

# Table of Contents

<b>ttH/tH Higgs Associated Production Process.....</b>	<b>1</b>
Goals of the group.....	1
Group Contacts.....	1
ttH/tH Mailing List.....	1
Meeting Plans for the ttH/tH subgroup (2017-Present).....	1
Modelling Studies.....	2

# ttH/tH Higgs Associated Production Process

## Goals of the group

The ttH/tH subgroup mandate is as follows:

- Based on a review of the current status and ongoing plans of ttH and tH experimental analyses and all relevant theory predictions we will:
  - ◆ Identify and characterize state-of-the art theoretical predictions+tools for signals and backgrounds in all relevant ttH and tH searches.
  - ◆ Identify all important theory related sources of uncertainties and prioritize them according to their impact on experimental analyses and the likelihood of theory improvements in the near future.
- In this context we will:
  - ◆ Give more emphasis to precision theory predictions/simulations for ttH/tH backgrounds.
  - ◆ Address nontrivial aspects of theory uncertainties that play an important role in the ATLAS/CMS analyses (e.g. signal and background shape uncertainties).
  - ◆ Try to involve more key experts (experimentalists and theorists) in the ttH/tH subgroup.
  - ◆ Foster communication between ATLAS and CMS, as well as between the experiments and theorists working on issues of interest to the experiments.

## Group Contacts

- Josh McFayden (Univ. of Sussex) - ATLAS
- Sergio Sanchez Cruz (UZH) - CMS
- Stefano Pozzorini (Zurich Univ.) - Theory
- Laura Reina (Florida State Univ.) - Theory
  
- Mail to Conveners

## ttH/tH Mailing List

Public meetings and general announcements regarding the ttH/tH subgroup will be communicated through the mailing list of WG1. Anybody who is interested in following or contributing to the ttH activities is invited to subscribe to the lhc-higgs-xsbr-tth mailing list using this link [↗](#) (search for "lhc-higgs-xsbr-tth") or by contacting the conveners.

## Meeting Plans for the ttH/tH subgroup (2017-Present)

After the delivery of YR4, Group meetings have been focusing on coordinating and advancing the study of the main background processes, in particular tt+b jets and, more recently, tt+V (V=W/Z). The dates and links to the Indico pages of the main meetings are listed below.

### Practical information

- Meetings will be announced to the mailing list above.
- A link to the WG1 Indico page can be found here: [Higgs XS&BR WG Indico Page](#) [↗](#)

Date	Time (CERN)	Title	Indico/Vidyo
Feb 6, 2017	17:00-18:30	Common meeting on tt+b-jet backgrounds to ttH(bb)	Indico <a href="#">↗</a>
July 6, 2017	17:00-18:30	Common meeting on tt+b-jet backgrounds to ttH(bb)	Indico <a href="#">↗</a>
Nov 6, 2017	17:00-18:30	Common meeting on tt+b-jet backgrounds to ttH(bb)	Indico <a href="#">↗</a>
Feb 12, 2018	16:30-18:00	Informal meeting with tt+b jets Monte Carlo's authors	Indico <a href="#">↗</a>
Mar 5, 2018	16:30-18:00	Informal meeting with tt+b jets Monte Carlo's authors	Indico <a href="#">↗</a>
Mar 19, 2018	16:30-18:00	Informal meeting with tt+b jets Monte Carlo's authors	Indico <a href="#">↗</a>
Apr 16, 2018	16:30-18:00	Informal meeting with tt+b jets Monte Carlo's authors	Indico <a href="#">↗</a>
Oct 22, 2018	14:30-16:00	Common meeting on tt+b-jet backgrounds to ttH(bb)	Indico <a href="#">↗</a>
Apr 1, 2019	14:30-16:00	Common meeting on tt+b-jet backgrounds to ttH(bb)	Indico <a href="#">↗</a>
Oct 2, 2019	15:30-17:30	ATLAS/CMS MC simulations for tt+b jets and ttV, comparison	Indico <a href="#">↗</a>
Oct 4, 2019	14:00-16:00	Update on theory comparison of tt+b jets NLO MC	Indico <a href="#">↗</a>
Oct 15, 2019	15:00-17:00	Theory update and future plans for tt+V	Indico <a href="#">↗</a>
Oct 23, 2020	16:00-18:00	Experimental and Theoretical studies of tt+bb and ttW	Indico <a href="#">↗</a>
Jul 1, 2021	15:00-17:00	Experimental and Theoretical studies of ttW	Indico <a href="#">↗</a>

## Modelling Studies

Among the important achievements of the ttH/tH working group collected in YR4 are: 1) the successful comparison of all existing NLO QCD+parton shower Monte Carlo generators for the simulation of the ttH signal, 2) the first comparison of NLO QCD+parton shower Monte Carlo generators for the simulation of the tt+b jets background, and 3) the recommendation of NLO QCD cross sections for ttW and ttZ background processes. Details of these studies can be found here:

- Modelling Studies for YR4

After YR4, the more recent activity of the ttH/tH working group has focused on background Monte Carlo studies, specifically:

- tt+bjets: as documented by the series of meeting since 2017 and by the reports presented at the various HXSWG General Assembly Meetings during the same period, this has been the major activity of the WG after YR4. Thanks to the collaboration of the Authors of different NLO QCD+parton

shower Monte Carlo generators, the comparison is now converging to a substantial agreement which will lead to the possibility of providing the experiments with well-defined recommendations for the use of the corresponding Monte Carlo tools in experimental analyses. A working-group note will be completed by 2020. Details of recent and ongoing studies can be found under "Ongoing Modelling Studies" below.

- $t\bar{t}+V$  ( $V=W/Z$ )->multileptons: the organization of a coordinate study of this background has started in late 2019 and a summary of the status of recent experimental analyses and theoretical results has been presented at the General Assembly Meeting in October 2019 . Starting in Spring 2020 we plan to have an updated comparison between experimental analysis tools and an update on recent theoretical developments that will inform how to proceed in the study of these signatures during the rest of 2020. Results will be presented at the next General Assembly Meeting in November 2020.

Details and updates on these studies can be found here:

- Recent and Ongoing Modelling Studies
- 

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