# Scale of new physics

For example, custodial breaking operator

$$\frac{1}{\Lambda^2}|H^\dagger D_\mu H|^2$$

For $10^{-3}$ correction to the W mass

$$\Lambda \simeq 6 \text{ TeV}$$

Also need a corresponding (and similar) contribution to

$$\frac{1}{\Lambda^2}(H^\dagger \tau^a H) W^a_{\mu\nu} B^{\mu\nu}$$

# Probing the new physics

$$\frac{1}{\Lambda^2}|H^\dagger D_\mu H|^2 \qquad \frac{1}{\Lambda^2}(H^\dagger \tau^a H) W^a_{\mu\nu} B^{\mu\nu} \qquad \Lambda \simeq 6\ \text{TeV}$$

If NP contribution to W mass at tree level, $M_{NP}$ ~ TeVs

Example: Z', triplet, …

Probably too heavy for LHC direct production.

Modification to Higgs coupling, at $10^{-3}$ , too small for Higgs factories.

Modification to Z coupling, $10^{-3}$, Tera Z will confirm.

# Probing the new physics

$$\frac{1}{\Lambda^2}|H^\dagger D_\mu H|^2 \qquad \frac{1}{\Lambda^2}(H^\dagger \tau^a H) W^a_{\mu\nu} B^{\mu\nu} \qquad \Lambda \simeq 6 \text{ TeV}$$

If NP contribution to W mass at tree level, $M_{NP}$ ~ TeVs

Example: Z', triplet, …




Indirect measurement, 4-fermi operator from Z'

# Probing the new physics

$$\frac{1}{\Lambda^2}|H^\dagger D_\mu H|^2 \qquad \frac{1}{\Lambda^2}(H^\dagger \tau^a H) W^a_{\mu\nu} B^{\mu\nu} \qquad \Lambda \simeq 6 \text{ TeV}$$

If NP contribution to W mass at 1-loop level, $M_{NP}$ ~ a few hundred GeV

LHC reach model dependent.

SM 1-loop couplings (e.g. $h \to gg$, $h \to \gamma\gamma$):

$$\sim \frac{1}{(4\pi v)^2} H^\dagger H F^2 \sim \frac{1}{(\text{a few TeV})^2} H^\dagger H F^2$$

The correction to these can be as large as 10(s)% (for $h \to gg$)

and a few percent for $h \to \gamma\gamma$

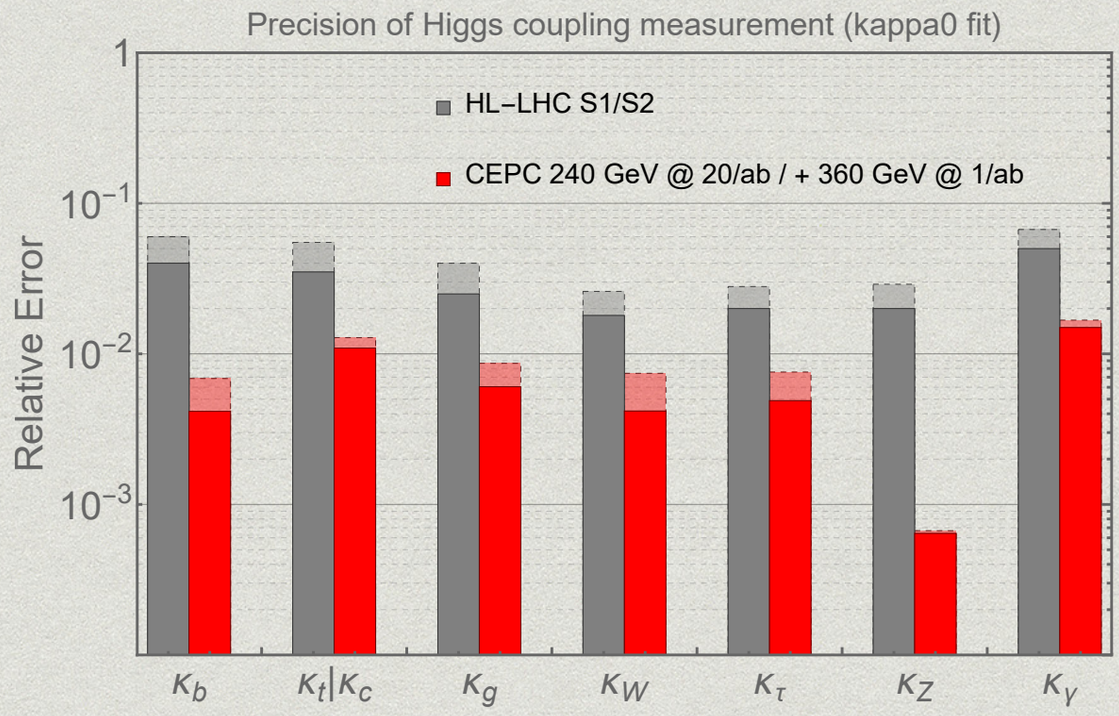
# Probing the new physics

$$\frac{1}{\Lambda^2}|H^\dagger D_\mu H|^2 \qquad \frac{1}{\Lambda^2}(H^\dagger \tau^a H) W^a_{\mu\nu} B^{\mu\nu} \qquad \Lambda \simeq 6\ \text{TeV}$$

If NP contribution to W mass at 1-loop level, $M_{NP}$ ∽ a few hundred GeV

The correction to these can be as large as 10(s)% (for $h \to gg$)

and a few percent for $h \to \gamma\gamma$



# Probing the new physics

$$\frac{1}{\Lambda^2}|H^\dagger D_\mu H|^2 \qquad \frac{1}{\Lambda^2}(H^\dagger \tau^a H) W^a_{\mu\nu} B^{\mu\nu} \qquad \Lambda \simeq 6\ \text{TeV}$$

If NP contribution to W mass at 1-loop level, $M_{NP}$ ~ a few hundred GeV

LHC reach model dependent.

Significant correction to SM coupling at tree level, can be at percentage level!

Such as top/bottom/lepton partners.

Precision Z measurement already constrain them.

Future Z factory, t tbar threshold run can go much further.