

Models/EFTs Subgroup Update

Nikolas Kauer

Royal Holloway, University of London

for the Off-shell Interpretations Task Force

<https://twiki.cern.ch/twiki/bin/view/LHCPhysics/HiggsOffshellTaskForce>

for contributions thanks to

Aleksandr Azatov, Adam Falkowski, Andrei Gritsan,
Christophe Grojean, Ennio Salvioni, Eleni Vryonidou

HXSWG Offshell Interpretations 3rd Joint Meeting

CERN

July 8, 2020

Guidelines

- ▶ discuss and make recommendations on which models/AnomCoupls/EFTs should be investigated with what priority in the context of off-shell $gg \rightarrow H \rightarrow VV$ analyses
- ▶ carefully consider and compare theoretical assumptions/choices made
- ▶ explore to what degree compatibility/translatability between ATLAS and CMS results is feasible

See also presentations at previous meetings:

- ▶ Offshell & Interference Meeting (25 November 2019) [\[link\]](#)
- ▶ HXSWG Offshell Interpretations 1st Joint Meeting (10 March 2020) [\[link\]](#)
- ▶ HXSWG Offshell Interpretations 2nd Joint Meeting (16 April 2020) [\[link\]](#)

Discussion Points

- ▶ EFT effects in $gg (\rightarrow H) \rightarrow ZZ$ (see below)
- ▶ Relation between the Higgs and Warsaw bases (see below)
- ▶ What types of BSM benchmark models should be analysed? Light degrees of freedom up to what scale? In particular to uncover limitations of EFT fits. Are common models sufficient (MSSM, 2HDM, SM+scalar)? What toy models (composite inspired, ...)?
- ▶ Interplay with other channels due to shared couplings, e.g. top production. How to disentangle coefficients? Independent subsets? Proper treatment? Best use of limited number of degrees of freedom in fits. How to expand? Take into account (better) bounds on relevant Wilson coefficients obtained in other channels.
- ▶ Can **off-shell data** resolve **on-shell parameter degeneracy**?
→ **Alex, Christophe and Ennio's slides**
- ▶ Statistics/data analysis methods available to include BSM effects in backgrounds (relative to Higgs production) when determining bounds on Wilson coefficients/model parameters?
- ▶ and others, see TWiki page [\[link\]](#)

Road Map

1. Immediate issues:

- ▶ discuss and converge to a “minimal” list of couplings/operators that deserve priority at this stage
- ▶ clarify basis issues and make recommendations
- ▶ take into account bounds on relevant Wilson coefficients obtained in other channels

2. Medium-term issues:

- ▶ what types of BSM benchmark models should be analysed? Light degrees of freedom up to what scale? In particular to uncover limitations of EFT fits.
- ▶ interplay with other channels due to shared couplings, e.g. top production. How to disentangle operators? Proper general treatment? Independent subsets?
- ▶ take into account VBF $\rightarrow H \rightarrow VV$ (VBF/VH)

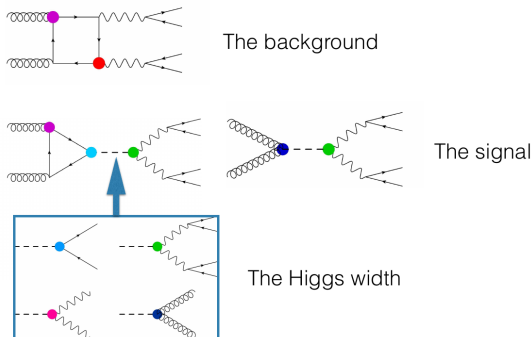
3. Long-term issues:

- ▶ take into account SMEFT effects in background amplitudes
- ▶ take into account NLO effects in EFT studies
- ▶ study specific BSM extended with higher-dimensional operators

SMEFT analysis of $gg \rightarrow H \rightarrow VV \rightarrow \text{leptons}$

Extension of the SM by dimension-6 operators Q_i composed of SM fields, which are invariant under the SM gauge symmetries (C_i : Wilson coefficients):

$$\mathcal{L}_{\text{SMEFT}} = \mathcal{L}_{\text{SM}} + \sum_i C_i Q_i \quad \text{detailed Higgs basis definition} \rightarrow \text{Adam's talk}$$



graphs by Eleni Vryonidou

What can $gg \rightarrow ZZ$ including off-shell tell us about the SMEFT?

\rightarrow Ennio's slides

Deadline for the complete first version of the write-up is 31 October 2020.

Thank you.