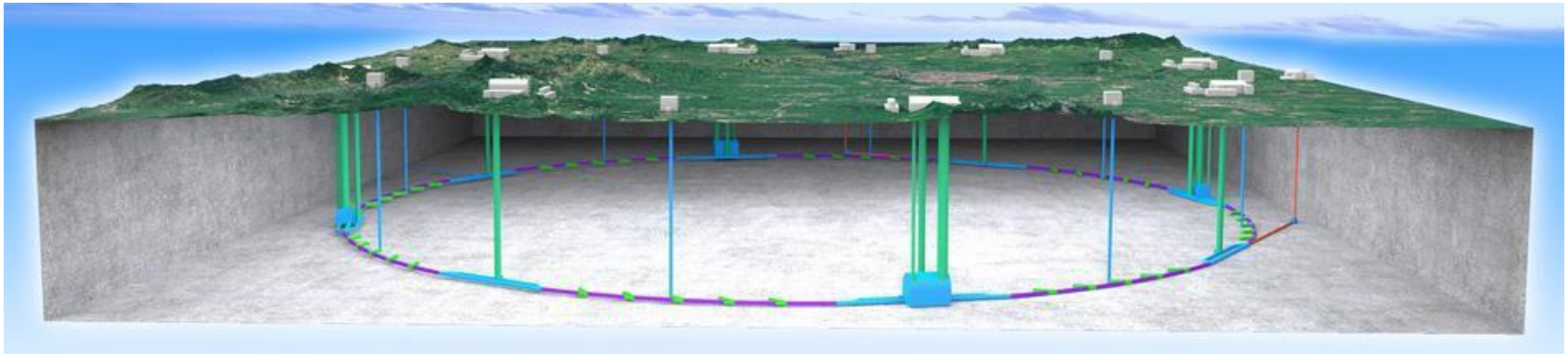
A. Drutskoy,

LPI, Moscow

Physics at CEPC collider



The 22nd Lomonosov Conference

Moscow State University, Moscow, Russia, August 21 - 27, 2025

Details about CEPC project were presented in Thursday plenary talk:
J. Gao (IHEP, CAS) "CEPC project status".

In my talk physics potential of CEPC project for Higgs boson parameter measurements and respective searches for Beyond the Standard Model (BSM) effects will be discussed.

Due to limited time I cannot cover other topics, which are relevant for studies at CEPC (deferred until next year ☺). Only a few summary slides will be shown.

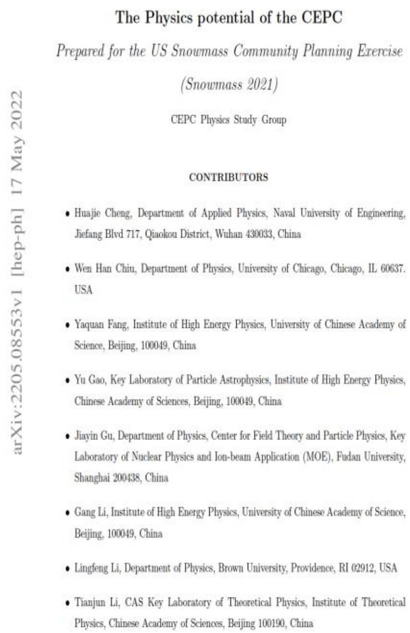
There are theoretical arguments (not strong, but very reasonable), that BSM physics have to emerge below ~50-100 TeV (Higgs mass?, astrophysics ?).

LHC ruled out Beyond the Standard Model physics up to ~1.5-2.0 TeV.
HL-LHC will increase the region of sensitivity to about 3 TeV.
CEPC can indirectly investigate region (depends on process) up to ~5-50 TeV.
SPPC can discover directly (or close) BSM up to ~40-50 TeV.

CEPC Physics white papers


Chinese Physics C Vol. 43, No. 4 (2019) 043002

Precision Higgs physics at the CEPC


The Physics potential of the CEPC

Prepared for the US Snowmass Community Planning Exercise

(Snowmass 2021)

CEPC Physics Study Group

arXiv:2205.08553v1 [hep-ph] 17 May 2022


Prepared for submission to JHEP

Flavor Physics at CEPC: a General Perspective

arXiv:2412.19743v2 [hep-ex] 31 Dec 2024


New Physics Search at the CEPC: a General Perspective

arXiv:2505.24810v1 [hep-ex] 30 May 2025

Higgs: 2019 Chinese Phys. C 43 043002, see also 1810.09037

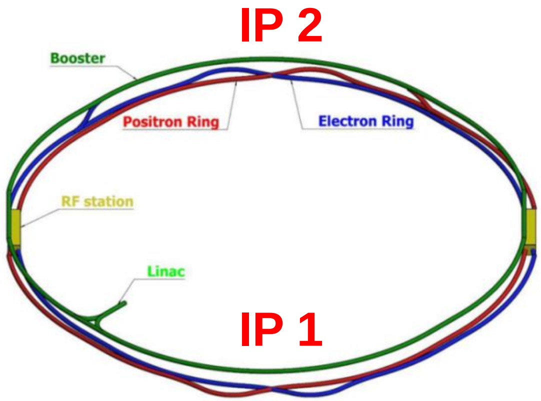
Snowmass Whitepaper: covers Higgs, EW, Flavor, NP, etc, available at 2205.08553v1

Flavor: Accepted by CPC (July 4th), available at 2412.19743v2

New Physics: Submitted to CPC (July 17th), available at 2505.24810v1

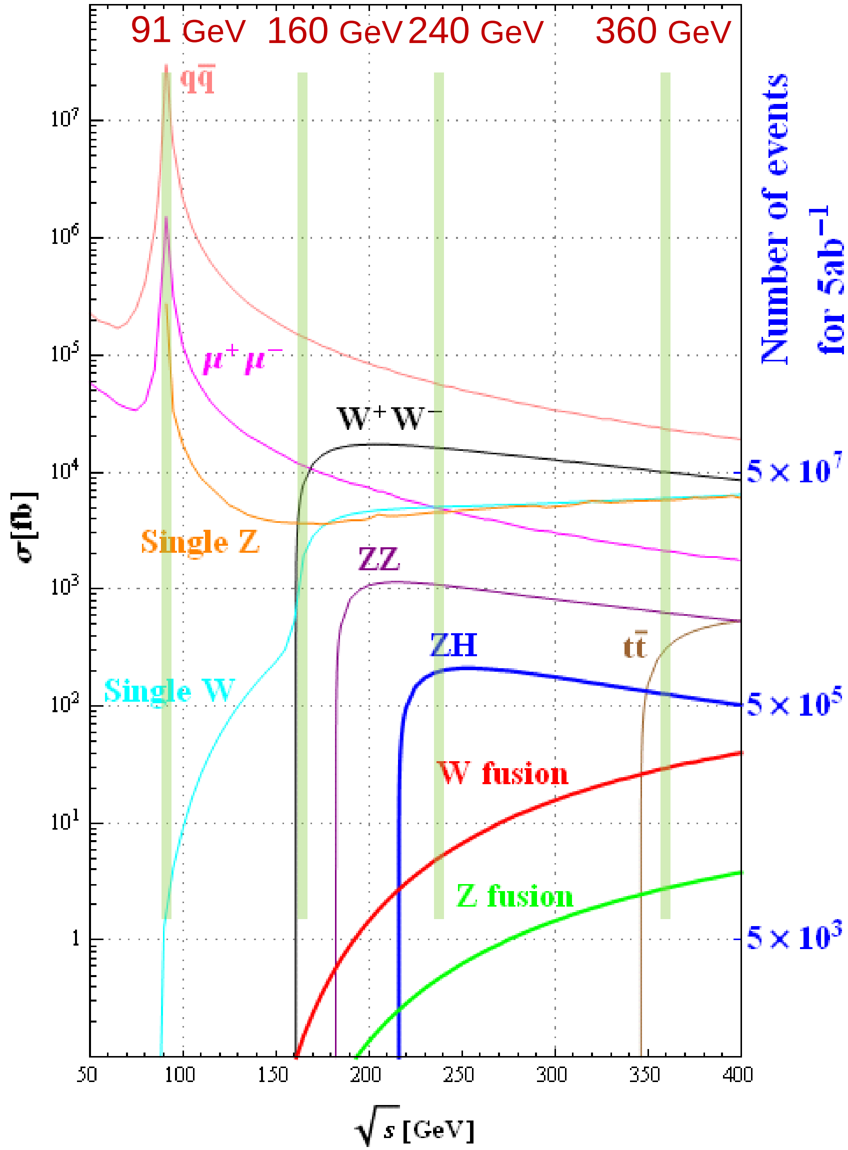
EW white paper: in progress. Plan to submit to ArXiv ~ Nov.

Circular e^+e^- collider CEPC (Higgs factory, China)



100 km ring, booster and collider in one tunnel. 2 interaction points, 2 detectors. Expected start of data taking is in 2035.

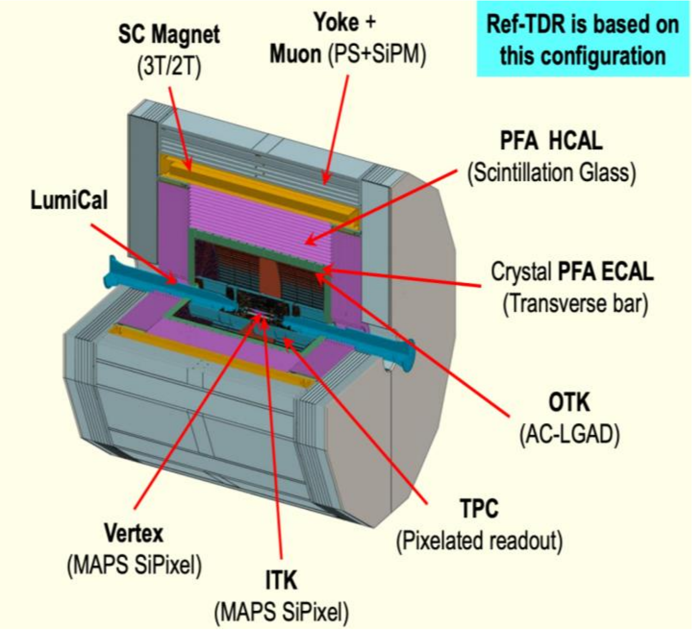
Operation mode		ZH	Z	W^+W^-	$t\bar{t}$
$\sqrt{s}$ [GeV]		~240	~91	~160	~360
Run Time [years]		10	2	1	5
30 MW	L / IP [$\times 10^{34}$ cm^{-2}s^{-1}]	**5.0**	**115**	**16**	**0.5**
	$\int L\,dt$ [ab^{-1}, 2 IPs]	13	60	4.2	0.65
	Event yields [2 IPs]	2.6×10^6	2.5×10^{12}	1.3×10^8	4×10^5
50 MW	L / IP [$\times 10^{34}$ cm^{-2}s^{-1}]	**8.3**	**192**	**26.7**	**0.8**
	$\int L\,dt$ [ab^{-1}, 2 IPs]	21.6	100	6.9	1
	Event yields [2 IPs]	4.3×10^6	4.1×10^{12}	2.1×10^8	6×10^5



Baseline detector

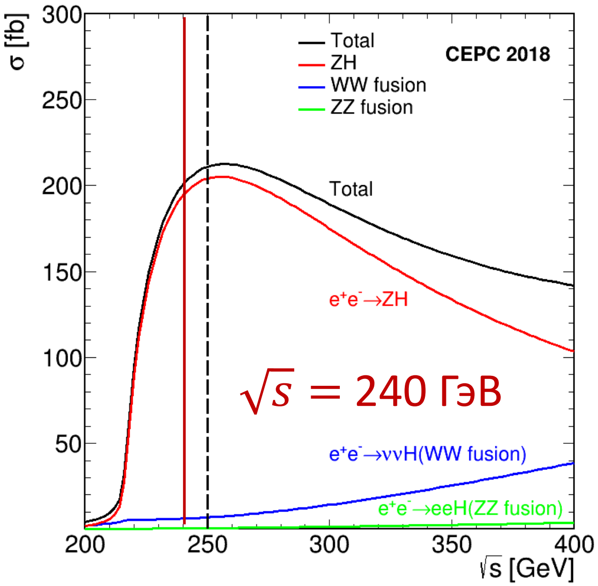
Design of the CEPC detector evolves with the R&D progressing and better understanding of the physic reach.

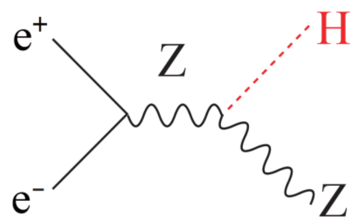
Record resolutions for all subdetectors.



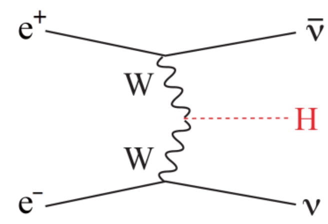
Sub-system	Key technology	Key Specifications
Vertex	6-layer CMOS SPD	$\sigma_{r\phi}$ ~ 3 μm, X/X_0 < 0.15% per layer
Tracking	CMOS SPD ITK, AC-LGAD SSD OTK, TPC + Vertex detector	$\sigma\left(\frac{1}{P_T}\right) \sim 2\times10^{-5} \oplus \frac{1\times10^{-3}}{P\times sin^{3/2}\theta}\left(GeV^{-1}\right)$
Particle ID	dN/dx measurements by TPC Time of flight by AC-LGAD SSD	Relative uncertainty ~ 3% σ(t) ~ 30 ps
EM calorimeter	High granularity crystal bar PFA calorimeter	EM resolution ~ $3\%/\sqrt{E(GeV)}$ Granularity ~ 1×1×2 cm^3
Hadron calorimeter	Scintillation glass PFA hadron calorimeter	Support PFA jet reconstruction Single hadron $\sigma_E^{had} \sim 40\%/\sqrt{E(GeV)}$ Jet $\sigma_E^{jet} \sim 30\%/\sqrt{E(GeV)}$

Higgs boson production processes at 240 GeV

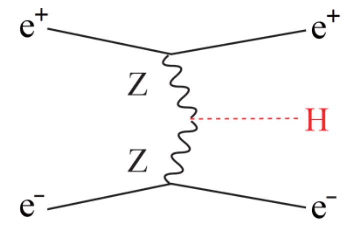




Higgs strahlung

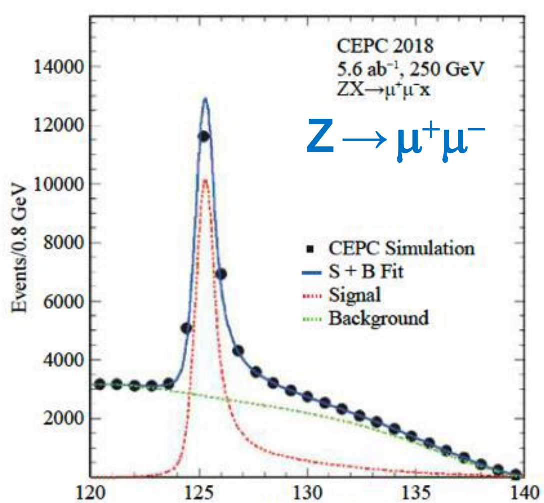


W boson fusion



Z boson fusion

Main backgrounds: $e^+e^- \to ZZ$, $e^+e^- \to WW$, $e^+e^- \to q\bar{q}$ and some others (see slide 3).



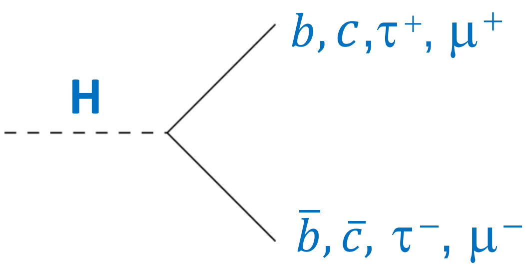
Recoil mass to $Z(\mu^+\mu^-)$

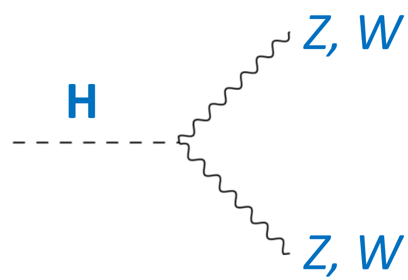
Process $e^+e^- \to Z(\mu^+\mu^-)H$ provides absolute normalization for branching fraction measurements. Number of Higgs bosons in data sample can be obtained from fit of recoil mass distribution to $\mu^+\mu^-$ combination, without any requirements on Higgs boson. Using this normalization Higgs boson decay branching fractions can be measured in model independent way.

Higgs boson decays

Branching fractions of Higgs boson decays (%), M(*h*) = 125.08 GeV (theory predictions).

$b\bar{b}$	$c\bar{c}$	$\tau^+\tau^-$	$\mu^+\mu^-$	WW^*	ZZ^*	gg	$\gamma\gamma$	$Z\gamma$
58.1 $\pm1.3\%$	2.88 $^{+5.5}_{-2.0}\%$	6.26 $\pm1.6\%$	0.0217 $\pm1.7\%$	21.5 $\pm1.5\%$	2.64 $\pm1.5\%$	8.18 $\pm5.2\%$	0.227 $\pm2.1\%$	0.154 $\pm5.8\%$

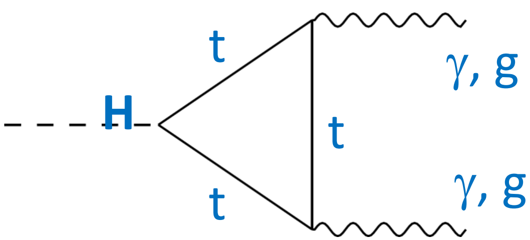


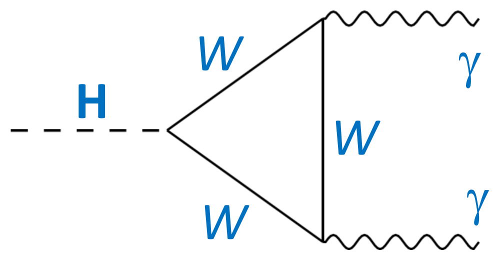


SM: $\kappa-$framework

$\kappa_i = g_i / g_i^{SM}$

SM global fit

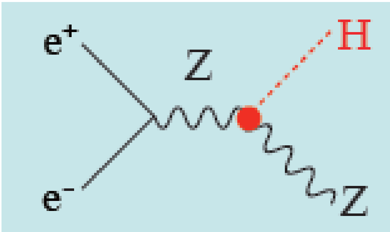




$$\kappa_g^2 = 1.06\,\kappa_t^2 - 0.07\kappa_t\kappa_b + 0.01\kappa_b^2$$
$$\kappa_\gamma^2 = 1.59\kappa_W^2 - 0.66\kappa_W\kappa_t + 0.07\kappa_t^2$$
$$\kappa_{Z\gamma}^2 = 71.12\kappa_W^2 - 0.15\kappa_W\kappa_t + 0.03\kappa_t^2$$

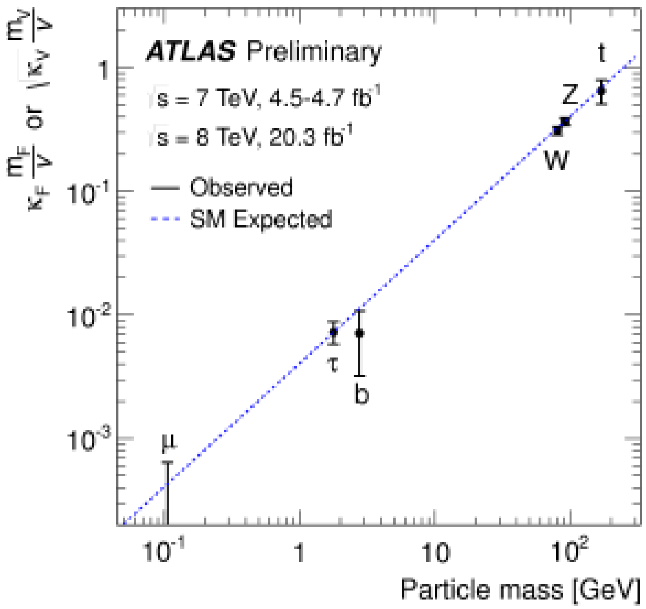
Additional diagrams are possible in **EFT**, where κ is not enough to get branching fractions.
Within EFT approach set of measured parameters can be constrained in EFT global fit.
Keep in mind difference between measured branching fractions and ones from EFT fit.

Measurement of Higgs boson parameters at CEPC



At CM energy 240 GeV the main process of Higgs boson production is $e^+ e^- \rightarrow ZH$ with cross section of ~ 200 fb.

# of Higgs bosons: 5600 fb^{-1} x 200 fb ~ 1.12 x10^6 H



Main task at CEPC: model-independent measurement of Higgs boson branching fractions (and, respectively, couplings) with accuracy of ~1% or better.

Within SM couplings are proportional to fermion masses and squared boson masses with a high accuracy.

$$\mathcal{L} = -g_{Hff}\, H \bar{f} f + \delta_V g_{HVV}\, H\, V_\mu V^\mu + 1/6 \times g_{HHH}\, H^3$$

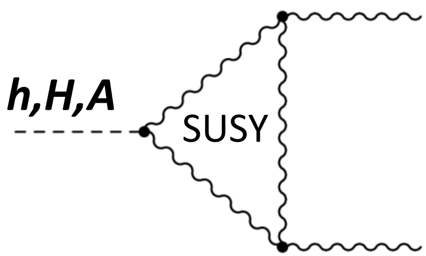
$$g_{Hf\bar{f}} = m_f/v, \qquad g_{HVV} = 2m_V^2/v, \qquad g_{HHH} = 3m_H^2/v.$$

Test of linearity:
high sensitivity to New Physics (NP fingerprint)

Other Higgs boson parameters measurements: mass, width Γ_H, search for *CP*-odd admixture, search for invisible decay and rare decays.

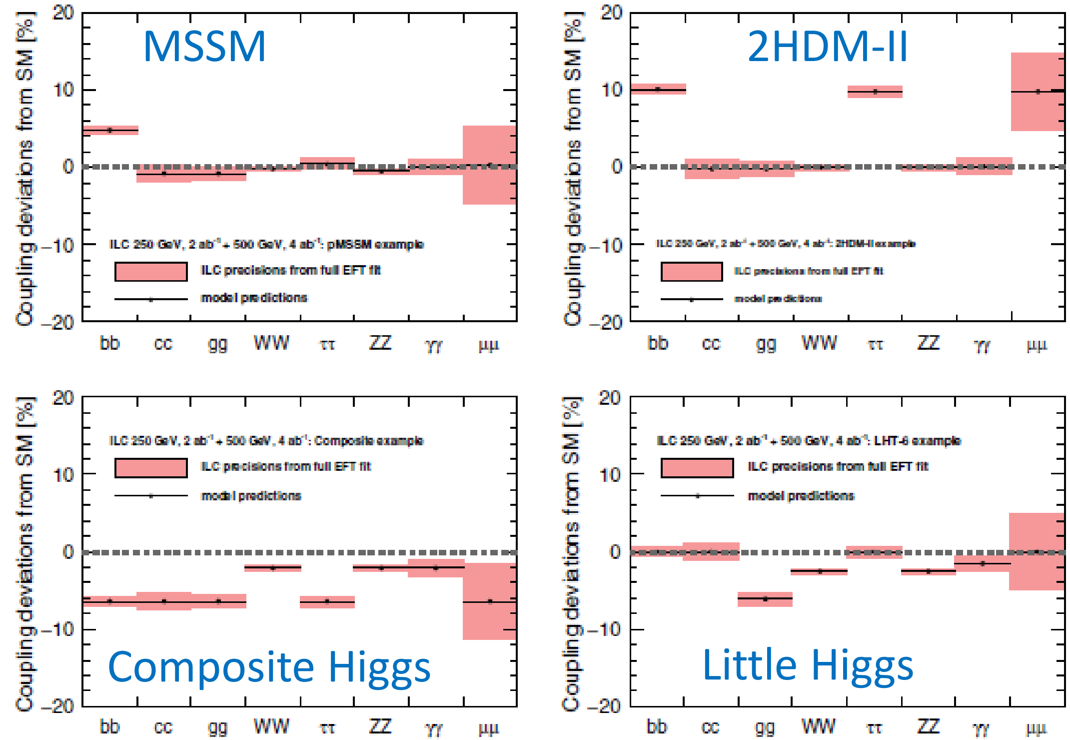
Higgs couplings shifts from linearity in different BSM models

Different BSM models result in different shifts from linearity (model fingerprint).



Some shifts from linearity are ~5%.
➔ we need to reach ~1% accuracy in branching fraction measurements.

Barklow *et al.* PRD 97 053003 (2018)



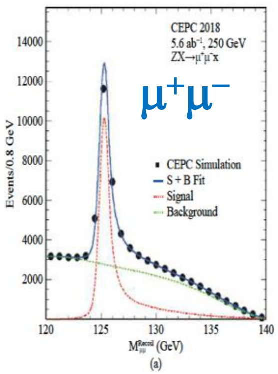
Shifts depend on BSM model and model parameters.
Shifts become smaller with increasing BSM masses.

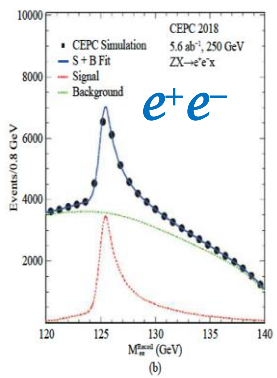
The study of the deviations from these predictions is guided by the idea that each Higgs coupling has its own personality and is guided by different types of new physics. This is something of a caricature, but, still, a useful one.

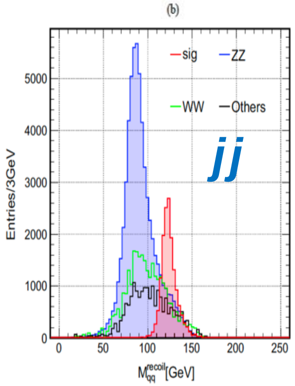
M. Peskin @ HPNP2015

Discovery power: Higgs precision

Recoil mass to

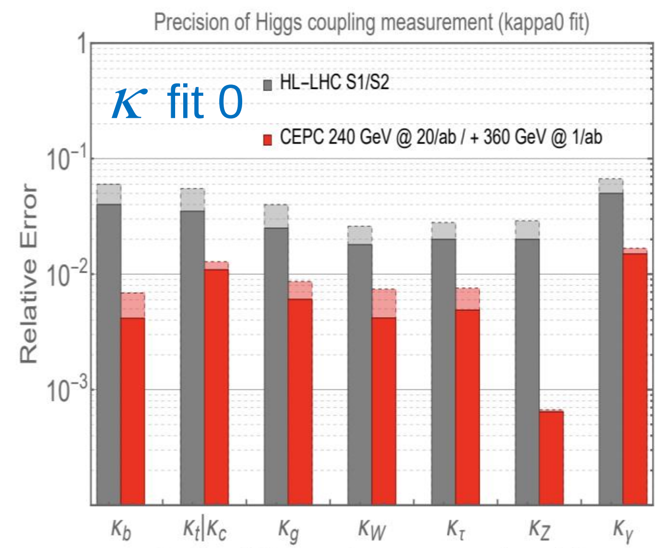


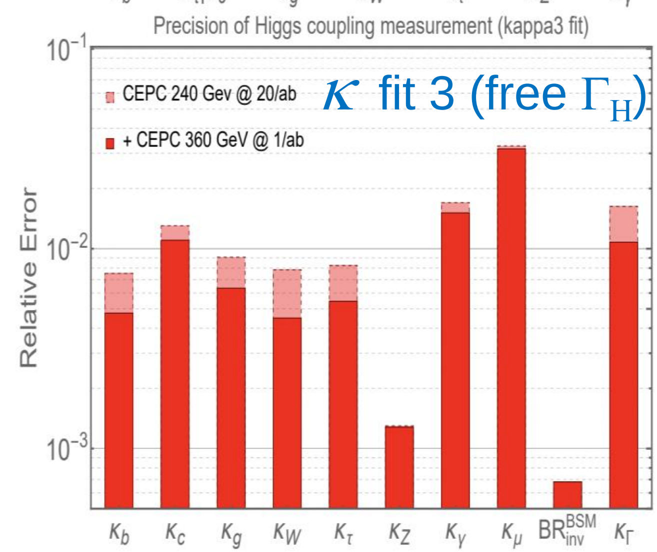




Expected CEPC measurements

	240 GeV, 20 ab^{-1}		360 GeV, 1 ab^{-1}		
	ZH	vvH	ZH	vvH	eeH
inclusive	0.26%		1.40%	\	\
H→bb	0.14%	1.59%	0.90%	1.10%	4.30%
H→cc	2.02%		8.80%	16%	20%
H→gg	0.81%		3.40%	4.50%	12%
H→WW	0.53%		2.80%	4.40%	6.50%
H→ZZ	4.17%		20%	21%	
$H \to \tau\tau$	0.42%		2.10%	4.20%	7.50%
$H \to \gamma\gamma$	3.02%		11%	16%	
$H \to \mu\mu$	6.36%		41%	57%	
$H \to Z\gamma$	8.50%		35%		
$Br_{upper}(H \to inv.)$	0.07%				
Γ_H	1.65%		1.10%		





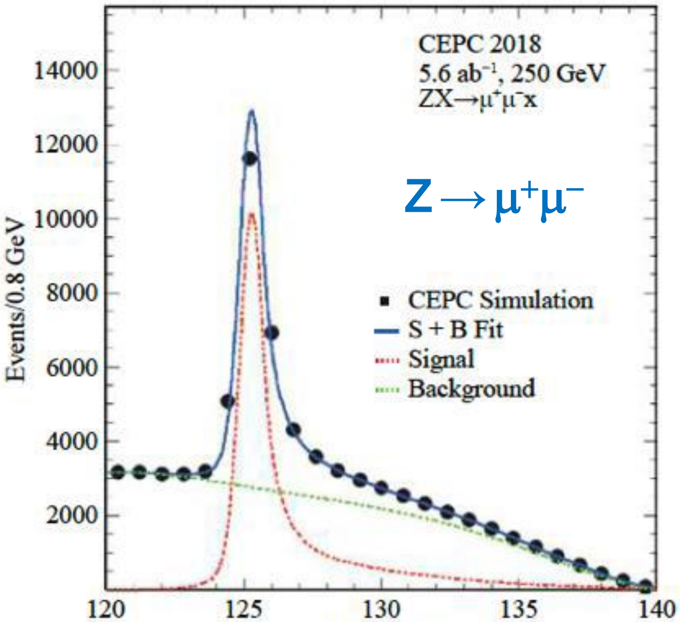
Higgs boson mass measurement

PDG (LHC) : M = 125.20 ± 0.11 GeV

HL-LHC (2030) : M = 125.20 ± 0.07 GeV

Recoil mass method: $e^+e^- \rightarrow$ **Z ($\mu^+\mu^-$) H**

Accuracy (CEPC, 5.6 ab^{-1}):
Z ($\mu^+\mu^-$) : $\sigma \sim$ 6.5 MeV
Z(e^+e^-) : $\sigma \sim$ 14 MeV



Recoil mass to Z($\mu^+\mu^-$)

Systematics (few MeV):

1. Precise charged particle momenta calibration
2. Precise beam energy measurement (~1-2 MeV)
3. Detailed knowledge of ISR (Initial State Radiation)
4. Detailed knowledge beam radiation (beamstrahlung)

Expected accuracy of Higgs mass measurement at CEPC ~6 MeV !
Important value for different theoretical calculations.

Higgs boson width measurement

PDG (LHC) : $\Gamma = 3.2^{+2.4}_{-1.7}$ MeV   HL-LHC (2030) : $\Gamma = 4.1 \pm 0.8$ MeV

$$\text{(i)} \quad \sigma(HZ) \times \mathcal{B}r(Z \to \mu^+\mu^-) = C_1 \cdot \mathrm{g}_Z^2$$

$$\text{(ii)} \quad \sigma(HZ) \times \mathcal{B}r(Z \to \mu^+\mu^-) \times \mathcal{B}r(H \to WW^*) = C_2 \cdot \mathrm{g}_Z^2\, \mathrm{g}_W^2 \,/\Gamma_H$$

$$\text{(iii)} \quad \sigma(HZ) \times \mathcal{B}r(Z \to \mu^+\mu^-) \times \mathcal{B}r(H \to b\bar{b}) = C_3 \cdot \mathrm{g}_Z^2\, \mathrm{g}_b^2 \,/\Gamma_H$$

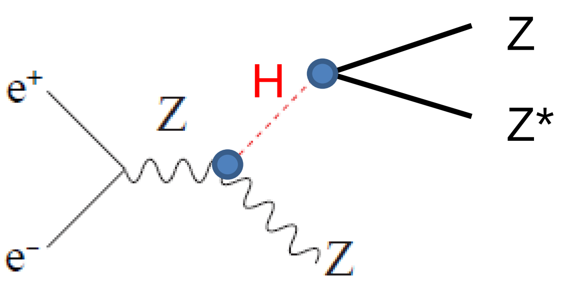
$$\text{(iv)} \quad \sigma(H\nu\bar{\nu}) \times \mathcal{B}r(H \to b\bar{b}) = C_4 \cdot \mathrm{g}_W^2\, \mathrm{g}_b^2 \,/\Gamma_H$$

Using these 4 measurements width of Higgs boson can be calculated.

Basic version CEPC, energy 240 GeV, accuracy ~ 3 % or ~ 0.1 MeV

$$\boldsymbol{\sigma(e^+e^- \to HZ) \times Br(H \to ZZ^*) = C \cdot \mathrm{g}_Z^4/\Gamma_H}$$

One of tree Z bosons decays in leptons others
In jets or neutrinos (to suppress backgrounds).
ILD: 2 ab^{-1} , accuracy ~5%, => ~3% for CEPC

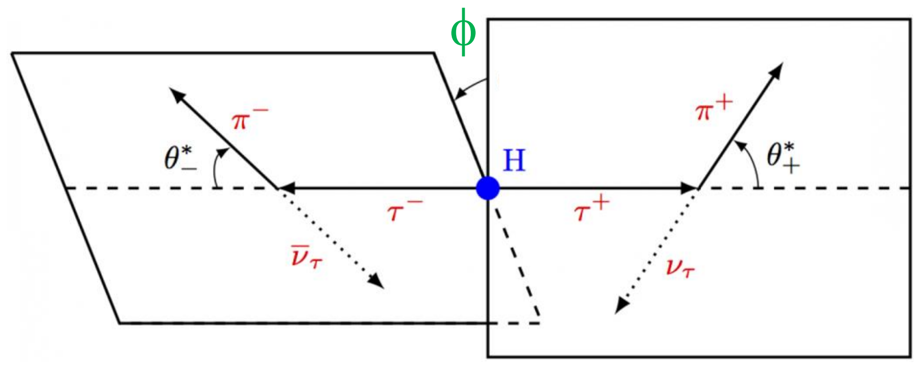


Finally, combined accuracy of 2 measurements
at CEPC: ~2% or < 0.1 MeV => important test of BSM models

Search for *CP*-odd admixture at 125 GeV Higgs using $H \to \tau^+\tau^-$

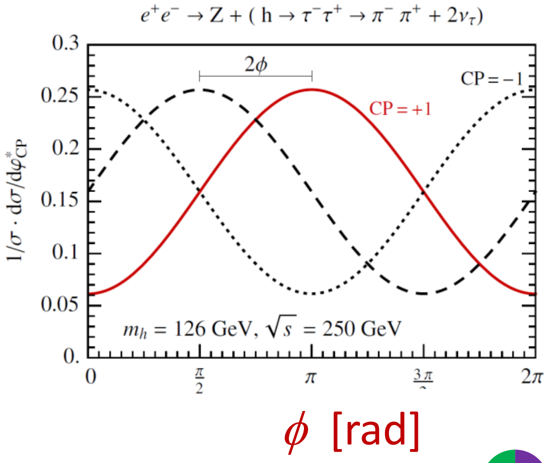
Higgs boson with mass 125 GeV cannot have spin 1, because decay $H \to \gamma\gamma$ is observed (Landau-Yang theorem). In some BSM models (2HDM, SUSY) additional Higgs bosons can appear (h, H, A) and mixing of 0- и 0+ states is possible. Upper limit on 0- component in 125 GeV Higgs boson has to be set.

Best method is measurement of angular distributions in decay $H \to \tau^+\tau^-$, $\tau \to \pi/\rho\ \nu$.



$$\mathcal{L} = -\frac{m_\tau}{v} H\, \bar{\tau}\, (\cos\psi_{CP} + i \sin\psi_{CP}\, \gamma^5)\, \tau$$

Distribution for angle ϕ is very sensitive to CP-admixture

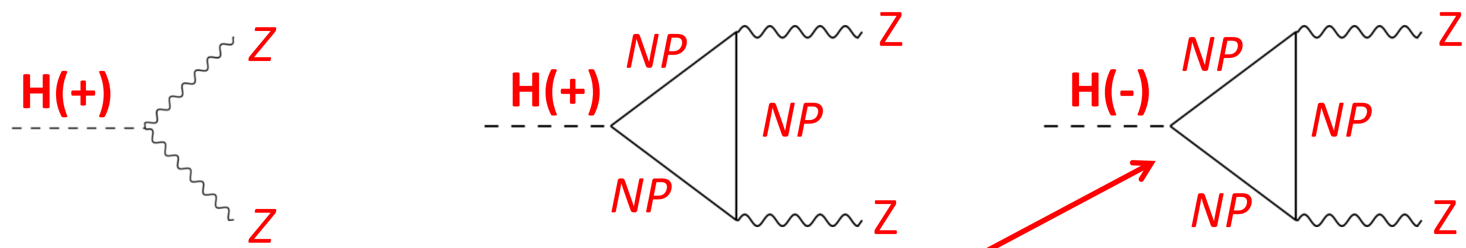


At ILD upper limit for mixing angle ψ_{cp} was calculated: ~4.3^0 at 250 GeV and 2 ab^{-1} (arXiv:1804.01241).

Search for *CP*-odd component in *HZZ* vertex

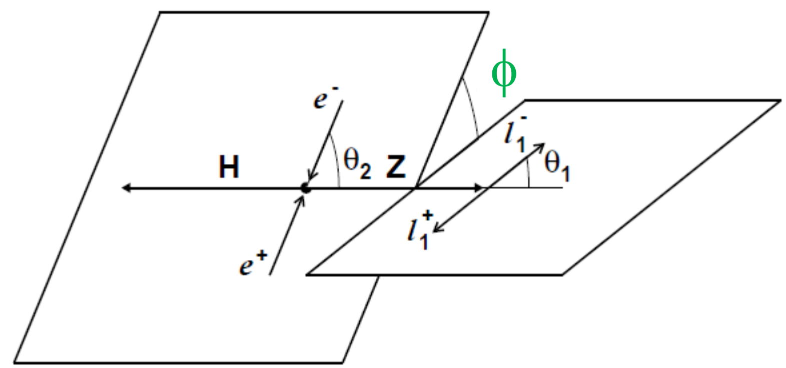
CP-odd component can be searched for in process $e^+e^- \longrightarrow Z\,(\mu^+\mu^-)\,H$

Higgs *CP*-odd component can connect to ZZ only by loop diagram. Potentially such loop diagrams can be enhanced in some BSM models (EFT approach).



$$\mathcal{L}_{\rm eff} \supset c^{(1)}_{ZZ} H Z_\mu Z^\mu + c^{(2)}_{ZZ} H Z_{\mu\nu} Z^{\mu\nu} + c_{Z\tilde{Z}} H Z_{\mu\nu} \tilde{Z}^{\mu\nu} + c_{AZ} H Z_{\mu\nu} A^{\mu\nu} + c_{A\tilde{Z}} H Z_{\mu\nu} \tilde{A}^{\mu\nu}$$

Search for *CP*–odd component can be done using angular distributions in process $e^+e^- \longrightarrow Z\,(\mu^+\mu^-)\,H$. Most sensitive parameter is angle ϕ between Z boson production and decay planes.



CEPC, arXiv: 2203.11707

CEPC (1σ, 5.6 ab^{-1}): $\tilde{c}_{ZZ}$: [-0.06 ; +0.06]

LHC (1σ, 3.0 ab^{-1}): $\tilde{c}_{ZZ}$: [-0.33 ; +0.33]

Invisible and exotic Higgs boson decays searches

$e^+e^- \rightarrow$ **Z ($\mu^+\mu^-$) H** *(invisible)*

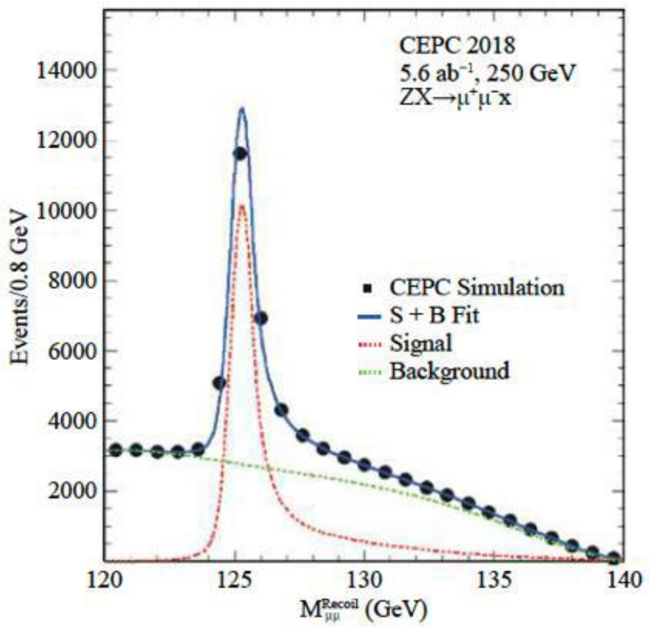
Potentially it is possible to use Z (jj).

BSM physics can enhance invisible BF.

Branching fraction for invisible decay in SM is very small (~0.3 %). Mostly $H \rightarrow ZZ^* \rightarrow 4\nu$.

This *BF* upper limit was estimated at CEPC for 5.6 ab^{-1} : < 0.1%.

Upper limits (2022): ATLAS < 11%, CMS < 19%, HL-LHC < 3.8%

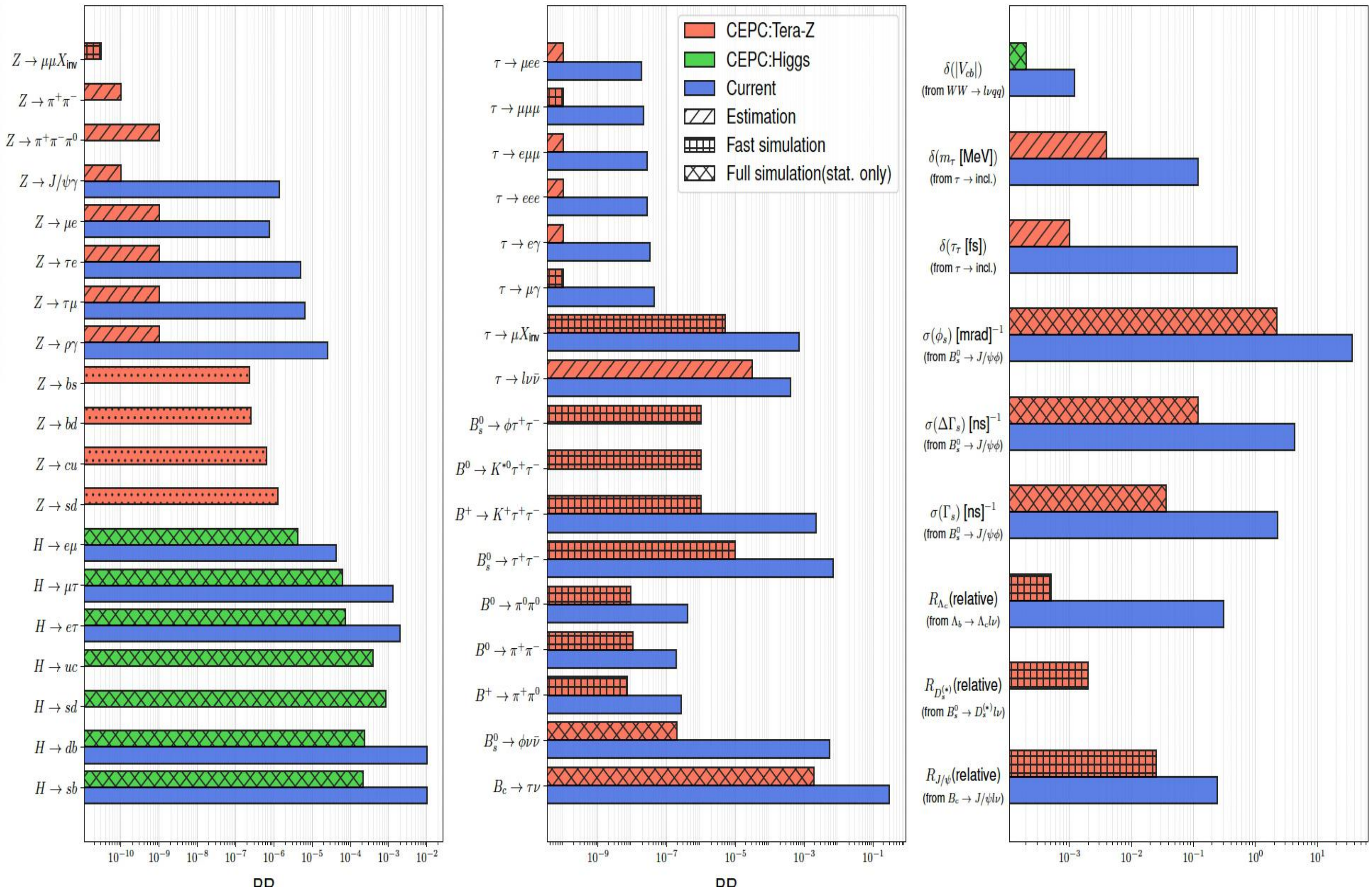


Within the Standard model branching fractions for rare decays shown below are very small (< 10^{-8}), and cannot be observed at CEPC.

$$h \rightarrow \tau^+\mu^-, \quad h \rightarrow b\,\bar{s}\,, \quad h \rightarrow c\,\bar{d}.$$

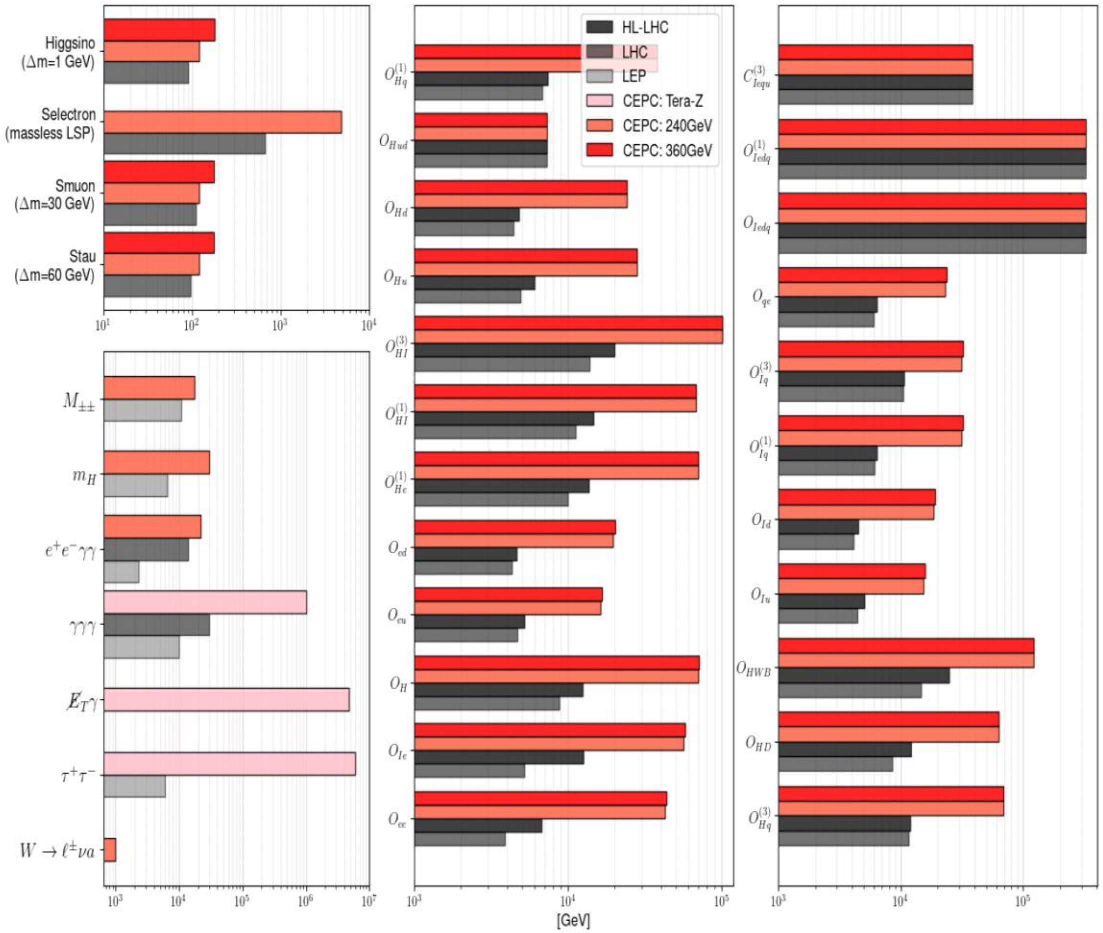
However these branching fractions can be enhanced in some BSM models. Therefore these processes have to be searched for at CEPC.

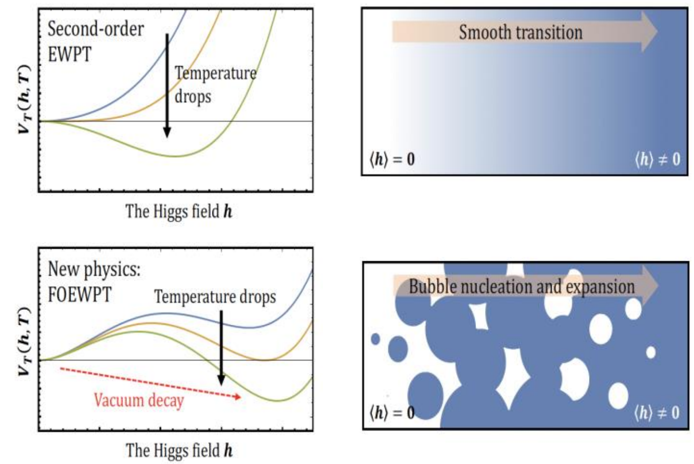
Discovery power: flavor

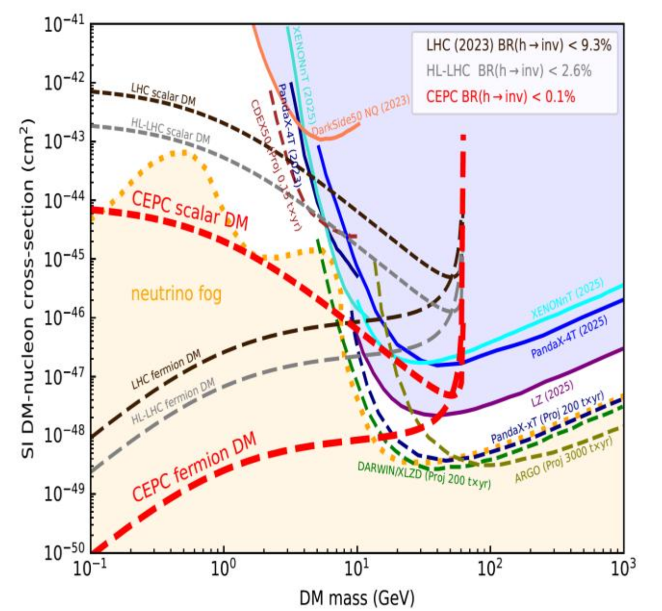


See the non-seen, order of magnitudes improvements, + access to NP of 10 TeV or higher…

Discovery power: direct NP search



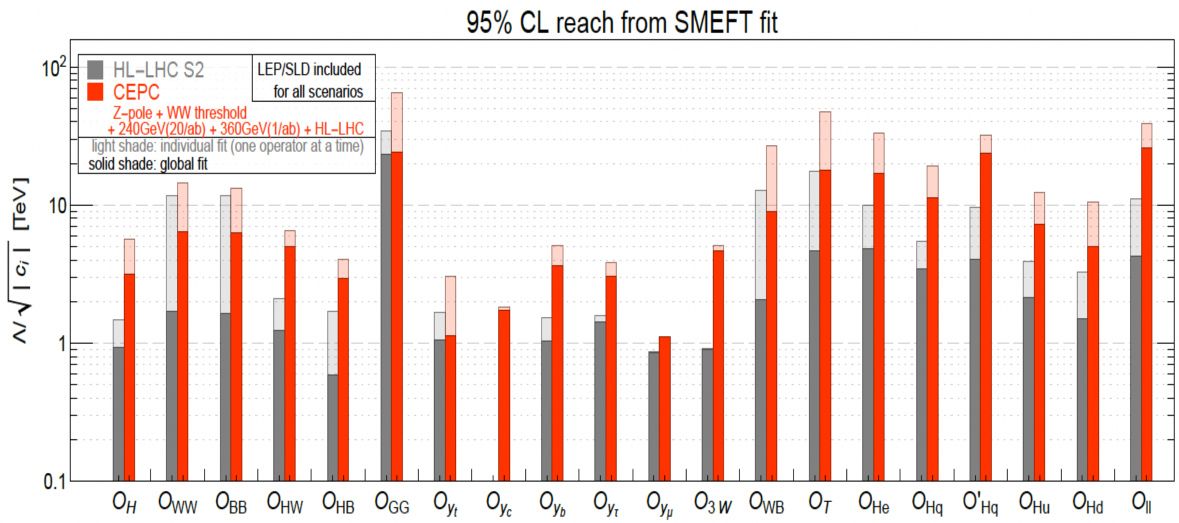


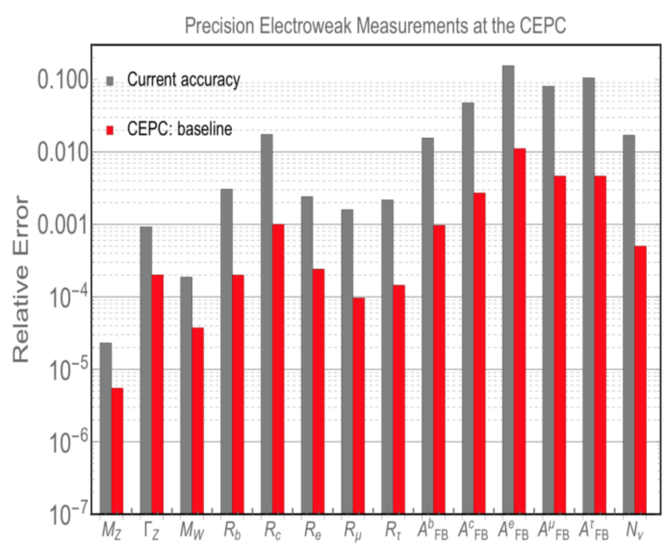


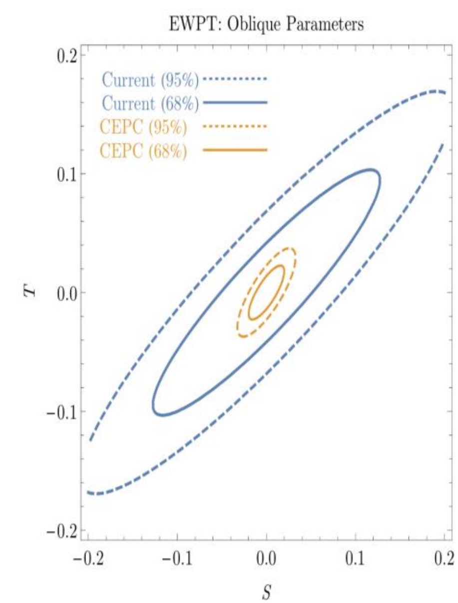
Order of magnitudes improvements, Dark matter Matter origin: decisive test of 1st order EW phase transition in early universe, synergy with CPV studies…

Discovery power: Higgs + EW

Observable	current precision	CEPC precision (Stat. Unc.)	CEPC runs	main systematic
Δm_Z	2.1 MeV [37–41]	0.1 MeV (0.005 MeV)	Z threshold	E_{beam}
$\Delta\Gamma_Z$	2.3 MeV [37–41]	0.025 MeV (0.005 MeV)	Z threshold	E_{beam}
Δm_W	9 MeV [42–46]	0.5 MeV (0.35 MeV)	WW threshold	E_{beam}
$\Delta\Gamma_W$	49 MeV [46–49]	2.0 MeV (1.8 MeV)	WW threshold	E_{beam}
Δm_t	0.76 GeV [50]	$\mathcal{O}(10)$ MeV[a]	$t\bar{t}$ threshold	
ΔA_e	4.9×10^{-3} [37, 51–55]	1.5×10^{-5} (1.5×10^{-5})	Z pole ($Z \to \tau\tau$)	Stat. Unc.
ΔA_μ	0.015 [37, 53]	3.5×10^{-5} (3.0×10^{-5})	Z pole ($Z \to \mu\mu$)	point-to-point Unc.
ΔA_τ	4.3×10^{-3} [37, 51–55]	7.0×10^{-5} (1.2×10^{-5})	Z pole ($Z \to \tau\tau$)	tau decay model
ΔA_b	0.02 [37, 56]	20×10^{-5} (3×10^{-5})	Z pole	QCD effects
ΔA_c	0.027 [37, 56]	30×10^{-5} (6×10^{-5})	Z pole	QCD effects
$\Delta\sigma_{had}$	37 pb [37–41]	2 pb (0.05 pb)	Z pole	lumiosity
δR_b^0	0.003 [37, 57–61]	0.0002 (5×10^{-6})	Z pole	gluon splitting
δR_c^0	0.017 [37, 57, 62–65]	0.001 (2×10^{-5})	Z pole	gluon splitting
δR_e^0	0.0012 [37–41]	2×10^{-4} (3×10^{-6})	Z pole	E_{beam} and t channel
δR_μ^0	0.002 [37–41]	1×10^{-4} (3×10^{-6})	Z pole	E_{beam}
δR_τ^0	0.017 [37–41]	1×10^{-4} (3×10^{-6})	Z pole	E_{beam}
δN_ν	0.0025 [37, 66]	2×10^{-4} (3×10^{-5})	ZH run ($\nu\nu\gamma$)	Calo energy scale



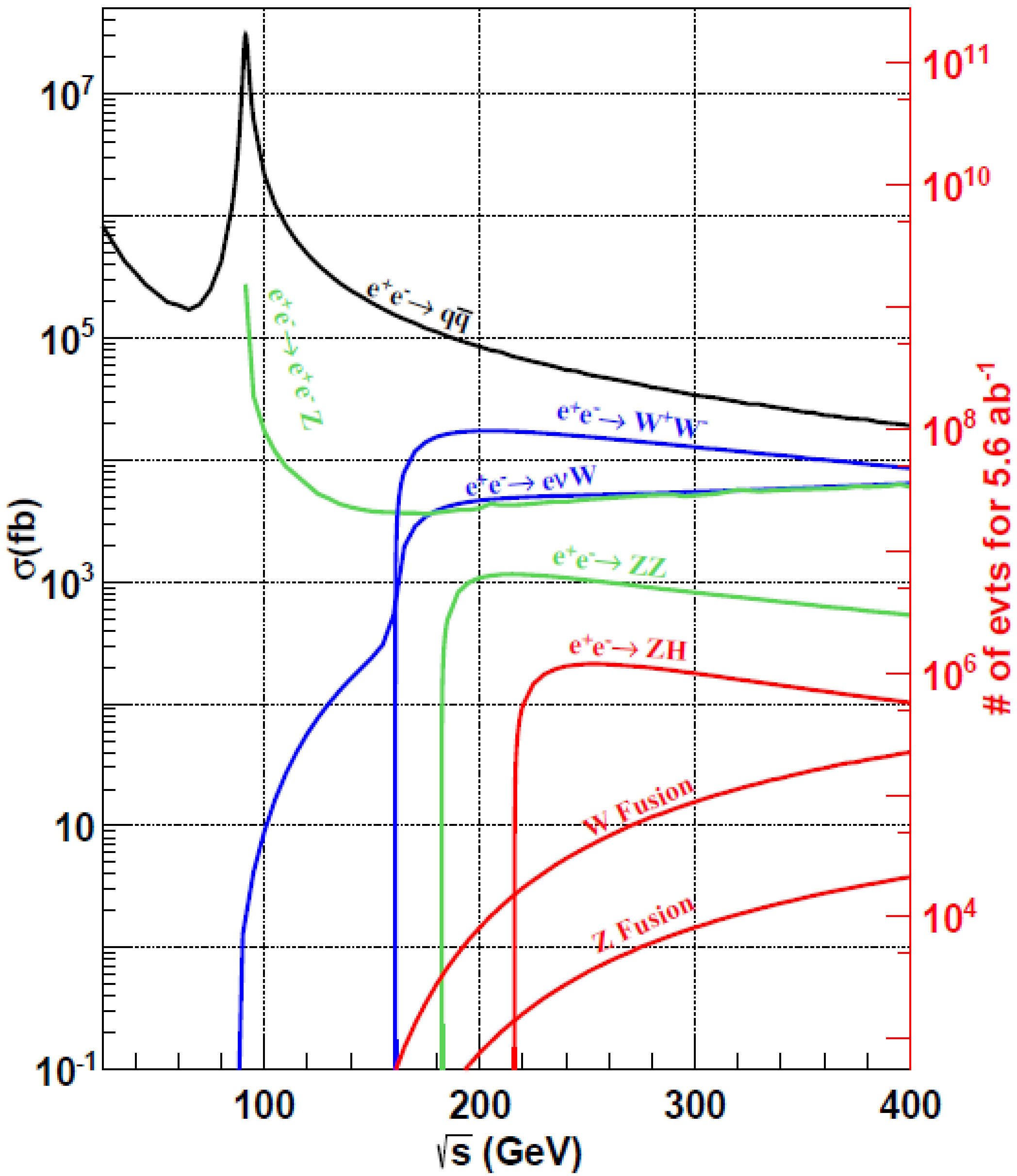




Conclusion

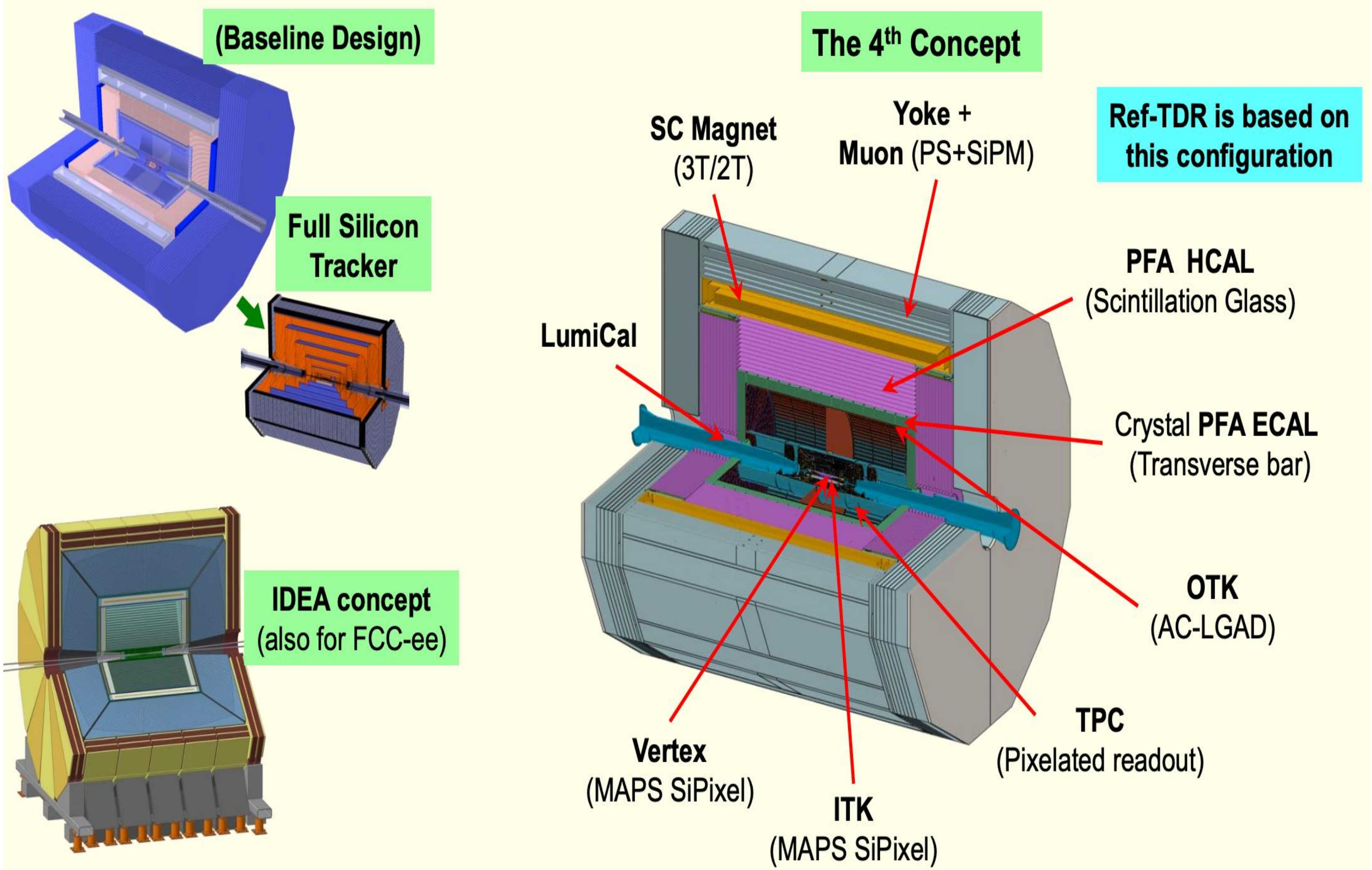
Project CEPC has great physics potential for detailed studies of Higgs boson and respective searches for effects Beyond the Standard Model.

Background slides



10^7
10^5
10^3
10
10^{-1}
10^{11}
10^{10}
10^8
10^6
10^4
σ(fb)
# of evts for 5.6 ab^{-1}
100
200
300
400
√s (GeV)
$e^+e^- \to q\bar{q}$
$e^+e^- \to e^+e^- Z$
$e^+e^- \to W^+W^-$
$e^+e^- \to e\nu W$
$e^+e^- \to ZZ$
$e^+e^- \to ZH$
W Fusion
Z Fusion

Two CEPC detectors



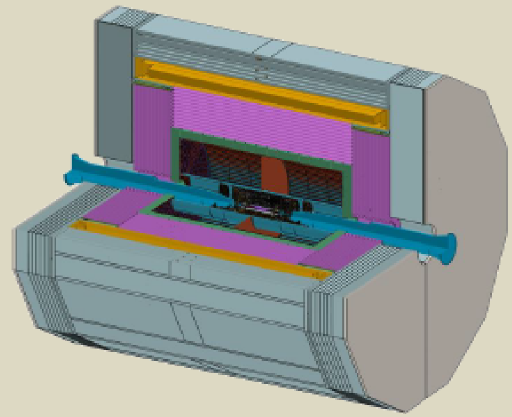
Baseline detector concept and detector IDEA.

Technologies for Ref-TDR

System	Technologies	
	Baseline	Backup / Comparison
Beam pipe	Φ20 mm	
LumiCal	SiTrk + Crystal	
Vertex	CMOS + Stitching	CMOS Si Pixel
Tracker	CMOS Si Pixel ITK	SSD + RO Chip, CMOS SSD
Tracker	Pixelated TPC	PID Drift Chamber
Tracker	AC-LGAD OTK	SSD / SPD OTK
Tracker	AC-LGAD OTK	LGAD ToF
ECAL	4D Crystal Bar	Stereo Crystal Bar, GS+SiPM, PS+SiPM+W, SiDet+W
HCAL	GS+SiPM+Fe	PS+SiPM+Fe, RPC+Fe
Magnet	LTS	HTS
Muon	PS bar+SiPM	RPC
TDAQ	Conventional	Software Trigger
BE electr.	Common	Independent

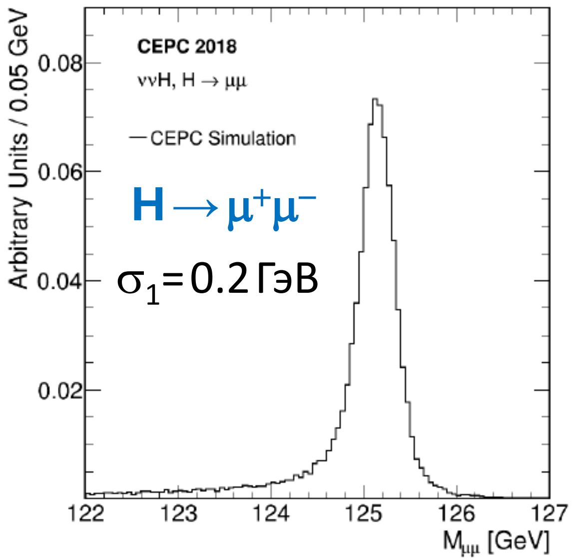
Radius

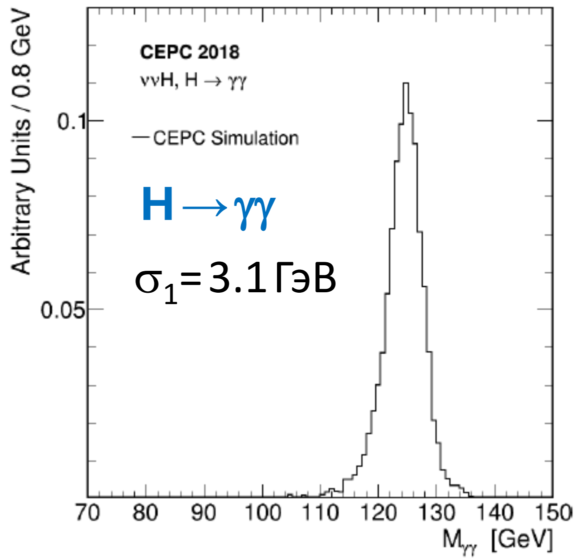
- The CEPC study group started to compare different technologies in January, 2024
- By the end of June, 2024 the baseline technologies were chosen.
- Multiple factors were considered in the process: performance, cost, R&D efforts, technology maturity, …

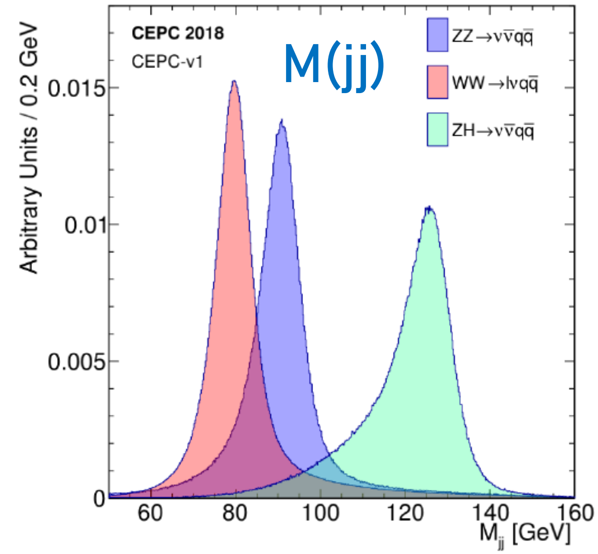


- We will continue pursuing better technologies for the two final detectors at CEPC

Signal resolutions







Perfect resolutions for charged particles, photons, jets

Perfect identification of *b*- and *c*- jets.

Jets reconstruction procedures can be further improved: ML methods, better counting of secondary vertices …

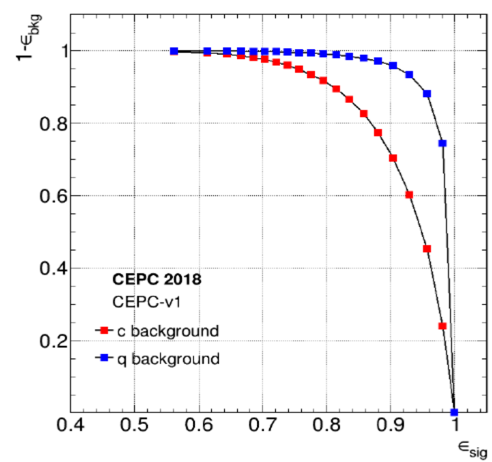
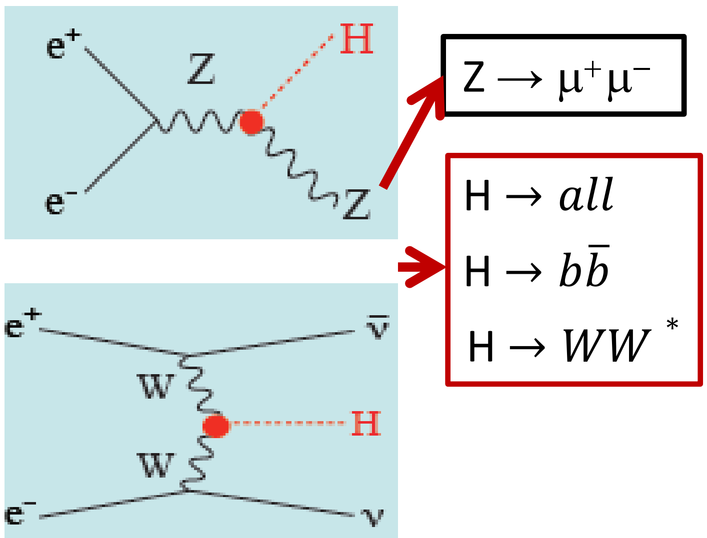


Fig. 6. Efficiency for tagging *b*-jets vs rejection for light-jet background (blue) and *c*-jet background (red), determined from an inclusive $Z \to q\bar{q}$ sample from the Z factory operation.

Higgs boson width measurement



Measurements at $\sqrt{s}$ ~ 250-500 GeV

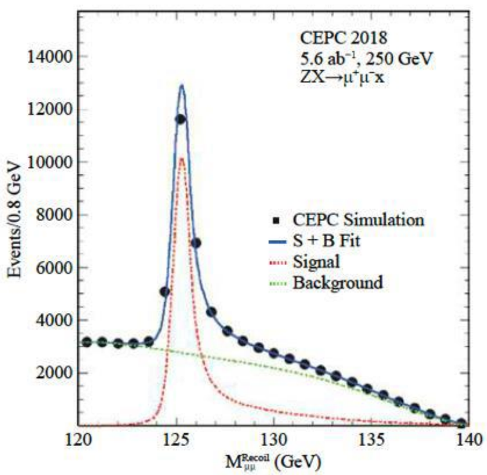
$$Y_1 = \sigma_{ZH} = F_1 \cdot g_Z^2$$

$$Y_2 = \sigma_{ZH} \times \mathrm{Br}(H \to b\bar{b}) = F_2 \cdot \frac{g_Z^2 g_b^2}{\Gamma_H}$$

$$Y_3 = \sigma_{\nu\bar{\nu}H} \times \mathrm{Br}(H \to b\bar{b}) = F_3 \cdot \frac{g_W^2 g_b^2}{\Gamma_H}$$

$$Y_4 = \sigma_{\nu\bar{\nu}H} \times \mathrm{Br}(H \to WW^*) = F_4 \cdot \frac{g_W^4}{\Gamma_H}$$

$$Y_5 = \sigma_{ZH} \times \mathrm{Br}(H \to WW^*) = F_5 \cdot \frac{g_Z^2 g_W^2}{\Gamma_H}$$



Constants F_1, F_2, F_3, F_4, F_5 can be calculated with a high accuracy and small theoretical uncertainties

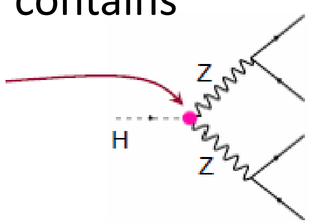
1. Obtain g_Z from first measurement of x-section
2. Obtain ratio g_Z/g_W from the second and third measurements
3. Using obtained g_Z and g_W, we can get Γ_H from four of fifth measurements

Higgs boson CPV studies at LHC (h→ZZ*)

Coupling *hZZ* is tree-level for *CP*-even Higgs and loop-induced for *CP*-odd (suppressed). Therefore decay $h \to Z\,(\lambda_1\lambda_2)\;\; Z'\,(\lambda_3\lambda_4)$ is not sensitive to Higgs *CP*-odd admixture. Only pure 100% *CP*-odd Higgs can be ruled out.

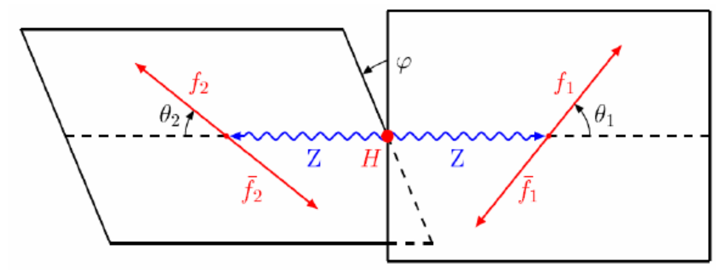
$h \longrightarrow Z\,(\ell_1\ell_2)\;\; Z'\,(\ell_3\ell_4)$

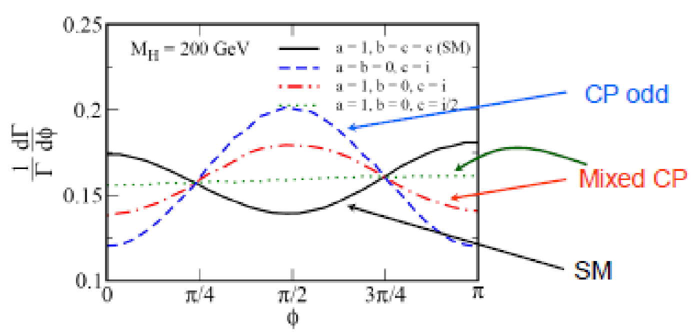
Information about *CP* contains in this vertex

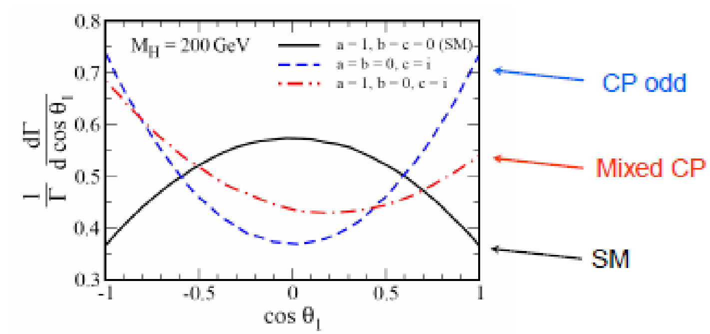


hep-ex/1308.4930

Polarization angles are used in analysis







hep-ex/1307.1432 ATLAS: 0^- is rejected at 97.8% CL

hep-ex/1212.6639 CMS: 0^- is rejected at 97.6% CLs

ATLAS and CMS rejected 0^- for *h*(125), but didn't get upper limit on *CP*-odd admixture

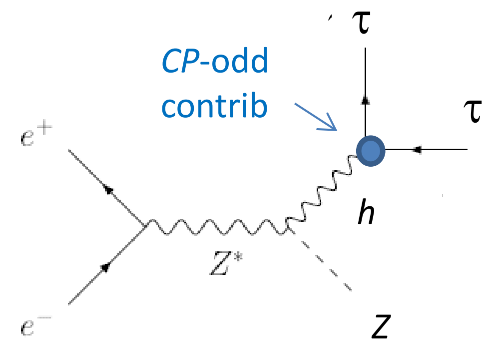
CPV in Higgs decay $H \to \tau^+\tau^-$

CPV appears in many extensions of Higgs Sector.

2HDM : two doublets of scalar fields with identical quantum numbers.

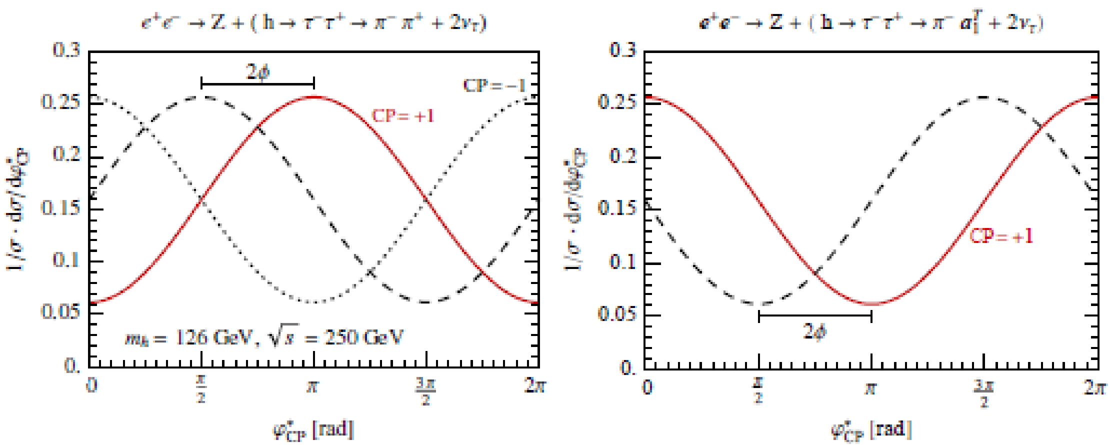
Three neutral fields : h, H, A ; two first are *CP*-even, last one is *CP*-odd.

These states are mixed to physical mass states in Higgs basis.



If *h(125)* has small *CP*-odd admixture:

$e^+ e^- \to Z h$, $h \to \tau^+\tau^-$, $\tau \to \pi, \rho, a_1$



$\varphi^* = \mathrm{acos}(\hat{n}^*_{-\perp} \cdot \hat{n}^*_{+\perp})$ $\quad \psi^*_{CP} = \mathrm{acos}(\hat{q}^*_{\pi^-} \cdot (\hat{n}^*_{-\perp} \times \hat{n}^*_{+\perp}))$

Uncertainties of about (5-10)° in mixing phase at ILC with a few hundreds fb^{-1}.

Here decay products (π, ρ, a_1) and their impact parameters have to be measured.

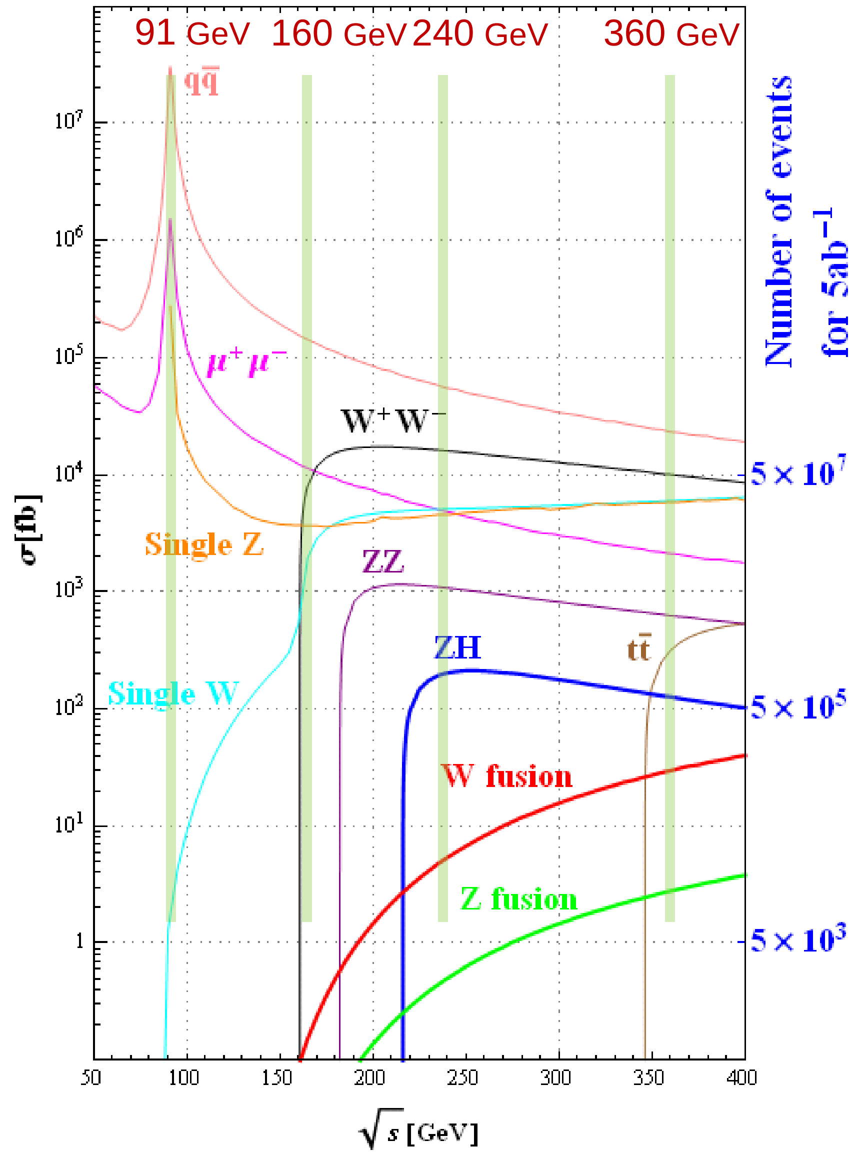
Physics at CEPC collider

91 GeV – Z factory.
Measurement of EW parameters,
$e^+e^- \to b\bar{b}, c\bar{c}, \tau^+\tau^-$

160 GeV - WW threshold.
W mass measurement,
W decays measurements

240 GeV – HZ, Higgs factory.
Precise measurement of Higgs boson parameters. Higgs boson, as window in New Physics

360 GeV - tt threshold.
t-quark mass measurement,
t-quark decays measurements.



Precision of parameter measurements for H, Z, W, *t* at CEPC

Table 2.1: Precision of the main parameters of interests and observables at the CEPC, from Ref. [1] and the references therein, where the results of Higgs are estimated with a data sample of 20 ab^{-1}. The HL-LHC projections of 3000 fb^{-1} data are used for comparison. [2]

Higgs		×2 (5.6 ab^{-1})	W, Z and top		
Observable	HL-LHC projections	CEPC precision	Observable	Current precision	CEPC precision
M_H	20 MeV	3 MeV	M_W	9 MeV	0.5 MeV
Γ_H	20%	1.7%	Γ_W	49 MeV	2 MeV
$\sigma(ZH)$	4.2%	0.26%	M_{top}	760 MeV	$\mathcal{O}(10)$ MeV
$B(H \to bb)$	4.4%	0.14%	M_Z	2.1 MeV	0.1 MeV
$B(H \to cc)$	-	2.0%	Γ_Z	2.3 MeV	0.025 MeV
$B(H \to gg)$	-	0.81%	R_b	3×10^{-3}	2×10^{-4}
$B(H \to WW^*)$	2.8%	0.53%	R_c	1.7×10^{-2}	1×10^{-3}
$B(H \to ZZ^*)$	2.9%	4.2%	R_μ	2×10^{-3}	1×10^{-4}
$B(H \to \tau^+\tau^-)$	2.9%	0.42%	R_τ	1.7×10^{-2}	1×10^{-4}
$B(H \to \gamma\gamma)$	2.6%	3.0%	A_μ	1.5×10^{-2}	3.5×10^{-5}
$B(H \to \mu^+\mu^-)$	8.2%	6.4%	A_τ	4.3×10^{-3}	7×10^{-5}
$B(H \to Z\gamma)$	20%	8.5%	A_b	2×10^{-2}	2×10^{-4}
Bupper$(H \to \text{inv.})$	2.5%	0.07%	N_ν	2.5×10^{-3}	2×10^{-4}

Accuracy can be improved for some parameters. Measurements can be combined in EFT global fit to get better accuracy.