



CEPC

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Fast Simulation Re-design

To latest Delphes

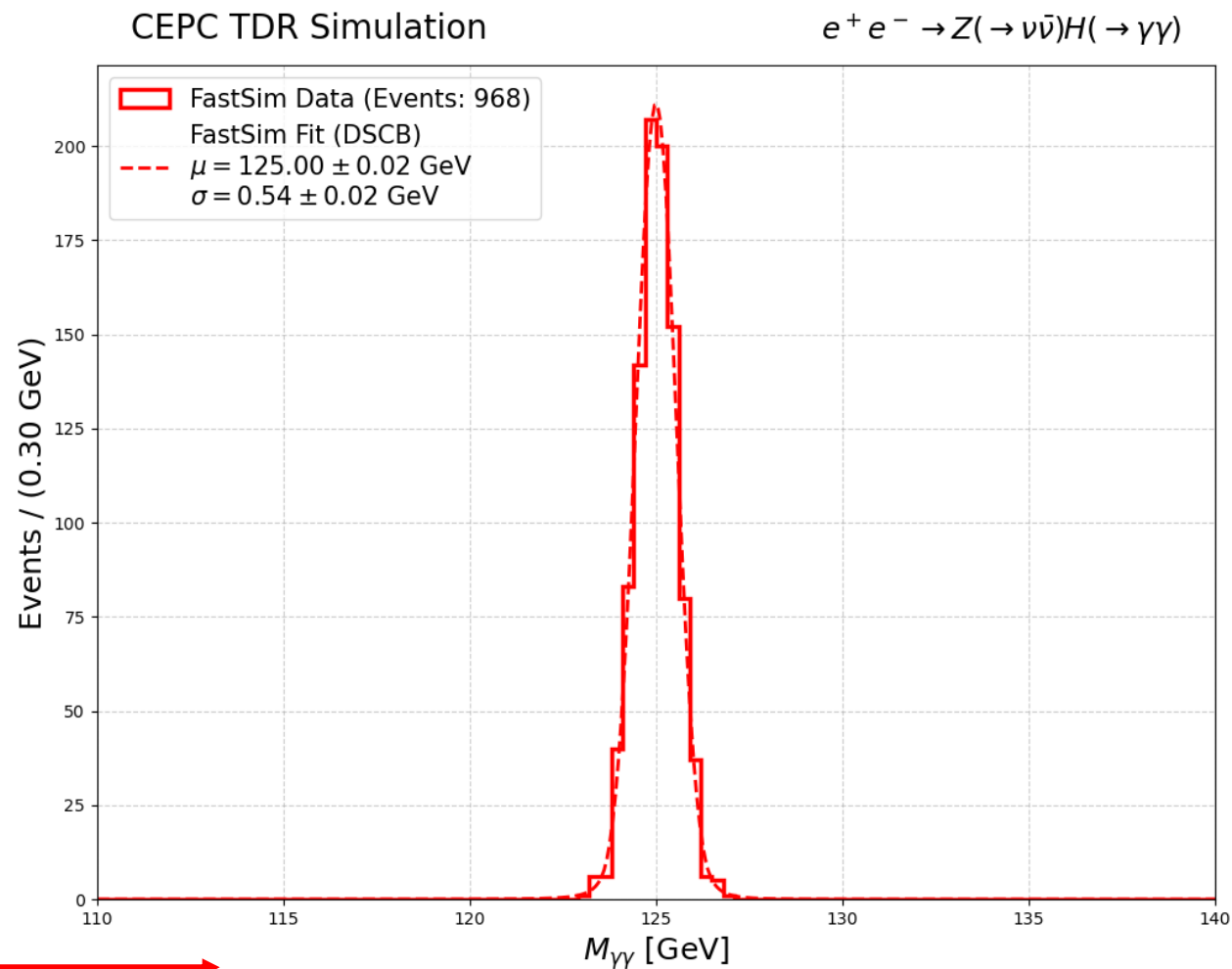
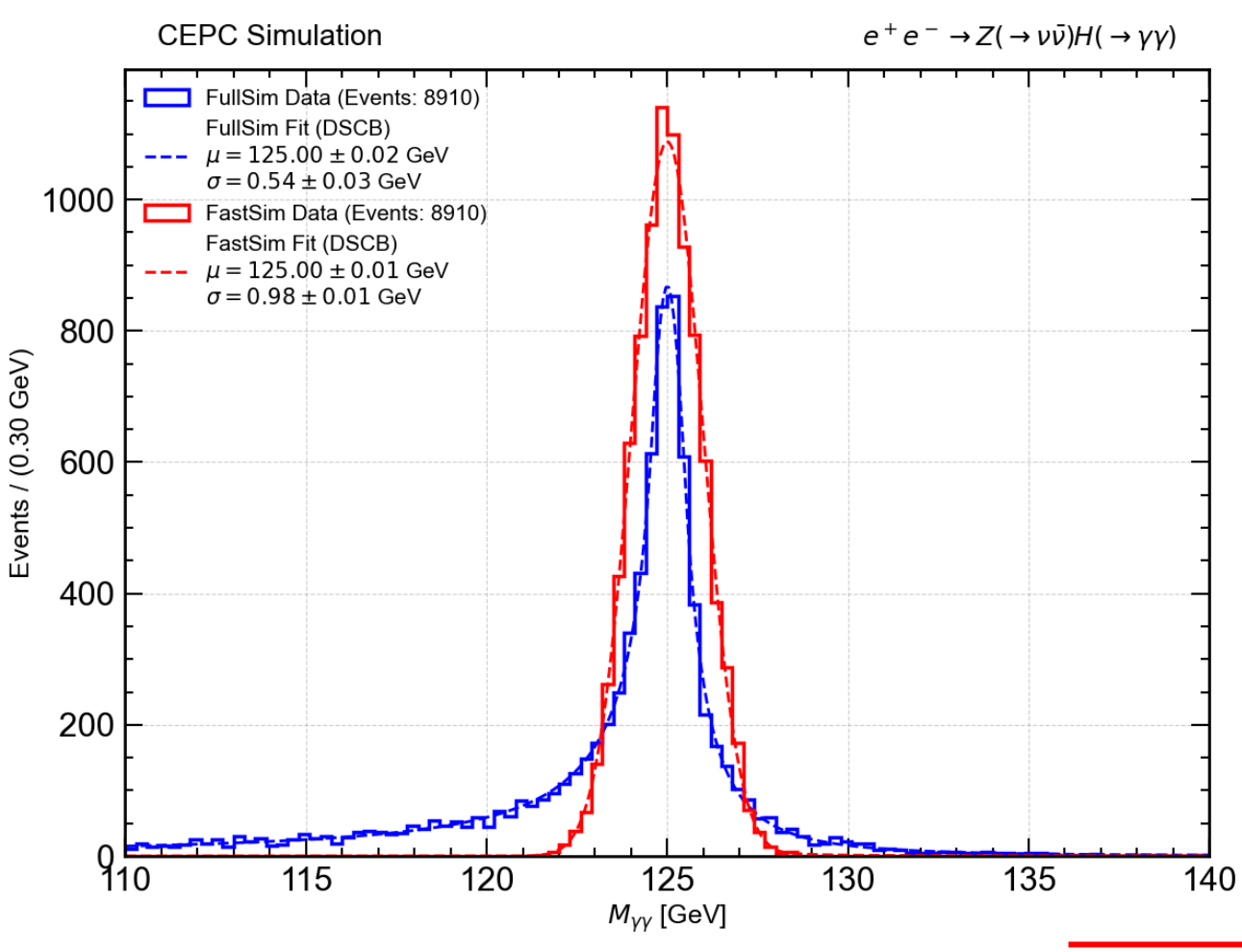


- Previously Gaoxu maintained Delphes_CEPC, not the latest release
- Now https://code.ihep.ac.cn/zhangkl/delphes_cepc/-/tree/CEPC follow the official release.
 - Fix one Cov matrix crash issue.
 - Provide 2 version of cards: One for geometry ideal case, one for closer to full simu.

Diphoton mass



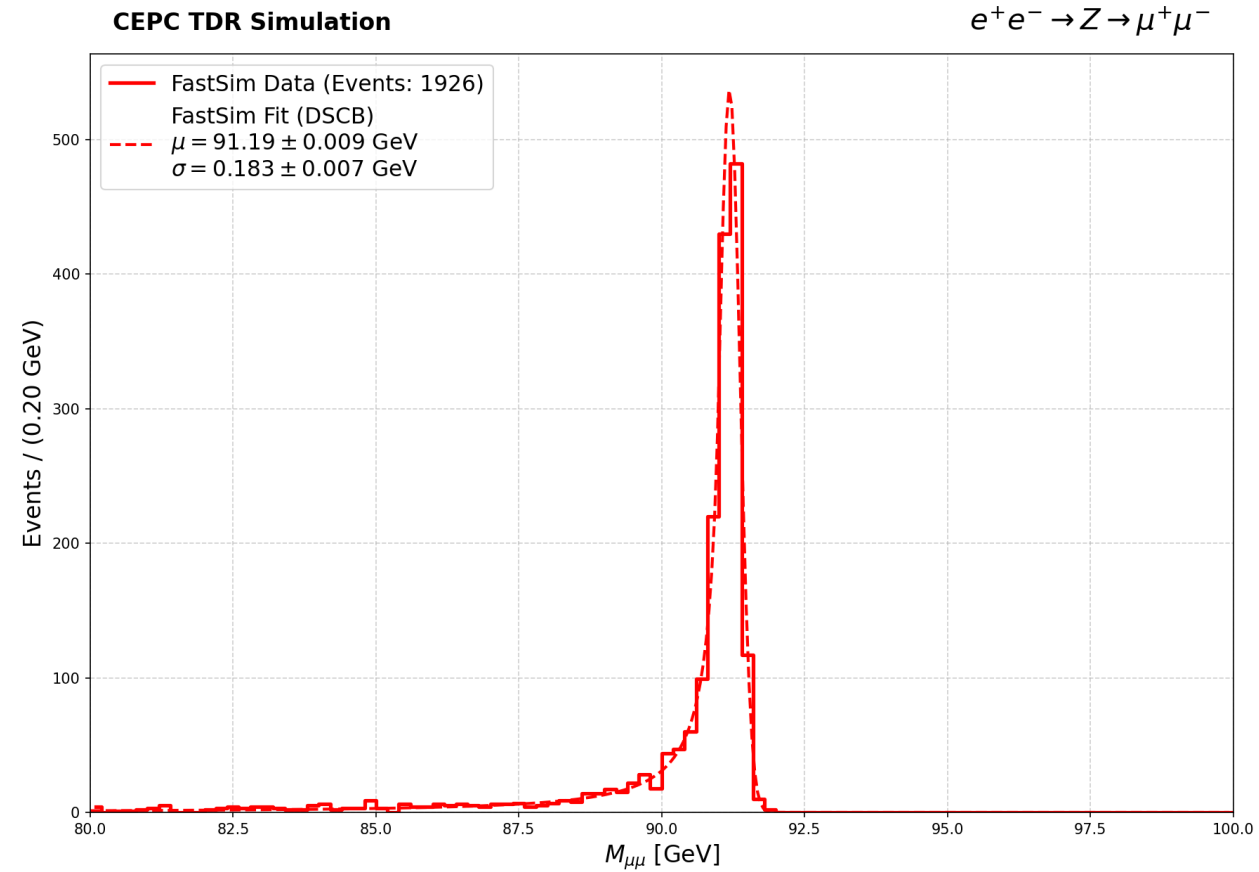
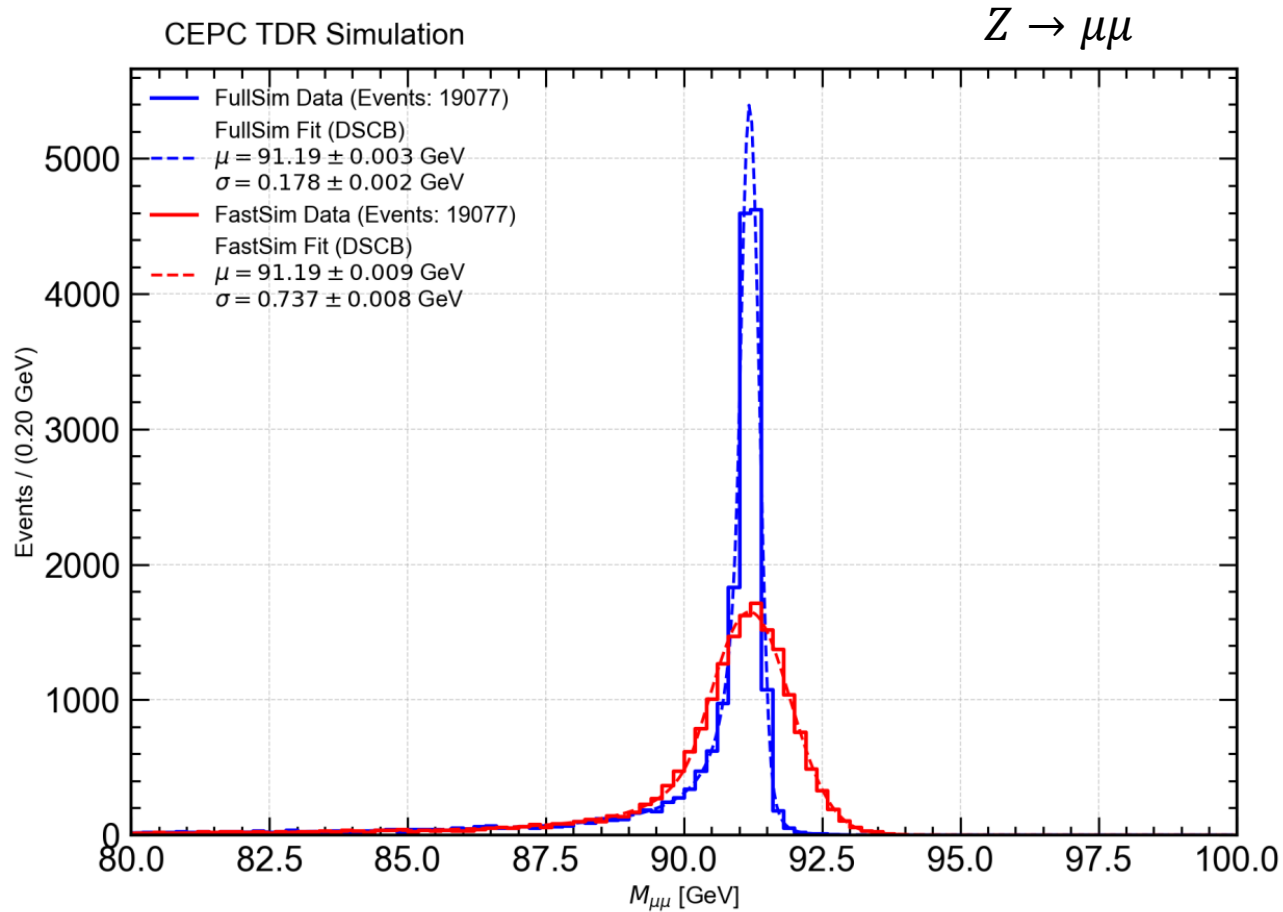
Using TDR Ecal resolution $1.3\%/\sqrt{E} \oplus 1\%$ would overestimate $\gamma\gamma$ width $\sim 100\%$. To meet $\sim 0.5\text{GeV}$ (also in TDR) Make A and B 100% better.



Plot from Yangchao

Dimuon Mass

Redesigned TPC geometry to make it work.
Using 50 slices TPC layers.
(200 layers would crash in latest Delphes).



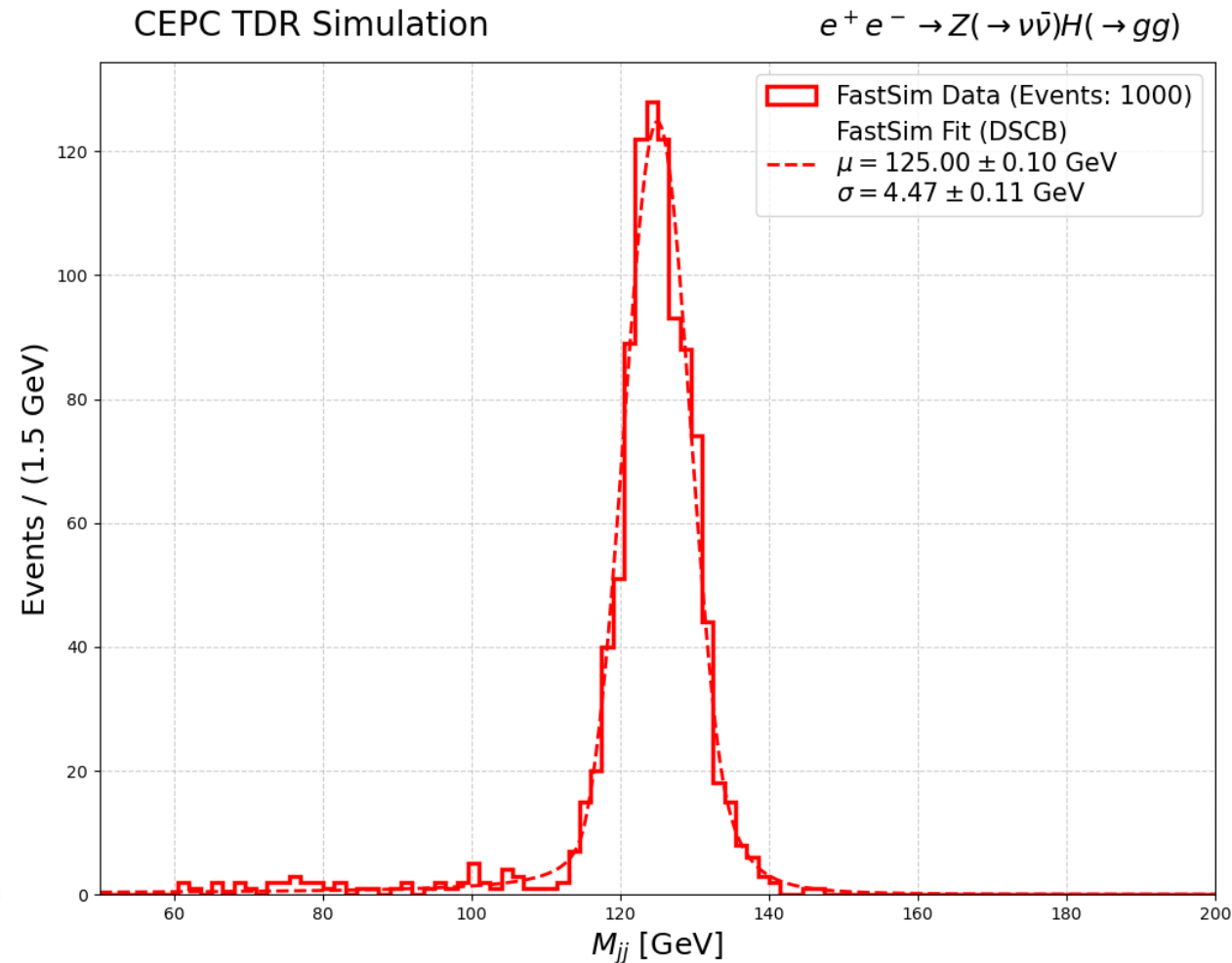
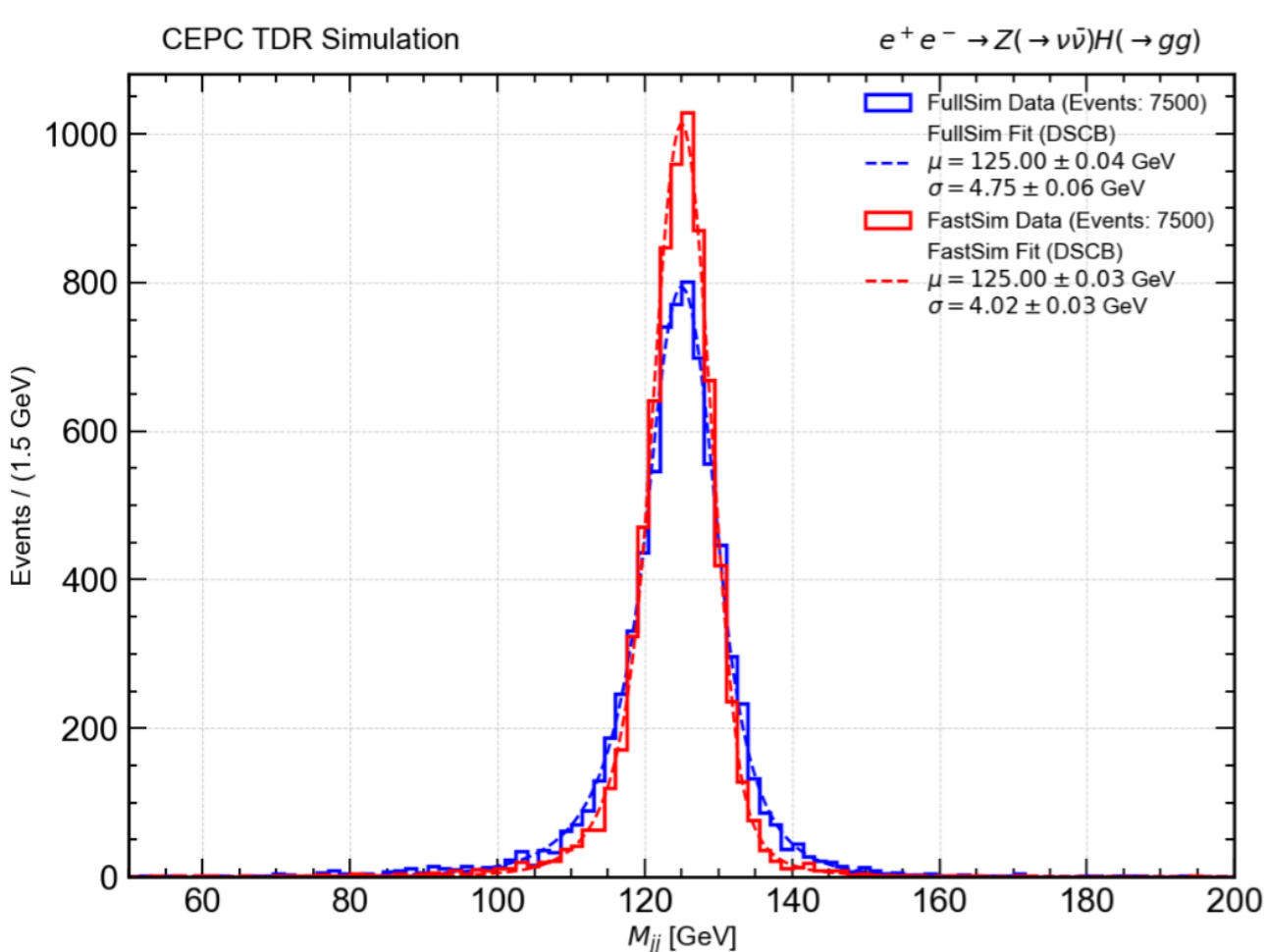
Dijet mass

H->gg, Full resolution is ~ 1.3 of fast simulation.

Impact of confusion and others -> Hint to improve, like 1-1 response.

Currently, worse Hcal resolution 30% to simulate Full simulation's behavior.

H->ss 1.6 worse. Fast simu can not simulate the 1.3-1.6 difference.

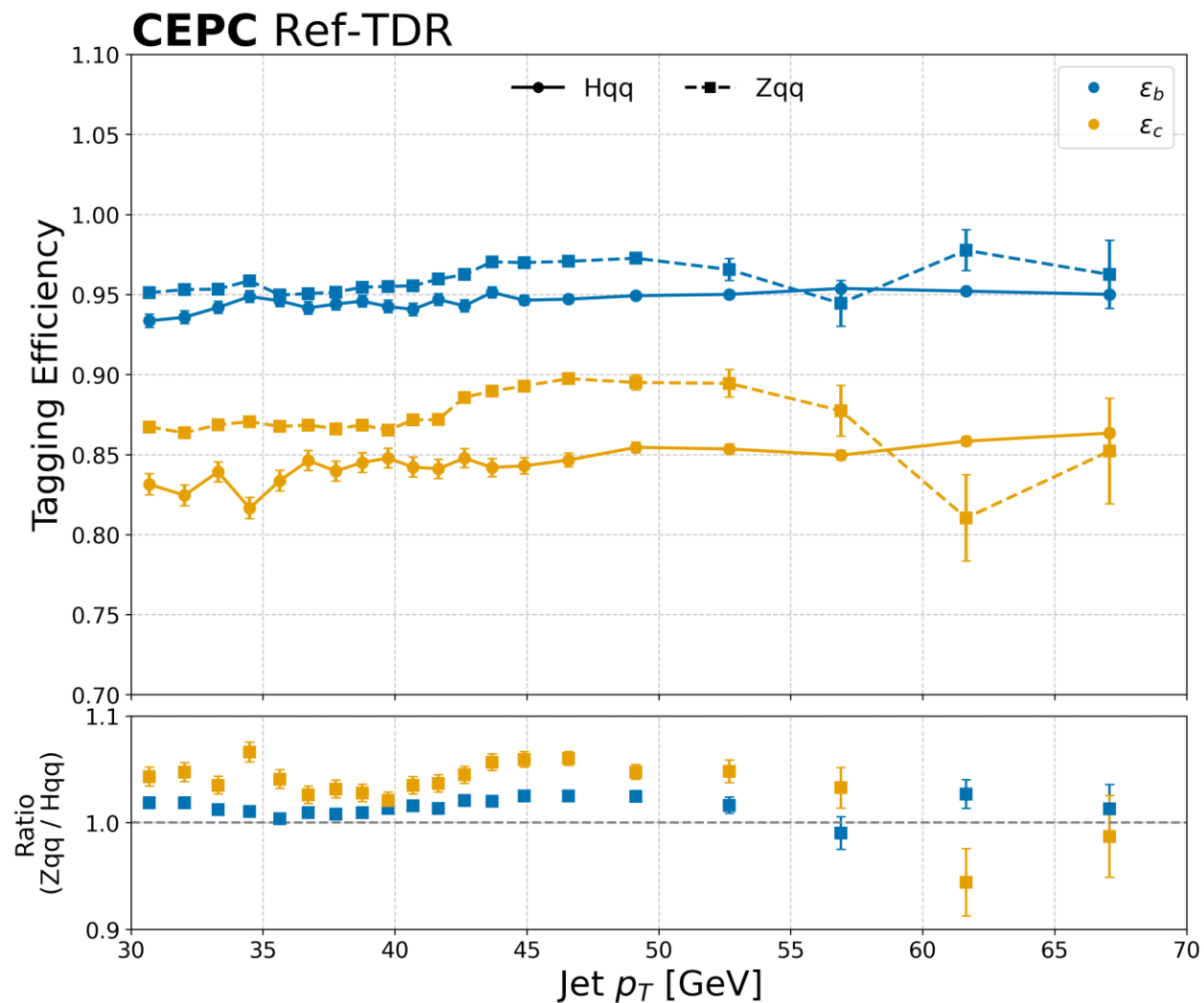
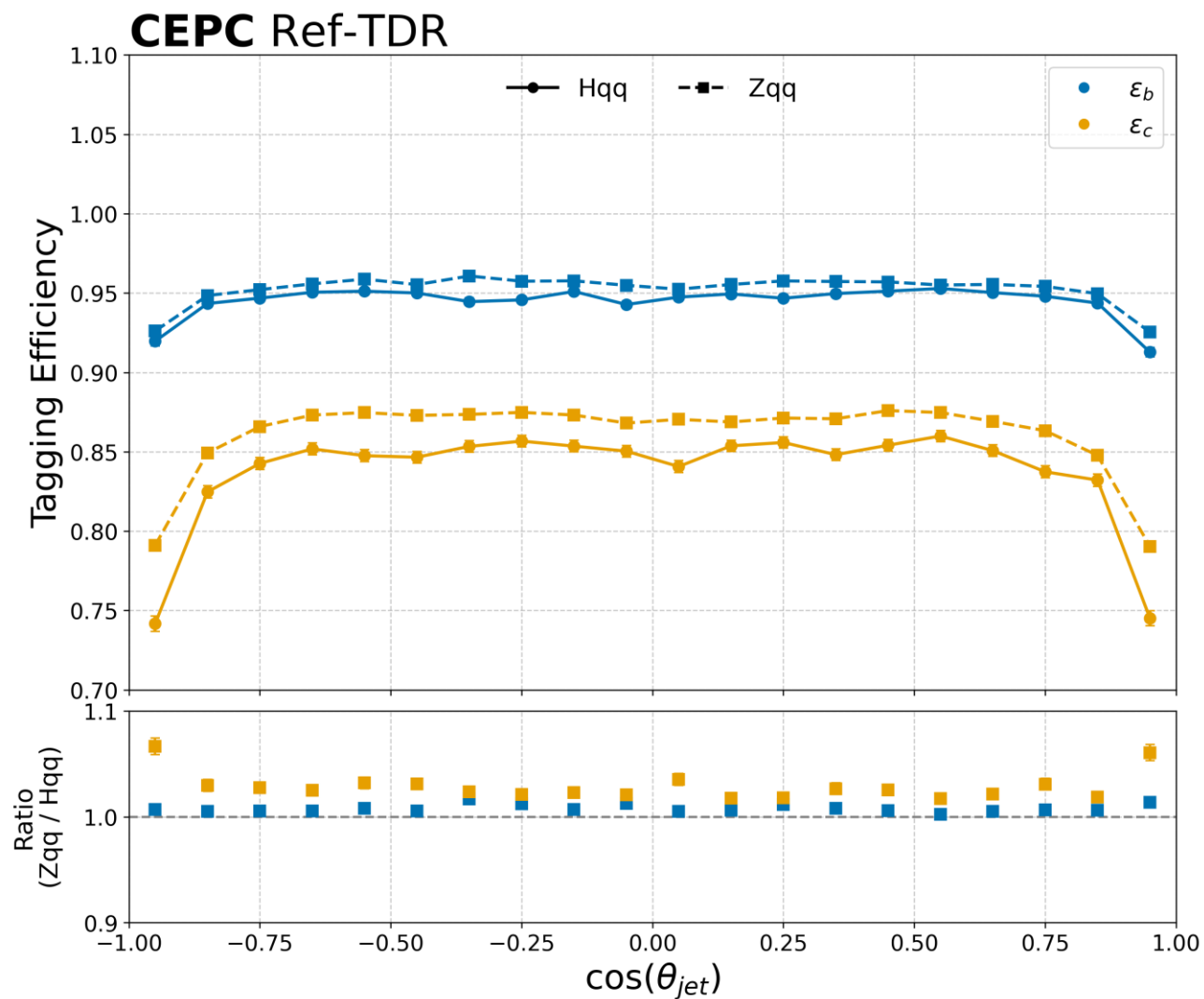


The Geant4 simulation and the target EM performance have been validated by prototype beam tests with electron beam data. For 1 GeV to 10 GeV electrons, the preliminary testbeam results with a crystal calorimeter prototype demonstrated the EM energy resolution to be $\sigma_E/E = 1.3\%/\sqrt{E(\text{GeV})} \oplus 1\%$. Physics benchmarks including $\pi^0 \rightarrow \gamma\gamma$ reconstruction and $H \rightarrow \gamma\gamma$ invariant mass resolution of 0.33 % are studied with CEPCSW full simulation.

- 0.33% need double precision of $1.3\%/\sqrt{E} \oplus 1\%$.
- Confirm with Fangyi.

JOI

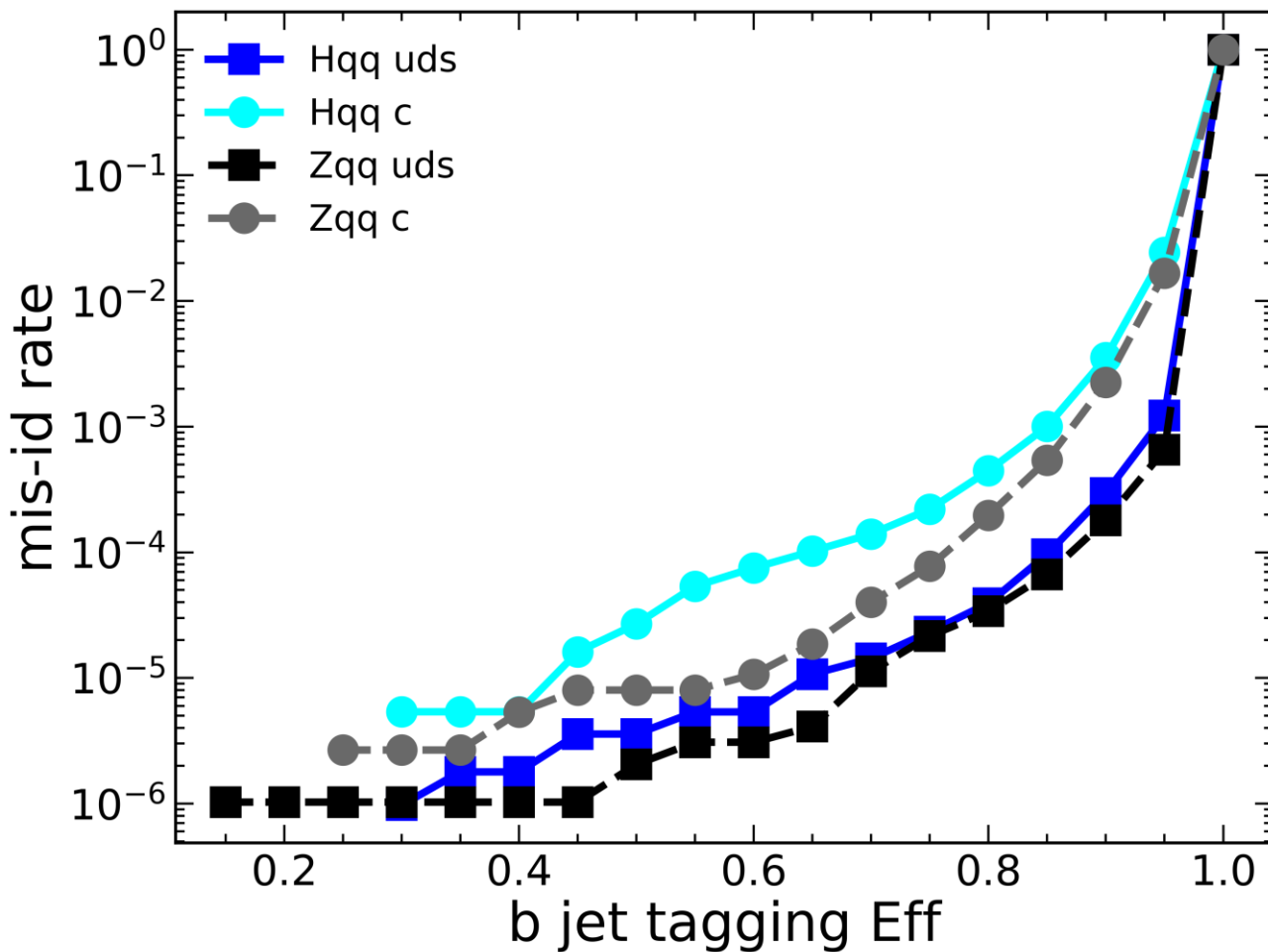
Kinematics distribution



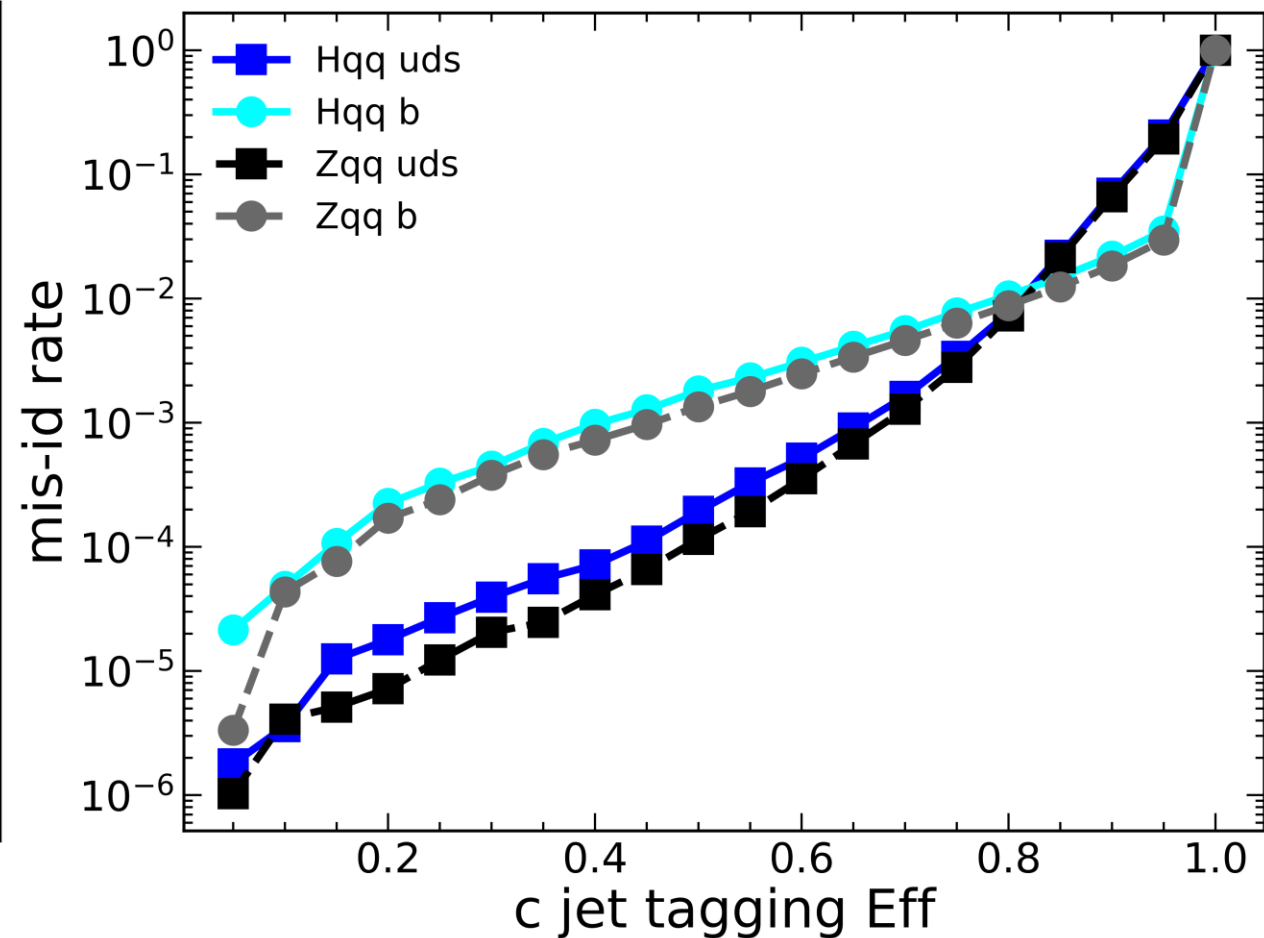
Hqq Zqq Tagging eff vs mis-id rate

Attached to overleaf for choice.

CEPC Ref-TDR



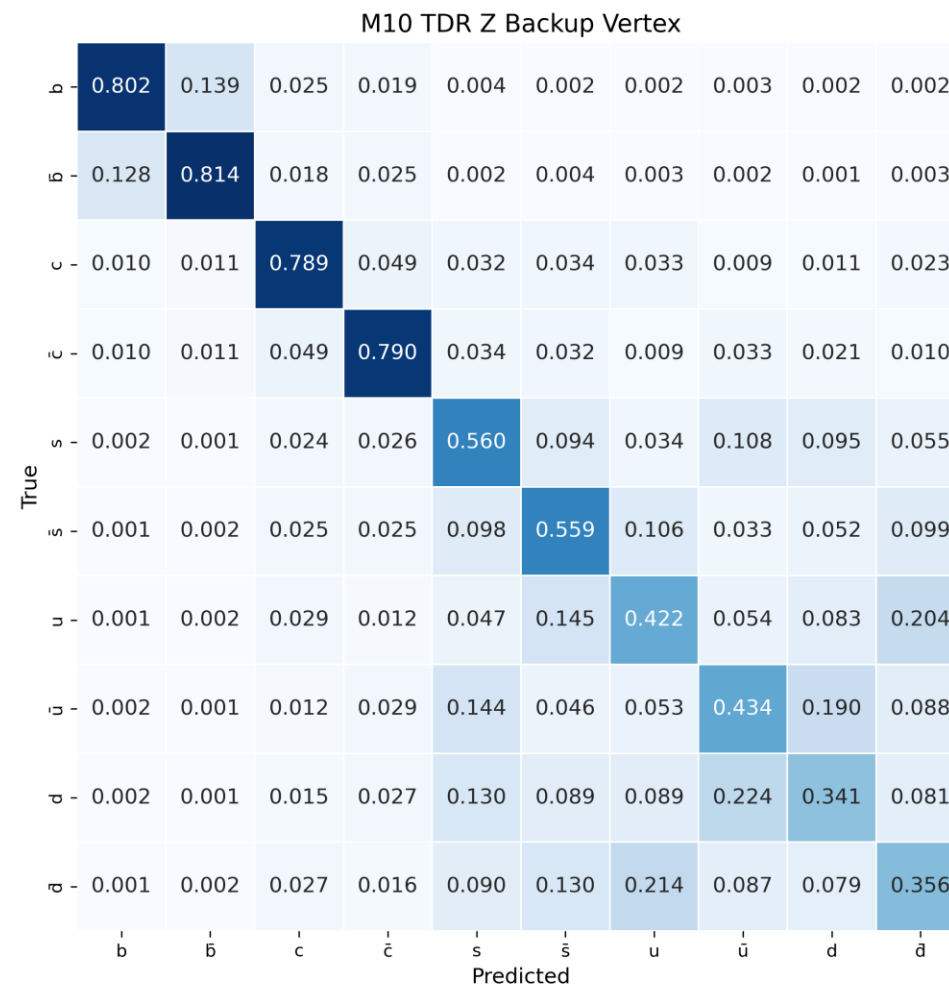
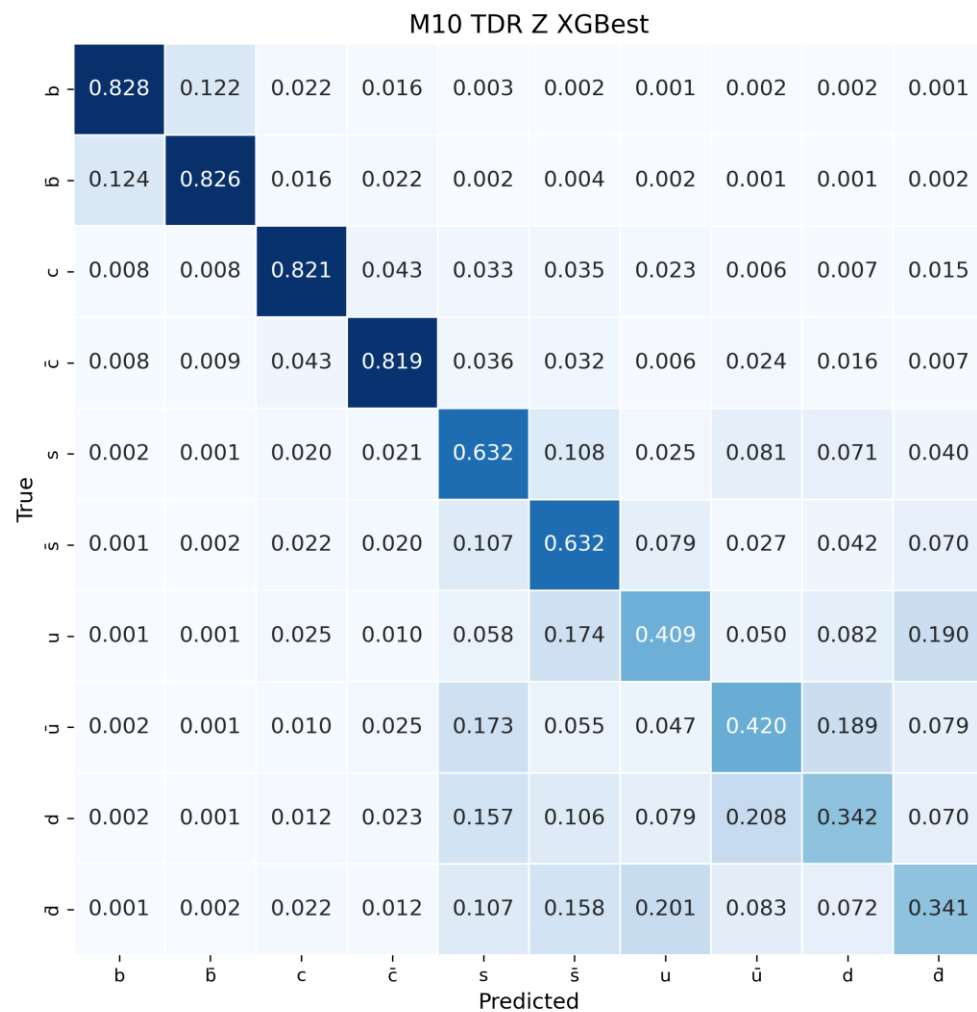
CEPC Ref-TDR



Detector optimization: Vertex design

Same hype-parameter and data size.

Baseline performance got 2% - 6% better from b and s tagging.



Detector optimization: U5V5 and U3V10

Truth ID, in baseline vertex, change precision is r and phi direction.

CEPC		TDR Full ParT TruthID										
Truth	b	0.832	0.113	0.019	0.016	0.002	0.001	0.001	0.002	0.001	0.001	0.012
	$\bar{b}$	0.113	0.831	0.016	0.018	0.001	0.002	0.002	0.001	0.001	0.002	0.012
	c	0.009	0.009	0.822	0.034	0.024	0.024	0.023	0.005	0.006	0.014	0.030
	$\bar{c}$	0.009	0.009	0.035	0.820	0.024	0.024	0.005	0.023	0.016	0.006	0.030
	s	0.002	0.001	0.015	0.017	0.584	0.081	0.023	0.085	0.081	0.042	0.069
	$\bar{s}$	0.001	0.001	0.015	0.016	0.079	0.586	0.087	0.023	0.046	0.076	0.070
	u	0.001	0.002	0.018	0.006	0.029	0.114	0.440	0.044	0.079	0.183	0.085
	$\bar{u}$	0.002	0.001	0.007	0.018	0.115	0.031	0.048	0.422	0.202	0.071	0.084
	d	0.001	0.001	0.009	0.016	0.096	0.074	0.072	0.212	0.362	0.071	0.086
	$\bar{d}$	0.001	0.001	0.016	0.009	0.074	0.099	0.233	0.067	0.079	0.334	0.087
	g	0.012	0.012	0.028	0.027	0.075	0.075	0.076	0.071	0.067	0.060	0.498
		b	$\bar{b}$	c	$\bar{c}$	s	$\bar{s}$	u	$\bar{u}$	d	$\bar{d}$	g
		Predicted										

		ParT_TruthID_U3V10										
Truth	b	0.846	0.114	0.017	0.015	0.002	0.001	0.001	0.002	0.002	0.001	0.012
	bbar	0.114	0.845	0.015	0.018	0.001	0.002	0.002	0.001	0.001	0.002	0.011
	c	0.011	0.010	0.805	0.034	0.022	0.021	0.024	0.006	0.007	0.018	0.028
	cbar	0.009	0.010	0.034	0.803	0.022	0.021	0.005	0.024	0.017	0.007	0.030
	s	0.002	0.001	0.018	0.020	0.531	0.073	0.023	0.088	0.086	0.050	0.065
	sbar	0.001	0.002	0.019	0.019	0.071	0.531	0.085	0.023	0.049	0.087	0.066
	u	0.001	0.002	0.022	0.008	0.028	0.101	0.440	0.046	0.085	0.212	0.077
	ubar	0.002	0.001	0.008	0.022	0.102	0.027	0.048	0.446	0.216	0.083	0.078
	d	0.002	0.001	0.010	0.020	0.088	0.067	0.072	0.221	0.384	0.083	0.080
	dbar	0.001	0.002	0.021	0.010	0.067	0.090	0.228	0.070	0.084	0.390	0.081
	g	0.012	0.012	0.030	0.031	0.067	0.067	0.073	0.075	0.070	0.069	0.471
		b	bbar	c	cbar	s	sbar	u	ubar	d	dbar	g
		Predicted										