The Higgs self coupling in the presence of $e^+e^- - t\bar{t}$ couplings

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Why this setting

- in trilinear Higgs self coupling λ_3 one of the last things in the SM, that is not measured precisely (Currently $\mathcal{O}(100\%)$) [ATLAS, 2024; Collaboration, 2019])
- using SMEFT the main change can be described by the coefficient of $\mathcal{O}_H = (HH^\dagger)^3$

Why this setting

- looking at the process $e^+e^- \to ZH$ this operator enters at NLO [Asteriadis et al., 2025]
- $e^+e^- - t\bar{t}$ couplings not restricted very well by measurements currently and are predicted by many BSM models, also enters at NLO
- Question: Would the presence of contributions to these couplings spoil the measurement of the trilinear Higgs coupling?

SMEFT Setting

The SMEFT operators modifying $e^+ e^- - t\bar{t}$ interactions are:

$$[\mathcal{O}_{lq}^{(1)}]_{1133} = (\bar{l}_1 \gamma_\mu l_1)(\bar{q}_3 \gamma^\mu q_3)$$

$$[\mathcal{O}_{lq}^{(3)}]_{1133} = (\bar{l}_1 \gamma_\mu \sigma^I l_1)(\bar{q}_3 \gamma^\mu \sigma^I q_3)$$

$$[\mathcal{O}_{qe}]_{3311} = (\bar{q}_3 \gamma^\mu q_3)(\bar{e}_1 \gamma_\mu e_1)$$

$$[\mathcal{O}_{lu}]_{1133} = (\bar{l}_1 \gamma_\mu l_1)(\bar{u}_3 \gamma^\mu u_3)$$

$$[\mathcal{O}_{eu}]_{1133} = (\bar{e}_1 \gamma_\mu e_1)(\bar{u}_3 \gamma^\mu u_3)$$

Observables

Only taking $e^+e^- \to ZH$ problem in restricting.

$\to$ take more observables into account (Electroweak precision, Drell-Yan)

$\to$ do they restrict the $e^+e^- - t\bar{t}$ interactions strong enough to not spoil the measurement of $\mathcal{C}_H$?

Observables

$\rightarrow$ take more observables into account (Electroweak precision, Drell-Yan)

$\rightarrow$ do they restrict the $e^+e^- - t\bar{t}$ interactions strong enough to not spoil the measurement of $\mathcal{C}_H$? Not really when all of them are activated at the same time

But the used operators automatically also generate an $e^+e^- - b\bar{b}$ interaction! $\rightarrow$ add the observable $e^+e^- \rightarrow b\bar{b}$

Fitting the coefficients to the data/data projections
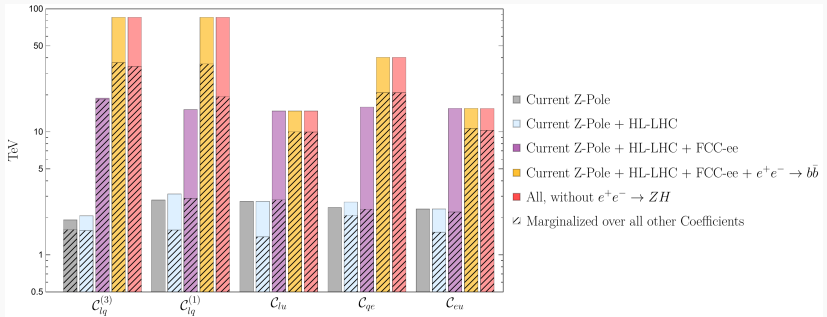
- Interests: BSM Pheno, Axions, Extra-Dim Axions, Generalized symmetries, Higher Groups
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- Outside Physics: Gymnastics & other sports
  Cooking & Baking (and Eating)