PARTICLE IDENTIFICATIONS IN SIDIS RECONSTRUCTIONS

SIDIS PWG meeting for ePIC

June 11° 2024

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DATA ANALYZED

This analysis presents the production of positive and negative pions, kaons and protons as a function of different kinematic variables over their kinematic range with PDG code PID performance.

The data are taken from (event analyzed from 1885 to 1888):

dtn-eic.jlab.org//work/eic2/EPIC/RECO/24.05.0/epic_craterlake/SIDIS/pythia6eic/1.0.0/18x275/q2_0to1

pythia_ep_noradcor_18x275_q2_0.000000001_1.0_run9.ab.1885-1888.eicrecon.tree.edm4eic.root

VARIABLE RECONSTRUCTION

The variables of interest are $Q^2, x_B, z, P_{hT}, \eta, \varphi$ (polar angle) and the momentum.

The DIS variables are reconstructed with the Double Angle method:

$$y = \frac{tan\frac{\varphi}{2}}{tan\frac{\varphi}{2} + tan\frac{\theta}{2}} \qquad Q^2 = 4E_0^2 cot\frac{\theta}{2}(1-y) \qquad x_B = \frac{Q^2}{4E_0E_p y}$$

Where y is the inelasticity, θ represents the polar angle of the scattered electron and E_0 and E_p are the correspective energy of the electron and proton beam.

VARIABLE RECONSTRUCTION

The SIDIS variables follow the theory and are defined as:

$$z = \frac{P \cdot P_h}{P \cdot q} \qquad \vec{P}_{hT} = \vec{P}_h - \frac{\vec{P}_h \cdot \vec{q}}{|\vec{q}|}\hat{q}$$

P denotes the momentum of the target hadron, P_h represents the momentum of the identified hadron, and q is the momentum of the virtual photon.

The regions with positive rapidity are the one along the proton beam direction, consequently, the electron beam derection refers to negative rapidity values.

PLOTS

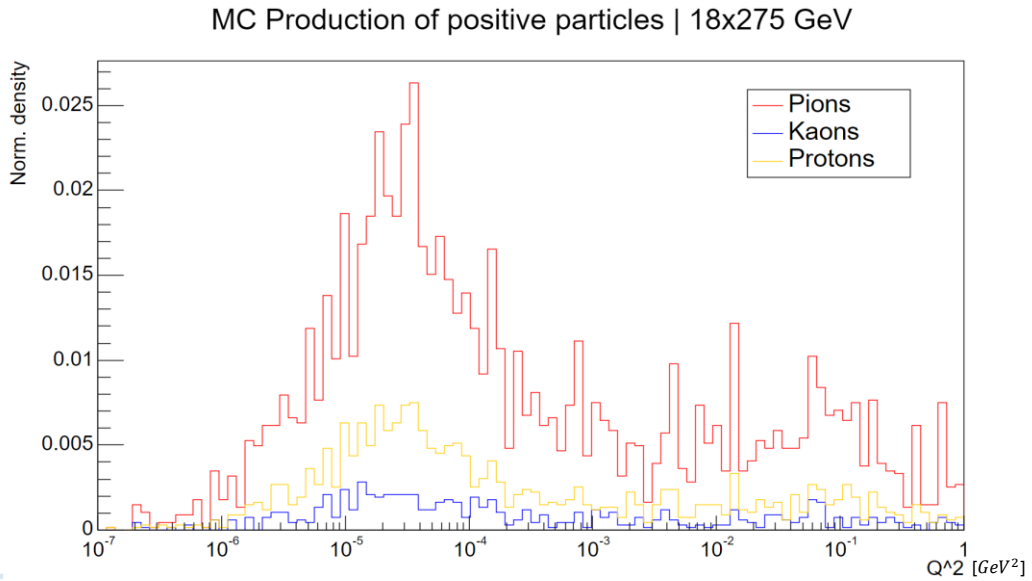
Three type of plots are displayed in the next slides:

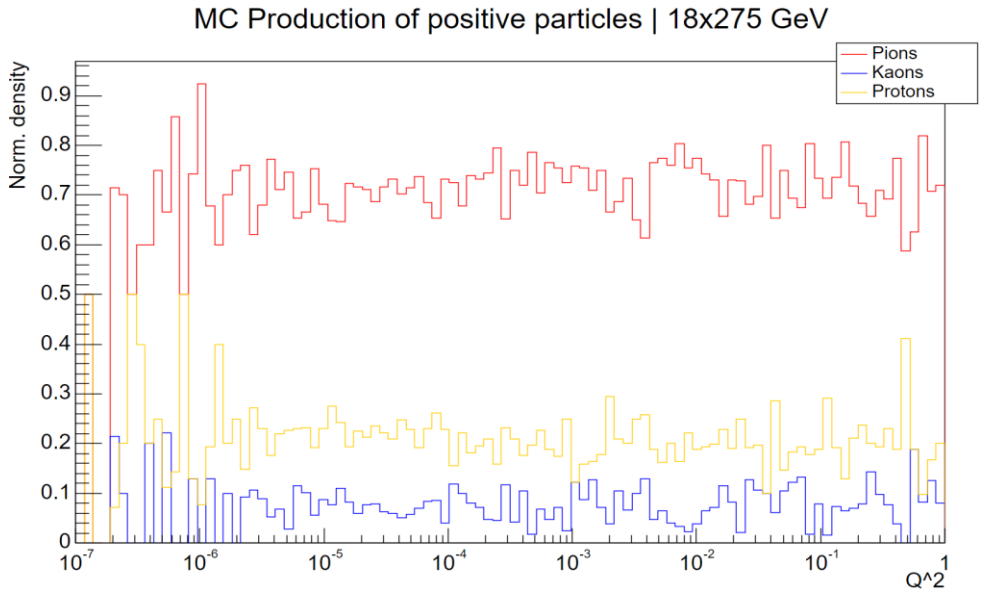
1. Particle production normalized over the summed area of the three histograms to show their densities in different kinematic regions.

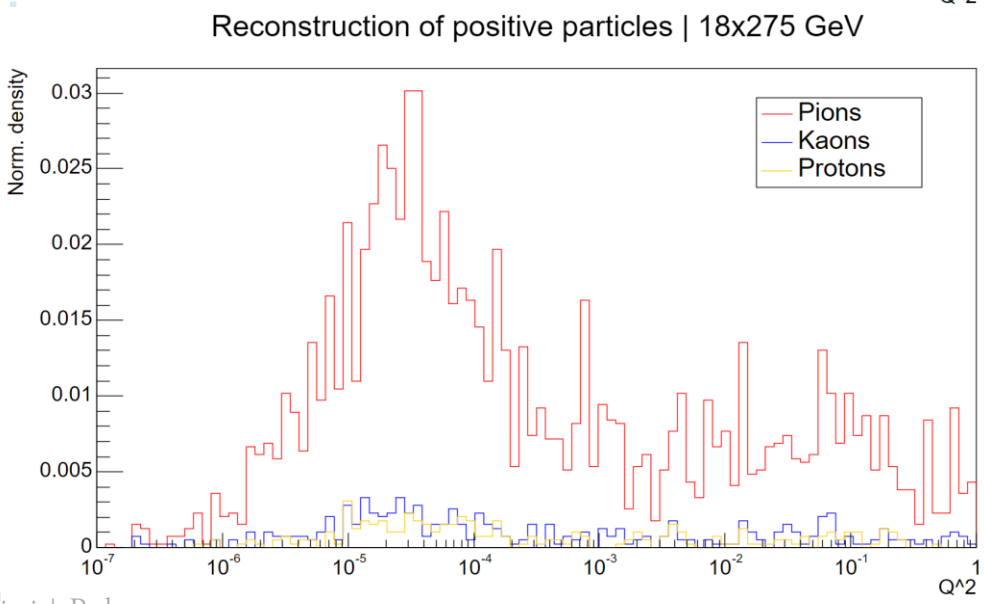
2. Relative fraction of particle types normalized over the sum of each bin content.

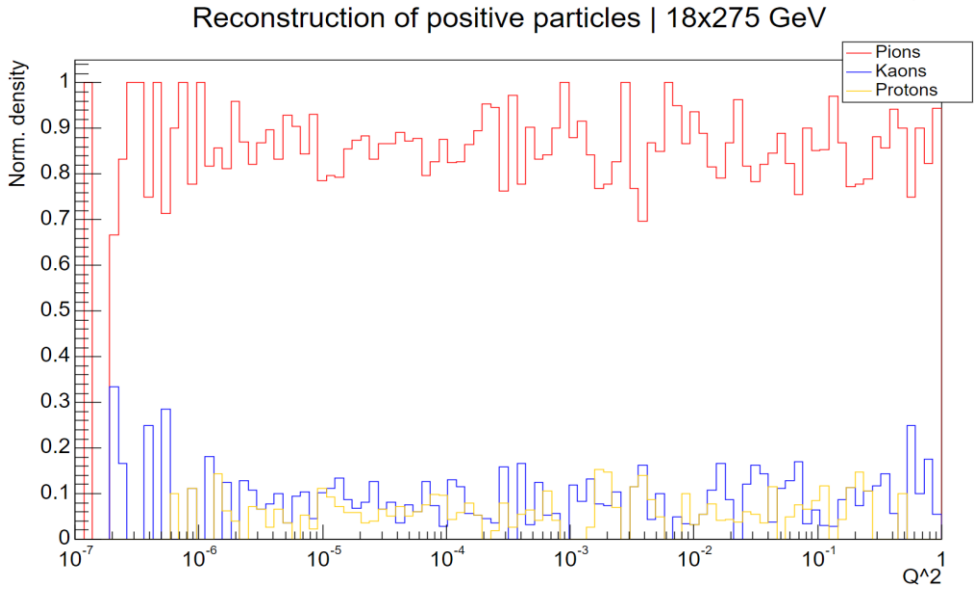
3. Reconstruction efficiency of the three hadron types, calculated as the fraction of reconstructed data over the MC generated data.

NORM. COUNTS vs Q^2 | POSITIVE CASE

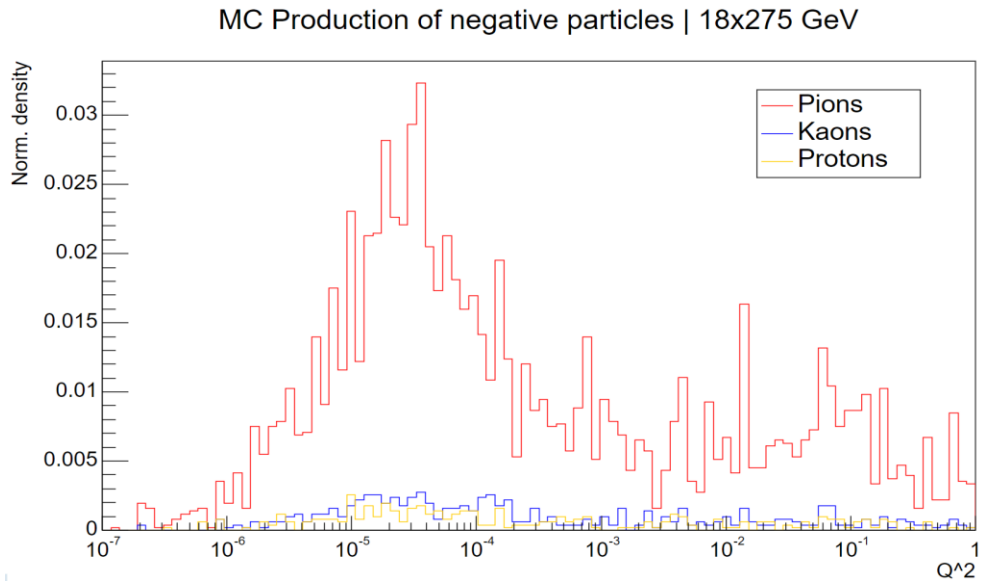


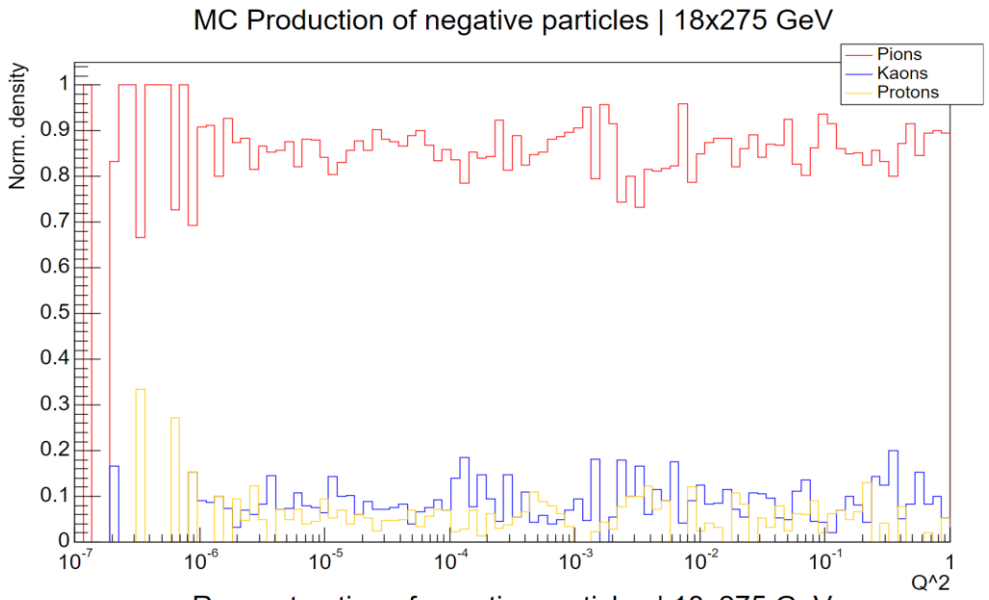


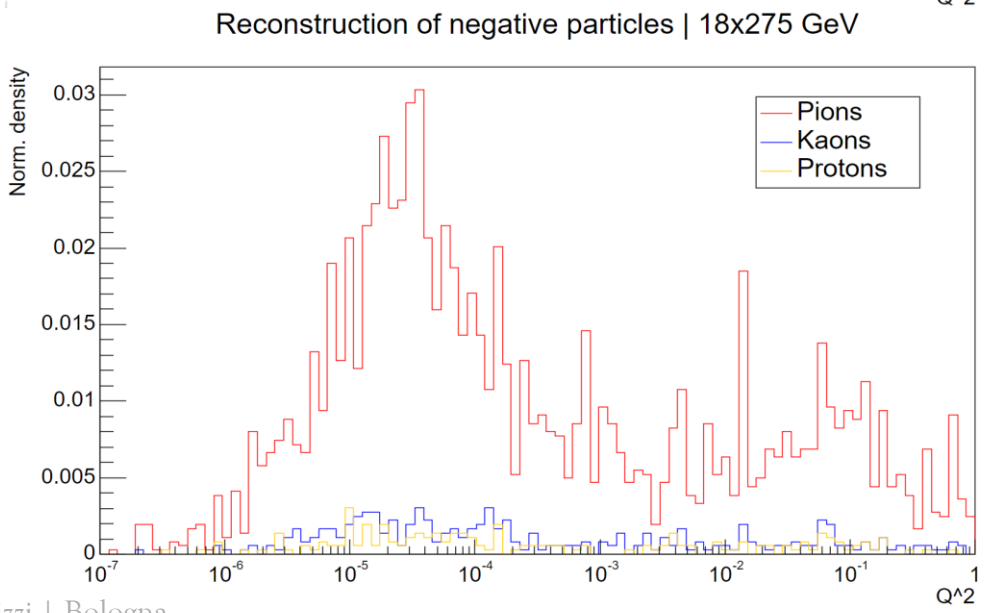


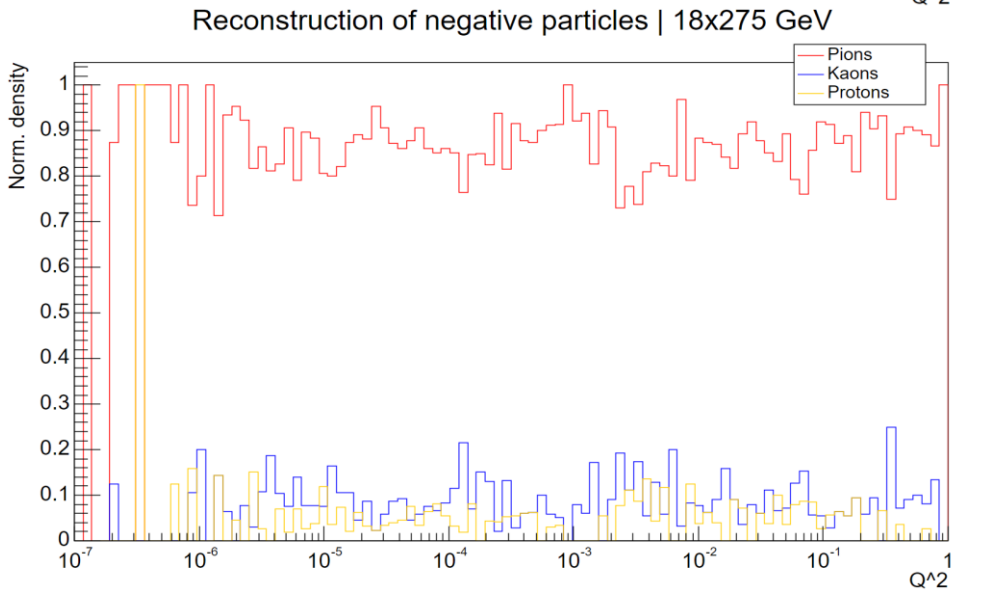


NORM. COUNTS vs Q^2 | NEGATIVE CASE

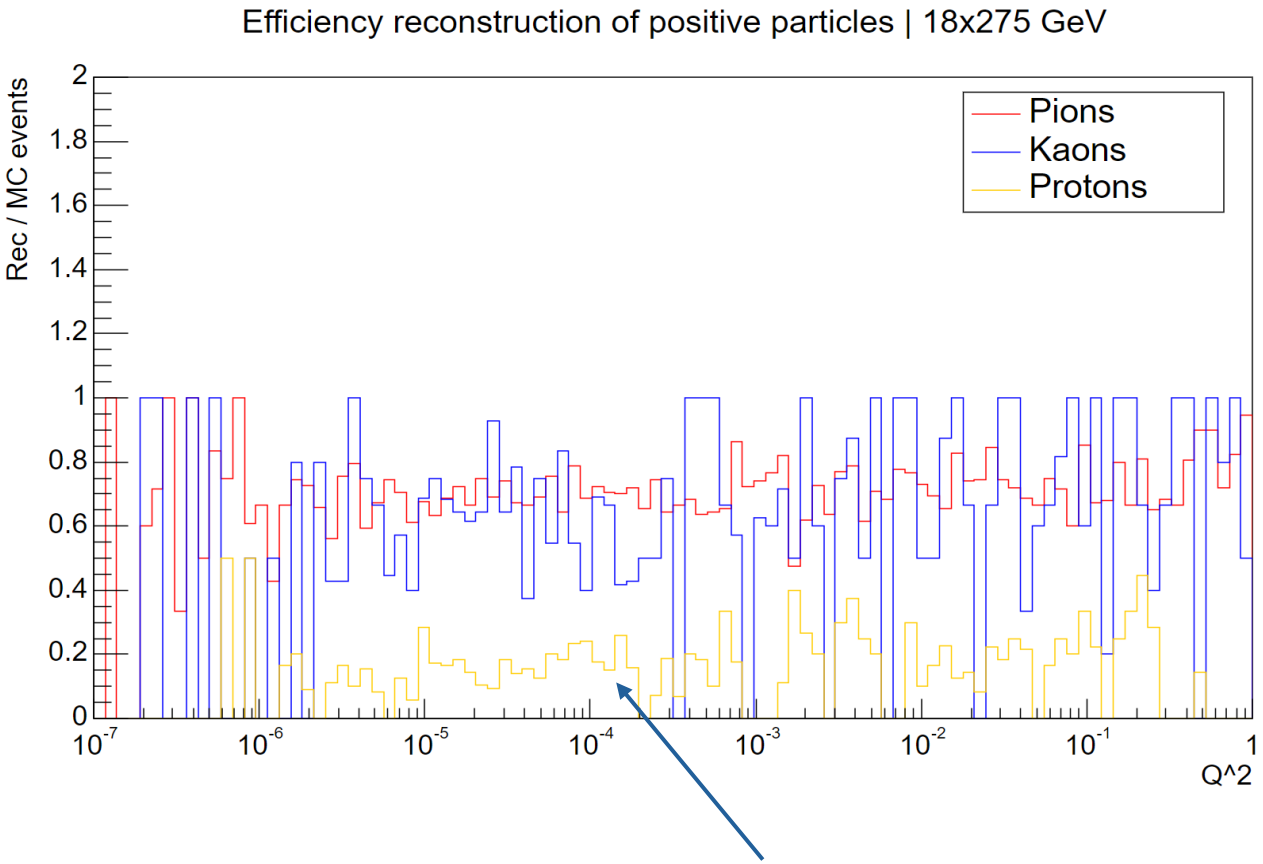


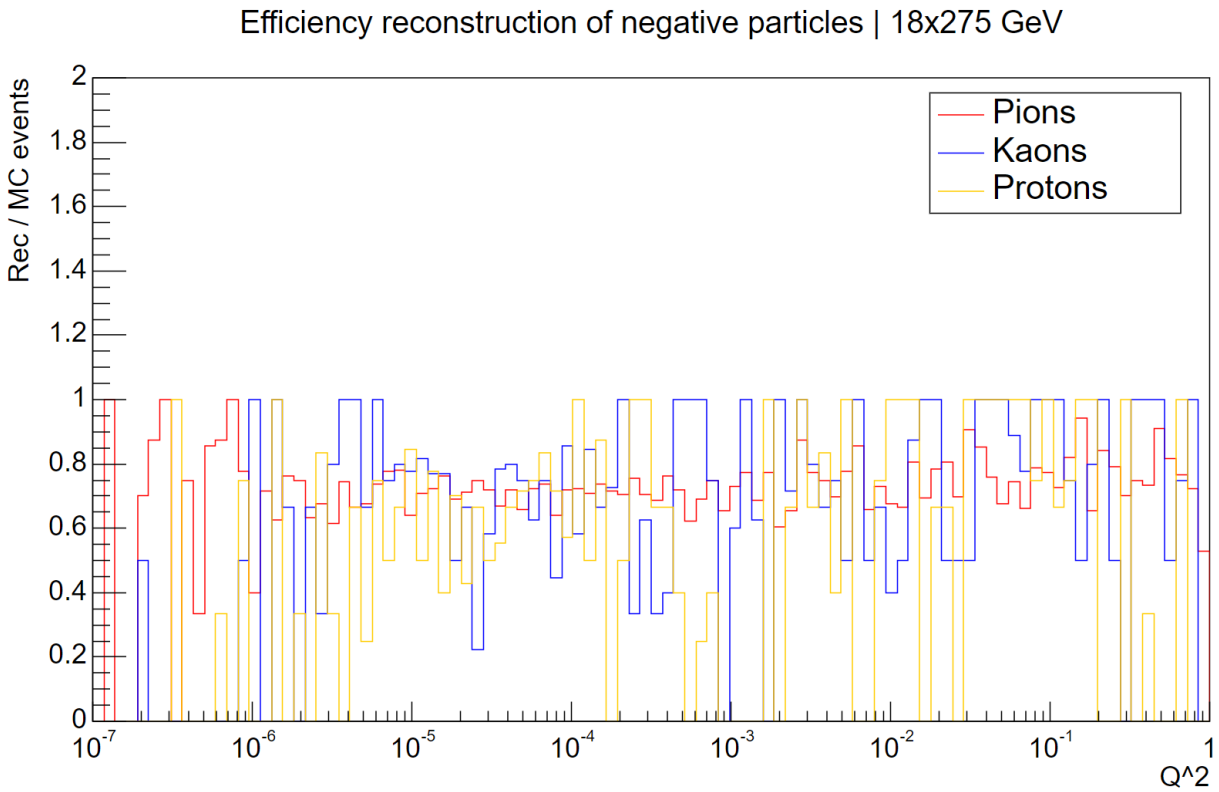






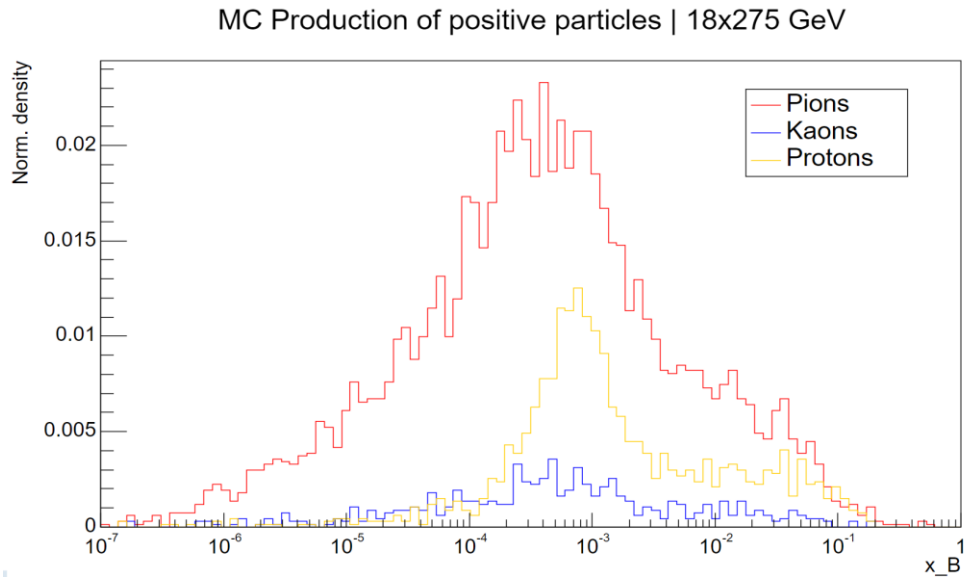
EFFICIENCY vs Q^2

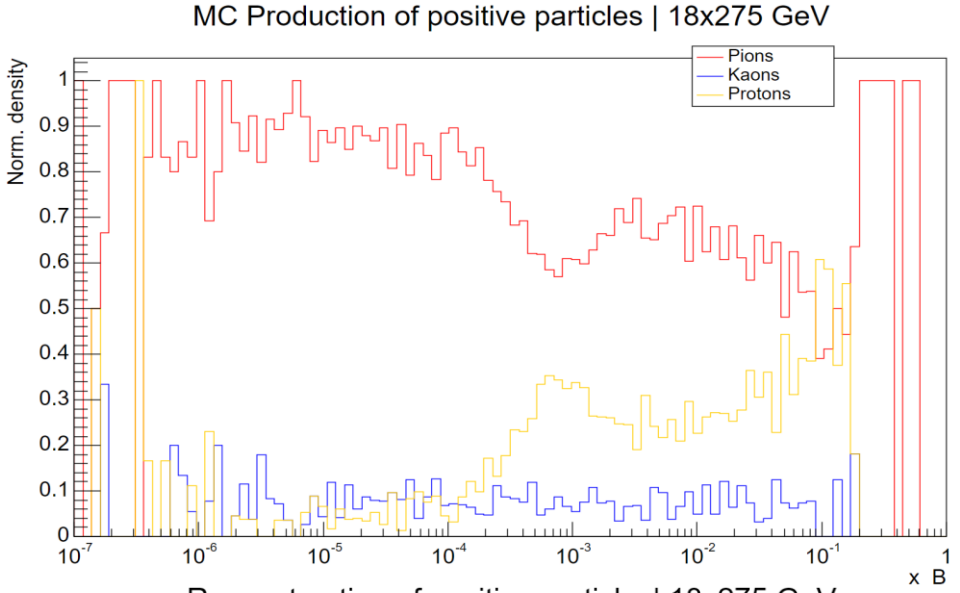


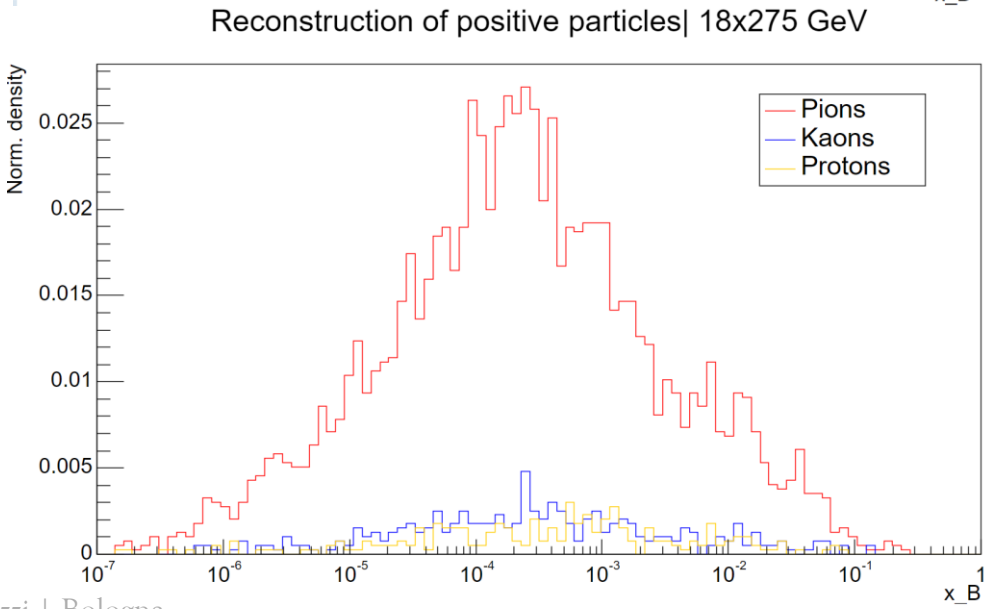


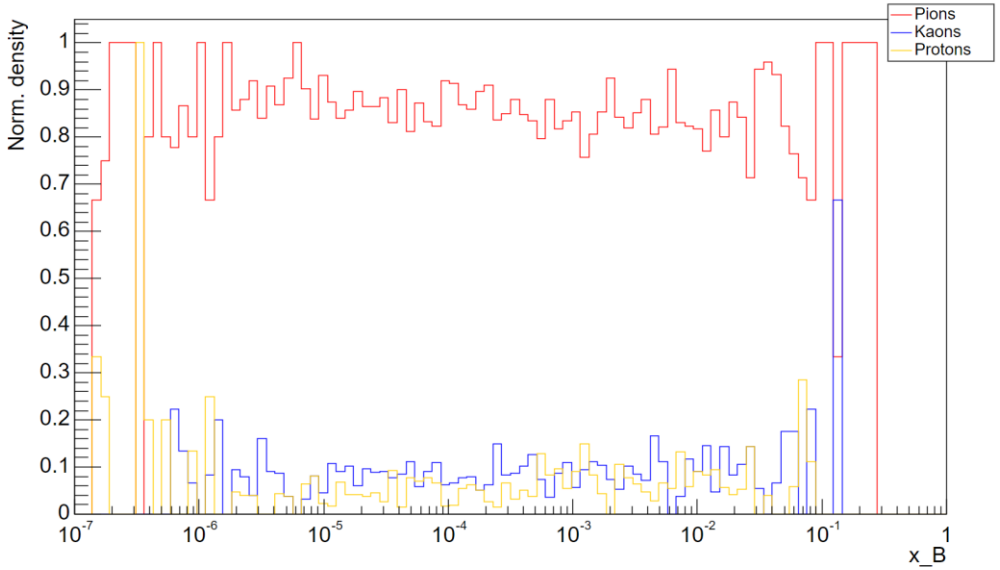
Low efficiency in the proton reconstruction

NORM. COUNTS VS x_B | POSITIVE CASE

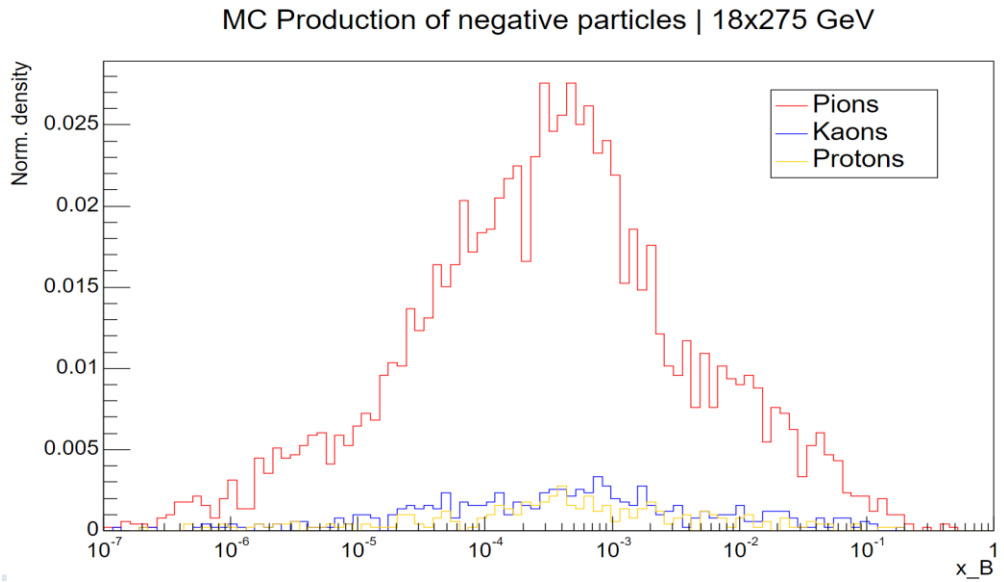


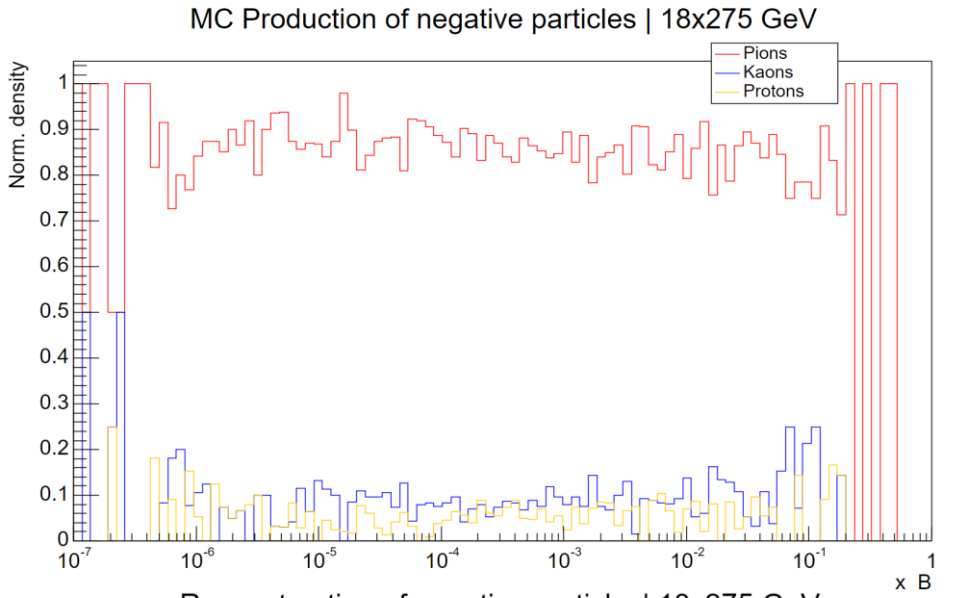


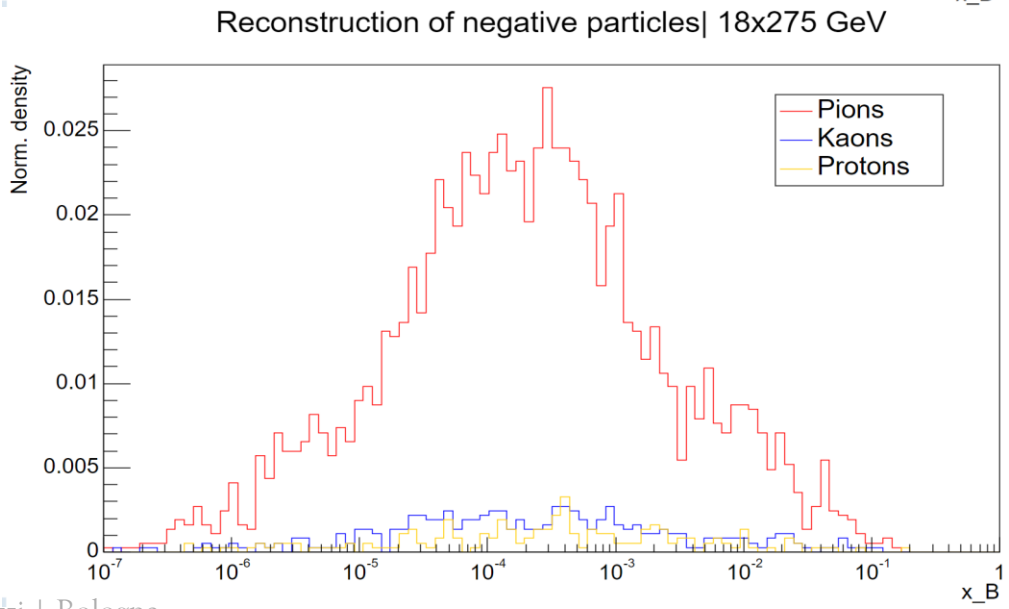


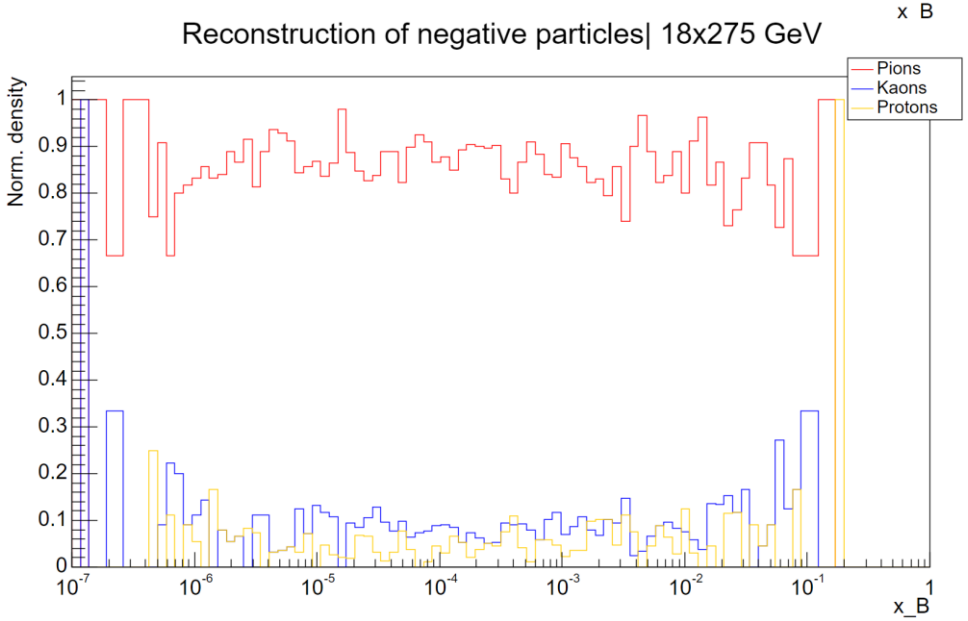


NORM. COUNTS VS x_B | NEGATIVE CASE

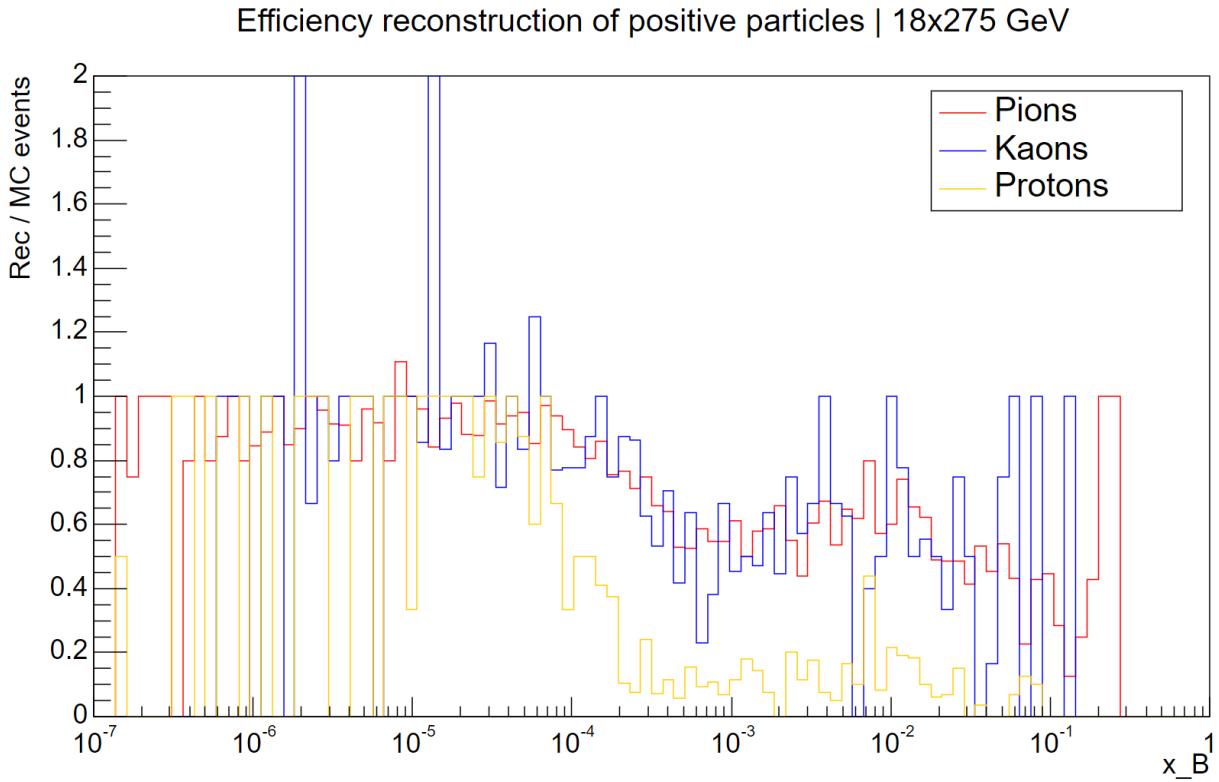


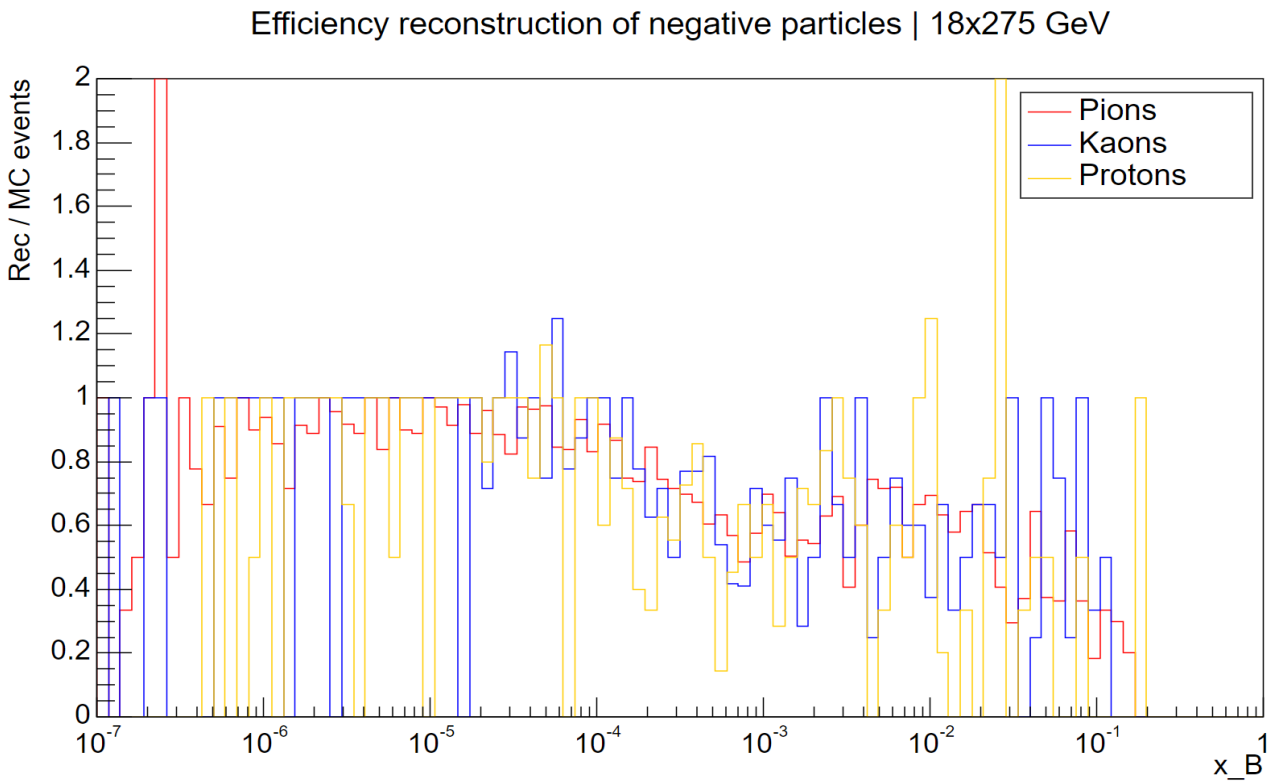




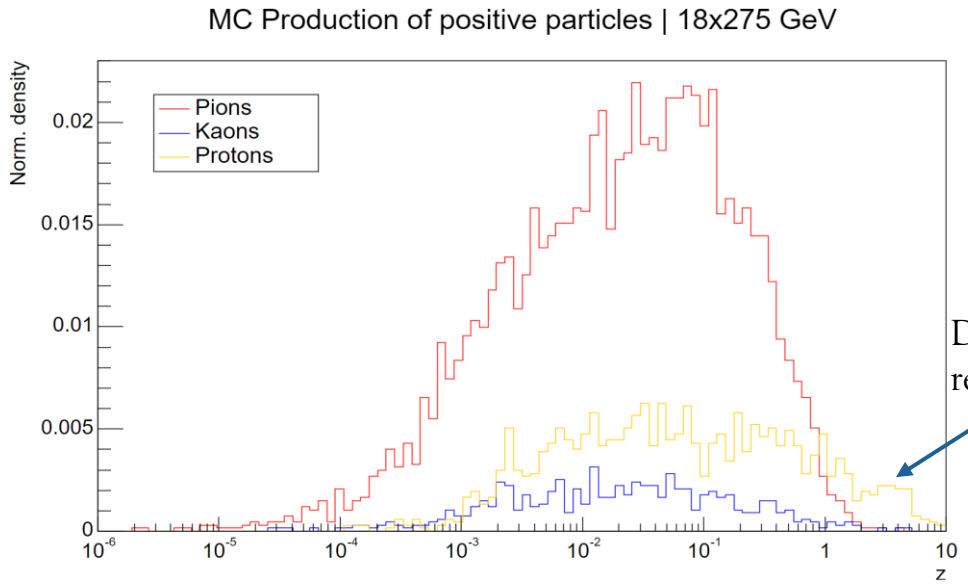


EFFICIENCY VS x_B

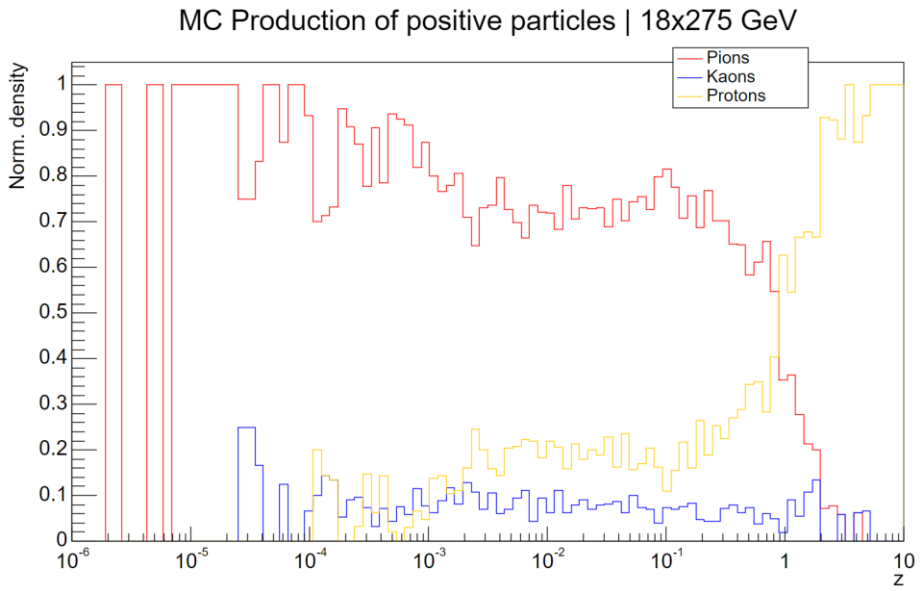


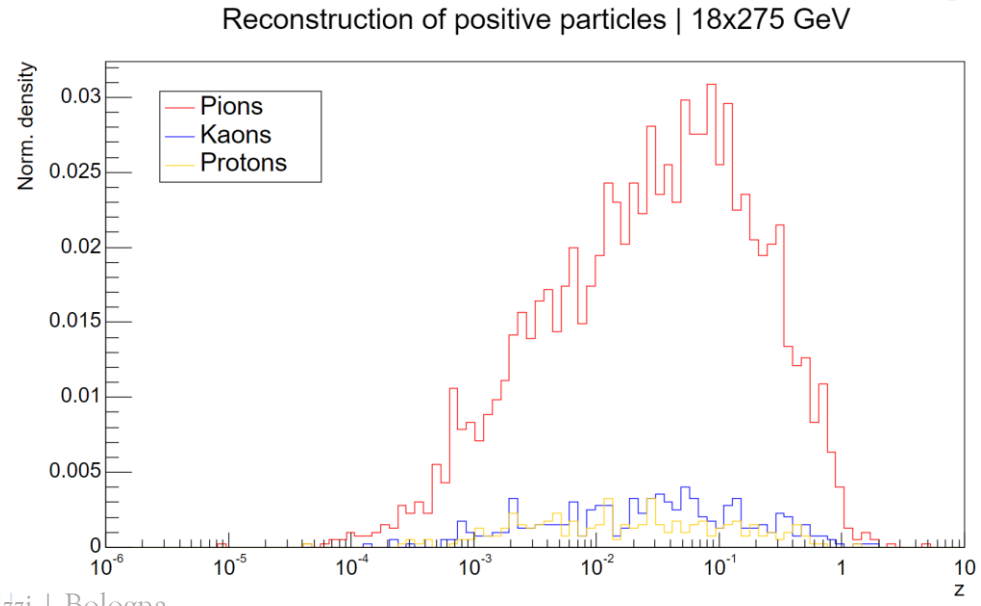


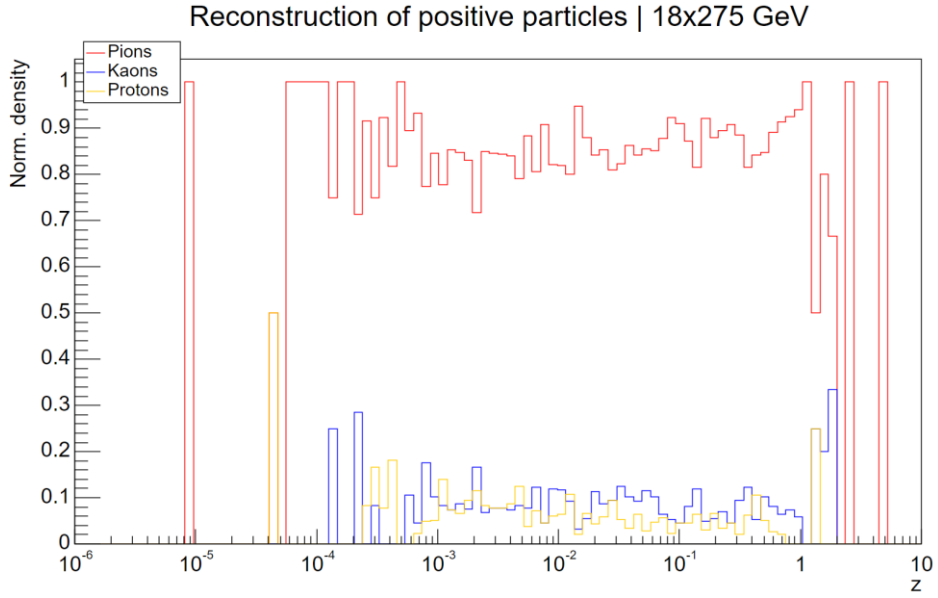
NORM. COUNTS vs z | POSITIVE CASE



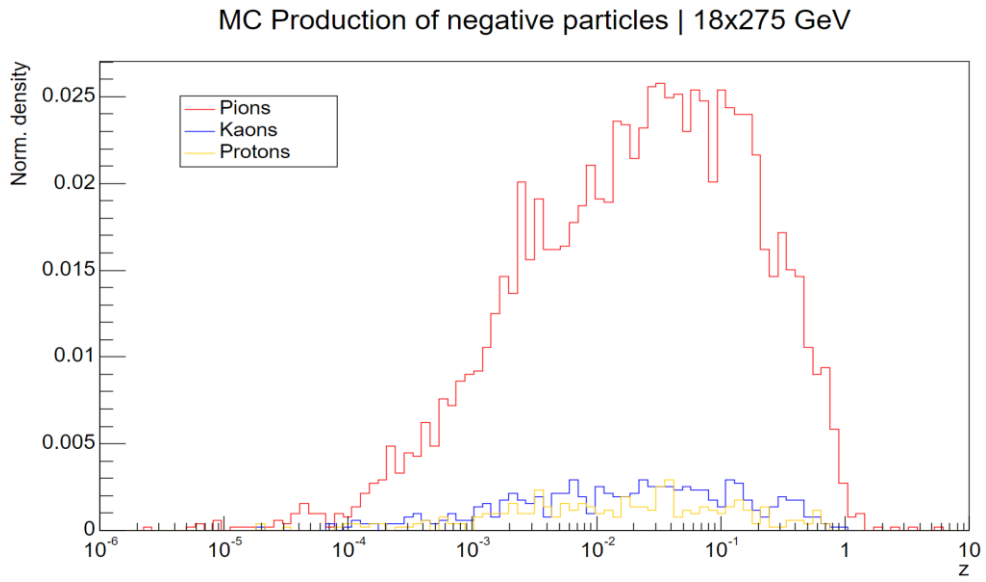
Deeper study required

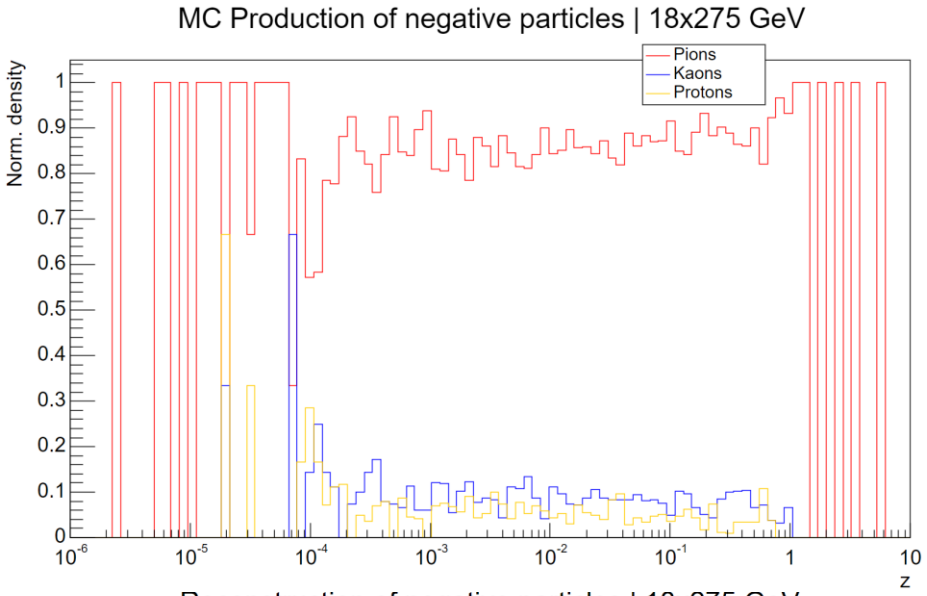


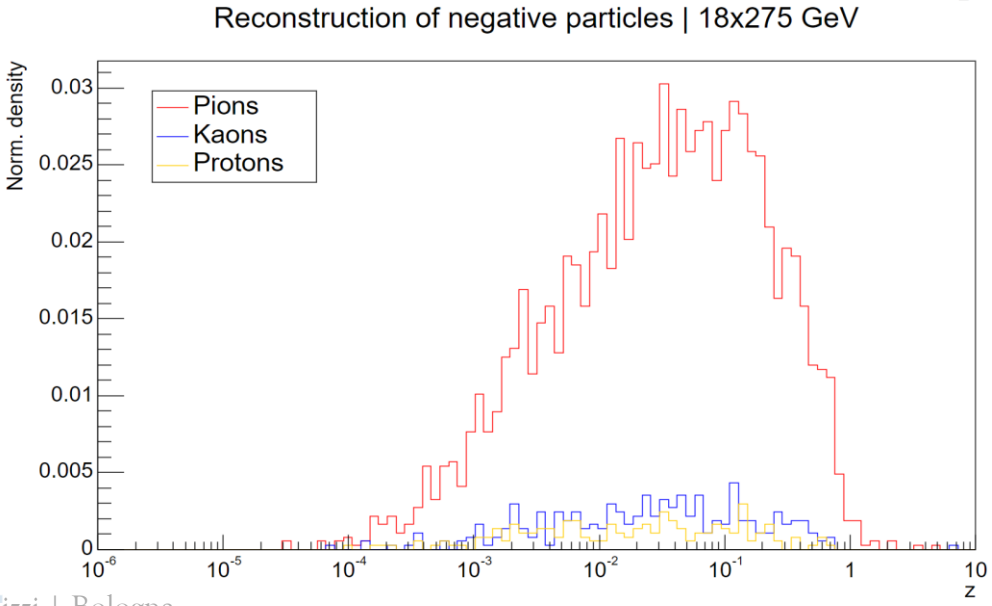


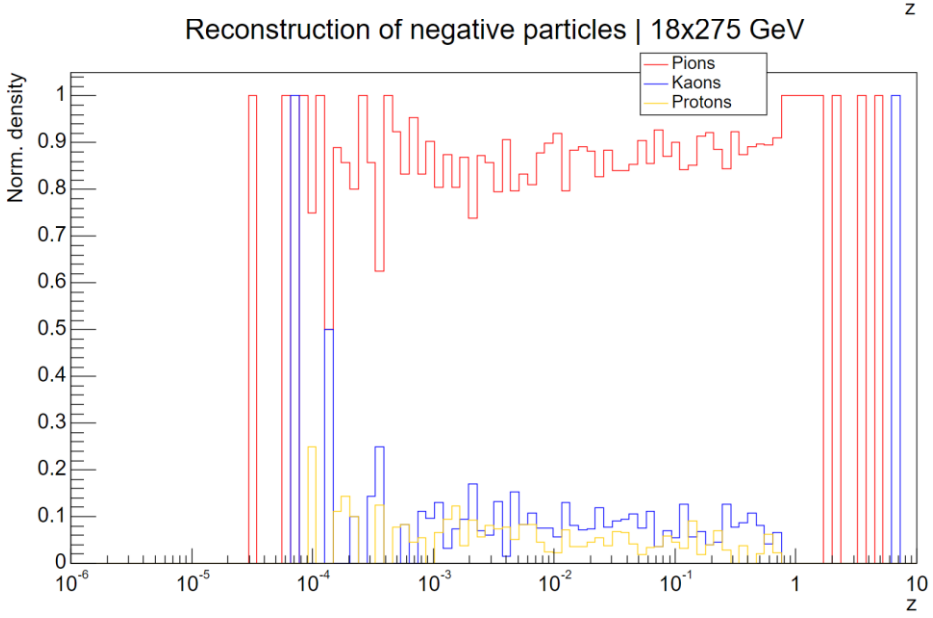


NORM. COUNTS vs z | NEGATIVE CASE

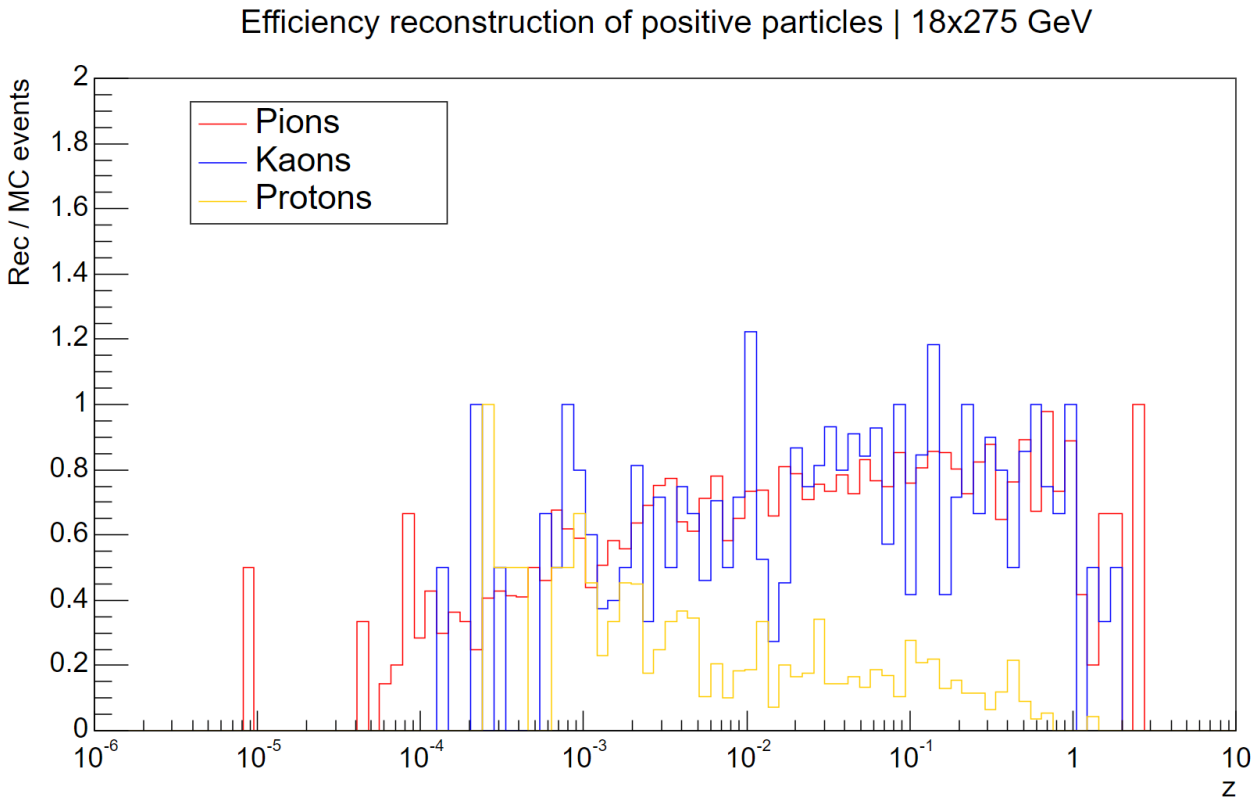


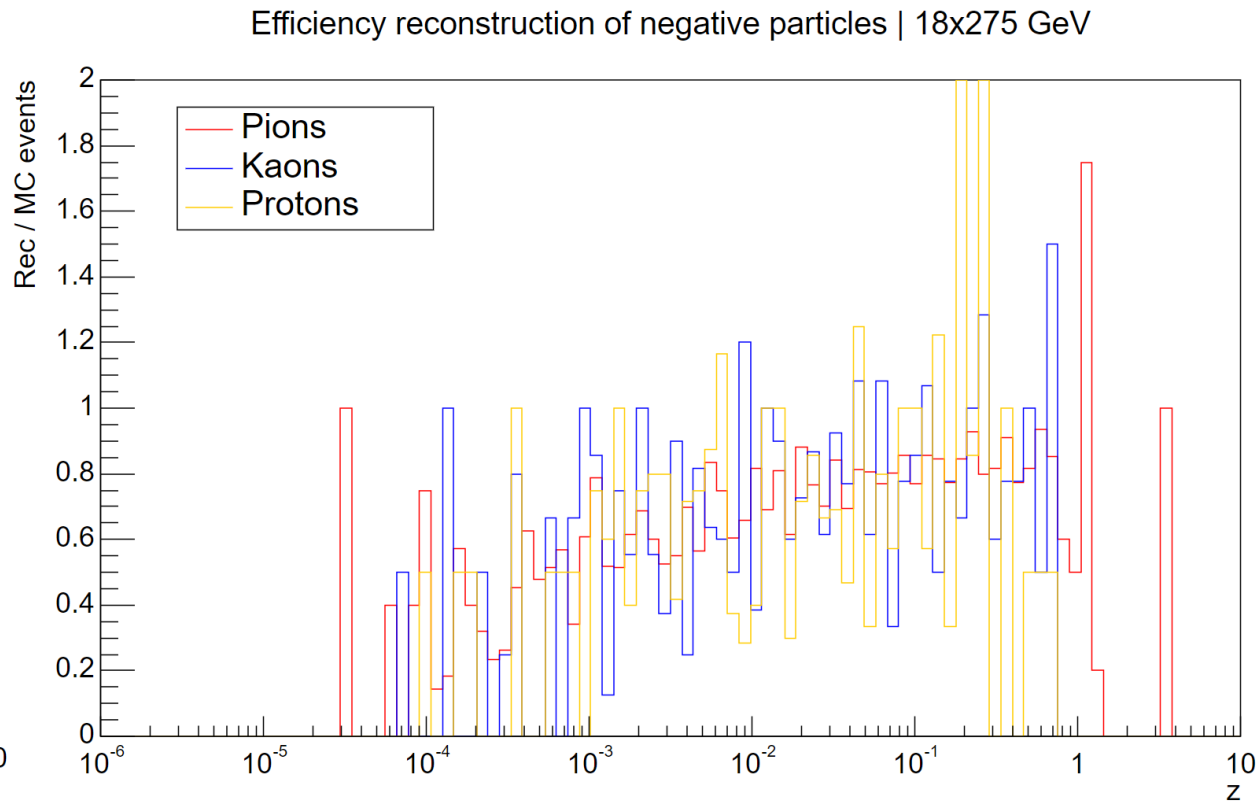




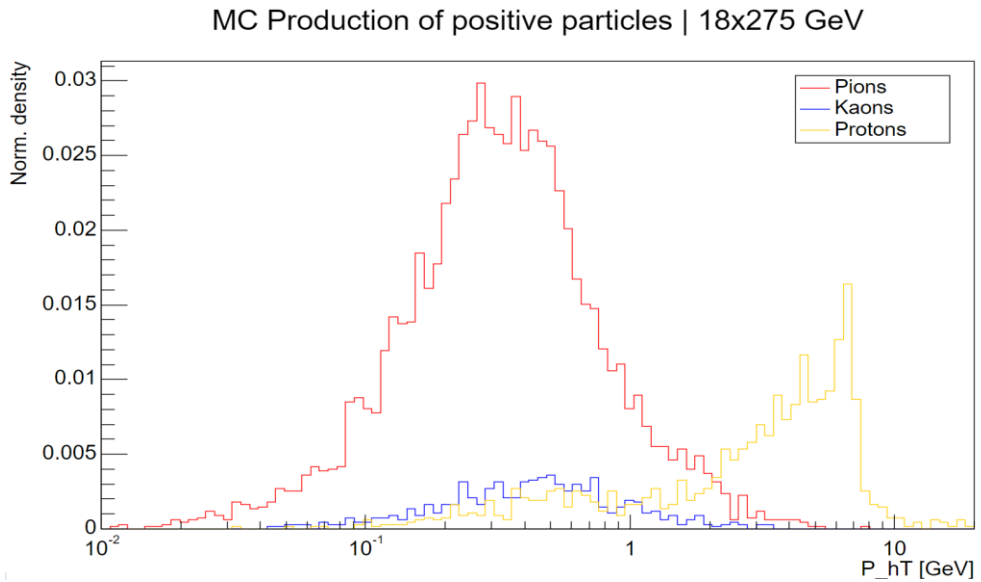


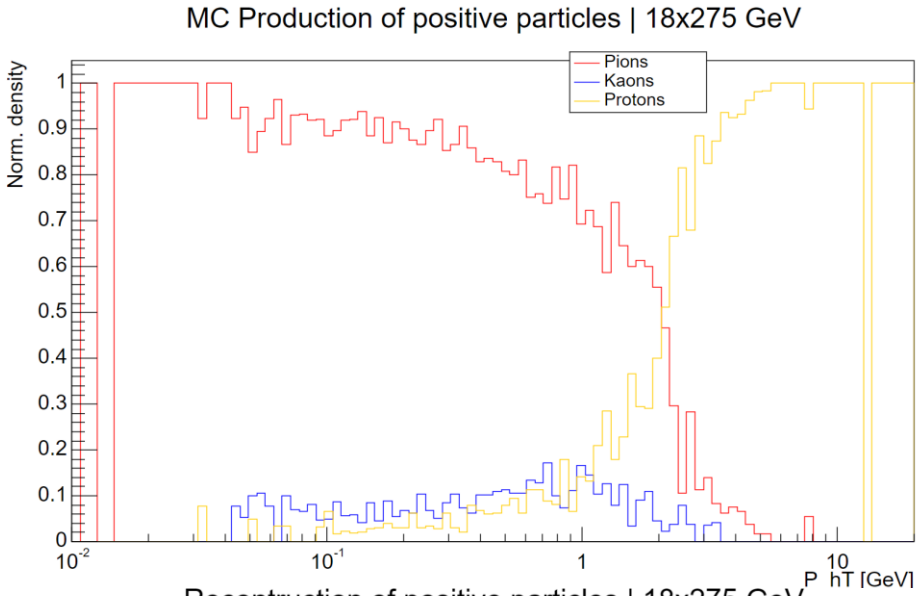
EFFICIENCY vs z

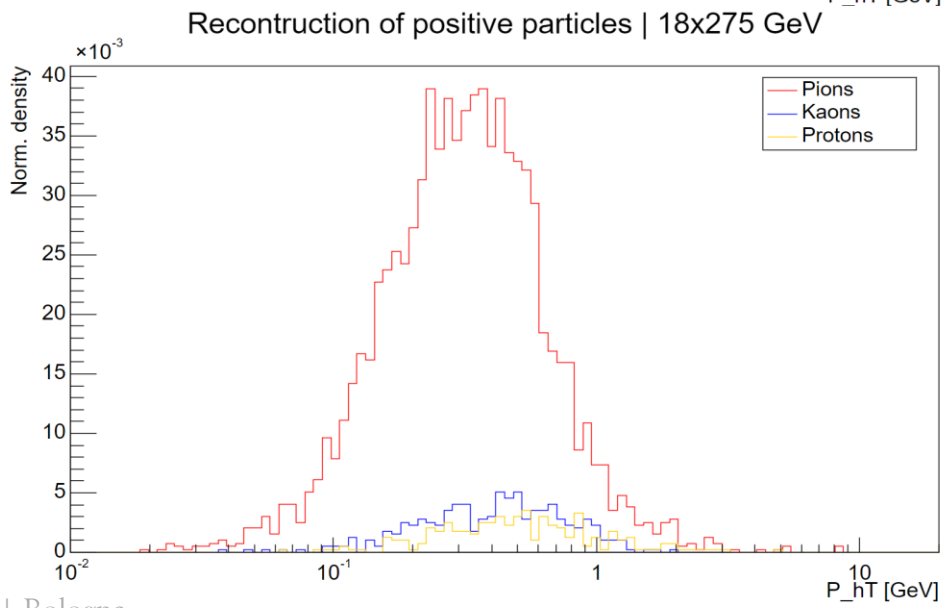


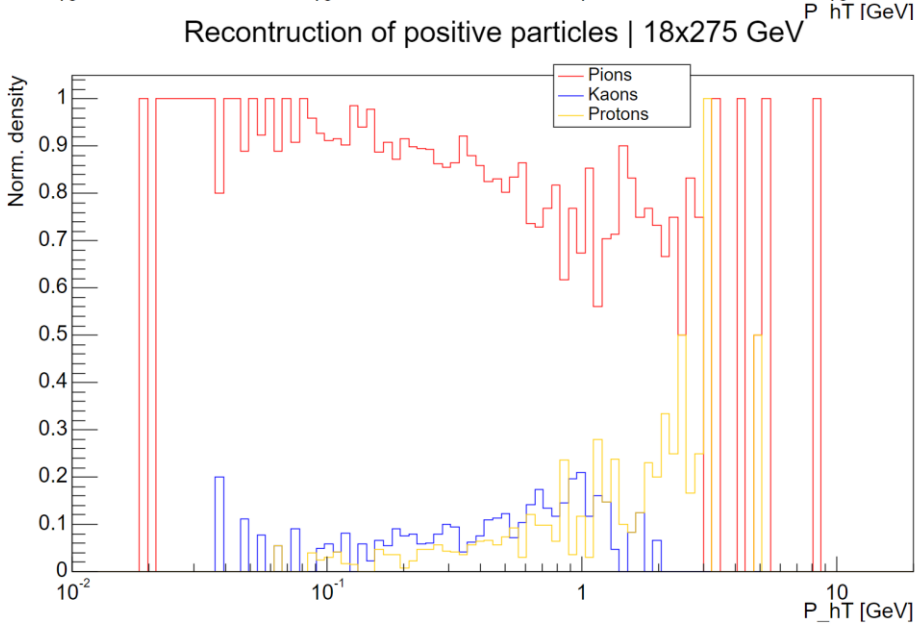


NORM. COUNTS VS P_{hT} | POSITIVE CASE

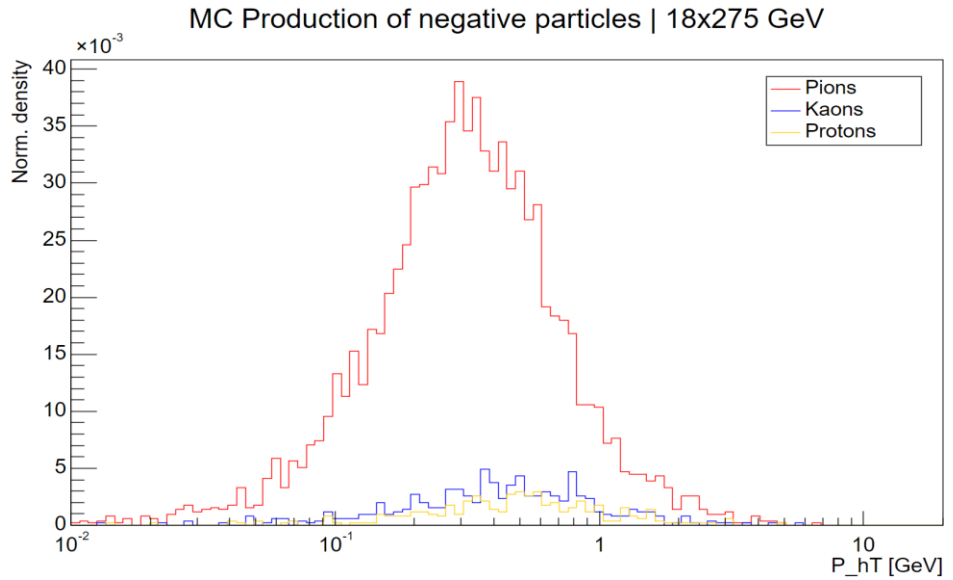


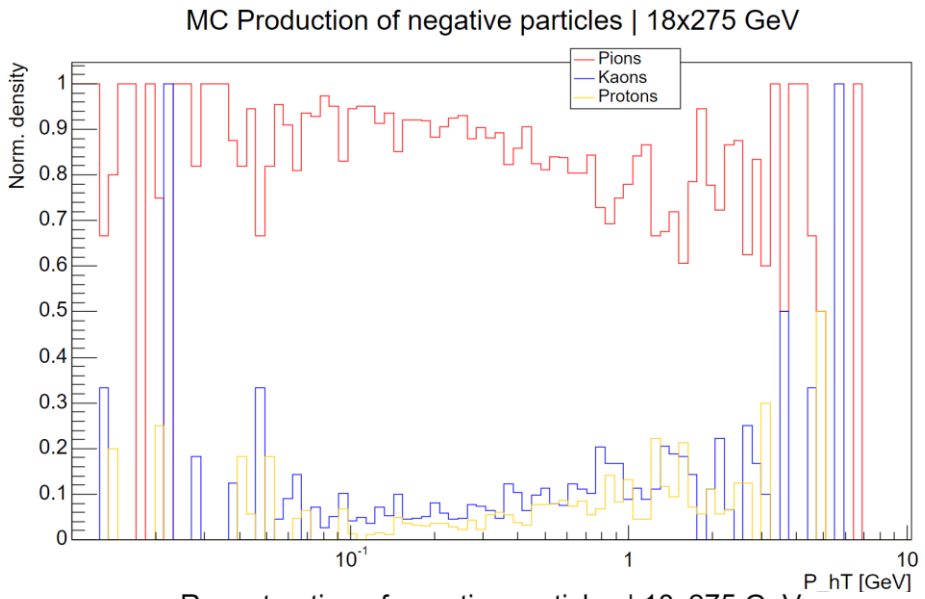


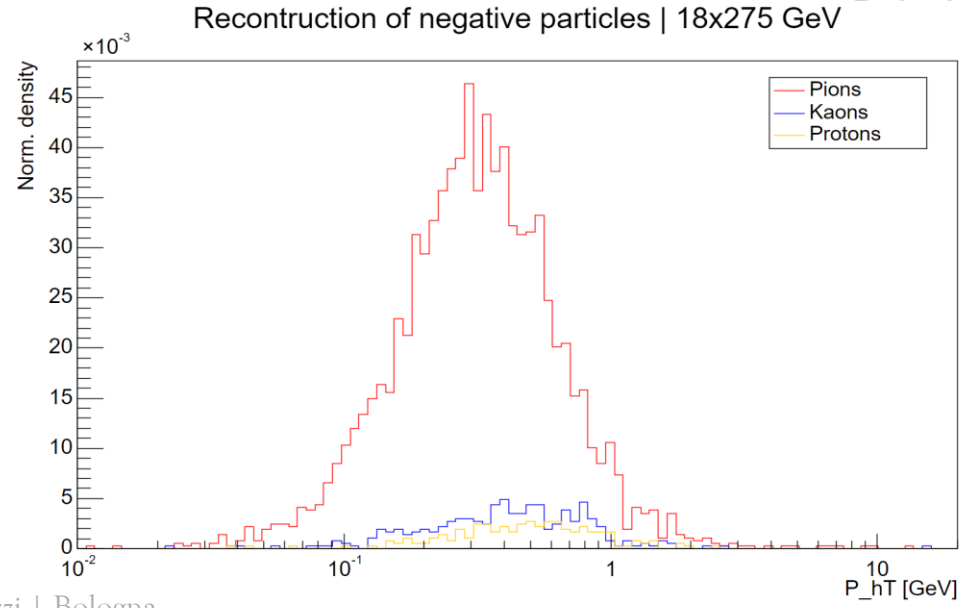


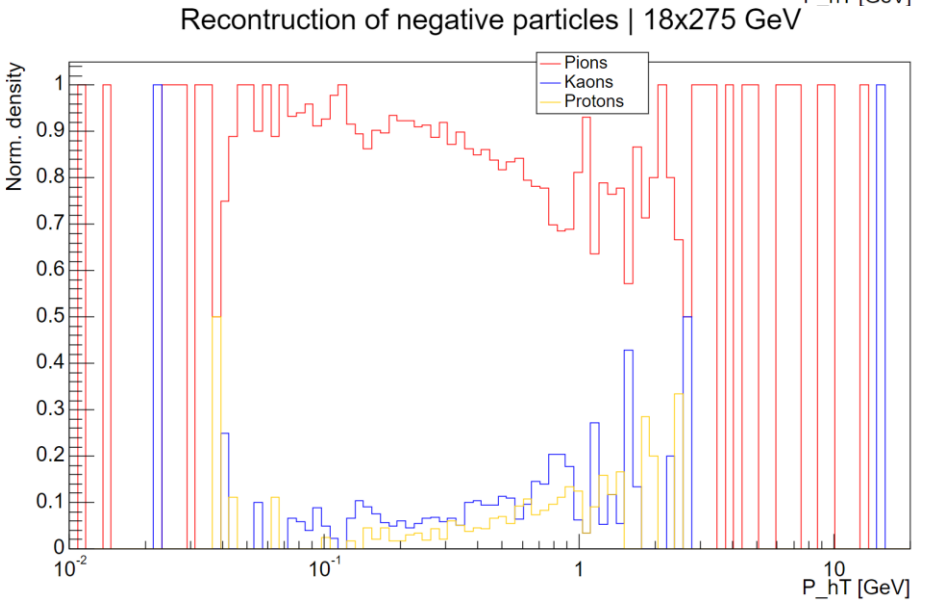


NORM. COUNTS VS P_{hT} | NEGATIVE CASE

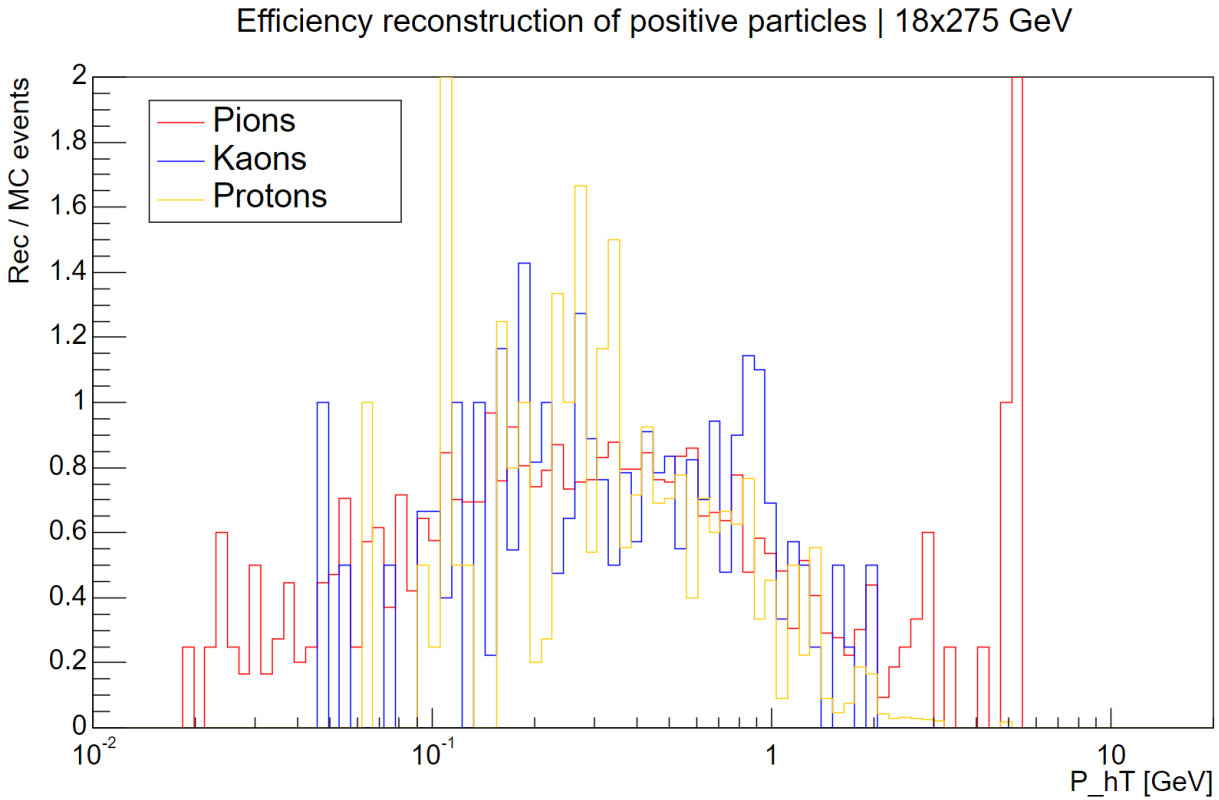


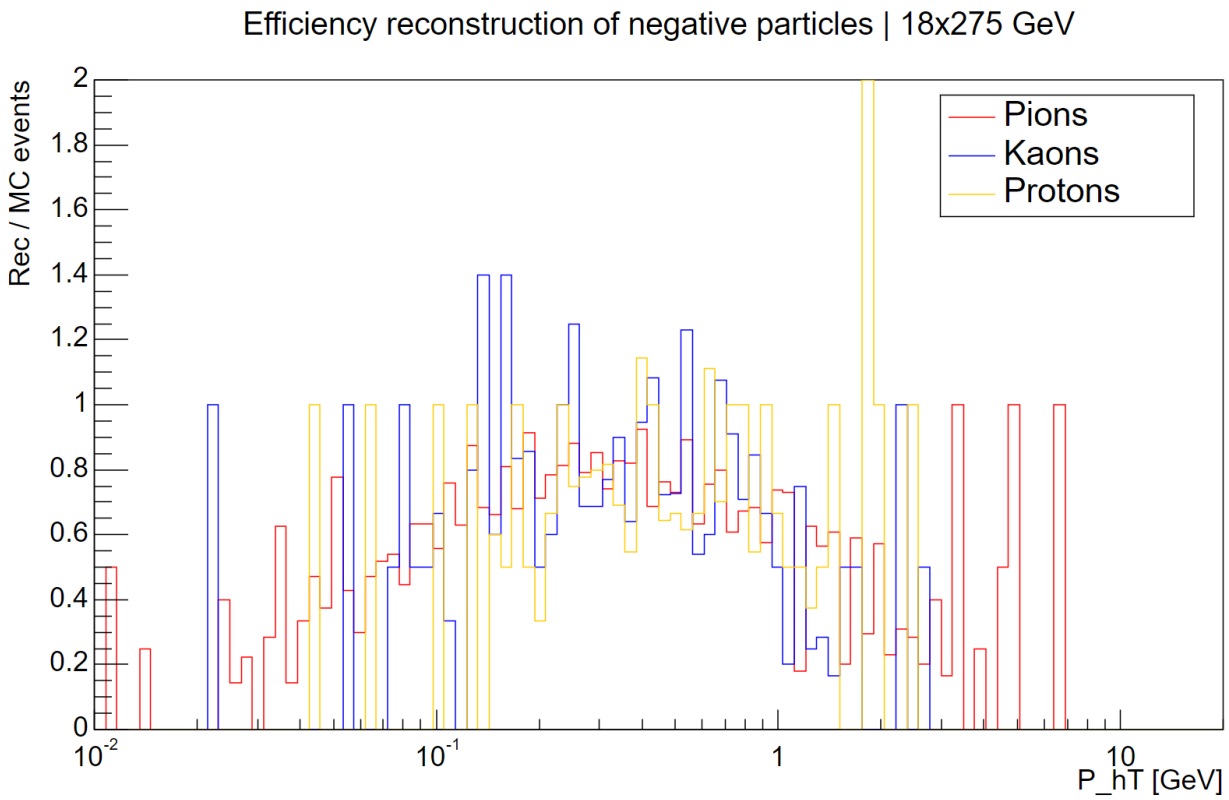




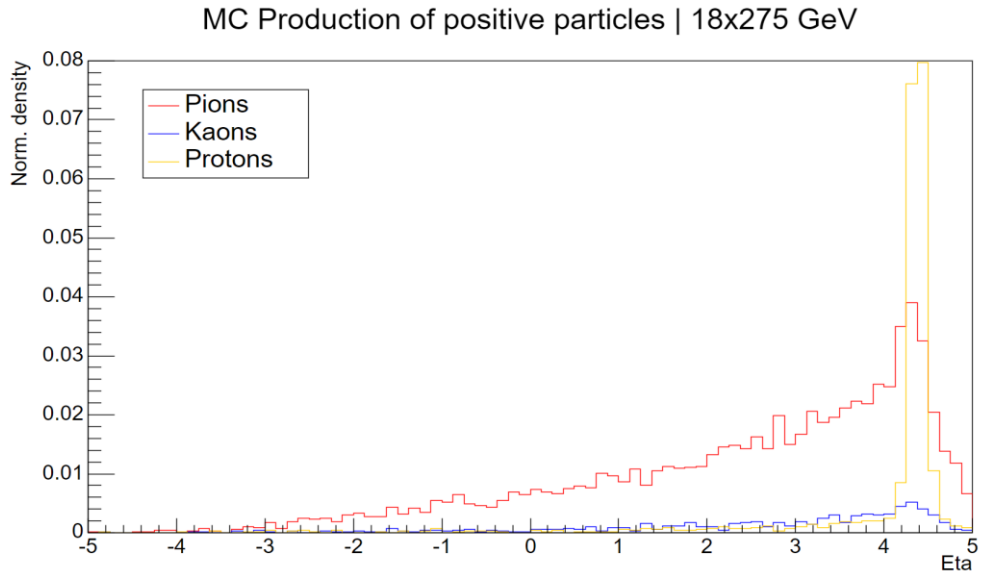


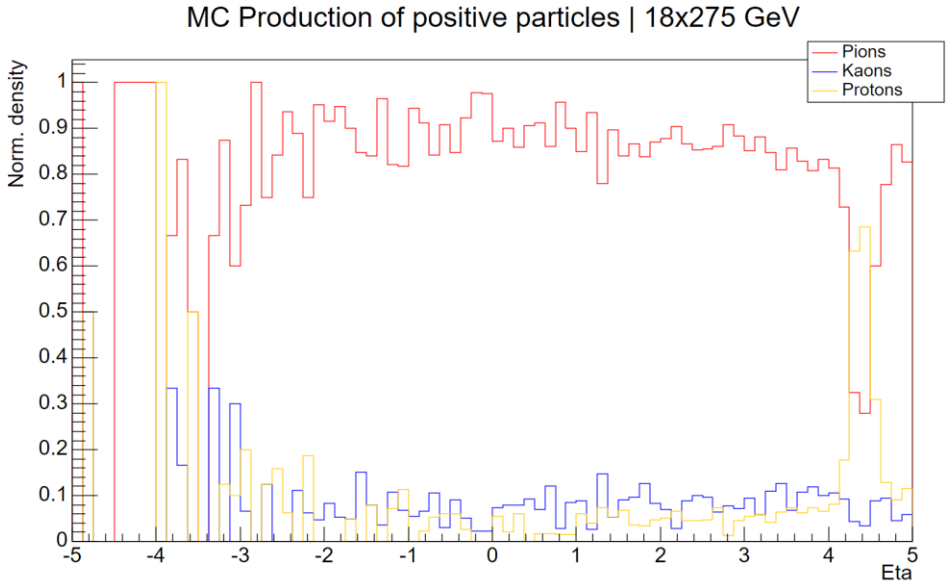
EFFICIENCY vs P_{hT}

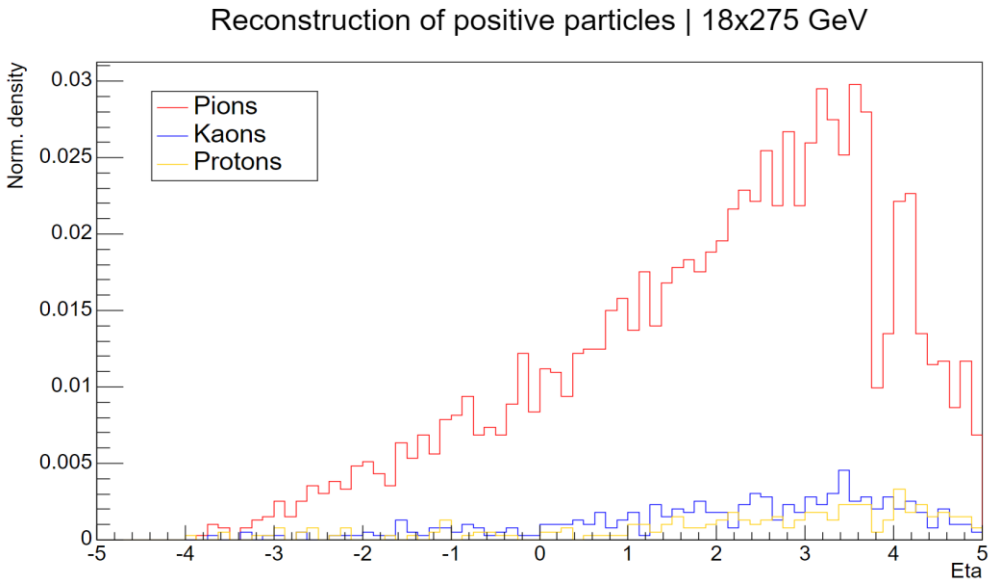


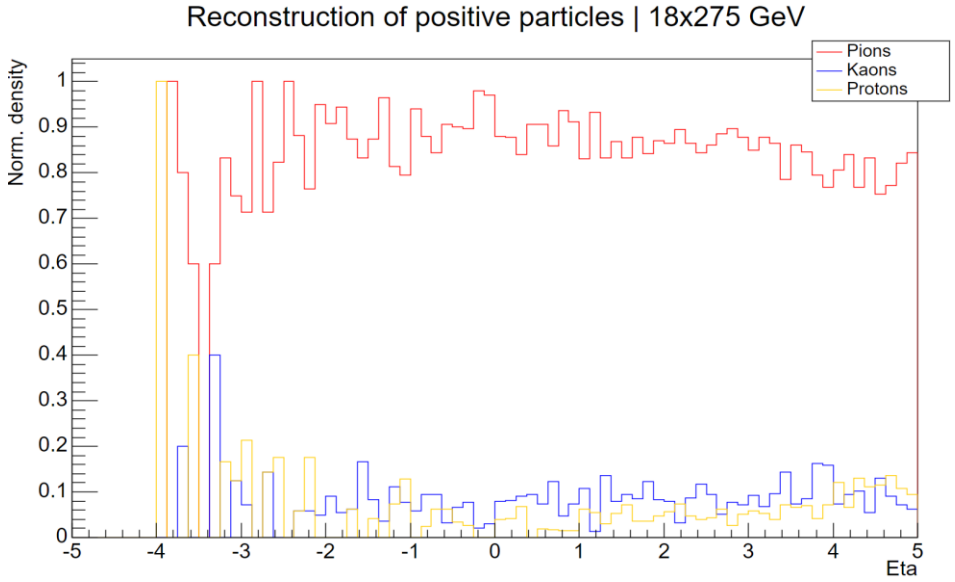


NORM. COUNTS VS η | POSITIVE CASE

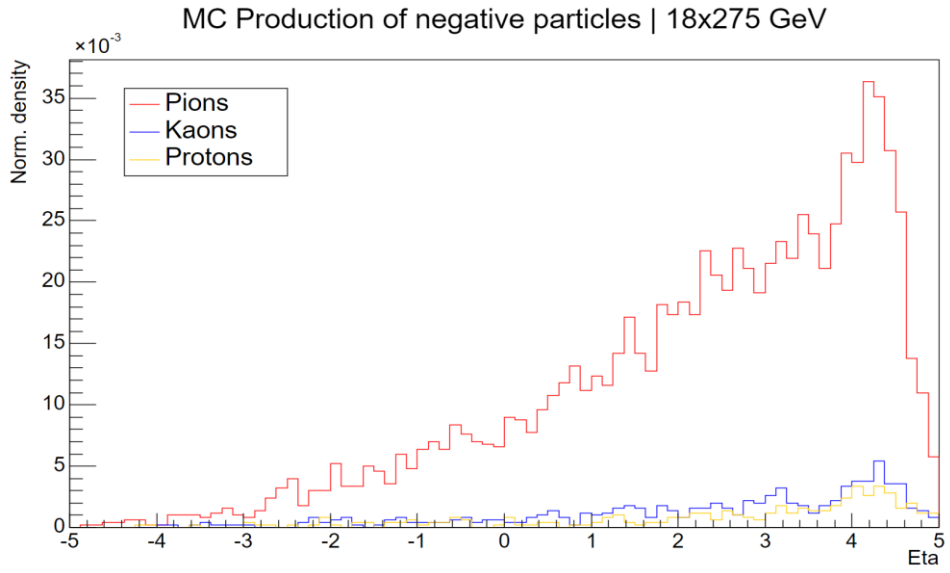


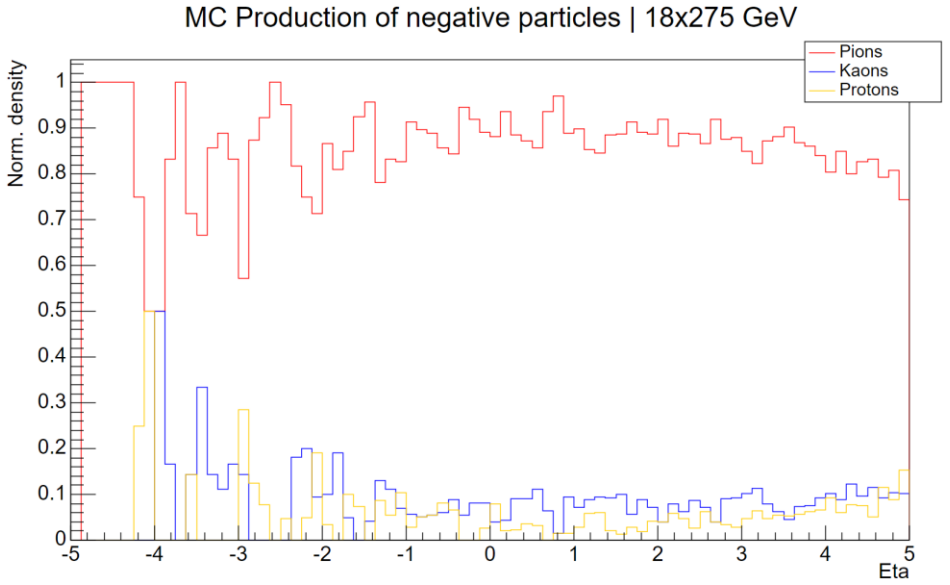


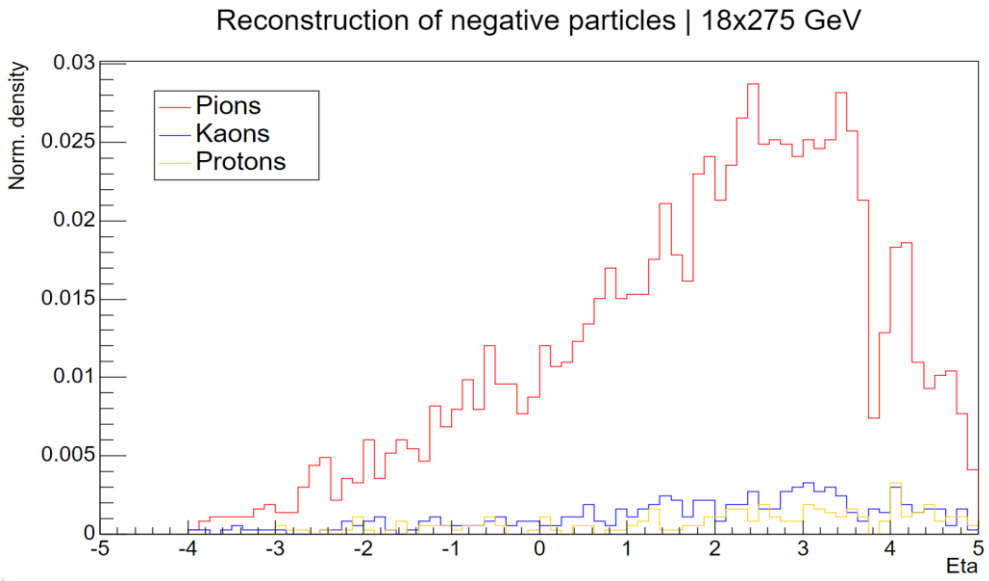


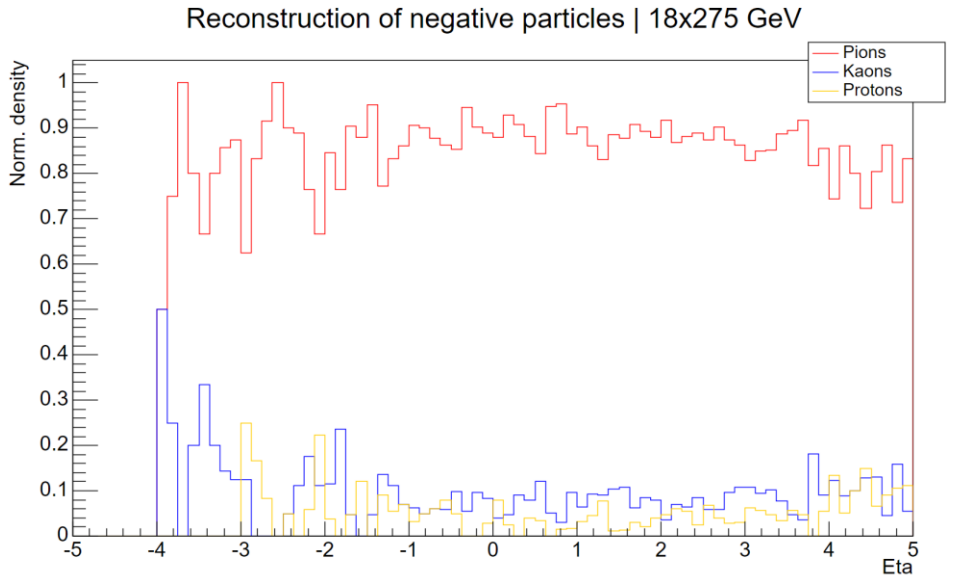


NORM. COUNTS VS η | NEGATIVE CASE

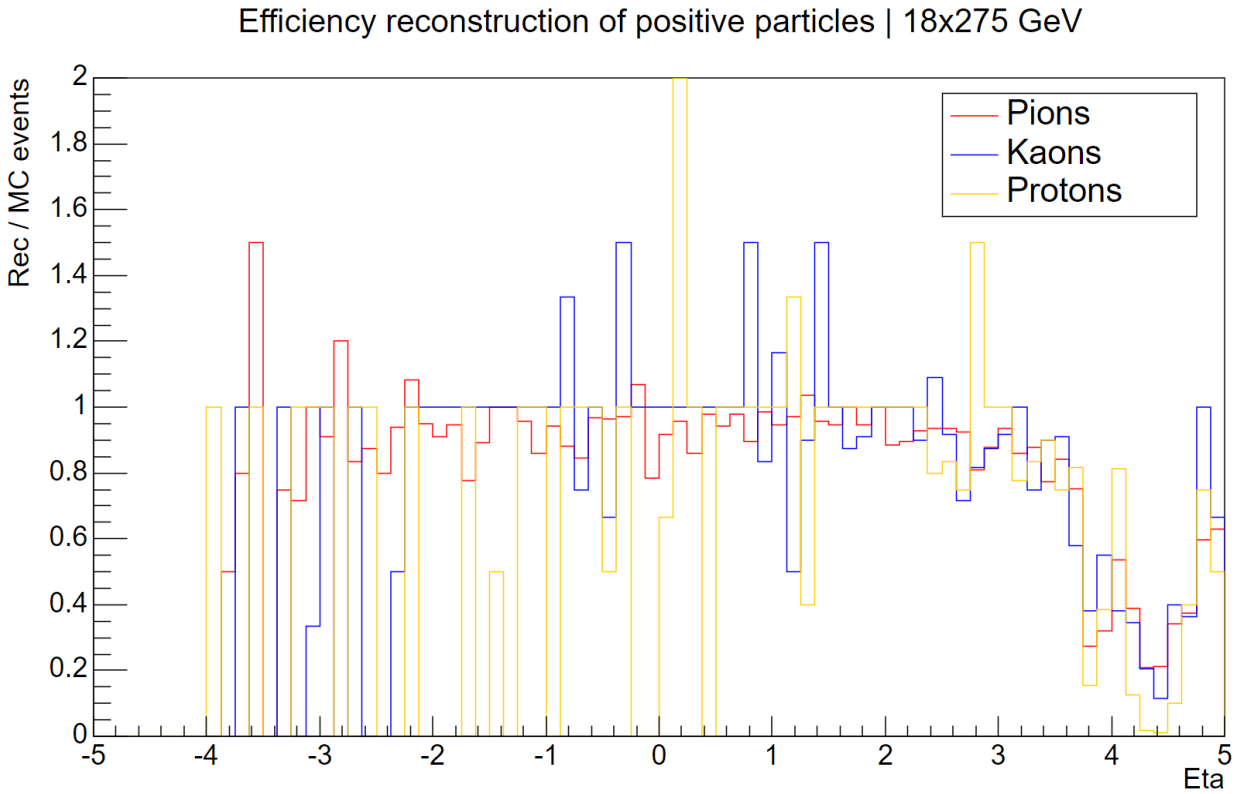


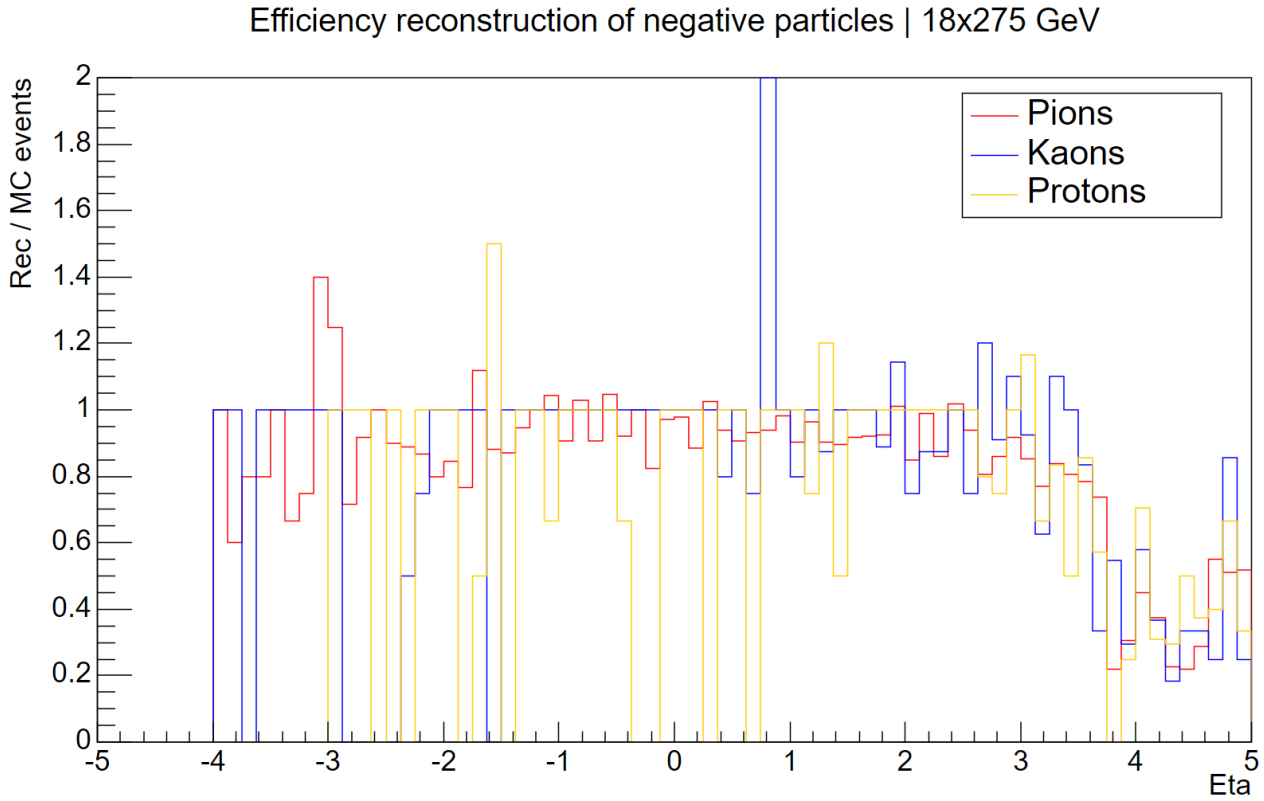






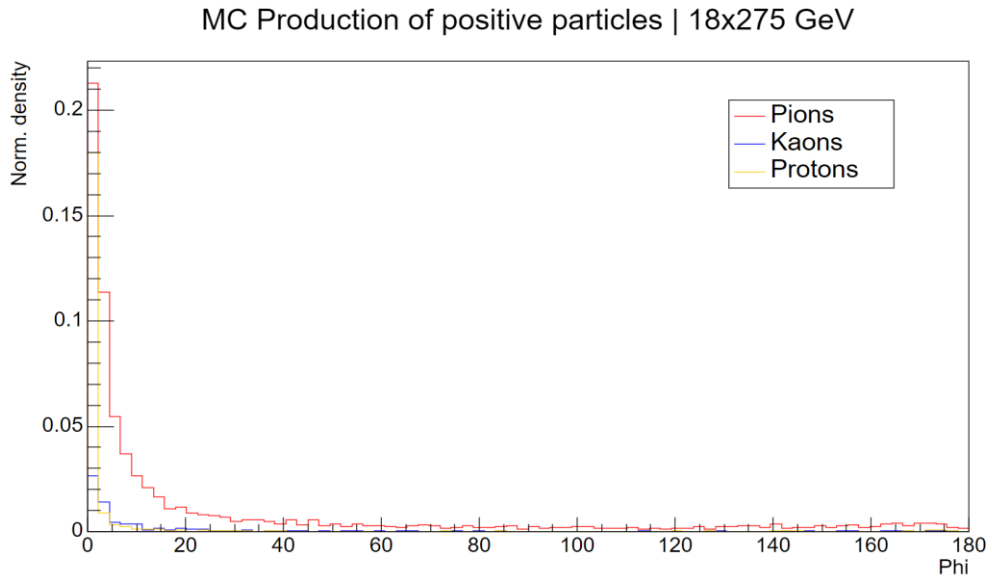
EFFICIENCY vs η

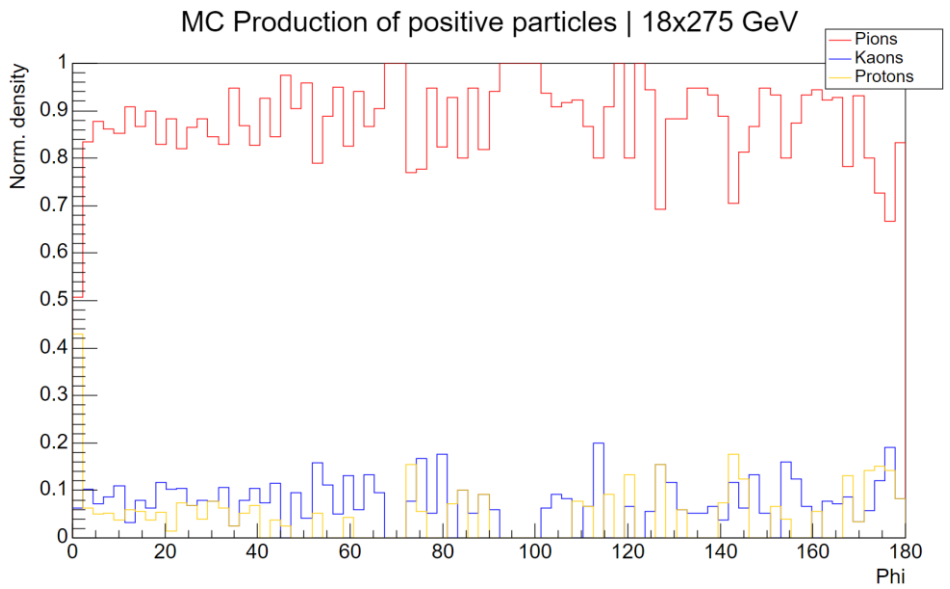


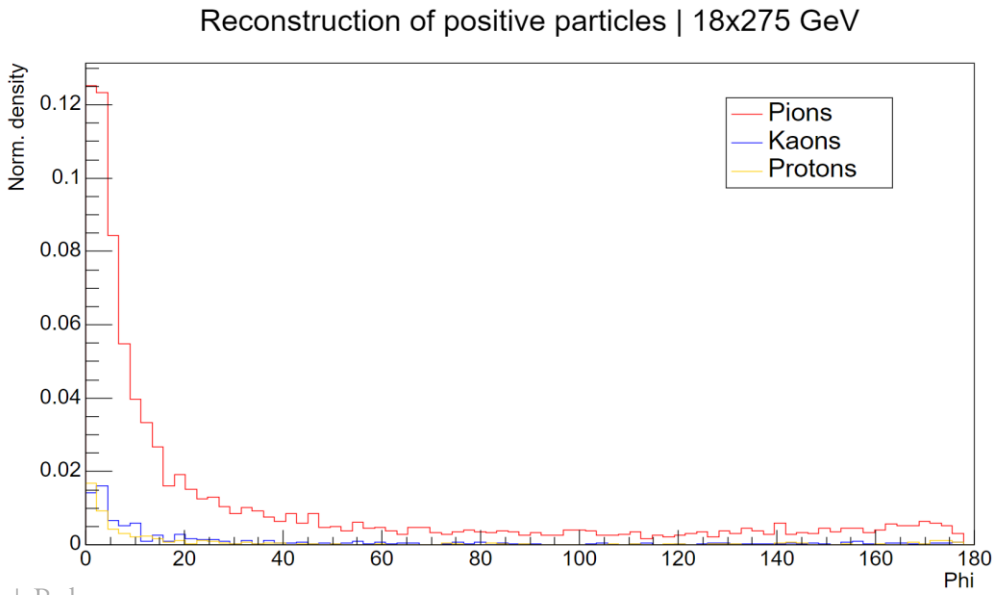


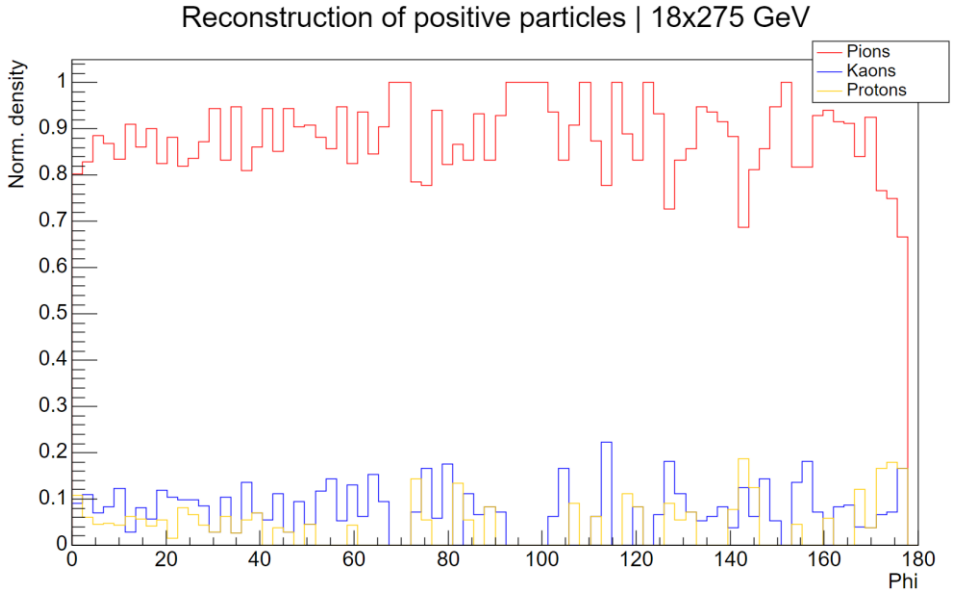
No cuts where performed in the pseudorapidity.

NORM. COUNTS VS φ | POSITIVE CASE

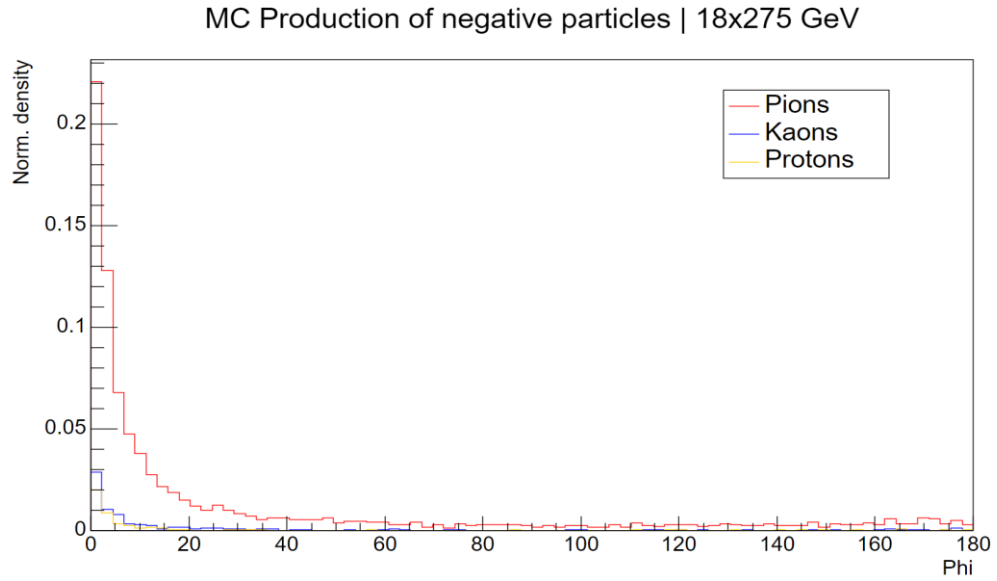


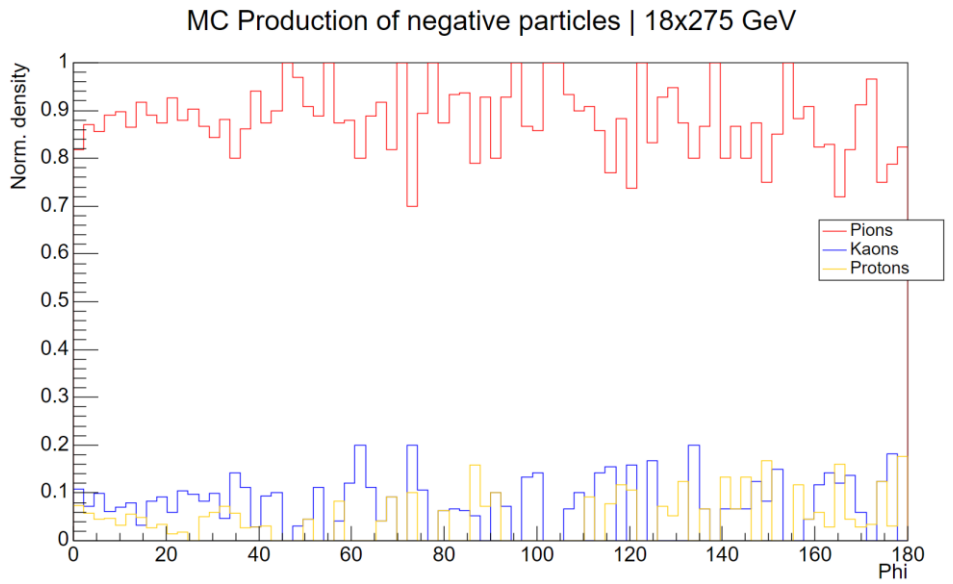


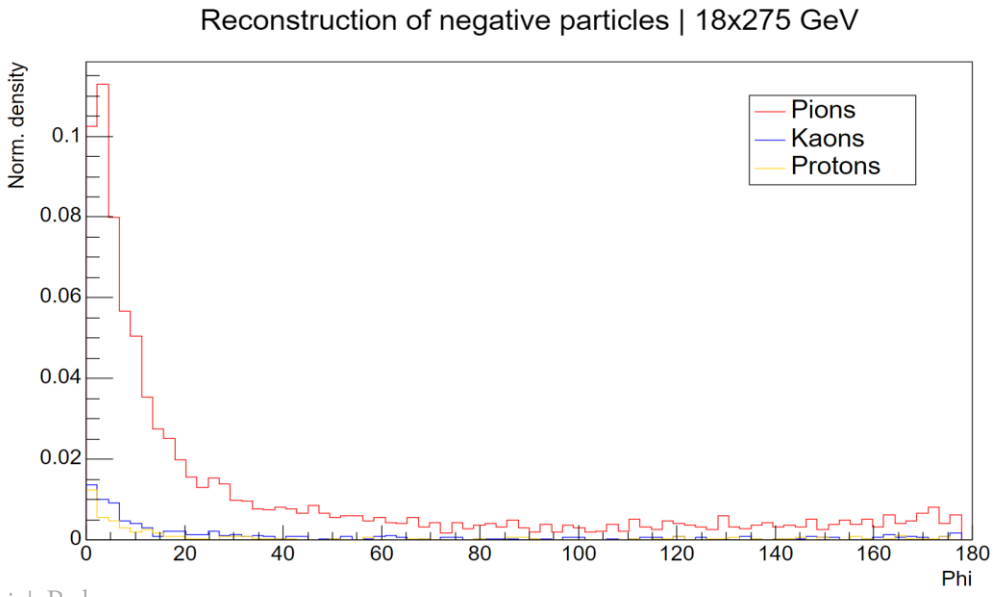


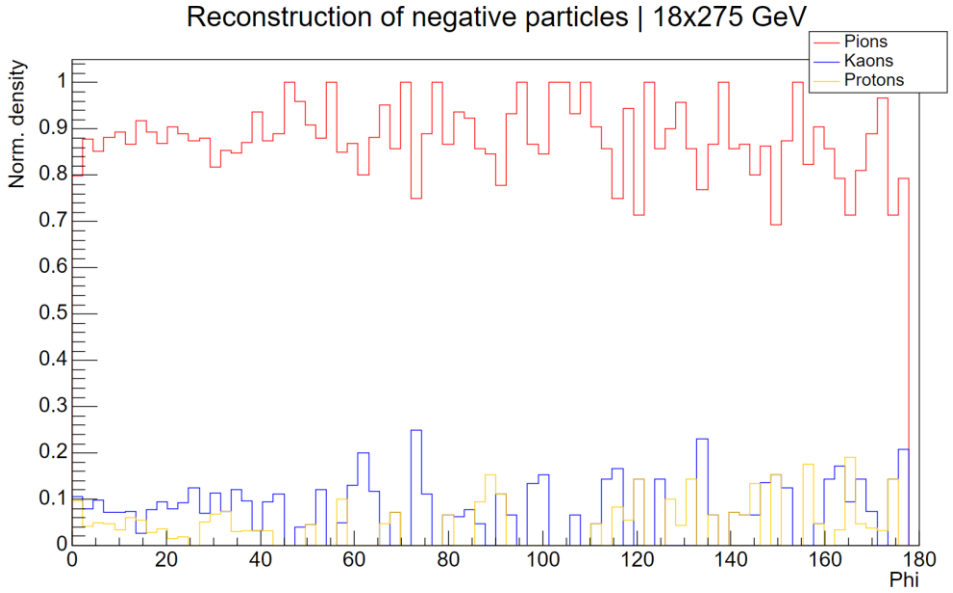


NORM. COUNTS VS φ | NEGATIVE CASE

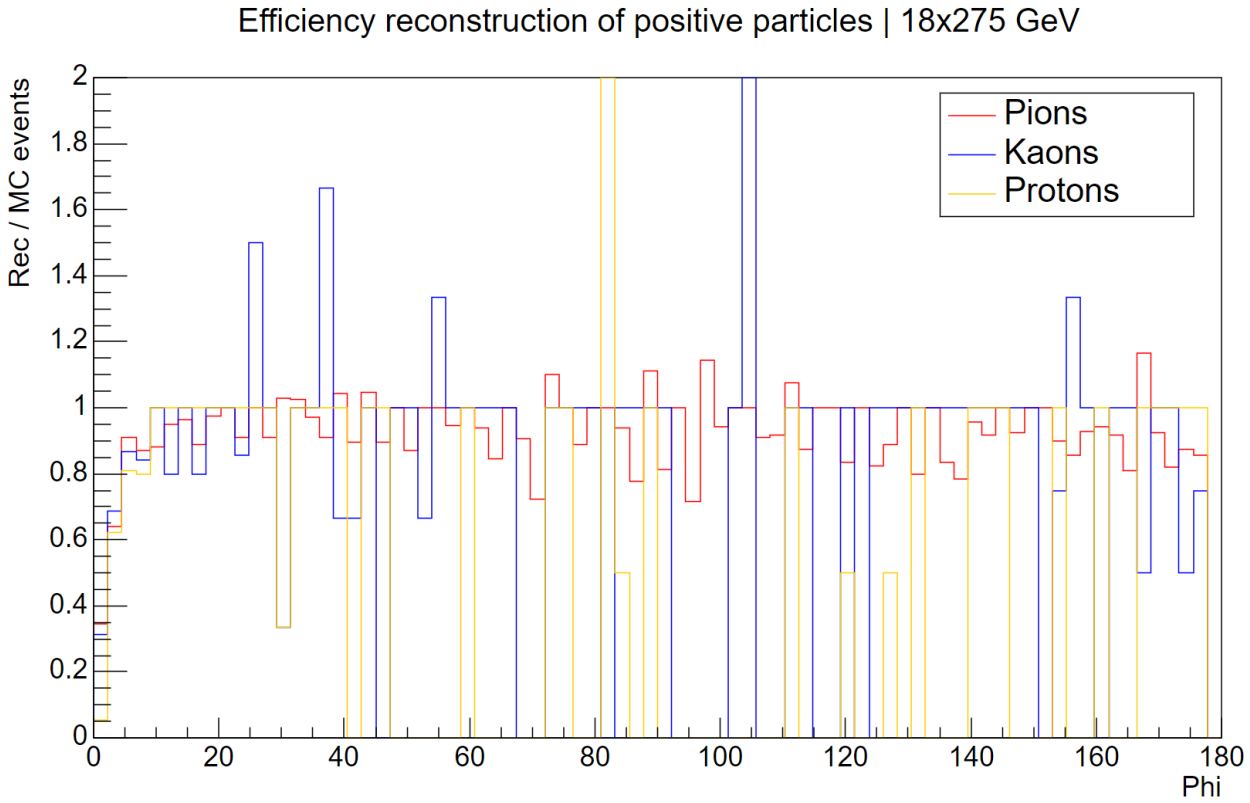


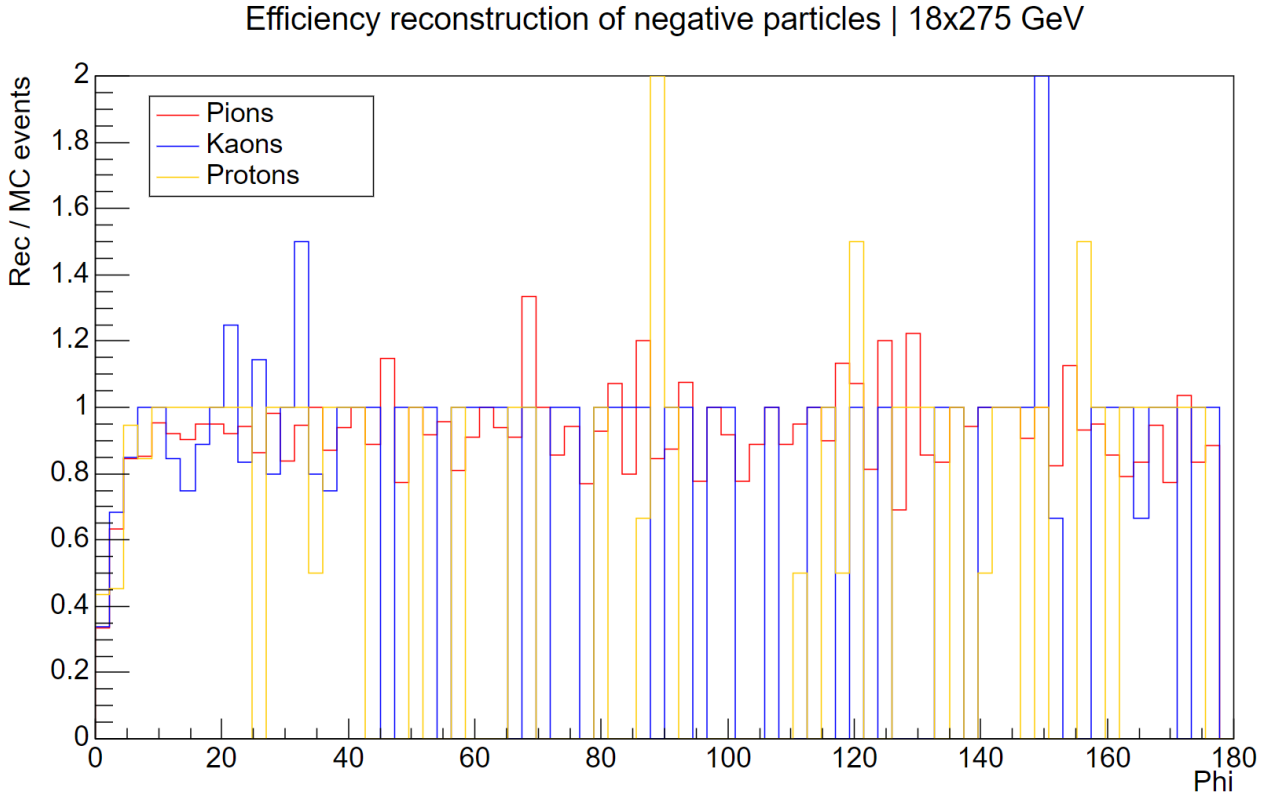




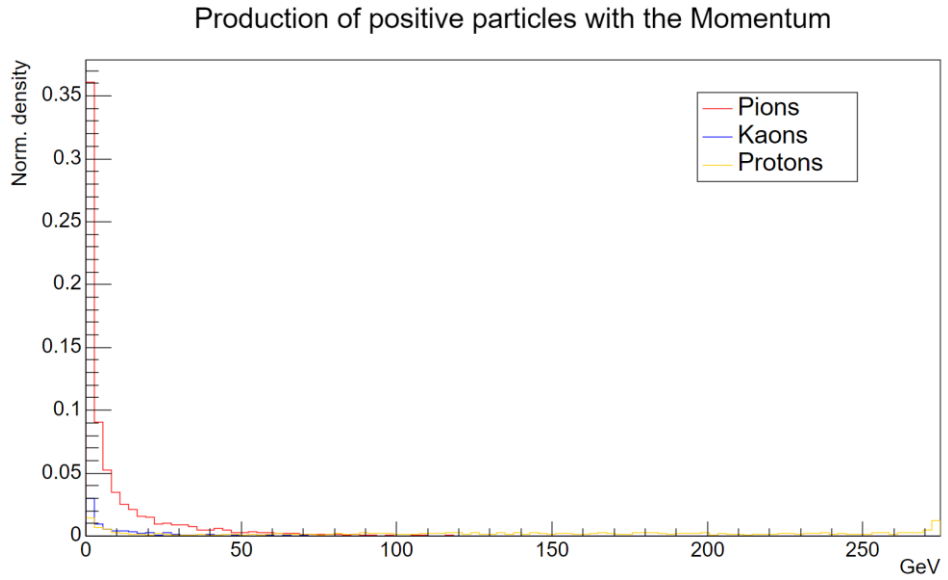


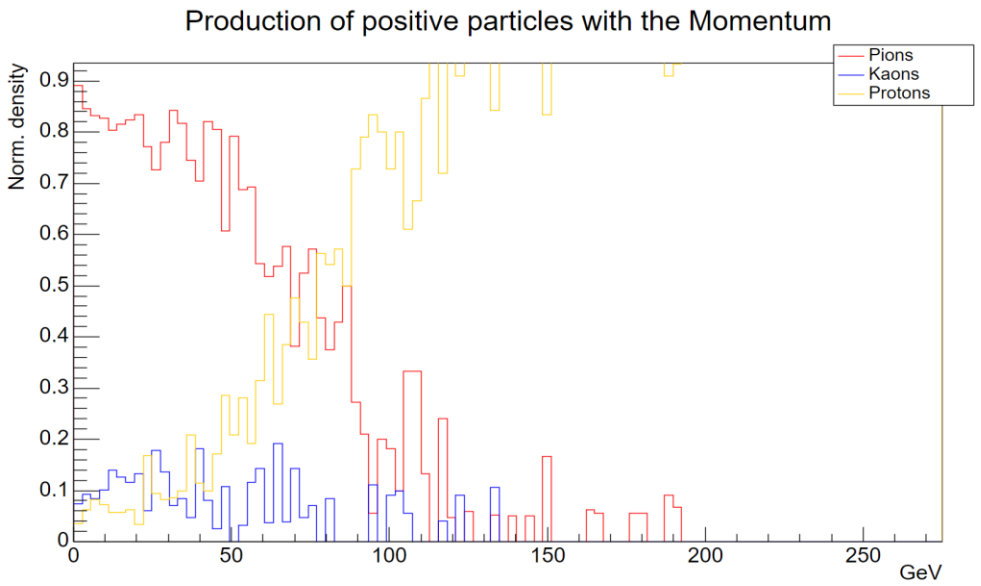
EFFICIENCY vs φ

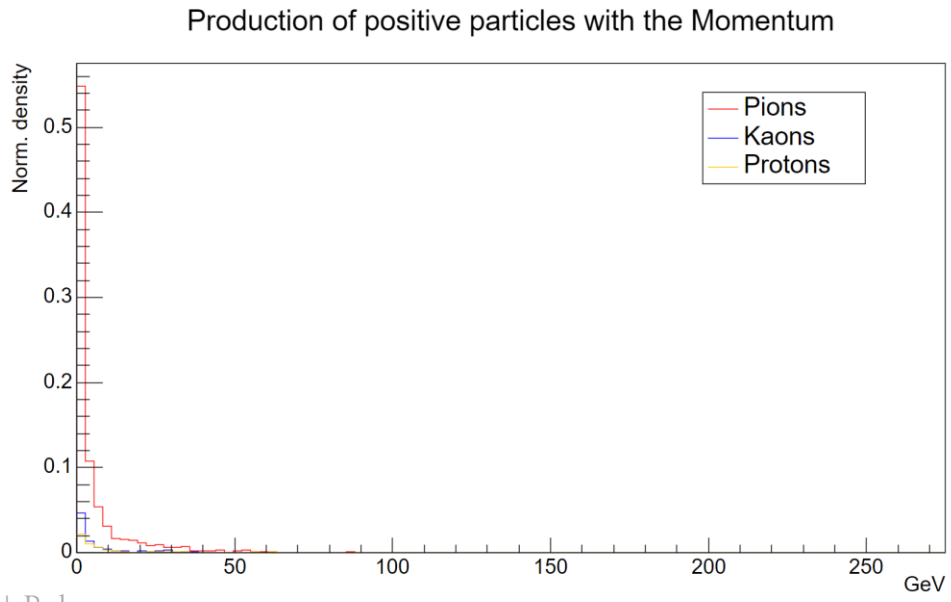


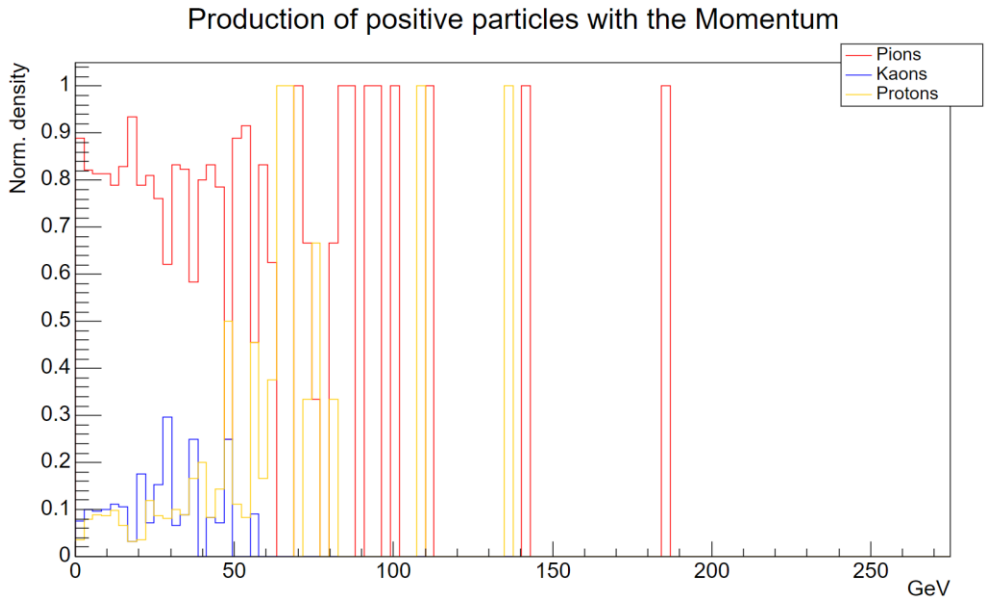


NORM. COUNTS vs *mom* | POSITIVE CASE

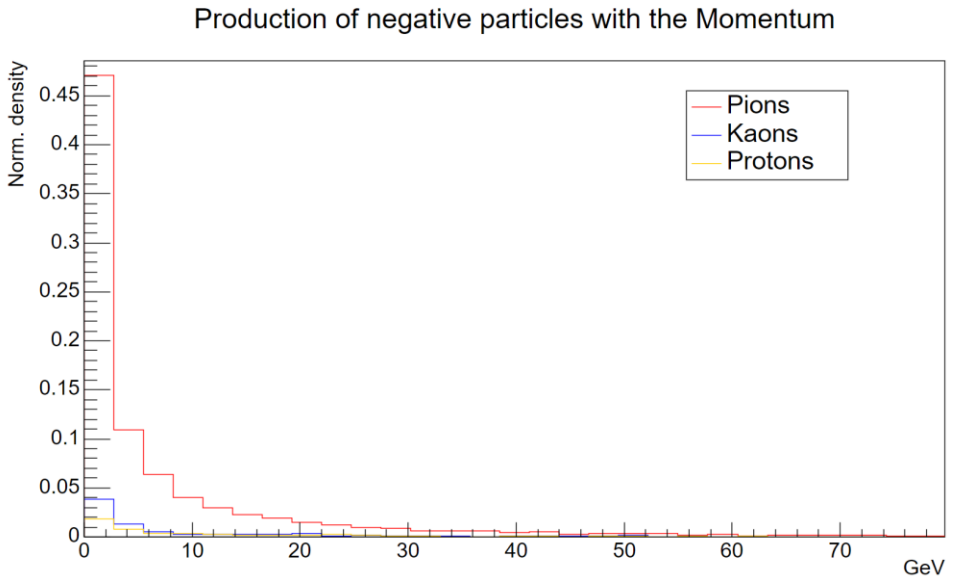


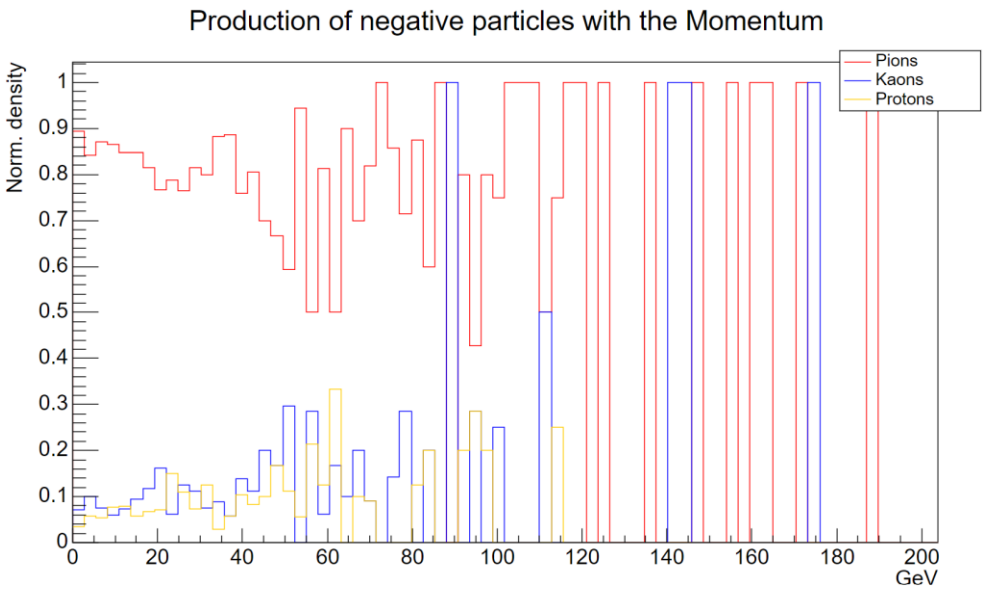


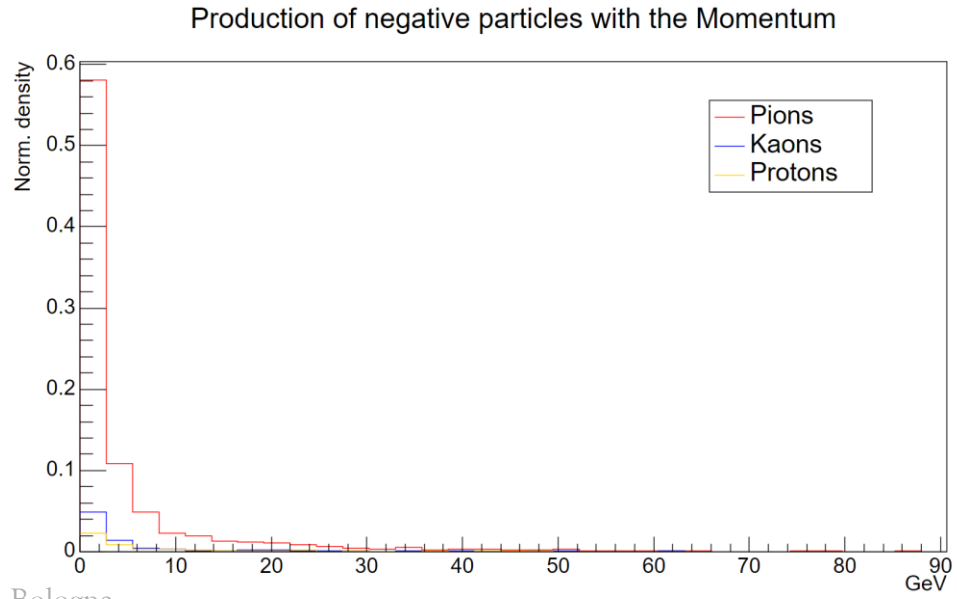


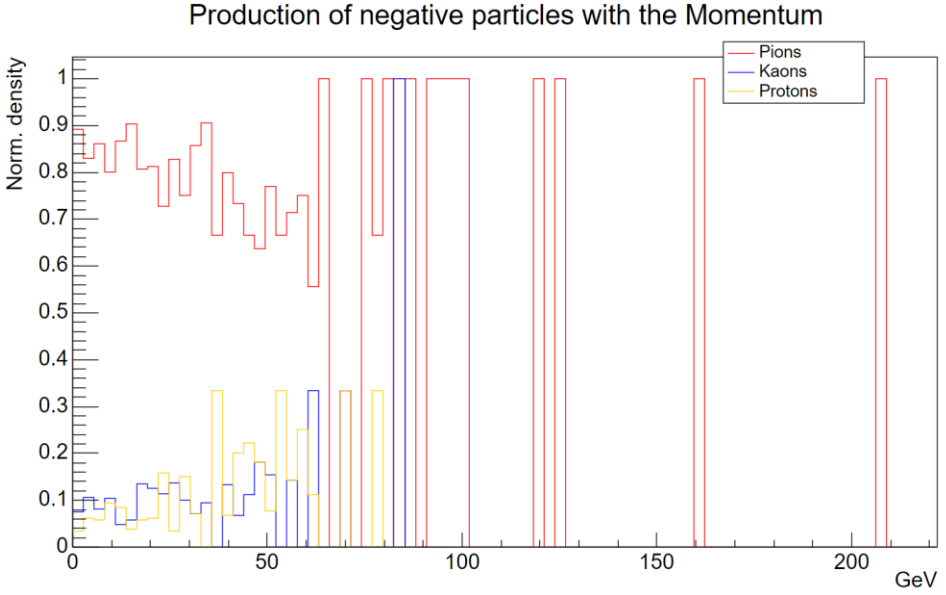


NORM. COUNTS vs *mom* | NEGATIVE CASE

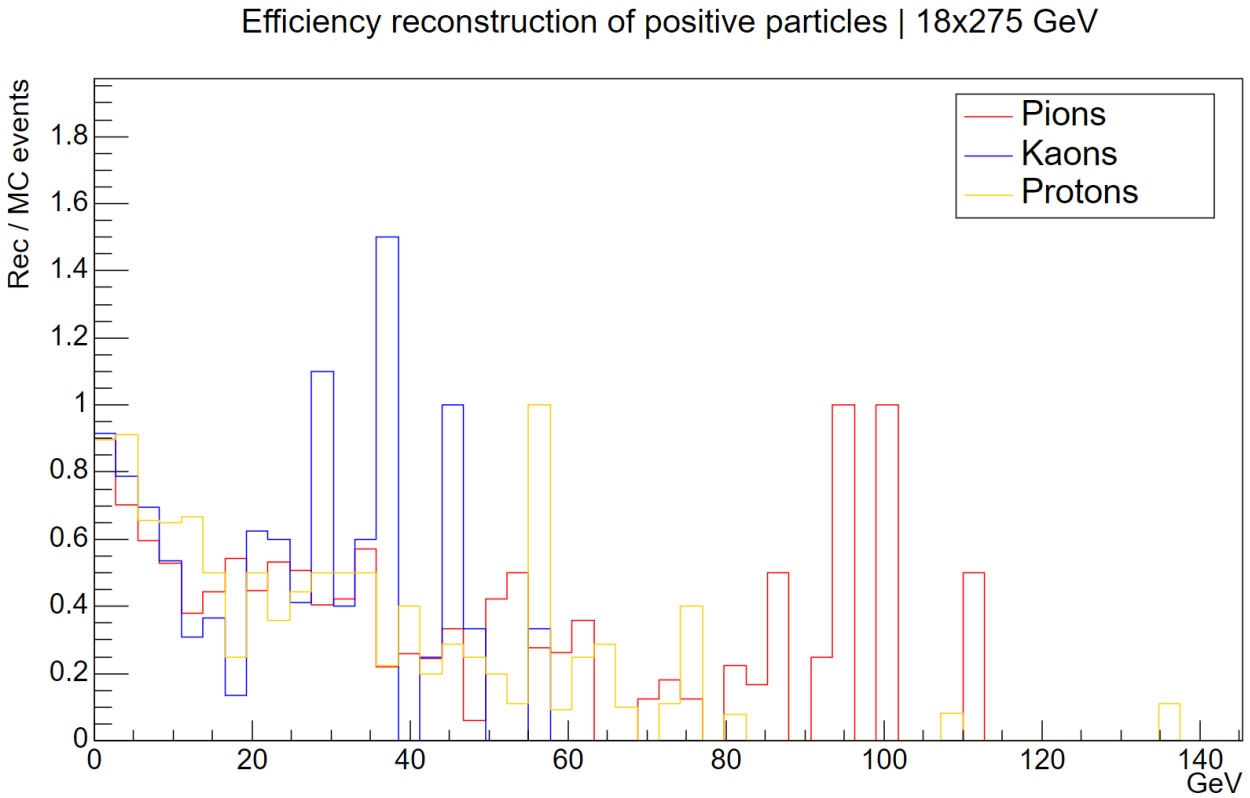


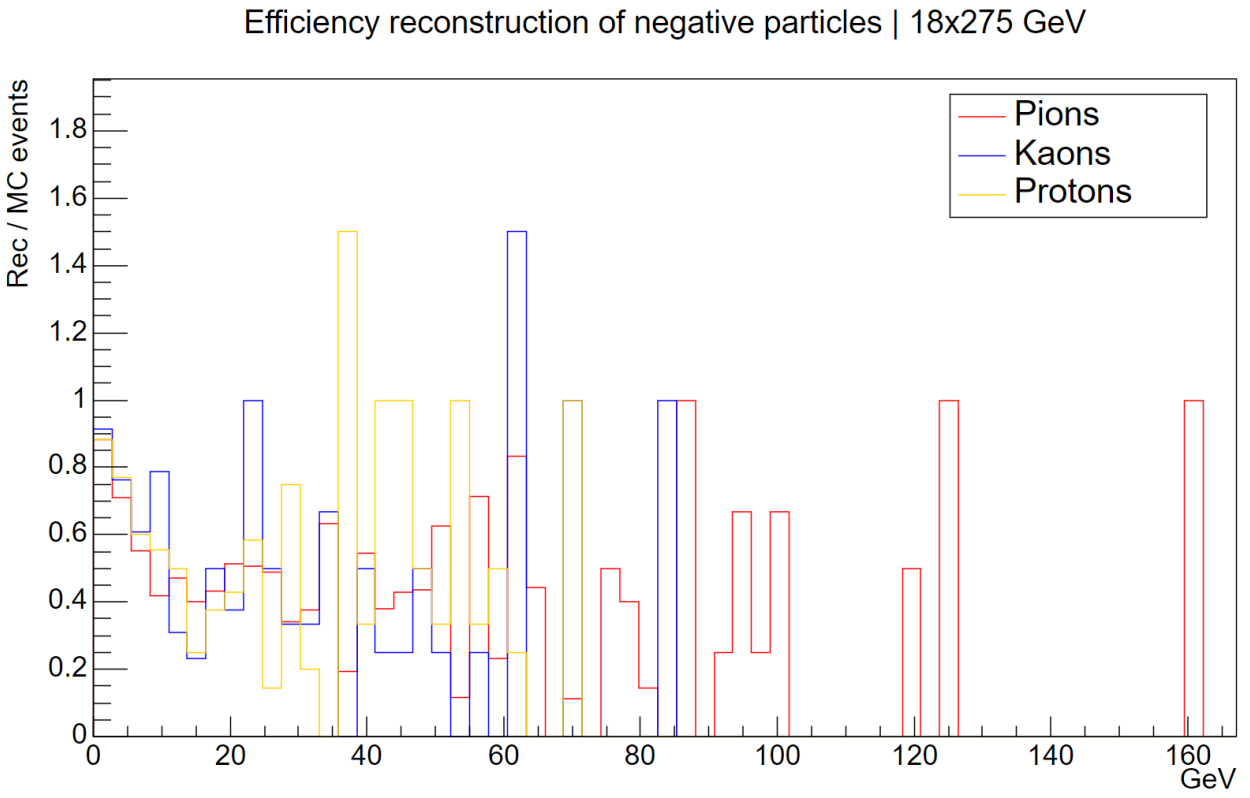






EFFICIENCY vs *mom*





More statistic and the integration of region cuts are needed.

SUMMARY

The calculations were made over a small fraction of the data, as shown in the first slide, due to personal technical limitation. The opportunity to use more data would enhance the performance of the curret simulations.

Nevertheless, the current PID technique shows the low ability in reconstructing these hadrons across particular kinematic ranges. Future integrations in the simulated data are necessary to improve the reconstruction performances and gain a better understanding of the physics at the EIC.

THANKS FOR YOUR ATTENTION