Prospects on the EFT constraints from the off-shell Higgs measurements

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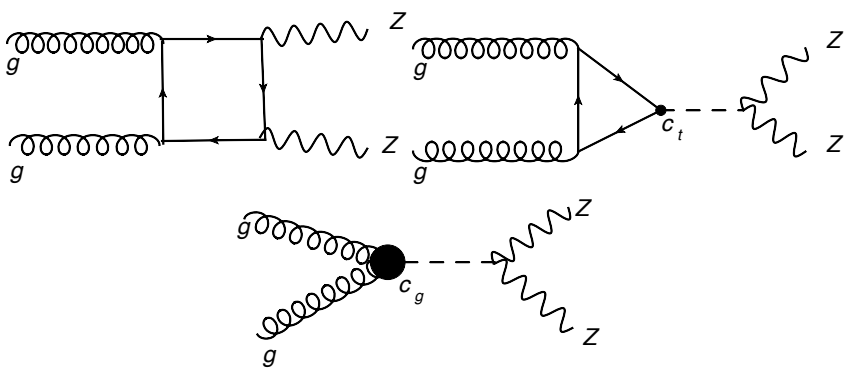
Off-shell Higgs production in gluon fusion $gg \to h \to ZZ$



- $\mathcal{L} = -c_t \frac{m_t}{v} \bar{t} t h + \frac{g_s^2}{48\pi^2} c_g \frac{h}{v} G_{\mu\nu} G^{\mu\nu}$
- on-shell production $\sigma \sim |c_t + c_g|^2$
- off-shell production :

$$\mathcal{M}_{gg\to ZZ} = \mathcal{M}_{bcg} + c_t \mathcal{M}_{c_t} + c_g \mathcal{M}_{c_g}$$

$$\mathcal{M}_{bcg}^{++00} \sim \mathcal{M}_{c_t}^{++00} \sim \log^2 \frac{\hat{s}}{m_t^2}, \quad \mathcal{M}_{c_g}^{++00} \sim \hat{s}$$

- New physics contribution grows with $\hat{s}$ - high energy bins become very important.

EFT interpretation

- c_t, c_g couplings can arise from the dimension-6 operators

$$\mathcal{L}^{\text{dim-6}} = c_y \frac{y_t |H|^2}{v^2} \bar{Q}_L \widetilde{H} t_R + \text{h.c.} + \frac{c_g g_s^2}{48\pi^2 v^2} |H|^2 G_{\mu\nu} G^{\mu\nu}$$

$$\mathcal{L} = -c_t \frac{m_t}{v} \bar{t} t h + \frac{g_s^2}{48\pi^2} c_g \frac{h}{v} G_{\mu\nu} G^{\mu\nu}, \quad c_t = 1 - Re(c_y)$$

- Operators modifying Higgs decay?

$$(D_\mu H)^\dagger \sigma^a D_\nu H W^{\mu\nu,a}, \quad (D_\mu H)^\dagger D_\nu H B^{\mu\nu}, \quad H^\dagger H B_{\mu\nu} B^{\mu\nu},$$
$$\left(H^\dagger \sigma^a \overleftrightarrow{D}_\nu H\right) (D^\mu W_{\mu\nu})^a, \quad \left(H^\dagger \overleftrightarrow{D}_\nu H\right) (D^\mu B_{\mu\nu})$$

  contribute only to the transverse Z polarizations $\rightarrow$ growth with $\sqrt{s}$ is SM-like

- $(\partial_\mu (H^\dagger H))^2$, $\left(H^\dagger \overleftrightarrow{D}_\mu H\right)^2 \Rightarrow h Z_\mu Z^\mu$ are strongly constrained by the on shell measurements
- $\Box h Z_\mu Z^\mu$ appears only at dim 8 level $\frac{(D_\mu H)^2 \Box (H^\dagger H)}{\Lambda^4}$

High Luminosity 3 ab^{-1} 100 TeV FCC prospects

- We simulate the signal and the background with the MCFM 6.8 code, and bin the events in six categories $\sqrt{\hat{s}}$=(250, 400, 600, 800, 1100, 1500,2000,3000,4000,5000) GeV
- K- factors: we assume the same K-factor for the signal and the interfering background and calculate them using the ggHiggs code.
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  - nonlinear analysis 95% $c_t \in [0.96, 1.07]$
  - linear analysis 95% $c_t \in [0.93, 1.07]$
  - keeping $\sqrt{s} < 1.5$ TeV 95% $c_t \in [0.92, 1.13]$