

IAS PROGRAM

# Fundamental Physics

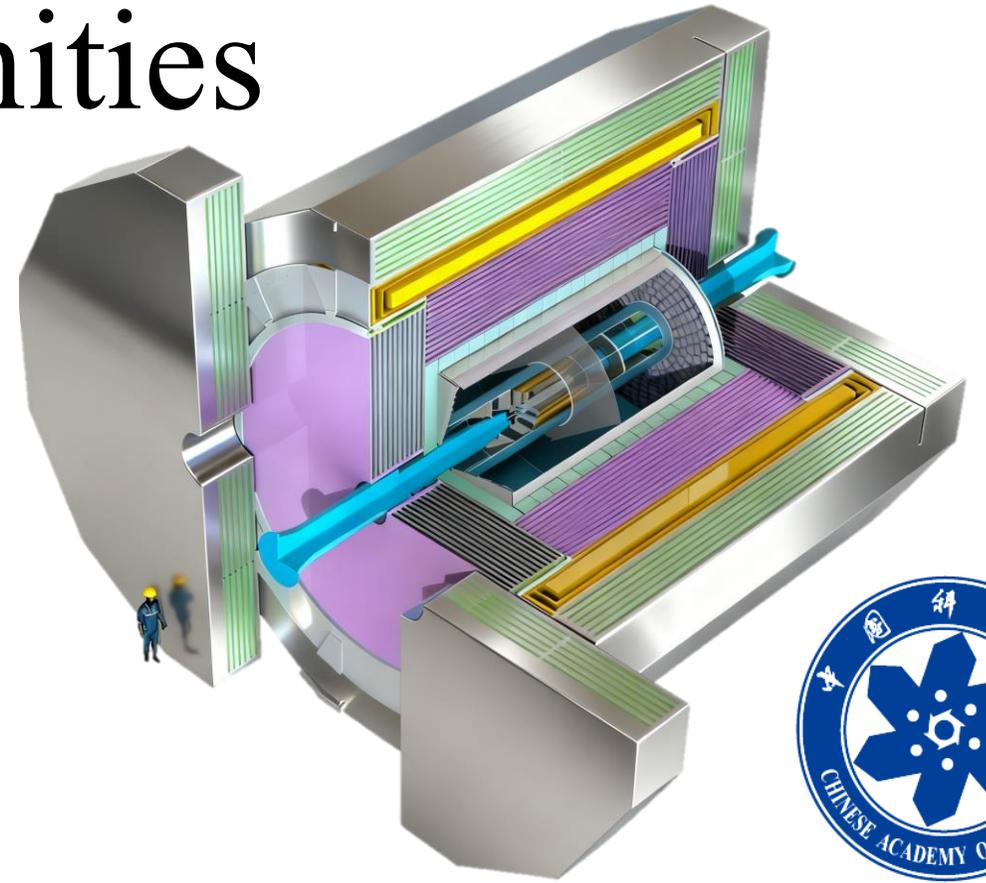
## Heavy flavour opportunities

@ CEPC

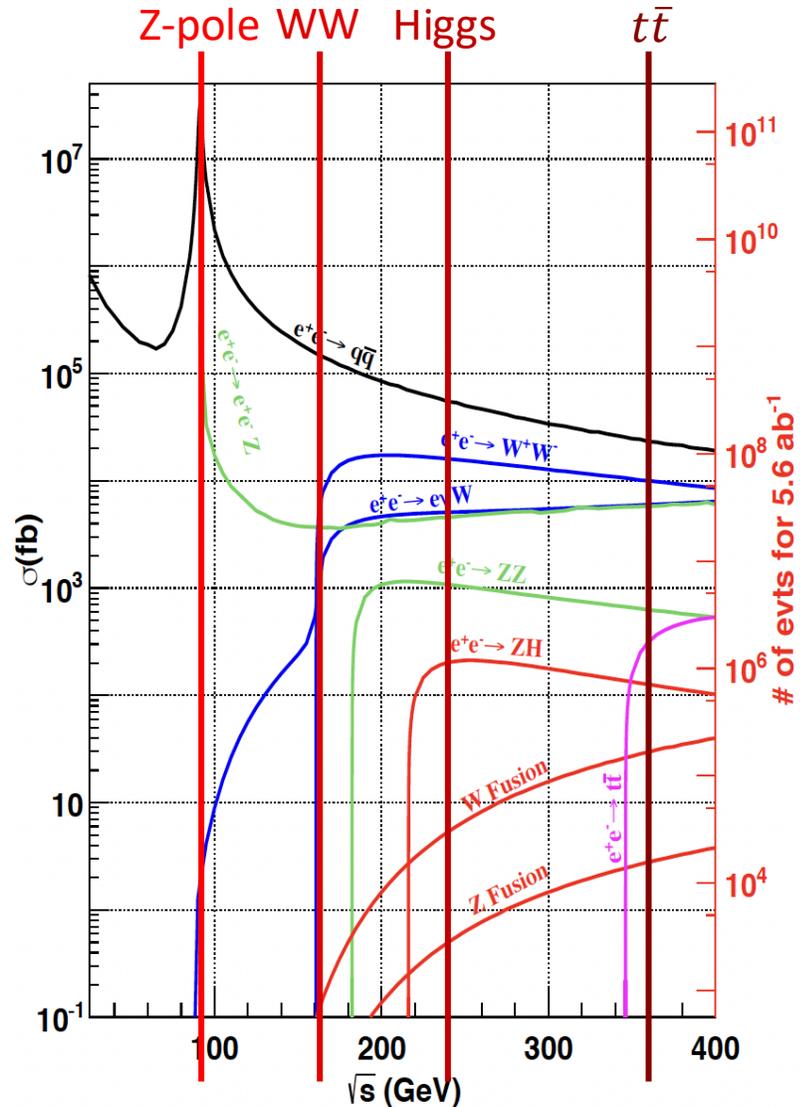
Shanzhen Chen

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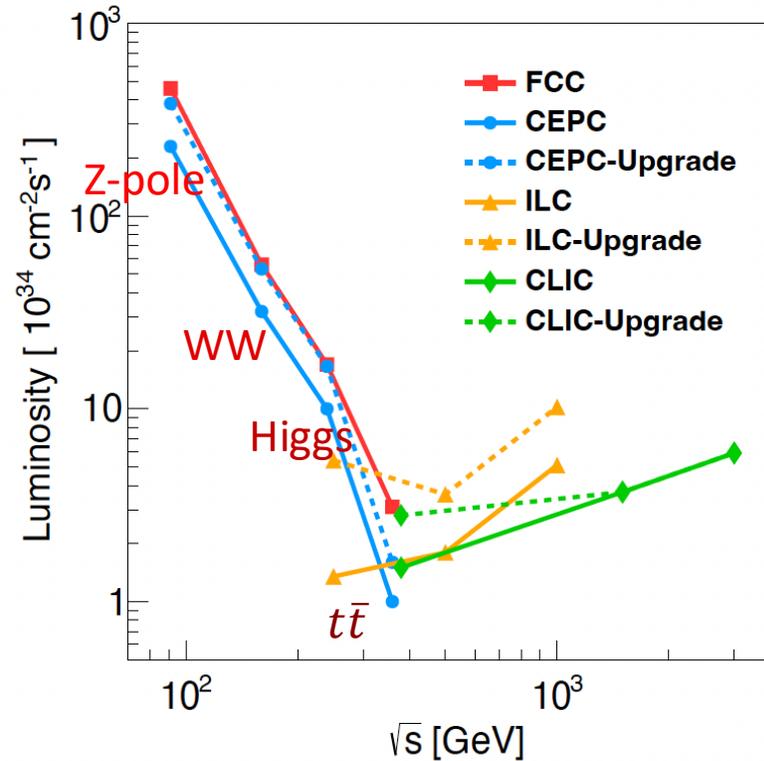
12 January 2026



# CEPC : a boson factory



• Yields  $\sim$  Xsec \* Lumi \* Time



- Higgs: 10 years  
~ 4 Million Higgs
- Z: 2 years  
~ 4 Tera Z
- WW: 1 year  
~ 0.2 Giga WW
- Upgradable:  
Top factory  
(~ 0.6 Million  $t\bar{t}$ )

2036-2040	2041-2045	2046-2050	2051-2055
Higgs		Z W	$t\bar{t}$

# CEPC Tera-Z mode

- CEPC 50 MW scenario: 4 Tera Z. Z decay modes:  $c\bar{c}$  (12.03  $\pm$  0.21 ) %  
 $b\bar{b}$  (15.12  $\pm$  0.05 ) %
- Heavy flavour particle yields
  - One of the largest heavy flavour samples from  $e^+e^-$  collider

Particle	BESIII	Belle II (50 ab <sup>-1</sup> on $\Upsilon(4S)$ )	LHCb (300 fb <sup>-1</sup> )	CEPC (4×Tera-Z)
$B^0, \bar{B}^0$	-	$5.4 \times 10^{10}$	$3 \times 10^{13}$	$4.8 \times 10^{11}$
$B^\pm$	-	$5.7 \times 10^{10}$	$3 \times 10^{13}$	$4.8 \times 10^{11}$
$B_s^0, \bar{B}_s^0$	-	$6.0 \times 10^8$ (5 ab <sup>-1</sup> on $\Upsilon(5S)$ )	$1 \times 10^{13}$	$1.2 \times 10^{11}$
$B_c^\pm$	-	-	$1 \times 10^{11}$	$7.2 \times 10^8$
$\Lambda_b^0, \bar{\Lambda}_b^0$	-	-	$2 \times 10^{13}$	$1 \times 10^{11}$
$D^0, \bar{D}^0$	$1.2 \times 10^8$	$4.8 \times 10^{10}$	$1.4 \times 10^{15}$	$8.3 \times 10^{11}$
$D^\pm$	$1.2 \times 10^8$	$4.8 \times 10^{10}$	$6 \times 10^{14}$	$4.9 \times 10^{11}$
$D_s^\pm$	$1 \times 10^7$	$1.6 \times 10^{10}$	$2 \times 10^{14}$	$1.8 \times 10^{11}$
$\Lambda_c^\pm$	$0.3 \times 10^7$	$1.6 \times 10^{10}$	$2 \times 10^{14}$	$6.2 \times 10^{10}$
$\tau^+\tau^-$	$3.6 \times 10^8$	$4.5 \times 10^{10}$		$1.2 \times 10^{11}$

# Expected charm / $\tau$ yields at STCF and CEPC

Facility	Collision Energy	Peak Luminosity	Integrated luminosity	Expected Particle yields per year <sup>[1,2]</sup>
STCF	2-7 GeV	$0.5 \times 10^{35} \text{cm}^{-2} \text{s}^{-1}$	1 ab <sup>-1</sup> per year	$D^0/\bar{D}^0 : 8 \times 10^9$ (energy 3.77 GeV) $D^+/D^- : 6 \times 10^9$ (energy 3.77 GeV) $D_s^+/D_s^- : 2 \times 10^9$ (energy 4.09-4.18 GeV) $\Lambda_c^+/\Lambda_c^- : 1.2 \times 10^9$ (energy 4.63 GeV) $\tau^+\tau^- : 3.6 \times 10^9$
CEPC Z pole	91.2 GeV	$1.92 \times 10^{36} \text{cm}^{-2} \text{s}^{-1}$ (50MW scenario)	50 ab <sup>-1</sup> per year (50MW scenario, 2 IPs)	$D^0/\bar{D}^0 : 4.2 \times 10^{11}$ $D^+/D^- : 2.5 \times 10^{11}$ $D_s^+/D_s^- : 9 \times 10^{10}$ $\Lambda_c^+/\Lambda_c^- : 3.1 \times 10^{10}$ $\tau^+\tau^- : 6 \times 10^{10}$

# Tera Z collider as a flavour factory

- Luminosity
  - $L=100/\text{ab}$ ,  $O(10^{12})$  Z decays  $\Rightarrow O(10^{11})$   $bb$ ,  $cc$ , and  $\tau\tau$  pairs
- Energy
  - besides producing states inaccessible at Belle II  
 $M_Z \gg 2m_b, 2m_\tau, 2m_c \Rightarrow$  surplus energy, boosted decay products  
(better tracking and tagging, lower vertex uncertainty etc.)
- Cleanliness
  - as for any leptonic machine, full knowledge of the initial state  
(e.g. Z mass constraint on invariant masses more powerful)  
 $\Rightarrow$  it enables searches involving neutral/invisible particles

# CEPC detector as a flavour experiment

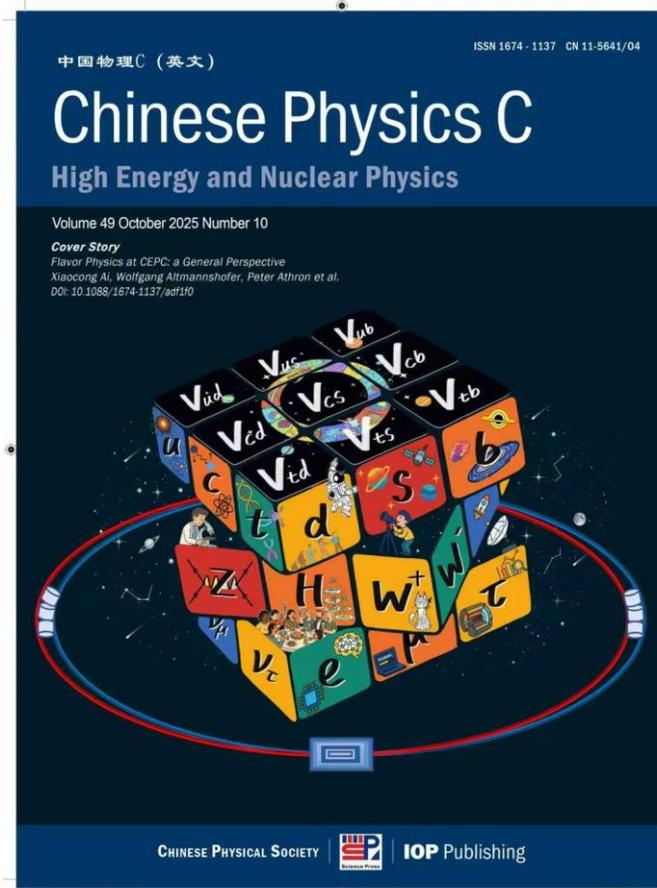
- Large acceptance
  - solid angle coverage of at least  $|\cos \theta| < 0.99$ .
  - low energy and momentum thresholds at the 100 MeV level to record and recognize low energy objects
- Able to identify the relevant physics objects – including neutrals
  - and to precisely reconstruct their properties — especially their energies and momenta
- High efficiency/purity PID
  - not only suppresses the combinatorial background, but also separates decays with similar topologies in the final states
- High-precision and low-material vertex system
  - critical for determining the decay time or lifetime

# Performance of CEPC detectors & some suggested objectives

Item	CDR [2]	4 <sup>th</sup> concept [42]	Comments
Basic Performance			
Acceptance	$ \cos\theta  < 0.99$ [2]		
Threshold	200 MeV [43, 44]	100 MeV	For tracks & photons
Beam energy spread	$\mathcal{O}(0.1\%)$ [2]		
Tracker momentum resolution	$\mathcal{O}(0.1\%)$ [2]		
ECAL energy resolution	$17\%/\sqrt{E(\text{GeV})} \oplus 1\%$ [2]	$3\%/\sqrt{E(\text{GeV})}$ [32]	
HCAL energy resolution	$60\%/\sqrt{E(\text{GeV})} \oplus 1\%$ [2]	$30\%/\sqrt{E(\text{GeV})}$ [45]	
Vertex resolution	10–200 $\mu\text{m}$ [2]	5–100 $\mu\text{m}$	
Jet energy resolution	3–5% [2, 46]		For 20–100 GeV
$\ell - \pi$ mis-ID	$< 1\%$ [47]		In jet, $ \vec{p}  > 2$ GeV
$\pi - K$ separation	$> 2\sigma$ [2]	$> 3\sigma$ [36]	In jet, $ \vec{p}  > 1$ GeV, TOF+ $dE/dx$
Flavor Physics Benchmarks (Depending on the Above)			
$\sigma(m_{H,W,Z})$	3.7% [2]		Hadronic decays
$b$ -jet efficiency $\times$ purity	$\sim 86\%$ [33]		In $Z$ hadronic decays
$c$ -jet efficiency $\times$ purity	$\sim 64\%$ [33]		In $Z$ hadronic decays
$b$ -jet charge tagging $\epsilon_{\text{eff}} = \epsilon(1 - 2\omega)^2$	$\sim 37\%$ [33]		
$c$ -jet charge tagging $\epsilon_{\text{eff}} = \epsilon(1 - 2\omega)^2$	$\sim 58\%$ [33]		
$\pi^0$ efficiency $\times$ purity	$\gtrsim 70\%$ [44]	$\gtrsim 80\%$ [32]	In $Z$ hadronic decays, $ \vec{p}_{\pi^0}  > 5$ GeV
$K_S^0, \Lambda$ efficiency	60%-85% [48]		In $Z$ hadronic decays, all tracks
$\tau$ efficiency $\times$ purity	70% [49]		In $WW \rightarrow \tau\nu q\bar{q}'$ , inclusive
$\tau$ mis-ID	$\mathcal{O}(1\%)$ [49]		In $WW \rightarrow \tau\nu q\bar{q}'$ , inclusive

# CEPC Flavour physics white paper

- CEPC detectors not specifically designed for flavour physics, but we have demonstrated that it can do many flavour physics programs
- Phase II of CEPC flavour physics feasibility studies will focus on:
  - CKM elements
  - Weak phases
  - CP-violations
  - ...



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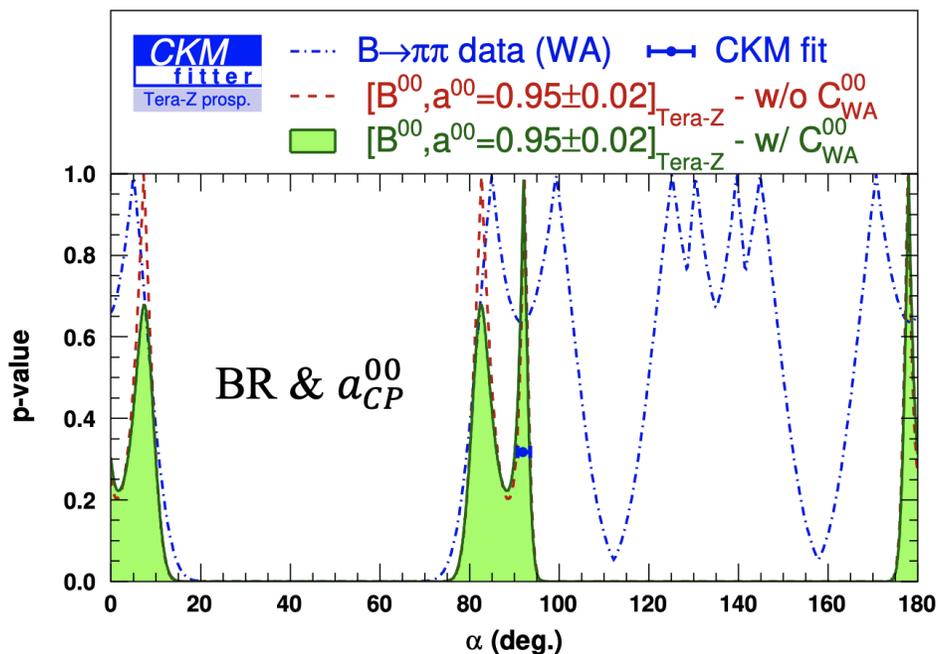
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# Physics Goal 1: Test SM with unprecedented precision

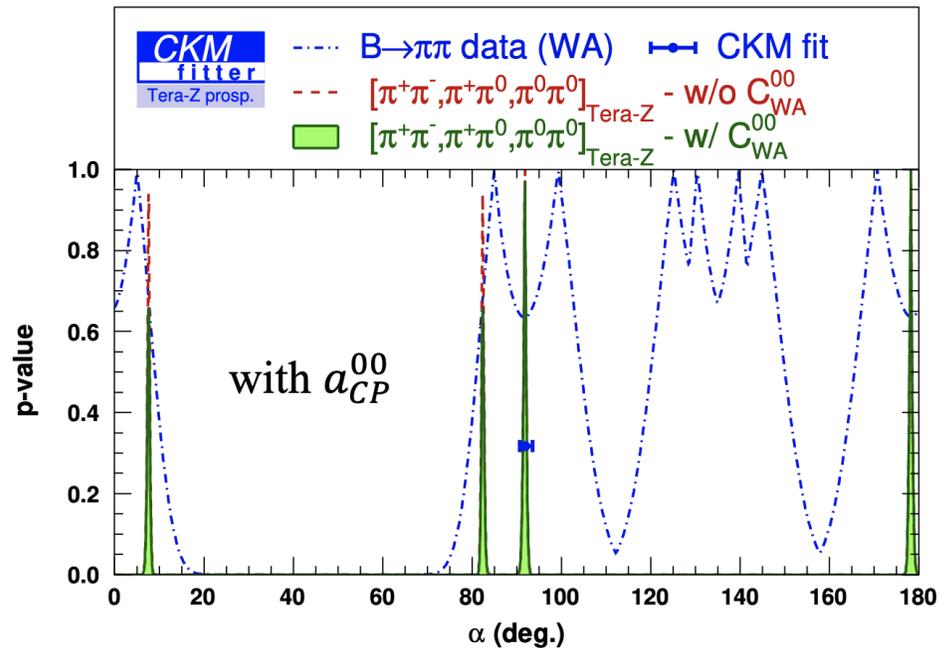
- CKM matrix elements measurements:
  - CKM matrix unitarity test by combining the measurements of CP violating phases.
- CP violation searches:
  - Direct / indirect CP violation searches with large statistics.
- Lepton universality:
  - Measure  $R(D^{(*)})$ ,  $R(J/\psi)$  ratios in  $B$  decays and  $Z \rightarrow \ell\ell$  branching fractions to  $10^{-4}$  precision, probing anomalies hinting at new physics.

# $\alpha$ measurements with $B \rightarrow \pi\pi$

- Studied with  $B \rightarrow \pi^0\pi^0$ ,  $B_S \rightarrow \pi^0\pi^0$ ,  $B \rightarrow \eta\eta$ ,  $B_S \rightarrow \eta\eta$  samples
  - Only  $B \rightarrow \pi^0\pi^0$  used in the estimation of CKM phase  $\alpha$
- Scenario 1, only use  $B \rightarrow \pi^0\pi^0$       Scenario 2, projected to three  $B \rightarrow \pi\pi$  modes



- precision of  $\alpha$ :  $2 \sim 3^\circ$



- precision of  $\alpha$ :  $0.4^\circ$

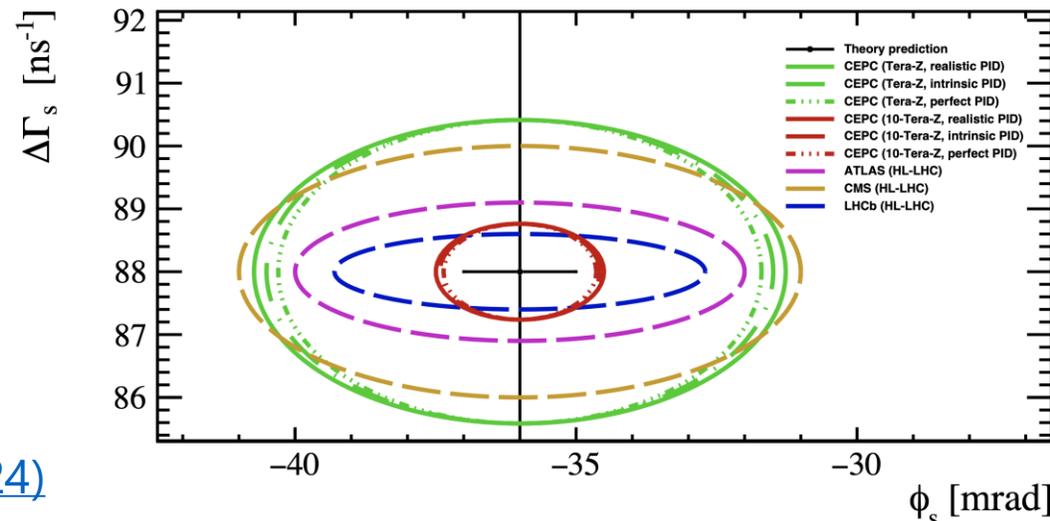
Theoretical systematic uncertainties  $\sim 1-2^\circ$  not considered

# $\phi_s$ measurements with $B_s \rightarrow J/\psi\phi$

- Estimated resolution with 1 Tera Z
  - And comparison with LHCb  $300 \text{ fb}^{-1}$

Table 1: Parameters table of factors to calculate the precision of  $\phi_s$ ,  $\Gamma_s$  and  $\Delta\Gamma_s$ . The terms with \* means that the factor is insensitive to the resolution of  $\Gamma_s$  and  $\Delta\Gamma_s$ .

	LHCb (HL-LHC)	CEPC (Tera-Z)	CEPC/LHCb
$bb$ statics	$43.2 \times 10^{12}$	$0.152 \times 10^{12}$	1/284
Acceptance $\times$ efficiency	7%	75%	10.7
Br	$6 \times 10^{-6}$	$12 \times 10^{-6}$	2
Flavour tagging*	4.7%	17.3%	3.7
Time resolution* ( $\exp(-\frac{1}{2}\Delta m_s^2\sigma_t^2)$ )	0.52	1	1.92
$\sigma_t$ (fs)	45	4.7	
scaling factor $\xi$	0.0015	0.0021	1.4
$\sigma(\phi_s)$	3.3 mrad	4.6 mrad	



# $\gamma$ measurements with $B_s \rightarrow D_s K$

- Inputs: central values of current measurements / calculations:
- Outputs: fitted results with MC sample (preliminary)

**Table 1.** The latest results of parameters

Parameters	Value
$\tau(B_s^0) = 1/\Gamma_s$	$1.520 \pm 0.005 [ps] [4]$
$\Delta\Gamma_s$	$+0.084 \pm 0.005 [ps^{-1}] [4]$
$\Delta m_s$	$17.765 \pm 0.006 [ps^{-1}] [4]$
$\beta_s$	$0.01882^{+0.00026}_{-0.00028} [rad] [5]$
$\gamma$	$(66.2^{+3.4}_{-3.6})^\circ [4]$
$\delta$	$(347.6^{+6.2}_{-6.1})^\circ [3]$
$r_{D_s K}$	$0.318^{+0.035}_{-0.033} [3]$

Fit results with 5.3% statistics

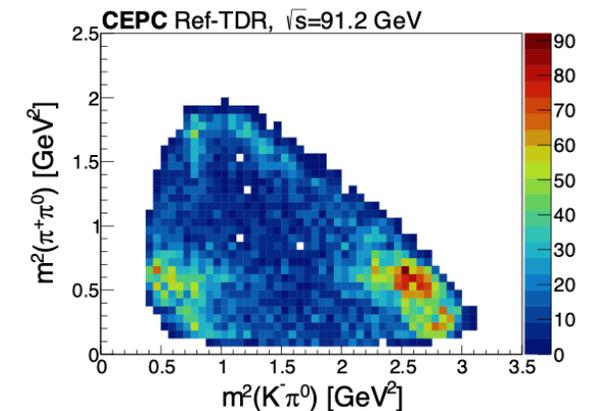
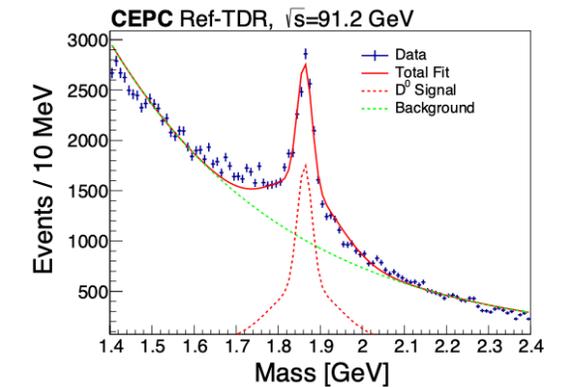
Fitted parameter	values
$\gamma$	$(66.43 \pm 3.01)^\circ$
$\delta$	$(349.64 \pm 2.39)^\circ$
$r_{D_s K}$	$0.314 \pm 0.007$

Projected to full statistics, all final states:  
uncertainty of  $\gamma$ :  $0.7^\circ$

# CPV searches with charm hadrons

- CEPC generally do not have advantages in statistics for charm hadrons compare to LHCb
- However, CEPC can have much higher efficiency with  $\pi^0$ s

Decays	LHCb ( 6 fb <sup>-1</sup> )	LHCb ( 300 fb <sup>-1</sup> )	CEPC (4 Tera Z)
$D^{*+}$	$4.7 \times 10^{12}$	$2.4 \times 10^{14}$	$4.6 \times 10^{11}$
$D^0$ from $D^{*+}$	$3.2 \times 10^{12}$	$1.6 \times 10^{14}$	$3.1 \times 10^{11}$
$D^{*+} \rightarrow (D^0 \rightarrow K^- K^+) \pi^+$	$1.6 \times 10^{10}$	$6.5 \times 10^{11}$	$1.3 \times 10^9$
$D^{*+} \rightarrow (D^0 \rightarrow \pi^- \pi^+) \pi^+$	$4.6 \times 10^9$	$2.3 \times 10^{11}$	$4.5 \times 10^8$
$D^{*+} \rightarrow (D^0 \rightarrow K^- \pi^+) \pi^+$	$1.6 \times 10^{11}$	$6.3 \times 10^{12}$	$1.2 \times 10^{10}$
$D^{*+} \rightarrow (D^0 \rightarrow \pi^- \pi^+ \pi^0) \pi^+$	$4.8 \times 10^{10}$	$2.4 \times 10^{12}$	$4.6 \times 10^9$
$D^{*+} \rightarrow (D^0 \rightarrow K^- \pi^+ \pi^0) \pi^+$	$4.6 \times 10^{11}$	$2.3 \times 10^{13}$	$4.4 \times 10^{10}$
Reco. & Sel. $D^0 \rightarrow K^- K^+$	$5.8 \times 10^7$ [147]	$2.9 \times 10^9$	$1.3 \times 10^8$
Reco. & Sel. $D^0 \rightarrow \pi^- \pi^+$	$1.8 \times 10^7$ [147]	$9 \times 10^8$	$4.5 \times 10^7$
Reco. & Sel. $D^0 \rightarrow K^- \pi^+$	$5.2 \times 10^8$ [147]	$2.6 \times 10^{10}$	$1.2 \times 10^9$
Reco. & Sel. $D^0 \rightarrow \pi^- \pi^+ \pi^0$	$2.5 \times 10^6$ [148]	$1.2 \times 10^8$	$4.6 \times 10^8$
Reco. & Sel. $D^0 \rightarrow K^- \pi^+ \pi^0$	$1.9 \times 10^7$ [148]	$9.6 \times 10^8$	$4.4 \times 10^9$



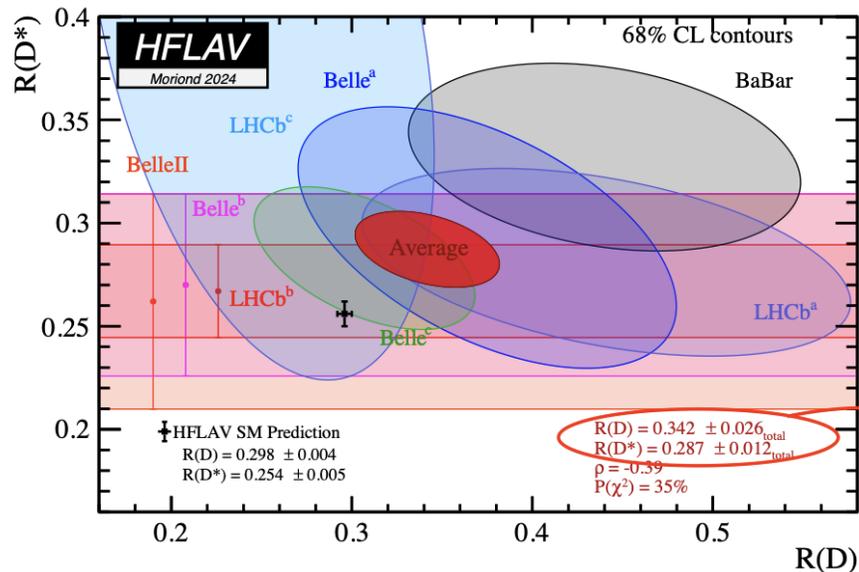
# LFU tests in B decays

- Gauge interactions are flavour blind: the SM predicts Lepton Flavour Universality (LFU) EW interactions  $\Rightarrow$  any deviation from LFU would be a clear indication of NP

Example: LFU tests in semileptonic (charged-current)  $B$  decays

$$R_{D^{(*)}} \equiv \frac{\text{BR}(B \rightarrow D^{(*)}\tau\nu)}{\text{BR}(B \rightarrow D^{(*)}\ell\nu)}, \quad \ell = e, \mu$$

CEPC can achieve a precision below 1%



$R_{H_c}$	SM Value	Tera-Z	4×Tera-Z	10×Tera-Z
$R_{J/\psi}$	0.289	$4.3 \times 10^{-2}$	$2.1 \times 10^{-2}$	$1.4 \times 10^{-2}$
$R_{D_s}$	0.393	$4.1 \times 10^{-3}$	$2.1 \times 10^{-3}$	$1.3 \times 10^{-3}$
$R_{D_s^*}$	0.303	$3.3 \times 10^{-3}$	$1.6 \times 10^{-3}$	$1.0 \times 10^{-3}$
$R_{\Lambda_c}$	0.334	$9.8 \times 10^{-4}$	$4.9 \times 10^{-4}$	$3.1 \times 10^{-4}$

Current precision: ~5-10%  
World average still somewhat in tension with the SM prediction

## Physics Goal 2: Rare & Forbidden Decays

CEPC's clean environment and particle-flow detectors excel at reconstructing elusive processes:

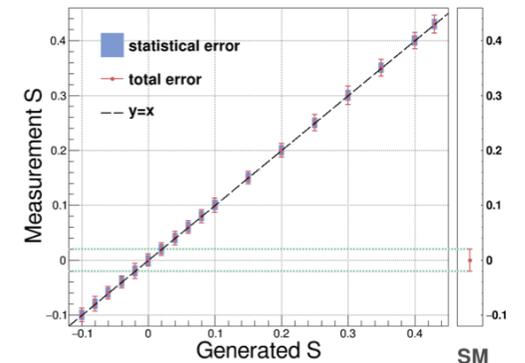
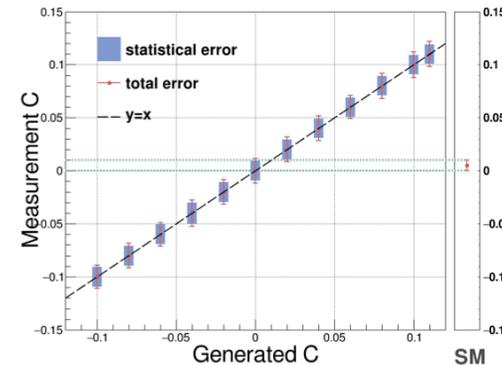
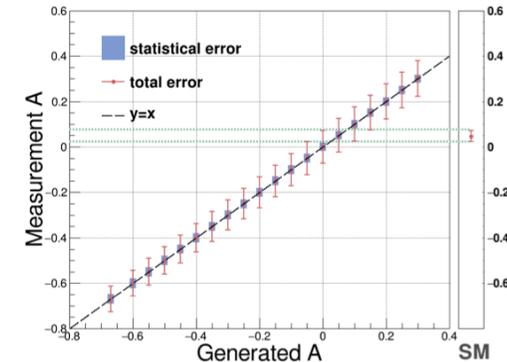
- Flavour-changing neutral currents (FCNC):
  - Search for  $b \rightarrow s$  transitions suppressed in the Standard Model, e.g.,  $B_s \rightarrow \phi \nu \nu$  (aiming for 2% precision),  $B \rightarrow K \tau \tau$ , and  $B_s \rightarrow \tau \tau$ . Sensitivity to branching ratios as low as  $10^{-7}$ .
- Lepton flavour violation (LFV):
  - Hunt for absolute forbidden decays like  $\tau \rightarrow \mu \gamma$  (target: BR  $10^{-10}$ ),  $Z \rightarrow e \mu$ . These "smoking guns" for new physics are inaccessible at hadron colliders due to backgrounds.
- Baryon/lepton number violation:
  - Probe decays like  $B^+ \rightarrow \pi^- \ell^+ \ell^+$  or  $\Lambda_b \rightarrow \pi^- \ell^+$  that challenge fundamental symmetries.

# Measurement of FCNC decay $B_s \rightarrow \phi\gamma$

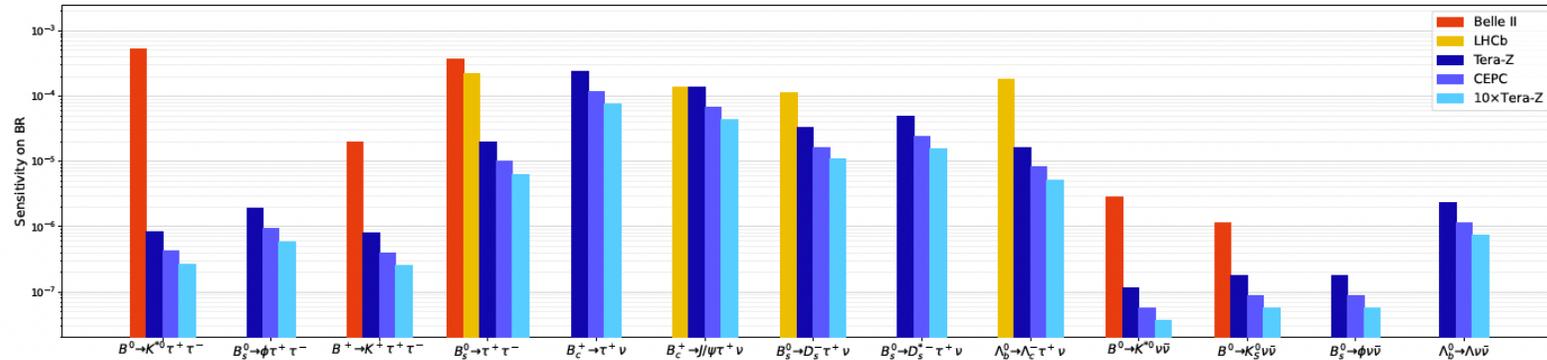
- Precision measurement of the time-dependent FCNC  $B_s \rightarrow \phi\gamma$  decay and extraction of CP-violating parameters to probe New Physics

$$\mathcal{P}(t) \propto e^{-\Gamma_s t} \left\{ \cosh\left(\frac{\Delta\Gamma_s t}{2}\right) - \mathcal{A}^\Delta \sinh\left(\frac{\Delta\Gamma_s t}{2}\right) + \zeta\mathcal{C} \cos(\Delta m_s t) - \zeta\mathcal{S} \sin(\Delta m_s t) \right\}$$

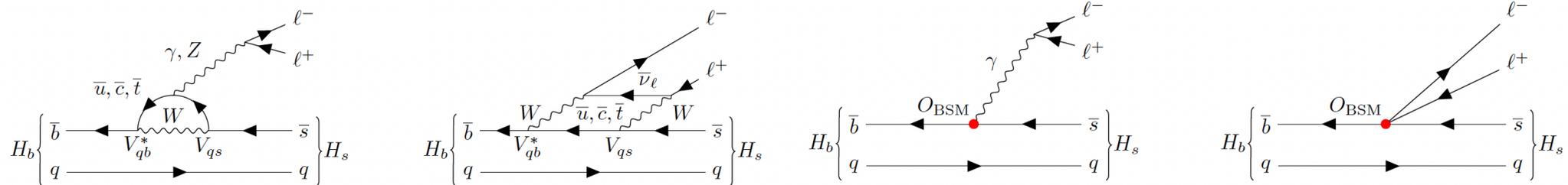
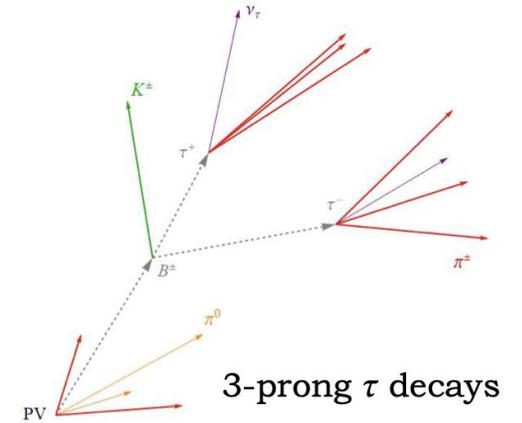
- Scan of CP-violating parameters inputs
- $1\sigma$  exclusion bounds (outside SM range):
  - $A^\Delta < -0.05$  or  $A^\Delta > 0.15$
  - $C < -0.02$  or  $C > 0.04$
  - $S < -0.04$  or  $S > 0.04$
- Improve uncertainty by  $O(10)$  compare to current LHCb



# FCNC b hadronic decays



**Figure 16:** Projected sensitivities of measuring the  $b \rightarrow s\tau\tau$  [85],  $b \rightarrow s\nu\bar{\nu}$  [36, 86] and  $b \rightarrow c\tau\nu$  [39, 68] transitions at the Z pole. The sensitivities at Belle II @  $50 \text{ ab}^{-1}$  [7, 87] and LHCb Upgrade II [18, 57] have also been provided as a reference. Note that LHCb sensitivities are generated by combining the analyses of  $\tau^+ \rightarrow \pi^+\pi^-\pi^-(\pi^0)\nu$  and  $\tau \rightarrow \mu\nu\bar{\nu}$ . This plot is taken from Ref. [39], with additional  $b \rightarrow s\nu\bar{\nu}$  modes included.



# prospects of LFV sensitivity in the $\tau$ and Z decays

Measurement	Current [126]	FCC [115]	Tera-Z Prelim. [127]	Comments
Lifetime [sec]	$\pm 5 \times 10^{-16}$	$\pm 1 \times 10^{-18}$		from 3-prong decays, stat. limited
$\text{BR}(\tau \rightarrow \ell \nu \bar{\nu})$	$\pm 4 \times 10^{-4}$	$\pm 3 \times 10^{-5}$		0.1× the ALEPH systematics
$m(\tau)$ [MeV]	$\pm 0.12$	$\pm 0.004 \pm 0.1$		$\sigma(p_{\text{track}})$ limited
$\text{BR}(\tau \rightarrow 3\mu)$	$< 2.1 \times 10^{-8}$	$\mathcal{O}(10^{-10})$	same	bkg free
$\text{BR}(\tau \rightarrow 3e)$	$< 2.7 \times 10^{-8}$	$\mathcal{O}(10^{-10})$		bkg free
$\text{BR}(\tau^\pm \rightarrow e\mu\mu)$	$< 2.7 \times 10^{-8}$	$\mathcal{O}(10^{-10})$		bkg free
$\text{BR}(\tau^\pm \rightarrow \mu ee)$	$< 1.8 \times 10^{-8}$	$\mathcal{O}(10^{-10})$		bkg free
$\text{BR}(\tau \rightarrow \mu\gamma)$	$< 4.4 \times 10^{-8}$	$\sim 2 \times 10^{-9}$	$\mathcal{O}(10^{-10})$	$Z \rightarrow \tau\tau\gamma$ bkg, $\sigma(p_\gamma)$ limited
$\text{BR}(\tau \rightarrow e\gamma)$	$< 3.3 \times 10^{-8}$	$\sim 2 \times 10^{-9}$		$Z \rightarrow \tau\tau\gamma$ bkg, $\sigma(p_\gamma)$ limited
$\text{BR}(Z \rightarrow \tau\mu)$	$< 1.2 \times 10^{-5}$	$\mathcal{O}(10^{-9})$	same	$\tau\tau$ bkg, $\sigma(p_{\text{track}})$ & $\sigma(E_{\text{beam}})$ limited
$\text{BR}(Z \rightarrow \tau e)$	$< 9.8 \times 10^{-6}$	$\mathcal{O}(10^{-9})$		$\tau\tau$ bkg, $\sigma(p_{\text{track}})$ & $\sigma(E_{\text{beam}})$ limited
$\text{BR}(Z \rightarrow \mu e)$	$< 7.5 \times 10^{-7}$	$10^{-8} - 10^{-10}$	$\mathcal{O}(10^{-9})$	PID limited

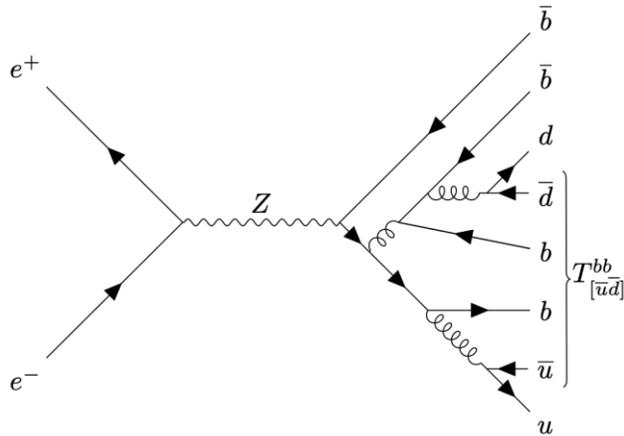
# Physics Goal 3: Exotic Hadrons & Spectroscopy

With  $10^{11}$   $b$ -hadrons and charm particles, CEPC will map the "heavy-flavour zoo":

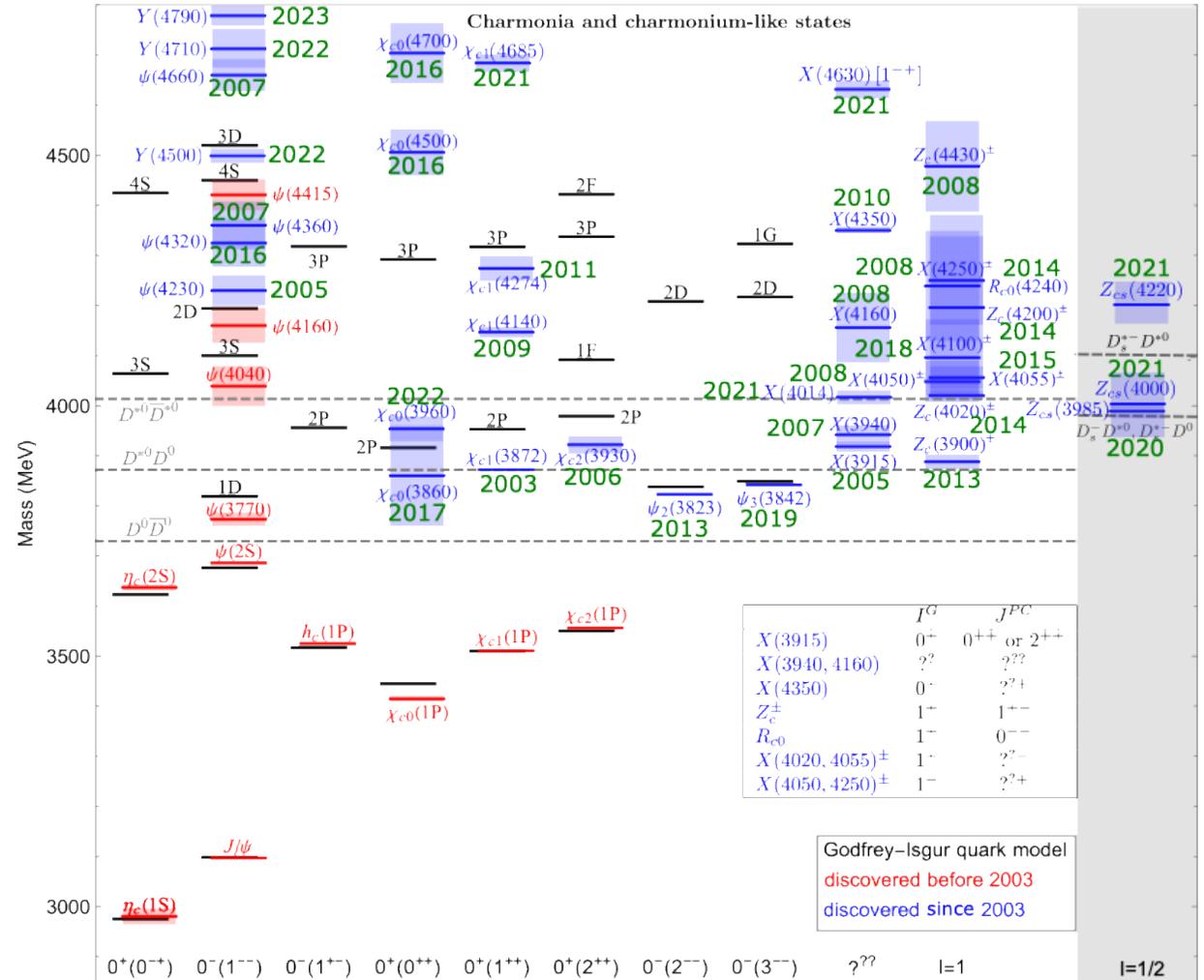
- Discover tetraquarks ( $T_{cc}$ ,  $T_{bb}$ ) pentaquarks ( $P_c$ ), and doubly heavy baryons ( $\Xi_{cc}$ ,  $\Xi_{bb}$ ), predicted by QCD but rarely observed.
- Study production mechanisms of charmonium-like states (e.g.,  $X(3872)$ ) via  $Z \rightarrow qq$  or B-decay chains.
- Precision spectroscopy of conventional  $b/c$ -mesons and baryons (e.g.,  $A_b$ ,  $B_c$ ), including excited states.

# Spectroscopy and Exotics - prospects

- A lot of states, guaranteed discovery at CEPC?
- $Z \rightarrow bbbb, bbcc, cccc$  processes may give rise to highly exotic species



- Need more theory inputs for simulation



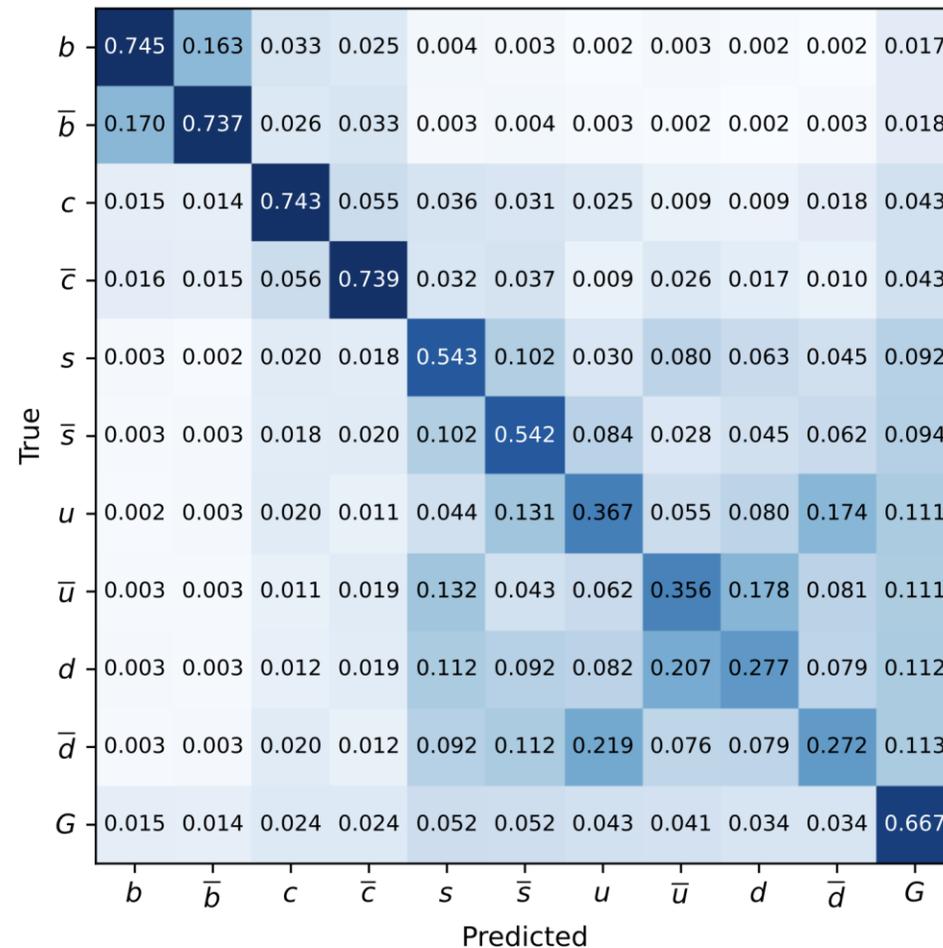
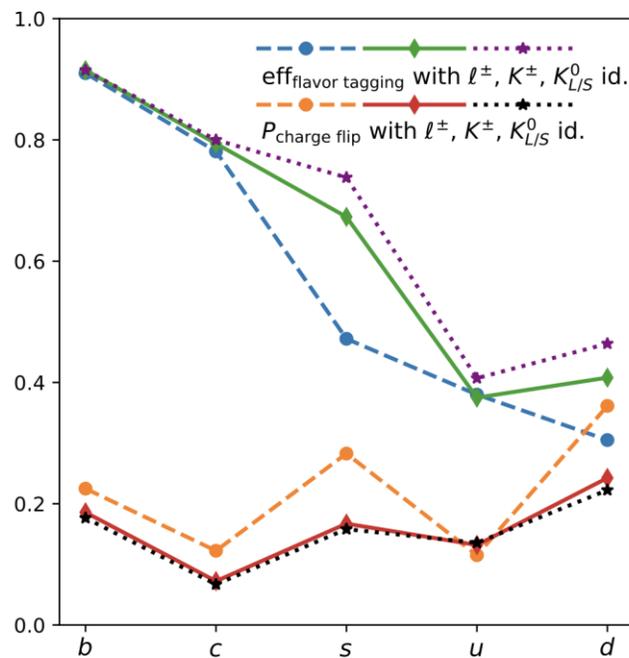
# Physics Goal 4: WW & Higgs & Top Quark Flavour Physics

Higher-energy CEPC runs extend flavour studies:

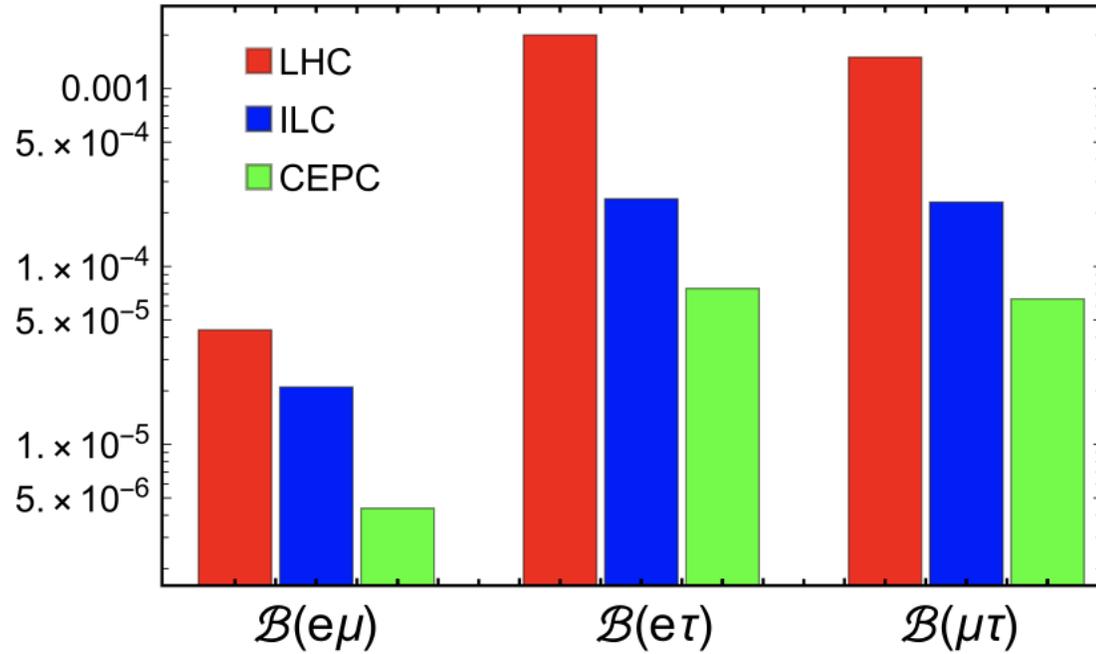
- Higgs flavour violation:
  - Search for  $H \rightarrow bs\bar{}$ ,  $H \rightarrow c\bar{u}$ , or  $H \rightarrow \tau\mu$  decays at the Higgs factory (240 GeV). Jet-origin identification via ML could constrain branching ratios to  $10^{-3}$ .
- Top quark FCNC:
  - At the  $t\bar{t}$  threshold (360 GeV), probe anomalous  $t \rightarrow cZ$  or  $t \rightarrow cH$  decays, sensitive to new physics in top-Higgs couplings.
- CKM elements from WW threshold:
  - Resolve long-standing tensions in CKM matrix elements (e.g.,  $|V_{cb}|$ ,  $|V_{ub}|$ ) by combining data from  $B/D$  meson decays and on-shell W boson decays at the  $WW$  threshold. Target precision for  $|V_{cb}|$  reaches 0.1–0.4%.

# Jet origin identification

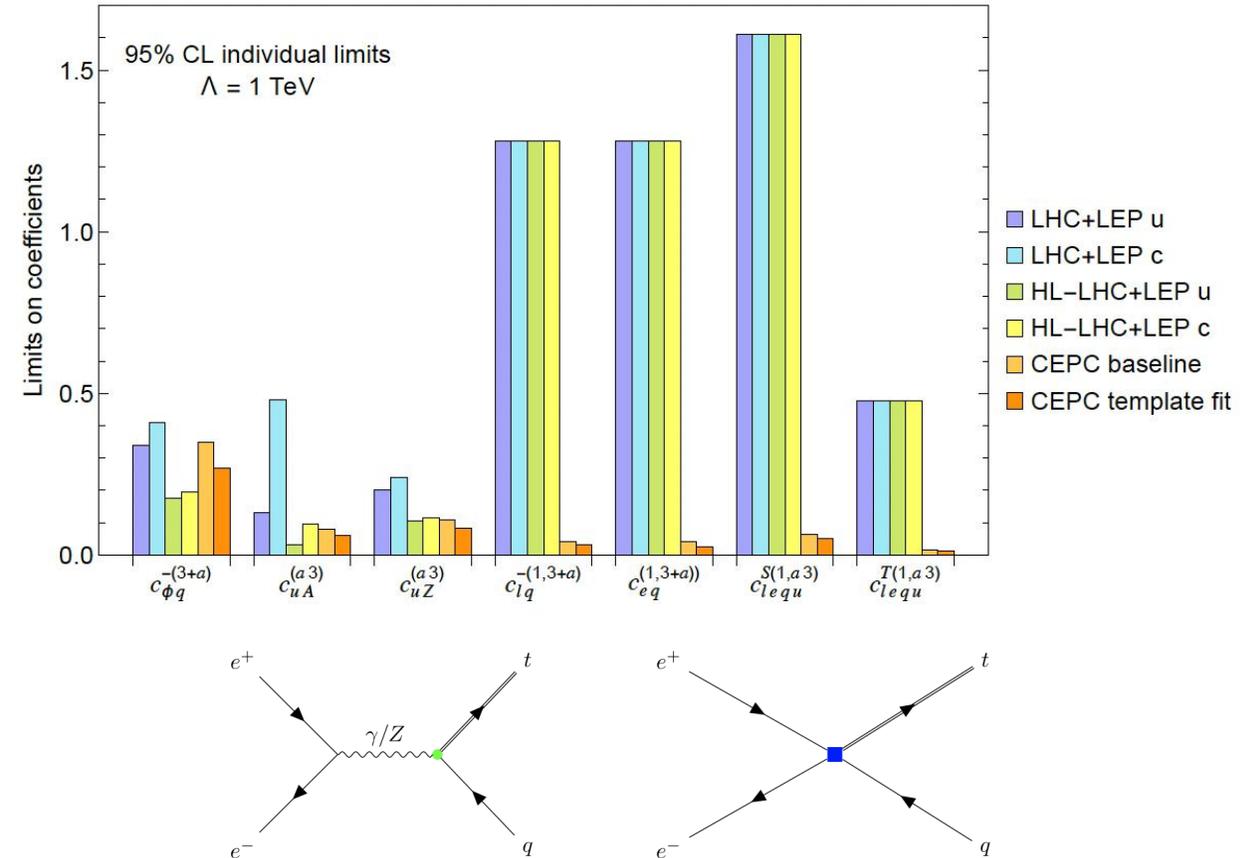
- Full Simulated  $\nu\nu H$ , Higgs to two jets sample at CEPC baseline configuration, reconstructed with deep learning techniques
- Jets identified as the category with highest likelihood
- 5 quarks+antiquarks + gluon



# Flavour violating Higgs decay & Top FCNC

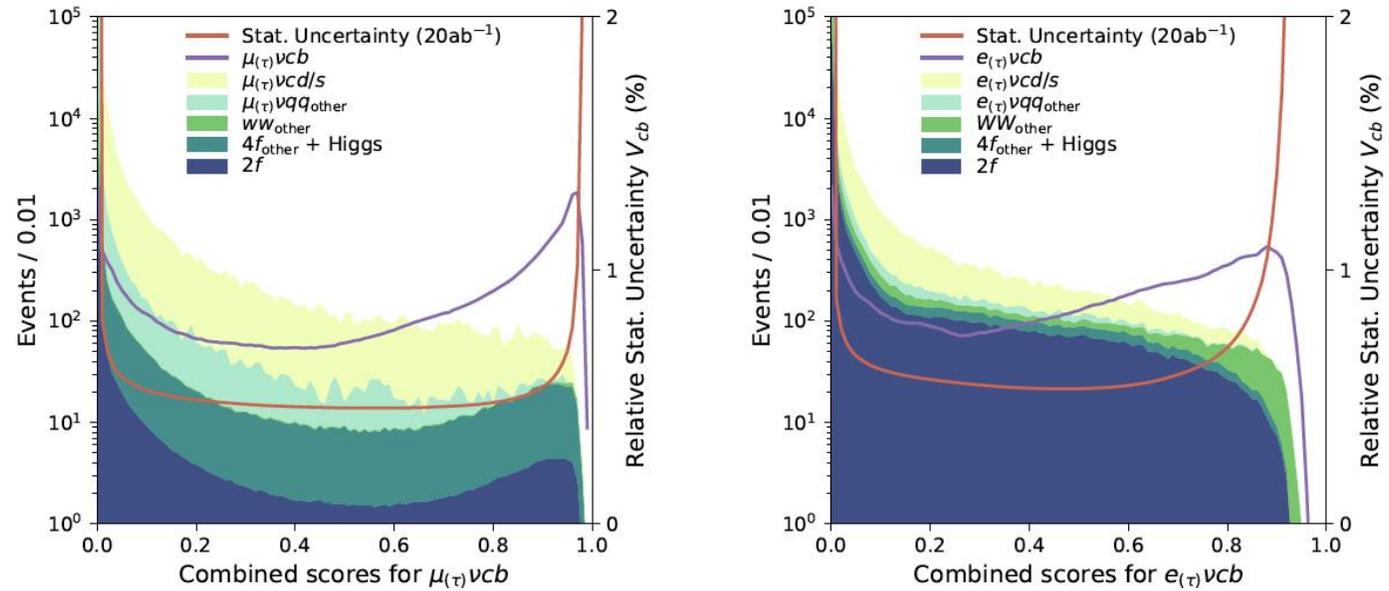


**Fig. 34.** (color online) Projected upper limits on the LFV Higgs decays at the LHC, ILC and CEPC. The figure is updated from [255].

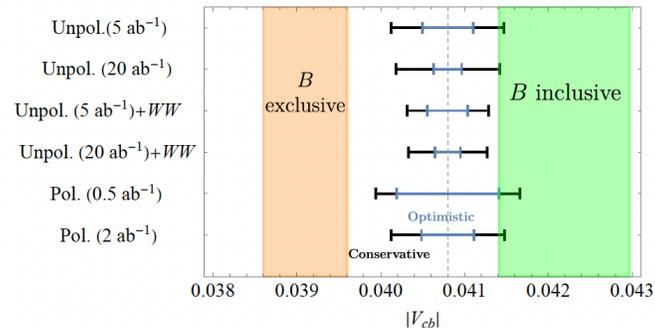


**Fig. 35.** (color online) Illustrative Feynman diagrams for the FCNC single top production  $e^-e^+ \rightarrow t(\bar{t})j$ . The green dot and blue square represent two-fermion FCNC and four-fermion (two-lepton two-quark) contact operators, respectively.

# CKM element from W decay



**Figure 4.** The BDT score distribution of signal and backgrounds in: the muon channel (left) and electron channel (right). The red curve indicates the projected statistical relative sensitivity estimated from eq. (4.1) assuming a luminosity of  $20 \text{ ab}^{-1}$ .



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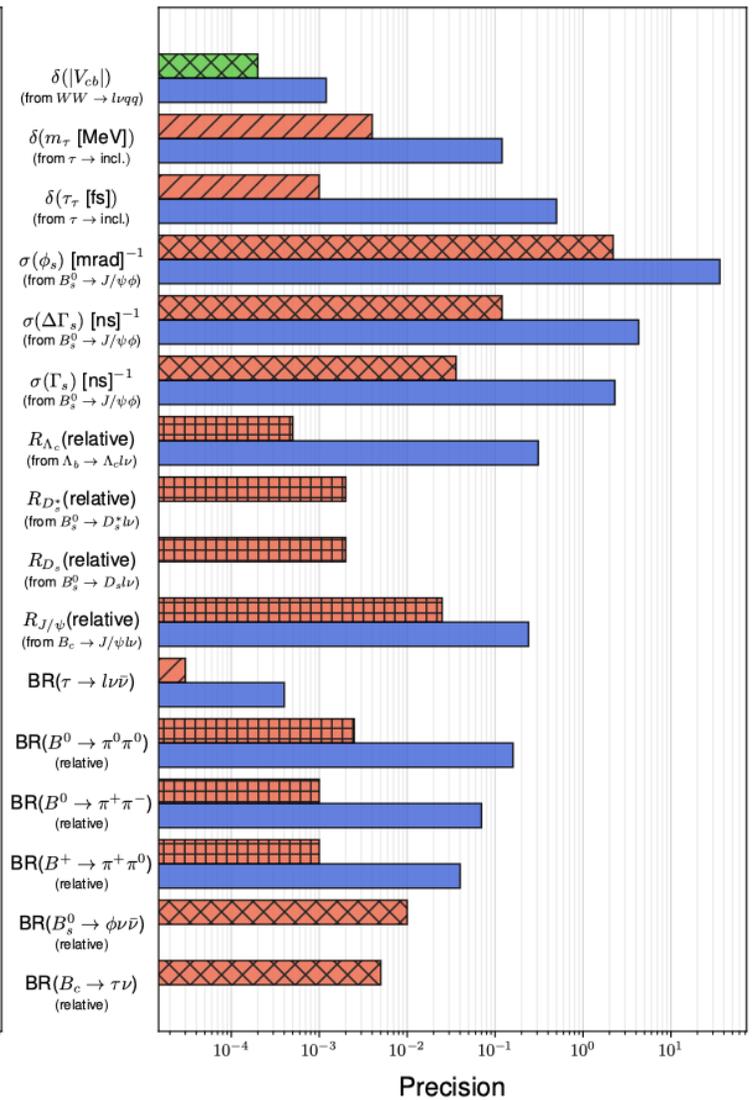
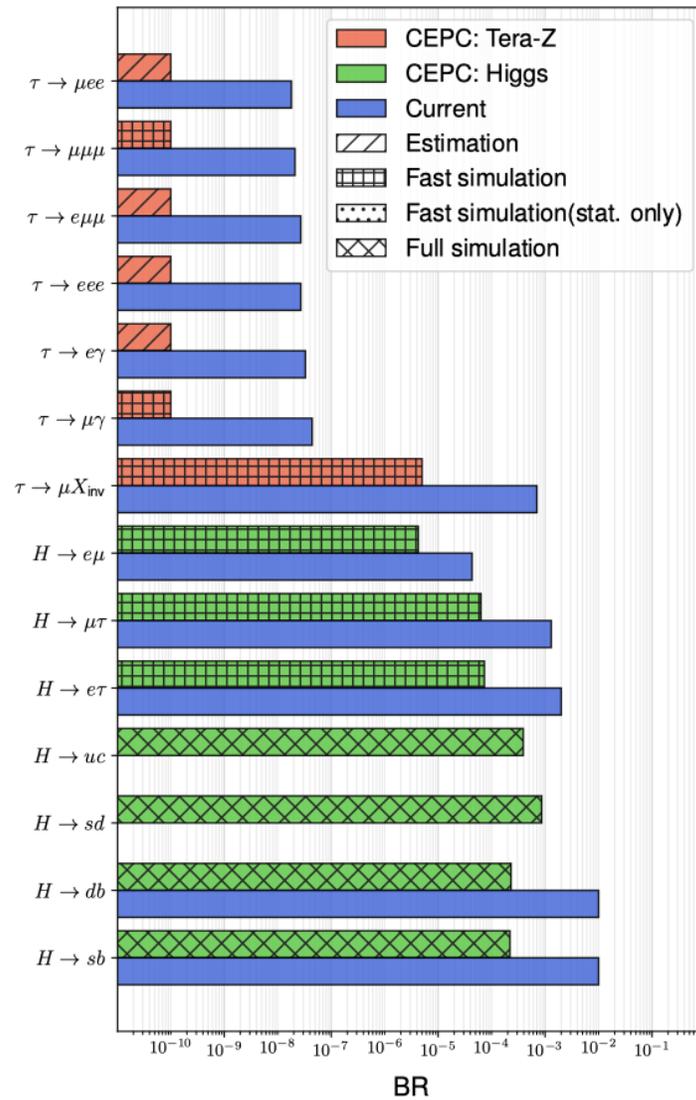
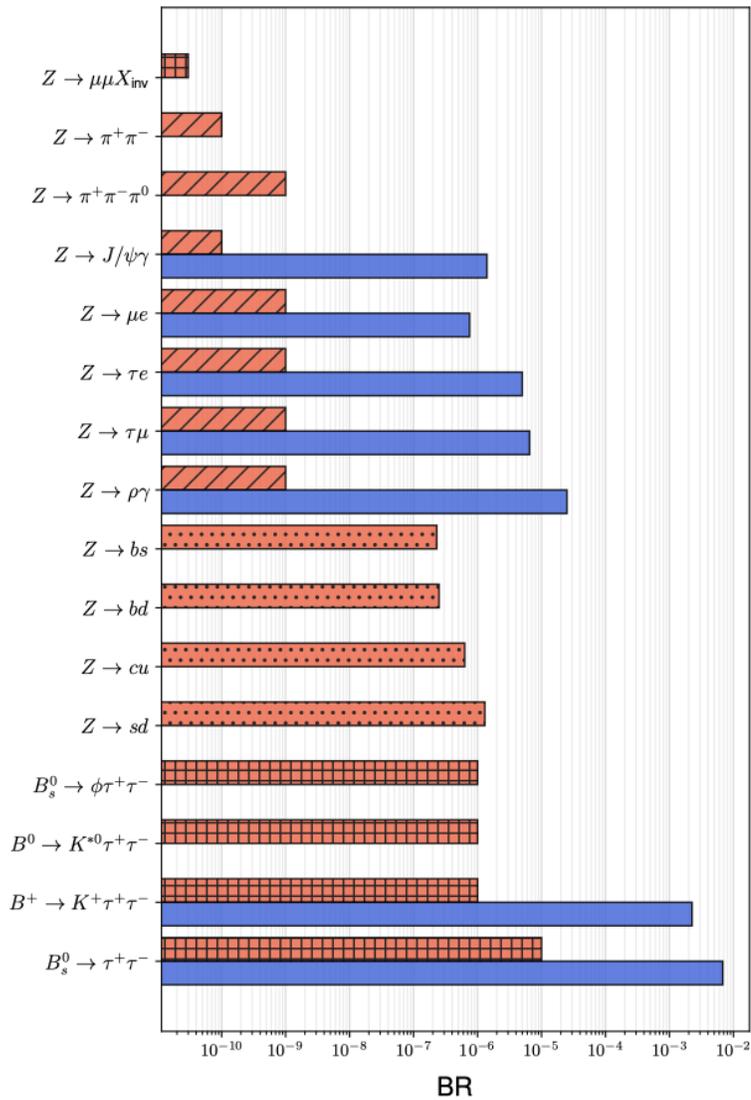
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## Measurement of CKM element $|V_{cb}|$ from $W$ boson decays at the future Higgs factories

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# Summary of flavour benchmark channels



# Summary

- We demonstrated the potential of studying flavour physics @ CEPC
- $O(10^{12})$  Z decays would enable us to study many processes with a much higher precision than (or inaccessible to) other experiments
- WW, Higgs, top runs extended the flavour program
- Extremely rich physics program results in stringent requirements on the detector performance, to be addressed by intensive study on detector design, key tech R&D, and algorithms development
- Will explore more possibilities in the next stage feasibility studies

Thanks!