

# Progress in the GoSam+Whizard interface for SMEFT at NLO

**CRC TRR257 meeting March 2024**

Marius Höfer | 12 March 2024

with Jens Braun, Pia Bredt, Gudrun Heinrich, Marijn van Geest

# B2c: Anomalous Couplings in the Top Quark Sector

## Motivation



**Goal:** providing a framework to scrutinise couplings involving top quarks

$$pp \rightarrow t\bar{t}, pp \rightarrow t\bar{t} + X, X = H, \gamma, Z, W^\pm$$

including off-shell effects and anomalous couplings within

Standard Model Effective Field Theory (**SMEFT**)

$$\mathcal{L}_{\text{SMEFT}} = \mathcal{L}_{\text{SM}} + \sum_i \frac{C_i^{(6)}}{\Lambda^2} \mathcal{O}_i^{\text{dim6}} + \mathcal{O}\left(\frac{1}{\Lambda^3}\right)$$

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maybe also HEFT?

## B2c: Anomalous Couplings in the Top Quark Sector

two independent approaches for CRC internal cross-checks and validation:

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# Whizard + GoSam: Setup

sindarin runcard:  
define process, specify parameters



Whizard (Monte Carlo event generator)

GoSam (amplitude provider)

# Whizard + GoSam: Setup

**UFO model**

- particles
- vertices

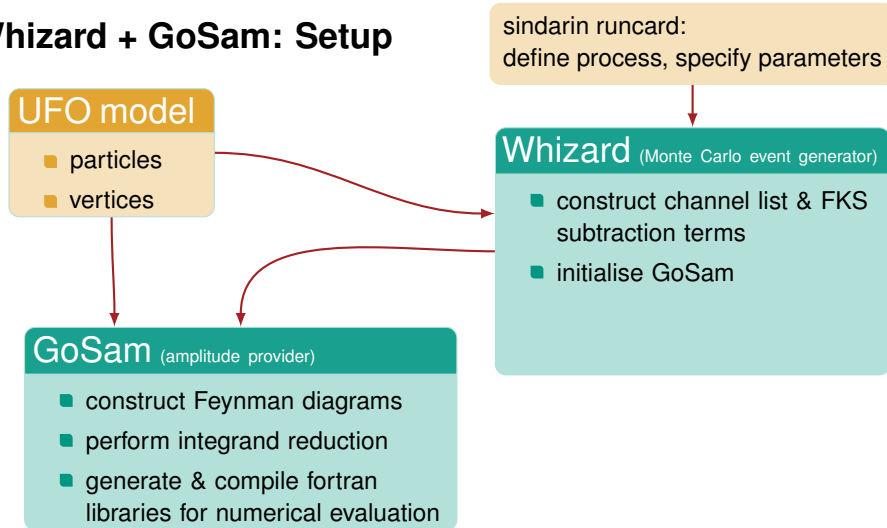
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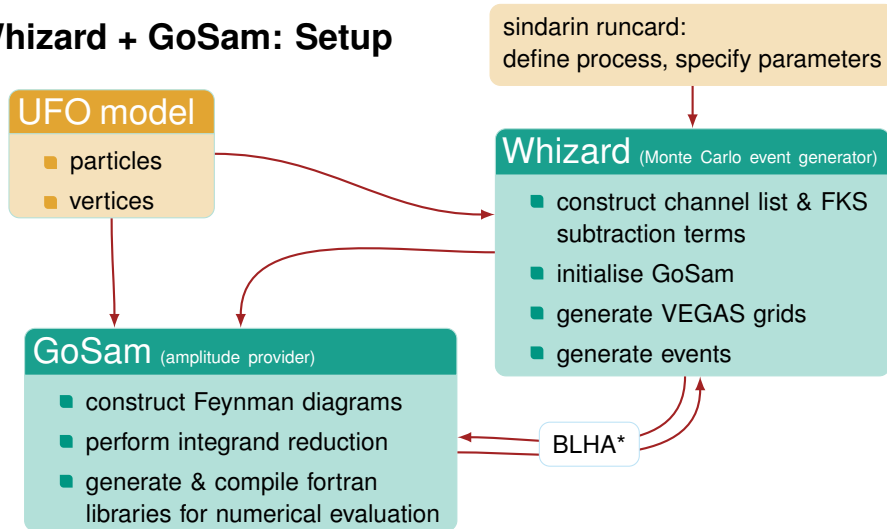
- construct channel list & FKS subtraction terms

**GoSam** (amplitude provider)

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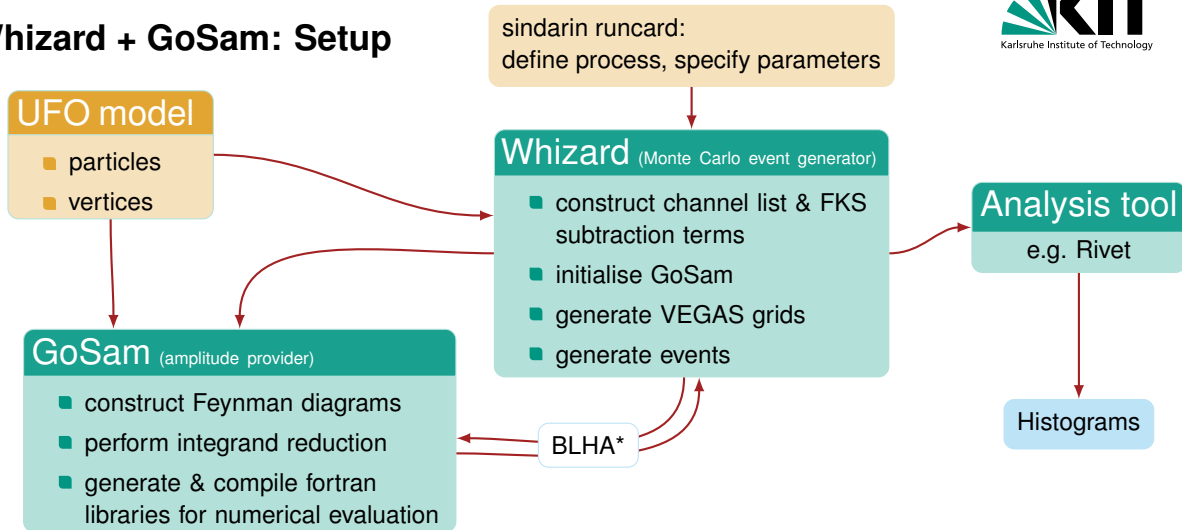


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\*Apart from stuff that doesn't work...

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check consistency for selection of SM processes:

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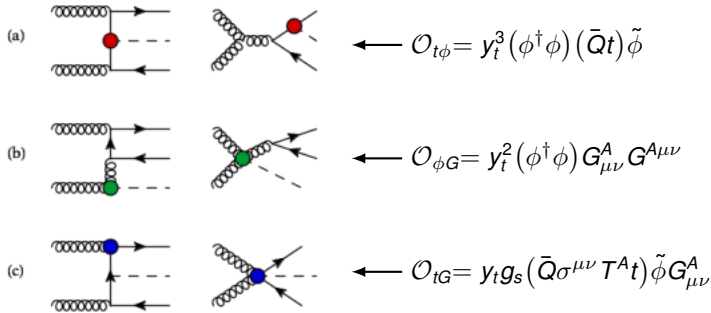
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## 2b) Checks against published results (SMEFT)

- $t\bar{t}H$  with stable tops & Higgs: [Maltoni et al. 2016](#) (MG5\_AMC)

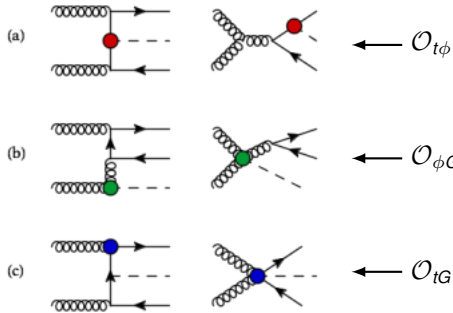
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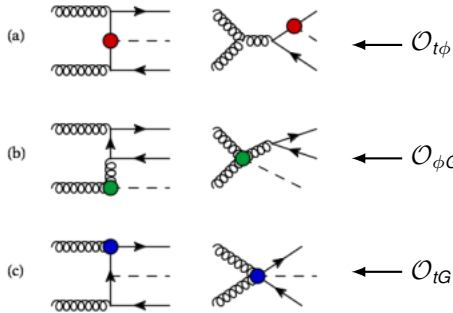


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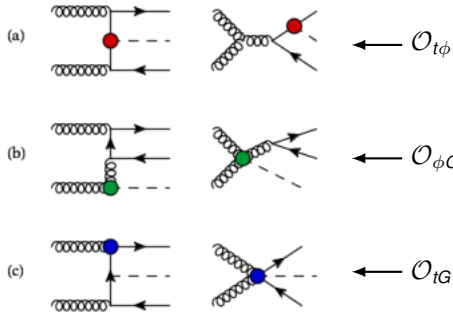
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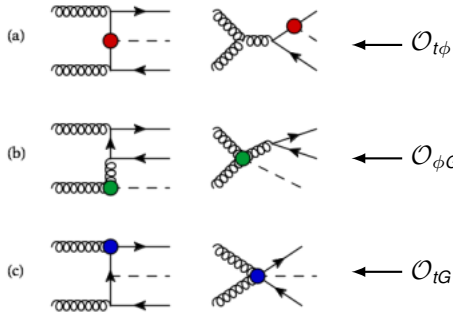
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for validation: try to reproduce  $\sigma_x$  at LO and NLO

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## Setting up the run

- UFO model generated with SmeftFR v3 [Dedes et al. 2023]
- tidy up output UFO manually:
  - remove flavour changing vertices
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✓ LO

✗ NLO → not yet fully functional

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- generation of FKS-subtraction terms by Whizard in presence of non-SM like vertices
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## Physics issues

- renormalization
- running Wilson coefficients

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handled automatically by GoSam

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## Beyond $t\bar{t}H$

- other processes:  $t\bar{t} + \gamma/Z/W^\pm$ ,  $t + Z/W^\pm$ , VBF-H(H) (in progress ...)
- other EFT models (e.g. HEFT)

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