



Jet@Clusters

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Hqq M11->M10



Exclude gluon, re-normalization:

Truth	CEPC										Hqq
	b	$\bar{b}$	c	$\bar{c}$	s	$\bar{s}$	u	$\bar{u}$	d	$\bar{d}$	g
b	0.811	0.132	0.019	0.016	0.002	0.001	0.001	0.002	0.002	0.001	0.013
$\bar{b}$	0.124	0.819	0.017	0.018	0.001	0.002	0.002	0.001	0.001	0.002	0.014
c	0.009	0.012	0.798	0.042	0.019	0.027	0.027	0.006	0.007	0.017	0.035
$\bar{c}$	0.013	0.011	0.049	0.790	0.027	0.022	0.006	0.026	0.016	0.007	0.033
s	0.002	0.001	0.016	0.019	0.488	0.095	0.028	0.119	0.093	0.053	0.084
$\bar{s}$	0.001	0.002	0.020	0.015	0.084	0.508	0.124	0.024	0.049	0.091	0.082
u	0.001	0.002	0.021	0.008	0.035	0.146	0.413	0.037	0.068	0.178	0.092
$\bar{u}$	0.002	0.001	0.008	0.021	0.139	0.040	0.045	0.391	0.189	0.070	0.093
d	0.002	0.001	0.011	0.019	0.124	0.088	0.066	0.218	0.296	0.080	0.096
$\bar{d}$	0.001	0.002	0.020	0.009	0.078	0.132	0.239	0.059	0.076	0.289	0.095
g	0.011	0.012	0.029	0.029	0.074	0.077	0.072	0.066	0.057	0.057	0.514
Predicted											

Truth	CEPC										Hqq
	b	$\bar{b}$	c	$\bar{c}$	s	$\bar{s}$	u	$\bar{u}$	d	$\bar{d}$	
b	0.815	0.134	0.020	0.017	0.003	0.002	0.002	0.003	0.003	0.002	
$\bar{b}$	0.126	0.822	0.018	0.018	0.002	0.004	0.003	0.002	0.002	0.002	
c	0.010	0.013	0.805	0.044	0.024	0.032	0.033	0.008	0.010	0.021	
$\bar{c}$	0.013	0.011	0.051	0.797	0.032	0.026	0.009	0.031	0.020	0.009	
s	0.002	0.002	0.019	0.022	0.515	0.107	0.035	0.133	0.104	0.062	
$\bar{s}$	0.001	0.002	0.022	0.017	0.095	0.536	0.138	0.030	0.057	0.101	
u	0.001	0.002	0.023	0.009	0.042	0.160	0.443	0.045	0.079	0.196	
$\bar{u}$	0.002	0.002	0.010	0.024	0.153	0.049	0.055	0.419	0.206	0.081	
d	0.002	0.002	0.012	0.022	0.137	0.099	0.078	0.238	0.319	0.091	
$\bar{d}$	0.002	0.002	0.022	0.011	0.088	0.147	0.261	0.069	0.086	0.313	
Predicted											

Zqq M10

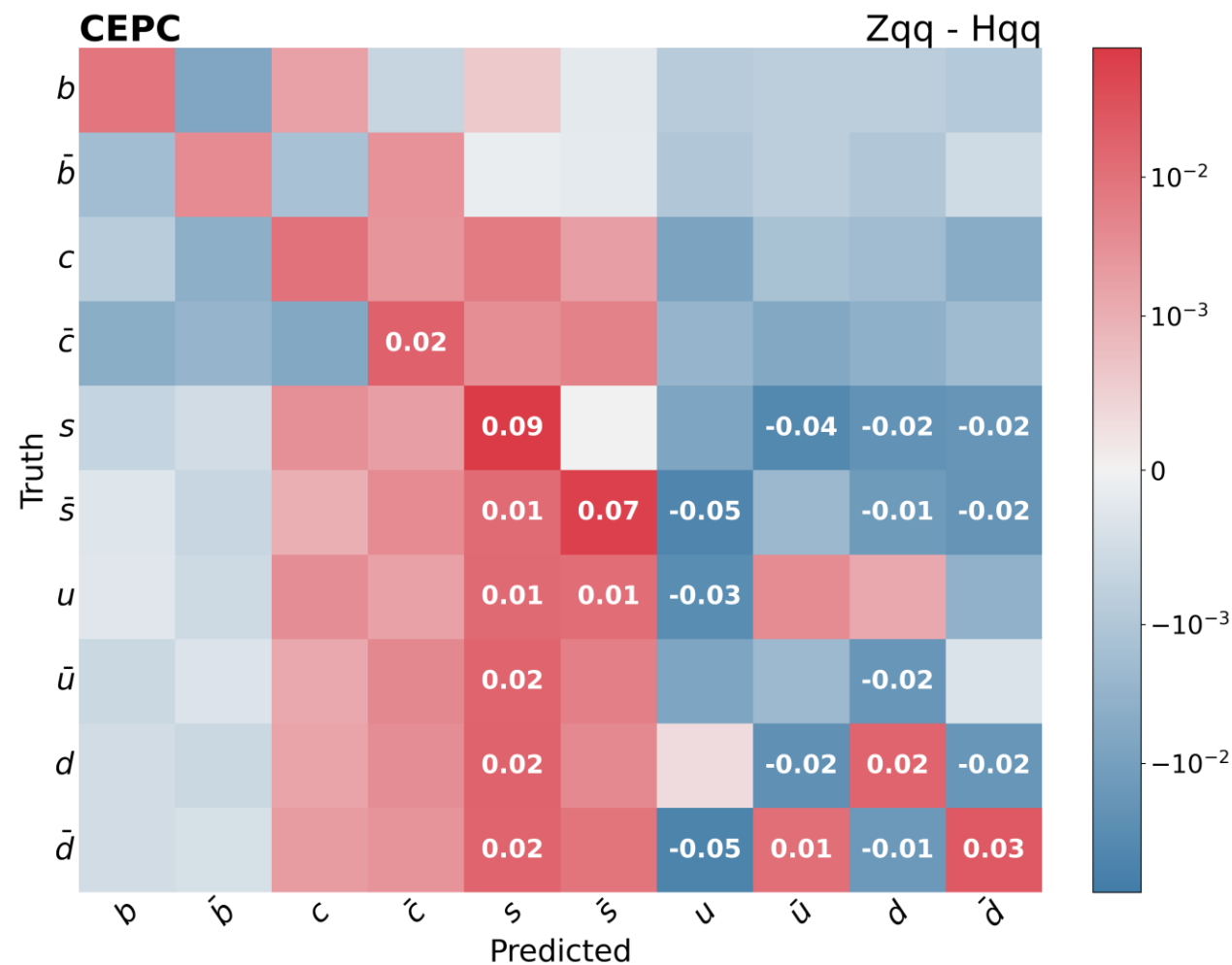
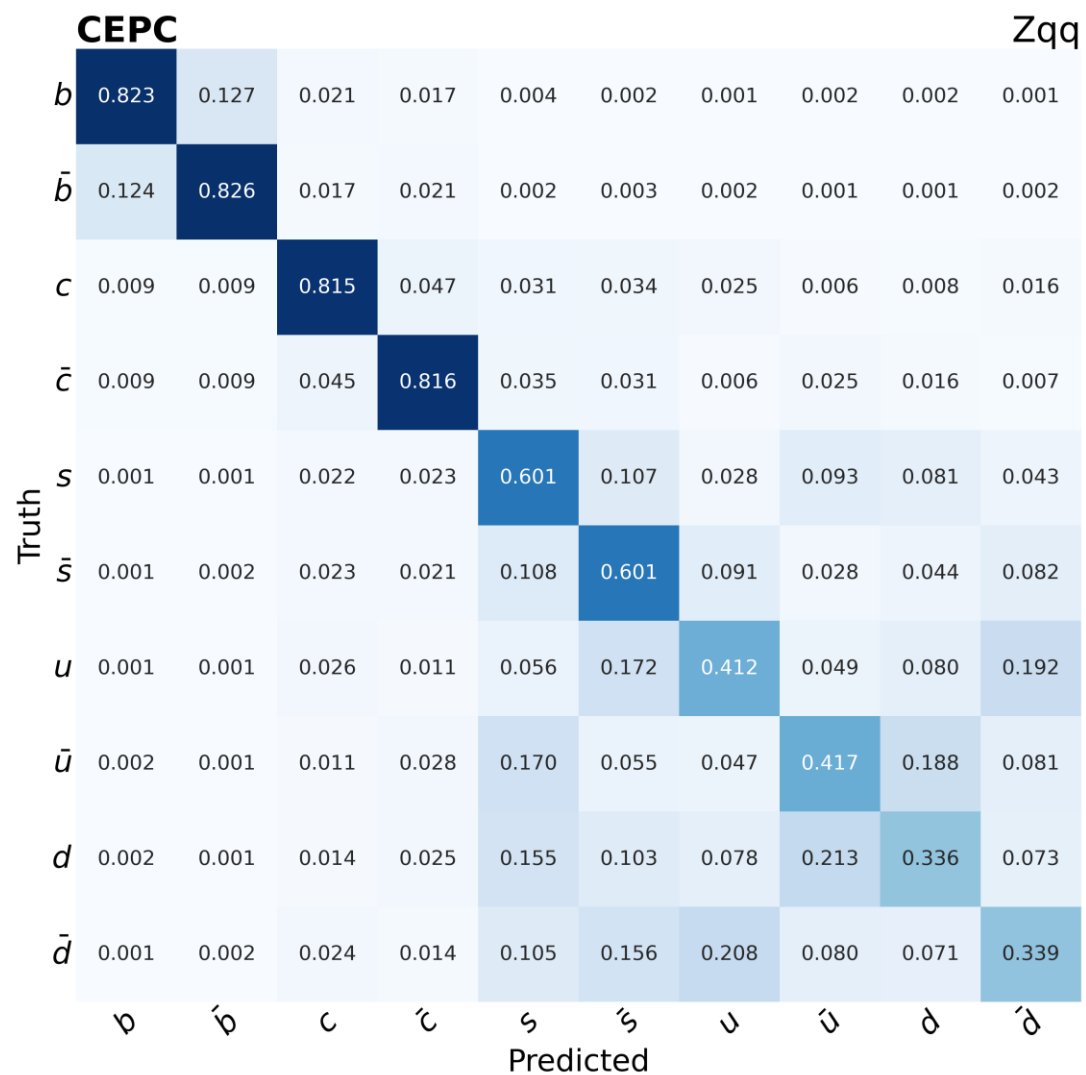


Hqq M10: 0.5784

Zqq M10: 0.5986

Difference: 3.5%

Major difference: better S, since no gluon contamination?



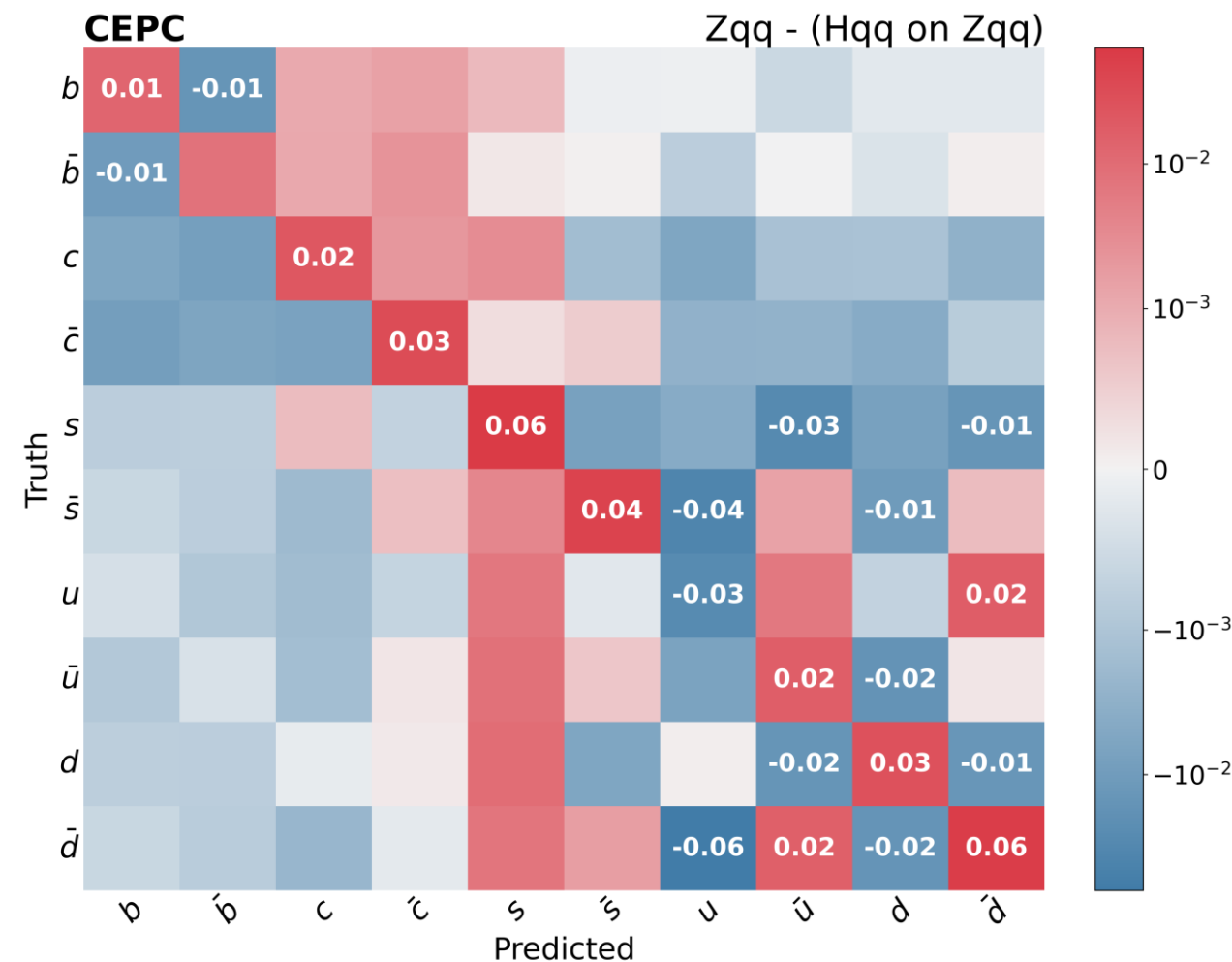
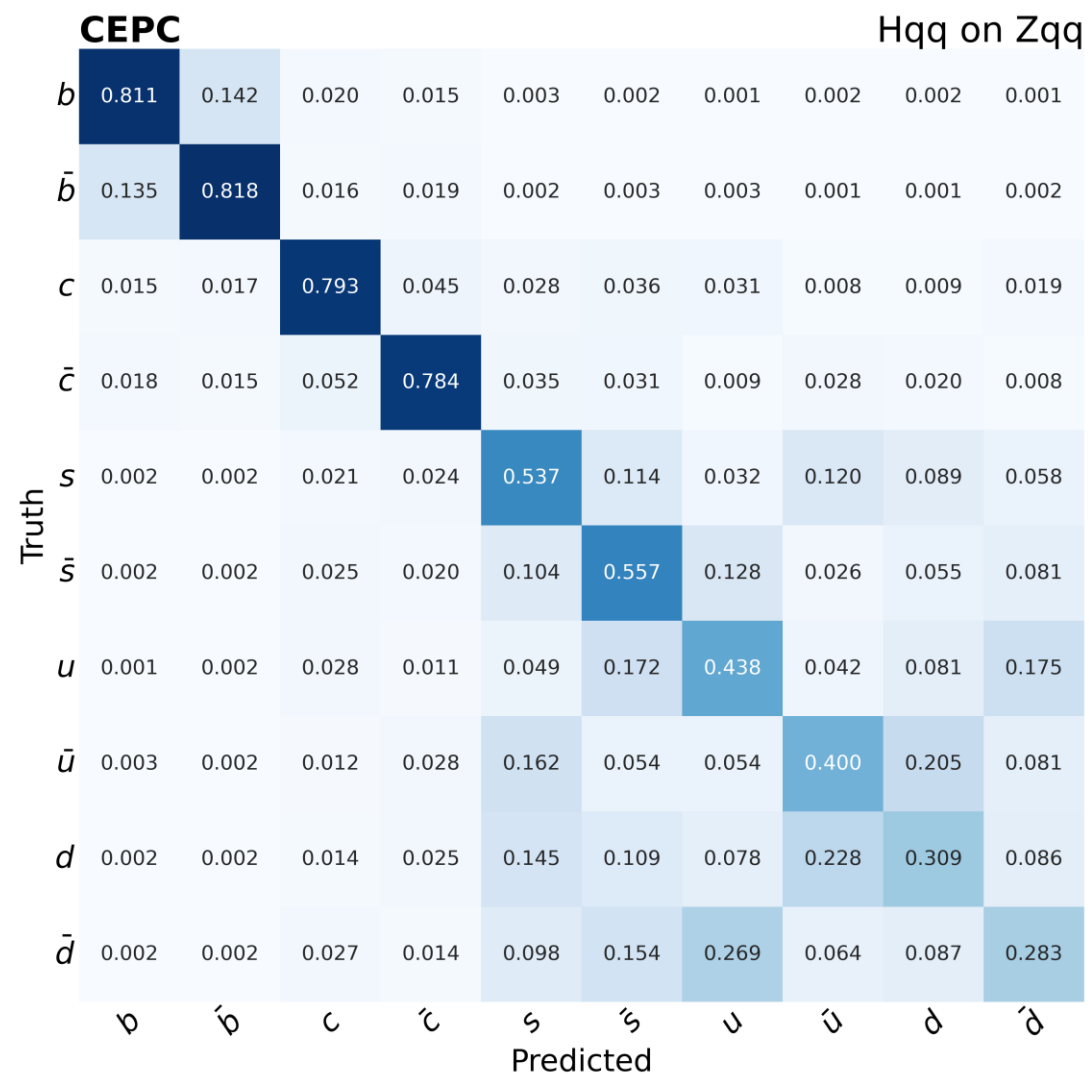
Hqq applied to Zqq



Hqq on Zqq M10: 0.5730

Reduce from Hqq: 0.94%

Reduce from Zqq: 4.4%



Continued Transfer learning

Continue training on Zqq sample for 3 epochs:
0.6010, with start_lr=1e-4. 0.4% better than Zqq.

[2025-08-24 06:07:27,733] INFO: Epoch #0: Current validation metric: 0.59294 (best: 0.59294)
[2025-08-24 07:06:06,571] INFO: Epoch #1: Current validation metric: 0.59724 (best: 0.59724)
[2025-08-24 08:05:00,657] INFO: Epoch #2: Current validation metric: 0.60101 (best: 0.60101)

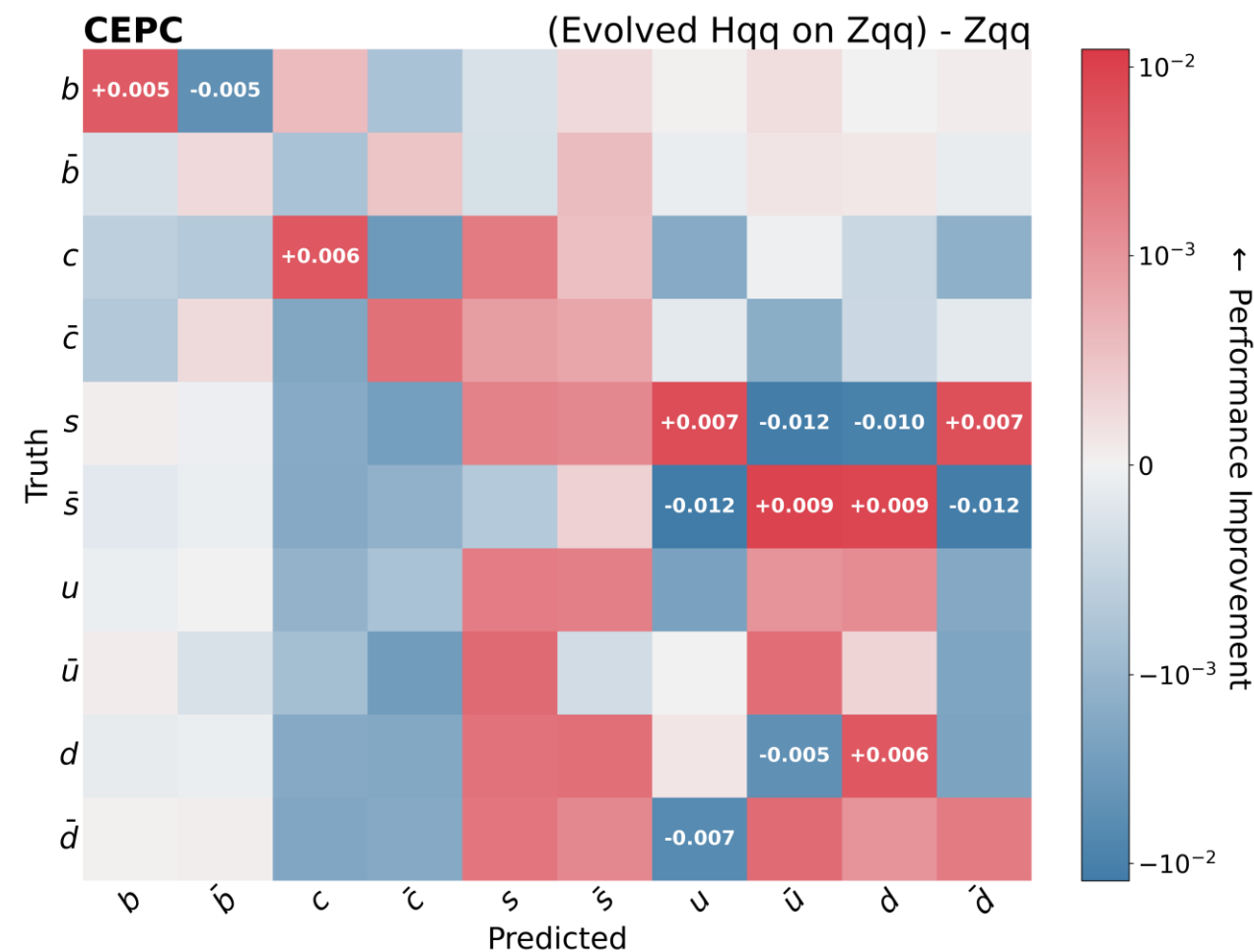
CEPC		Zqq									
Truth	b	0.823	0.127	0.021	0.017	0.004	0.002	0.001	0.002	0.002	0.001
	$\bar{b}$	0.124	0.826	0.017	0.021	0.002	0.003	0.002	0.001	0.001	0.002
	c	0.009	0.009	0.815	0.047	0.031	0.034	0.025	0.006	0.008	0.016
	$\bar{c}$	0.009	0.009	0.045	0.816	0.035	0.031	0.006	0.025	0.016	0.007
	s	0.001	0.001	0.022	0.023	0.601	0.107	0.028	0.093	0.081	0.043
	$\bar{s}$	0.001	0.002	0.023	0.021	0.108	0.601	0.091	0.028	0.044	0.082
	u	0.001	0.001	0.026	0.011	0.056	0.172	0.412	0.049	0.080	0.192
	$\bar{u}$	0.002	0.001	0.011	0.028	0.170	0.055	0.047	0.417	0.188	0.081
	d	0.002	0.001	0.014	0.025	0.155	0.103	0.078	0.213	0.336	0.073
	$\bar{d}$	0.001	0.002	0.024	0.014	0.105	0.156	0.208	0.080	0.071	0.339
		b	$\bar{b}$	c	$\bar{c}$	s	$\bar{s}$	u	$\bar{u}$	d	$\bar{d}$
Predicted											

CEPC		Evolved Hqq on Zqq									
Truth	b	0.828	0.122	0.022	0.016	0.003	0.002	0.001	0.002	0.002	0.001
	$\bar{b}$	0.124	0.826	0.016	0.022	0.002	0.004	0.002	0.001	0.001	0.002
	c	0.008	0.008	0.821	0.043	0.033	0.035	0.023	0.006	0.007	0.015
	$\bar{c}$	0.008	0.009	0.043	0.819	0.036	0.032	0.006	0.024	0.016	0.007
	s	0.002	0.001	0.020	0.021	0.602	0.108	0.035	0.081	0.071	0.050
	$\bar{s}$	0.001	0.002	0.022	0.020	0.107	0.602	0.079	0.037	0.053	0.070
	u	0.001	0.001	0.025	0.010	0.058	0.174	0.409	0.050	0.082	0.190
	$\bar{u}$	0.002	0.001	0.010	0.025	0.173	0.055	0.047	0.420	0.189	0.079
	d	0.002	0.001	0.012	0.023	0.157	0.106	0.079	0.208	0.342	0.070
	$\bar{d}$	0.001	0.002	0.022	0.012	0.107	0.158	0.201	0.083	0.072	0.341
		b	$\bar{b}$	c	$\bar{c}$	s	$\bar{s}$	u	$\bar{u}$	d	$\bar{d}$
Predicted											

Transfer learning:



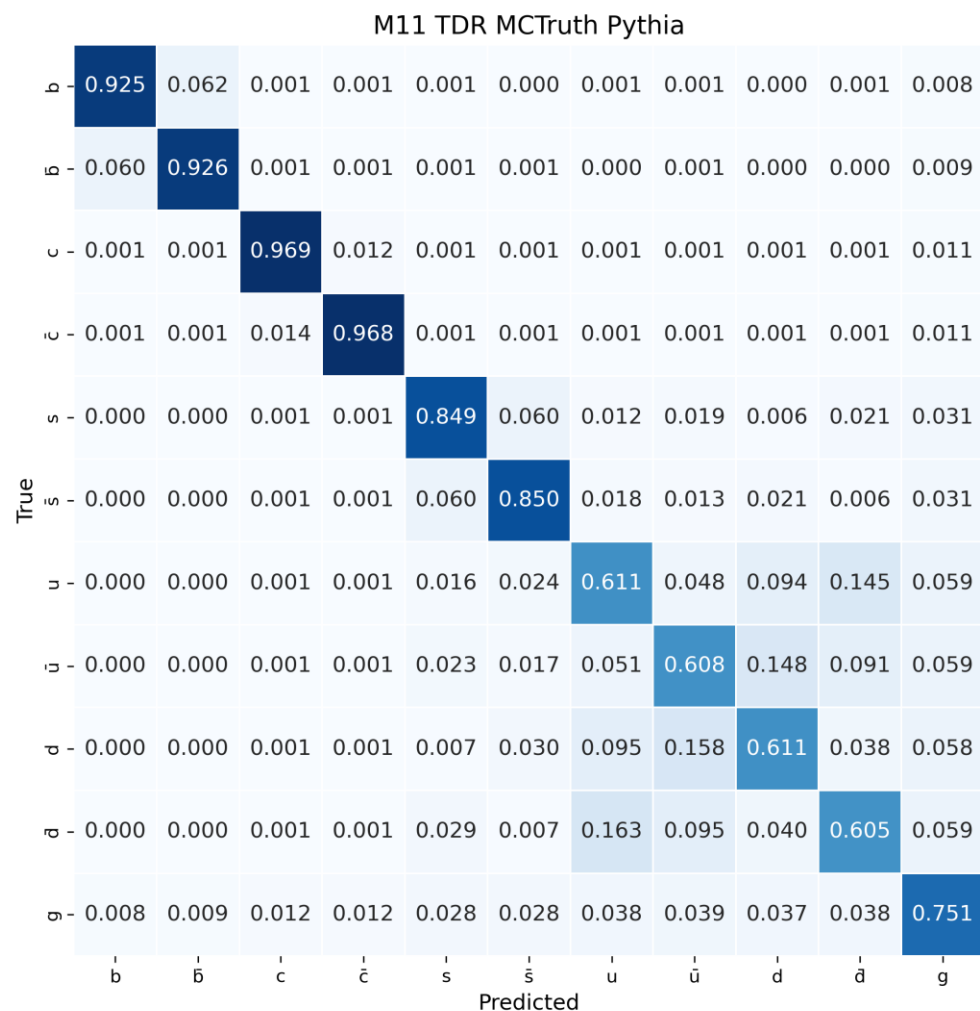
- Hqq applied to Zqq: 0.94% drop
 - Reasonable generalization, minor drop
- Zqq 4.4% better than Generalized Hqq
 - Significant gap to the native model.
- Fine-tuning with Zqq sample:
 - Gap bridged, and 0.4% more.



Can add another plot to demonstrate if needed.

370 This JOI model, optimized within a Higgs-boson production environment, demon-
371 strates its capability for knowledge transfer across diverse kinematic energy scales. across
372 diverse kinematic energy scales. A brief fine-tuning process on $Z \rightarrow q\bar{q}$ final states
373 proves adequate to surpass the performance of models explicitly tailored for that data.
374 This validates the pre-trained model not just as a foundation, but as a superior starting
375 point for related tasks, showcasing its energy-independent robustness and the power of the
376 transfer learning approach.

0.7884



Generator	PID	Simu	Metric
Whizard195+Py6	Truth	Truth	0.7438
Whizard195+Py6	Truth	Fast	0.6007
Whizard195+Py6	Truth	Full	0.5936
Whizard195+Py6	Reco	Full	0.5562

Generator	PID	Simu	Metric
Mg5+Pythia8	Truth	Truth	0.7884
Mg5+Pythia8	Truth	Fast	0.6226

Generator	PID	Simu	Metric
Mg5+Herwig	Truth	Truth	0.7454
Mg5+Herwig	Truth	Fast	0.6053