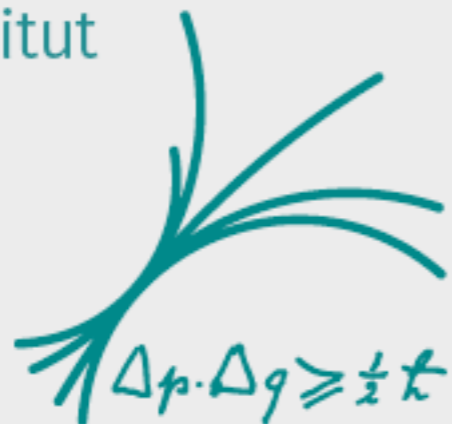


A study of anomalous couplings and NLO effects in Higgs+Jet production

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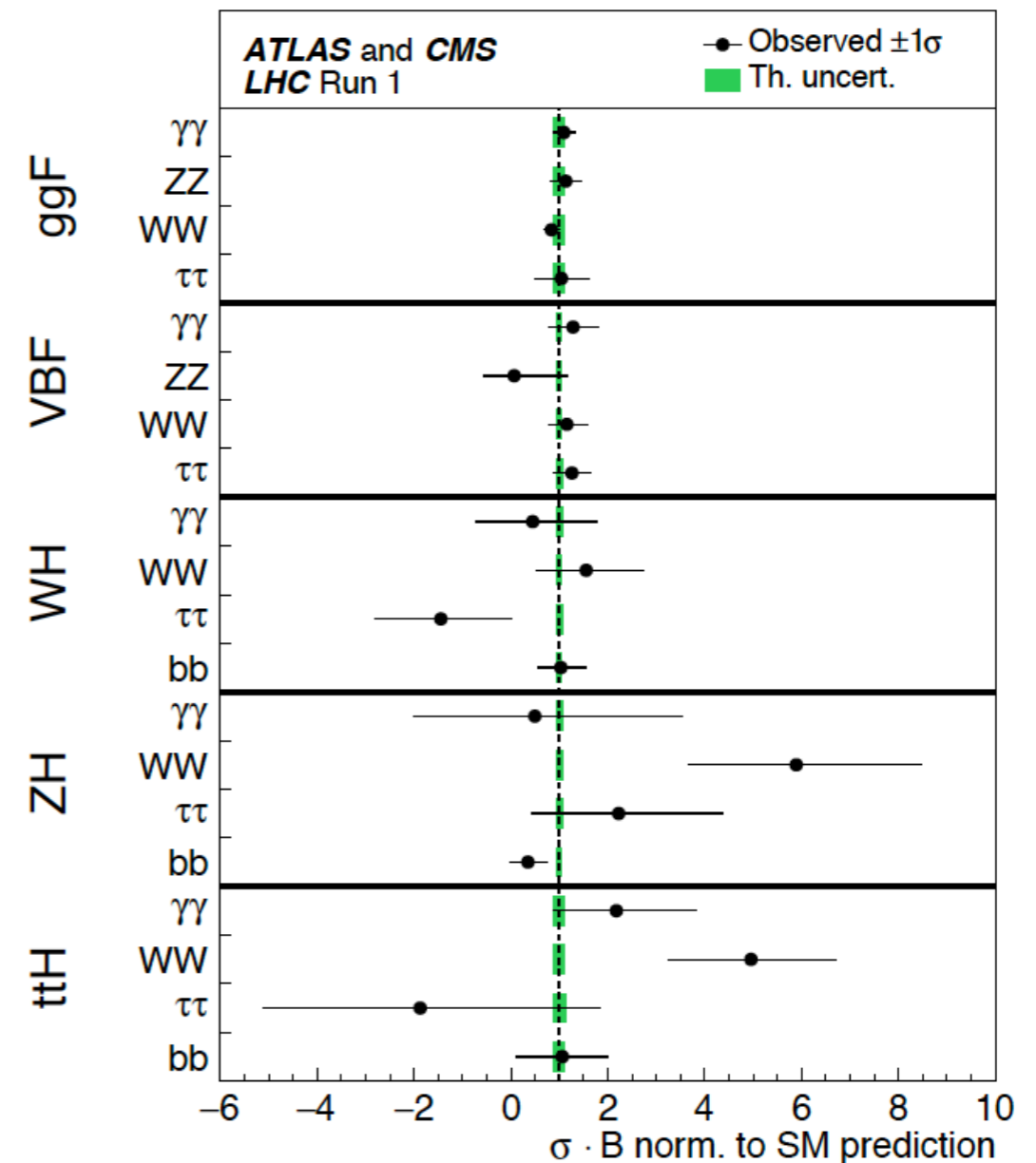
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Motivations

- Discovery of the Higgs boson: most important element in our understanding of electroweak symmetry breaking.**
- The hierarchy problem and other open questions in the SM motivate us to explore extensions to the Higgs sector.**
- SM is very well tested. New physics effects could likely show up in the Higgs sector but no evidence of new physics found up to date.**
- New physics may hide at higher scales, therefore we use a low energy approximation to parametrize new physics contributions.**
- We work in an Effective Field Theory (EFT) framework, the one provided by the ElectroWeak Chiral Lagrangian (EWChL).**

Motivations

- **EWChL provides a non linear realization of the electroweak symmetry breaking sector.**
- **By construction there are anomalous couplings without constrains on their magnitude.**
- **Some are rescaling of SM quantities while others introduce new kind of interaction.**
- **Focusing on the Higgs plus jet production one can study the rescaling of top Yukawa coupling and anomalous coupling describing the effective interaction of one Higgs boson with two gluons.**



ATLAS, CMS collaboration
arXiv:1606.02266

EFT + higher order QCD Higgs plus Jet brief state of art

LO full m_t dependency:

- Ellis, Hinchliffe, Soldate, van der Bij 87
Baur, Glover 89

NLO Heavy Top Quark Limit including EFT contributions:

- Grazzini, Inicka, Spira, Wieseemann 16
- Grazzini, Inicka, Spira, Wieseemann 18

NNLO Heavy Top Quark Limit:

- Boughezal, Caola, Melnikov, Petriello, Schulze 13, 14
- Chen, (Martinez,) Gehrmann, Glover, Jaquier 14, 16
- Boughezal, Focke, Giele, Liu, Petriello 15

NLO QCD full m_t dependency:

- Jones, Kerner, Luisoni 18

Higgs plus Jet in the EWChL framework

□ The relevant terms from the Lagrangian are given by:

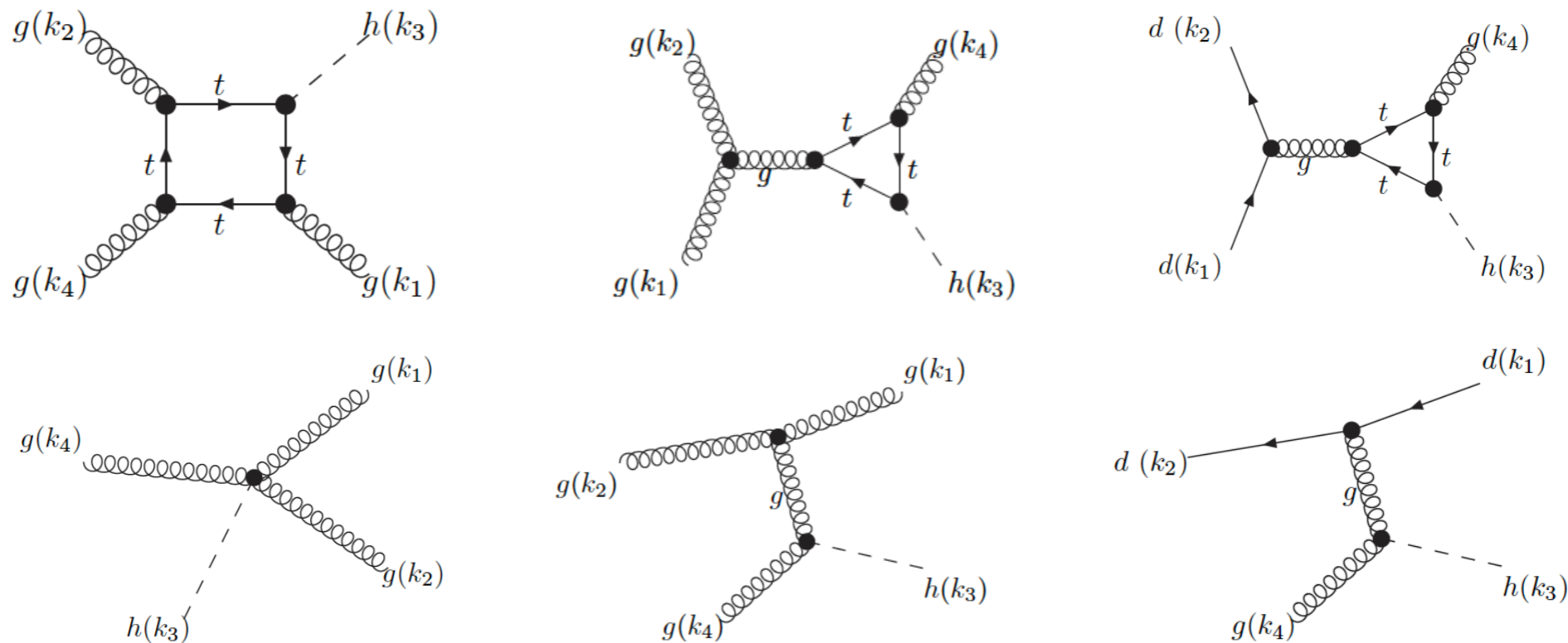
$$L \supset -c_t \frac{h}{v} \bar{t}t + \frac{\alpha_S}{8\pi} c_{ggh} \frac{h}{v} G_{\mu\nu}^a G^{a,\mu\nu}$$

□ Two anomalous couplings.

□ We want to provide the NLO QCD full top mass dependent cross section and pT distributions including EFT contributions.

□ Work based on the results of arXiv:1802.00349.

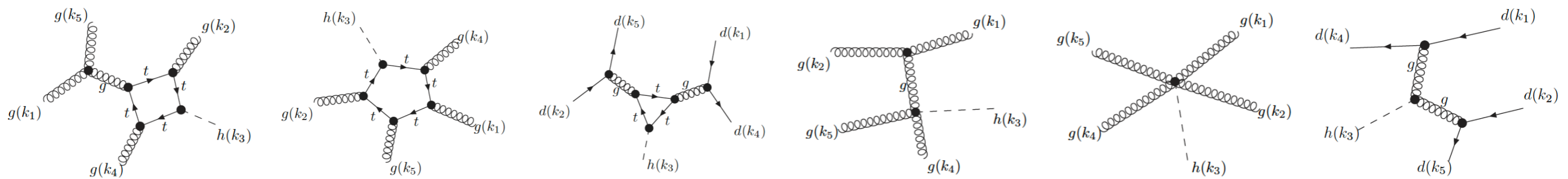
Higgs plus Jet in the EWChL framework: Born Feynman diagrams



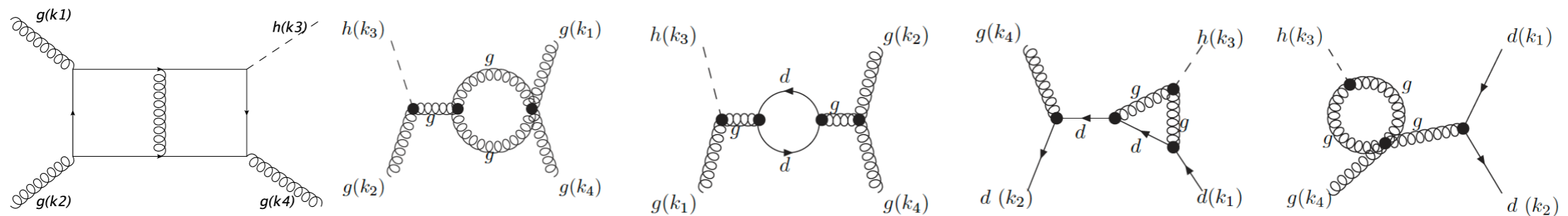
Within the EWChL framework 3 new diagrams appear at the born level and the total cross section is function of 2 anomalous couplings: c_t and c_{ggh} .

Higgs plus Jet in the EWChL framework: Real and Virtual Feynman diagrams

Some of the real radiation diagrams

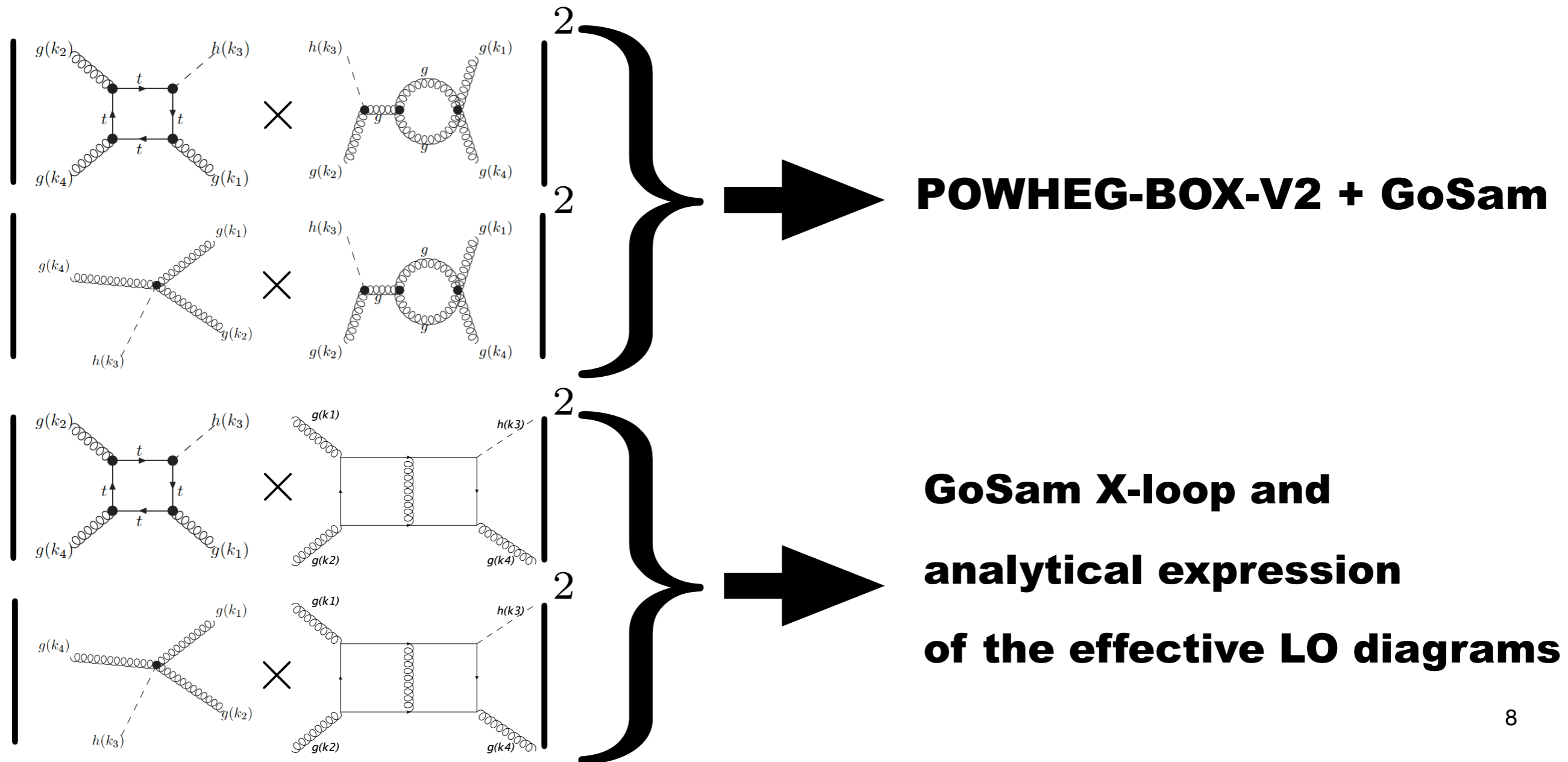


Some of the virtual diagrams



Higgs plus jet in the EWChL framework: setup

- ❑ Born computed analytically in POWHEG-BOX-V2
- ❑ Real radiation computed via GoSam in POWHEG-BOX-V2
- ❑ Virtual contributions split in 2 parts

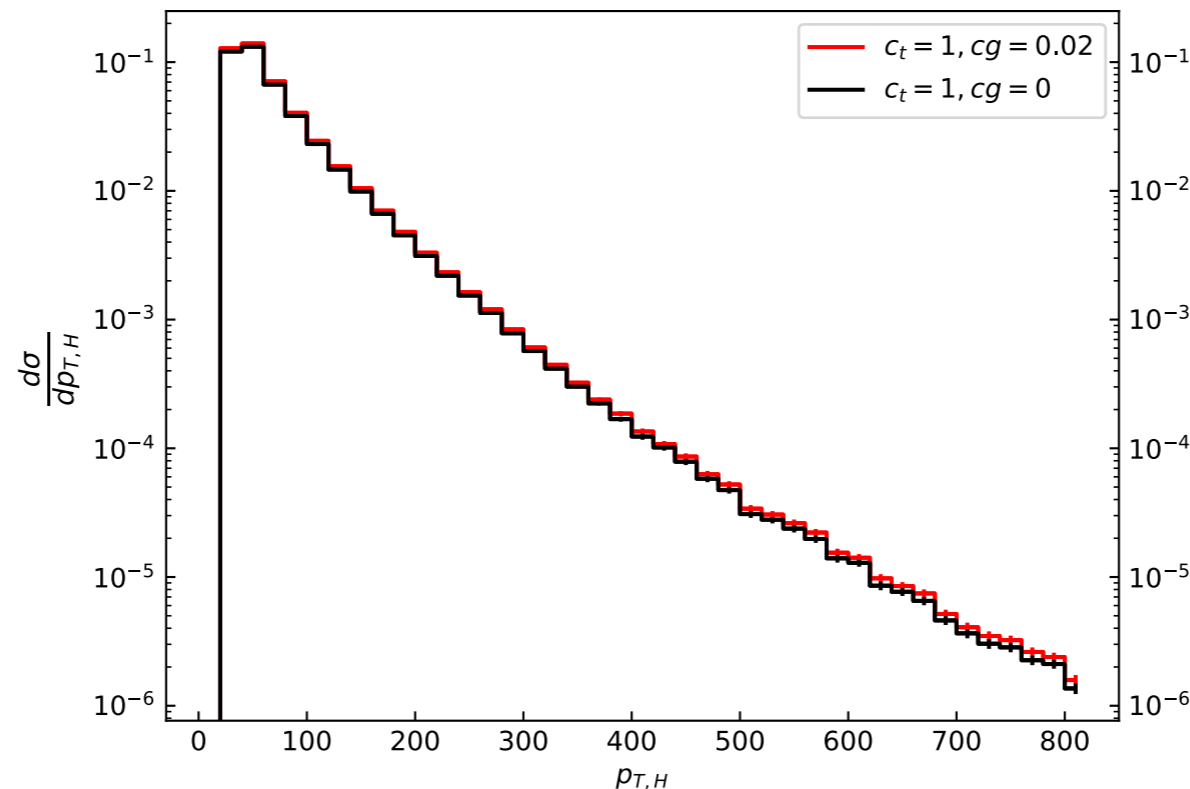


Higgs plus jet in the EWChL framework: Current state

- The idea is to parametrize the cross section and the differential p_T distribution expressing it as a function of the two anomalous couplings:

$$\sigma = A_1 c_t^2 + A_2 c_{ggh}^2 + A_3 (c_t \cdot c_{ggh}) \quad \frac{d\sigma}{dp_{T,H}} = \tilde{A}_1 c_t^2 + \tilde{A}_2 c_{ggh}^2 + \tilde{A}_3 (c_t \cdot c_{ggh})$$

- Now we are evaluating the seven point scale variation for SM in order to provide the coefficient A1 with the associated scale uncertainty.
- The next step will be to act in the same way to obtain the coefficients A2 and A3.



PRELIMINARY

Conclusions and outlooks

- The Higgs plus jet production give us an opportunity to study the effects of the c_{ggh} coupling and experimentally to observe deviation from the SM.**
- Our project will provide the first NLO QCD top quark mass dependent analysis including EFT contributions.**
- Our setup can be used by experimentalists to improve their analysis.**
- We are close to finish our computation and publish our paper.**