Heavy Flavor Meeting

SSbar 250 GeV Analysis

Yuichi Okugawa
Sep 27th, 2022

December Updates

1. Efficiency and Purity
    a. Kaon Identificatin
    b. dE/dx distance initialization fault
2. The pq-method
    a. Correction to the polar angle
3. The uubar result
    a. First polar angle result
    b. Efficiency & purity

KaonID
Efficiency & Purity

Efficiency & Purity

- Kaon identification
  - Efficiency
  - Purity
- Definition

$$\text{stability} = \frac{N_{rec} \cap N_{gen}}{N_{gen}}$$

$$\text{purity} = \frac{N_{rec} \cap N_{gen}}{N_{reco}}$$

Efficiency & Purity

- Kaon identification
  - Efficiency
  - Purity
- Definition

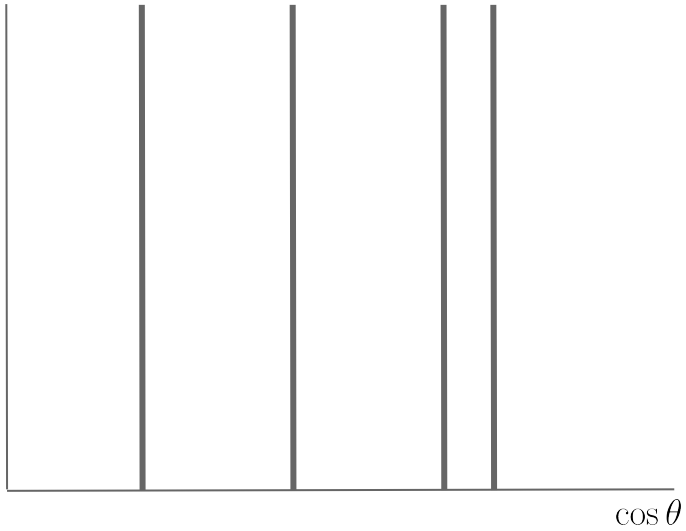
$$\text{stability} = \frac{N_{rec} \cap N_{gen}}{N_{gen}}$$

$$\text{purity} = \frac{N_{rec} \cap N_{gen}}{N_{reco}}$$

N_{gen} **4**

N_{rec}

$N_{rec} \cap N_{gen}$



Efficiency & Purity

- Kaon identification
  - Efficiency
  - Purity
- Definition

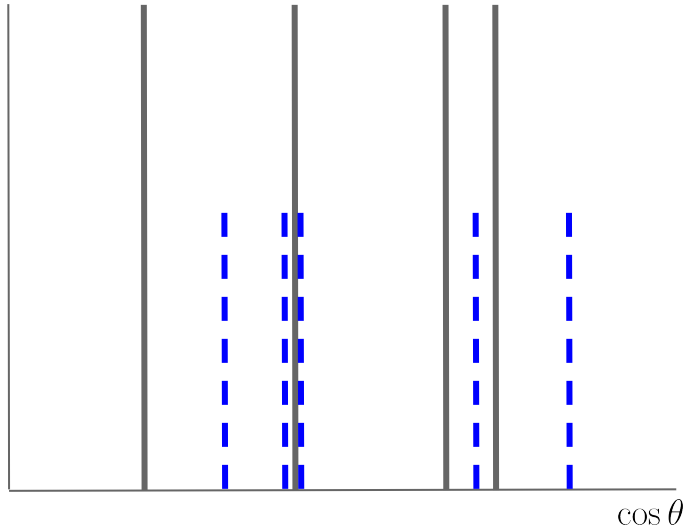
$$\text{stability} = \frac{N_{rec} \cap N_{gen}}{N_{gen}}$$

$$\text{purity} = \frac{N_{rec} \cap N_{gen}}{N_{reco}}$$

N_{gen} **4**

N_{rec} **5**

$N_{rec} \cap N_{gen}$



Efficiency & Purity

- Kaon identification
  - Efficiency
  - Purity
- Definition

$$\text{stability} = \frac{N_{rec} \cap N_{gen}}{N_{gen}}$$

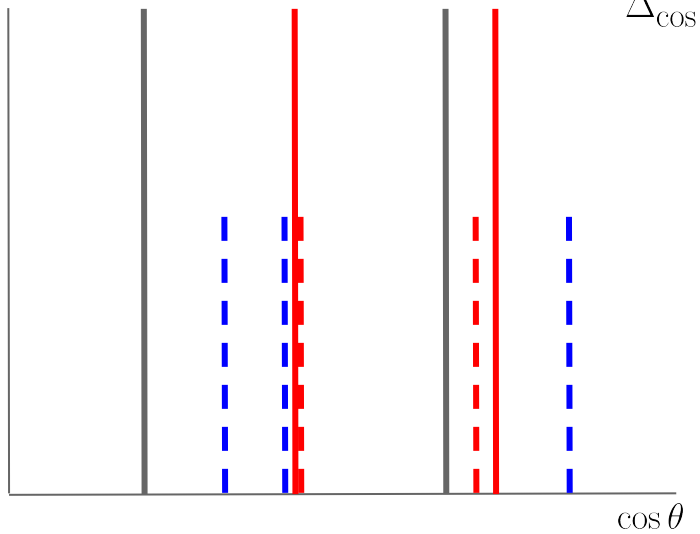
$$\text{purity} = \frac{N_{rec} \cap N_{gen}}{N_{reco}}$$

N_{gen} **4**

N_{rec} **5**

$N_{rec} \cap N_{gen}$ **2**

$\Delta_{\cos\theta} < 0.02$

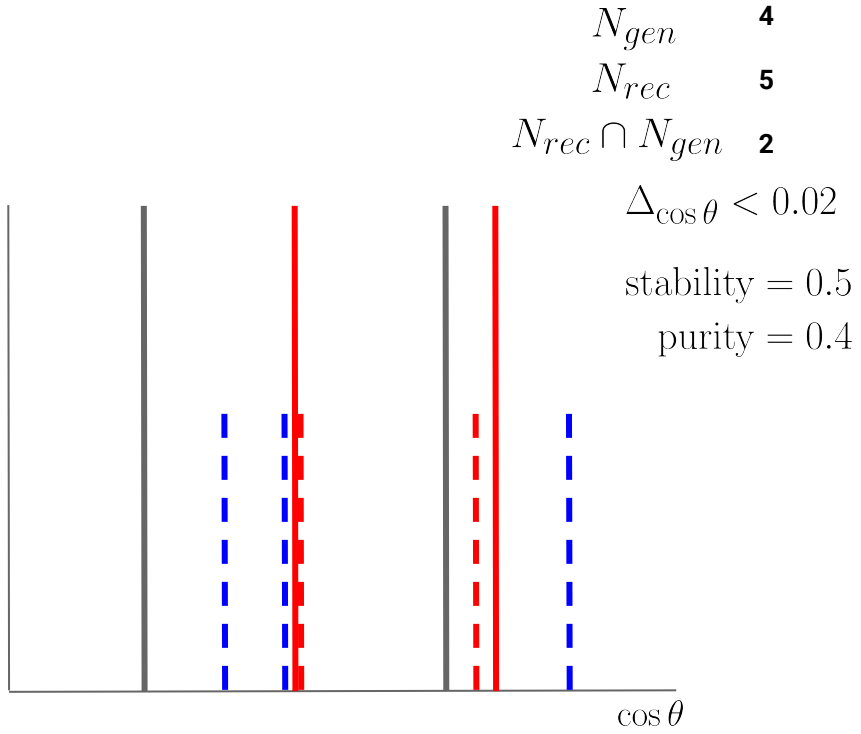


Efficiency & Purity

- Kaon identification
  - Efficiency
  - Purity
- Definition

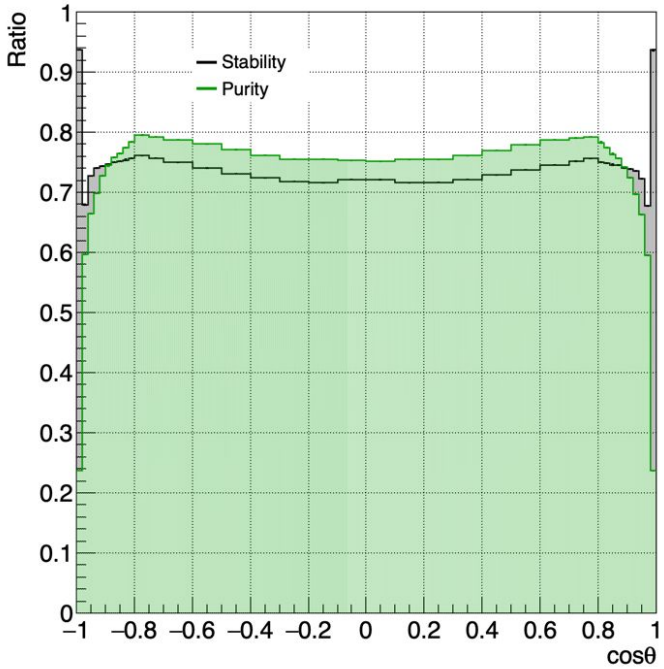
$$\text{stability} = \frac{N_{rec} \cap N_{gen}}{N_{gen}}$$

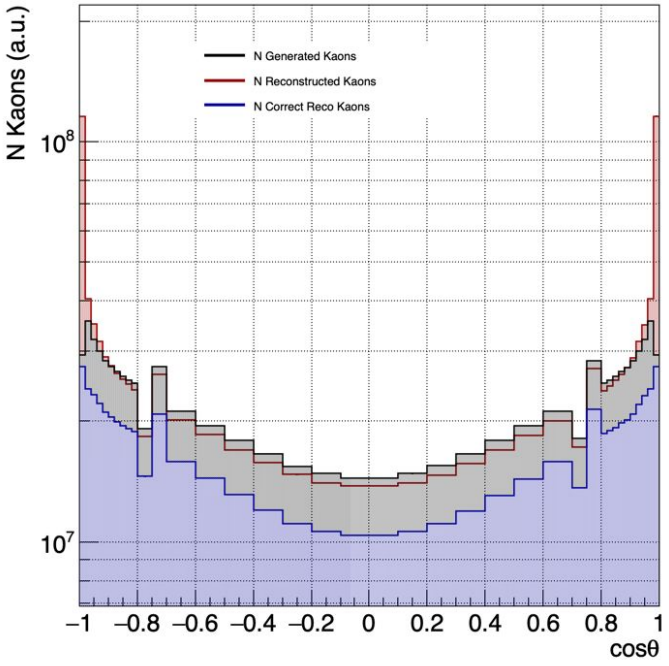
$$\text{purity} = \frac{N_{rec} \cap N_{gen}}{N_{reco}}$$



Efficiency & Purity

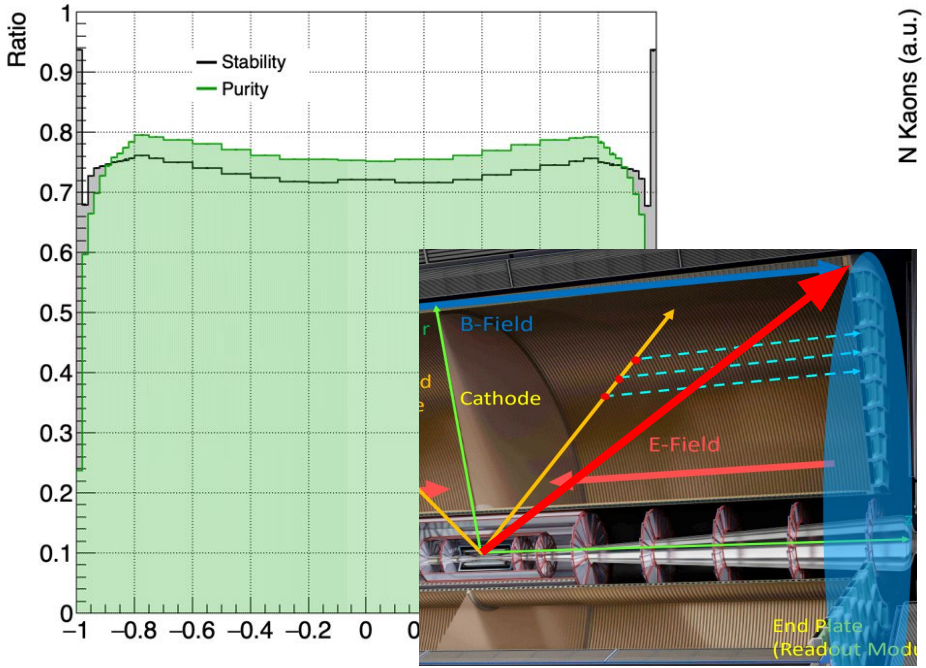
Using PFO_cheat | p > 5 GeV

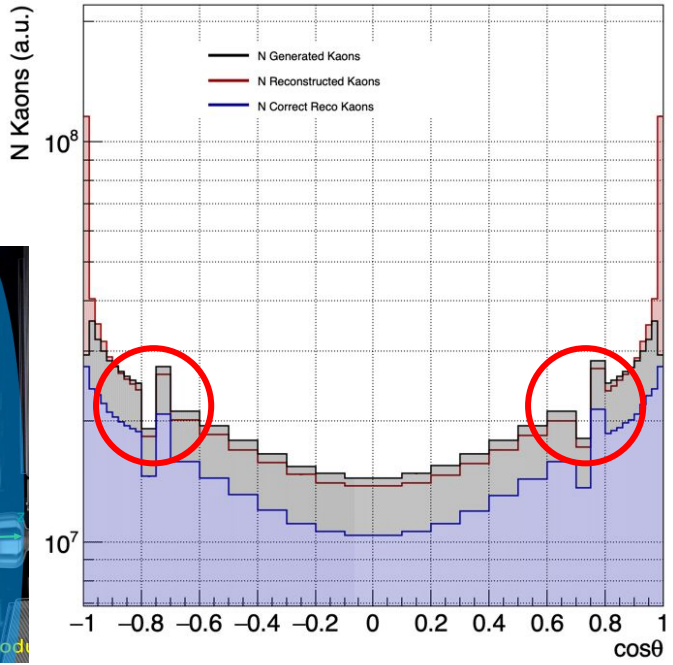




Efficiency & Purity

Using PFO_cheat | p > 5 GeV

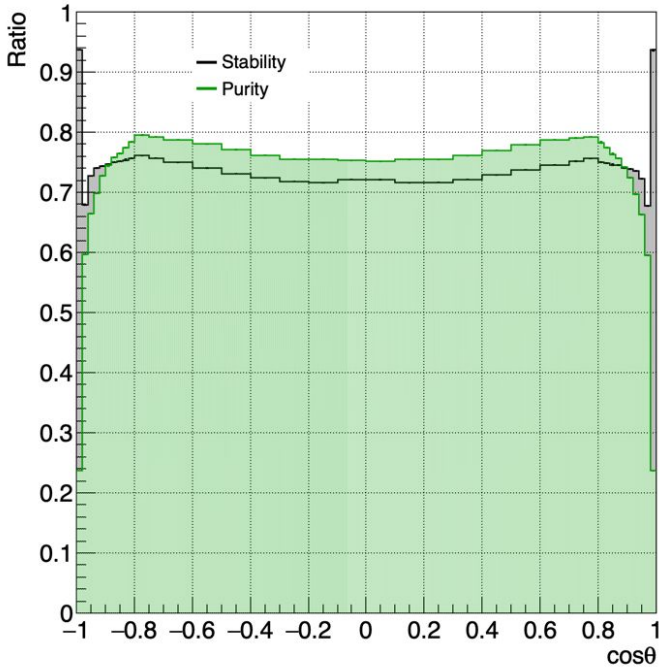


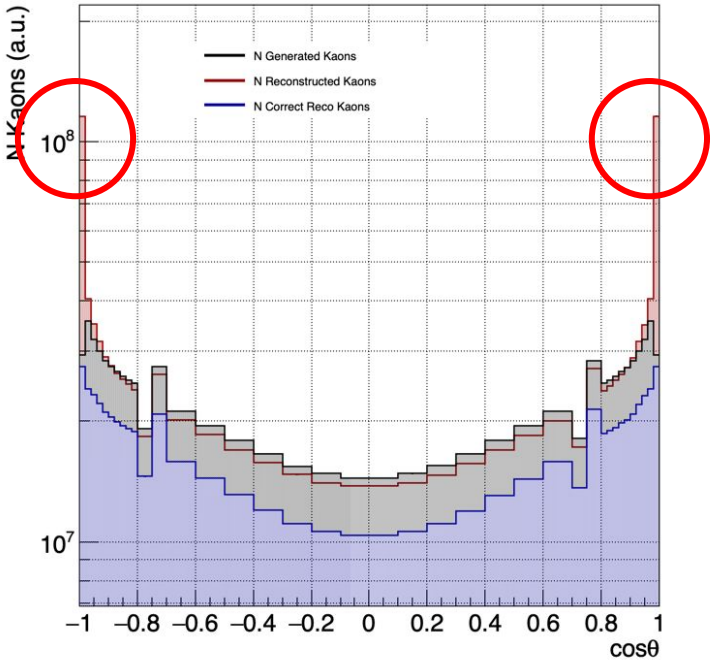


- Lack of PFO
- Failure to associate clusters to the PFO
- …

Efficiency & Purity

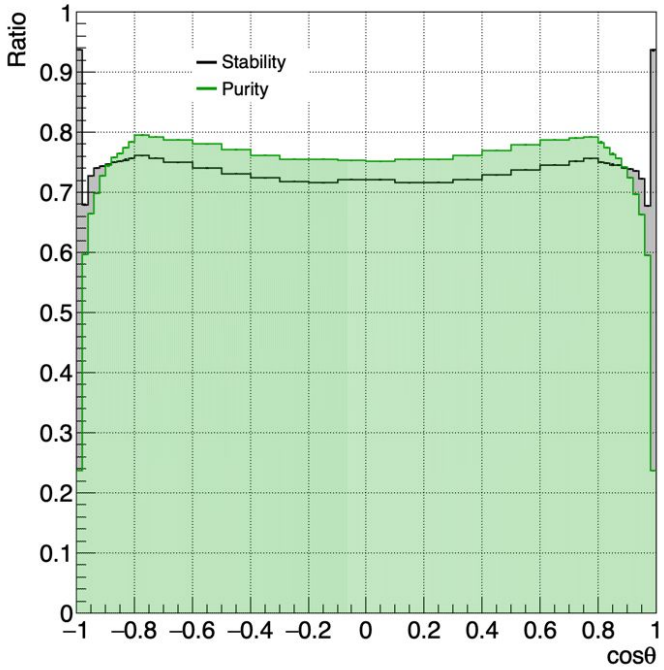
Using PFO_cheat | p > 5 GeV

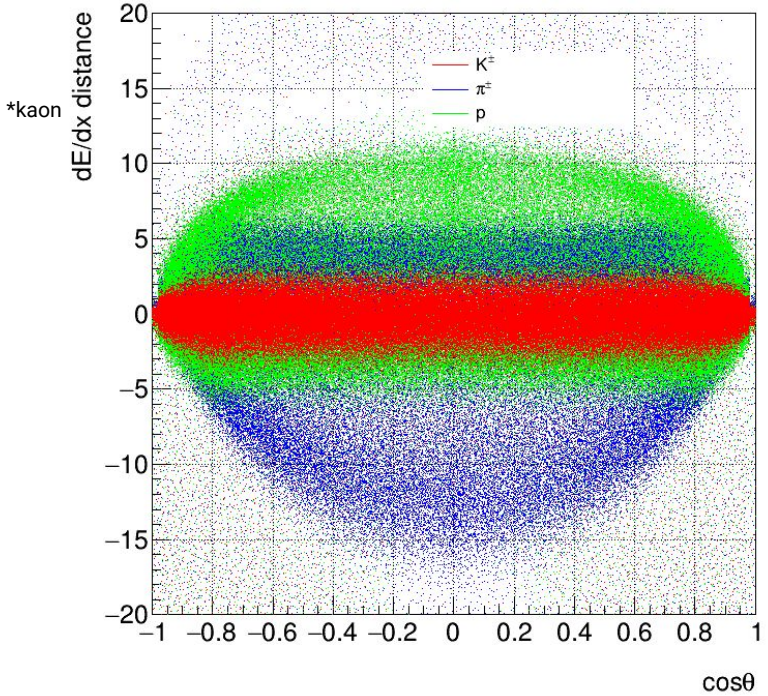




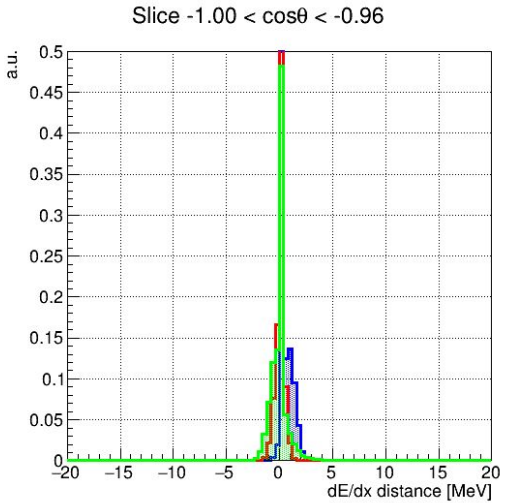
Efficiency & Purity

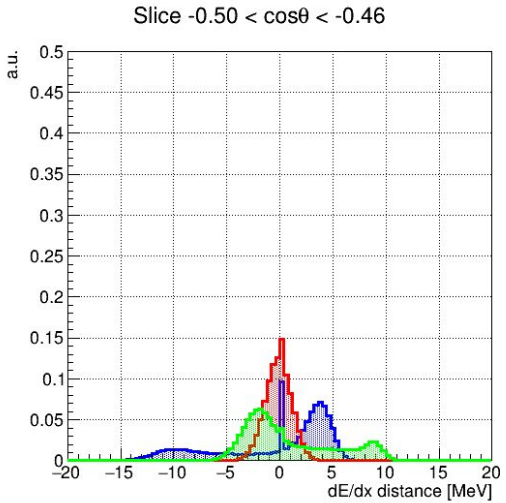
Using PFO_cheat | p > 5 GeV

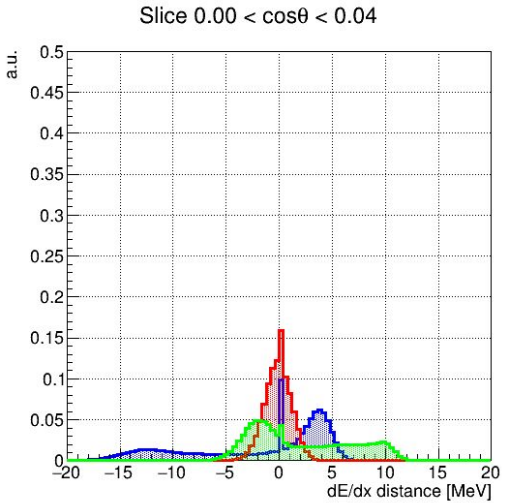




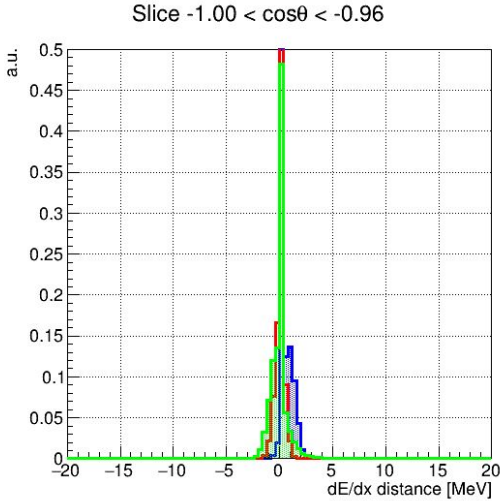
Efficiency & Purity

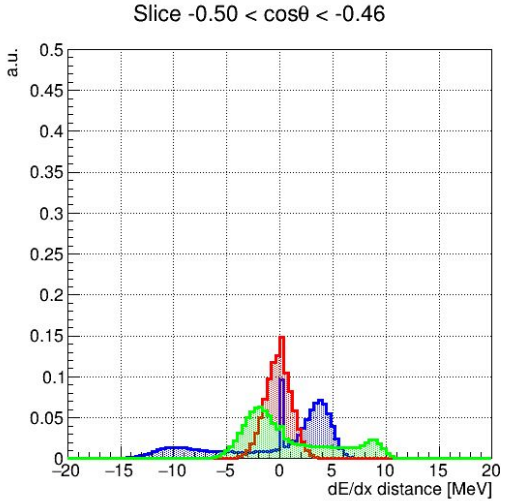


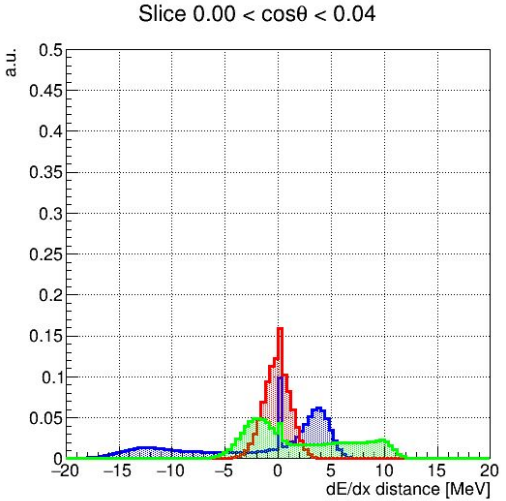




Efficiency & Purity





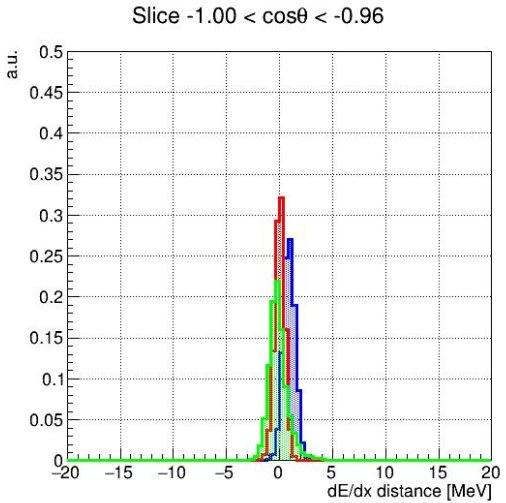


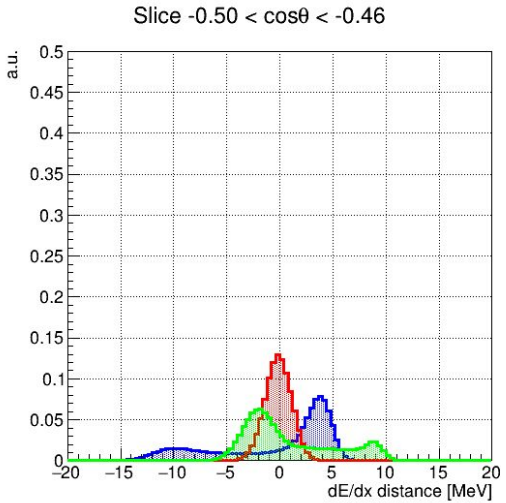
Trivial bug, but one should keep in mind “0” is the ideal case for the dE/dx dist particle ID.
The intrinsic problem probably happens in the MarlinReco/LikelihoodPID

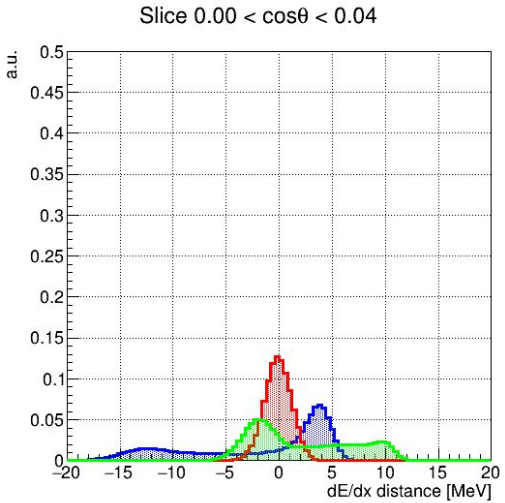
```
_pfo_piddedx_e_dedxdist[ipfo]=0;
_pfo_piddedx_mu_dedxdist[ipfo]=0;
_pfo_piddedx_pi_dedxdist[ipfo]=0;
_pfo_piddedx_k_dedxdist[ipfo]=0;
_pfo_piddedx_p_dedxdist[ipfo]=0;
```

Efficiency & Purity

Remove PFOs with dEdx_dist == 0

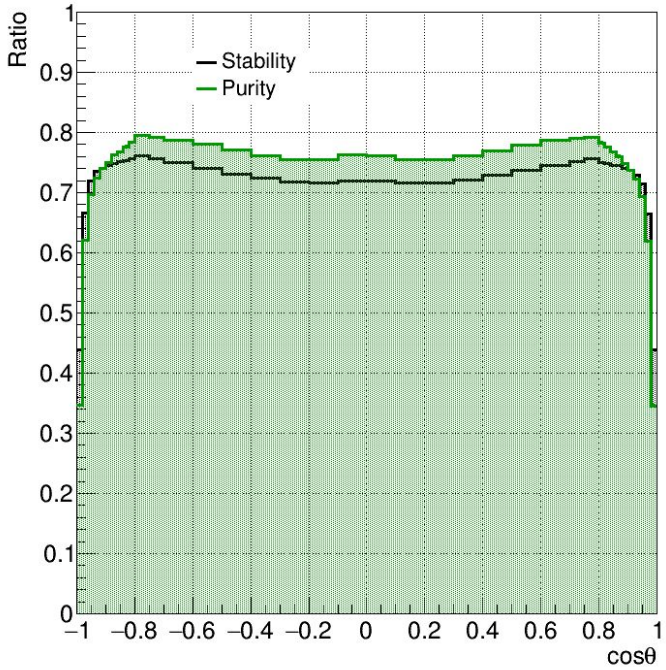


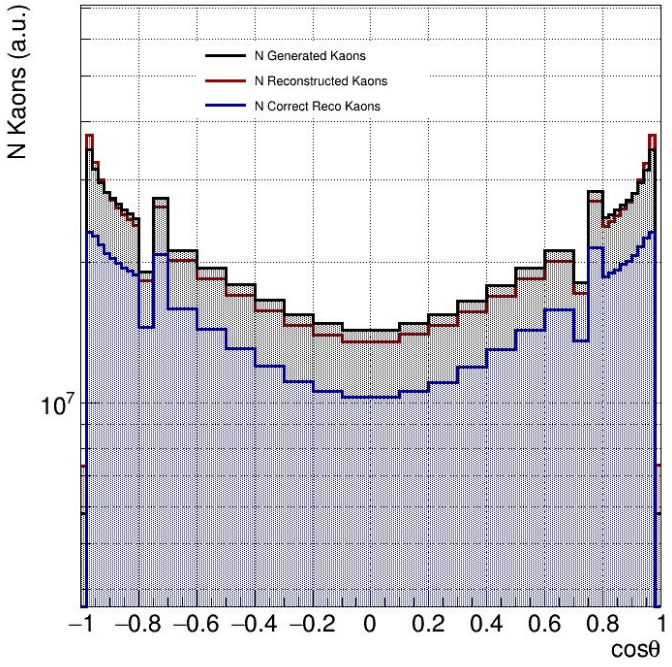




Stability and Purity

Using PFO_cheat | p > 5 GeV





The pq-method

Previously on ssbar analysis...

Fit function:

$$S(1+\cos^2\theta)+A\cos\theta$$

Gen:

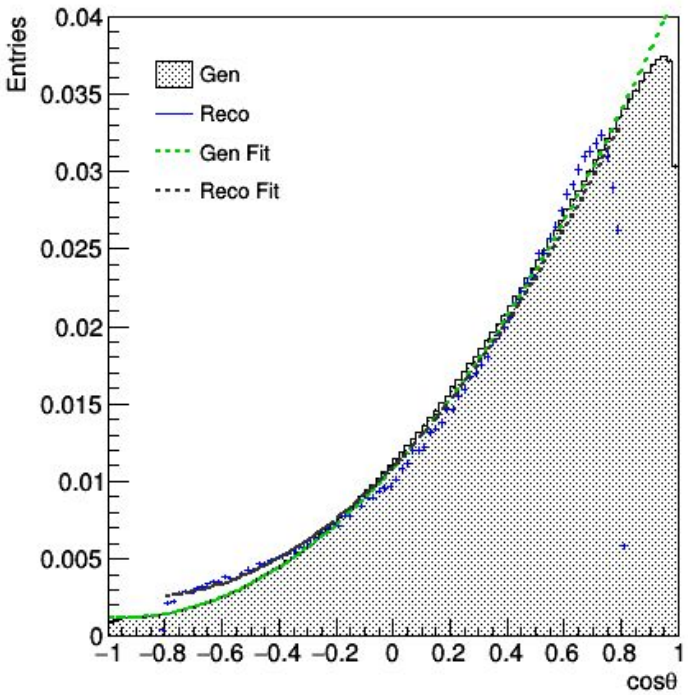
S = 1.07E-2 ± 1.7E-6

A = 2.01E-2 ± 3.7E-6

Reco:

S = 1.08E-2 ± 1.9E-5

A = 1.90E-2 ± 4.7E-5



Normalization range (-0.76,0.76)

pq method

pq calculation

- Solve :

$$N_{acc} = p^2 N + q^2 N$$
$$N_{rej} = 2pqN$$
$$1 = p + q$$

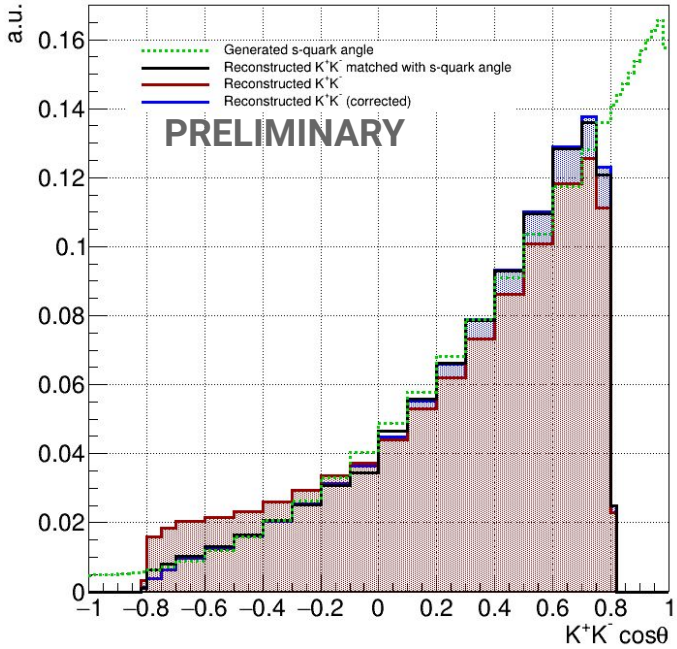
- Solution :

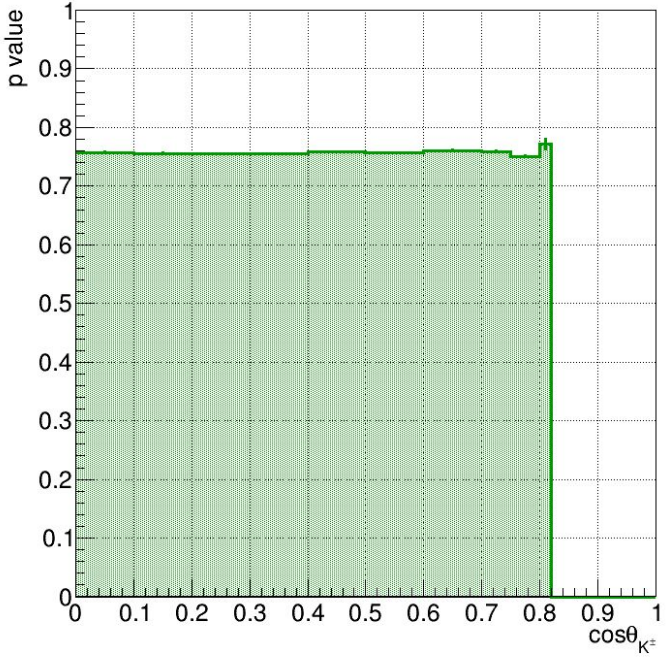
$$p = \frac{N \pm \sqrt{N(N - 2N_{rej})}}{2}$$
$$q = \frac{N \mp \sqrt{N(N - 2N_{rej})}}{2}$$

- Weight
  - Scale each bin in AFB plot so that we will obtain N_acc with eq on the right.
  - Take average of p values over 4 different points with polar angle value ± stat errors

pq method (4.3 ab-1)

LPFO 20.0 < p < 60.0 GeV





N (KxK) = 232457

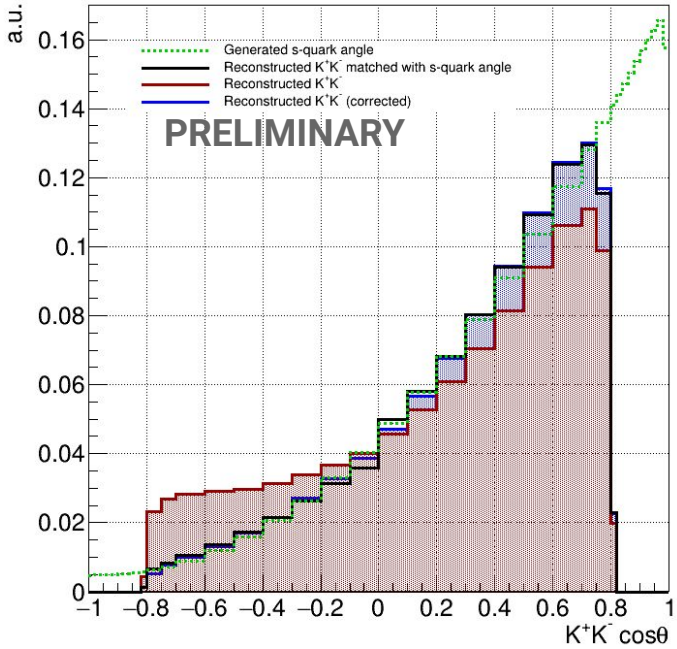
Efficiency

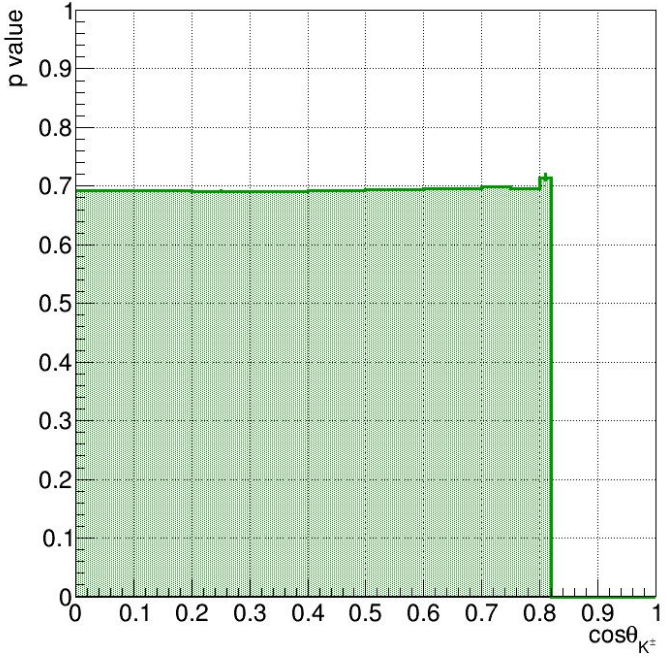
The Main Efficiency Killer

- **TPC Hits cut**
  - Restricts detector acceptance region ($0.8 < |\cos\theta|$)
- **Momentum cut**
  - Tight cut for LPFO momentum selection ($20 < p < 60$ GeV)
- dE/dx distance selection
  - The minimum K dE/dx distance is selected.

pq method (4.3 ab-1)

LPFO 10.0 < p GeV

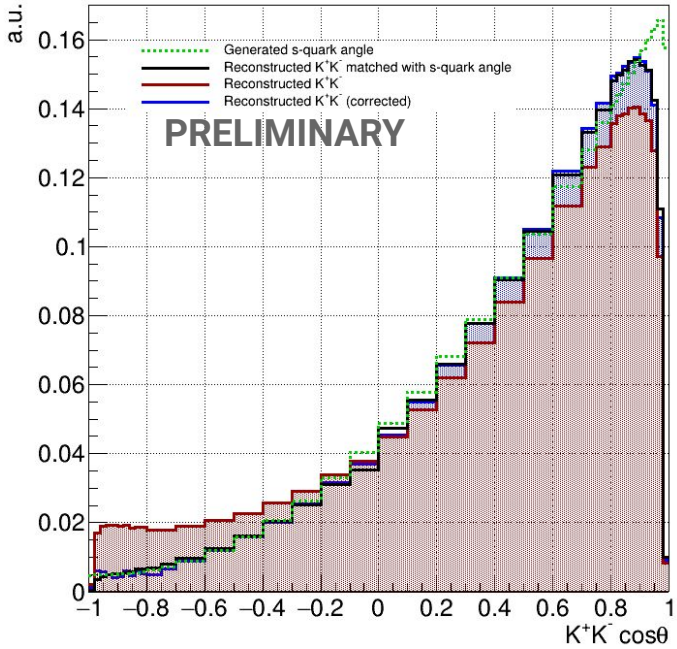


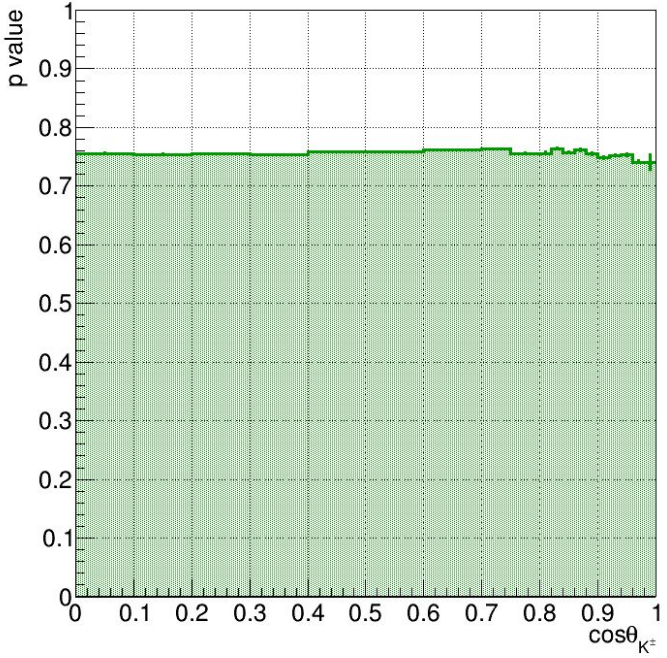


N (KxK) = 833627

pq method (4.3 ab-1)

LPFO 20.0 < p < 60.0 GeV | 0 < TPC Hits

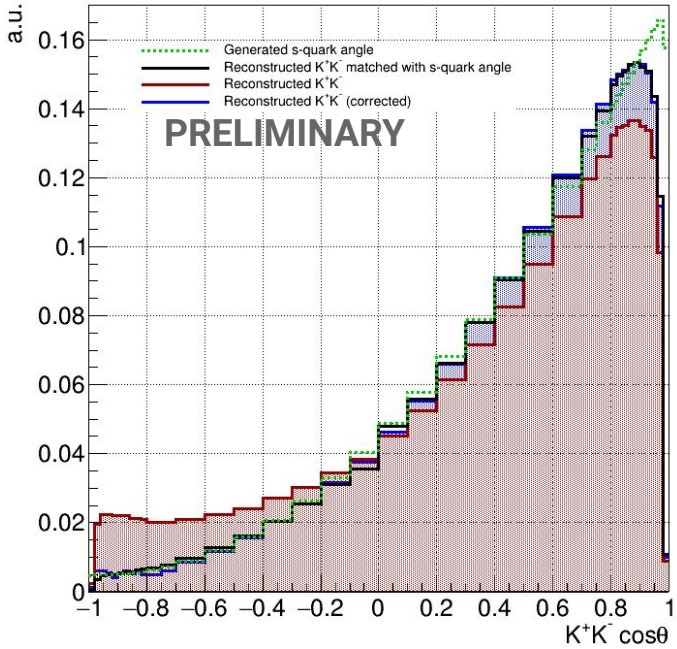


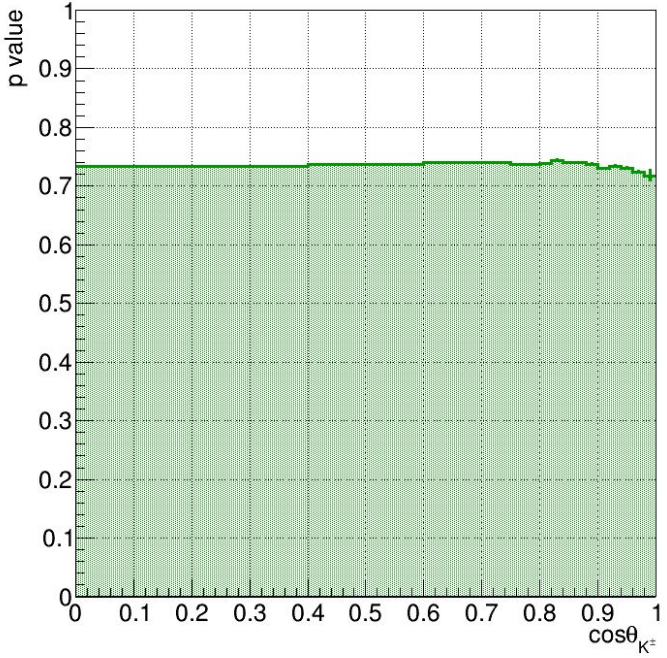


N (KxK) = 489246

pq method (4.3 ab-1)

LPFO 15.0 < p GeV | 0 < TPC Hits

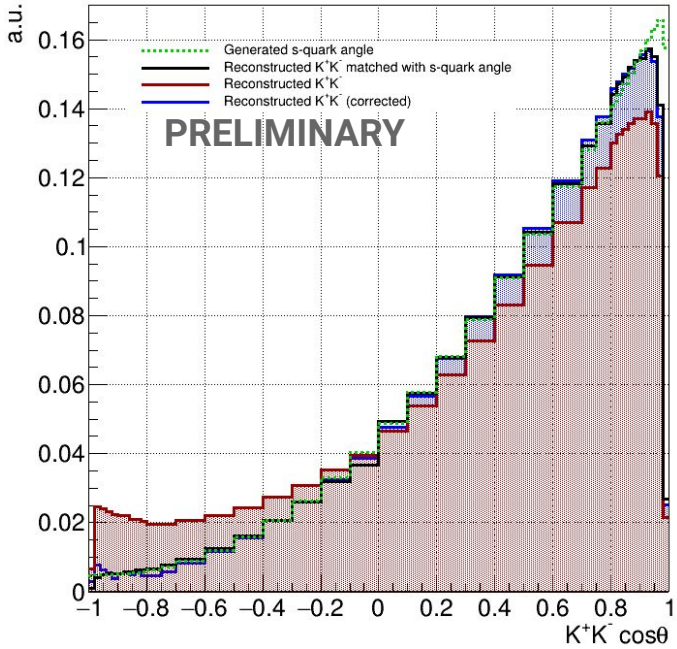


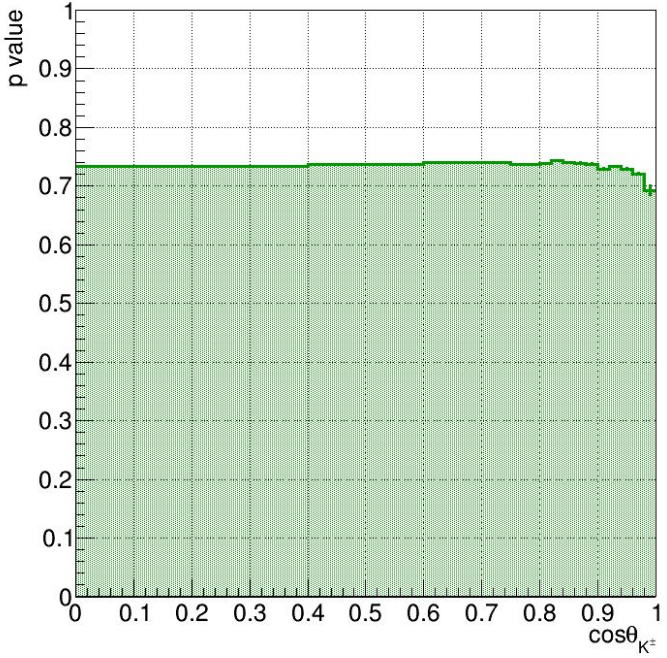


N (KxK) = -

pq method (4.3 ab-1)

LPFO 15.0 < p GeV | 0 < TPC Hits (Efficiency correction)



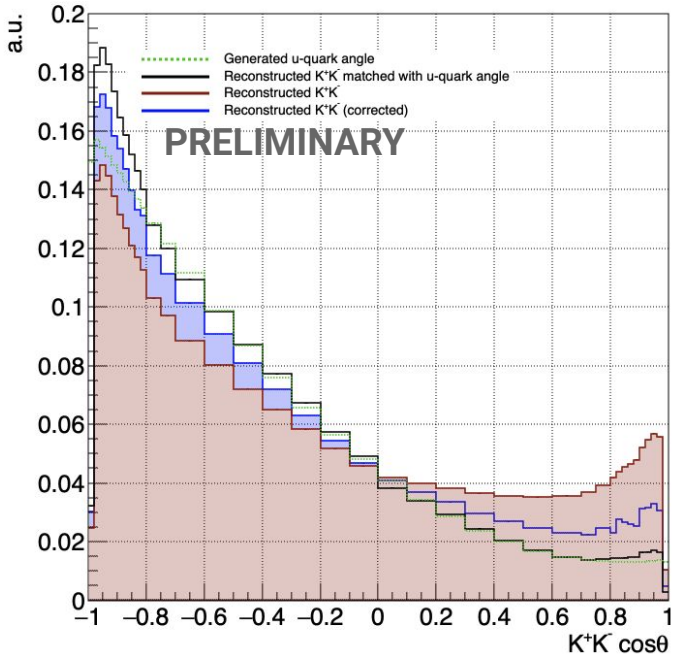


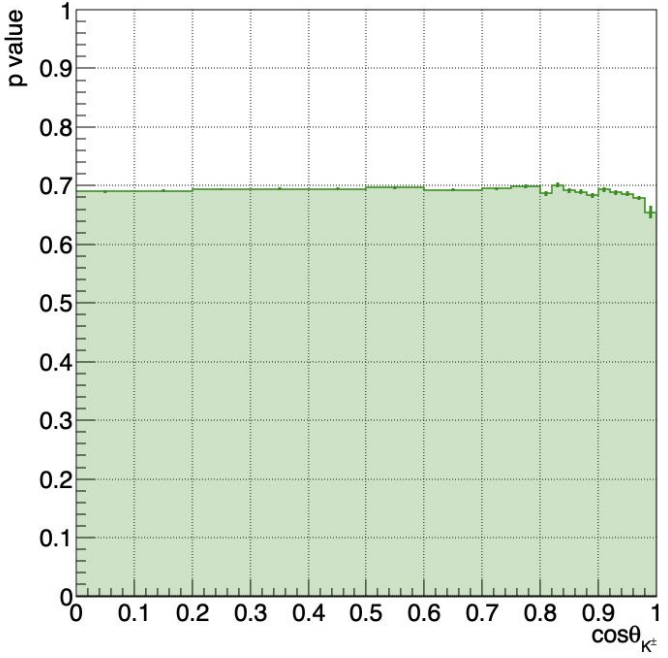
N (KxK) = -

The uubar result

pq method (4.3 ab-1)

LPFO 15.0 < p GeV | 0 < TPC Hits (Efficiency correction)





N (KxK) = -

Summary & Prospects

Summary

- **Efficiency & Purity**
  - Defined and calculated
  - Operating efficiency, average 0.75 at the barrel region
  - Application of efficiency correction to compensate the forward region.
- **The pq-method**
  - Corrects tagging without the use of mc information.
  - It can work while loosening the cuts.
  - Operating p-value ~ 0.7
  - Opened the possibility of gaining statistics
- **The uubar result**
  - First preliminary results have shown.

Prospects

- Mix other light/heavy flavor quark pair production events.
  - ss + uu/dd/cc/bb
- The ccbar background analysis
  - On going with help of new intern student (Yevhenii)
- Optimization of momentum cut