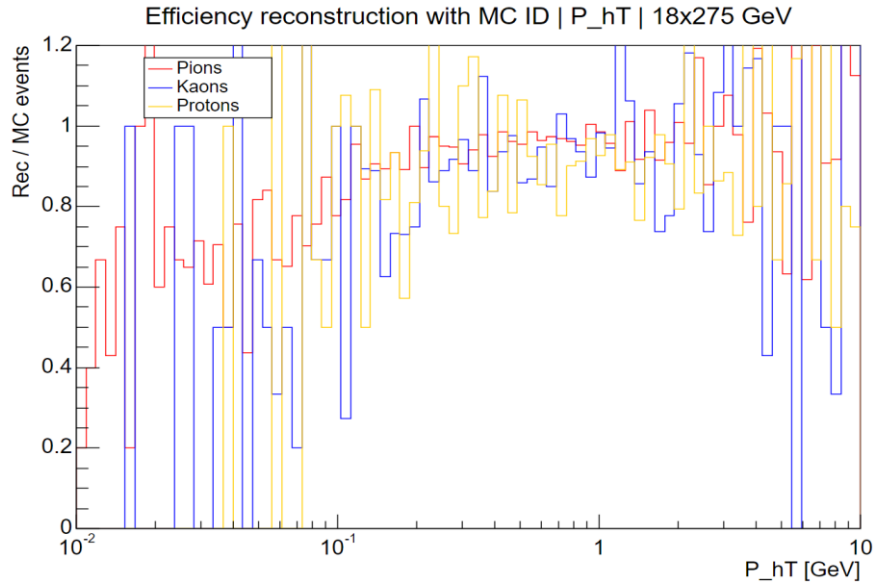


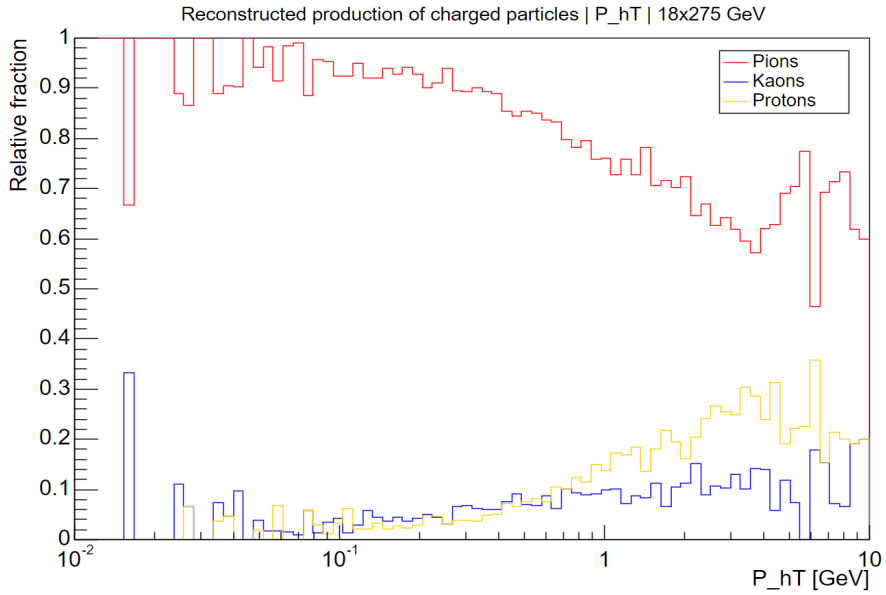


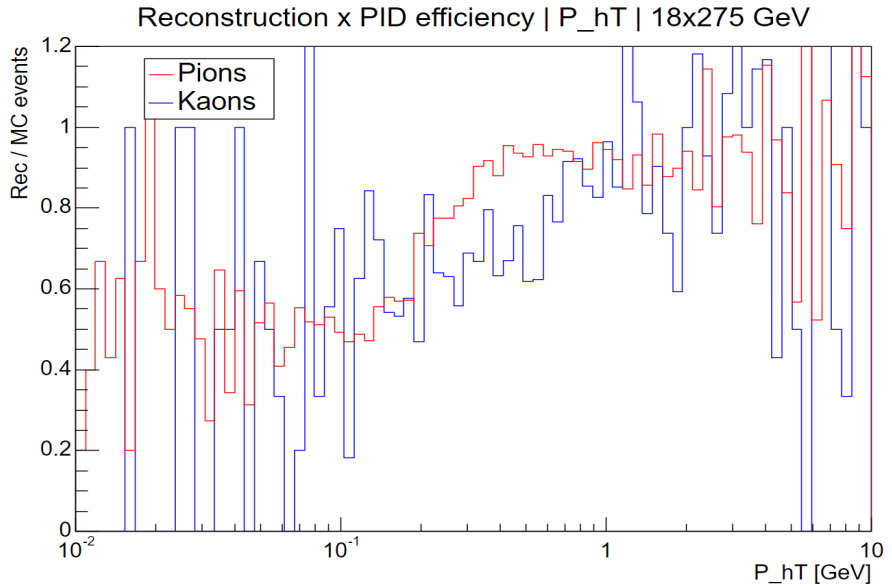


PRODUCTION & EFFICIENCY OVER P_{hT}

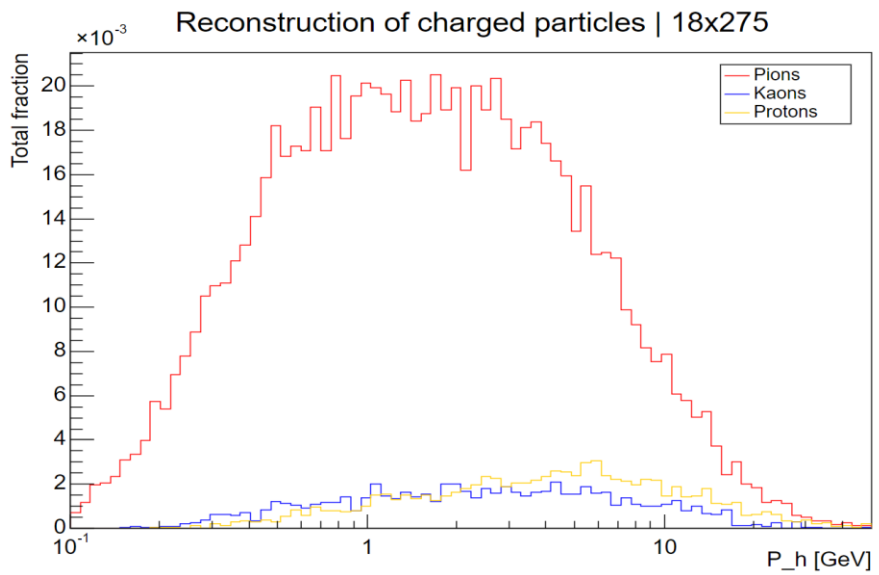


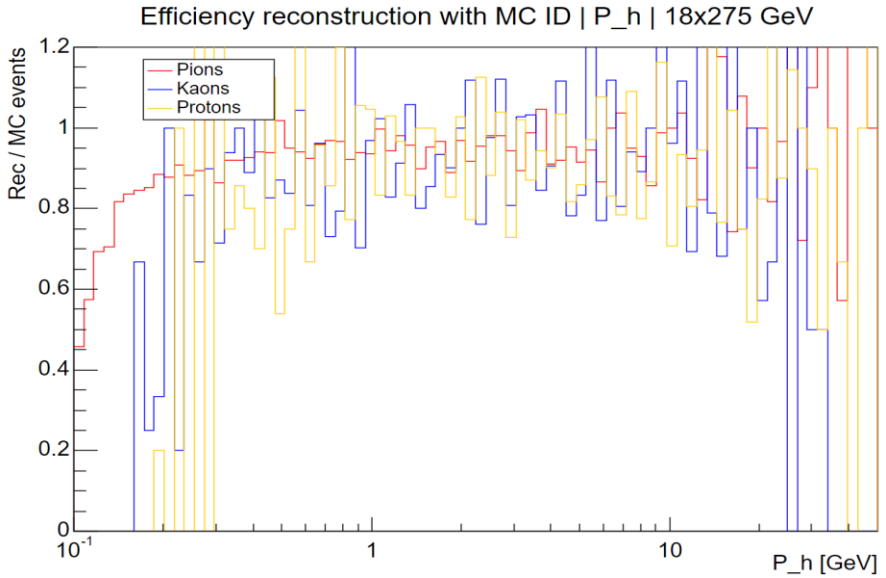


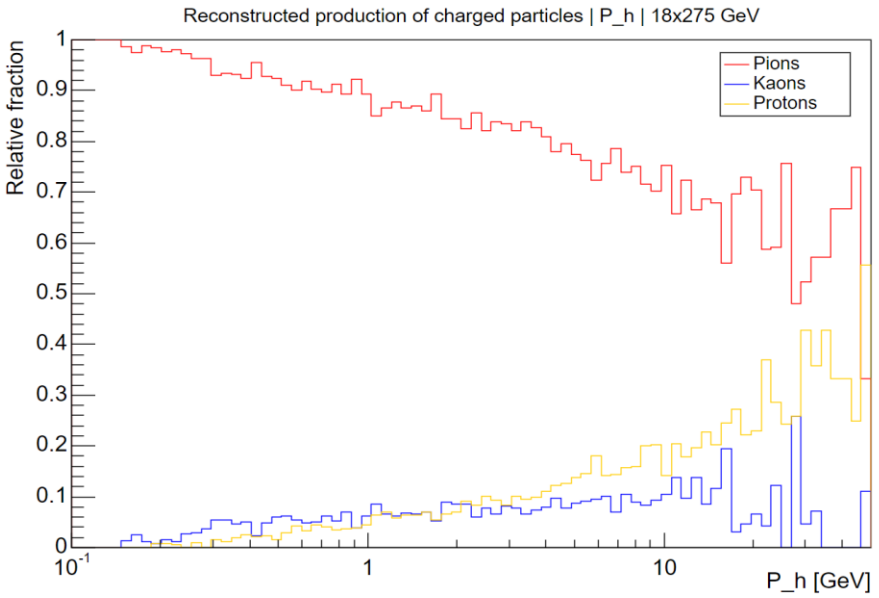


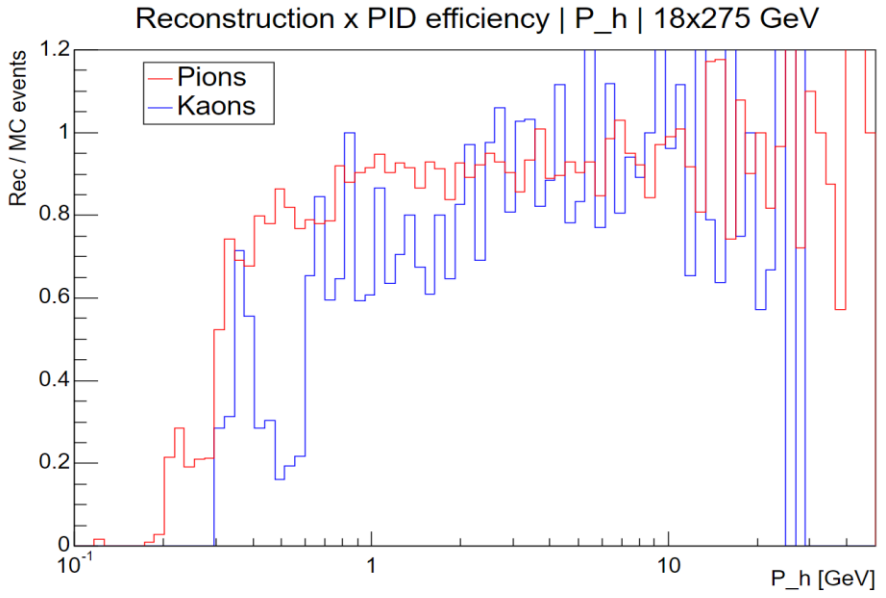


PRODUCTION & EFFICIENCY OVER P_h

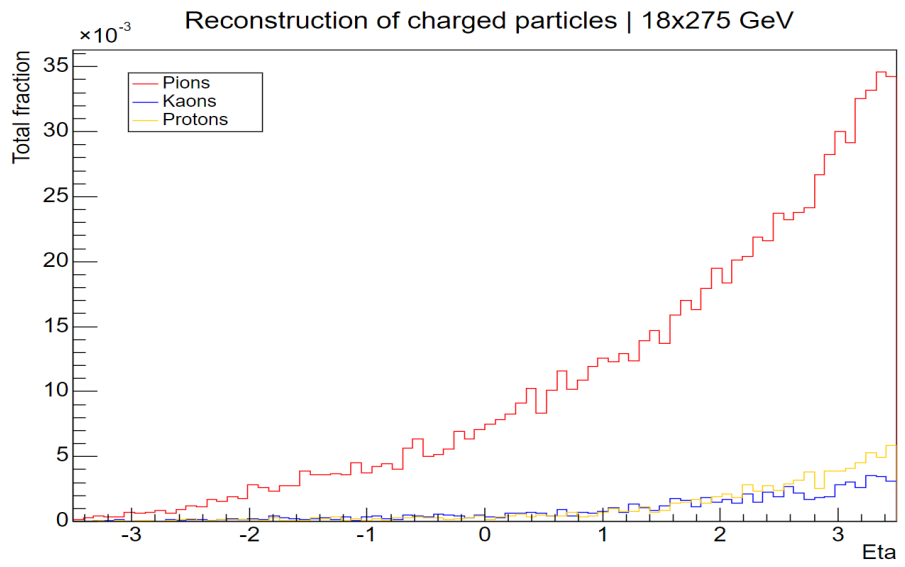


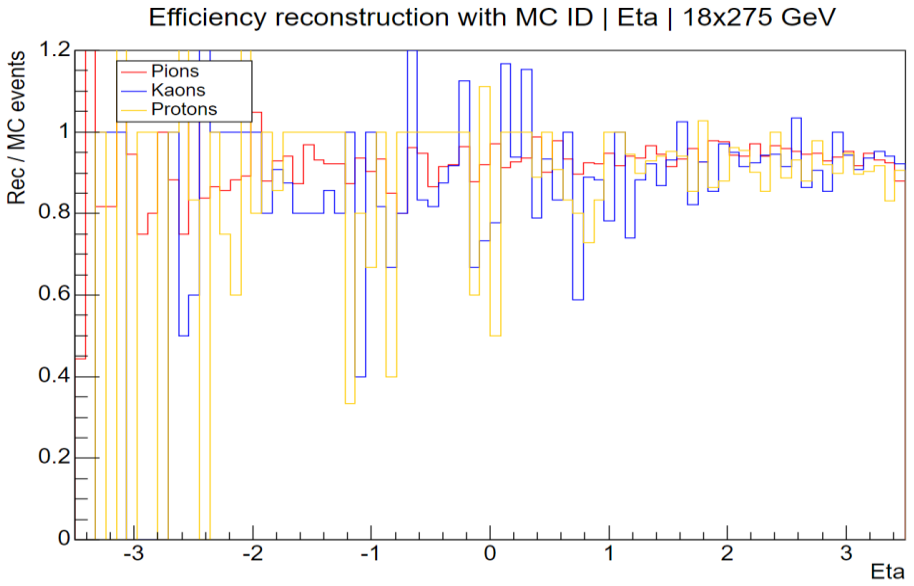


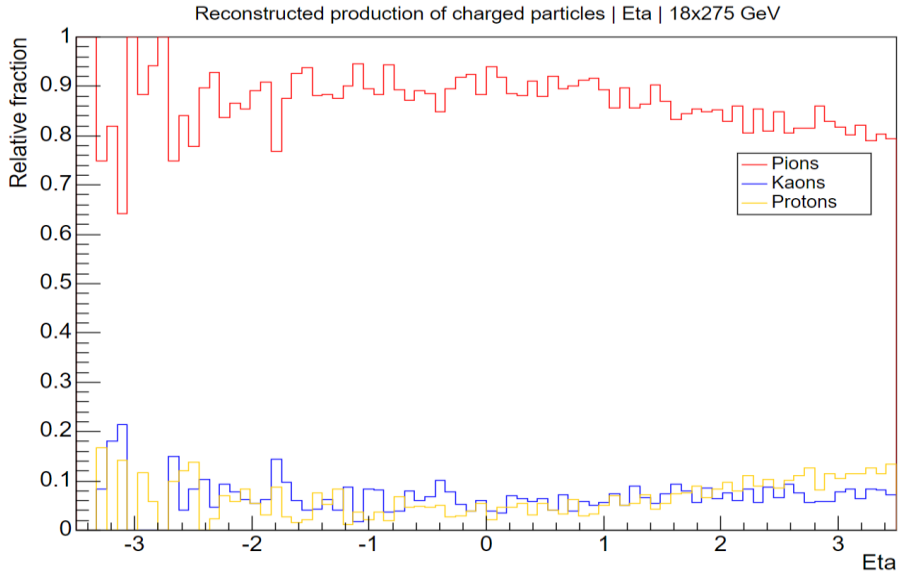


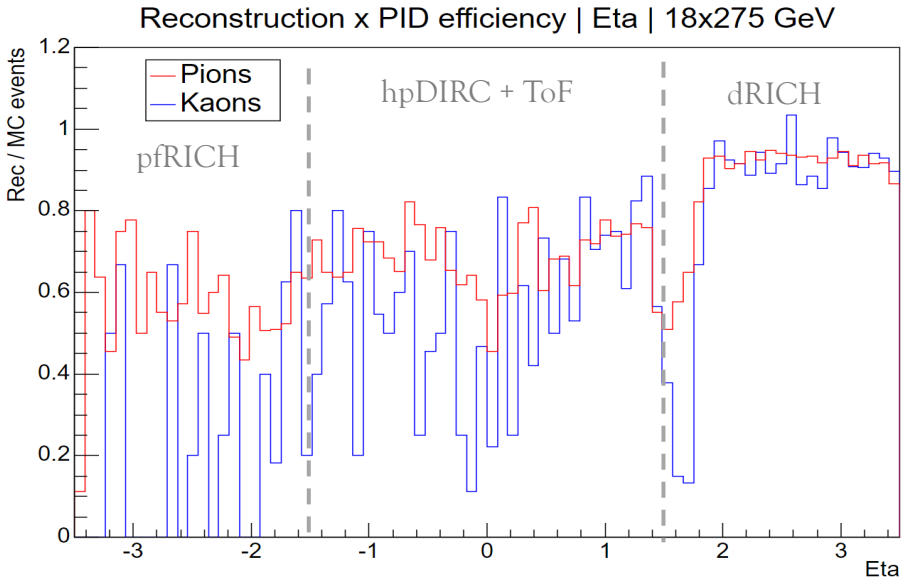


PRODUCTION & EFFICIENCY OVER η









PRODUCTION & EFFICIENCY OVER φ