



# CEPC

Jets, samples and Wednesday working meeting Kaili Zhang <u>zhangkl@ihep.ac.cn</u>

### NaN issue solved



#### Now training results can predict.

#### - confusion\_matrix:

com aston_mactiv.	
[[0.73624665 0.15256558 0	.03817973 0.04011828 0.00385521 0.00157713
0.00193856 0.00315426 0	.00226713 0.00139094 0.01870653]
[0.13643385 0.75958368 0	.03271432 0.0379622 0.00164339 0.00387839
0.00436045 0.00124897 0	.0013914 0.00303478 0.01774856]
[0.0088283 0.02205431 0	71456615 0.04852825 0.03377786 0.03685954
0.04519433 0.006284 0	.00943148 0.02762546 0.04685032]
[0.01422383 0.01668038 0	.03591599 0.72146735 0.03470966 0.04223282
0.00911334 0.03592696 0	.03005977 0.01095575 0.04871415]
[0.00215073 0.00283852 0	.02557944 0.02370165 0.50521305 0.08571241
0.02929135 0.08798323 0	.09359477 0.04942302 0.09451183]
[0.00129923 0.00375575 0	.02286201 0.02024172 0.06878255 0.53297741
0.11532541 0.0183966 0	.04953435 0.08119616 0.08562881]
[0.00106888 0.00303212 0	.02275181 0.01093963 0.03029939 0.12441512
0.43260075 0.02721274 0	.08220538 0.16920979 0.09626438]
[0.00219195 0.00231191 0	.01137417 0.02365347 0.12105912 0.03432971
0.05412273 0.32365675 0	2476581 0.07156021 0.10808188]
[0.00194135 0.00278114 0	.01369848 0.02190012 0.0983215 0.08385957
0.07341121 0.176477 0	.34151316 0.07596331 0.11013317]
[0.00146183 0.00288002 0	.02325835 0.012131 0.07471691 0.10363712
0.26983833 0.04602579 0	.09357886 0.27157288 0.10089892]
[0.01225046 0.01678854 0	.0336829 0.03244845 0.06609608 0.07951045
0.09167862 0.05502128 0	.06615486 0.05685532 0.48951304]]
[2025-04-11 11:10:55,425]	<pre>INFO: ^[[1mEpoch #0: Current validation metric: 0.52981 (best: 0.52981)^[[0m</pre>
[2025-04-11 11:10:55,425]	INFO:

#### Results with ParT under preparing.

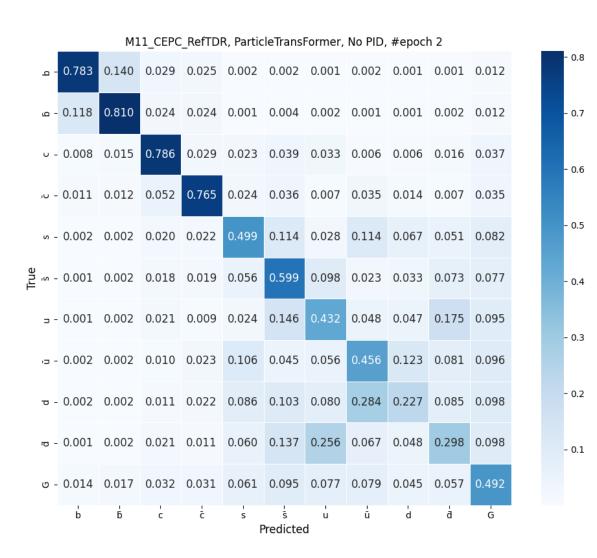
#### By adding protection like, then retraining:

47	def	<pre>to_ptrapphim(x, return_mass=True, eps=1e-8):</pre>									
48		# x: (N, 4,), dim1 : (px, py, pz, E)									
49		<pre>px, py, pz, energy = x.split((1, 1, 1, 1), dim=1)</pre>									
50		<pre>pt = torch.sqrt(to_pt2(x, eps=eps))</pre>									
51		<pre># rapidity = 0.5 * torch.log((energy + pz) / (energy - pz))</pre>									
52		# rapidity = 0.5 * torch.log(1 + (2 * pz) / (energy - pz).clamp(min=1e-20))									
53	2										
54	· · ·	phi = torch.atan2(py, px)									
55		if not return_mass:									
56		return torch.cat((pt, rapidity, phi), dim=1)									
57		else:									
58		<pre>m = torch.sqrt(to_m2(x, eps=eps))</pre>									
59		return torch.cat((pt, rapidity, phi, m), dim=1)									
60		return toren.cat((pt, rapidity, phi, m), dim-i)									
61											
	[202	<pre>[ 5.8874, 5.9991, -2.0369,, -1.5459, -1.1884, -0.3939], [-2.8019, -3.6526, -0.5501,, 1.7558, 0.5533, 1.5981], [ -3.0114, -2.7739, -1.2288,, 0.6679, 1.3693, 1.5613], [ 0.6619, 0.1554, 6.8964,, -1.5974, -1.2169, 1.1553], [ 2.2230, 4.0747, 5.6043,, -2.4179, -1.1996, -0.1980], device='cuda:0') 5-04-1 11:10:37,774] IMFO: torch.Size([512]), tensor([ 3, 1, 6, 2, 7, 1, 3, 8, 9, 6, 4, 1, 1, 3, 3, 10, 3, 3, 9, 7, 10, 9, 7, 0, 6, 5, 5, 8, 10, 5, 9, 8, 3, 10, 3, 1, 0, 2, 3, 1, 1, 4, 8, 7, 2, 10, 7, 8, 9, 3, 5, 7, 5, 1, 5, 44, 3, 0, 2, 9, 9, 10, 10, 3, 7, 8, 6, 0, 8, 6, 8, 2, 4, 1, 0, 6, 0, 16, 9, 10, 3, 8, 2, 1, 7, 1, 7, 9, 8, 7, 9, 5, 5, 4, 7, 2, 0, 8, 8, 5, 8, 0, 4, 6, 7, 6, 9, 1, 3, 10, 8, 2, 7, 8, 3, 6, 18, 6, 9, 9, 0, 1, 2, 3, 3, 6, 2, 0, 9, 8, 6, 9, 6, 2, 2, 2, 9, 8, 0, 4, 10, 4, 8, 4, 8, 5, 2, 0, 10, 0, 2, 2, 6, 3, 8, 7, 10, 7, 5, 5, 7, 7, 2, 1, 4, 2, 6, 9, 4, 10, 4, 5, 10, 3, 2, 1, 5, 5, 8, 9, 0, 8, 0, 5, 2, 10, 0, 0, 2, 2, 6, 6, 9, 3, 1, 1, 10, 3, 5, 6, 3, 2, 0, 7, 3, 10, 5, 8, 6, 2, 9, 9, 0, 3, 9, 0, 8, 0, 5, 2, 10, 0, 3, 9, 2, 2, 2, 6, 0, 9, 3, 1, 1, 10, 3, 5, 6, 3, 2, 0, 7, 3, 10, 5, 8, 6, 2, 9, 9, 0, 5, 4, 6, 9, 2, 5, 9, 0, 6, 8, 2, 9, 10, 7, 10, 2, 9, 8, 7, 5, 5, 7, 7, 2, 5, 9, 0, 6, 8, 2, 9, 10, 7, 10, 5, 8, 6, 2, 9, 9, 0, 5, 4, 6, 9, 2, 5, 7, 10, 1, 9, 3, 1, 6, 8, 6, 2, 9, 9, 0, 5, 4, 6, 9, 2, 5, 7, 9, 0, 6, 8, 2, 9, 10, 7, 10, 2, 9, 8, 7, 5, 4, 3, 9, 6, 5, 7, 10, 1, 9, 3, 1, 7, 10, 5, 6, 6, 0, 5, 8, 3, 5, 9, 0, 1, 7, 0, 3, 10, 6, 3, 5, 2, 2, 9, 9, 5, 4, 6, 9, 2, 5, 9, 9, 6, 6, 8, 2, 9, 10, 7, 10, 2, 9, 5, 7, 5, 4, 3, 1, 1, 6, 3, 5, 0, 10, 0, 11, 5, 2, 2, 9, 2, 7, 0, 6, 9, 5, 3, 1, 2, 0, 2, 7, 6, 10, 1, 10, 3, 1, 7, 10, 5, 6, 6, 9, 5, 3, 1, 2, 0, 1, 7, 0, 3, 10, 6, 3, 5, 2, 10, 9, 0, 3, 1, 7, 9, 1, 10, 8, 9, 2, 3, 0, 3, 1, 7, 3, 4, 5, 1, 3, 10, 6, 9, 7, 8, 7, 2, 6, 1, 2, 3, 11, 1, 6, 3, 11, 4, 6, 11, 6, 10, 2, 9, 5, 7, 8, 7, 2, 6, 1, 2, 3, 11, 1, 6, 3, 11, 4, 6, 11, 6, 10, 2, 9, 5, 3, 6, 5, 3, 1, 1, 6, 3, 5, 9, 0, 4, 4, 5, 6, 7, 2, 6, 7, 6, 9, 7, 8, 7, 2, 6, 1, 2, 3, 11, 1, 6, 3, 11</pre>									

## ParT, no ID result

Intermediate stage, final results can better; Metric: 0.55868



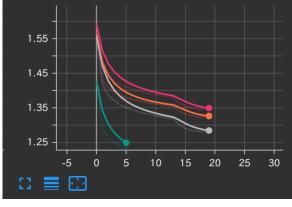


2025/4/11

#### ParticleNet:



Acc/train (epoch) tag: Acc/train (epoch) 0.540.540.460.42-50.460.42-5010 15 20 25 30C Loss/train (epoch) tag: Loss/train (epoch)



No PID; (No PID information entry) TruthPID (not finished yet) RecoPID RecoPID+Only ChargedTracks(No nertral PFO)

Value	Step
0.4889	
0.5476	5
0.5234	19
0.5052	19

No overtraining; Results shows:

TruthPID > RecoPID > RecoPID chargedtracksonly > No PID.

### PN, truth PID

Intermediate stage, final results can better; Issue: charge asymmetry; Metric: 0.55052



0.8

M11\_CEPC\_RefTDR, PartieNet, TruthPID.png 0.805 0.116 0.028 0.023 0.002 0.001 0.001 0.002 0.001 0.000 0.019 ച -0.026 0.026 0.001 0.002 0.002 0.001 0.001 0.001 0.019 o - 0.156 0.764 - ص - 0.7 <u>u</u> - 0.010 0.016 0.779 0.042 0.026 0.029 0.028 0.005 0.007 0.012 0.045 - 0.6 <u>-0.017 0.010 0.041 0.779 0.027 0.025 0.005 0.029 0.015 0.004 0.047</u> - 0.5 ω - 0.002 0.001 0.017 0.022 0.526 0.081 0.021 0.111 0.074 0.032 0.113 <u>2 v</u> - 0.001 0.002 0.020 0.020 0.086 0.548 0.088 0.027 0.046 0.057 0.105 0.4 **-** - 0.001 0.002 0.020 0.010 0.036 0.151 0.389 0.058 0.070 0.139 0.123 - 0.3 - - 0.002 0.001 0.010 0.022 0.124 0.036 0.040 0.439 0.147 0.044 0.136 - 0.2 **v** - 0.002 0.001 0.011 0.022 0.110 0.084 0.060 0.280 0.248 0.046 0.134 ro - 0.001 0.002 0.020 0.012 0.084 0.128 0.239 0.081 0.080 0.224 0.129 - 0.1 v - 0.013 0.012 0.032 0.031 0.067 0.076 0.066 0.045 0.039 0.553 0.067 b b ċ ċ d à Ġ ū s u Predicted

2025/4/11

### PN, reco PID



#### Metric: 0.52211

M11_CEPC_RefTDR, ParticleNet, Reco PID 98%WP											
þ	0.777	0.147	0.024	0.028	0.003	0.001	0.001	0.002	0.001	0.001	0.015
۰D	0.145	0.780	0.027	0.024	0.001	0.002	0.002	0.001	0.001	0.001	0.016
U ·	0.010	0.015	0.755	0.059	0.021	0.035	0.031	0.006	0.007	0.017	0.044
. ن	0.014	0.010	0.057	0.760	0.033	0.022	0.006	0.032	0.016	0.007	0.044
s .	0.002	0.001	0.014	0.022	0.450	0.098	0.027	0.144	0.083	0.052	0.107
True <sup>s</sup>	0.001	0.002	0.021	0.015	0.096	0.462	0.138	0.026	0.049	0.082	0.108
D.	0.001	0.002	0.021	0.009	0.044	0.173	0.376	0.034	0.063	0.163	0.113
L	0.002	0.001	0.008	0.023	0.170	0.044	0.035	0.383	0.156	0.063	0.115
q	0.002	0.001	0.010	0.021	0.154	0.092	0.055	0.245	0.225	0.076	0.118
g	- 0.001	0.002	0.019	0.011	0.088	0.155	0.243	0.056	0.075	0.232	0.118
ڻ ا	0.013	0.013	0.029	0.029	0.074	0.076	0.065	0.067	0.044	0.046	0.543
	b	Б	c	ċ		s redicte		ů	ď	å	Ġ

98% Lepton WP used in this JOI. May not the best option. (high pi to muon migration rate, worse purity) Impact of different WP Under tuning.

- 0.7

- 0.6

- 0.5

- 0.4

- 0.3

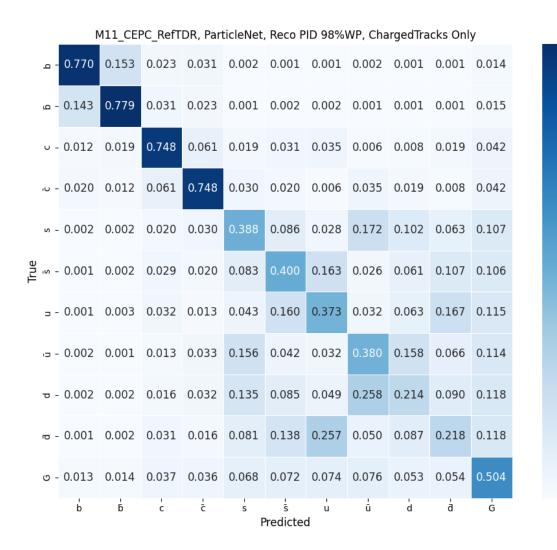
- 0.2

- 0.1

@geliang: 70%WP recommended in Jet. (purity essential). 98%WP for high energy leptons.

### PN, reco PID, charged tracks only

Metric: 0.50198



0.7	
	Only charged track
0.6	informations in JOI.
	Neutral PFOs not included.
0.5	This corresponds to
	committee question
0.4	"What if no Calorimeter".

- 0.3

- 0.2

- 0.1



### PN, no PID



#### Metric: 0.48355

				MII_CE	FC_Ref	DR, Pal	liciene	t, NOPID				1
- م	0.770	0.161	0.020	0.026	0.002	0.001	0.001	0.003	0.001	0.000	0.015	
- ص	0.159	0.772	0.026	0.020	0.001	0.002	0.002	0.001	0.001	0.001	0.017	
U -	0.016	0.026	0.731	0.080	0.014	0.032	0.033	0.006	0.006	0.011	0.045	
.u -	0.025	0.015	0.078	0.733	0.032	0.014	0.006	0.034	0.012	0.006	0.045	
ν-	0.003	0.002	0.020	0.037	0.337	0.107	0.031	0.214	0.077	0.050	0.121	
True <sup>s</sup>	0.002	0.003	0.035	0.021	0.105	0.343	0.215	0.030	0.051	0.072	0.123	
5 -	0.002	0.003	0.036	0.015	0.047	0.178	0.393	0.032	0.053	0.115	0.126	
- C	0.004	0.002	0.015	0.038	0.176	0.046	0.033	0.390	0.120	0.050	0.126	
ס -	- 0.003	0.002	0.018	0.034	0.190	0.087	0.050	0.273	0.145	0.068	0.130	
- סו	0.002	0.003	0.034	0.019	0.087	0.187	0.278	0.048	0.071	0.142	0.130	
ۍ ت <u>ا</u>	0.015	0.015	0.038	0.037	0.065	0.064	0.070	0.071	0.031	0.032	0.562	
	b	Б	c	ċ	s F	s redicte		ū	ď	å	Ġ	

M11\_CEPC\_RefTDR, ParticleNet, NoPID

### Extrapolation



#### Red: from extrapolation.

	PN		ParT	
Truth PID	0.55052	+5.4%	0.63605	
Reco PID	0.52211	+4.0%	0.60323	
Reco PID, charged tracks only	0.50198	+3.8%	0.57997	
No PID	0.48355		0.55868	+15.5%

10 points plot, ROC curve under preparation.