Kaon ID using dEdx in $e^-e^+ \to q\bar{q}$ events at ILC@500GeV

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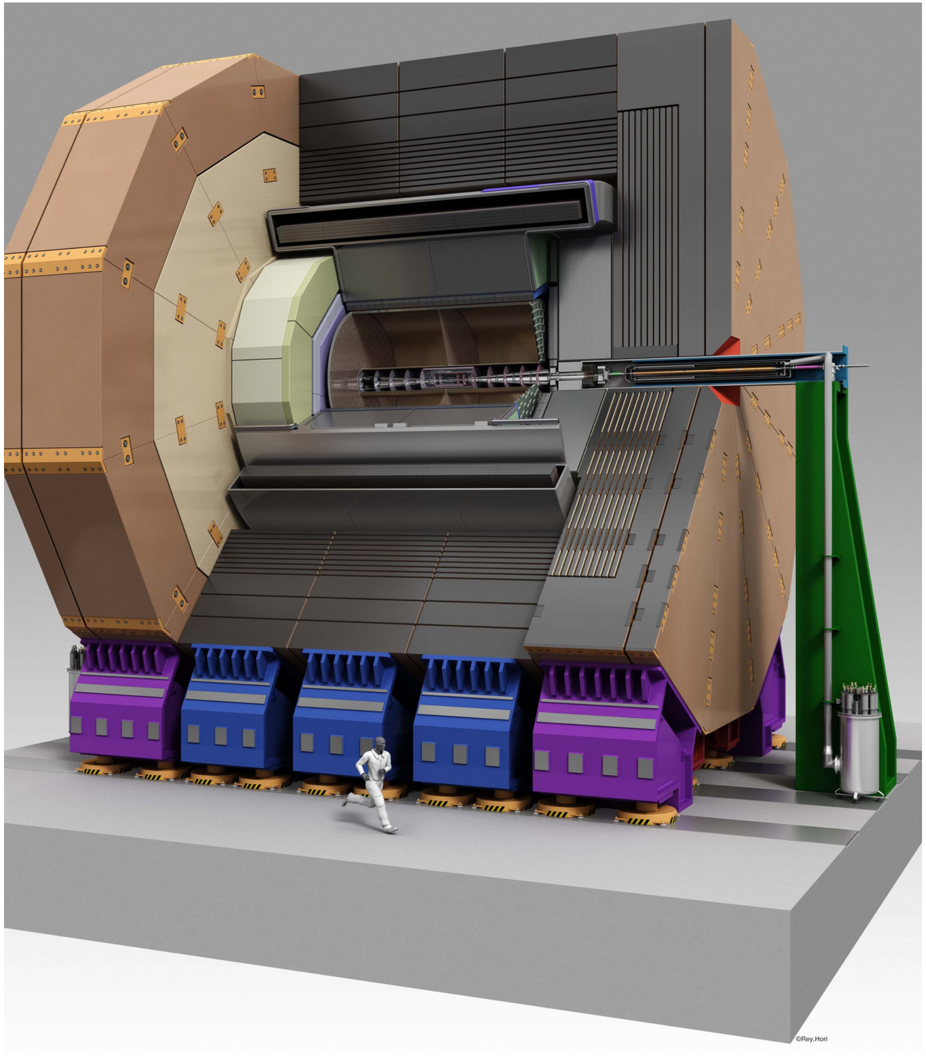
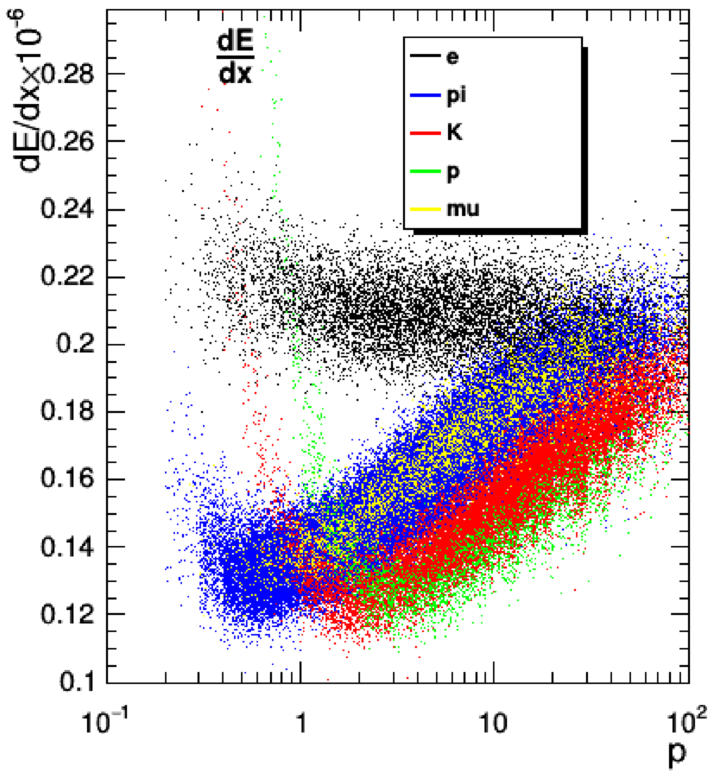
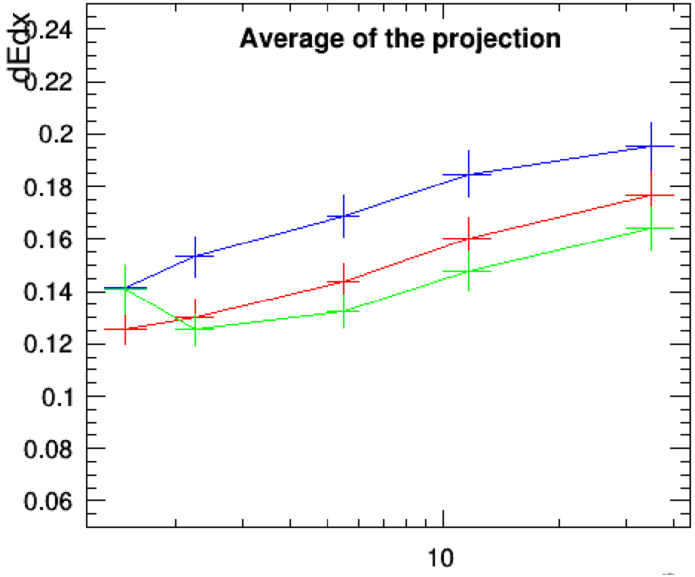
ILD Benchmarking Days 2019



Hadron separation using dEdx (I5)

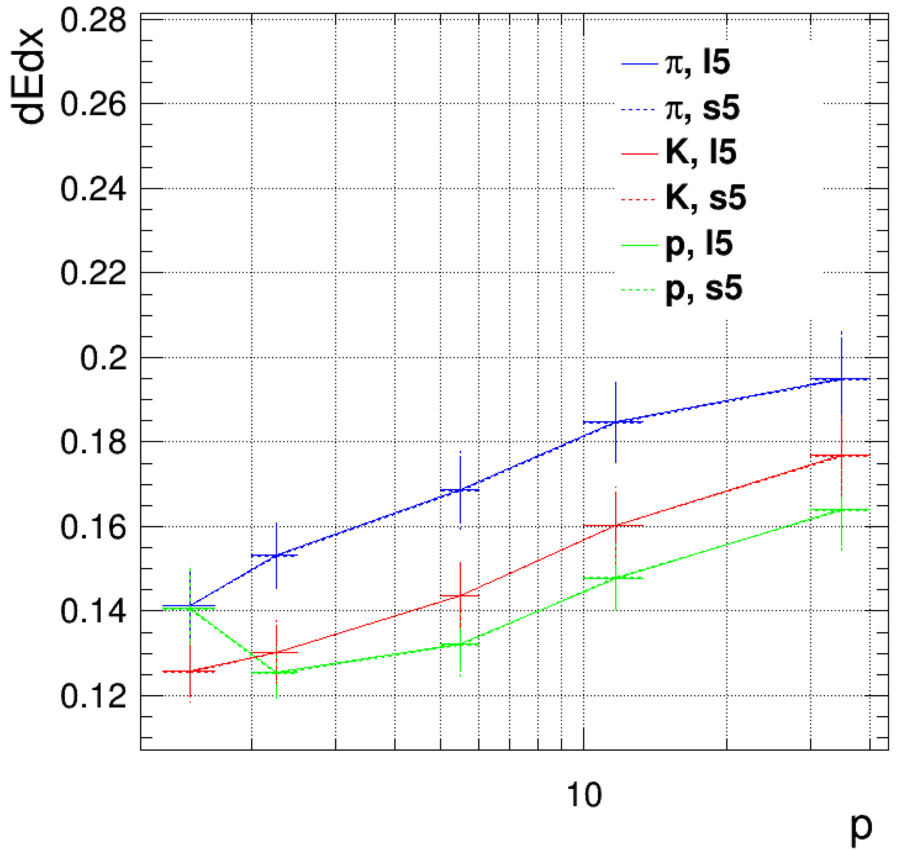
- Plot dEdx for all particles from secondary vertexes produced in ee→ bb (500GeV)

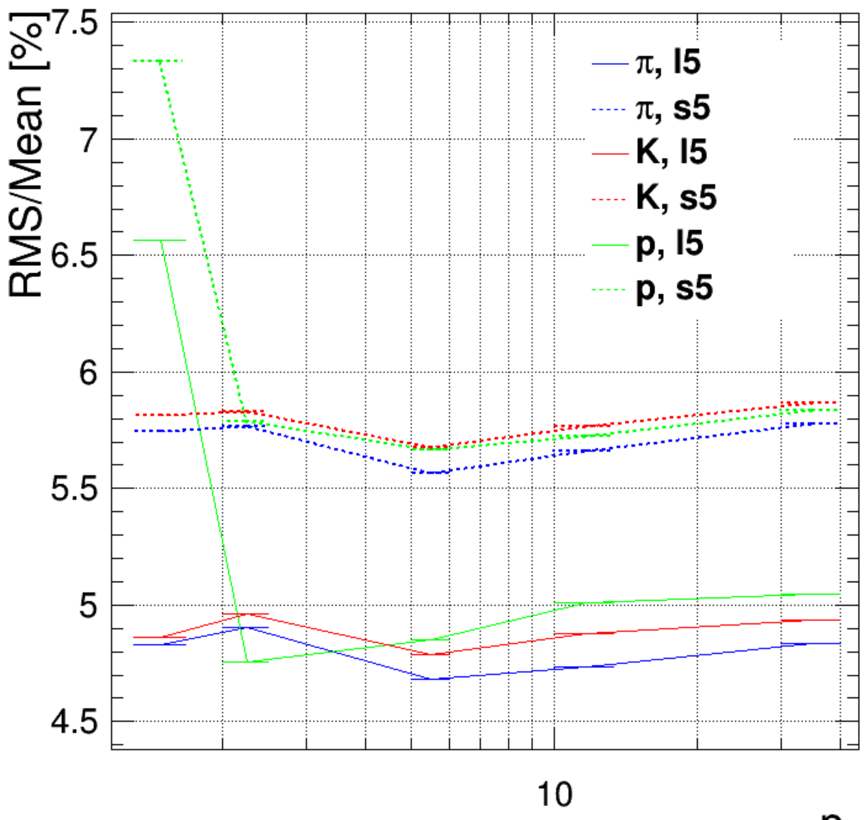




- Projection plot for few “momentum slices”.
- The error bars correspond to the RMS of the projected histogram

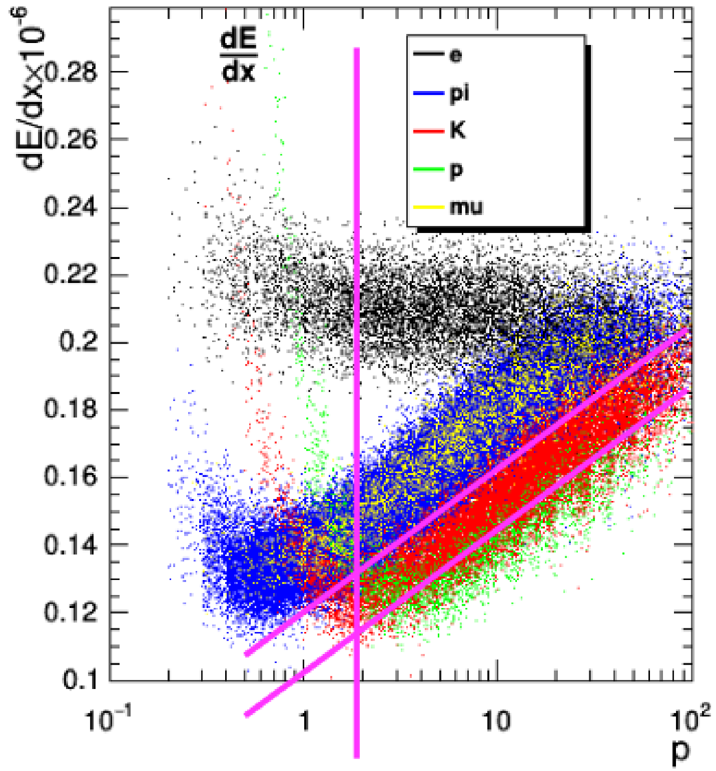
Hadron separation: model comparison





Proposal of Benchmarking plot

KaonTagger (bb@500GeV)



- For relatively large momentum tracks (~2 GeV), we select the area of larger concentration of kaons:
  - For an input value of minimum efficiency of selection, we play with the slope and offsets of the two diagonals to optimize the purity of selection.
  - Purity calculated for the full sample. May the purities improve a bit when using "nicely reconstructed" b-jets (high b-tag) ?
- L5 model

```
CASE a (eff>0.5):     purity=0.87671 eff=0.506061;
CASE b (eff>0.7):     purity=0.852161 eff=0.70102;
```

- s5 model

```
CASE a (eff>0.5):     purity=0.814879 eff=0.504739;
CASE b (eff>0.7):     purity=0.787238 eff=0.702447;
```

- Kaon ID is better with a large TPC. Purity improved by ~7%

KaonTagger Performance

- KaonTagger parameters for tt 500GeV. Only secondary tracks with p>2 GeV

- L5 model

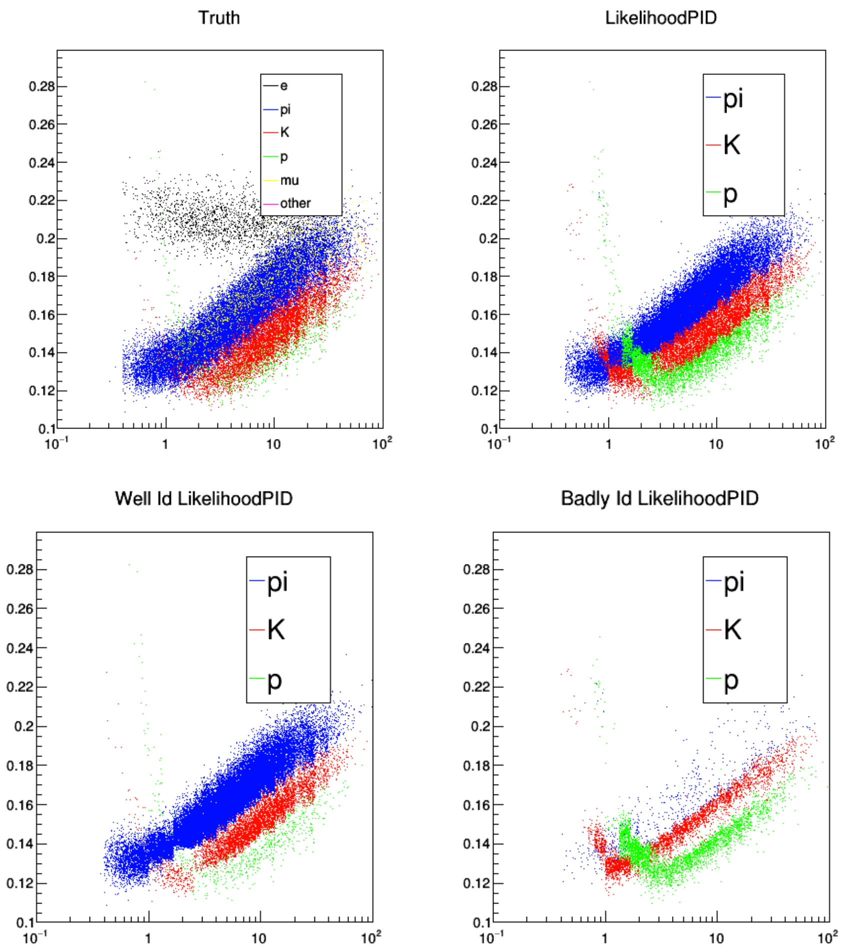
```
CASE a (eff>0.5):     purity=0.92901 eff=0.501025;    slope=0.0183399 upper=0.108564 lower=0.0986112
CASE b (eff>0.7):     purity=0.905287 eff=0.704606;    slope=0.0183399 upper=0.11086 lower=0.0959317
```

- s5 model

```
CASE a (eff>0.5):     purity=0.870715 eff=0.50362;    slope=0.0186674 upper=0.106411 lower=0.0940049
CASE b (eff>0.7):     purity=0.841827 eff=0.701225;    slope=0.0186674 upper=0.108123 lower=0.0884433
```

- Kaon ID is better with a large TPC. Purity improved by ~8%

Performance of the LikelihoodPID with new parametrization



- New Parametrization by Uli.
- Still lot of contamination from pions identified as kaons, due to the width of the pion distribution.
- It should be improvable by playing with variables like dEdx_distance (distance to the expected dEdx value from the parametrization)
  - Similar concept to what we have done in the KaonTagger.

Conclusions and summary

- Still it is possible a bit of polishing of the results but in general, we do not expect any conceptual difference coming from new analysis.
- A larger detector seems clearly better for the hadron ID with the TPC.

Back-up slides

KaonTagger Performance

- KaonTagger parameters for bb 500GeV. All secondary tracks with p>2.0 GeV
  - Git repository, analysis folder, macro: CalculateParameters.C
  - Optimize parameters to enhance the purity with a minimum efficiency requirement.
- L5 model

```
CASE a (eff>0.5):     purity=0.87671 eff=0.506061;     slope=0.0179864 upper=0.109328 lower=0.0984784
CASE b (eff>0.7):     purity=0.852161 eff=0.70102;     slope=0.0179864 upper=0.112041 lower=0.0969284
```

- s5 model

```
CASE a (eff>0.5):     purity=0.814879 eff=0.504739;     slope=0.0179396 upper=0.10853 lower=0.0961404
CASE b (eff>0.7):     purity=0.787238 eff=0.702447;     slope=0.0179396 upper=0.110365 lower=0.0906341
```

- Kaon ID is better with a large TPC. Purity improved by ~7%