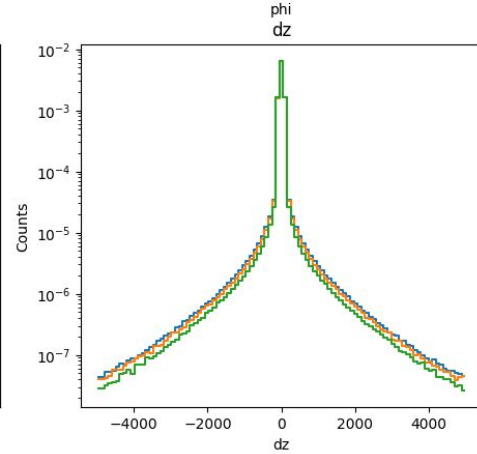
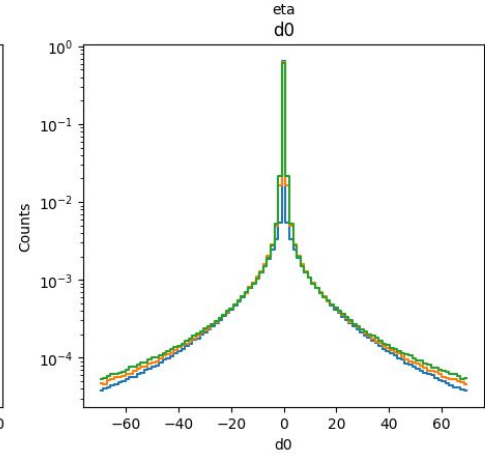
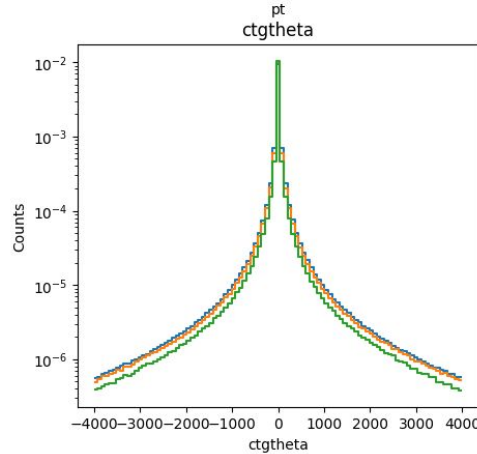
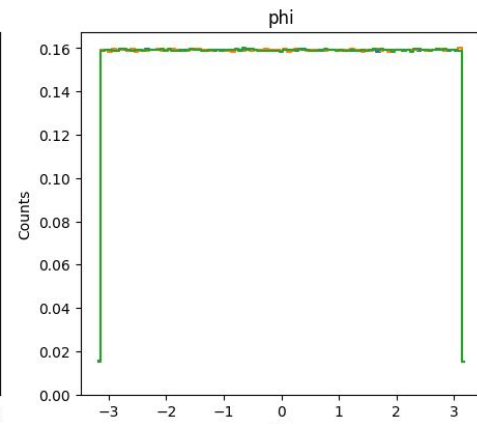
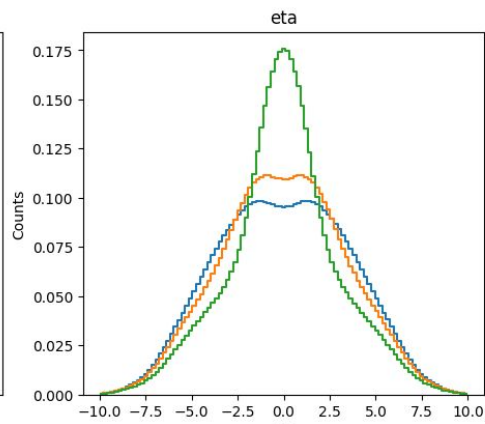
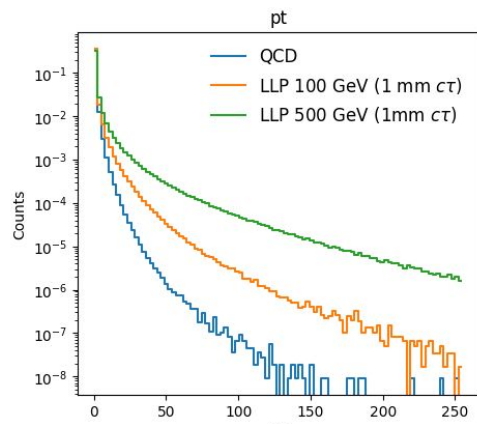


Update on (Optimal Transport) Displaced Track Classification

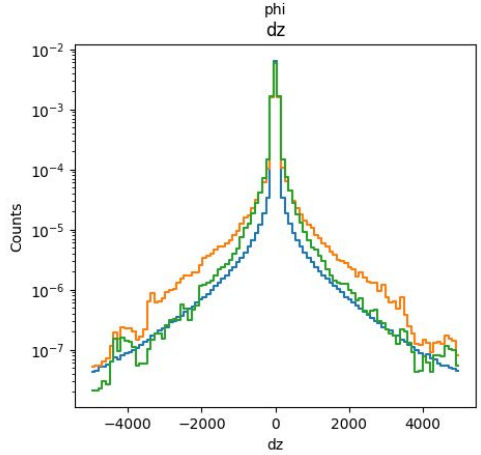
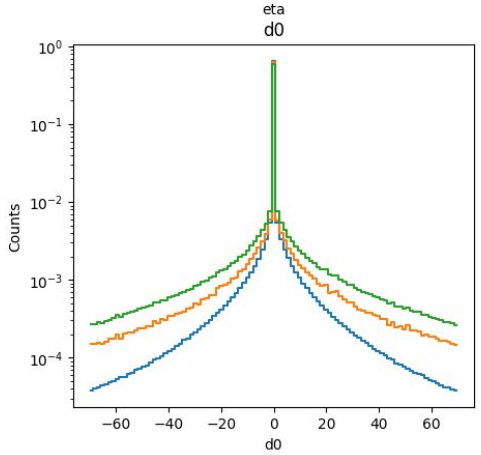
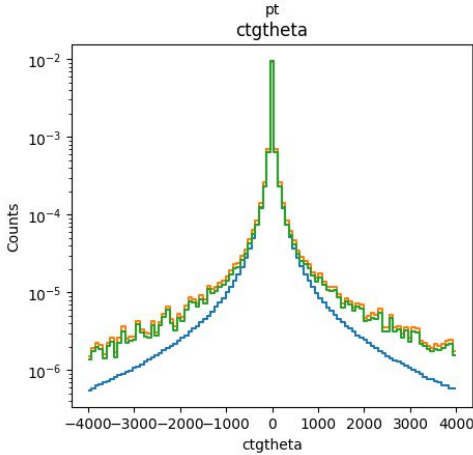
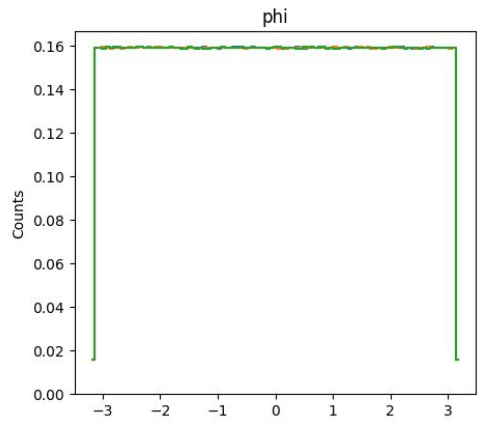
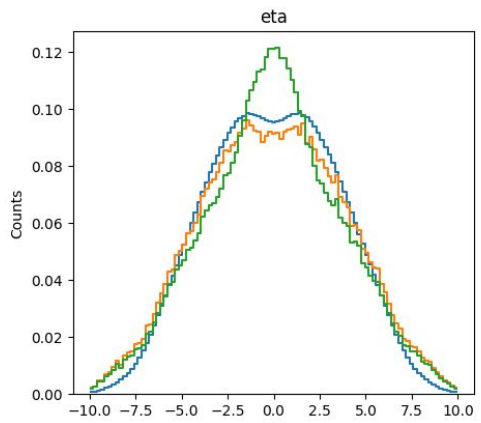
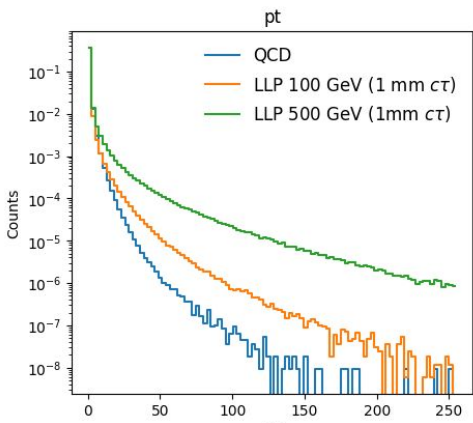
Nathan Suri
SLAC-Yale Weekly Meeting
4/30/24



Samples Overview



No Pileup



Pileup Inclusive

Phase 0: Track-by-track
BDT (XGBoost)

Parameters

n_estimators=2

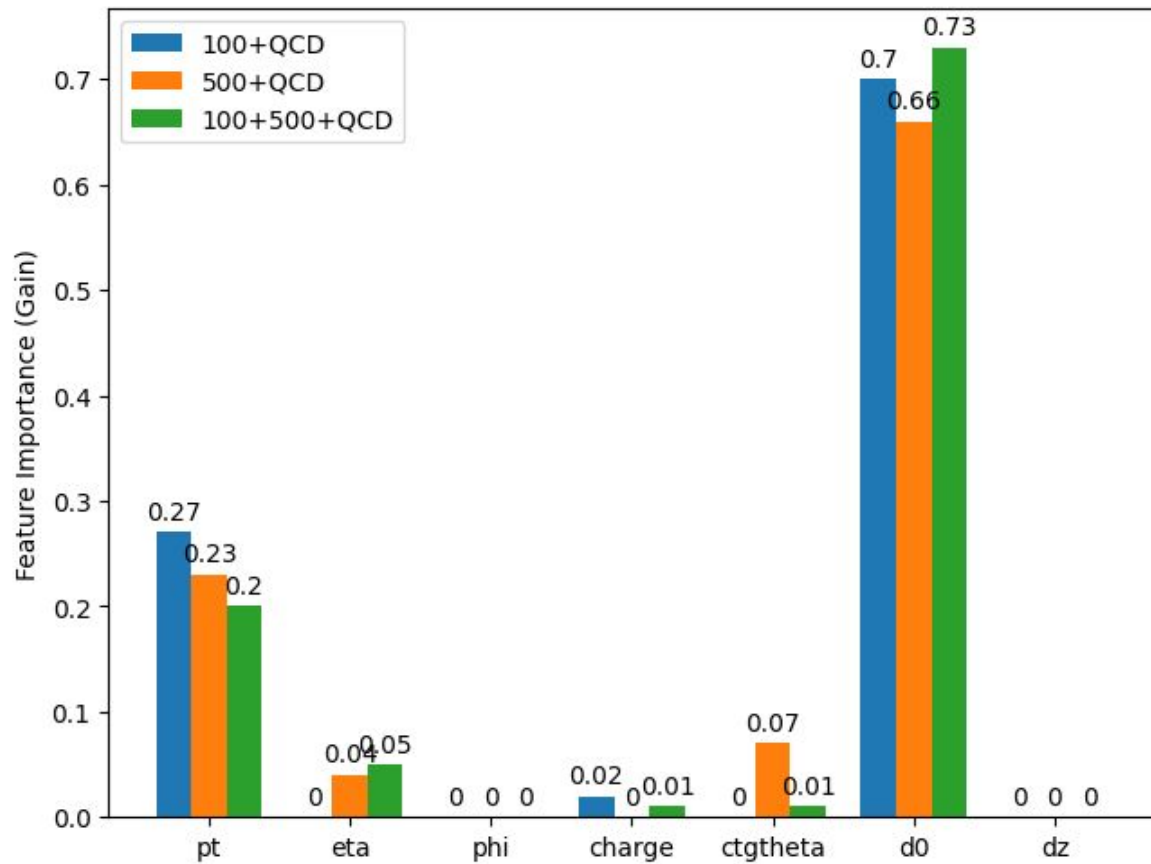
max_depth=4

learning_rate=0.5

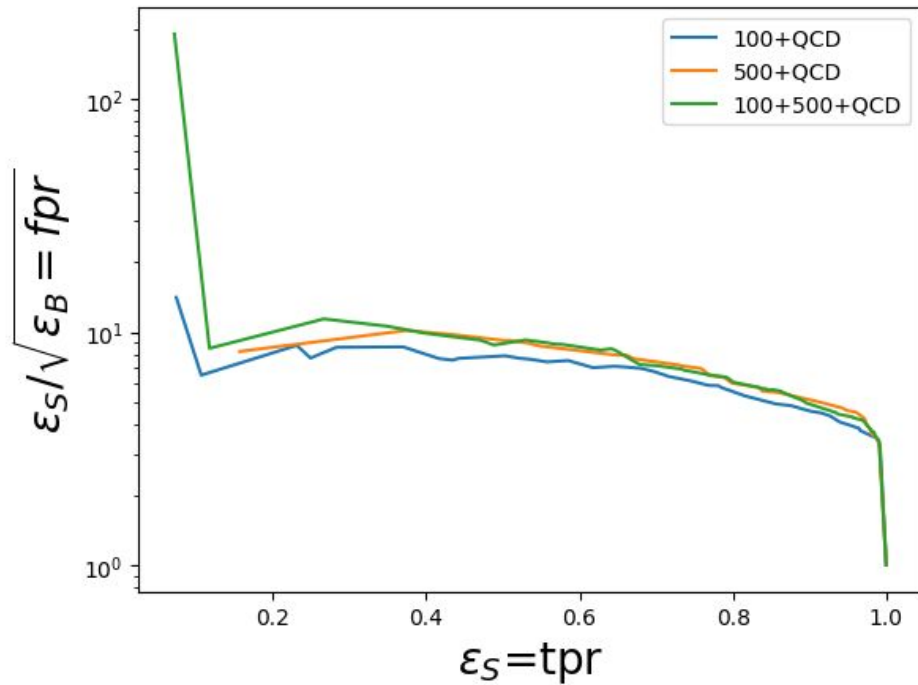
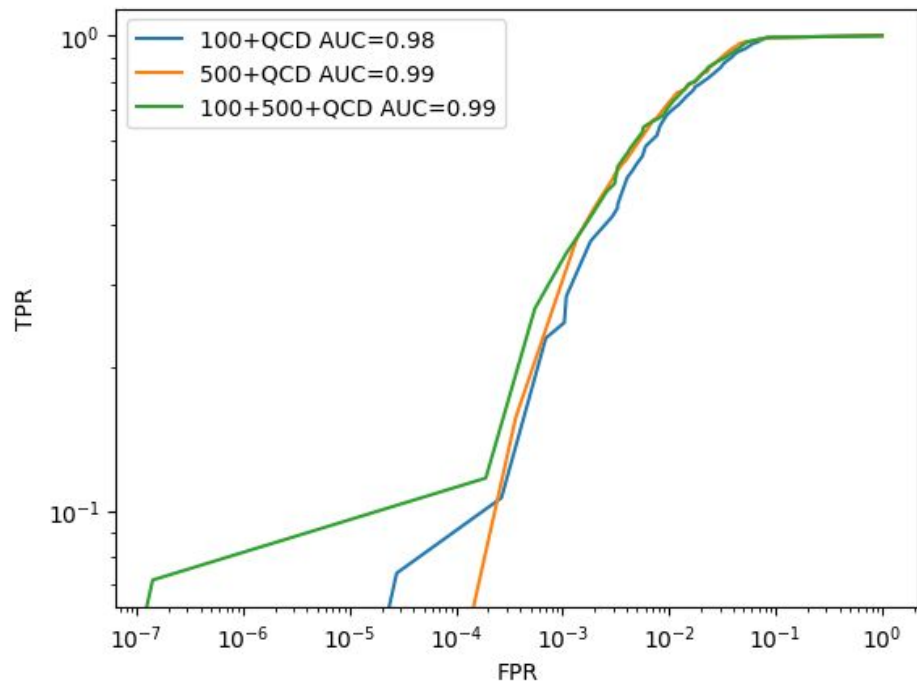
objective='binary:logistic'

- Signal data includes pileup now

```
▼ XGBClassifier
XGBClassifier(base_score=None, booster=None, callbacks=None,
               colsample_bylevel=None, colsample_bynode=None,
               colsample_bytree=None, device=None, early_stopping_rounds=None,
               enable_categorical=False, eval_metric=None, feature_types=None,
               gamma=None, grow_policy=None, importance_type=None,
               interaction_constraints=None, learning_rate=0.5, max_bin=None,
               max_cat_threshold=None, max_cat_to_onehot=None,
               max_delta_step=None, max_depth=4, max_leaves=None,
               min_child_weight=None, missing=nan, monotone_constraints=None,
               multi_strategy=None, n_estimators=2, n_jobs=None,
               num_parallel_tree=None, random_state=None, ...)
```



Feature Importance



Phase 1: Track-by-track Transformer (ABCNet)

Architecture

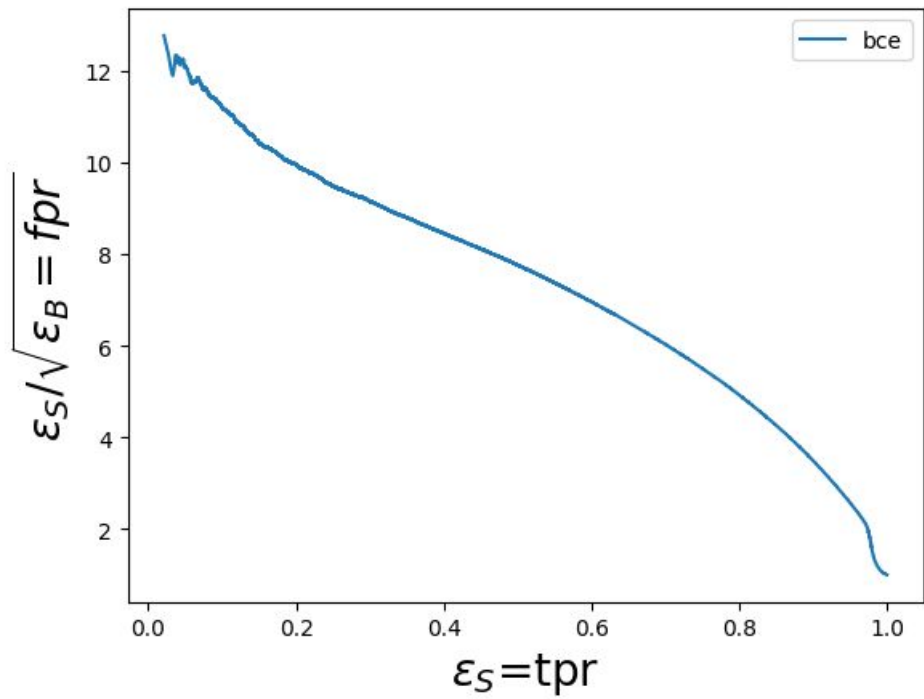
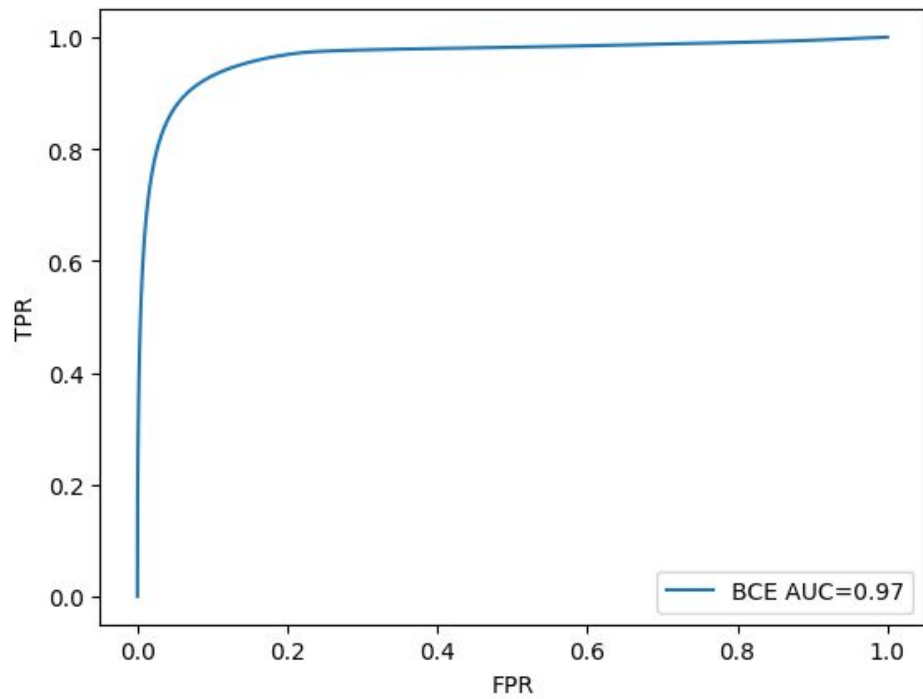
<https://github.com/ViniciusMikuni/ABCNet/tree/master>

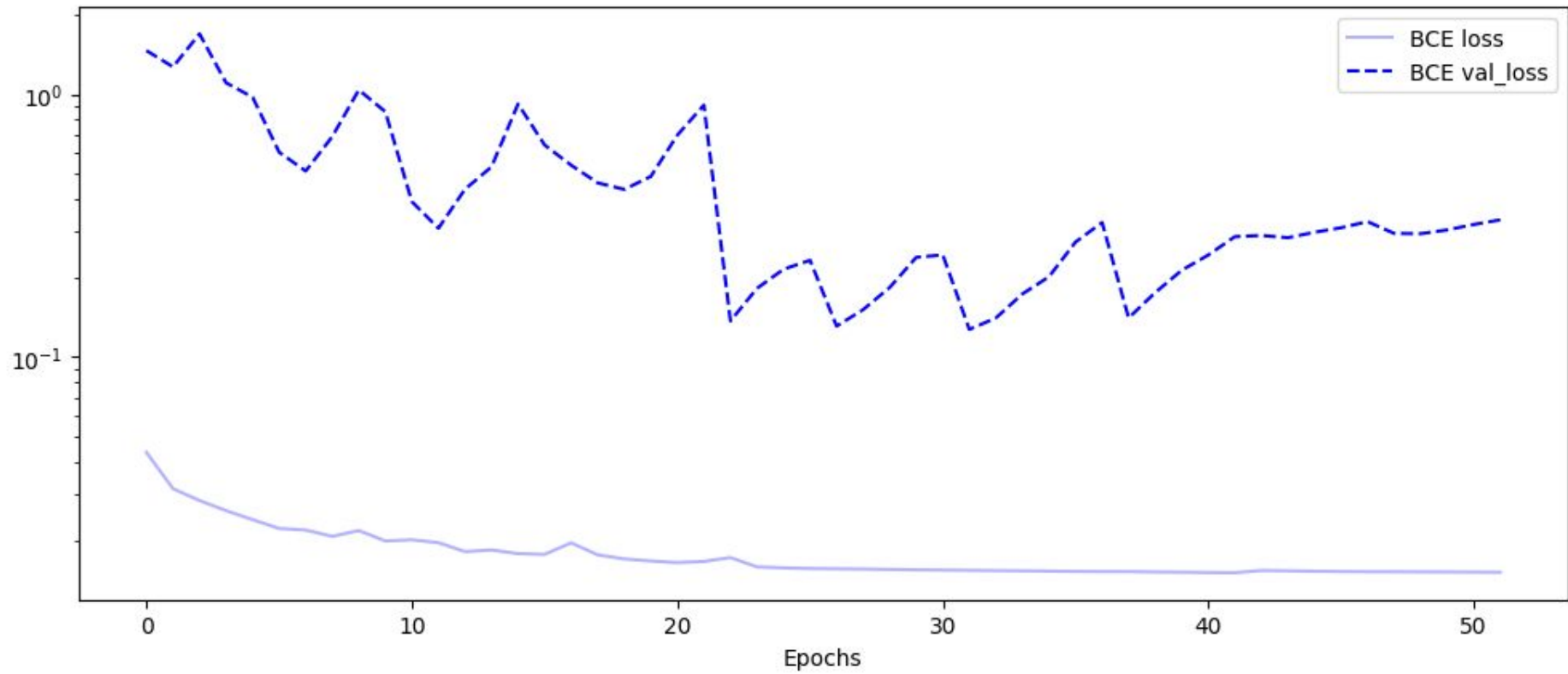
Total params: 160,117

Trainable params: 159,021

Non-trainable params: 1,096

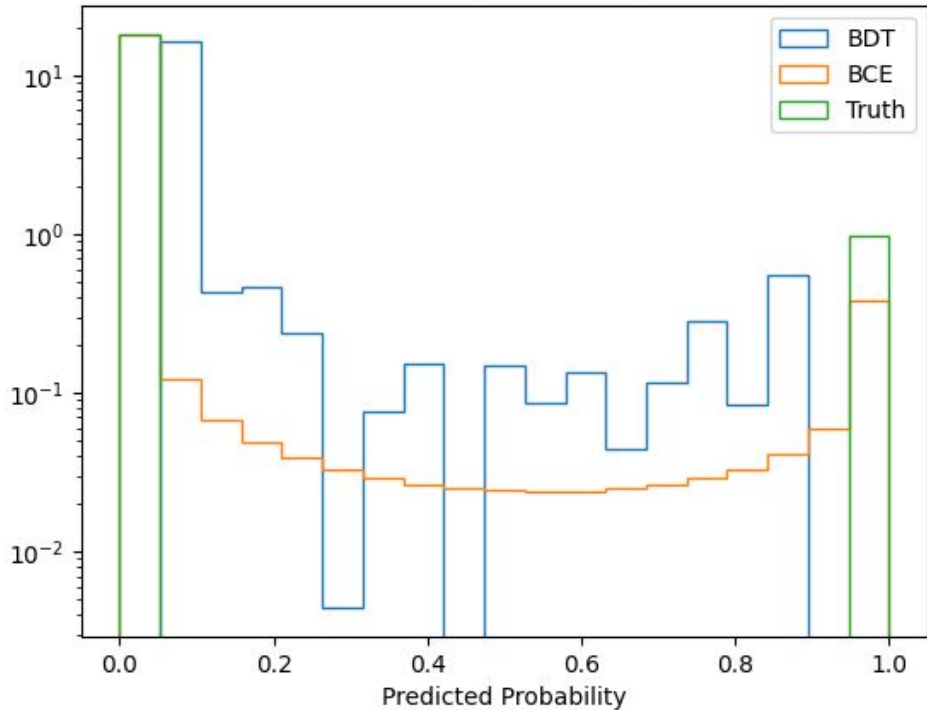
[Trained using full data without pileup]



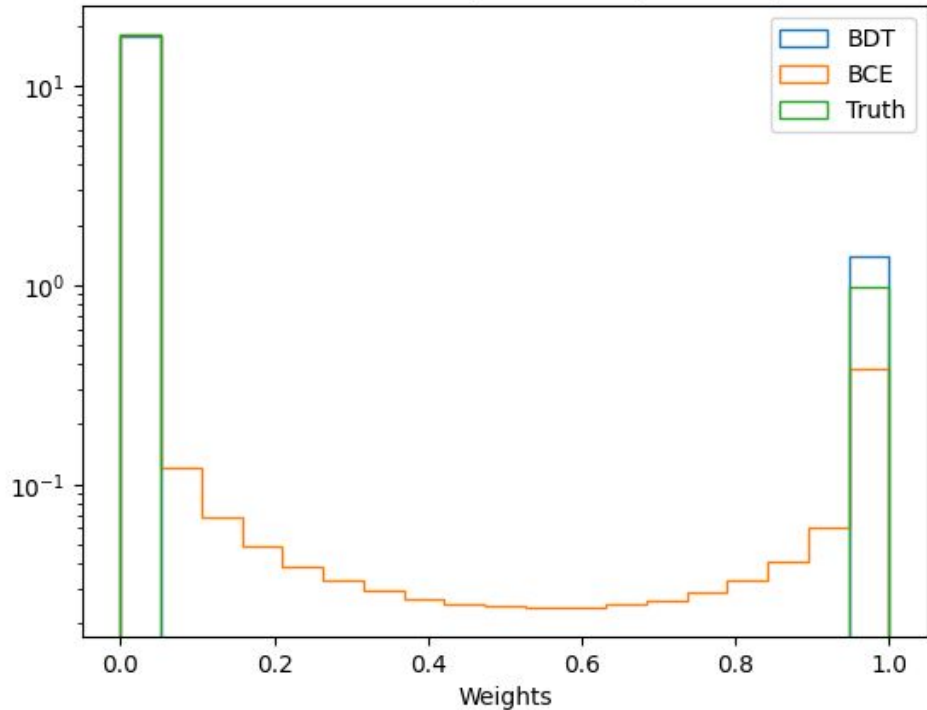


Comparisons

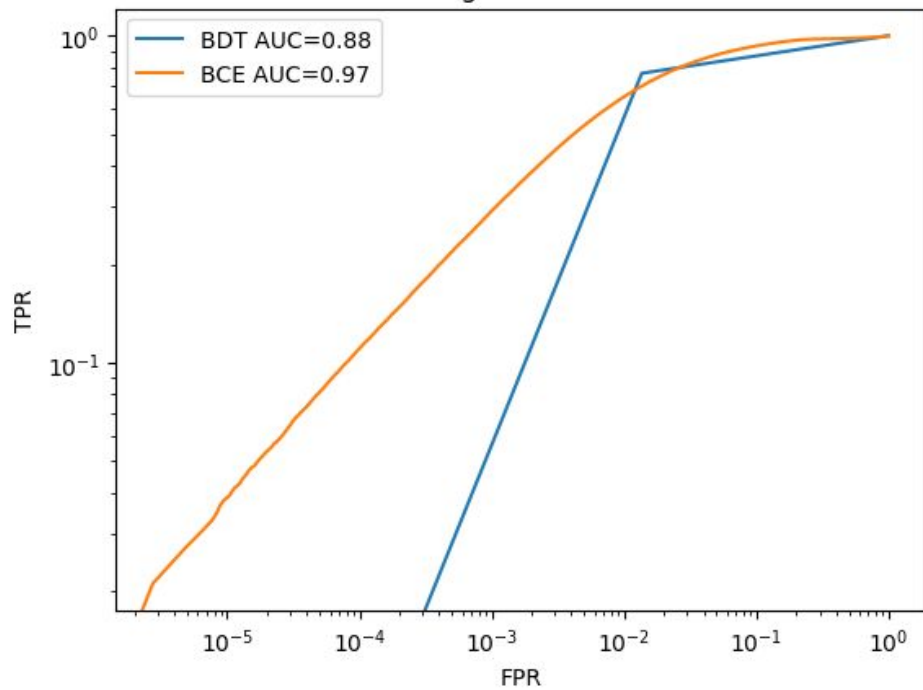
Data: 100+500+QCD with Signal Pileup



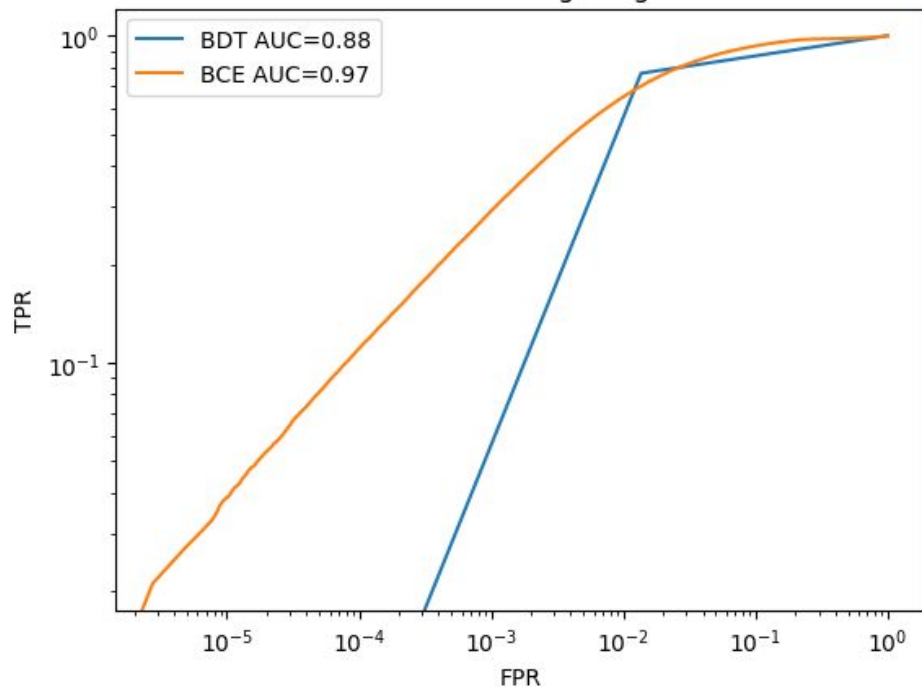
Data: 100+500+QCD with Signal Pileup



Calculated using Predicted Probabilities



Calculated using Weights



Thoughts

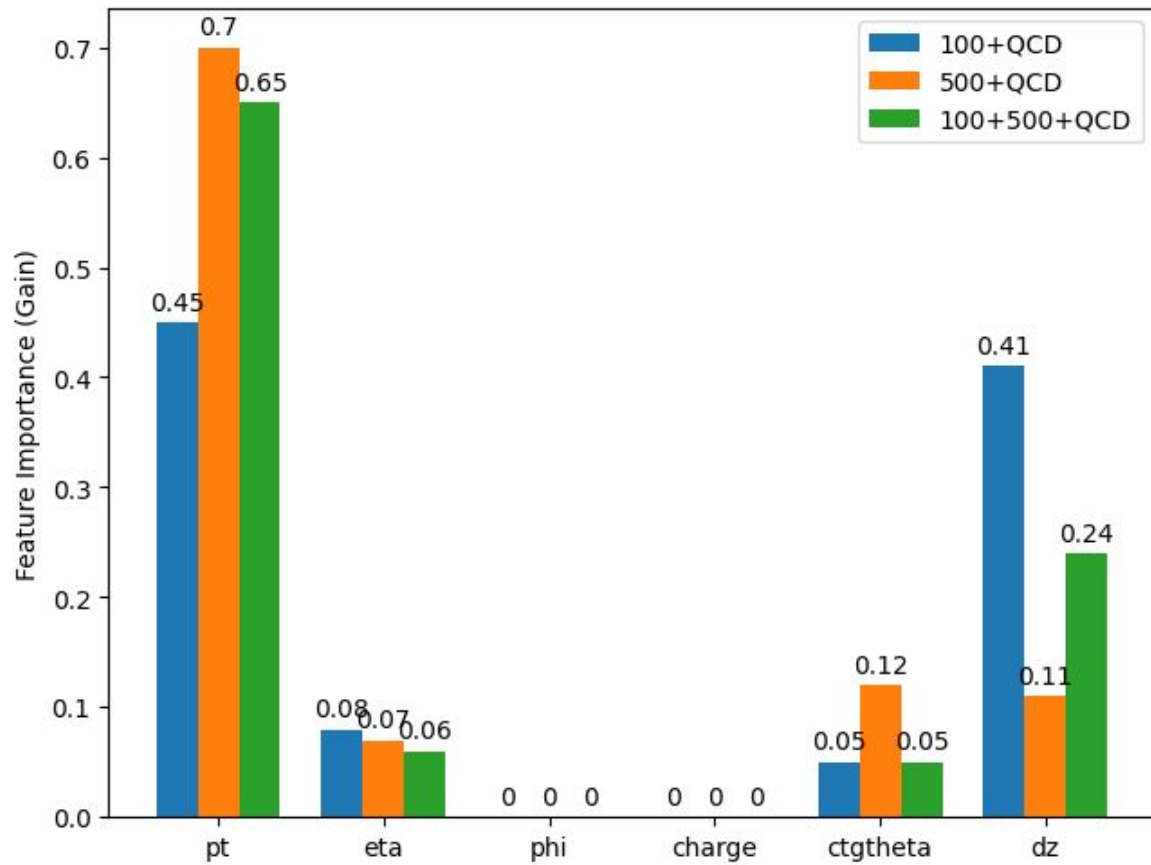
- BDT
 - Overall, task seems (more than) viable even with the inclusion of pileup in signal samples
 - Results generalize well for more signals so far
- Supervised Transformer
 - Similar results found to the BDT
 - Transformer results can be tuned via thresholds
 - Sigmoid -> Hard Sigmoid?

Tasks

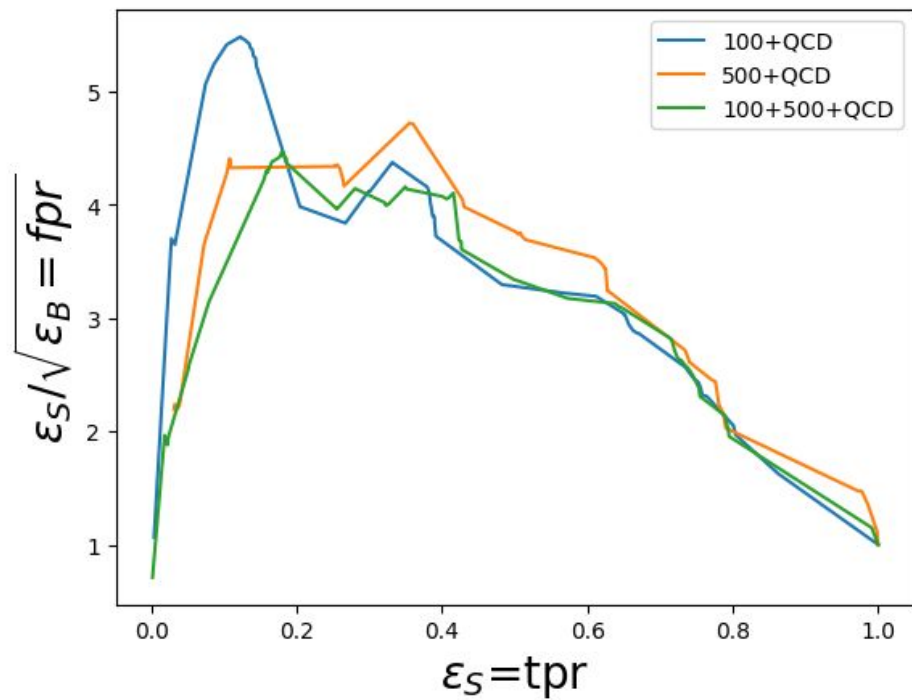
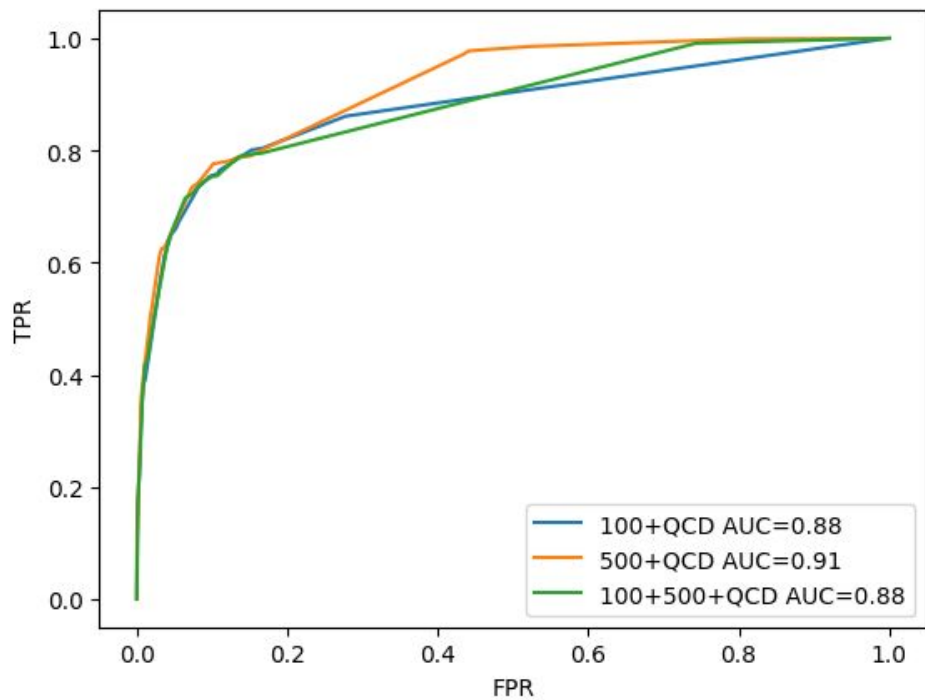
- Data
 - Generate QCD sample with pileup
 - Option 1: Use synthetic pileup via HGMM
 - Option 2: Use Delphes with high stats pileup file
 - Sam mentioned that they were passed over to the Columbia group
- Training
 - Apply data preprocessing such as $p_T > 0.5$ GeV, more rigorous normalization
 - Optimize supervised transformer
 - Review both autoencoder and OT approaches with new data formats
- Logistics
 - Draft slides for ATLAS ML workshop

Backup Slides

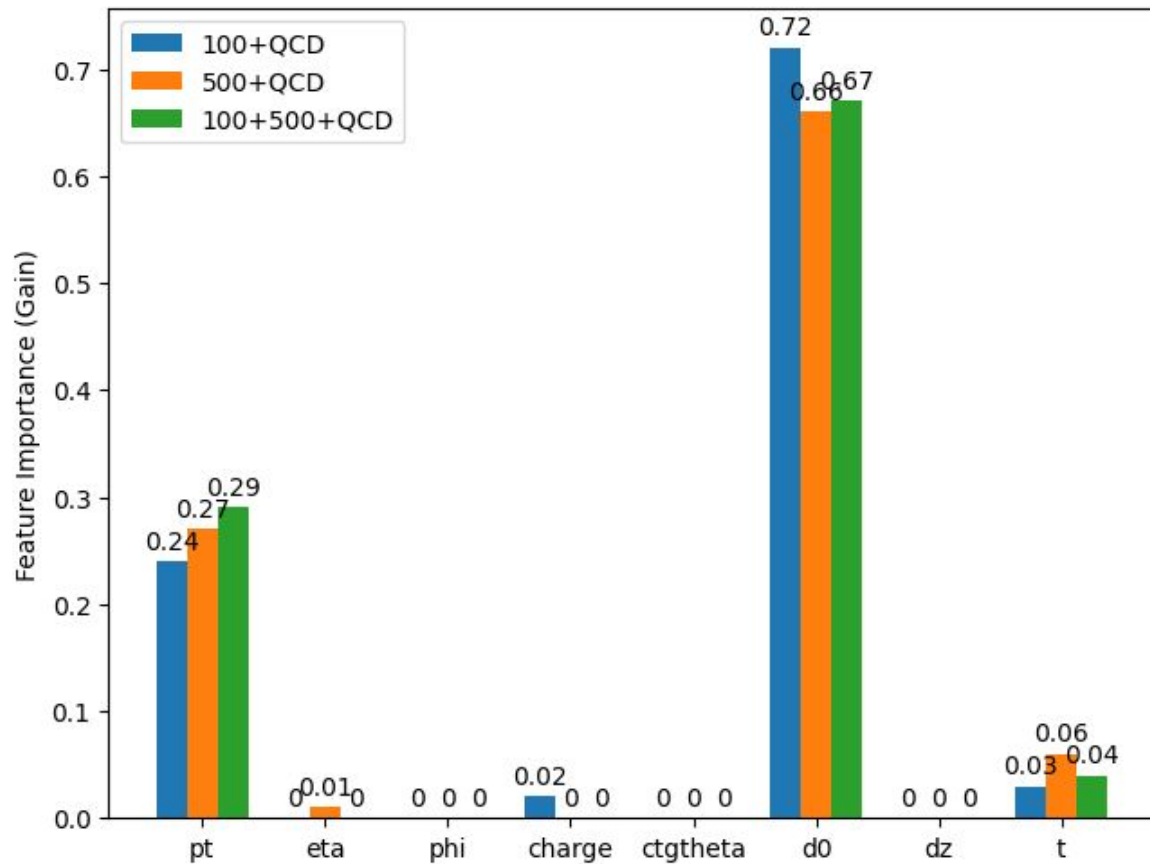
Pileup Inclusive



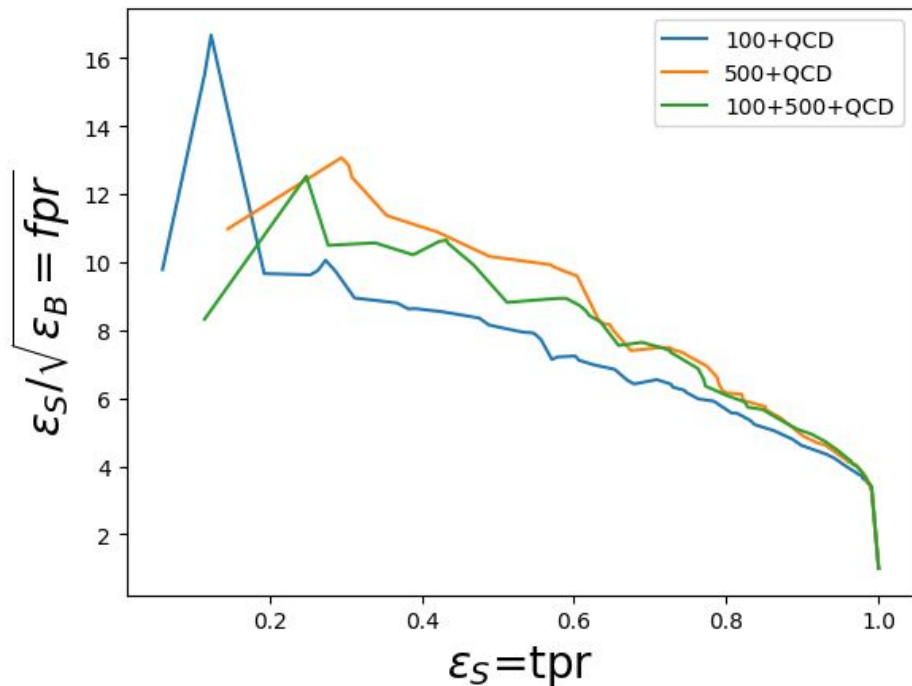
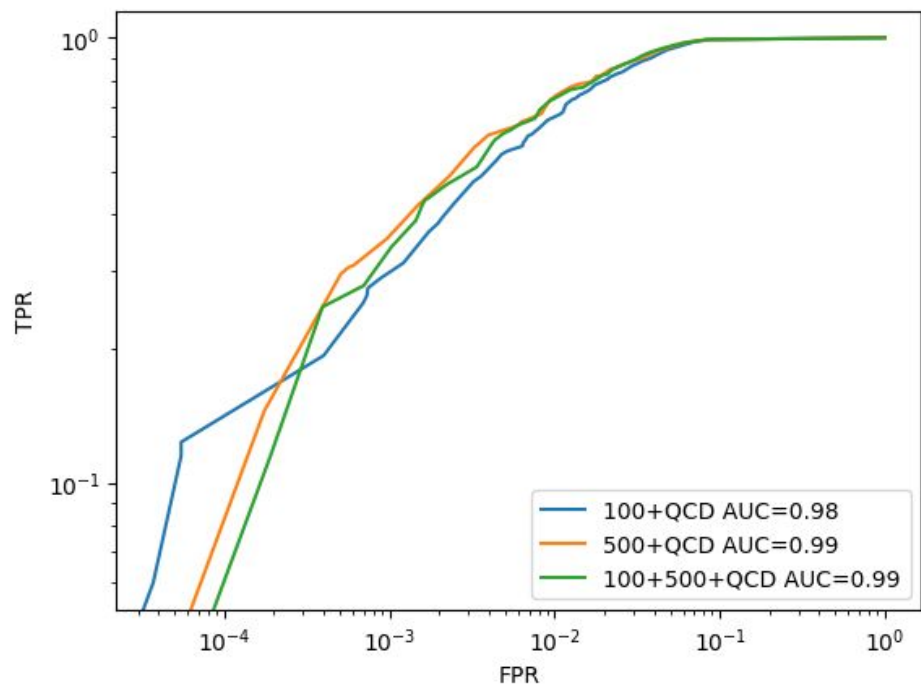
Feature Importance (without Do)



Removal of DO Feature



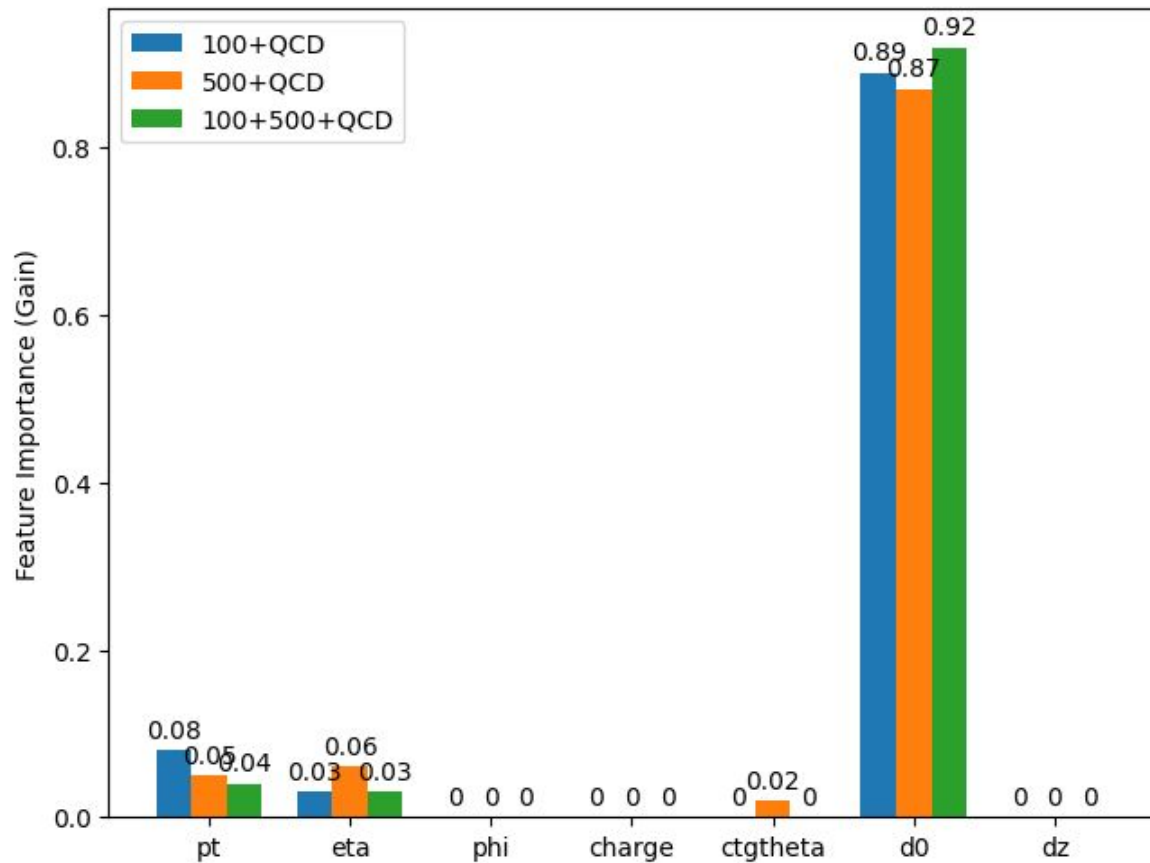
Feature Importance (with t)



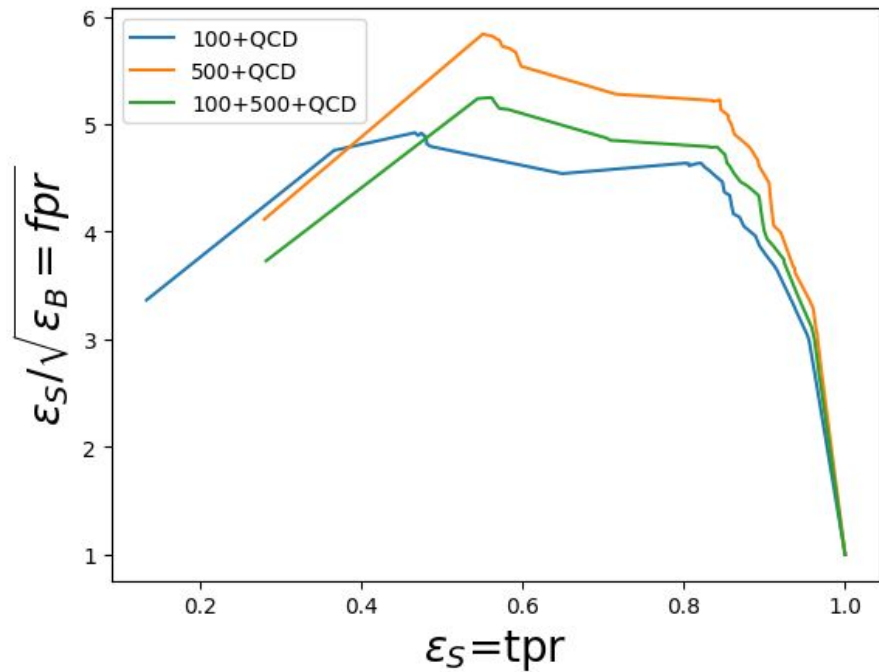
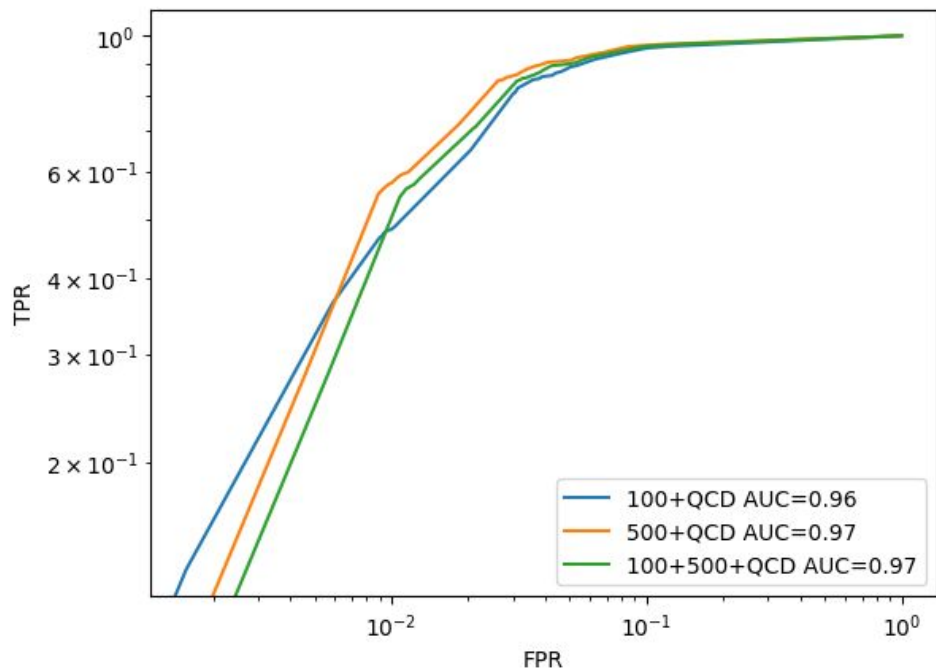
Inclusion of Timing Feature

Last Week (No Pileup)

Phase 0: Track-by-track
BDT (XGBoost)



Feature Importance



Phase 1: Track-by-track Transformer (ABCNet)

