SVD to CDC CKF validation
Simple filter vs MVA filter

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DESY

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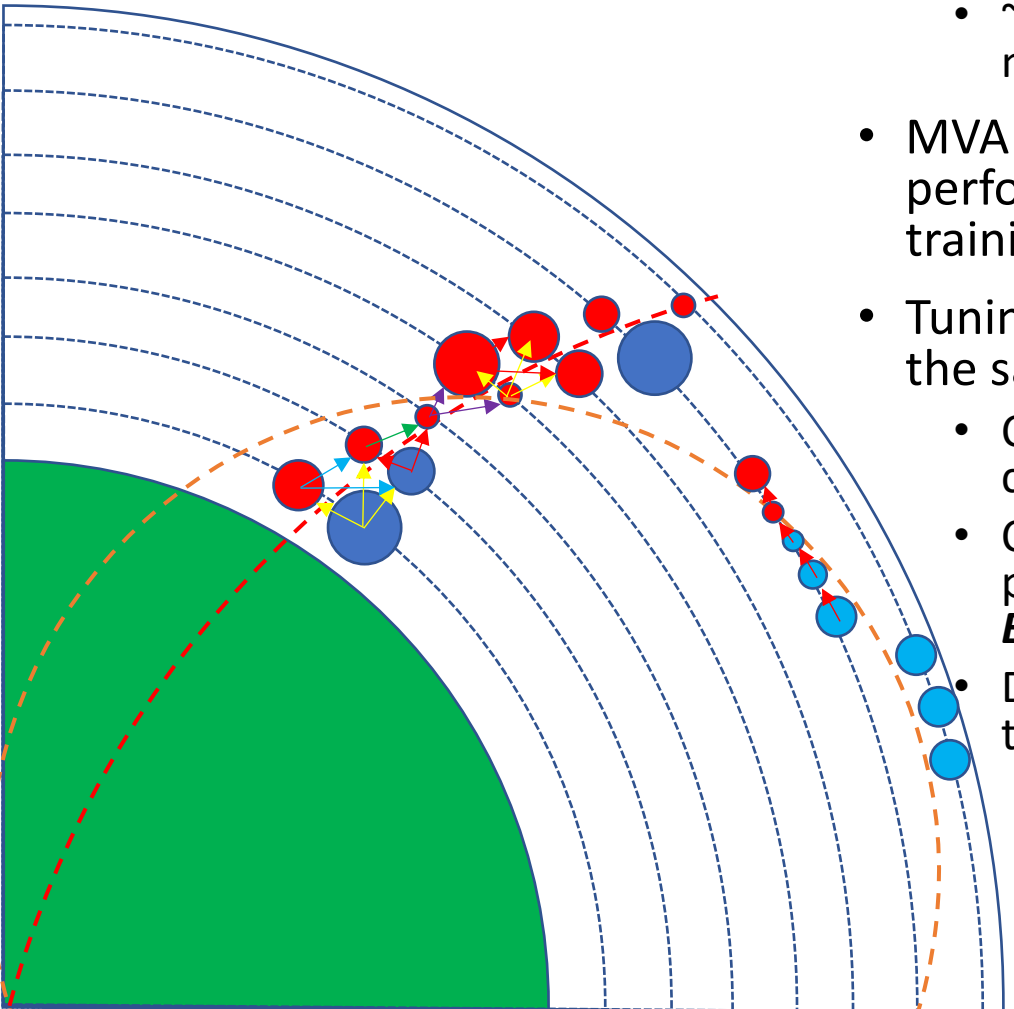
Motivation

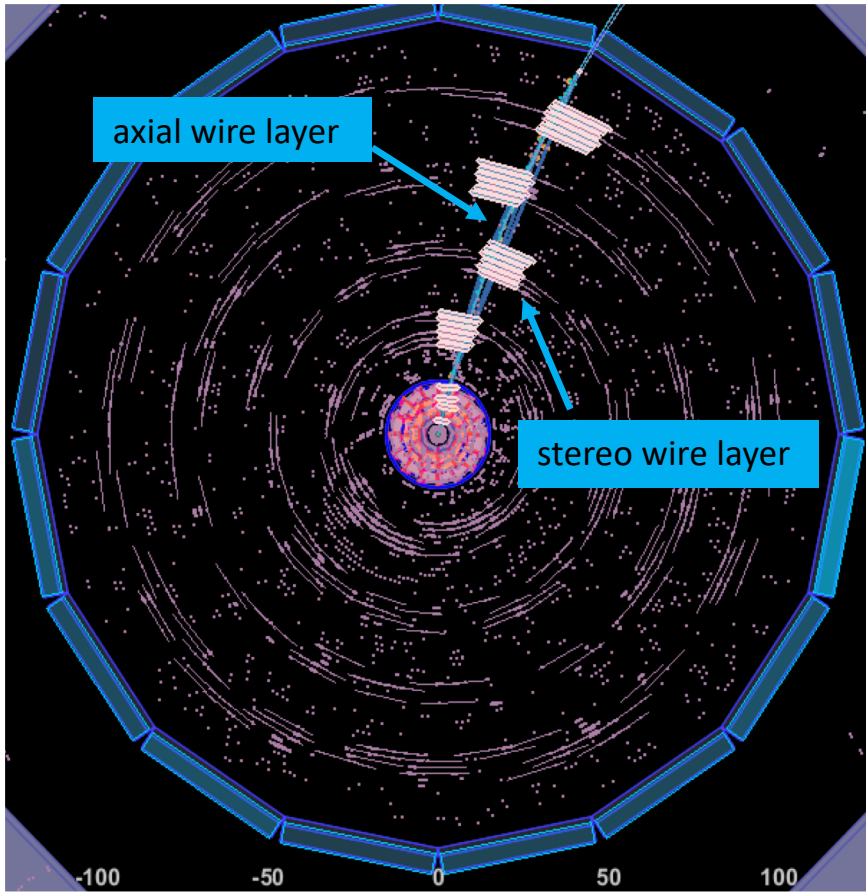


- Simple filter:
  - Based on distance and layer
- MVA filter:
  - ~Dozen variables trained by 5000 single muon events
- MVA filter is supposed to have better performance and need validation. e.g. is the training sample sufficient?
- Tuning the filter to prefer selecting the hit in the same layer to increase the hit efficiency.
  - Charge dependent relation: too time-consuming
  - Current solution: pick one best hit firstly, then pick the rest hits which pass the filter. ***Extrahitfilter*** is introduced.
  - Dose it work for mva filters? How to merge these two algorithms?

Configuration

- Simple filter:
  - 2 filters are implemented
  - Distance_xy + layer for filter1
  - Distance_mSoP_xy + layer for filter2
  - Extrahitfilter = simple
  - Prefers hits with smaller layer ID. This avoids jumps over layers.
  - Among them prefers closest in XY hits

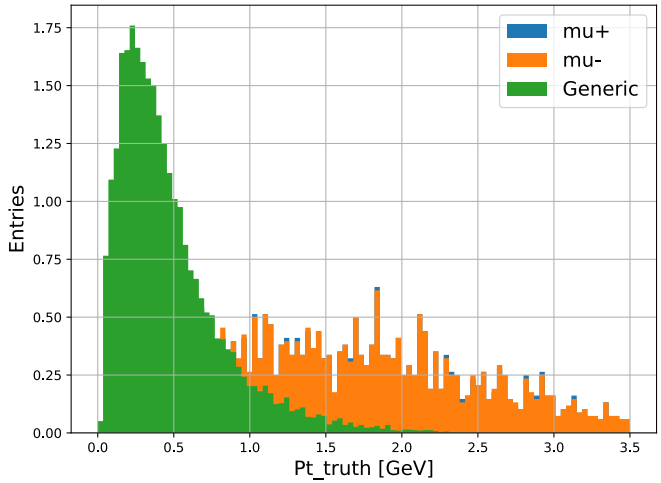
- MVA filter:
  - 3 filters are implemented
  - 1st -- simple extrapolation (select multiple good)
  - 2nd -- genfit extrapolation (+mSoP vars, select single best)
  - 3rd -- after kalman update (+pull and chi2)
  - Extrahitfilter = mva (variables for filter1)

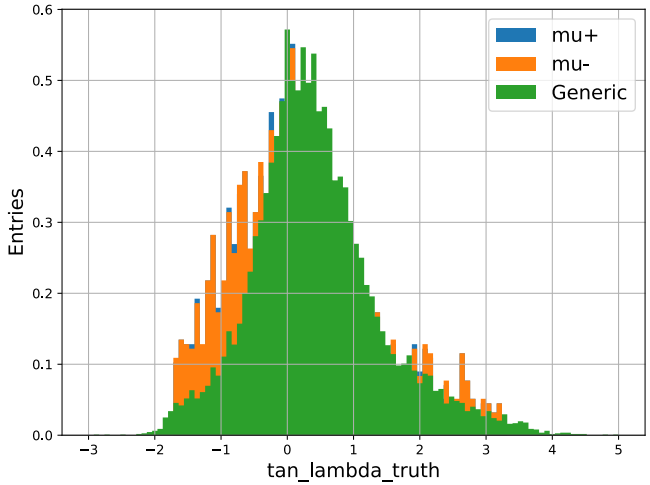


Configuration

- Work flow:
  1. VXD track finding
  2. Apply CKF, extrapolate VXD track to CDC
  3. Combine VXD and CDC tracks
  4. Apply PXD CKF
- Samples for test
  - 2000 μ^- and μ^+ and $\Upsilon(4S)$ generic decay with phase3 Bg.

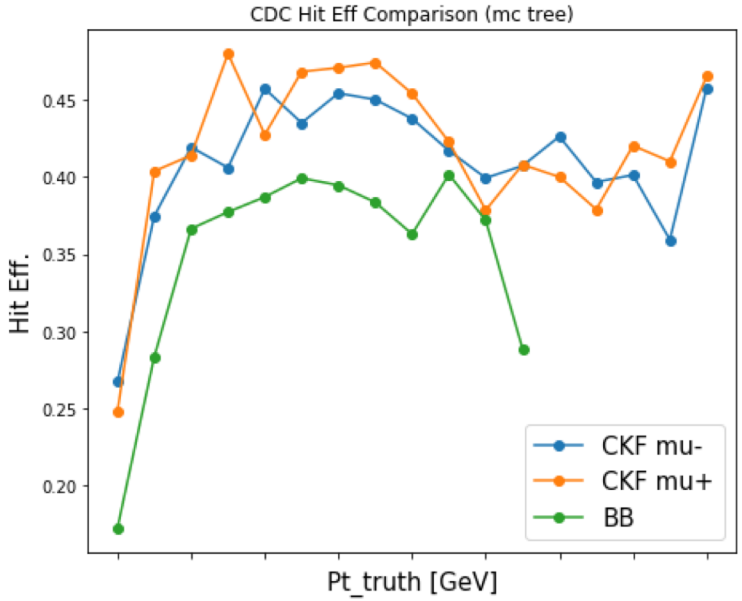
Just to validate the SVD to CDC CKF linking efficiency, It is not the default work flow for TF in BelleII

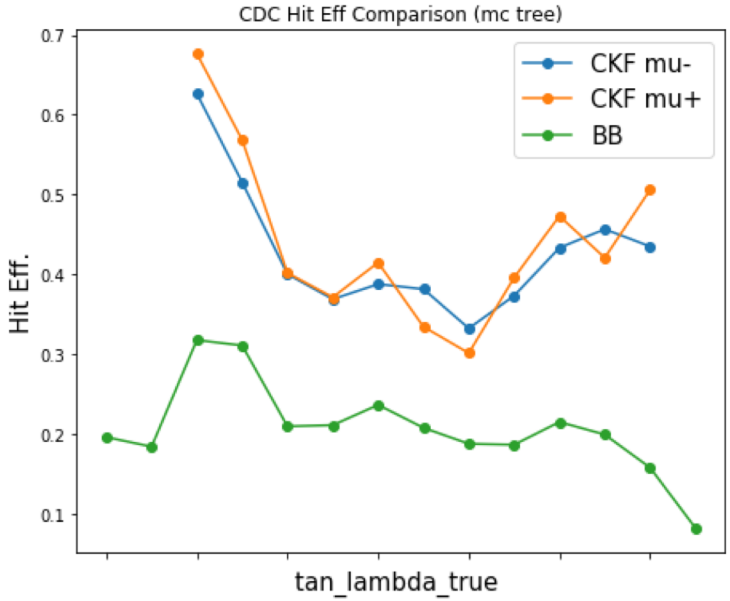




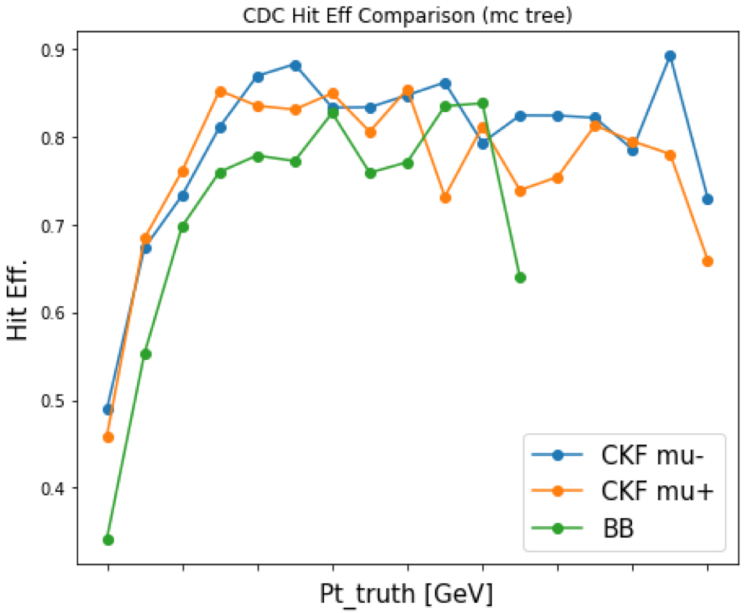
CDC hit efficiency (only for CKF)

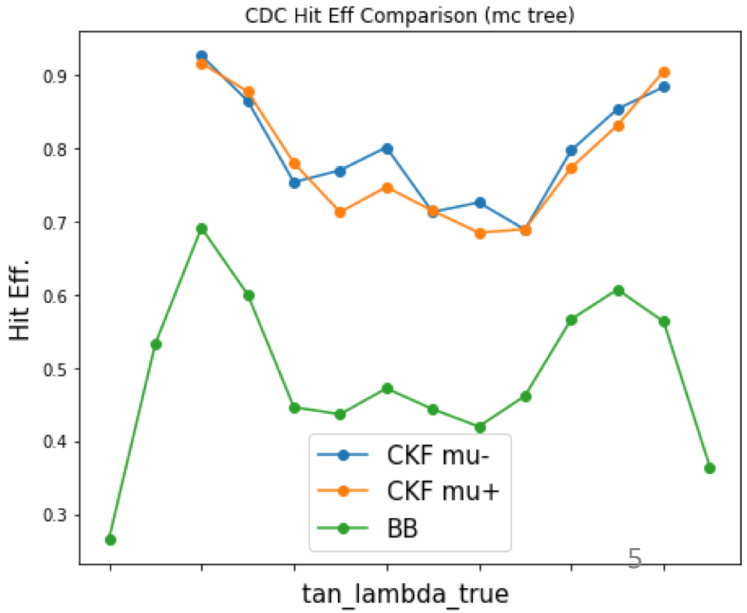
MVA





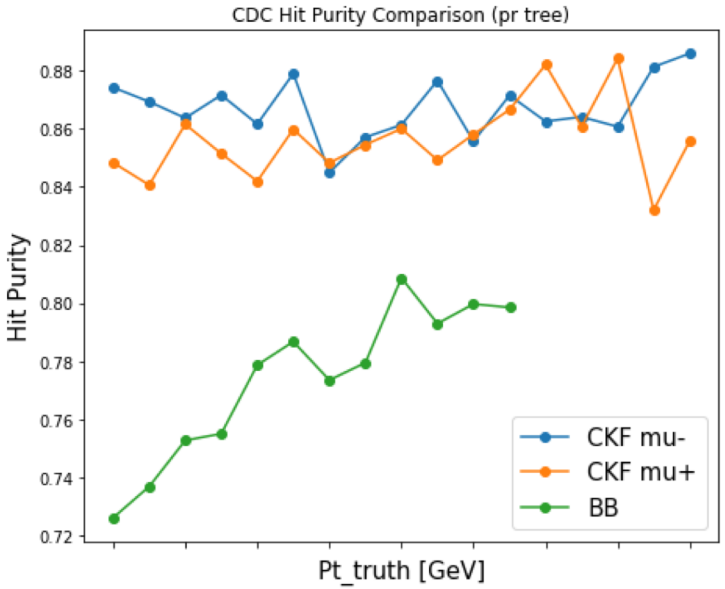
SIM

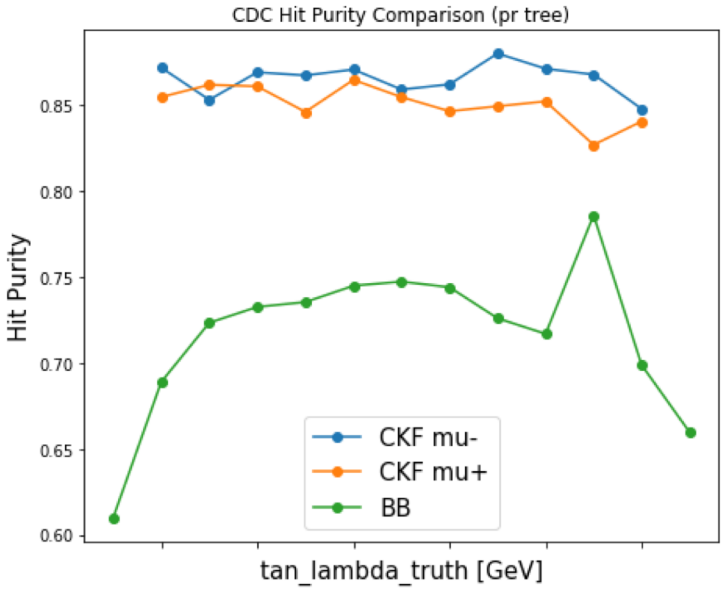




CDC hit purity

MVA





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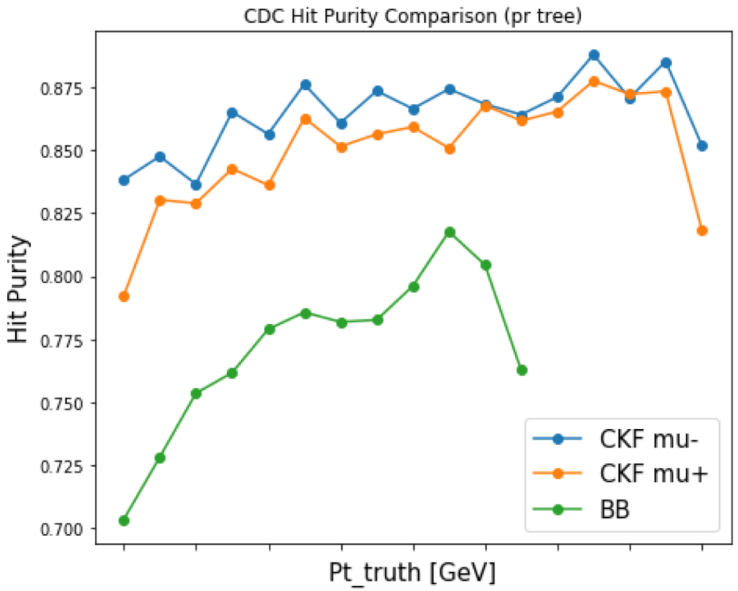
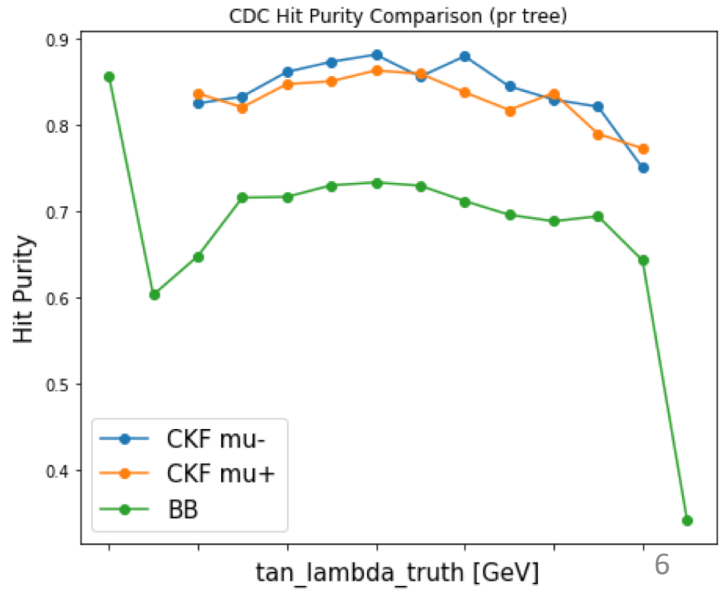




Overall performance

MVA

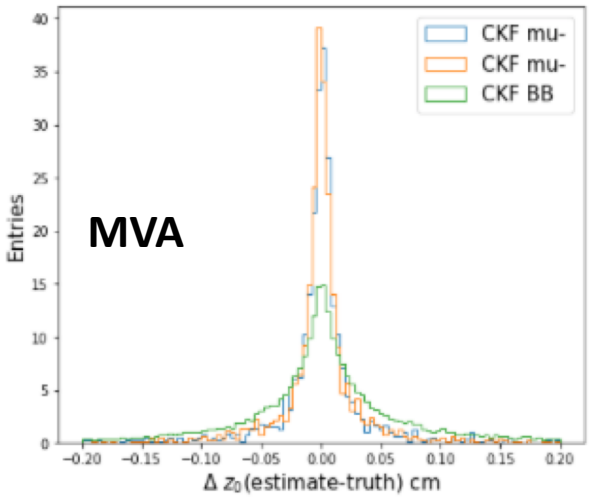
	Mu+	Mu-	BB
Find efficiency	0.9875	0.985	0.8319299
Hit efficiency	0.521157	0.51395154	0.39752185
Clone rate	0.0015159171	0.0010141988	0.012393325
Fake rate	0.13769063	0.14074074	0.09694679

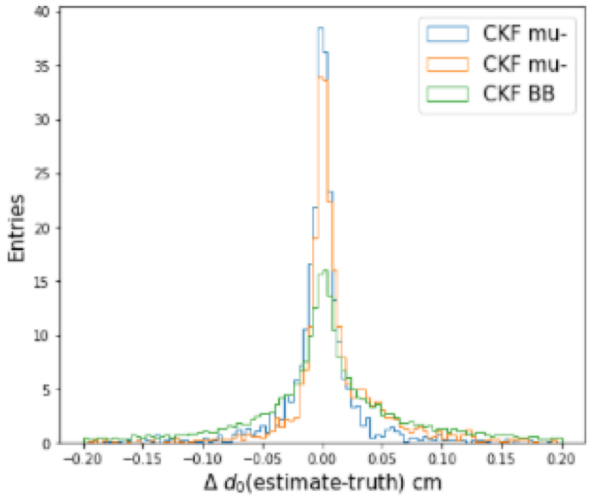
SIM

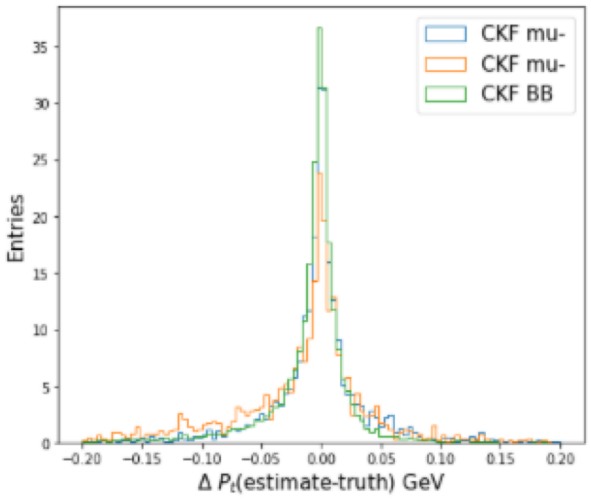
	Mu+	Mu-	BB
Find efficiency	0.9755	0.9735	0.64103186
Hit efficiency	0.749393	0.7646679	0.5540402
Clone rate	0.0010240655	0.0010261673	0.008859674
Fake rate	0.13084112	0.135315	0.23014301

Resolutions comparison

MVA







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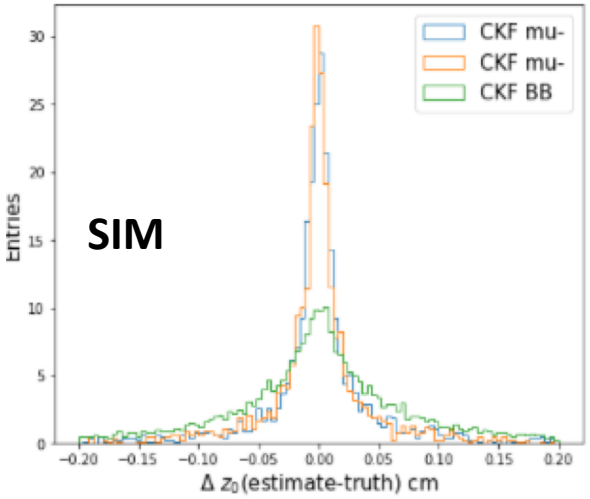
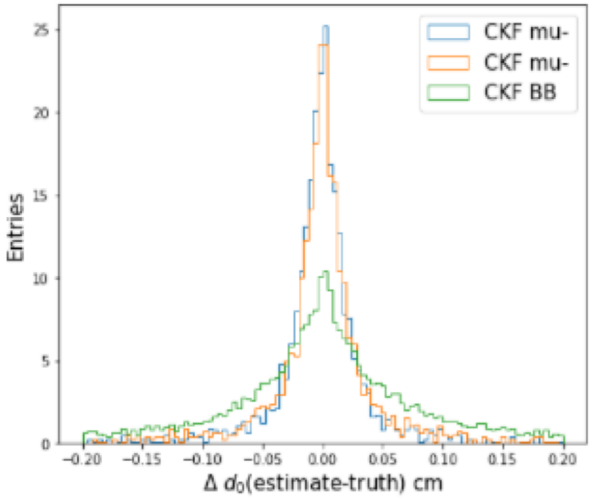
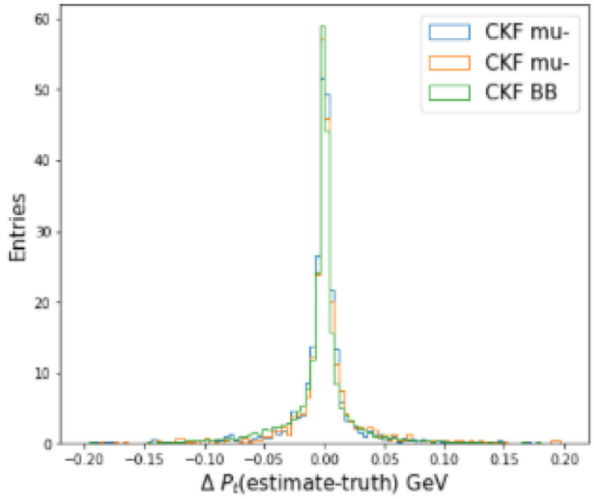
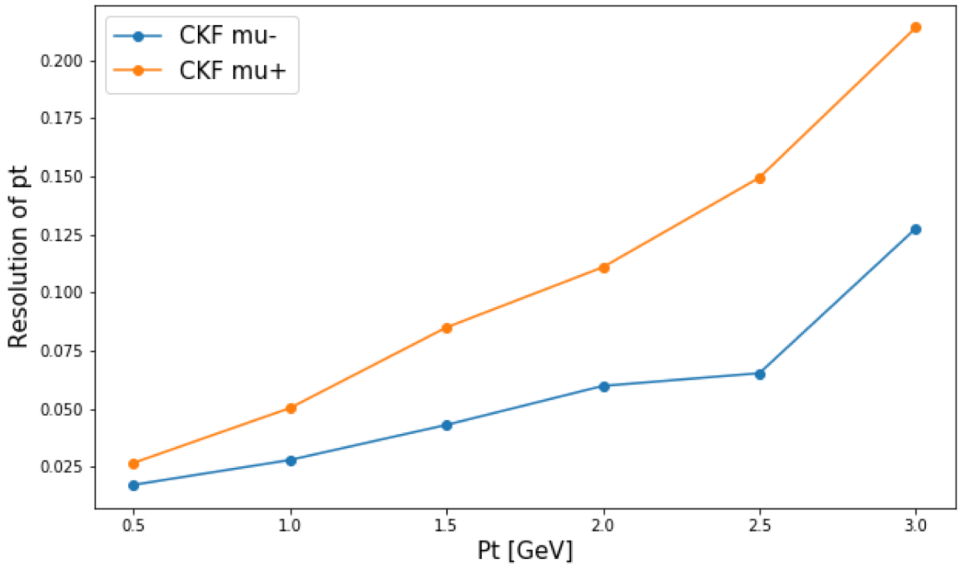






Pt Resolutions vs Pt

MVA



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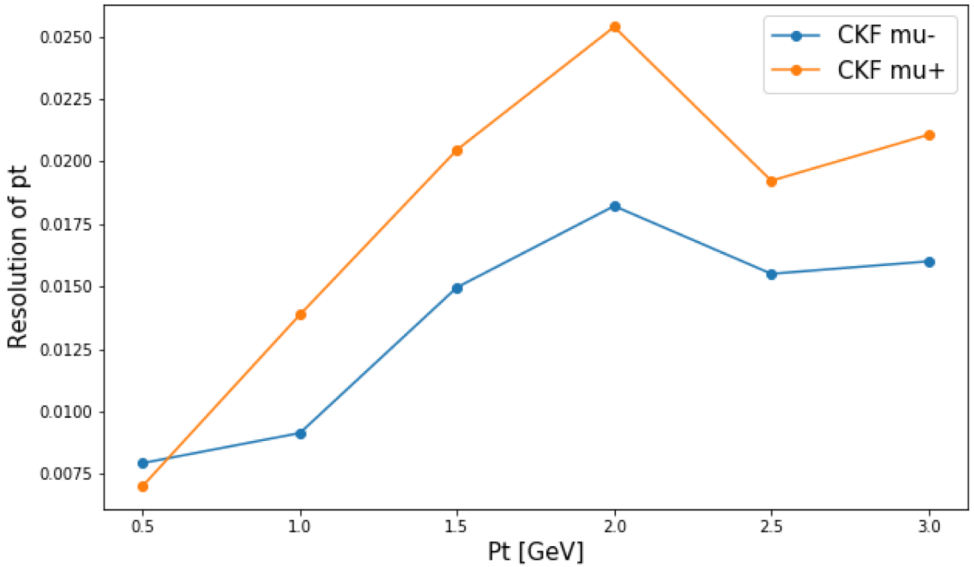
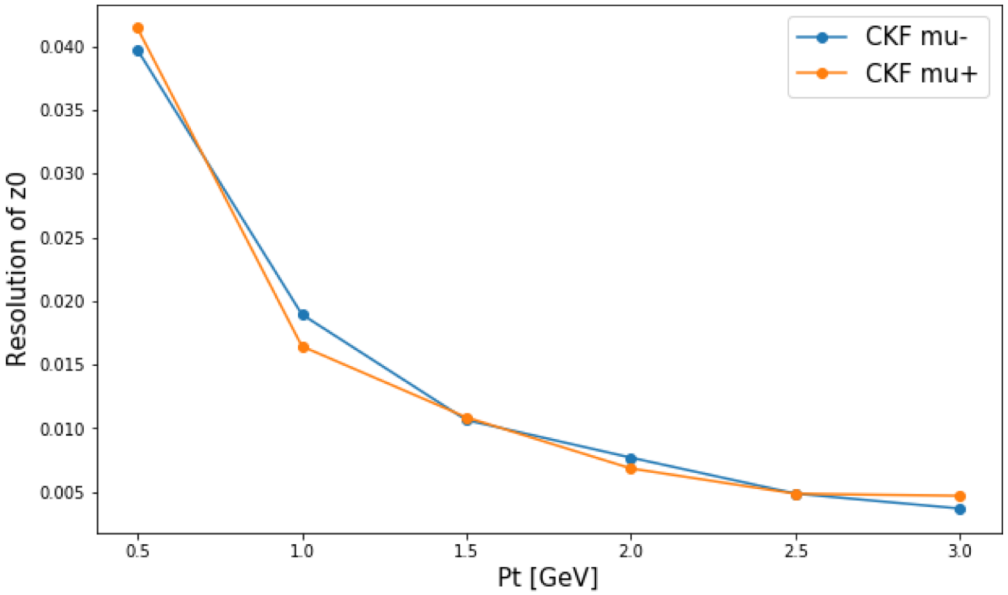


Z0 Resolutions vs Pt

MVA



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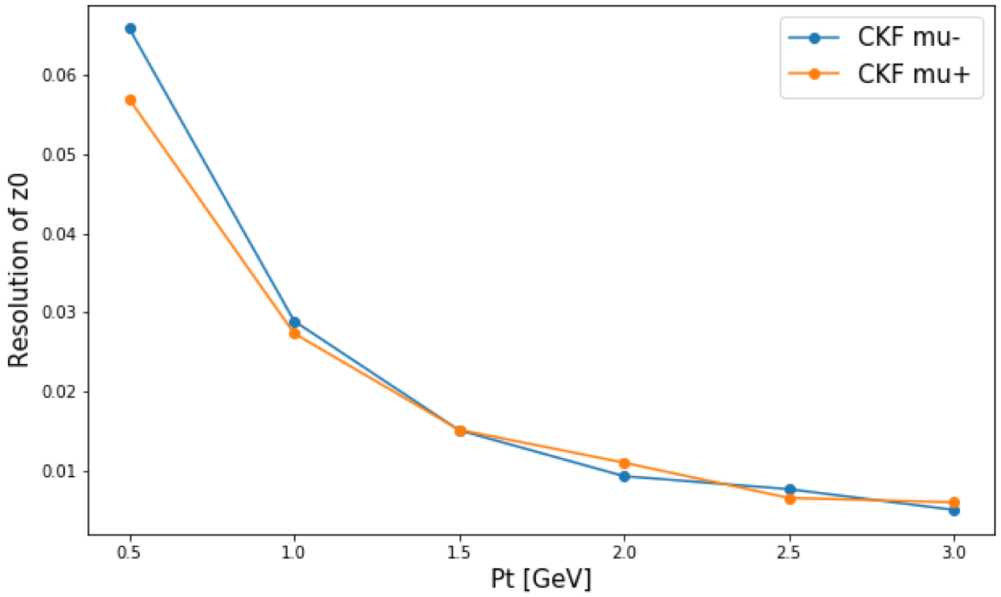
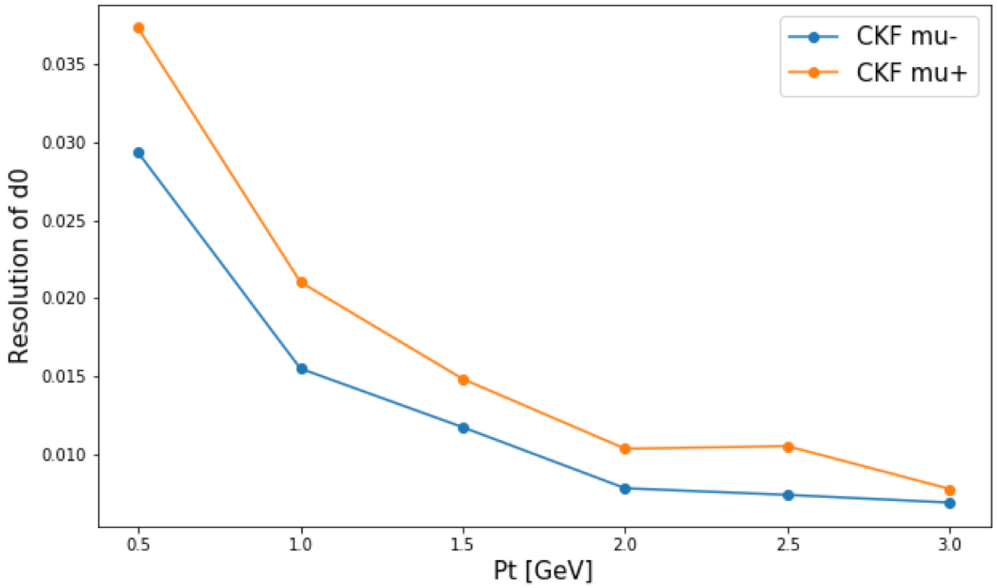


D0 Resolutions vs Pt

MVA



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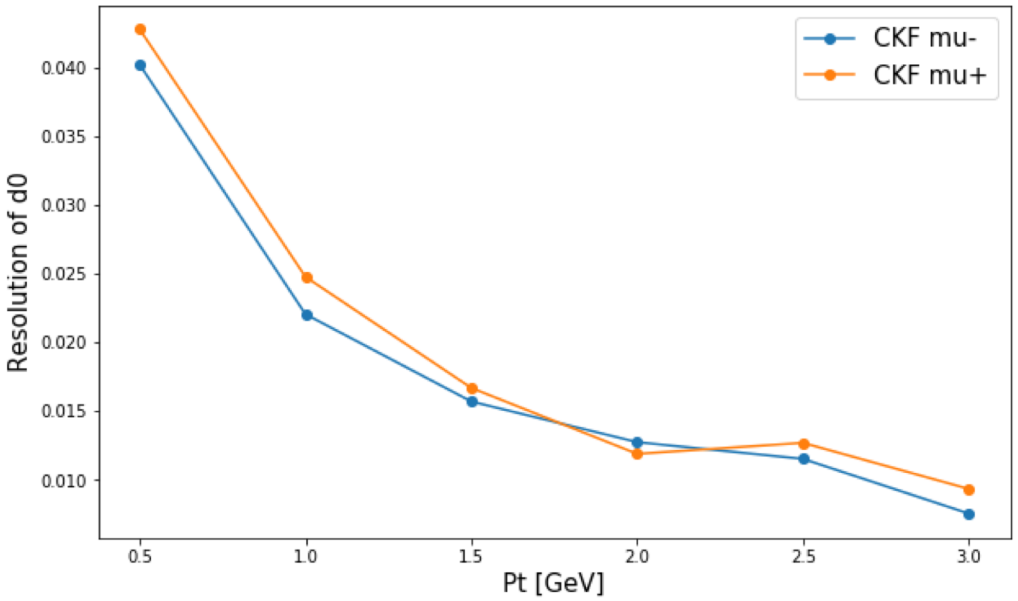
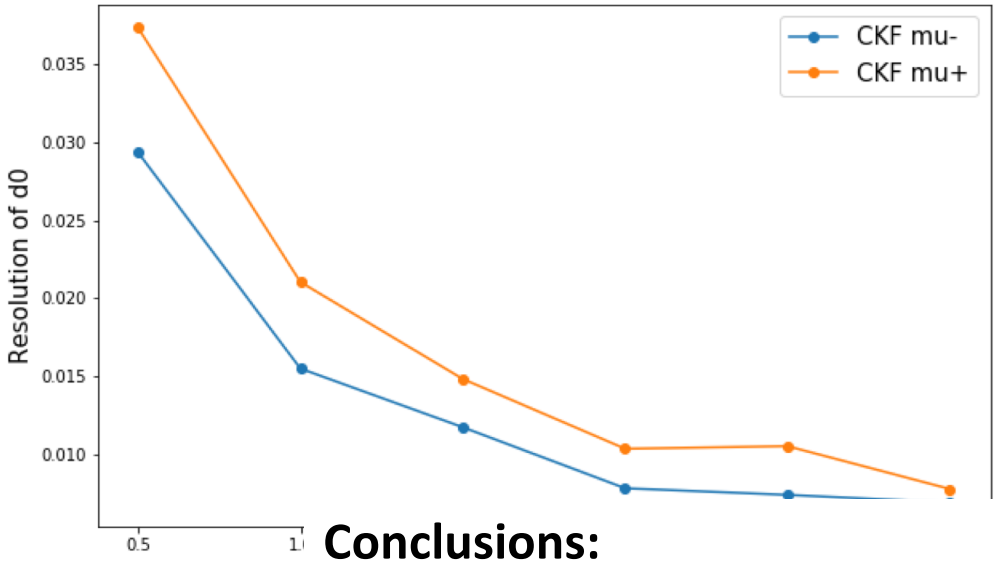


D0 Resolutions vs Pt

MVA



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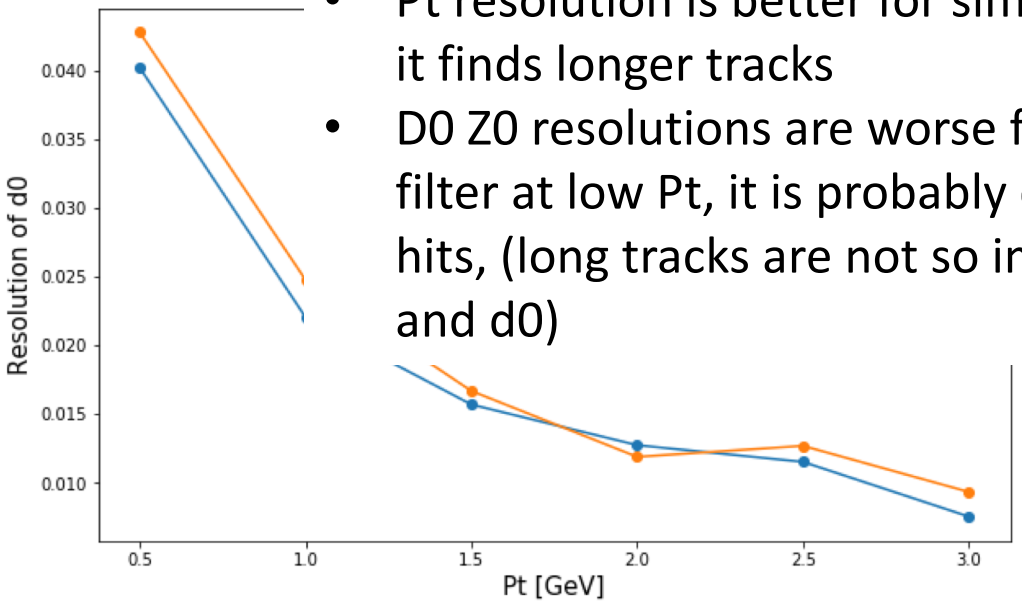


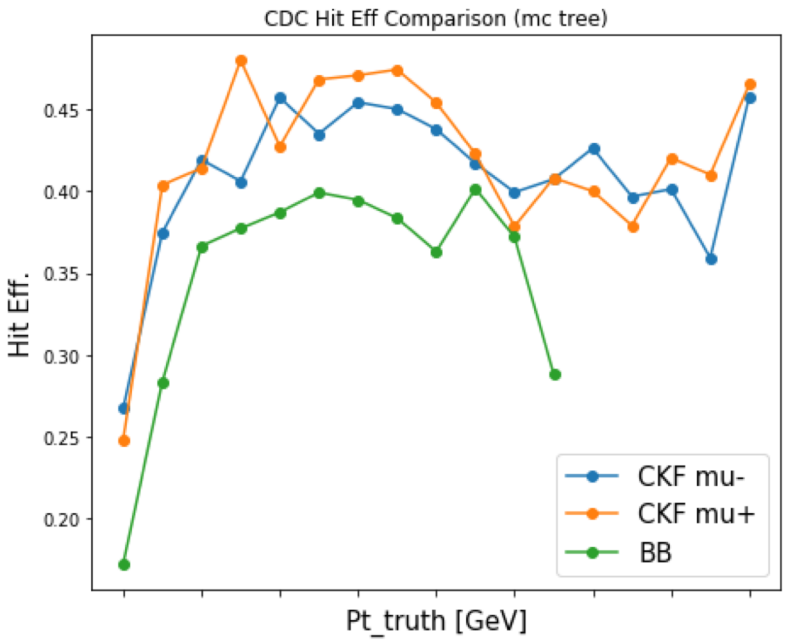
Conclusions:

- Pt resolution is better for simple filter since it finds longer tracks
- D0 Z0 resolutions are worse for the simple filter at low Pt, it is probably due to fakes hits, (long tracks are not so important for z0 and d0)

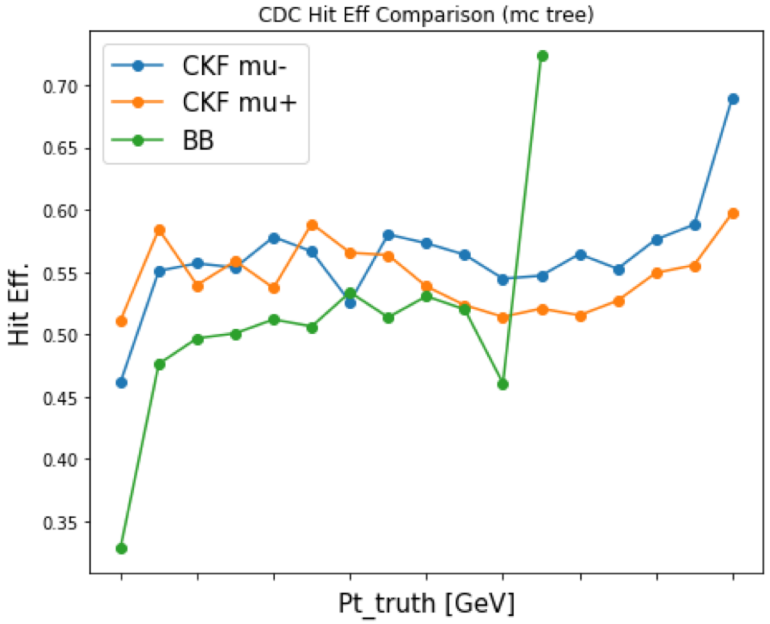
Conclusion

- The simple filter has the better performance for both efficiency and purity (better resolution)
- Why the hit efficiency of mva filter is less than 50%
- We find the third mva filter (+residual and chisq) will cut off all the hits in outer layer (Layer > ~25), remove of 3rd filter will gain 10% improvement

3 mva filter



2 mva filter



To do list

- Train the mva filter with larger samples: μ + Y(4S) generic decay
- Optimize the weight of layer for the mva filter to increase the hit efficiency

Thank you!