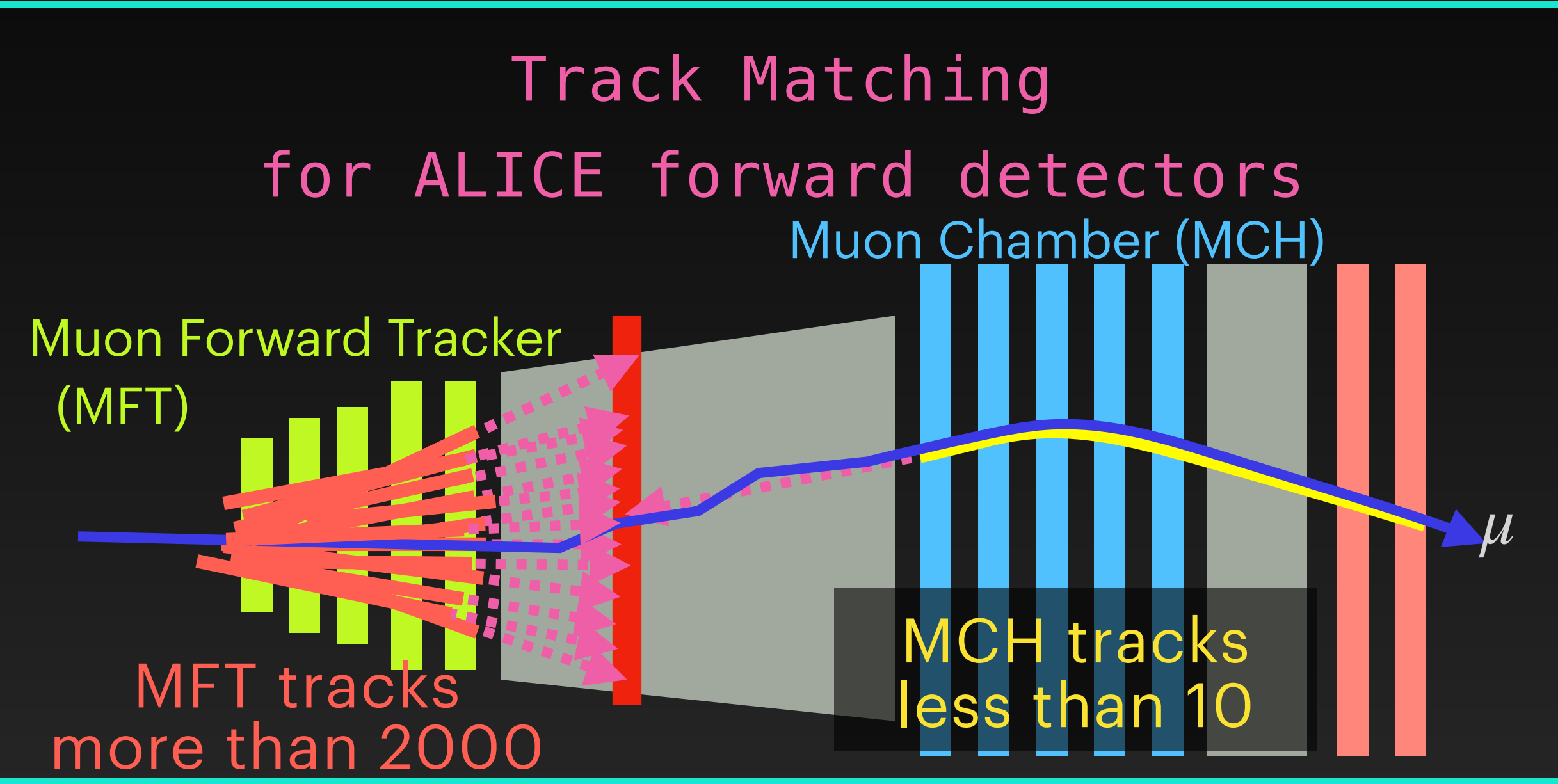


Performance Evaluation of Forward Muon Track Matching in ALICE Run 3

Ren Ejima for the ALICE collaboration, Hiroshima Univ. Japan



Assessment of track matching

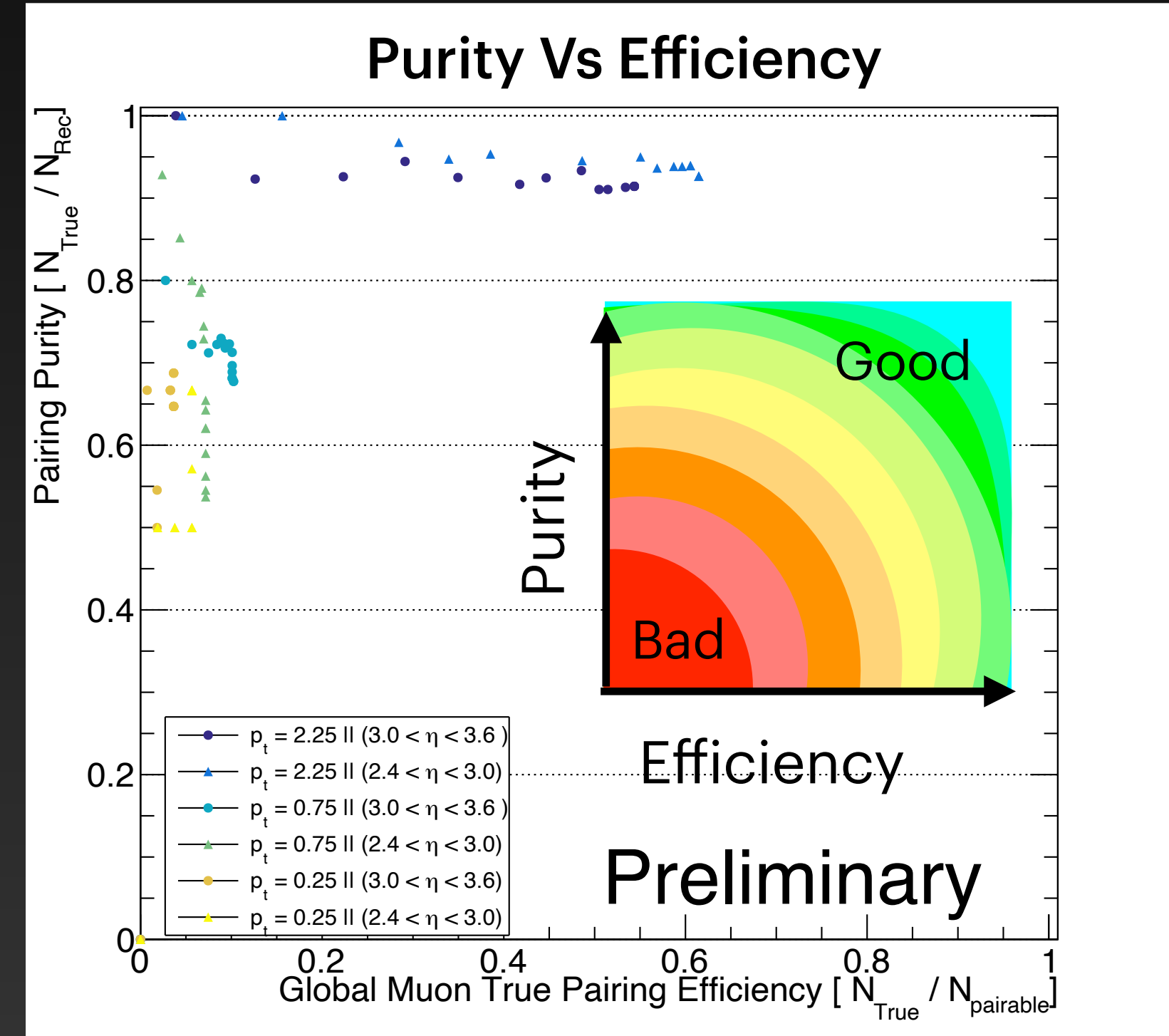
Purity = $\frac{\text{Correctly Matched}}{\text{All Matched}}$

Efficiency = $\frac{\text{Correctly Matched}}{\text{Reconstructed at both detectors}}$

Traditional method (Kalman filter)

Pb-Pb + $\rho \times 4, \omega \times 2, \phi \times 2 \rightarrow \mu^+ \mu^-, \sqrt{s_{NN}} = 5.5 \text{ TeV}$ minimum bias

Simulation with Pythia8hi



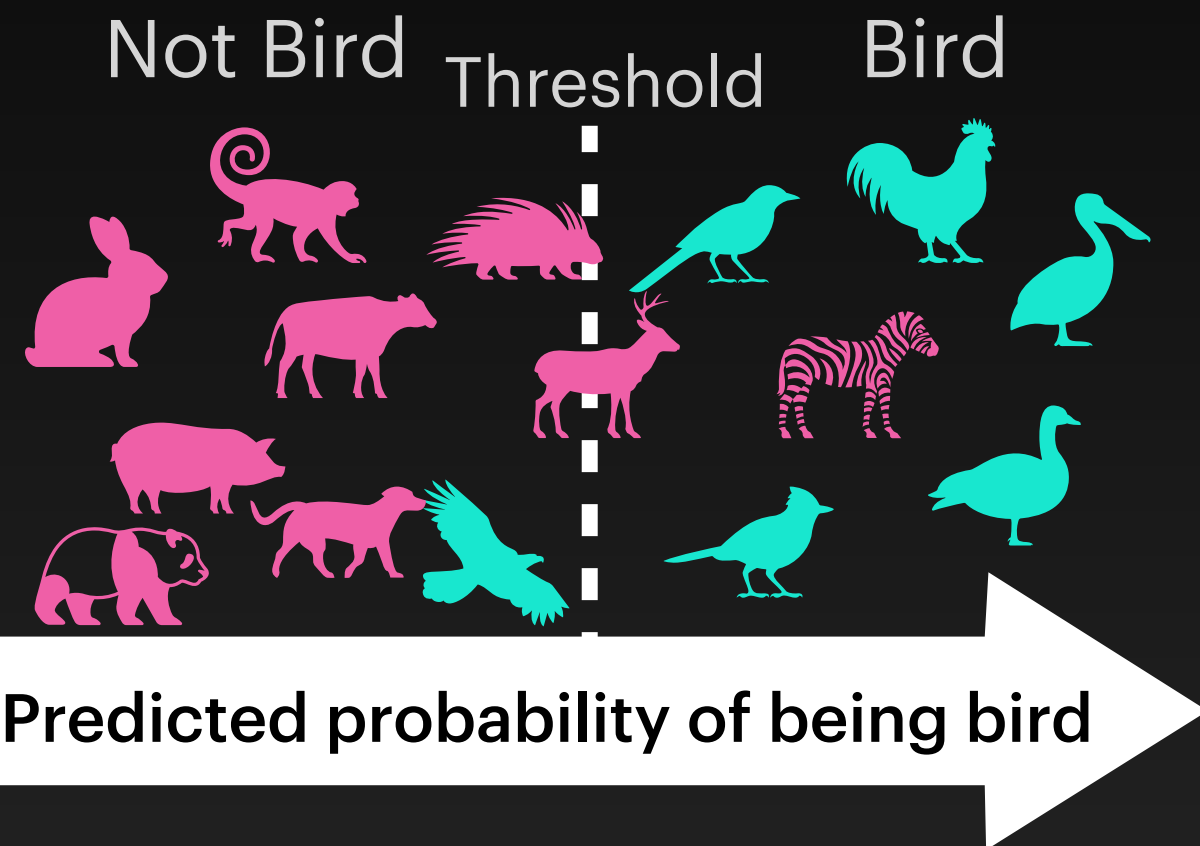
Both Efficiency and Purity is not good at low p_T

Issue : Traditional method's result is not enough...

Track Matching with Machine Learning

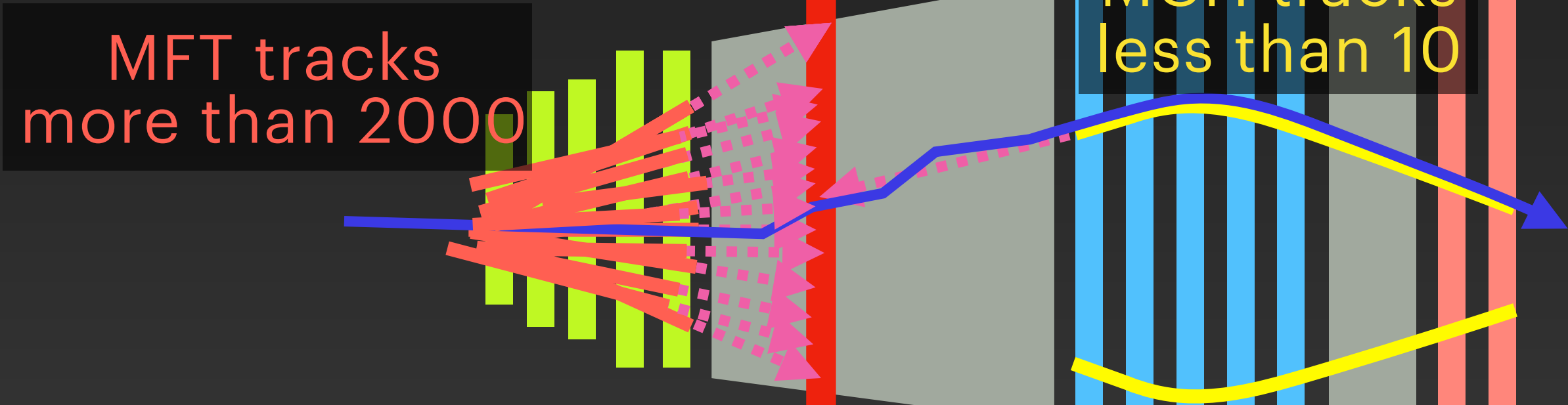
Classification by machine learning

Example: Classify whether Bird or any other animals



Learn to improve purity and efficiency of classification.

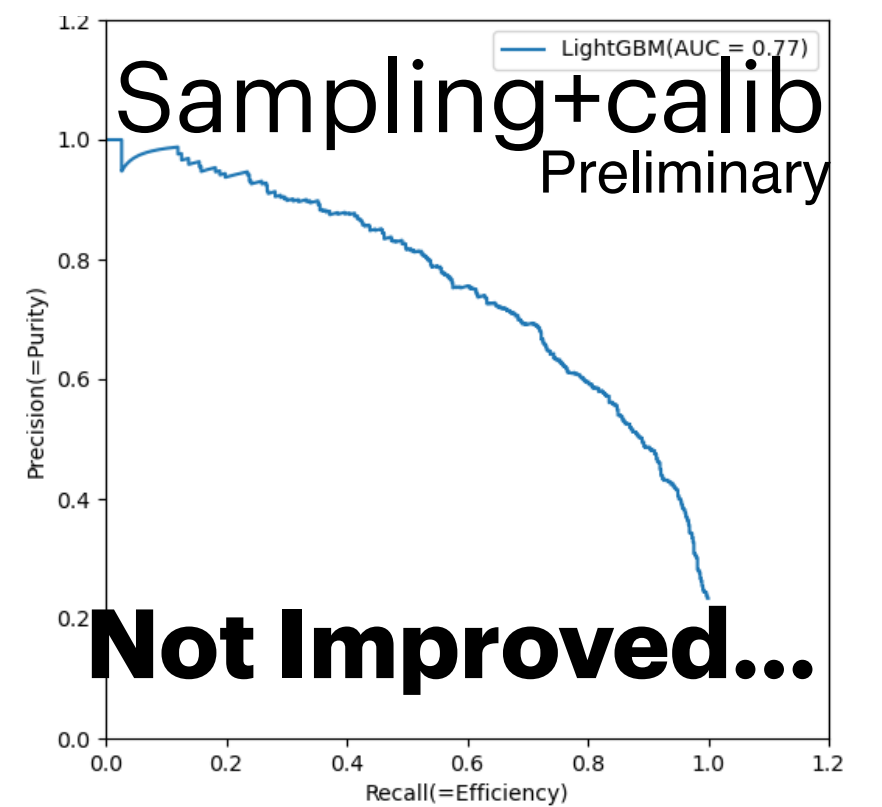
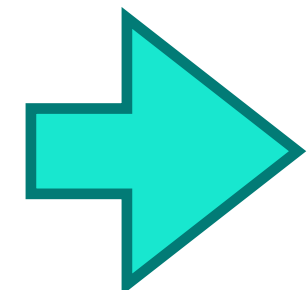
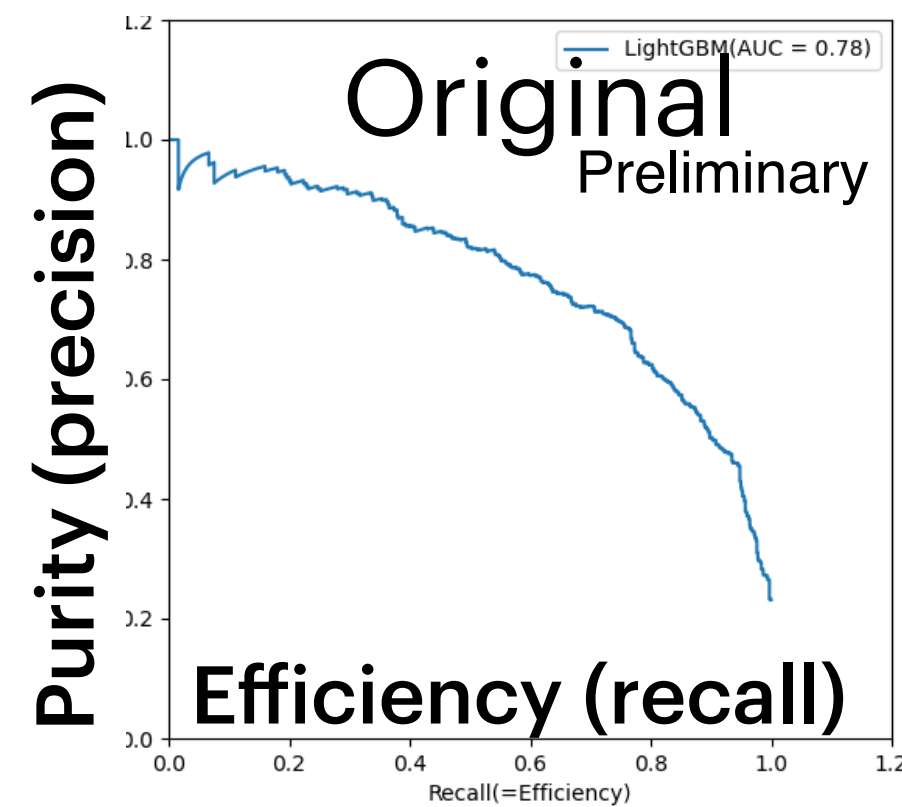
Track Matching:
Classify whether Correct or Wrong



Unbalance (Correct << Wrong) will disturb training...

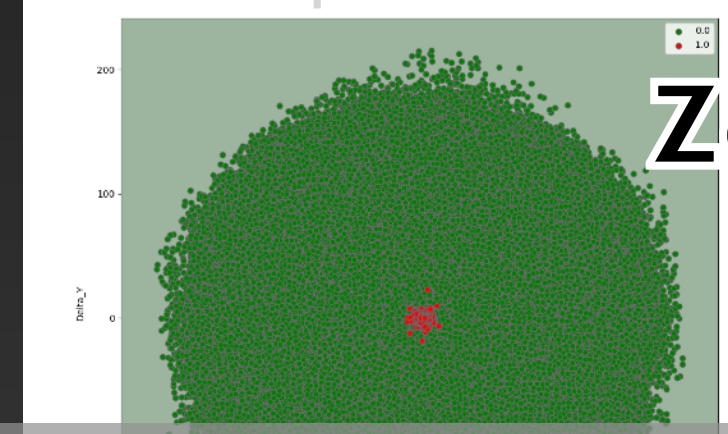
Some methods against unbalance but...

Example: data processing (sampling) at training stage

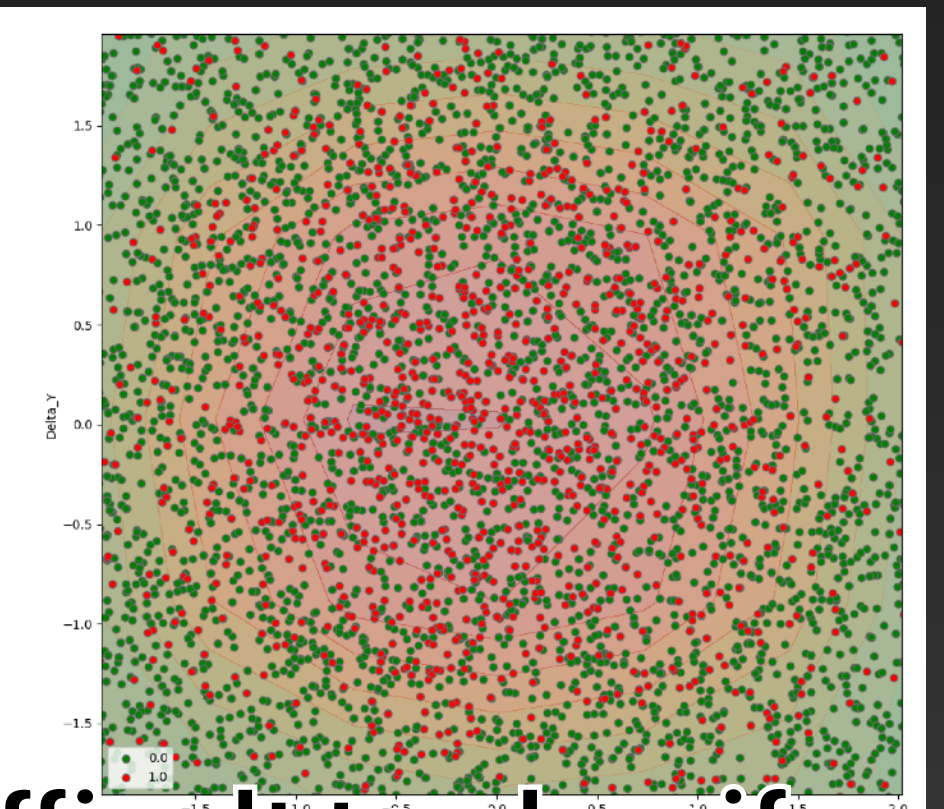


The reason why these methods didn't work well

one of the input distributions



Zoom in

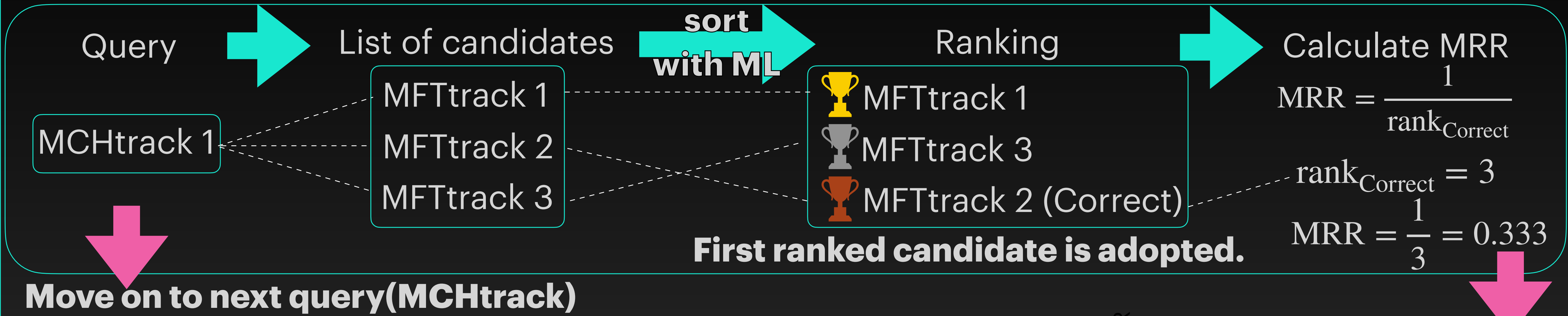


Difficult to classify...

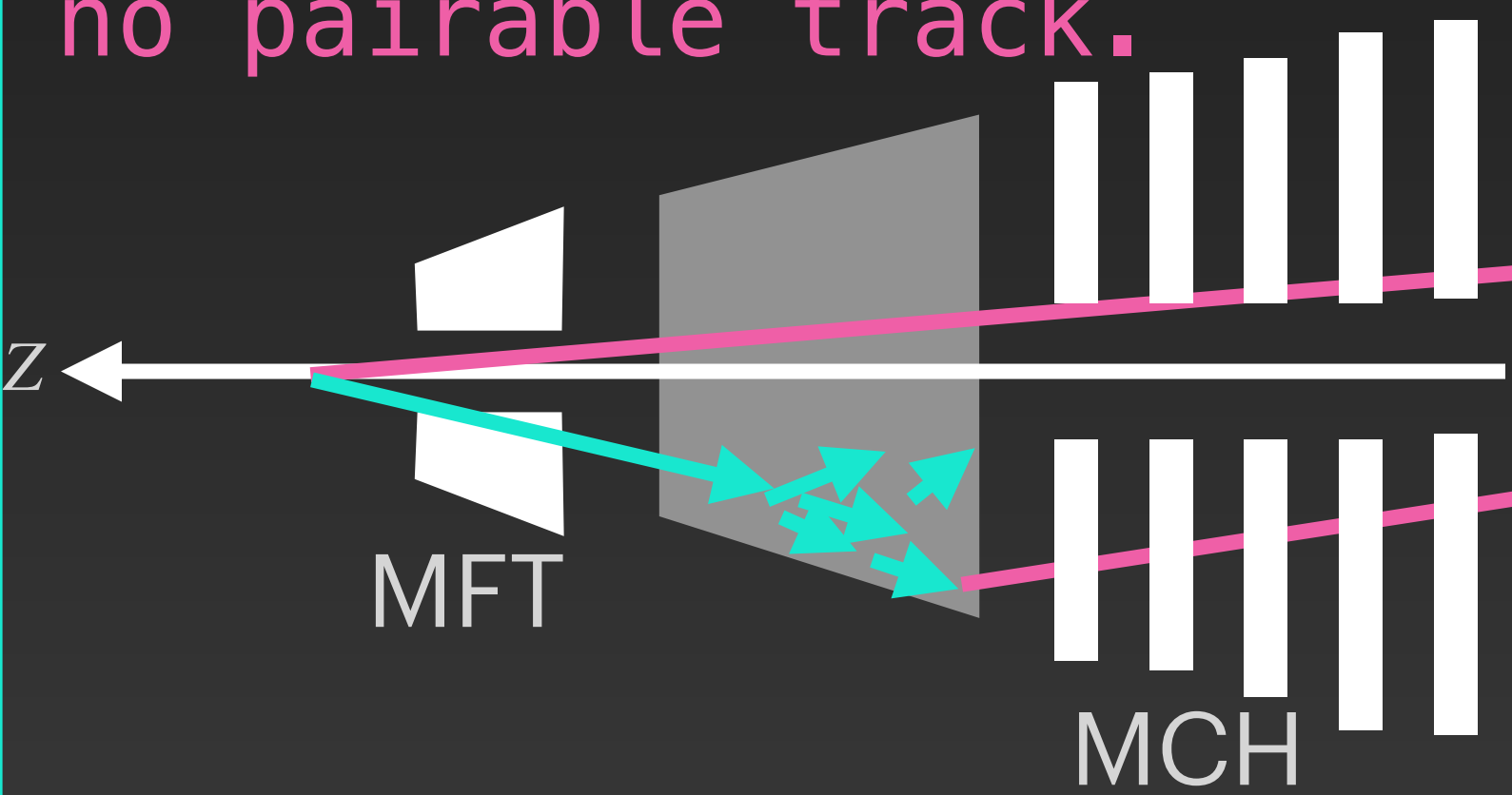
Difficult to classify ...

New Technique

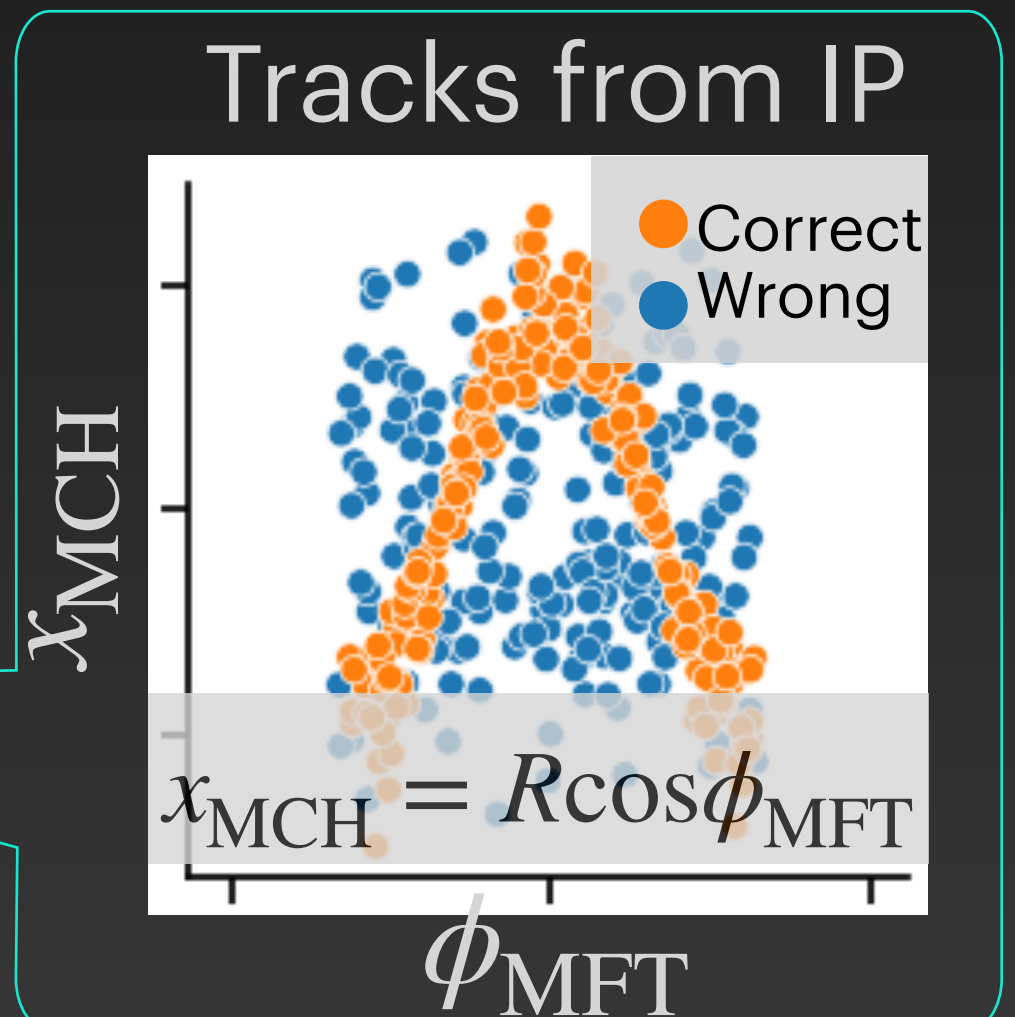
New technique : "Learn to Rank"



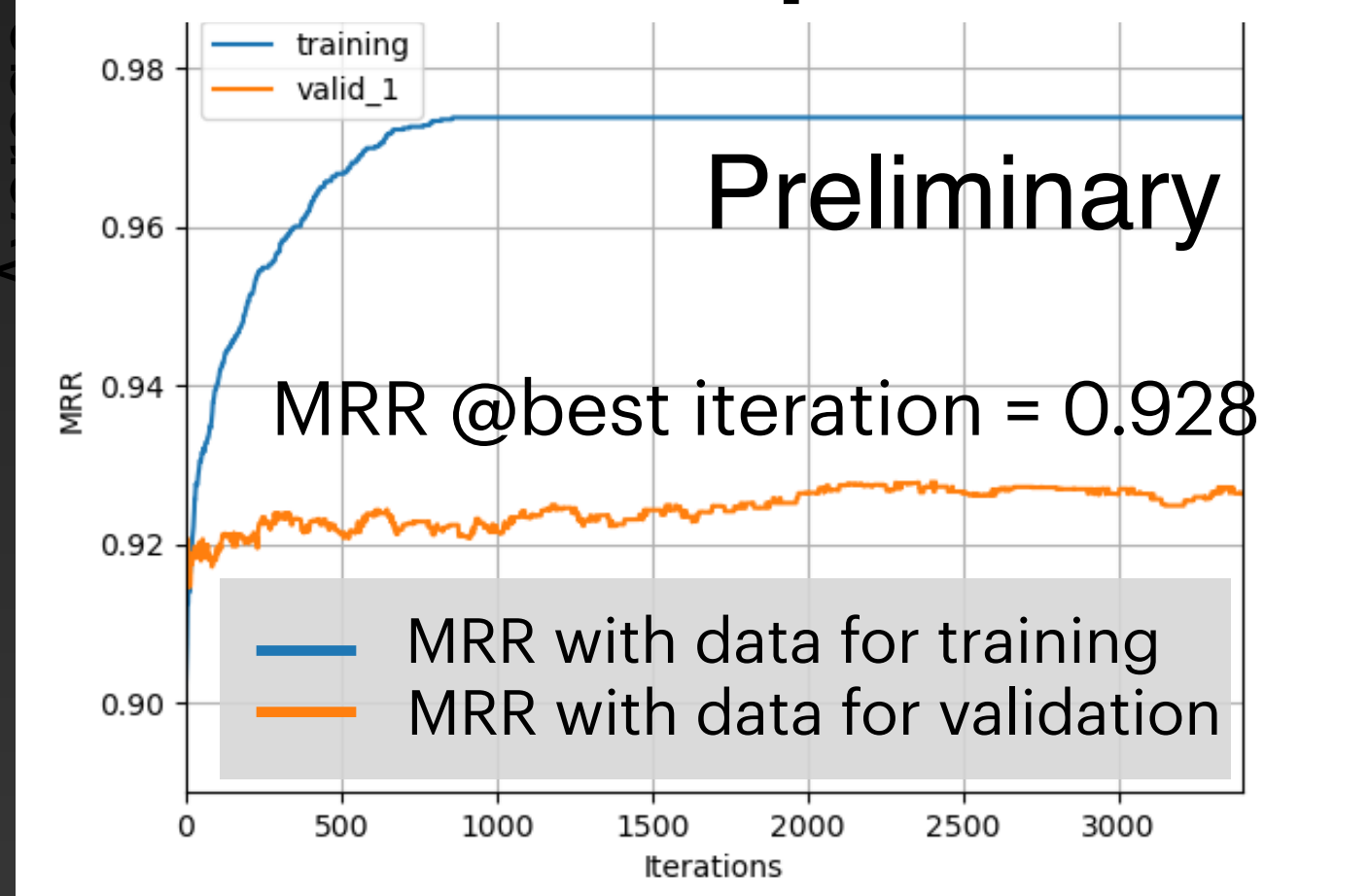
But sometimes, there is no pairable track.



Exclusion of MFT+MCH acceptance edge



ML learns to improve MRR.



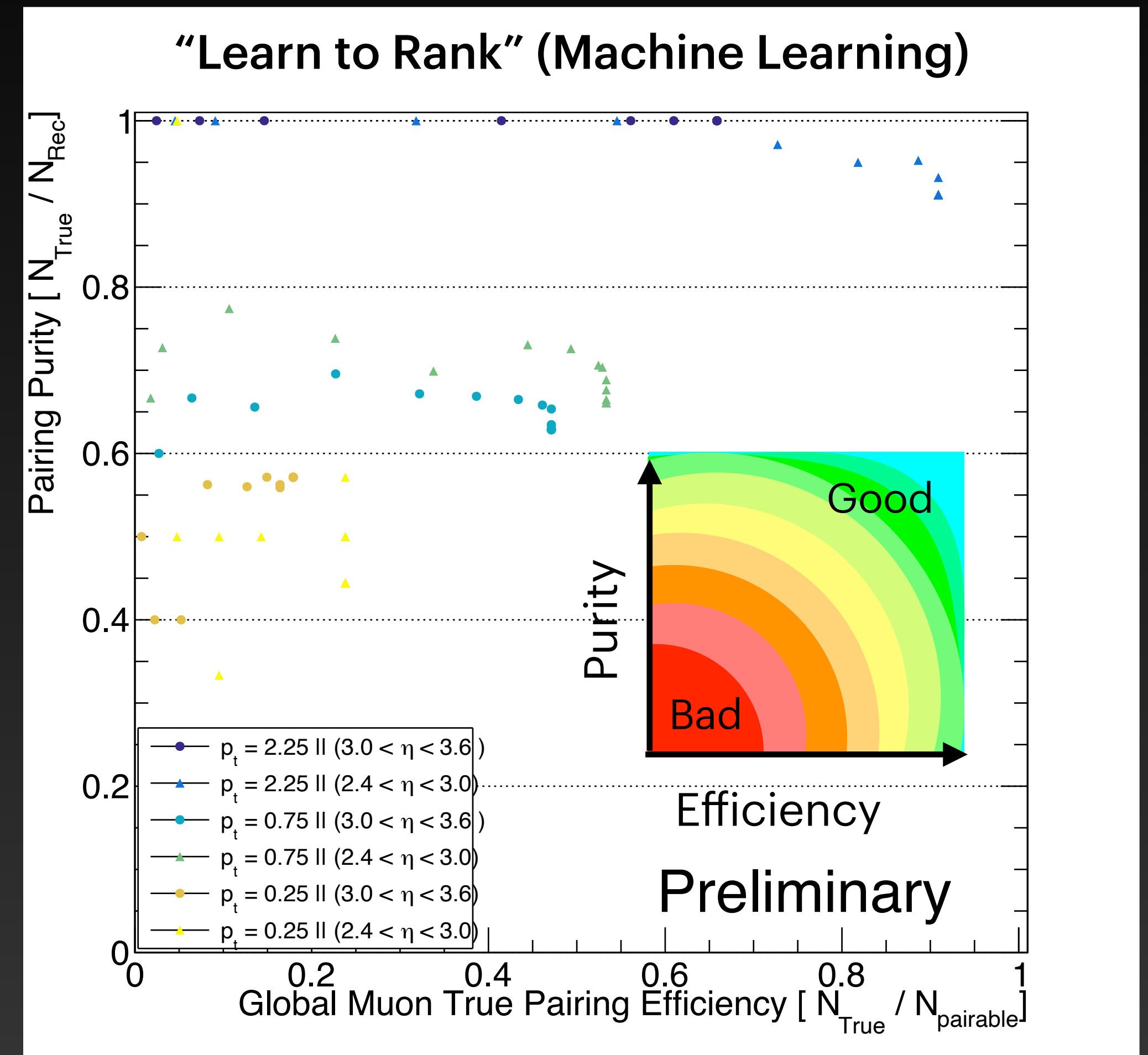
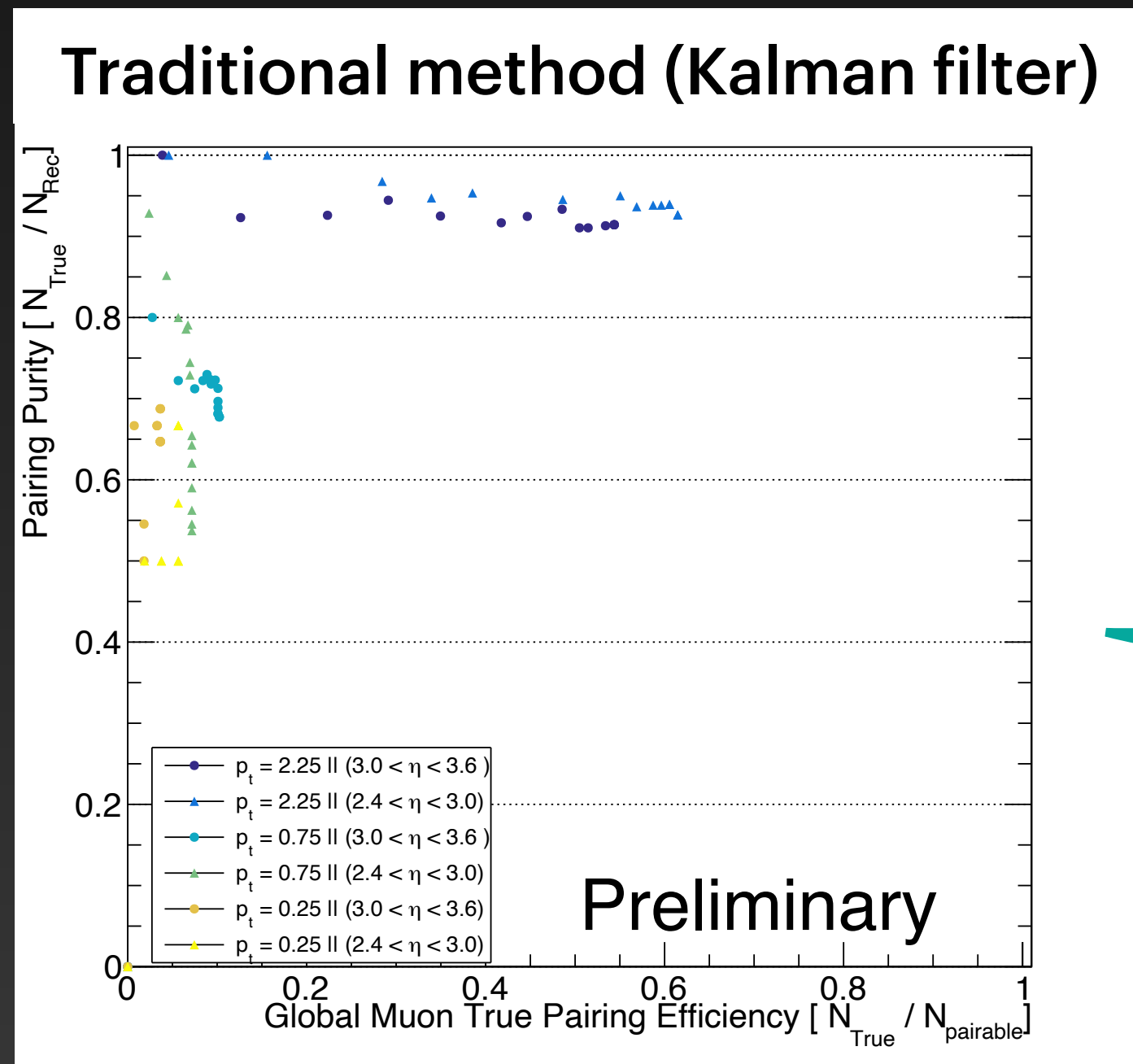
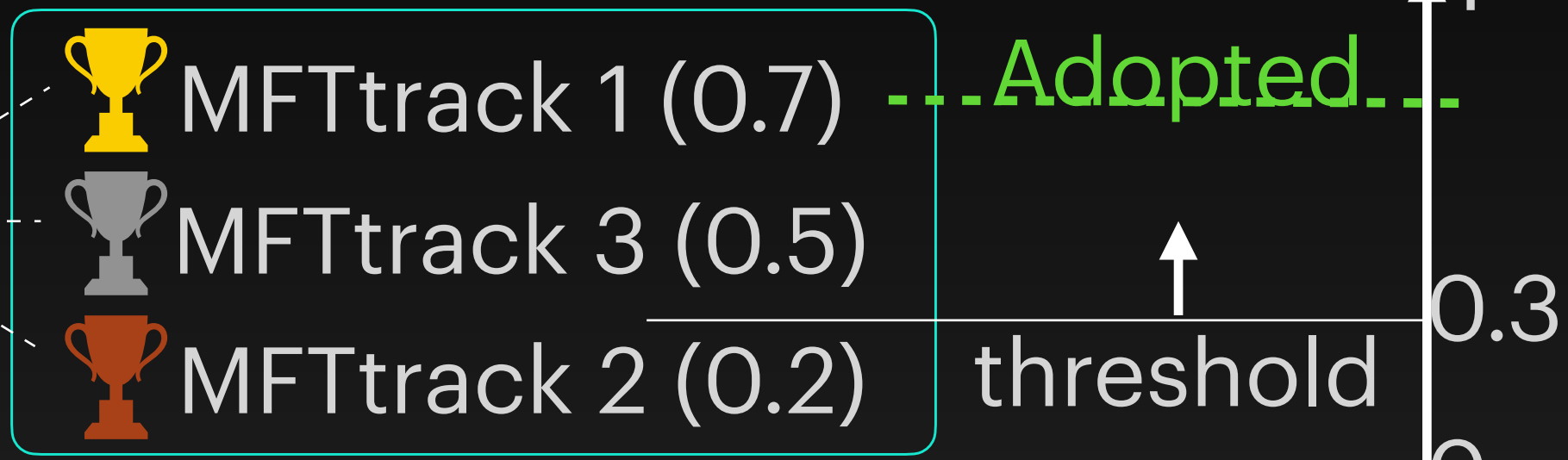
Idea : Learn of each query and learn to improve ranking

Result of Machine Learning

Purity Vs Efficiency for different thresholds of predicted probability

Ranking (predicted probability)

Query
MCHtrack 1



Purity is almost the same, but Efficiency is improved.

Result : Improved

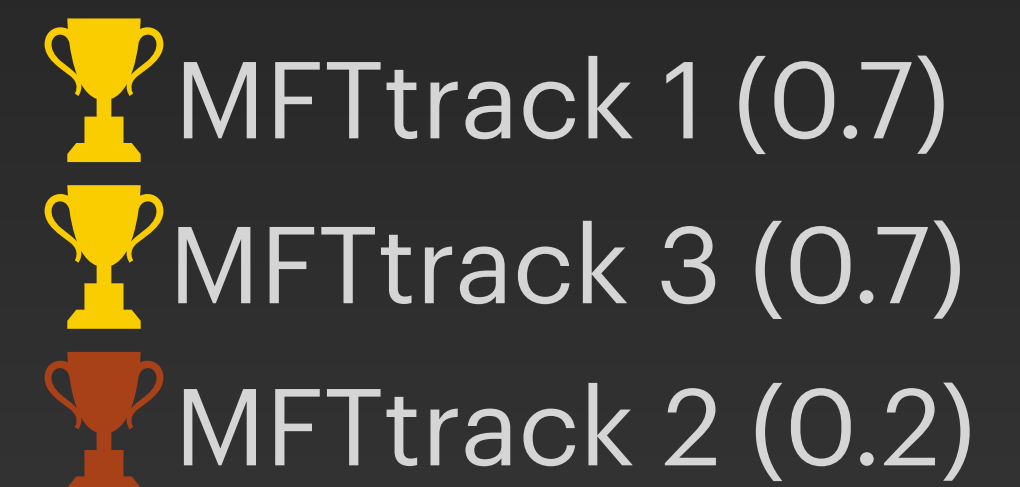
Summary and Outlook

Summary

- Track Matching for ALICE forward detectors is very challenging due to high multiplicity and multiple scattering
- Data processing at training stage and weighted learning didn't contribute to improve results due to overlapping of the distribution of feature parameters
- New technique "Learn to Rank" helps to improve result.

Outlook

- Reduce the number of candidates with the highest prediction



Thank you !