

Complementarities between Higgs and electroweak measurements at future lepton colliders

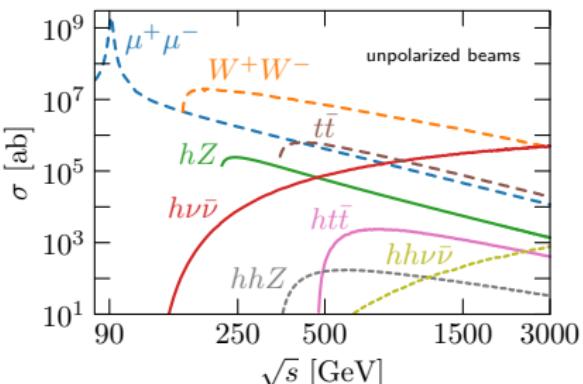
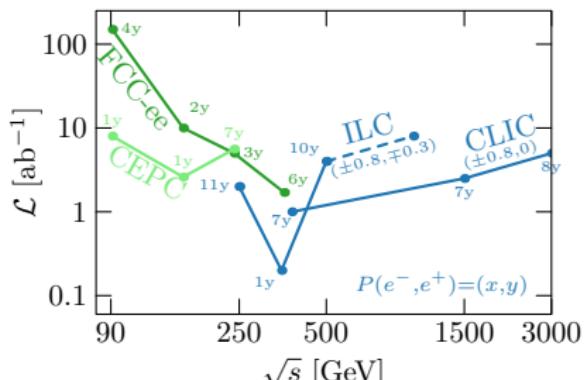
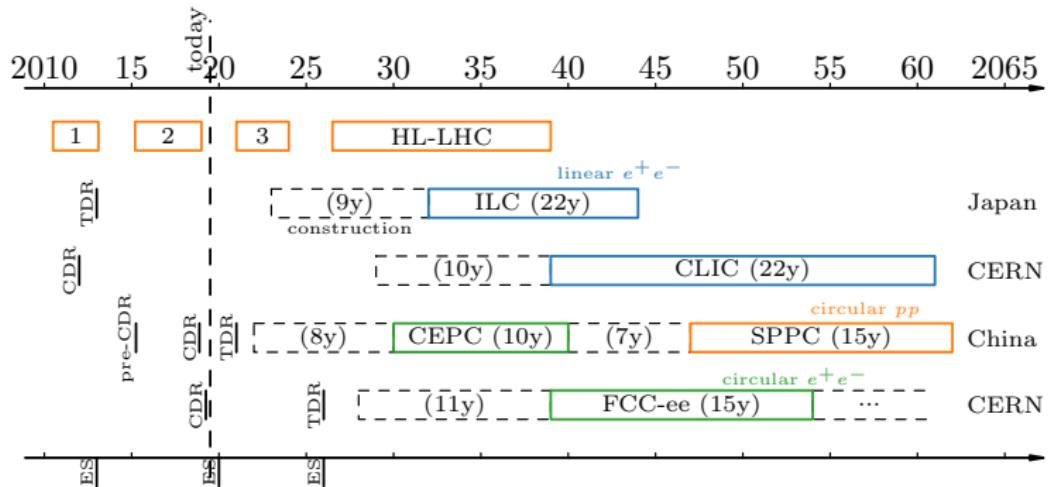
Gauthier Durieux
(Technion)

to appear
with Jorge de Blas, Christophe Grojean, Jiayin Gu, Ayan Paul



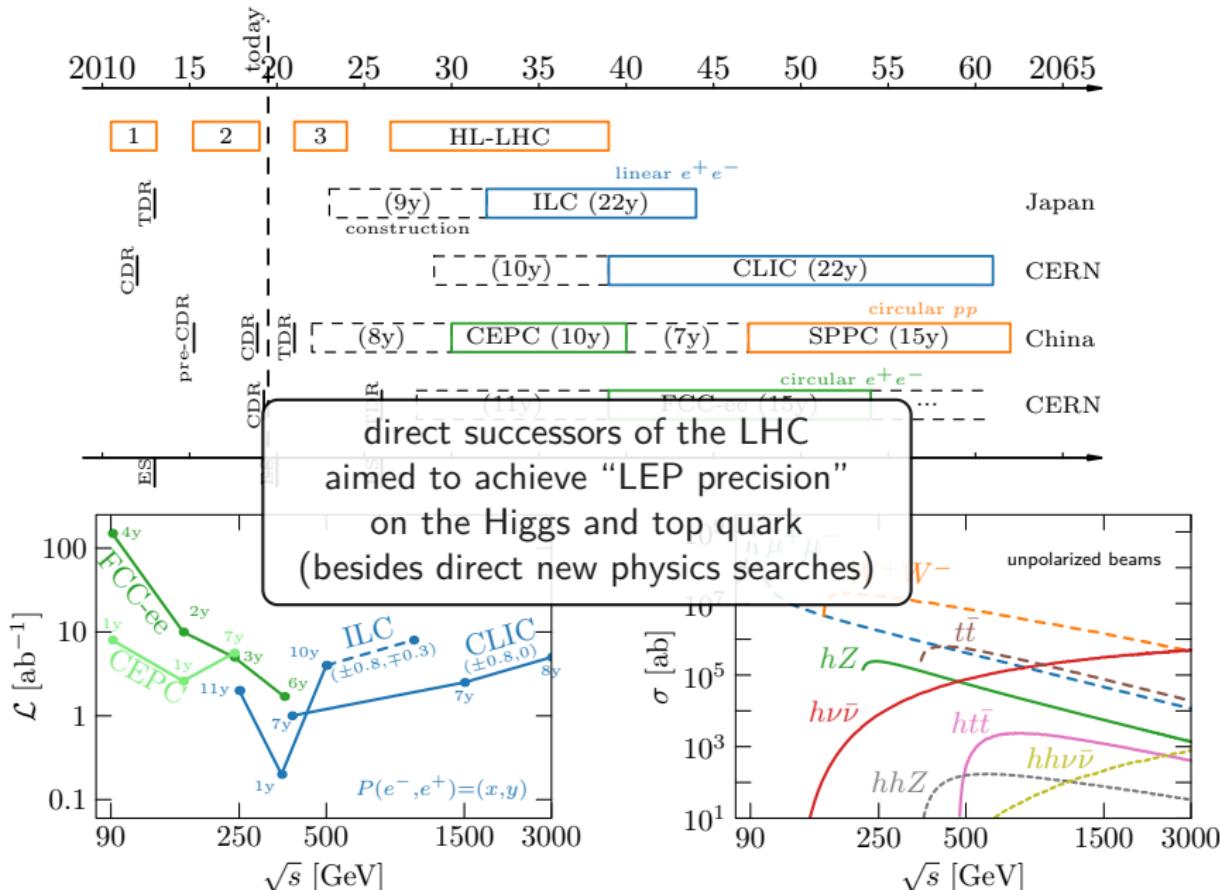
Future lepton colliders

Timeline and run plans
subject to frequent updates!



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Higgs/EW interplay

With permil precision on Higgs couplings,
current uncertainties on EW parameters
should become relevant!

Uncertainties on top-quark param.
would become very relevant too
(assumed well constrained
by LHC and $e^+e^- \rightarrow t\bar{t}$).

[GD,Gu,Vryonidou,Zhang '18]

Questions?

What's the deterioration in Higgs coupling determinations incurred from EW uncertainties?

How important are Z -pole and WW -threshold runs for Higgs physics?

How can the impact of their absence be mitigated at linear colliders?

Can Higgs measurements help constraining EW parameters?

Framework

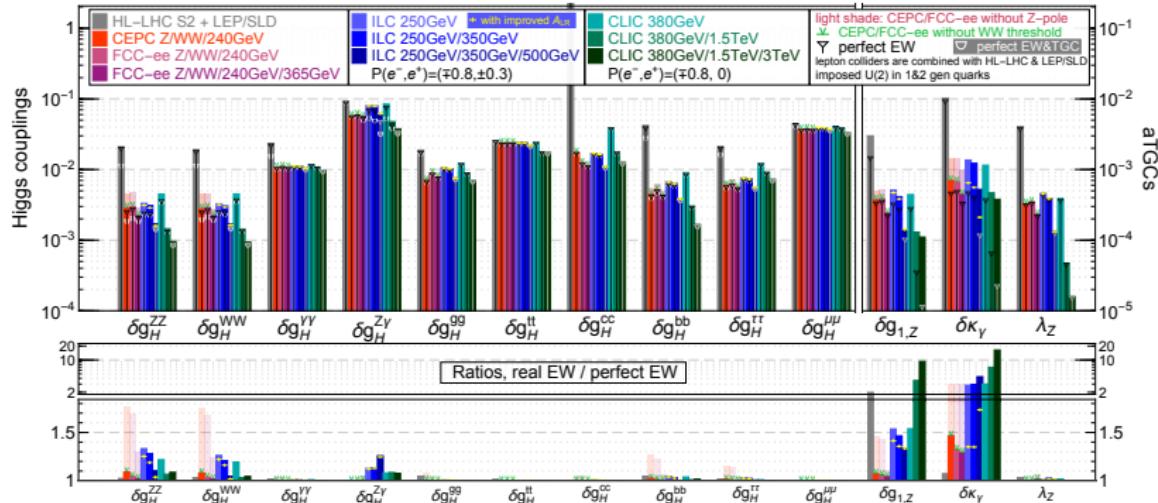
A global Higgs+EW EFT analysis (13+15 param.)
of CEPC, FCC-ee, ILC and CLIC prospects
combined with existing measurements (incl. LEP)
and detailed HL-LHC projections.

Examining the impact of:

- different measurements
- beam polarization
- centre-of-mass energy

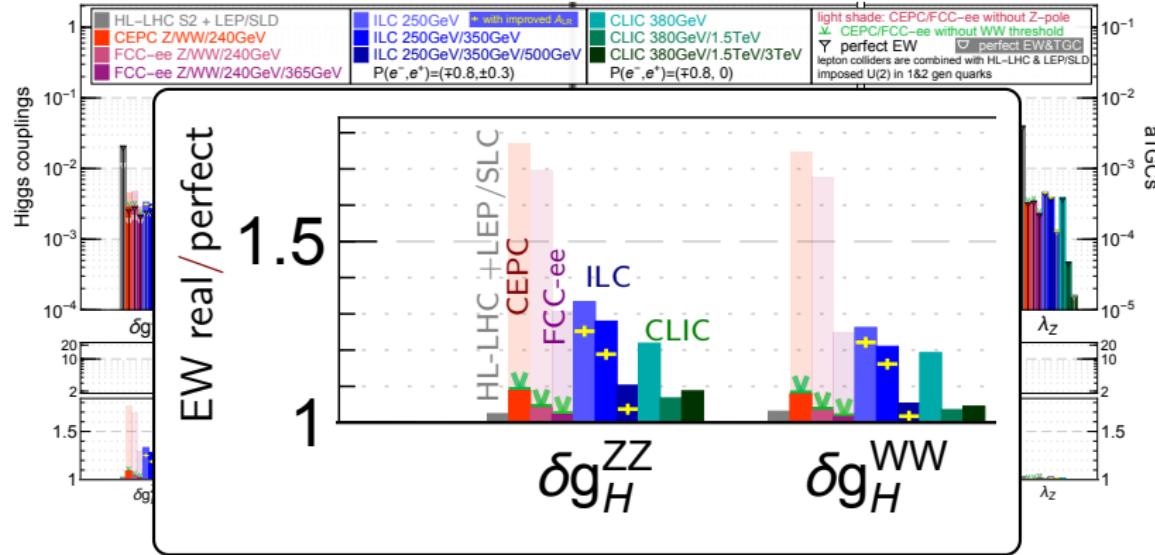
leaving aside EW top-quark couplings,
CP and flavour violation
imposing $U(2)_q \times U(2)_u \times U(2)_d$ among first two quark gen.

Global Higgs-TGC constraints



15 EW param. also marginalized over \diagup assumed perfectly constrained

Global Higgs-TGC constraints

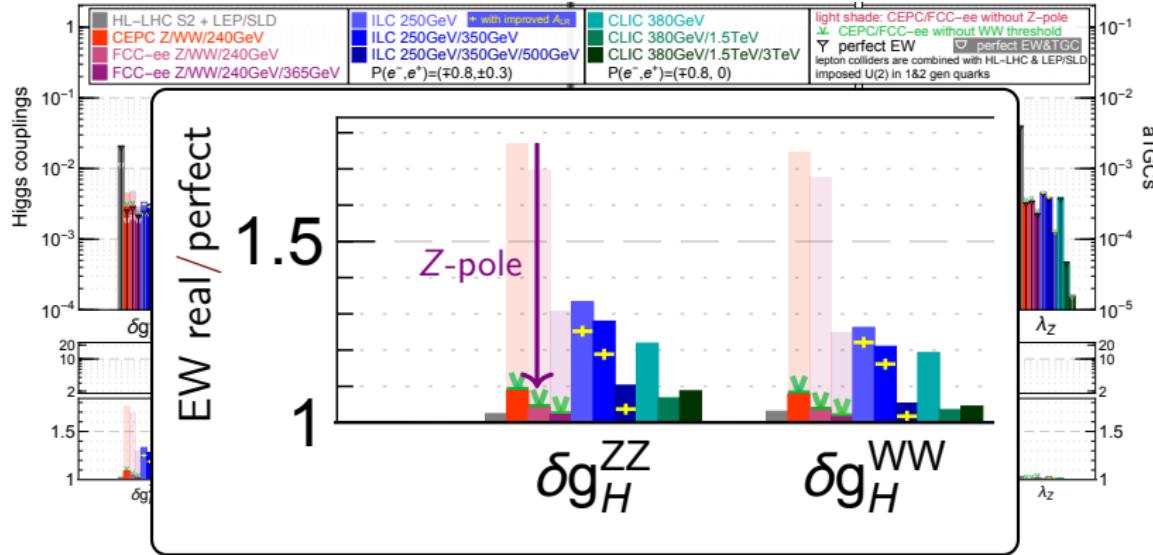


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$$\delta g_H^{ZZ} \equiv \sqrt{\frac{\text{Br}(H \rightarrow ZZ^* \rightarrow \text{all})}{\text{Br}(H \rightarrow ZZ^* \rightarrow \text{all})^{\text{SM}}} - 1}$$

$$\delta g_H^{WW} \equiv \sqrt{\frac{\text{Br}(H \rightarrow WW^* \rightarrow \text{all})}{\text{Br}(H \rightarrow WW^* \rightarrow \text{all})^{\text{SM}}} - 1}$$

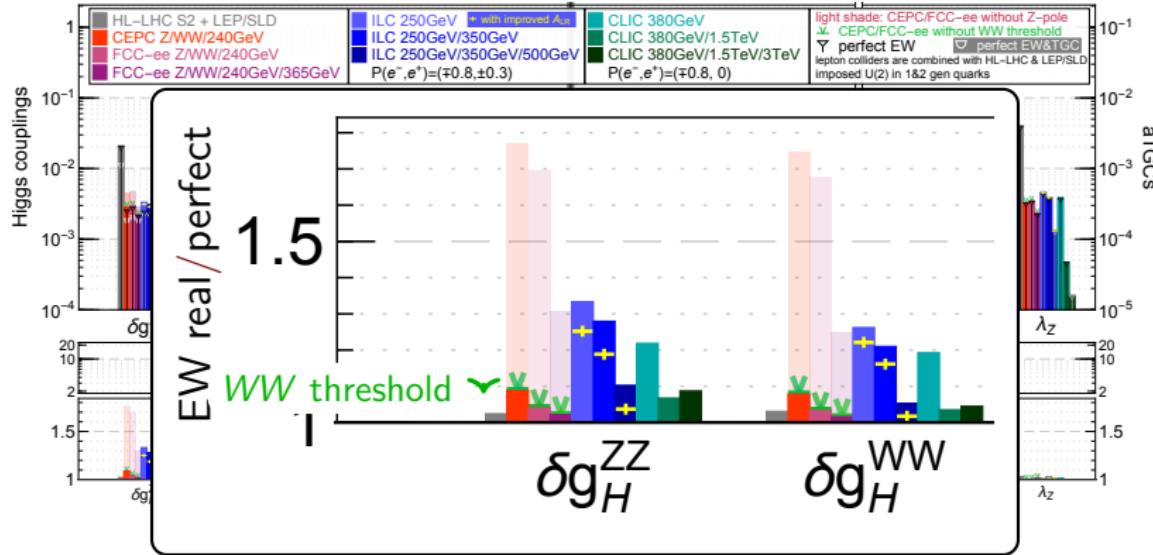
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- Z-pole run has a big impact

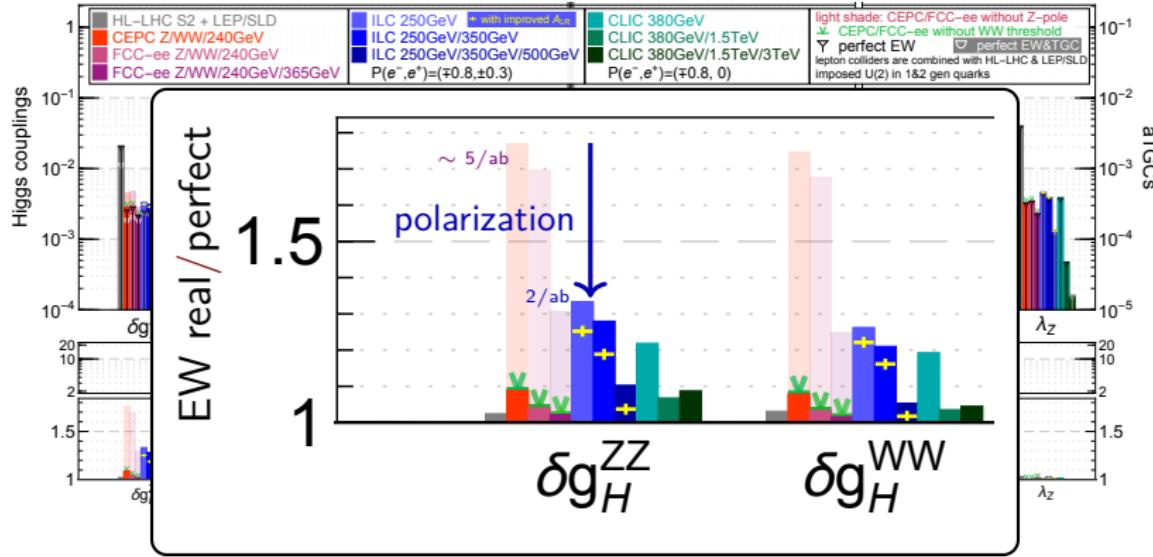
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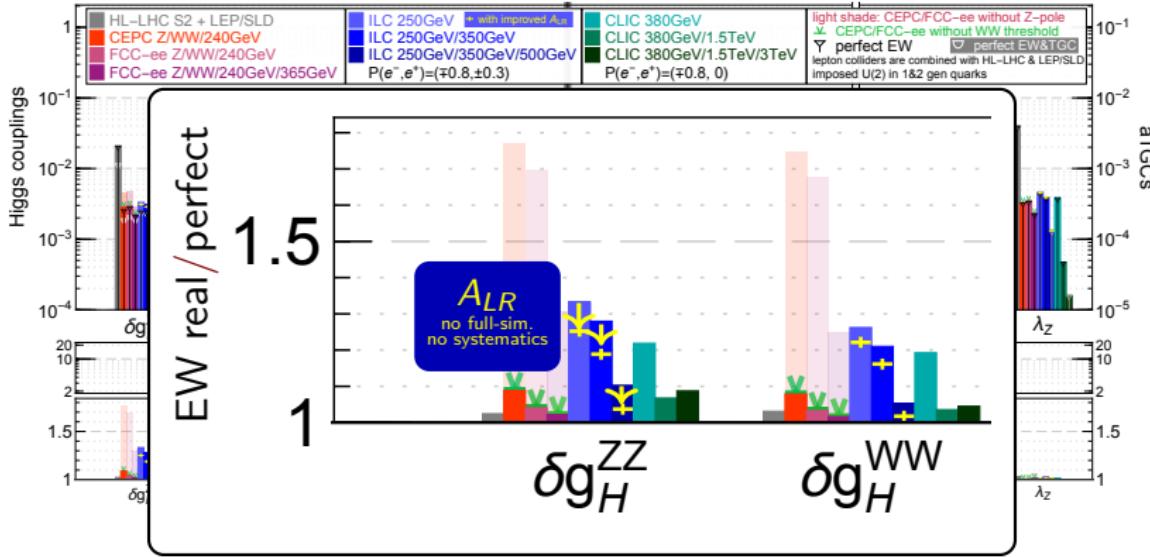
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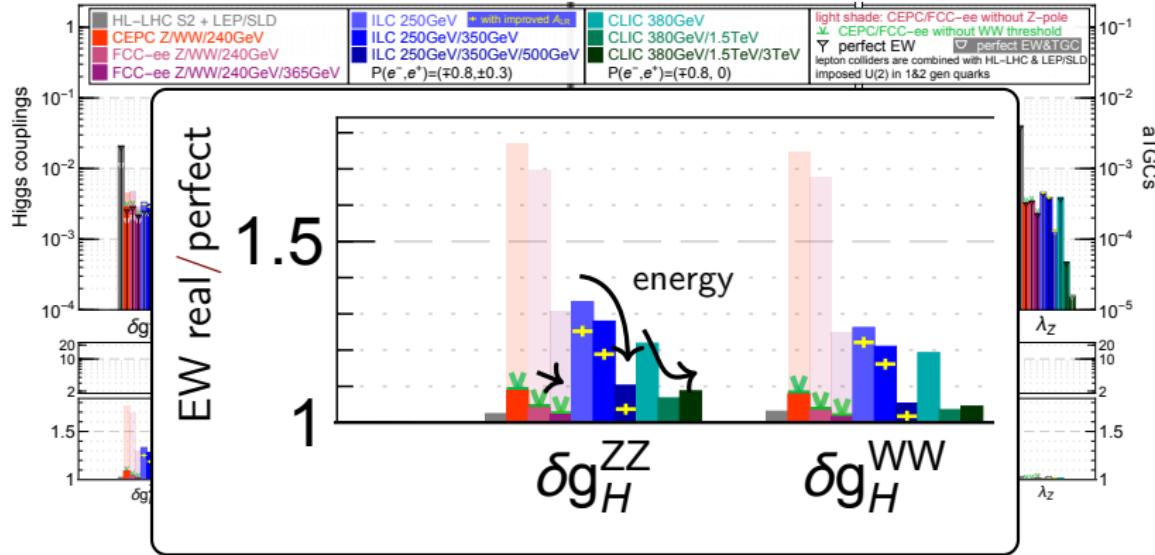
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 - new electroweak measurement help (e.g. A_{LR} in radiative Z-pole return)

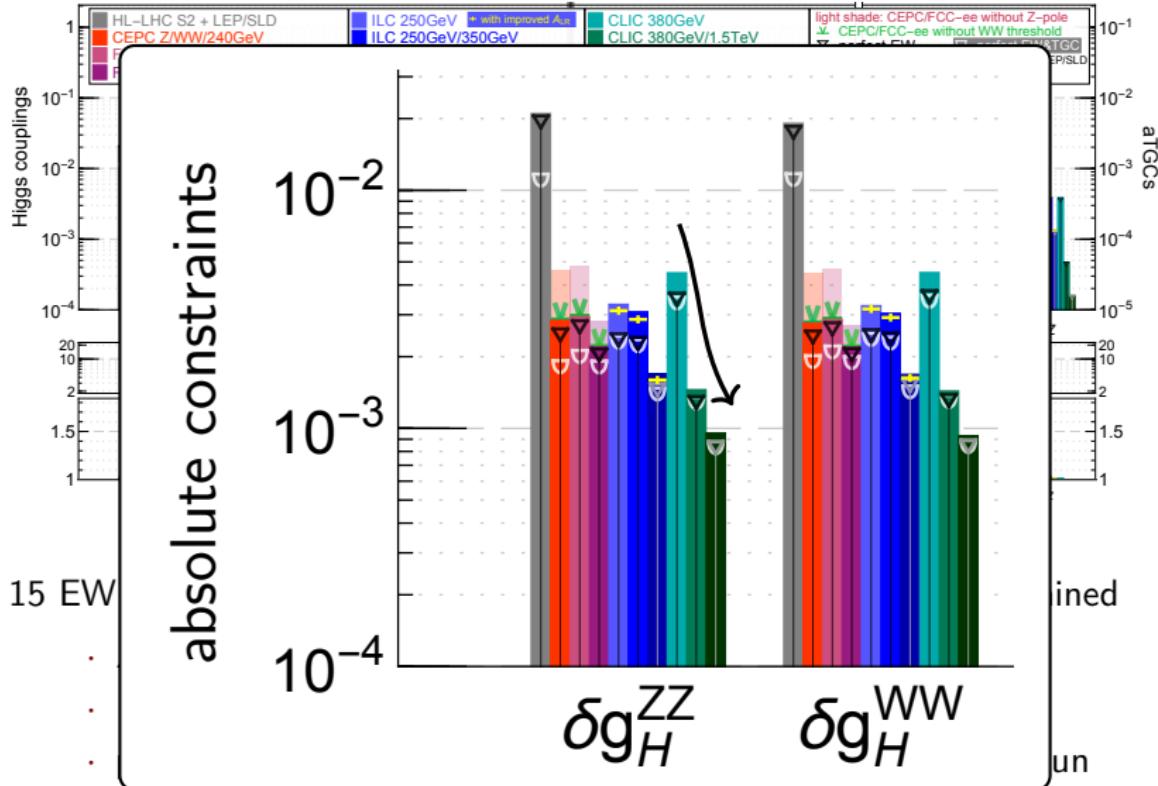
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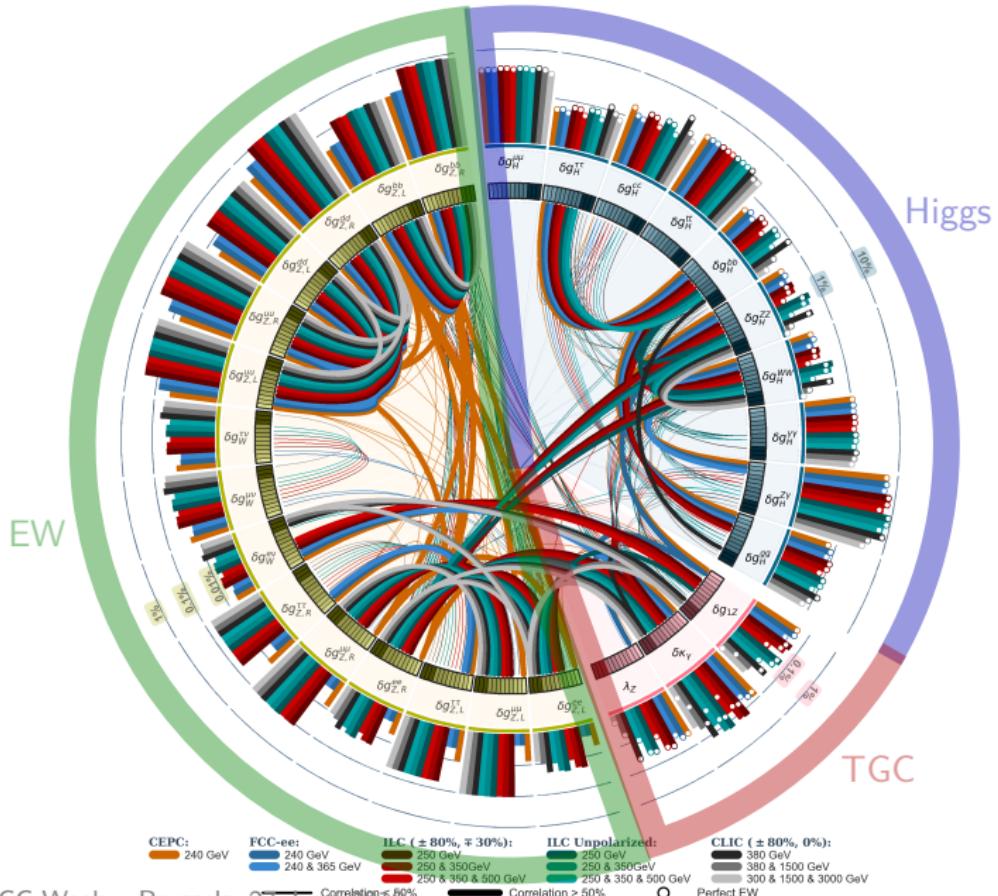
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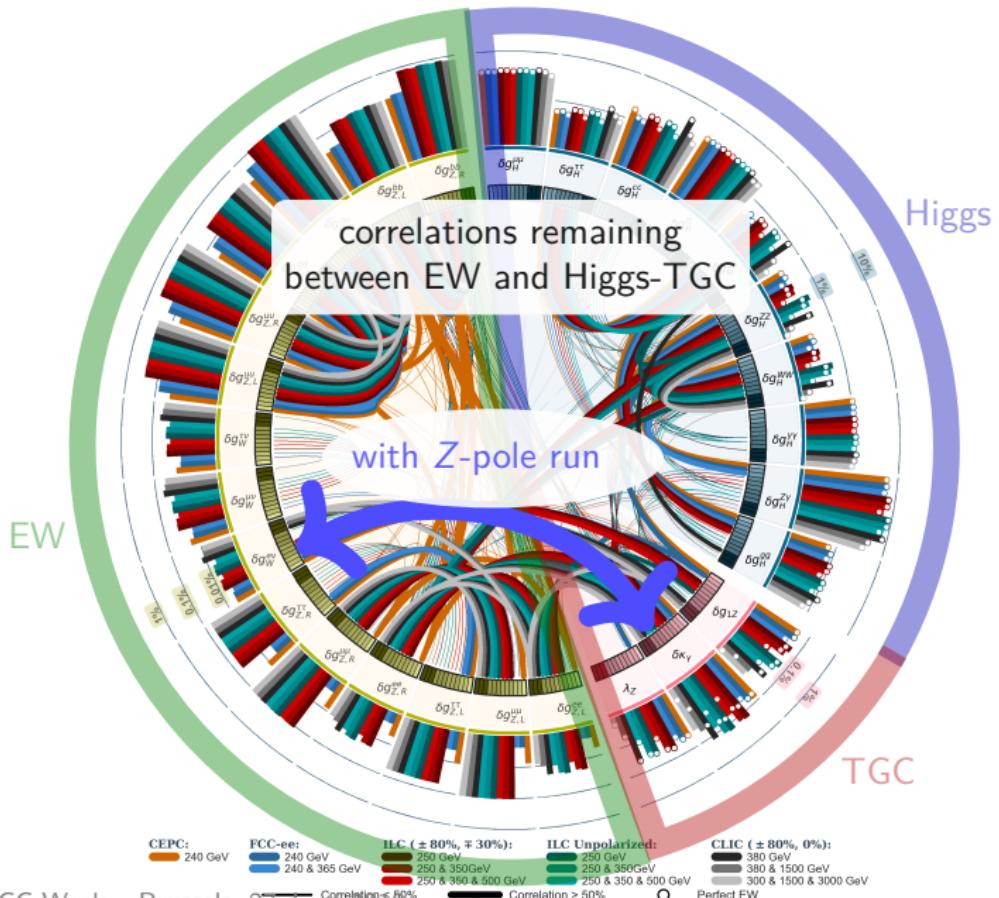


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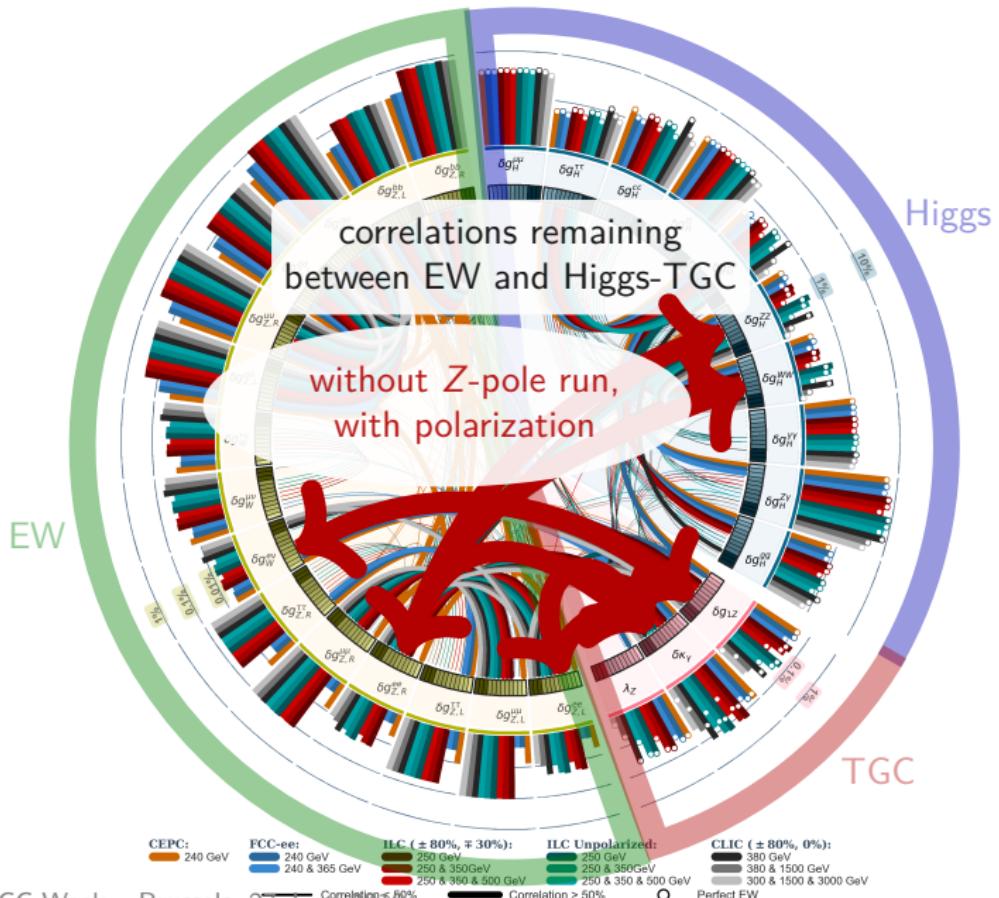
Higgs-TGC / EW correlations



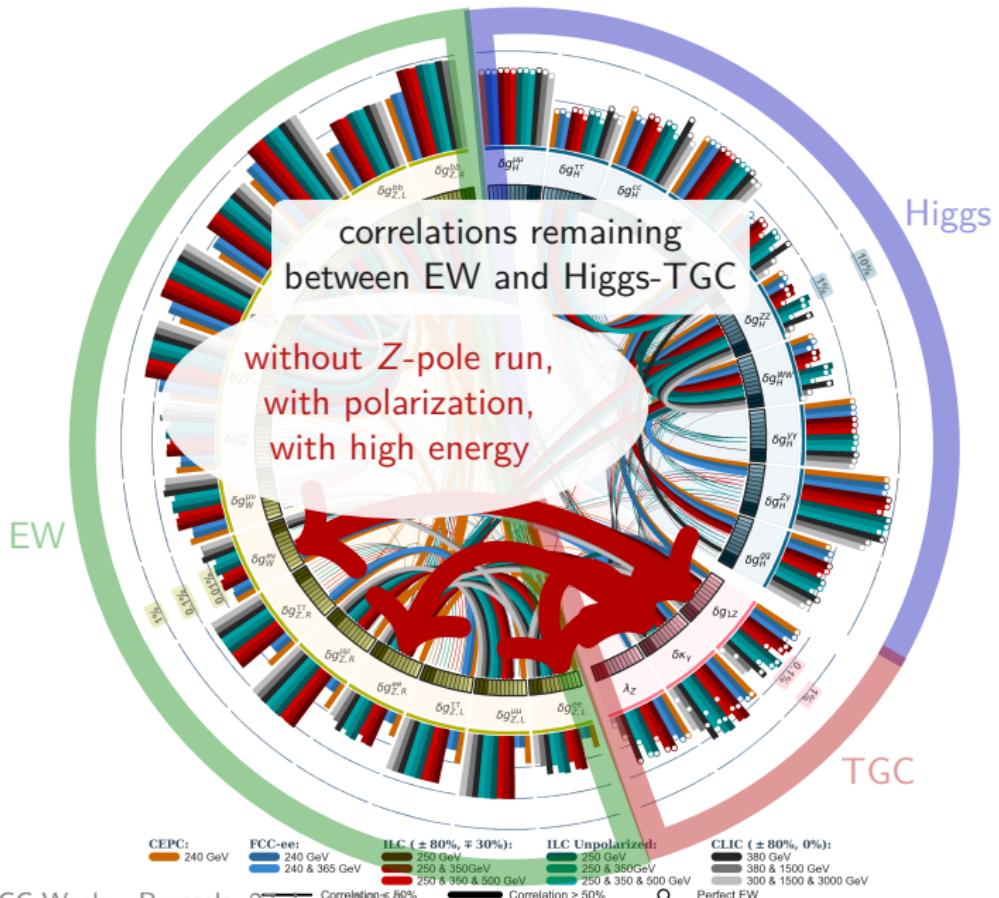
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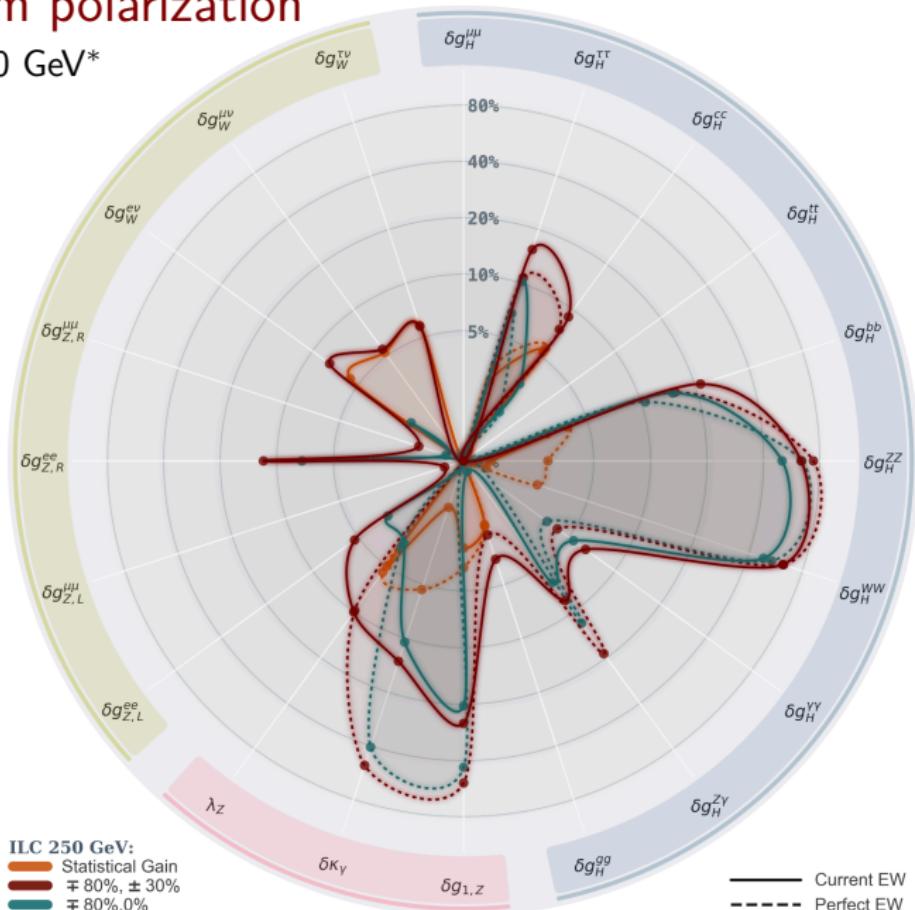
Higgs-TGC / EW correlations



Gain from polarization

at $\sqrt{s} = 250 \text{ GeV}^*$

* decreases, like degeneracies, if higher-energy runs are included

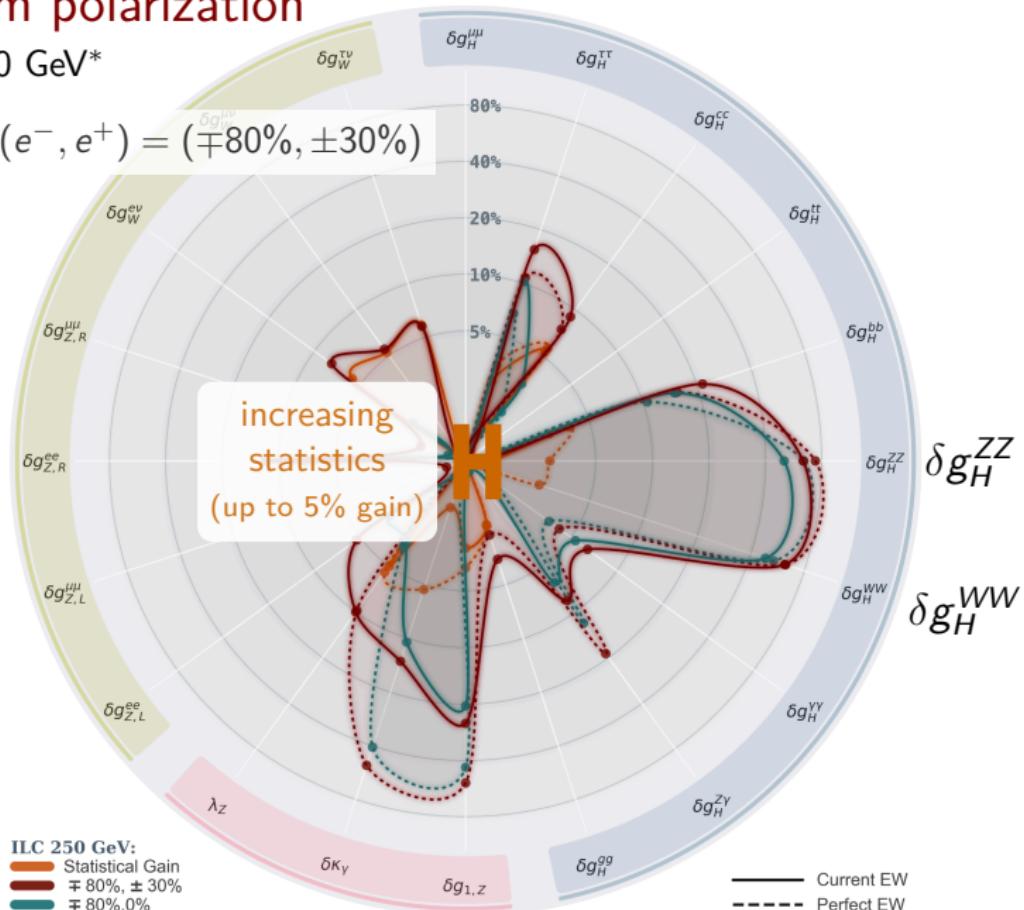


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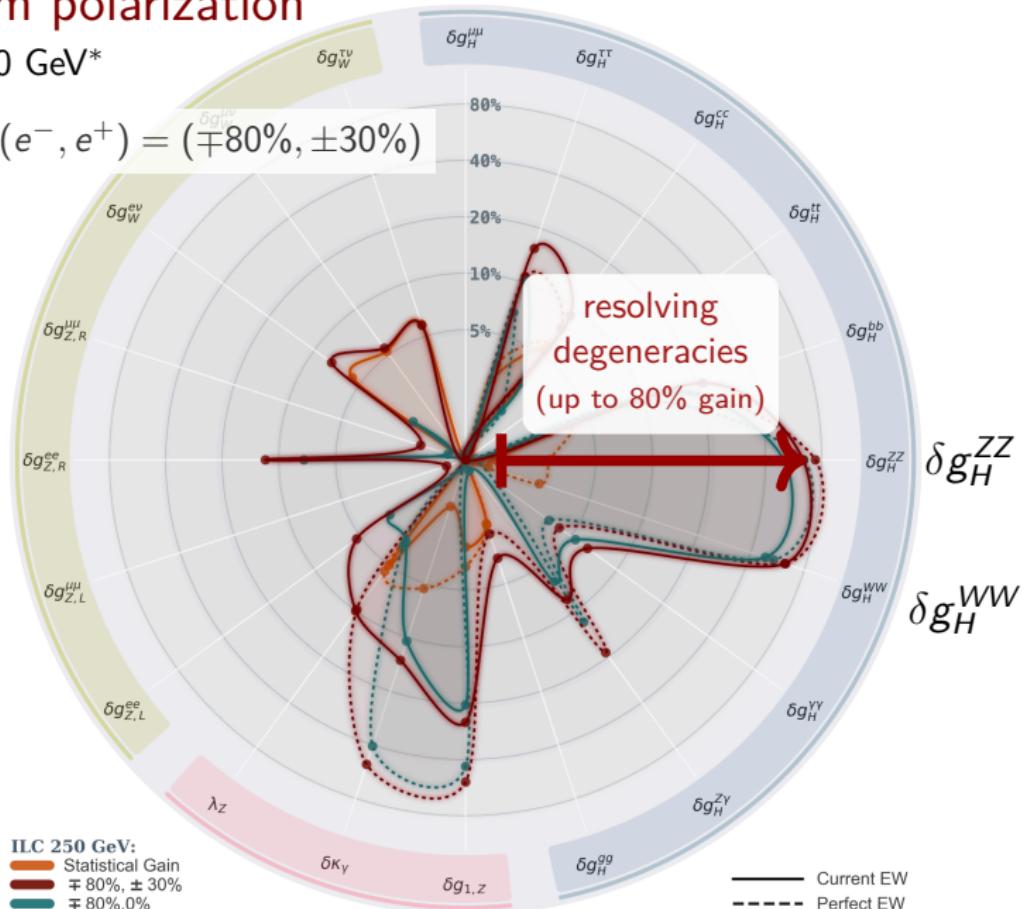


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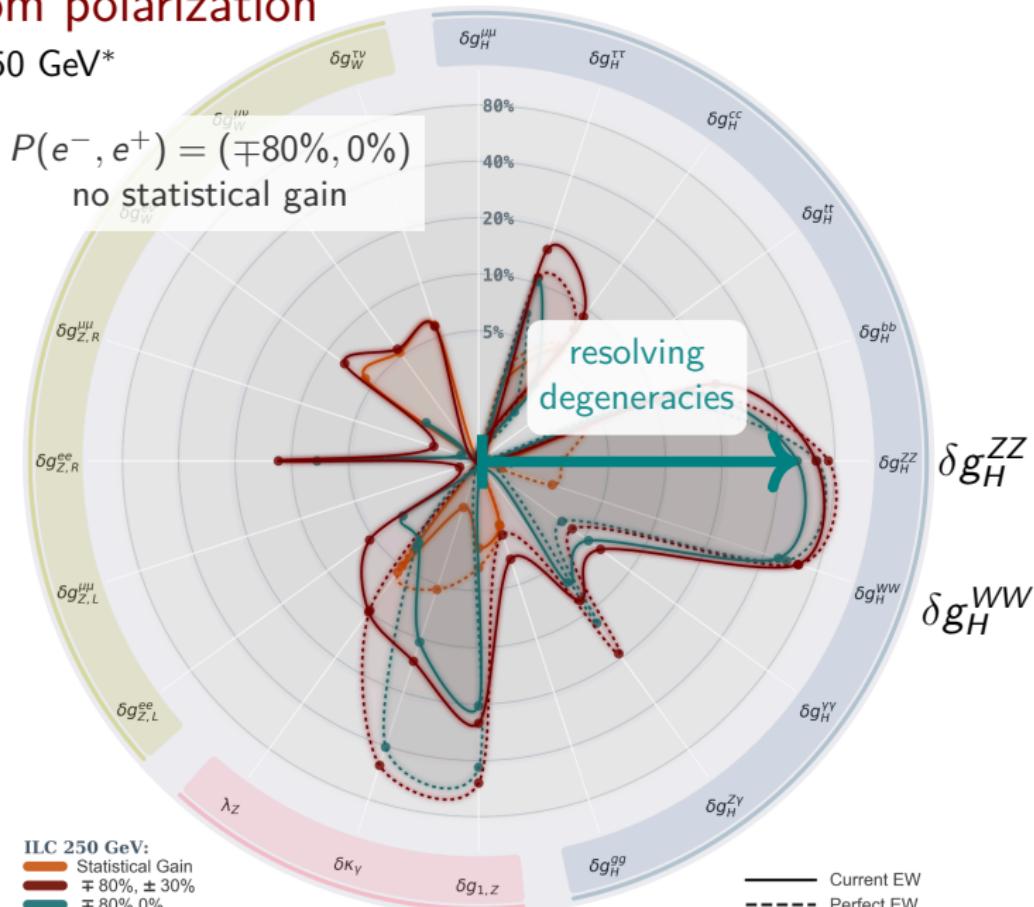
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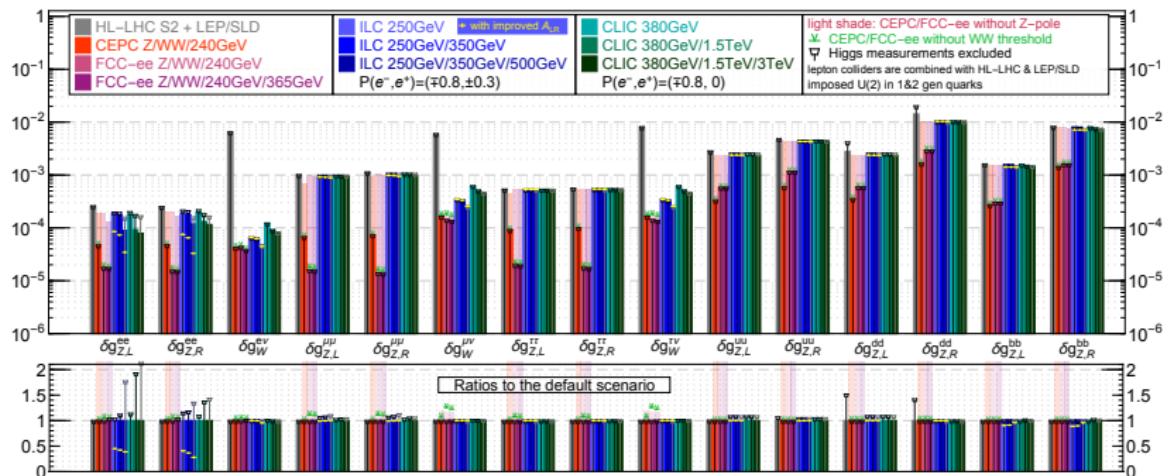
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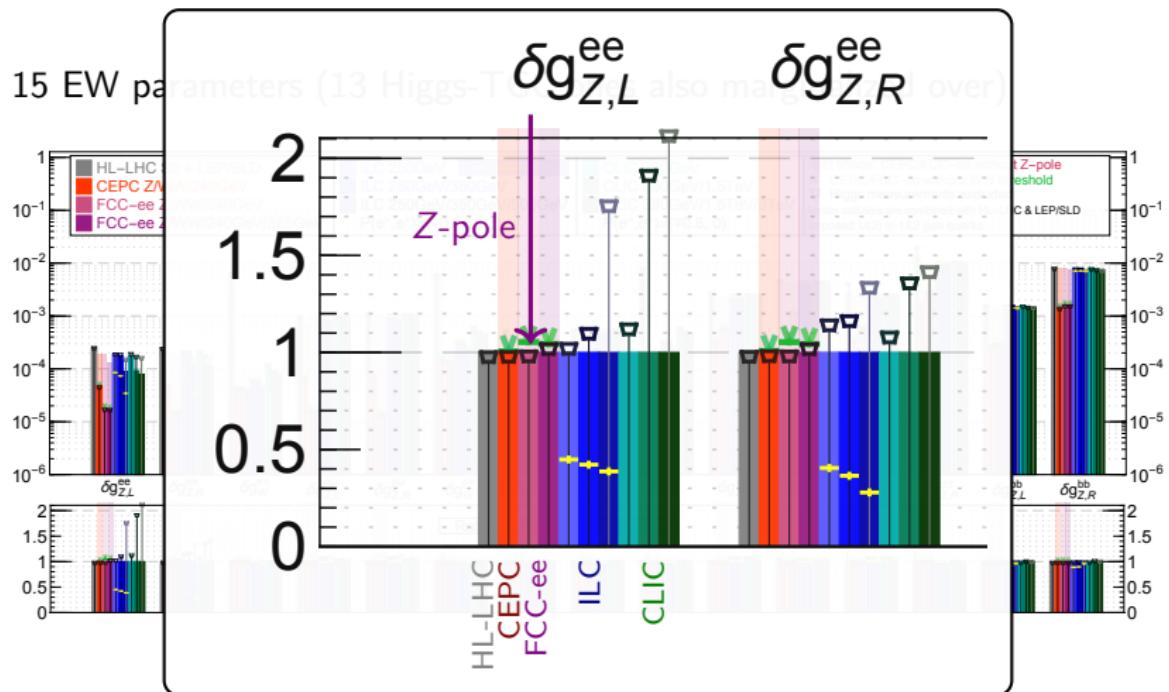


Global EW constraints

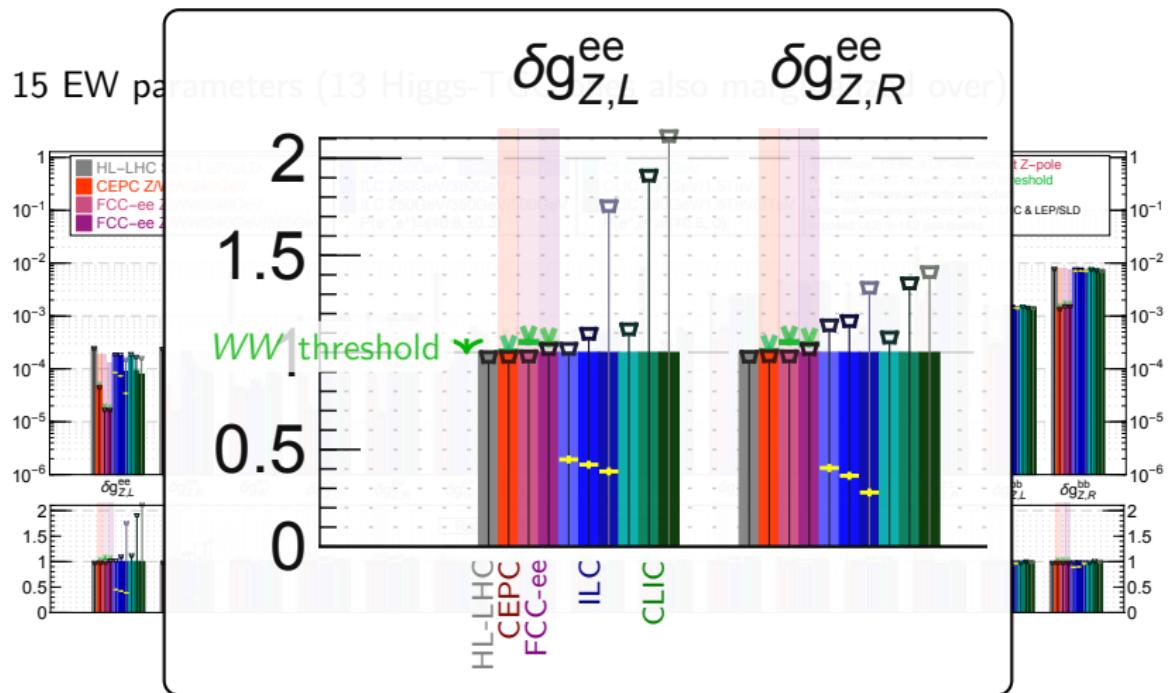
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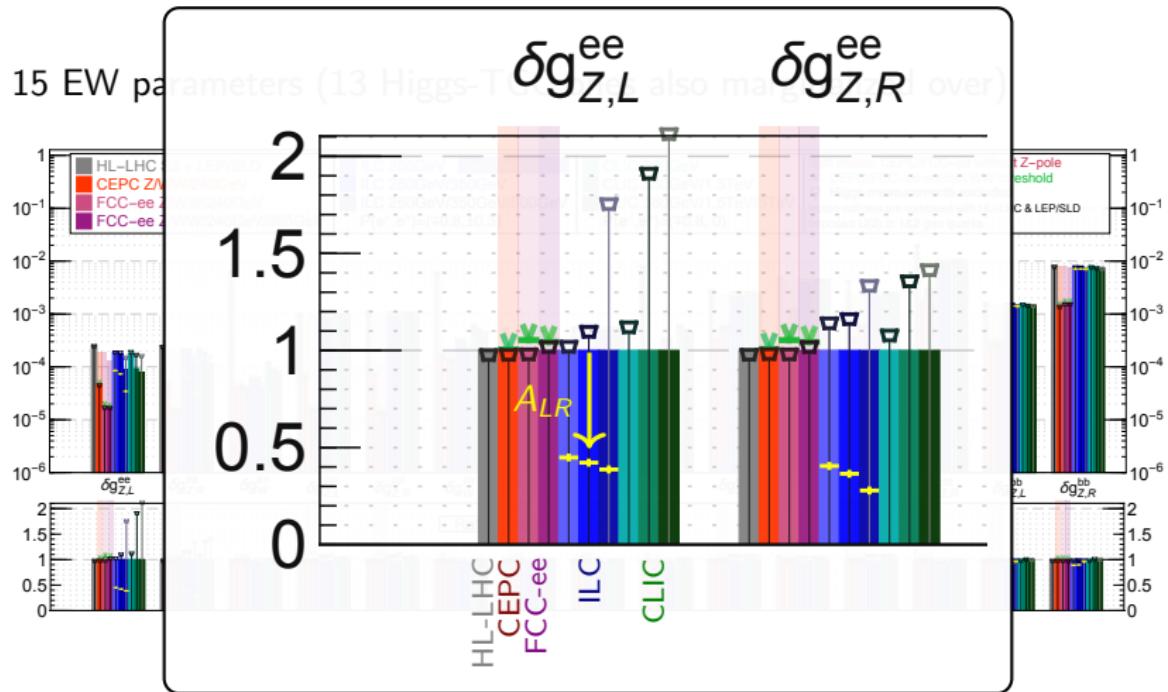
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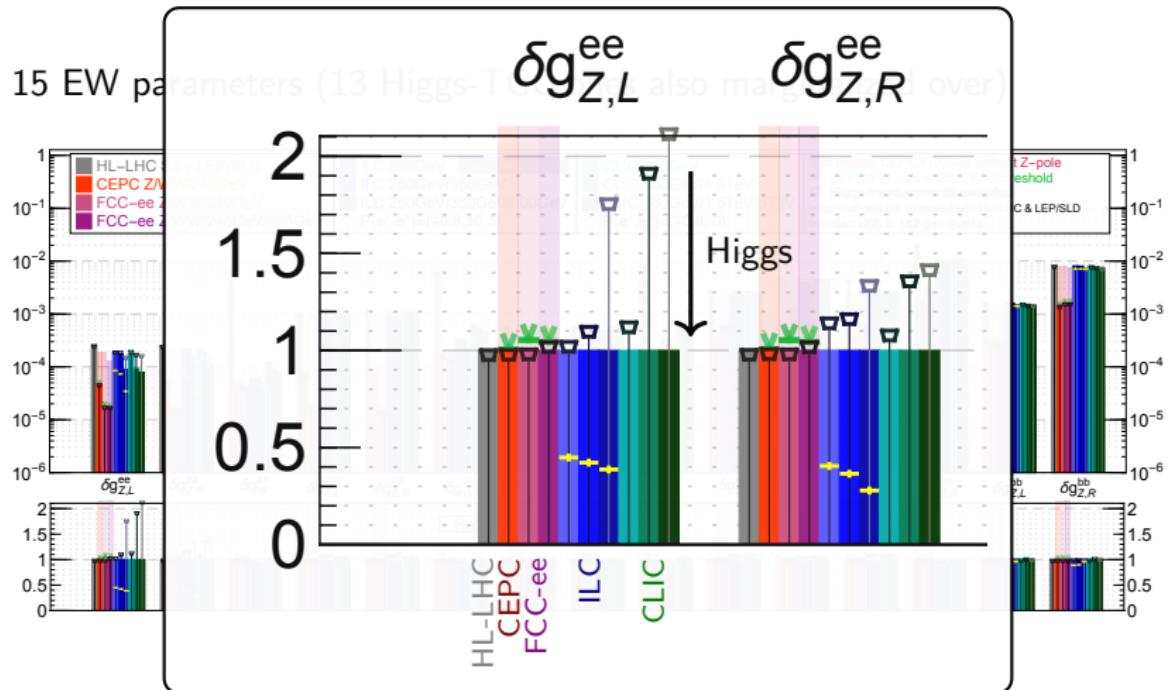
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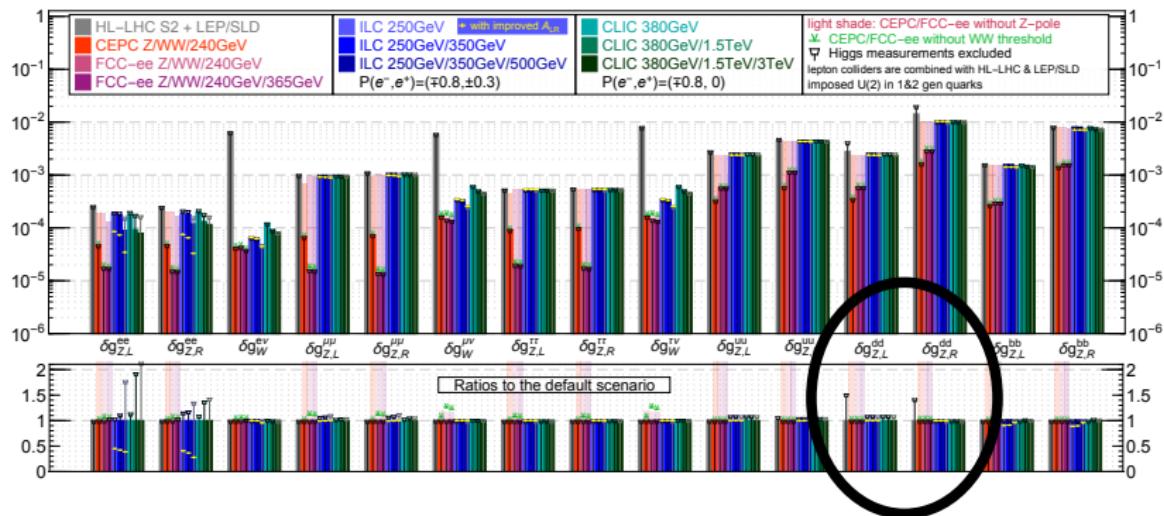
Global EW constraints



Higgs measurements could help constraining Zee at linear colliders,

Global EW constraints

15 EW parameters (13 Higgs-TGC ones also marginalized over)



Higgs measurements could help constraining Zee at linear colliders,
and V_{dd} couplings at the HL-LHC.*

* only diboson and m_W included as EW measurements

Complementarities between Higgs and electroweak measurements at future lepton colliders

At circular colliders, a Z -pole run is crucial for controlling EW uncertainties in Higgs coupling determinations (a WW threshold run isn't).

At linear colliders, beam polarization and high-energy runs help mitigating the absence of Z -pole run.

New EW measurements (radiative Z -pole return, ZZ , $Z\gamma$, etc.) could bring further improvements.

Higgs measurements could otherwise help improving EW parameter determinations.

Backup

Run scenarios

