Tracking with ML

19th March 2025

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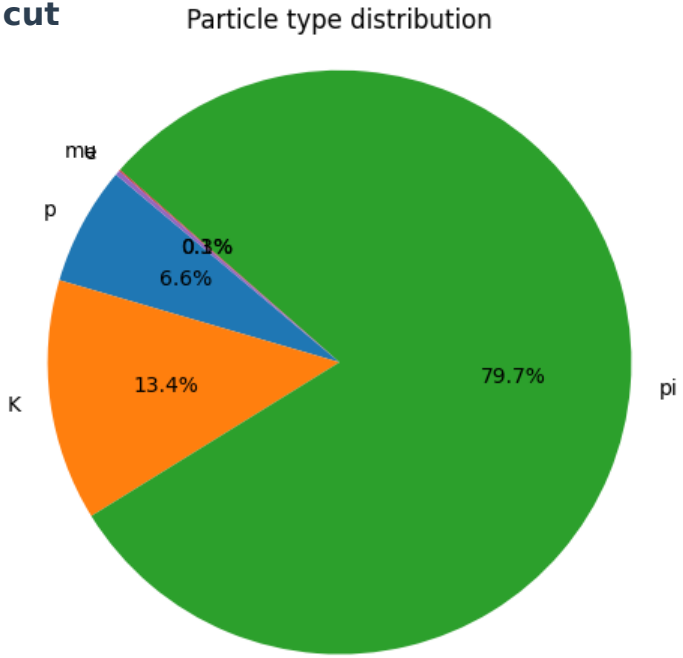
Signed p_T vs unsigned

1st file (test dataset)
After scattering cut

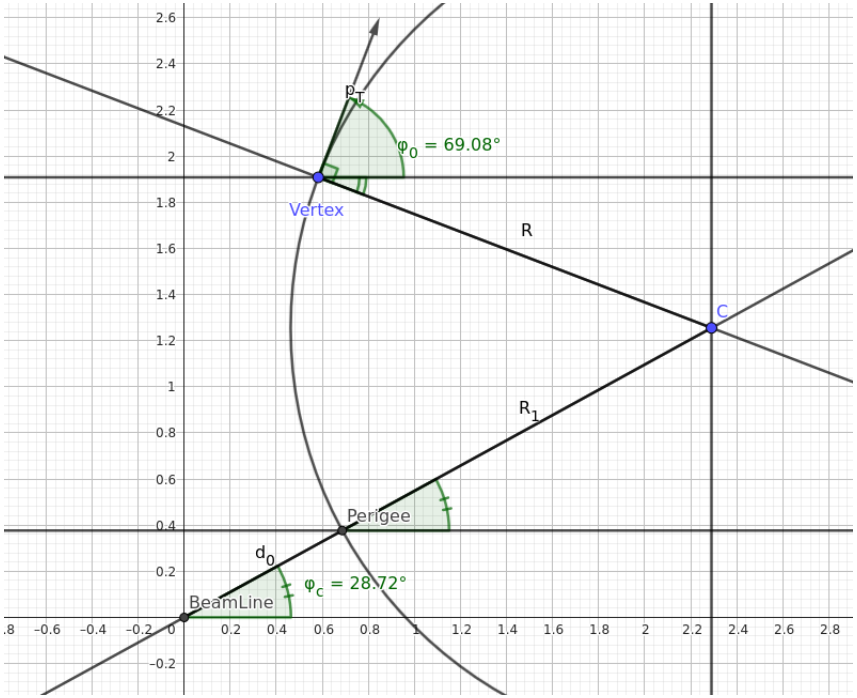


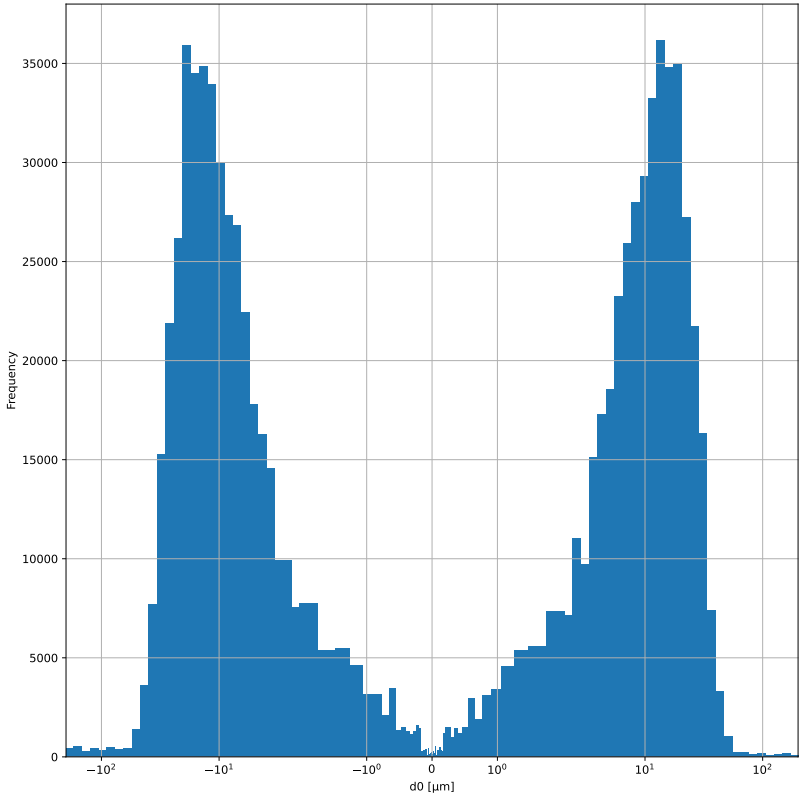
pi: 79.72% (62457) / 78345
K: 13.37% (10471) / 78345
p: 6.57% (5149) / 78345
e: 0.26% (205) / 78345
mu: 0.08% (63) / 78345

Computation of d0

Lorentz force

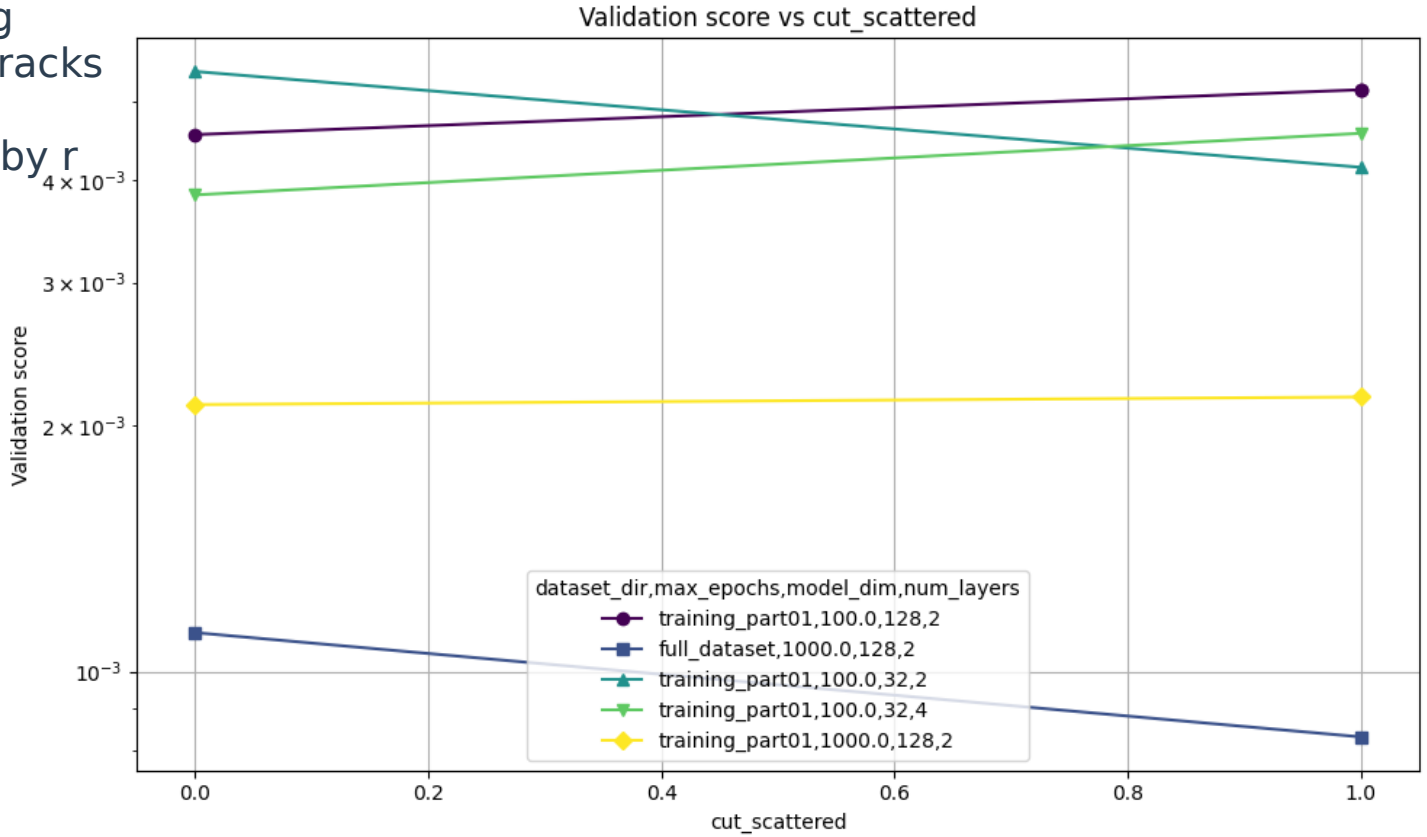
$$R\,[m] = \frac{p_T\,[GeV/c]}{q\,[C] \times B\,[T]}$$



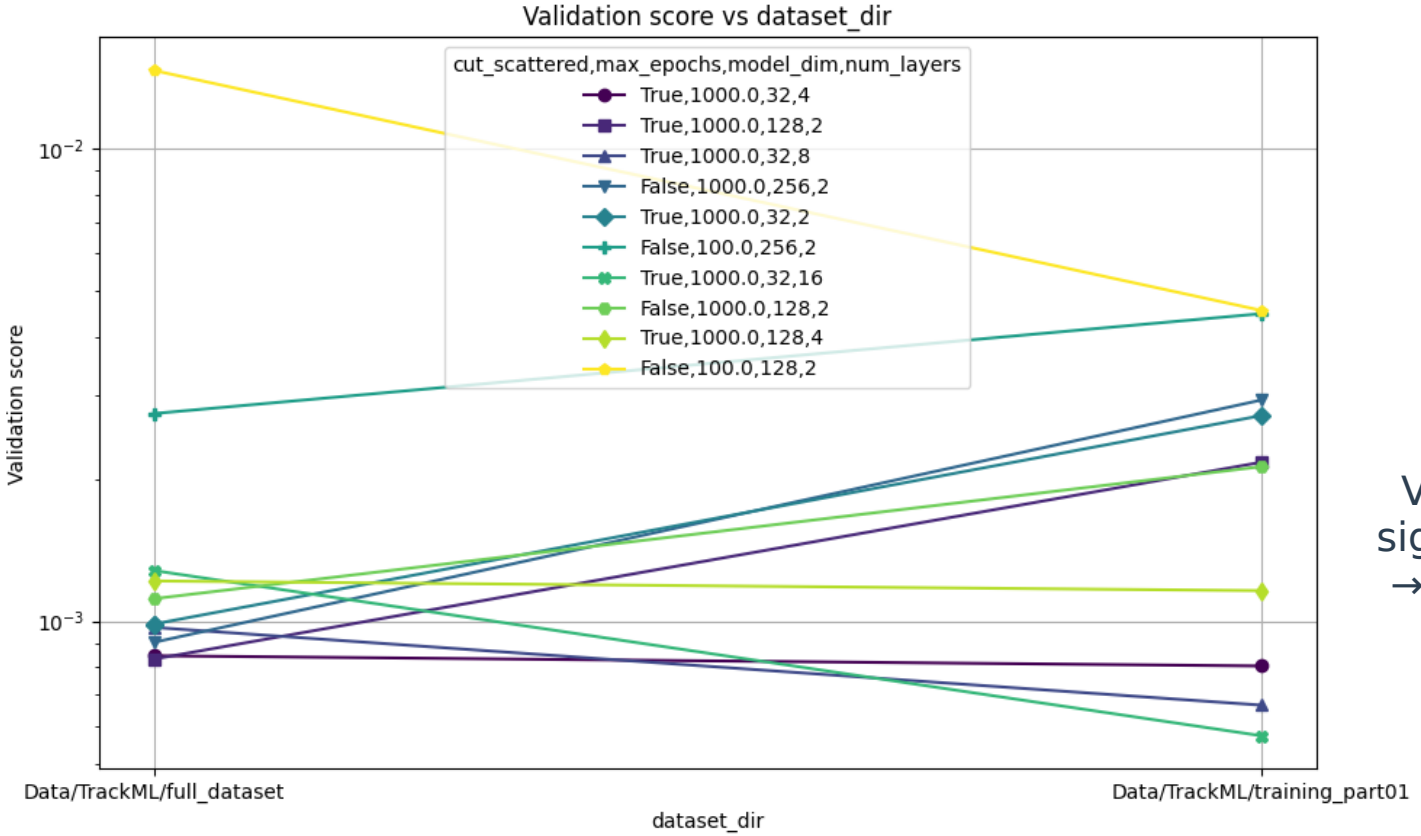


Hyperparameter optimization

Removing
0.3% of the tracks
and
sorting hits by r

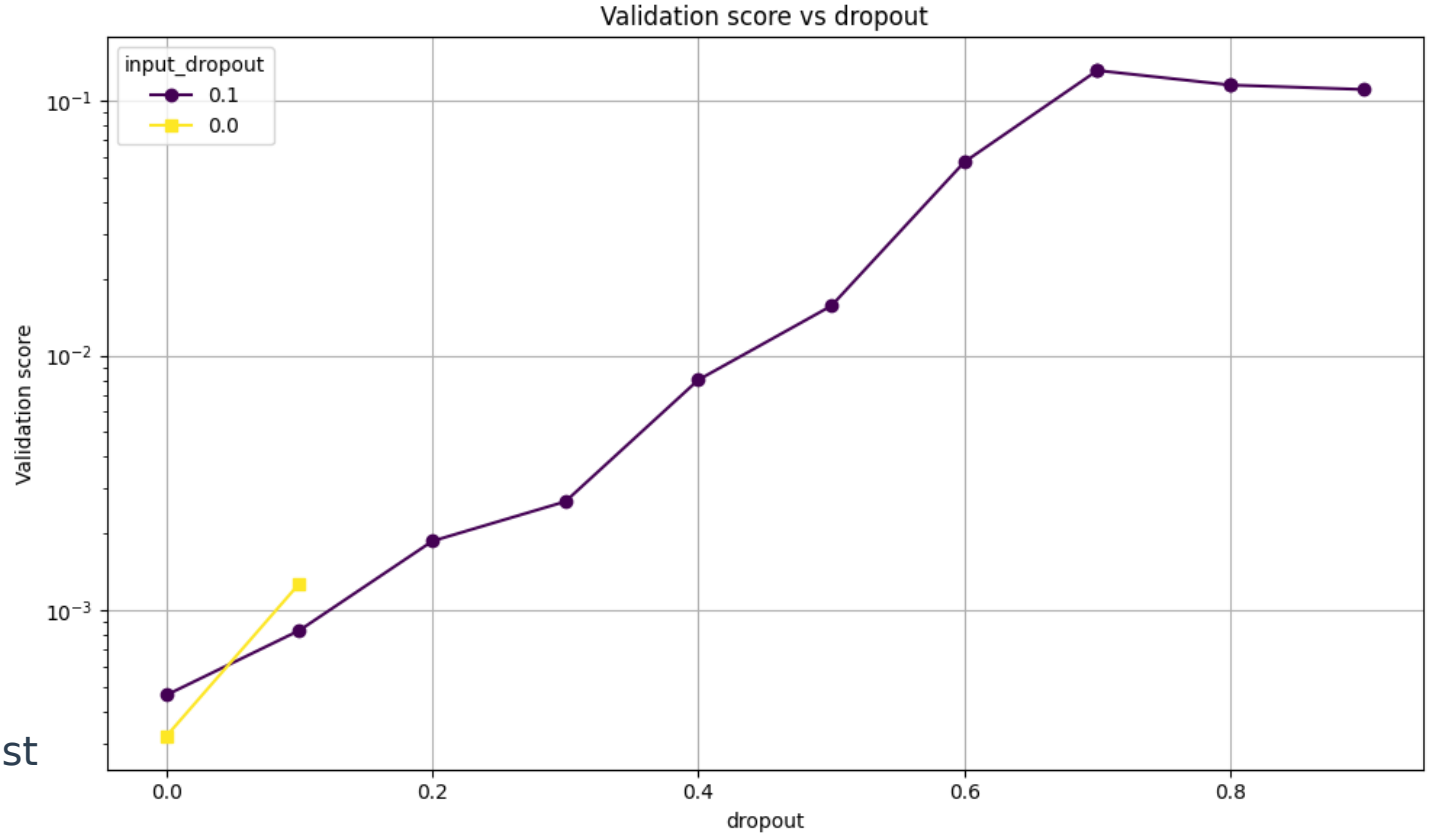


Hyperparameter optimization



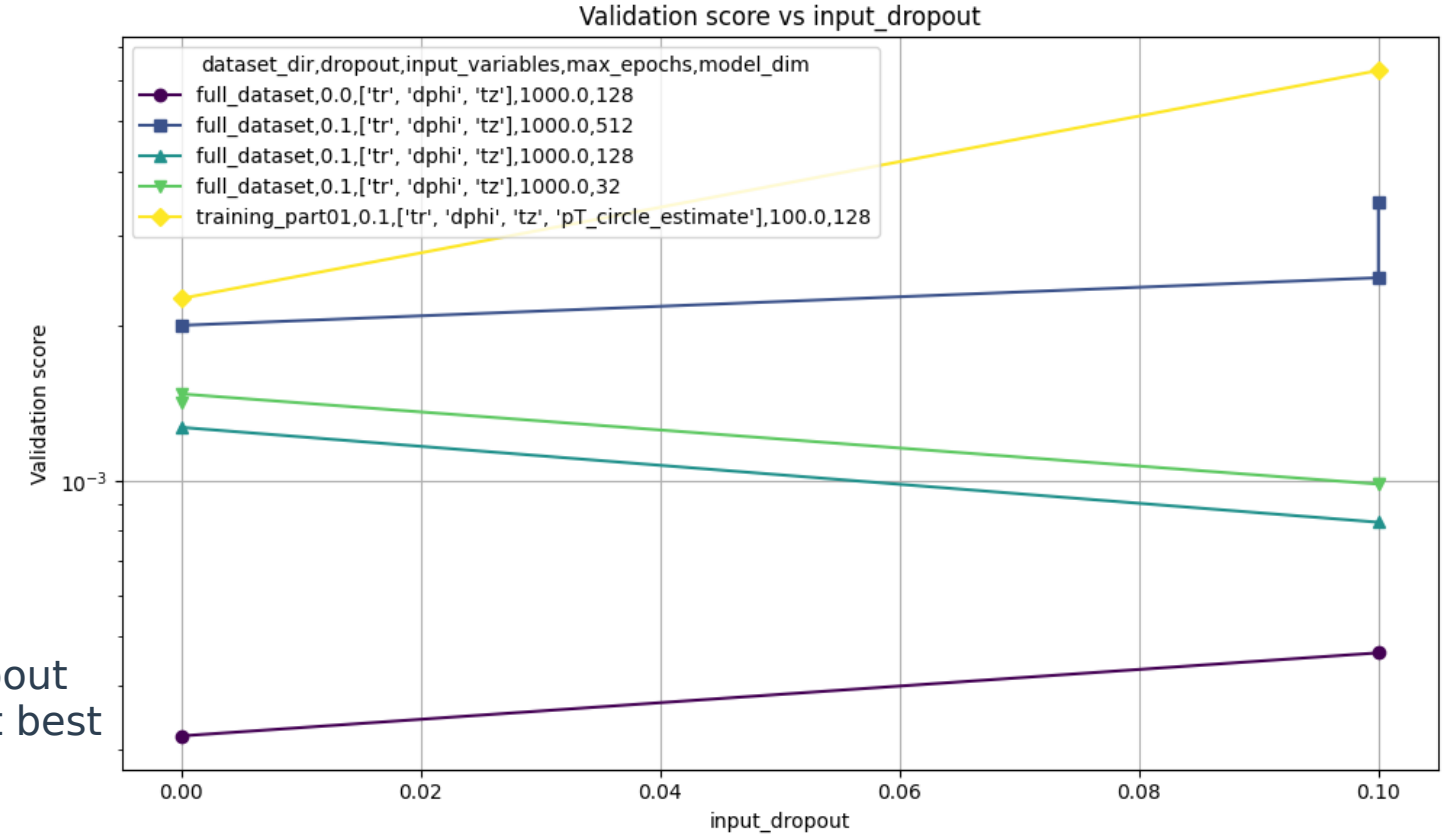
Validation dataset significantly different → hard to conclude

Hyperparameter optimization



No dropout works the best

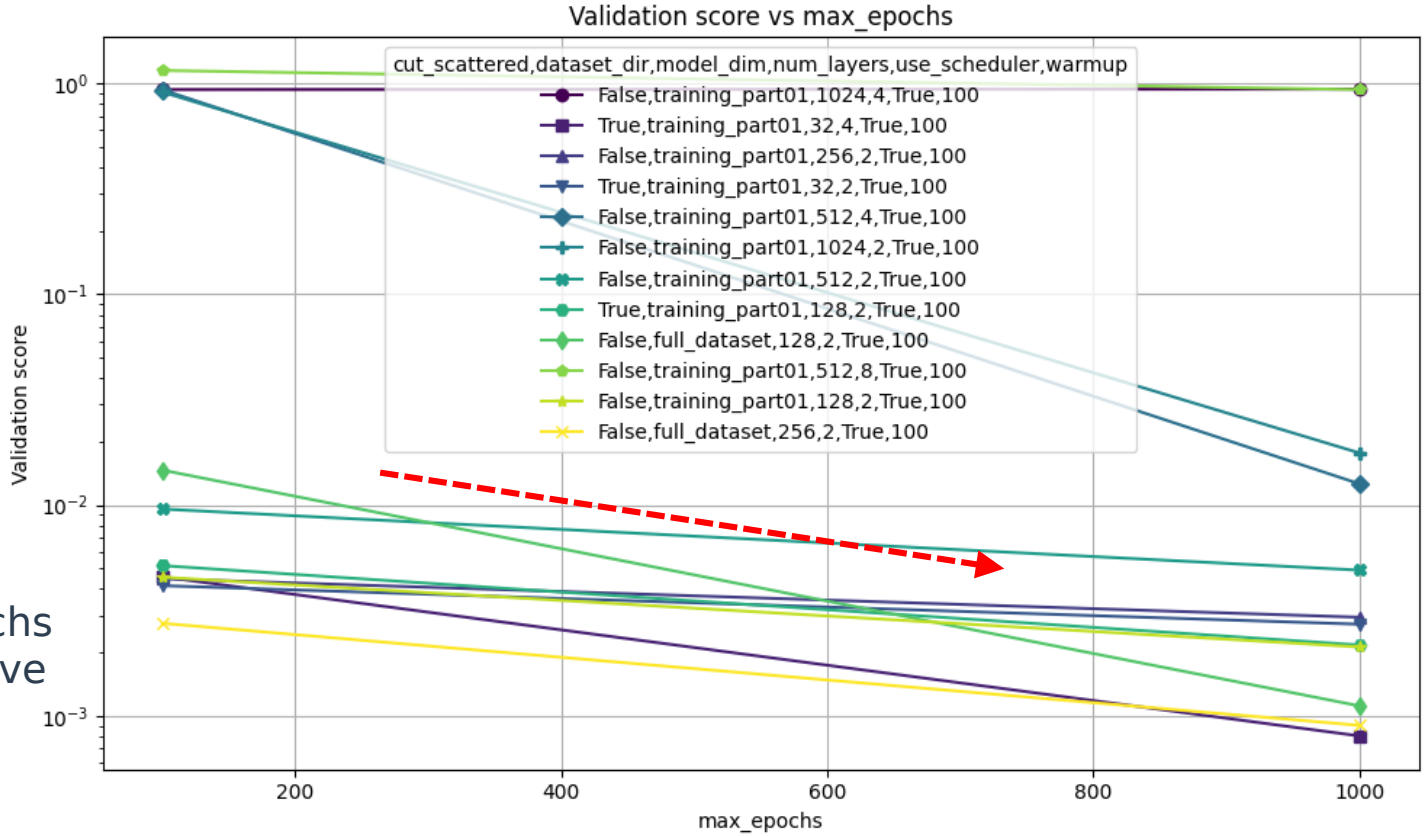
Hyperparameter optimization



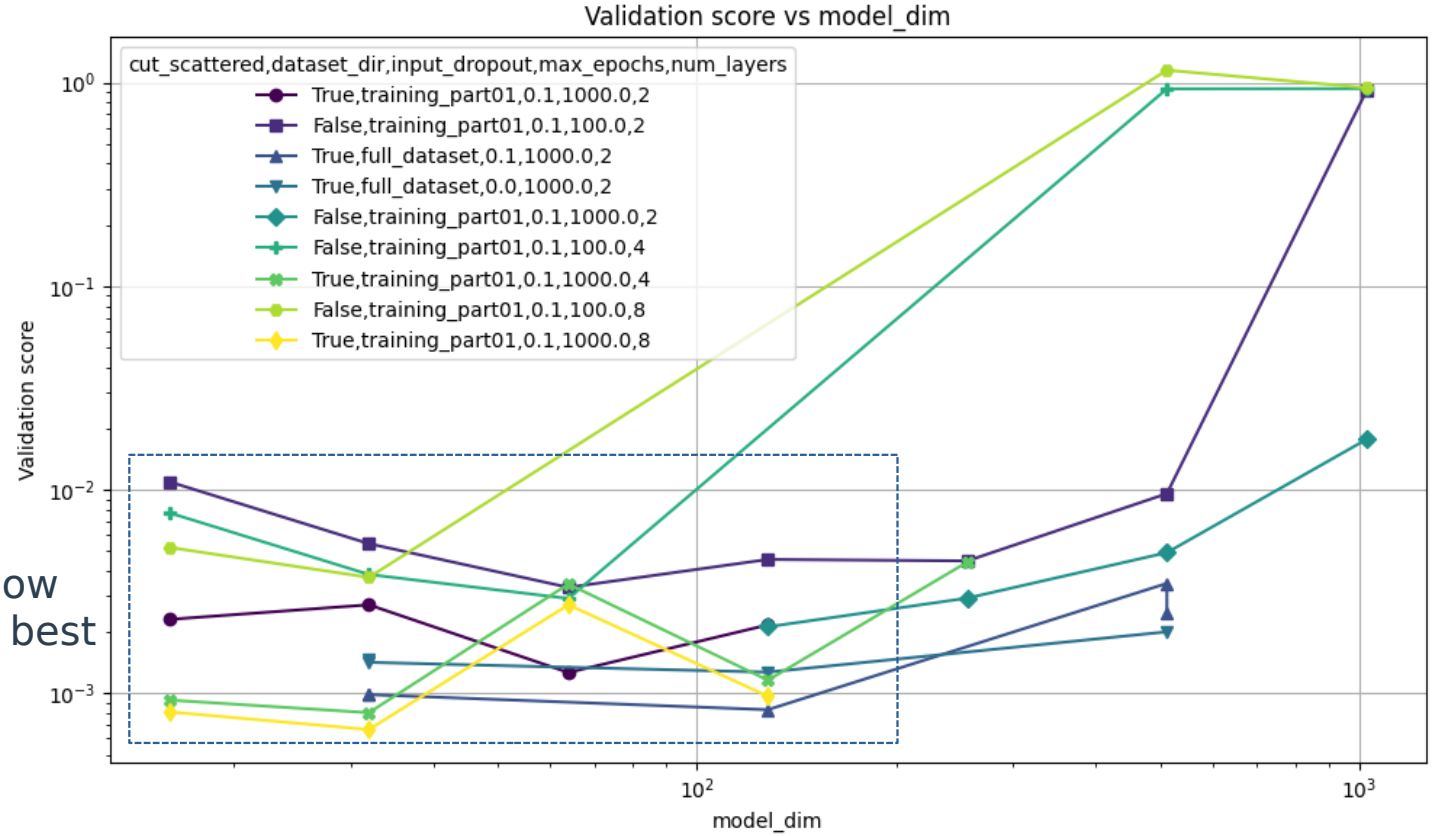
Unclear
but no dropout
is the current best

Hyperparameter optimization

Training
for more epochs
always improve



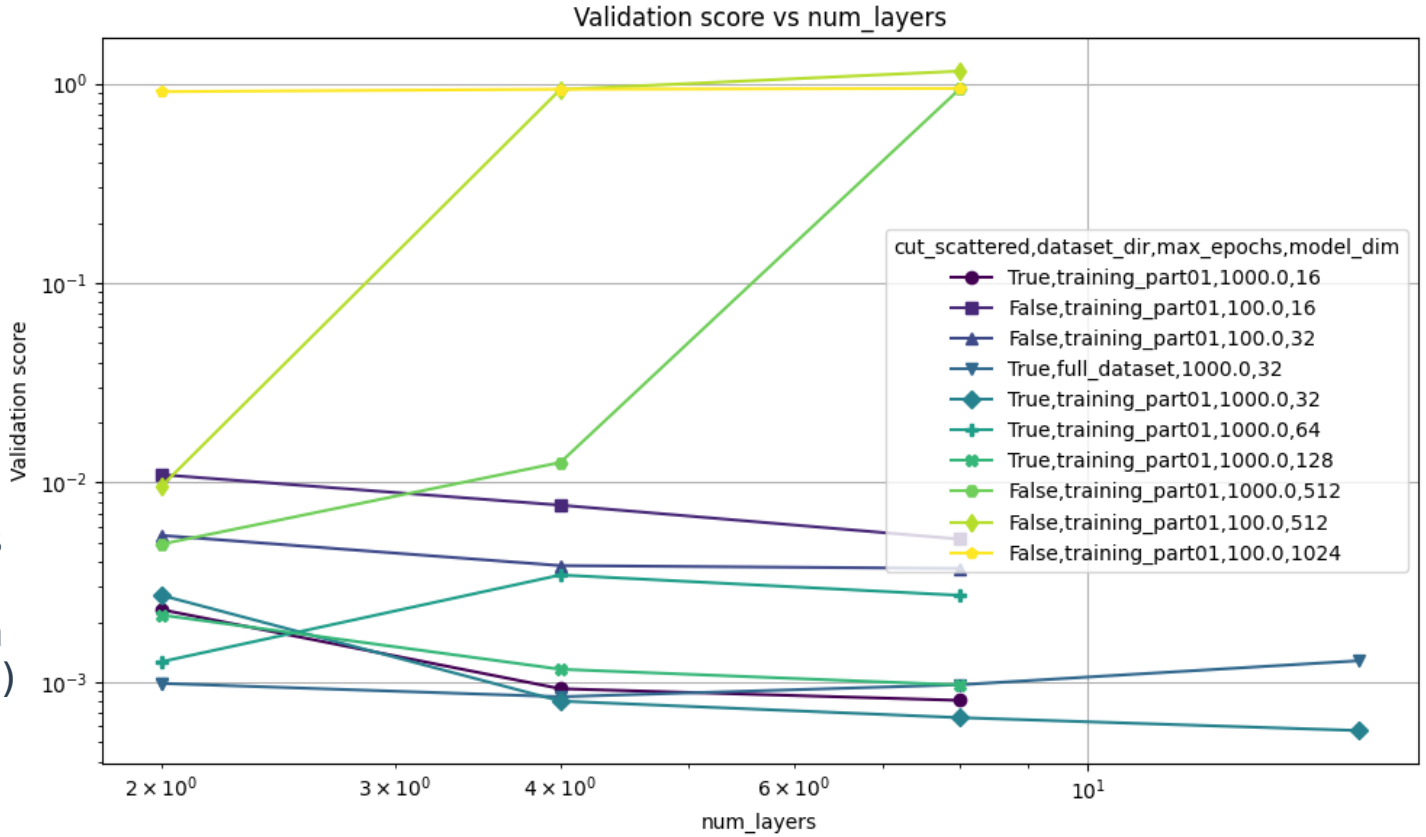
Hyperparameter optimization



128 and below seem to work best

Hyperparameter optimization

More layers is better (except with dim >= 512)

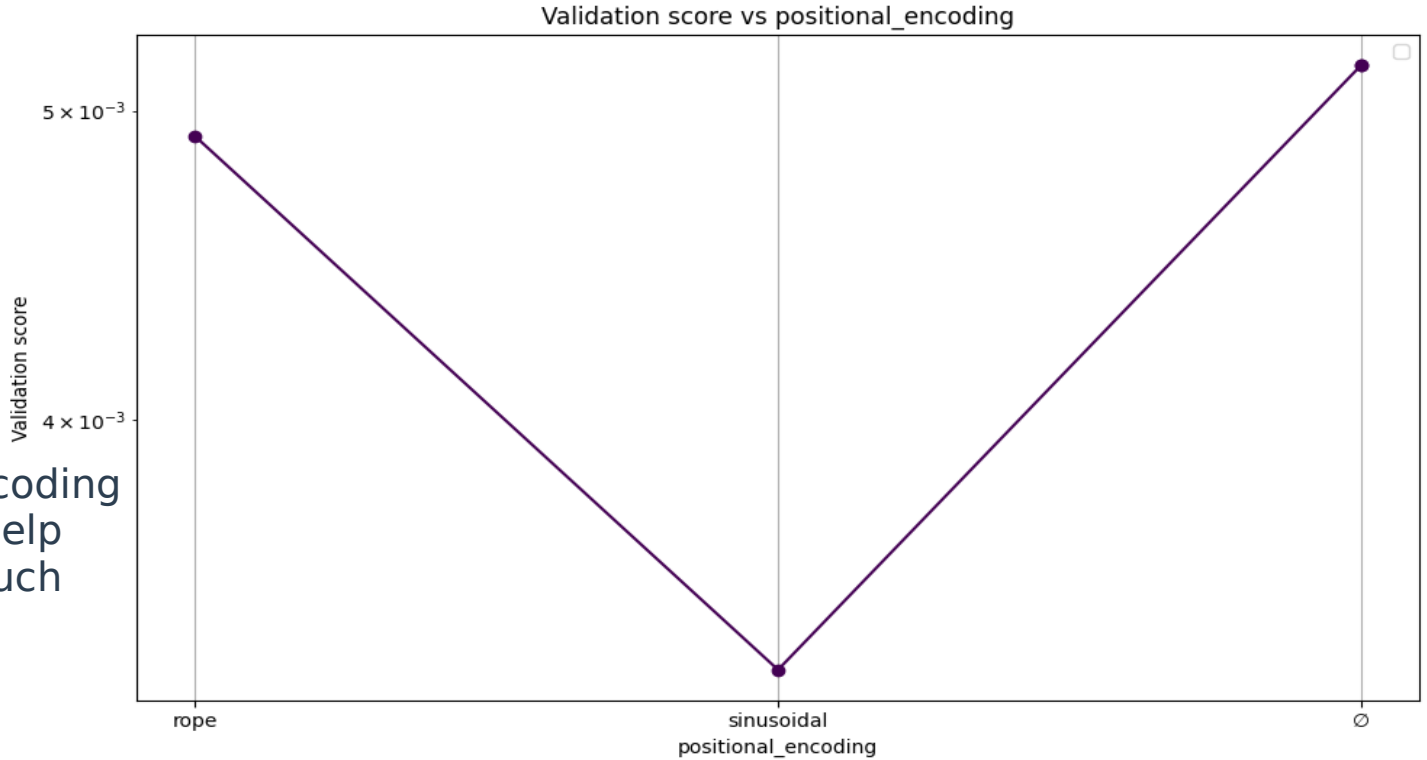


Hyperparameter optimization

Tested giving track hit index position to the model

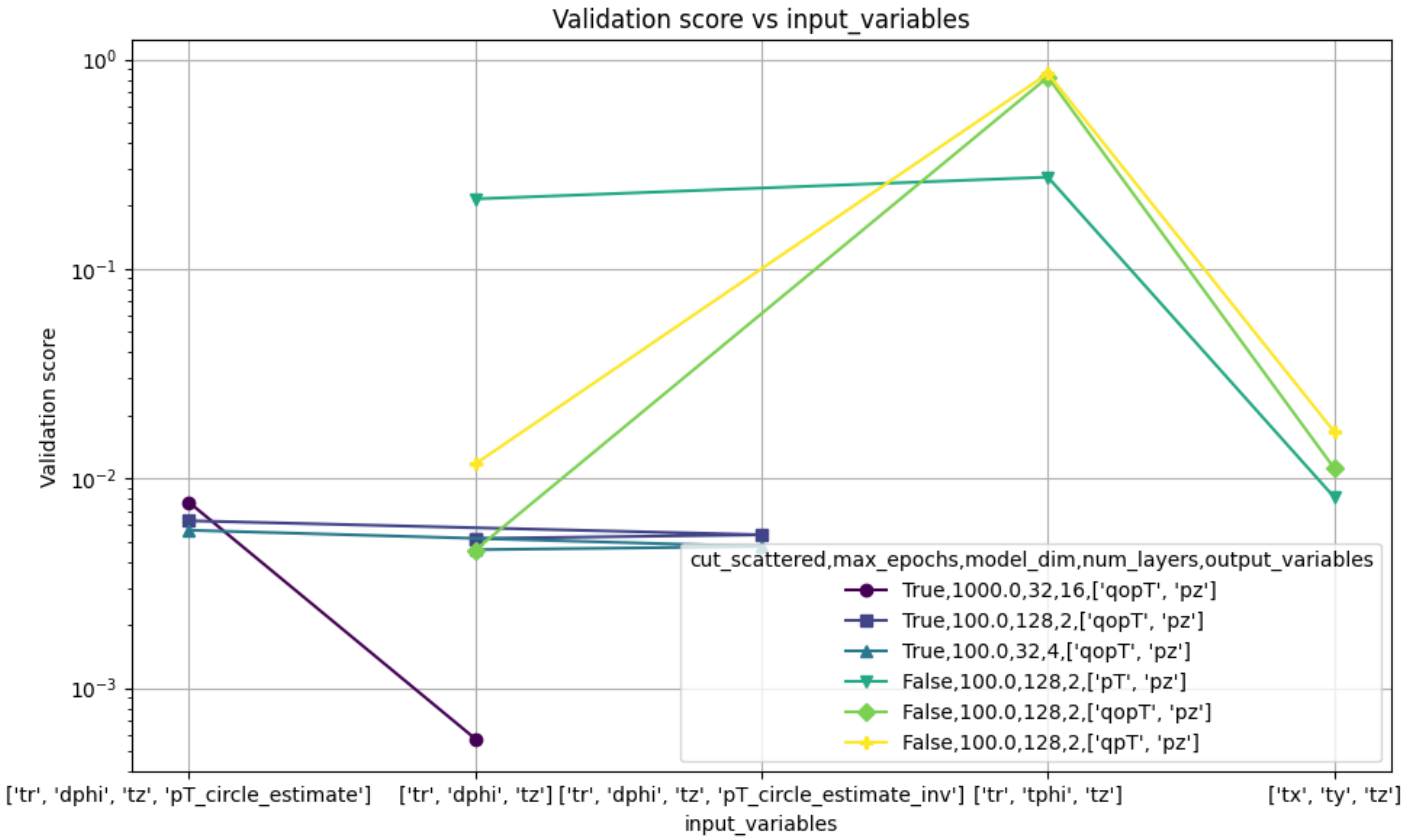
100 epochs
Sorted by r

Still testing



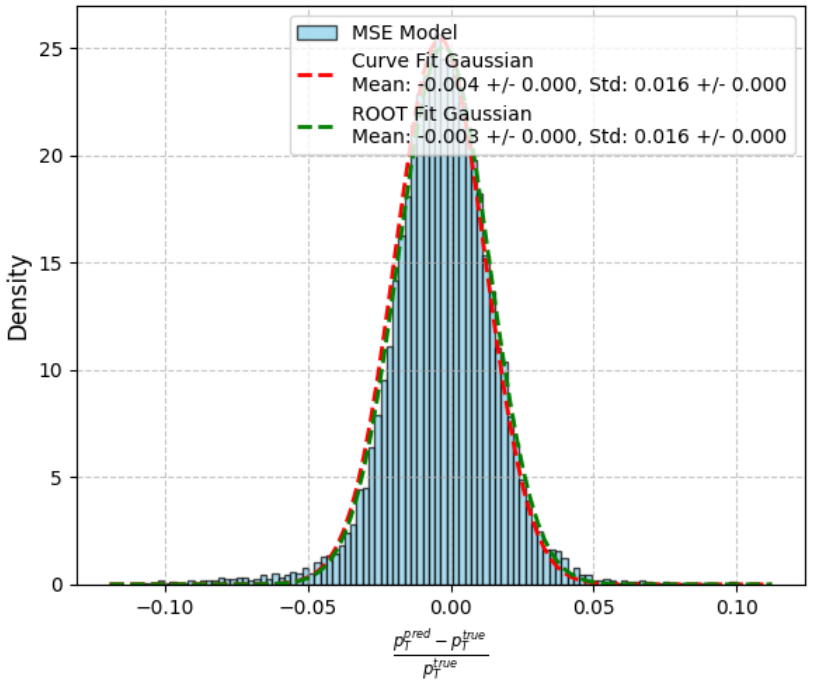
Positional encoding seems to help but not much

Hyperparameter optimization

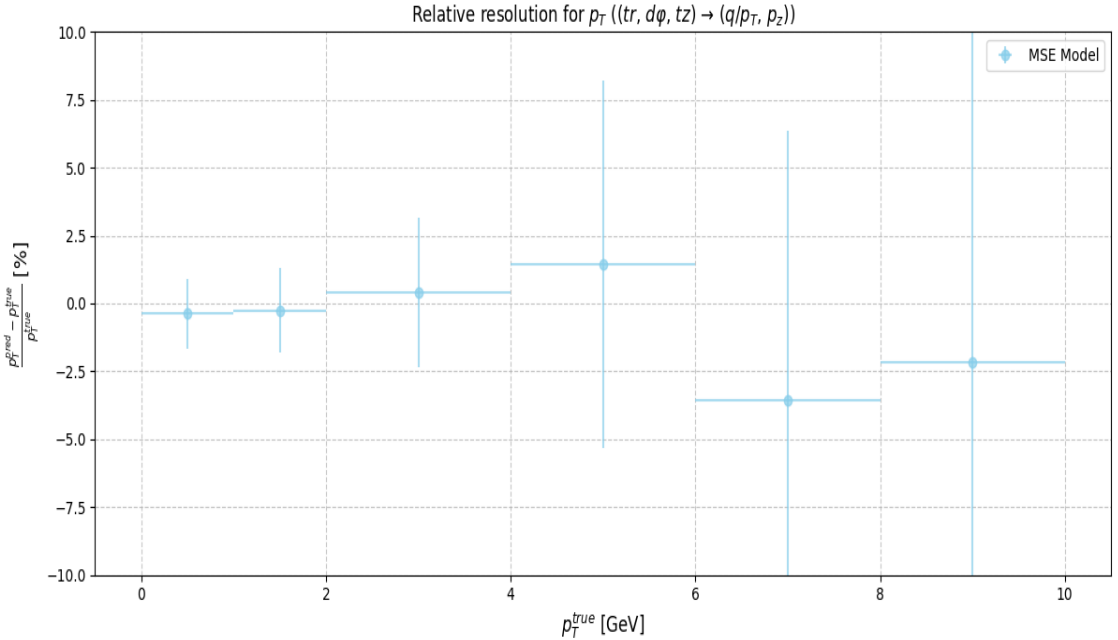


Current best models

r Distributions for p_T (1 GeV < p_T < 2 GeV) ((tr, $d\varphi$, tz)

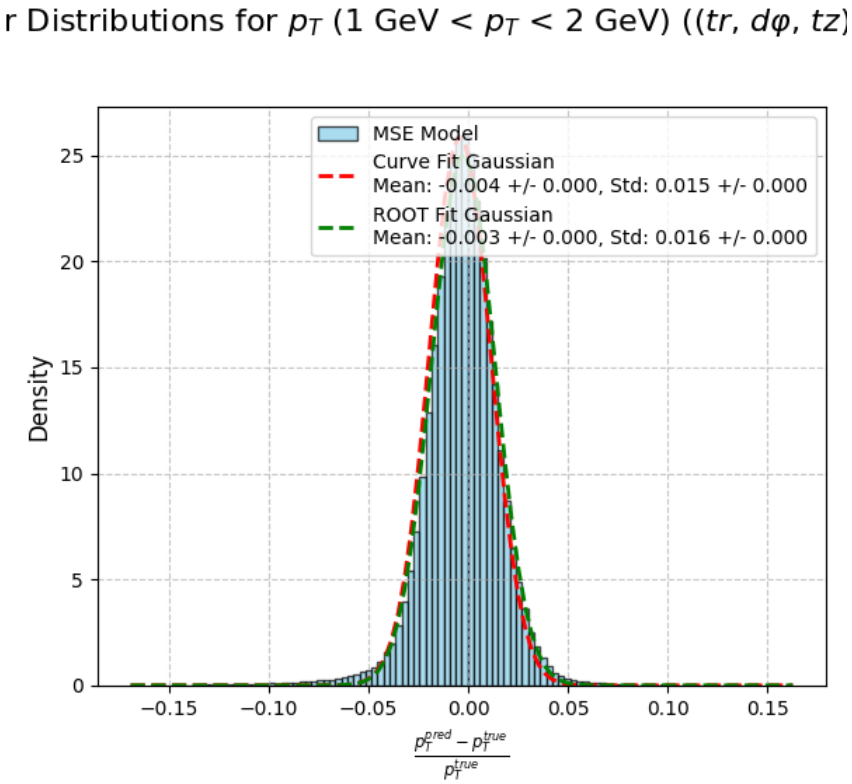


Embedding: 32; 16 layers



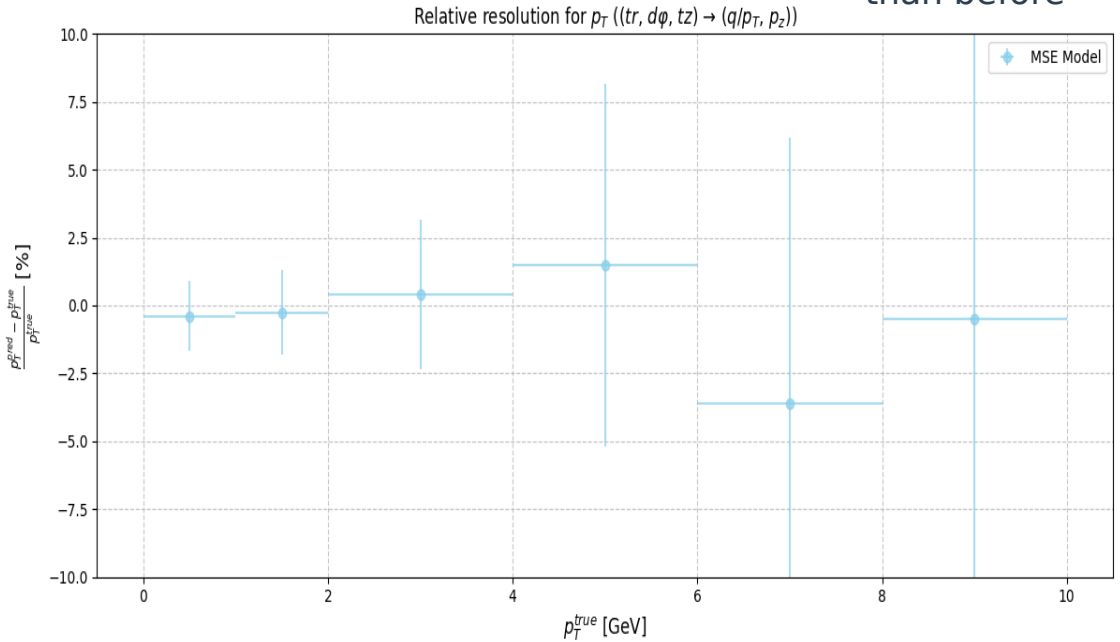
1st file (test dataset)
After scattering cut

Current best models



Embedding: 32; 16 layers

Same model than before

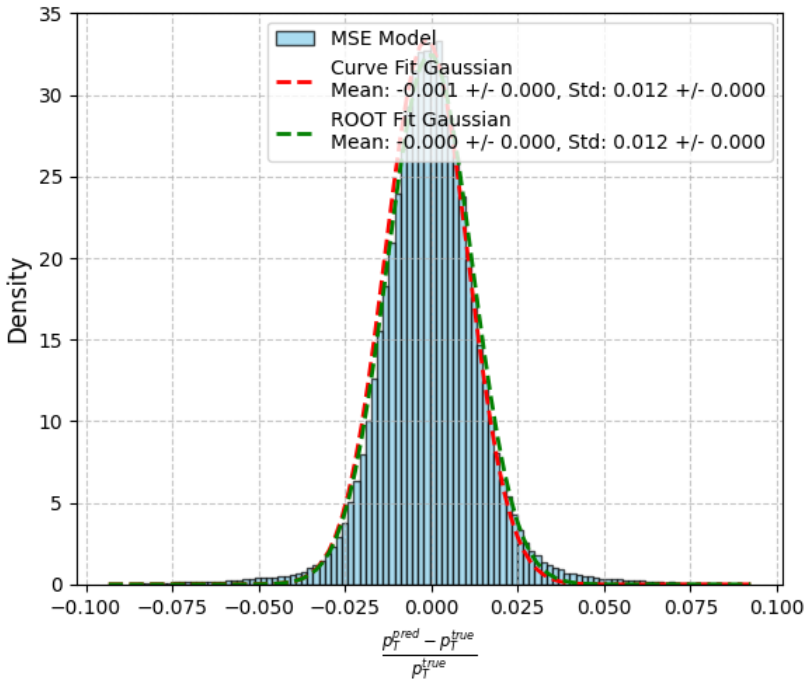


Full dataset (test dataset)

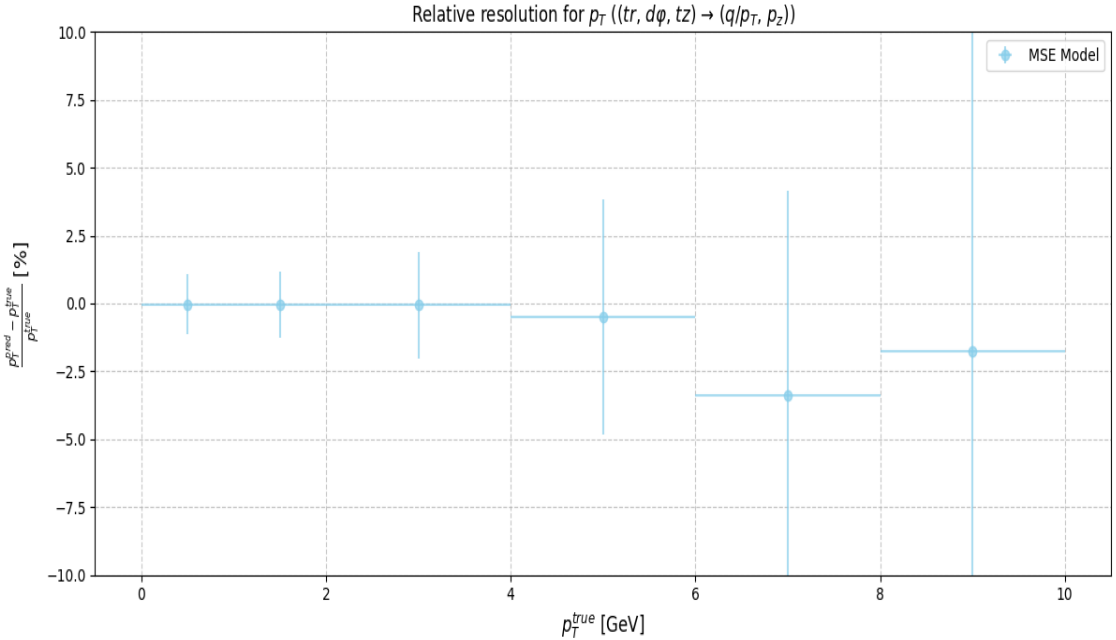
After scattering cut

Current best models

r Distributions for p_T (1 GeV < p_T < 2 GeV) ((tr, $d\varphi$, tz)



Embedding: 128; 2 layers; no dropout



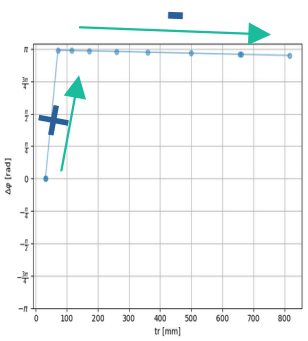
Full dataset (test dataset)
After scattering cut

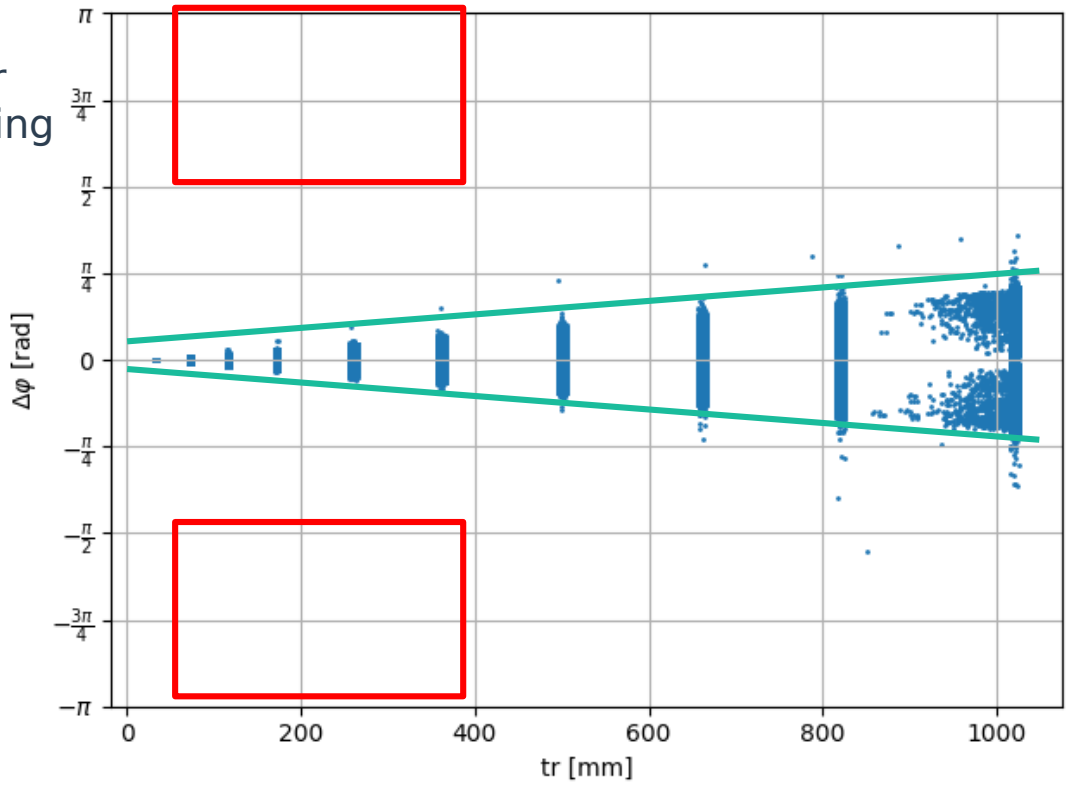
BACKUP

Δφ distribution after scattering cut

Cut any sign change in d(Δφ)/dr
→ remove all scattering

~ 0.3 % of the dataset
(257 particles)





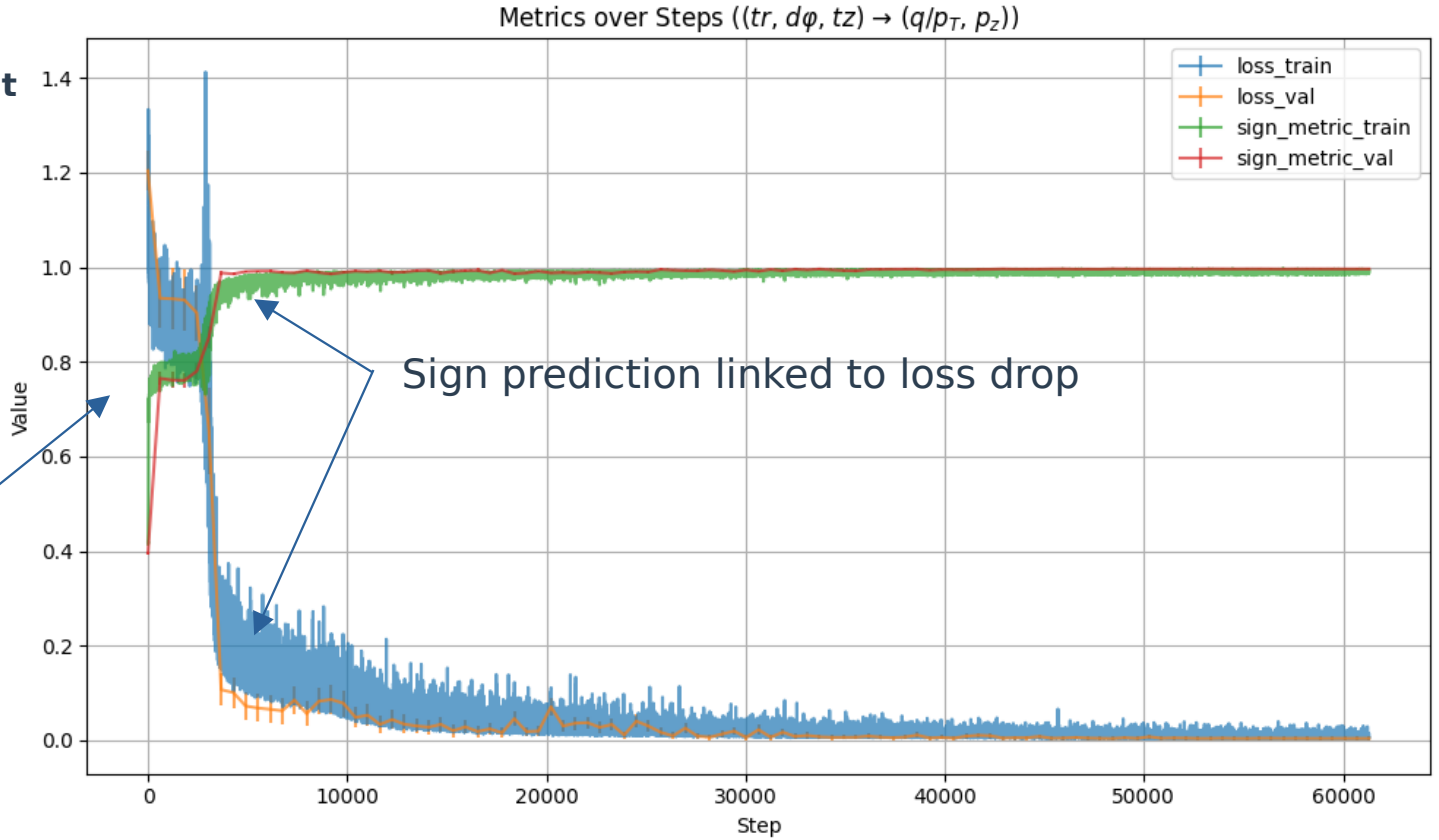
78 345 test particles

Expected

Not expected

Loss and charge sign

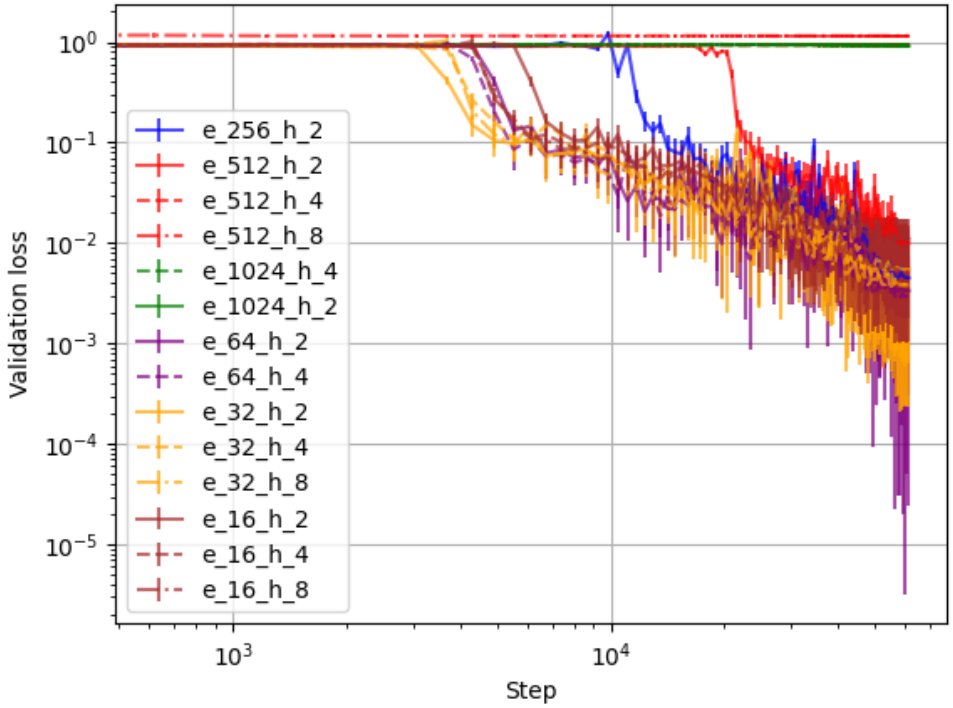
Scattering cut



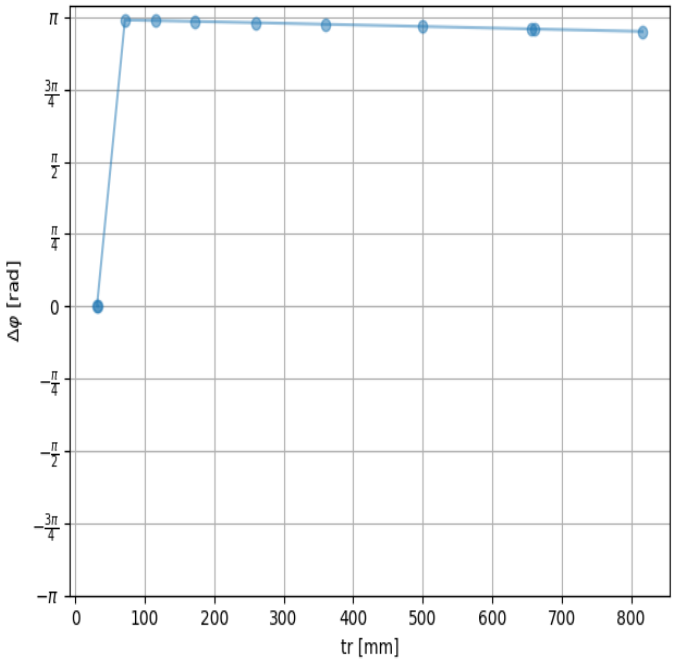
Why 80%?

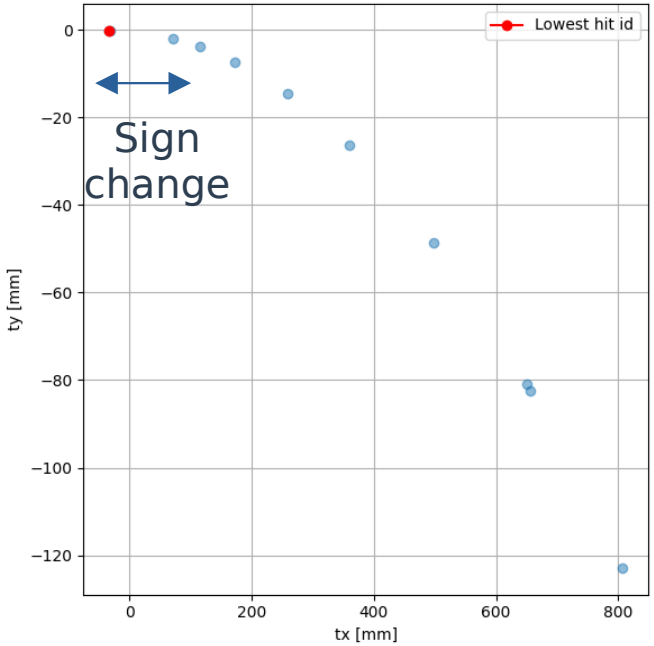
Architecture optimization

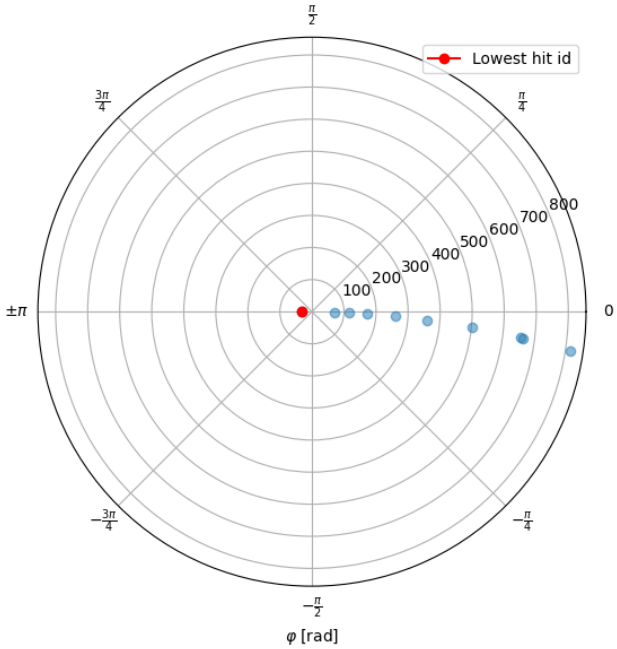
No scattering cut
100 epochs



Some inspections







Some inspections