

Table of Contents

LHC HWG for BSM Higgs (WG3)	1
Group organization	2
Extended Higgs Sector (neutral + charged Higgs bosons):.....	3
MSSM Higgs.....	3
NMSSM Higgs.....	4
Exotic Higgs Decays.....	4
bbH/bH Associated Production.....	5
Other groups.....	5
gitlab repository and tools	6
Meetings	7
Mailing lists	8
WG3 related documentation	9
General documentation	10

LHC HWG for BSM Higgs (WG3)

LHCHWG3 is responsible to provide support and recommendations for BSM Higgs related issues.

Group organization

Group conveners:

ATLAS	CMS	THEORY
Jana Schaarschmidt (U of Washington) (2021)	Jan Steggemann (EPFL) (2020-2021) Abdollah Mohammadi (U Wisconsin) (2021-)	Zhen Liu (U of Minnesota) (2019) Shufang Su (Arizona) (2021)

The conveners can be globally reached at the address [lhc-higgs-bsm-convener@cernNOSPAMPLEASE.ch](mailto:lhc-higgs-bsm-convener@cern.ch) (only if you already subscribed to the WG3 mailing list or the general HWG mailing list, see here).

WG3 acknowledges historical contributors, especially leadership from all conveners, and we look forward to your future contributions. These conveners are recorded here; please contact Zhen Liu (U of Minnesota) to update this information.

WG3 Conveners		Subgroup Conveners					
		Exotic Higgs Decays		Extended Higgs Sector		MSSM	
Zhen Liu	2019-Current	Lorenzo Sestini	2017-Current	Rui Santos	2015-Current	Michael Spira	2010-Current
Jan Steggemann	2020-Current	Georgia Karapostoli	2020-Current	Santeri Laurila	2021-Current	Pietro Slavich	2012-Current
Jana Schaarschmidt	2021-Current	Brian Shuve	2020-Current	Tania Robens	2021-Current	Timothy Barklow	2019-Current
Shufang Su	2021-Current	Matthias Konig	2020-Current	Nikos Rompotis	2021-Current	Artur Gottmann	2020-Current
Pietro Slavich	2021	Verena Martinez	2021-Current	Jana Schaarschmidt	2016-2020	Emanuele Bagnaschi	2020-Current
Anna Goussiou	2020	Jesse Shelton	2013-2020	Jan Steggemann	2019-2021	Andrew Gilbert	2017-2020
Stefania Gori	2017-2019	Cecile Caillol	2017-2020	Mariarosaria d'Alfonso	2021-2021	Guillermo Hamity	2017-2019
Liron Barak	Previous	Ljiljana Morvaj	2018-2020	Lidija Zivkovic	2019-2021	Allison McCarn	Previous
Nikos Rompotis	Previous	Zhen Liu	2017-2019	Healthier Logan	2015-2021	Stefan Liebler	Previous
Roger Wolf	Previous	Stefania Gori	2013-2017	Shufang Su	2015-2021	Rebecca Lane	Previous
Ian Low	Previous	Abdollah Mohammadi	2015-2017	Ulrich Ellwanger	2015-2021	Daniel Winterbottom	Previous
Maggie Mühlleitner	Previous	Shikma Bressler	Previous	Xiaohu Sun	Previous		
David Sperka	Previous	Abdollah Mohammadi	Previous	Raffaele Gerosa	Previous		
Mario Pelliccioni	Previous	Roger Caminal	Previous	Martin Flechl	Previous		
				Maria Ubiali	Previous		
				Marco Zaro	Previous		
				Xiangyang Ju	Previous		

Extended Higgs Sector (neutral + charged Higgs bosons):

- ATLAS: Lidija Zivkovic (2019), Nikos Rompotis (02/2021)
- CMS: Mariarosaria d'Alfonso (01/2021), Santeri Laurila (07/2021)
- Theory: Tania Robens, Rui Santos, Shufang Su.
- The conveners can be reached at the address
lhc-higgs-neutral-extended-scalars-convener@cernNOSPAMPLEASE.ch (only if you already subscribed to the WG3 mailing list or the general HWG mailing list) or individually here.
- Dedicated Twiki page with detailed information.
- Tasks discussed in the group and timelines:

Task	Involved persons	Status	Timescale
Keep an eye on potentially missing signatures		In progress	Continuous

MSSM Higgs

- ATLAS: Tim Barklow (2019)
- CMS: Afiq Anuar (07/2021) (replacing Artur Gottmann (2020))
- Theory: Michael Spira, Pietro Slavich, Emanuele Bagnaschi
- Contact all conveners either via lhc-higgs-mssm-neutral-convener@cernNOSPAMPLEASE.ch (only if you already subscribed to the WG3 mailing list or the general HWG mailing list) or contact all the conveners here
- Dedicated twiki with all the latest information is here.
- Tasks discussed in the group and timelines:

Task	Involved persons	Status	Timescale
Keep an eye on potentially missing signatures		In progress	Continuous
WG support to the release of experimental likelihoods		In progress	Continuous
Prioritize channels according to importance for end of LHC run2/3 or HL-LHC		In progress	End Continuous
A/H decay to SUSY states and corresponding ROOT files		In progress	2021
Higgs pT public note		In progress (link) ↗	2021
Provide description and common tool for BSM Higgs pT calculation @ NLO+PS precision for gluon fusion		In progress (link) ↗	2021
ROOT files public note		In progress	2021
Release ROOT files with proper HDECAY/FH matching		In progress	End 2020
Release ROOT files for mh125 variants with negative mu		Complete	Nov 2020
Update of the ROOT files (SM BRs, HDECAY modification of SUSY-QCD corrections to h/H/A -> bb for proper Delta_b terms, FH proper version)		Complete	Nov 2020
Provide updated ROOT files for end RunII analyses		Complete	End 2018
Provide benchmark scenario for low tanβ using EFT approach		Complete	End 2018
Provide new MSSM benchmark scenarios		Complete	Sept 2018
Update SM parameters for MSSM calculations to be consistent with YR recommendations for SM calculations		Complete	Sept 2018

NMSSM Higgs

- ATLAS: Nikos Rompotis (2018)
- CMS: Daniel Winterbottom (07/2021)
- Theory: Ulrich Ellwanger, Margarete Mühlleitner, Nausheen Shah
- Email all the conveners lhc-higgs-nmssm-convener@cern.ch (only if you already subscribed to the WG3 mailing list or the general HWG mailing list) or individually here
- Twiki with all group information: LHCHWGNMSSM
- Tasks and timelines:

Task	Involved persons	Status	Timescale
Re-interpretation of public experimental results	Theorists	In progress	Continuous
Release of first set of benchmarks	All	Done	Spring 2020
Additional benchmarks for $H_2 \rightarrow H_1 Z$	All	In progress	December 2020

Exotic Higgs Decays

- ATLAS: Verena Martinez (02/2021)
- CMS: Georgia Karapostoli (2020)
- LHCb: Lorenzo Sestini
- Theory: Brian Shuve, Matthias Konig
- Dedicated twiki with all the latest information is here
- email all the conveners lhc-higgs-exotic-decay-convener@cern.ch (only if you already subscribed to the WG3 mailing list or the general HWG mailing list) or individually here
- Tasks discussed in the group and timelines:

Task	Involved persons	Status	Timescale
Provide a benchmark for interpretations of $h \rightarrow aa \rightarrow 4\gamma/2g2\gamma$ searches	Andrea Thamm	DONE	ALP benchmark
Add feasibility studies for $h \rightarrow g\gamma$	All	planned	lower priority
List uncovered, but well motivated, Higgs decays searches involving one or more displaced vertices.	Brian Shuve	Note In progress	June 2021
What is the best way to present Higgs searches with displaced vertices to allow a simple recast by theorists?	Theorists	In progress	winter 2021
Reinterpret prompt decays results for LLP signatures	Experimentalists	In progress within collaborations	Full Run 2 papers
List of high priority channels for inclusion into BSM H fits and for which experimentalists are highly encouraged to publish likelihood scans (see p7-9 ↗). In the form of slides or a short document.	Theorists	In progress	Spring 2021
Parameter calculations for Higgs rare decays beyond $\gamma+J/\Psi$, $\gamma+\phi$, $\gamma+Upsilon$	Matthias Koenig	DONE	Parameter_calculations
Provide final recommendations for $h \rightarrow W/Z + \text{meson}$: link ↗	Zhen Liu, Stefan Alte	superseded, see below	
Update predictions $h \rightarrow W/Z + \text{meson}$, publish as note	Matthias Koenig	In Progress	Summer 2021

Determine model benchmarks giving $h \rightarrow 2f + \text{MET}$	Brian Shuve	In Progress	Summer 2021
Determine future meeting structure and organization in subgroup	All	In Progress	Summer 2021

bbH/bH Associated Production

- ATLAS: Tim Barklow (02/2021)
- CMS: Chayanit Asawatangtrakuldee (07/2021)
- Theory: Michael Spira Marius Wiesemann
- email all conveners
- Dedicated twiki with all the latest information is here.
- Tasks discussed in the group and timelines:

Task	Involved persons	Status	Timescale
TBA	All	Planned	ongoing

Other groups

Other useful information for LHC HWG task forces/sub-groups that are relevant to WG3 activities:

- Branching ratio sub-group: twiki is here, contact them by clicking here
- Di-Higgs sub-group: twiki is here, contact them by clicking here.

gitlab repository and tools

There is a gitlab repository in which various WG3 items are stored. For the time being the following folders are

- [2HDM](#)
- [MSSM](#) for neutral and charged Higgs

If you need to put something on gitlab or you have some question please contact the WG3 conveners.

The list of the notes (public, interim recommendations and internal) is [here](#).

Meetings

Indico page of the WG3 [↗](#)

Mailing lists

How to subscribe to mailing lists

The mail address for the WG3 is `lhc-higgs-bsm@cernNOSPAMPLEASE.ch`. All messages are archived [here](#).

We highly recommend to also be subscribed to the general HWG mailing list:
`lhc-higgs@cernNOSPAMPLEASE.ch`.

The conveners can be reached at `lhc-higgs-bsm-convener@cernNOSPAMPLEASE.ch`, but only if you already subscribed to either the WG3 mailing list or the generic lh-c-higgs HWG mailing list.

WG3 related documentation

All the documents, public and internal can be found in the LHC HWG Library.

- [arXiv:1607.05291](#): Intermediate mass region for charged Higgs production, Celine Degrande, Rikkert Frederix, Valentin Hirschi, Maria Ubiali, Marius Wiesemann, Marco Zaro.
- [LHCHXSWG-2015-002](#): public note on low tanbeta MSSM scenarios.
- The 10th workshop of the LHC HXSWG has a good overview of the topics studied in WG3 up to July 2015.
- Low tanbeta scenarios note [LHCHXSWG-INT-2015-004](#), to become public soon.
- Georgi-Machacek VBF $H^+ \rightarrow WZ$ Public LHC HXSWG note [LHCHXSWG-2015-001](#).
- Heavy charged Higgs cross sections update: Martin Flechl, Richard Klees, Michael Krüamer, Michael Spira, Maria Ubiali, Improved cross-section predictions for heavy charged Higgs boson production at the LHC. [arXiv:1409.5615](#), Phys.Rev. D91 (2015) 7, 075015.
- Interim recommendations for the evaluation of Higgs production cross sections and branching ratios at the LHC in the Two-Higgs-Doublet Model, [LHCHXSWG-2013-001](#).

General documentation

A great deal of information can be found in the three CERN Reports: Handbook of LHC Higgs Cross Sections:

1. Inclusive Observables ([CERN-2011-002](#), [arXiv:1101.0593](#)).
 2. Differential Distributions ([CERN-2012-002](#), [arXiv:1201.3084](#)).
 3. Higgs Properties ([CERN-2013-004](#), [arXiv:1307.1347](#)).
 - ◆ BibTeX and LaTeX citation format for CERN-2011-002 ([arXiv:1101.0593](#)), CERN-2012-002 ([arXiv:1201.3084](#)) and CERN-2013-004 ([arXiv:1307.1347](#)).
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