

# **The 19th Workshop of the LHC Higgs Working Group**

## **Report of Contributions**

Contribution ID: 41

Type: **not specified**

## **Workshop Dinner at Luigia Academy in Meyrin**

*Tuesday 29 November 2022 19:00 (3 hours)*

Contribution ID: 42

Type: **not specified**

## **WG1 Higgs XS&BR: Outlook and Plans**

*Wednesday 30 November 2022 16:10 (13 minutes)*

**Presenter:** MISTLBERGER, Bernhard (SLAC National Accelerator Laboratory (US))

**Session Classification:** Summary, Plans, Outlook, and Closeout Plenary

Contribution ID: 43

Type: **not specified**

## **WG2 Higgs Properties: Outlook and Plans**

*Wednesday 30 November 2022 16:30 (13 minutes)*

**Presenter:** BARDUCCI, Daniele (Sapienza Universita e INFN, Roma I (IT))

**Session Classification:** Summary, Plans, Outlook, and Closeout Plenary

Contribution ID: 44

Type: **not specified**

## **WG3 BSM Higgs: Outlook and Plans**

*Wednesday 30 November 2022 16:50 (13 minutes)*

**Presenter:** MOHAMMADI, Abdollah (University of Wisconsin Madison (US))

**Session Classification:** Summary, Plans, Outlook, and Closeout Plenary

Contribution ID: 45

Type: **not specified**

## HH: Outlook and Plans

*Wednesday 30 November 2022 17:10 (13 minutes)*

**Presenter:** MANZONI, Stefano (CERN)

**Session Classification:** Summary, Plans, Outlook, and Closeout Plenary

Contribution ID: 46

Type: **not specified**

## Introduction

*Tuesday 29 November 2022 09:00 (5 minutes)*

**Presenters:** Dr KARLBERG, Alexander (CERN); MISTLBERGER, Bernhard; MISTLBERGER, Bernhard (SLAC National Accelerator Laboratory (US)); MALCLES, Julie (Université Paris-Saclay (FR)); DINARDO, Roberto (Università e INFN Roma Tre (IT))

**Session Classification:** WG1 Higgs XS&BR Plenary

Contribution ID: 47

Type: **not specified**

## **VBF group report**

*Tuesday 29 November 2022 09:10 (25 minutes)*

**Presenter:** COOPERSTEIN, Stephane Brunet (Univ. of California San Diego (US))

**Session Classification:** WG1 Higgs XS&BR Plenary



Contribution ID: 48

Type: **not specified**

## VH update

*Tuesday 29 November 2022 17:00 (20 minutes)*

**Presenter:** ARNOLD, Hannah (Nikhef)

**Session Classification:** WG1 Higgs XS&BR Plenary

Contribution ID: 49

Type: **not specified**

## Offshell

*Tuesday 29 November 2022 16:30 (20 minutes)*

**Presenter:** RONTSCH, Raoul Horst

**Session Classification:** WG1 Higgs XS&BR Plenary

Contribution ID: 50

Type: **not specified**

## ttH/tH update

*Tuesday 29 November 2022 15:30 (20 minutes)*

**Presenter:** ZARO, Marco (Università degli Studi e INFN Milano (IT))

**Session Classification:** WG1 Higgs XS&BR Plenary

Contribution ID: 51

Type: **not specified**

## ggF update

*Tuesday 29 November 2022 17:30 (20 minutes)*

**Presenter:** JONES, Stephen Philip (University of Durham (GB))

**Session Classification:** WG1 Higgs XS&BR Plenary

Contribution ID: 52

Type: **not specified**

## MSSM

*Monday 28 November 2022 14:00 (12 minutes)*

**Presenter:** BAGNASCHI, Emanuele Angelo (INFN Laboratori Nazionali di Frascati)

**Session Classification:** WG3 BSM Higgs Plenary

Contribution ID: 53

Type: **not specified**

## NMSSM

*Monday 28 November 2022 14:18 (9 minutes)*

**Presenter:** ROMPOTIS, Nikolaos (University of Liverpool (UK))

**Session Classification:** WG3 BSM Higgs Plenary

Contribution ID: 54

Type: **not specified**

## Extended Scalars

*Monday 28 November 2022 14:32 (12 minutes)*

**Presenter:** ROBENS, Tania Natalie (Rudjer Boskovic Institute (HR))

**Session Classification:** WG3 BSM Higgs Plenary

Contribution ID: 55

Type: **not specified**

## Summary of exotic Higgs decay results

*Monday 28 November 2022 14:50 (17 minutes)*

**Presenter:** COELHO LOPES DE SA, Rafael

**Session Classification:** WG3 BSM Higgs Plenary



Contribution ID: **56**

Type: **not specified**

## **bbH**

*Monday 28 November 2022 15:16 (9 minutes)*

**Presenter:** ASAWATANGTRAKULDEE, Chayanit (Chulalongkorn University (TH))

**Session Classification:** WG3 BSM Higgs Plenary

Contribution ID: 57

Type: **not specified**

## **Brief Introduction**

*Monday 28 November 2022 16:00 (5 minutes)*

**Presenter:** BROST, Elizabeth (Brookhaven National Laboratory (US))

**Session Classification:** HH Plenary

Contribution ID: 58

Type: **not specified**

## **ATLAS - experimental summary (10'+5')**

*Monday 28 November 2022 16:05 (10 minutes)*

**Presenter:** BALUNAS, William (University of Cambridge (GB))

**Session Classification:** HH Plenary

Contribution ID: 59

Type: **not specified**

## **CMS - experimental summary (10'+5')**

*Monday 28 November 2022 16:20 (10 minutes)*

**Presenter:** LANGE, Torben (National Institute of Chemical Physics and Biophysics (EE))

**Session Classification:** HH Plenary

Contribution ID: **60**

Type: **not specified**

## **Benchmarking resonant di-Higgs production in extended scalar sectors (20'+10')**

*Monday 28 November 2022 16:35 (20 minutes)*

**Presenter:** AZEVEDO, Duarte (ITP/IAP - Karlsruher Institut für Technologie)

**Session Classification:** HH Plenary

Contribution ID: **61**

Type: **not specified**

## **HH at N3LO+N3LL(20'+10')**

*Monday 28 November 2022 17:05 (20 minutes)*

**Presenters:** A H, AJJATH; ABDUL HAMEED, Ajjath (LPTHE, Paris)

**Session Classification:** HH Plenary

Contribution ID: 62

Type: **not specified**

## **Effective Field Theories in Higgs boson pair production(20'+10')**

*Monday 28 November 2022 17:35 (20 minutes)*

**Presenter:** LANG, Jannis

**Session Classification:** HH Plenary

Contribution ID: 63

Type: **not specified**

## New constraints on extended Higgs sectors from the trilinear Higgs coupling ( $10'+8'$ )

*Monday 28 November 2022 09:00 (10 minutes)*

The trilinear Higgs coupling is a crucial tool to determine the structure of the Higgs potential and to probe possible effects of physics beyond the Standard Model (SM). Focusing on a Two-Higgs-Doublet Model as a concrete example, I will discuss the calculation of the dominant two-loop corrections to the trilinear Higgs coupling, and show that this coupling can be significantly enhanced with respect to its SM prediction, in certain regions of parameter space. Taking into account all relevant corrections up to the two-loop level, I will demonstrate that the current experimental bounds on the trilinear coupling already rule out significant parts of the parameter space that would otherwise be unconstrained. Finally, I will present a benchmark scenario illustrating the interpretation of the current results and future measurement prospects.

Based on Bahl, Braathen, Weiglein 2202.03453, accepted for publication in Phys. Rev. Lett.

**Presenter:** BRAATHEN, Johannes (DESY)

**Session Classification:** HH Parallel



Contribution ID: 64

Type: **not specified**

## Two-loop Yukawa corrections to double Higgs production (10'+8')

*Monday 28 November 2022 09:18 (10 minutes)*

Double Higgs production will be a key observable to probe the structure of the Higgs potential. In this talk I will present the first step in obtaining the electroweak corrections to double Higgs production by considering the leading Yukawa corrections to this process in the high energy limit. I will describe the methods we used and show that we obtain precise numerical results down to  $p_T \approx 100$  GeV.

based on JHEP 08 (2022) 259 (arxiv:2207.02587)

**Presenter:** SCHÖNWALD, Kay (University of Zuerich)

**Session Classification:** HH Parallel

Contribution ID: 65

Type: **not specified**

## Triple Higgs production in the SM and in models with singlet NP scalars at proton-proton colliders (10'+8')

*Monday 28 November 2022 09:36 (10 minutes)*

In this talk we will discuss the production of three Higgs bosons in the LHC and at a proton-proton collider running at a centre-of-mass energy of 100 TeV. We will argue that the seemingly challenging 6-bottom jets final state is a very good candidate to investigate triple Higgs production within and beyond the SM in proton-proton colliders. In particular we will consider three different scenarios: one in which the triple and quartic Higgs boson self-couplings are not affected by new physics phenomena besides the Standard Model (SM) and in addition, we will explore two possible SM extensions by one and two new scalars. We will show that a 100 TeV machine can impose competitive constraints on the quartic coupling in the SM-like scenario. In the case of the scalar extensions of the SM, we will show that large significances can be obtained in the LHC and the 100 TeV collider while obeying current theoretical and experimental constraints including a first order electroweak phase transition.

**Presenter:** TETLALMATZI-XOLOCOTZI, Gilberto (Siegen University)

**Session Classification:** HH Parallel

Contribution ID: 66

Type: **not specified**

## Invariant mass distribution of di-Higgs production at HL-LHC in the 2HDM (10'+8')

*Monday 28 November 2022 09:54 (10 minutes)*

The dominant Higgs pair production process in the HL-LHC is gluon fusion, which we study in the framework of the Two Higgs Doublet Model. As a key observable we evaluate the invariant mass distribution of two Higgses at 125 GeV in the final state. We analyze in particular the contribution of the resonant diagram involving a heavy CP-even Higgs boson exchange. We analyze the potential sensitivity to the triple Higgs couplings involved. We show that for the benchmark points where the resonant production is dominant, the contribution of different parameters of the extra scalar can be traced. These parameters are its mass, total decay width and relative sign of BSM Higgs trilinear and top Yukawa couplings. Finally, we discuss the effects of experimental uncertainties by applying smearing and binning to the invariant mass.

**Presenter:** RADCHENKO SERDULA, Kateryna (DESY)

**Session Classification:** HH Parallel

Contribution ID: 67

Type: **not specified**

## Search for the Higgs boson pair production in the $bb\mu+\mu-$ final state at the LHC ( $10'+8'$ )

*Monday 28 November 2022 10:12 (10 minutes)*

The Higgs boson pair production via gluon-gluon fusion and vector boson fusion in the  $bb\mu+\mu-$  final state at the LHC is studied to probe the Higgs self-coupling  $\kappa\lambda$  and the four-boson HHVV coupling  $\kappa 2V$  for the first time. A cut-based analysis and a machine learning analysis using boosted decision trees are performed with categorizations and optimizations depending on the variations of these couplings. The expected sensitivities are extracted with different luminosities assumed up to the full HL-LHC runs. The expected upper limit at 95% confidence level on the HH production is calculated as 47 (28) times the Standard Model cross-section using the cut-based method (boosted decision trees) for the gluon-gluon fusion production, and 928 for the vector boson fusion production, assuming an integrated luminosity of 3000 fb<sup>-1</sup>. The expected constraints on the couplings at 95% confidence level are calculated to be  $-13.8 < \kappa\lambda < 19.1$  ( $-10.0 < \kappa\lambda < 15.5$ ) and  $-3.4 < \kappa 2V < 5.5$  using the cut-based method (boosted decision trees), respectively, assuming an integrated luminosity of 3000 fb<sup>-1</sup>.

<https://arxiv.org/abs/2207.10912>

**Presenter:** GUO, Botao (Peking University (CN))

**Session Classification:** HH Parallel

Contribution ID: **68**

Type: **not specified**

## **Top Yukawa corrections (20'+10')**

*Monday 28 November 2022 11:00 (20 minutes)*

**Presenter:** SPIRA, Michael (Paul Scherrer Institute (CH))

**Session Classification:** HH Parallel

Contribution ID: 69

Type: **not specified**

## **Higgs Pair Production in a Composite 2HDM. (15'+5')**

*Monday 28 November 2022 11:30 (15 minutes)*

**Presenter:** EGLE, Felix (Institute for Theoretical Physics (ITP), Karlsruhe Institute of Technology (KIT))

**Session Classification:** HH Parallel

Contribution ID: 70

Type: **not specified**

## **Linking Higgs pair production with an SFOEWPT in a 2HDM-EFT (15'+5')**

*Monday 28 November 2022 11:50 (15 minutes)*

**Presenter:** BIERMANN, Lisa (Karlsruhe Institute of Technology (KIT))

**Session Classification:** HH Parallel

Contribution ID: 71

Type: **not specified**

## **NLO+PS study of bbH background to HH (15'+5')**

*Monday 28 November 2022 12:10 (15 minutes)*

**Presenters:** MAZZITELLI, Javier (Universidad de Buenos Aires (AR)); MAZZITELLI, Javier (Paul Scherrer Institut (CH)); MAZZITELLI, Javier

**Session Classification:** HH Parallel



Contribution ID: 72

Type: **not specified**

## V+jets background modeling in CMS

*Monday 28 November 2022 11:30 (10 minutes)*

**Presenter:** NIGAMOVA, Aliya (University of Hamburg (DE))

**Session Classification:** WG1 Higgs XS&BR parallel

Contribution ID: 73

Type: **not specified**

## **V+jets background modeling in ATLAS**

*Monday 28 November 2022 11:50 (10 minutes)*

**Presenter:** MIRONOVA, Maria (Lawrence Berkeley National Lab. (US))

**Session Classification:** WG1 Higgs XS&BR parallel

Contribution ID: 74

Type: **not specified**

## **ggZH 0+1J studies in ATLAS**

*Monday 28 November 2022 12:15 (10 minutes)*

**Presenter:** WINDISCHHOFER, Philipp (University of Chicago (US))

**Session Classification:** WG1 Higgs XS&BR parallel

Contribution ID: 75

Type: **not specified**

## STXS binnings for CP sensitivity (20' + 10')

*Monday 28 November 2022 11:00 (20 minutes)*

The current Simplified Template Cross-Section (STXS) categorization leaves STXS analyses insensitive to CP-odd contributions in Higgs boson production, which are predicted by several models beyond the Standard Model. This presentation proposes to categorize events with two jets additionally via the  $d\Phi_{ij}$  observable to make future Run 2+3 analyses sensitive to CP violation. The feasibility of such a splitting based on our present sensitivity is also discussed

**Presenter:** WINTER, Benedict Tobias (Albert Ludwigs Universitaet Freiburg (DE))

**Session Classification:** WG2 Higgs Properties Parallel

Contribution ID: 76

Type: **not specified**

## **Towards STXS 1.3 (20'+10')**

*Monday 28 November 2022 11:30 (20 minutes)*

**Presenter:** BONANOMI, Matteo (Hamburg University)

**Session Classification:** WG2 Higgs Properties Parallel

Contribution ID: 77

Type: **not specified**

## **Summary of WG2 CPV activity (20'+10')**

*Monday 28 November 2022 12:00 (20 minutes)*

**Presenter:** MIMASU, Ken (King's College London)

**Session Classification:** WG2 Higgs Properties Parallel

Contribution ID: 78

Type: **not specified**

## **Summary of recent Higgs results (20'+10')**

*Monday 28 November 2022 09:00 (20 minutes)*

**Presenter:** CALANDRI, Alessandro (Eidgenoessische Technische Hochschule Zuerich (CH))

**Session Classification:** WG2 Higgs Properties Parallel

Contribution ID: 79

Type: **not specified**

## **SMEFT parametrisations for STXS and common format proposal (40'+20')**

*Monday 28 November 2022 09:30 (40 minutes)*

**Presenters:** CUETO GOMEZ, Ana Rosario (CERN); Mr KNIGHT, Matthew (Imperial College London)

**Session Classification:** WG2 Higgs Properties Parallel



Contribution ID: **80**

Type: **not specified**

## **CP properties and the connection to Baryogenesis (20'+10')**

*Tuesday 29 November 2022 14:00 (20 minutes)*

**Presenter:** FUCHS, Elina (CERN)

**Session Classification:** WG2 Higgs Properties Plenary

Contribution ID: **81**

Type: **not specified**

## **Higgs properties: present and future (20'+10')**

*Tuesday 29 November 2022 14:30 (20 minutes)*

**Presenter:** GROJEAN, Christophe (DESY (Hamburg) and Humboldt University (Berlin))

**Session Classification:** WG2 Higgs Properties Plenary

Contribution ID: **82**

Type: **not specified**

## **Prospects for CP measurements in $t\bar{t}H$ (20'+10')**

*Tuesday 29 November 2022 15:00 (20 minutes)*

**Presenter:** GONÇALVES, Dorival (Oklahoma State University)

**Session Classification:** WG2 Higgs Properties Plenary

Contribution ID: 83

Type: **not specified**

## Searches for $X \rightarrow hY$ in the $bb \gamma\gamma$ state (14'+6')

*Monday 28 November 2022 09:00 (20 minutes)*

**Presenter:** Dr PANWAR, Lata (Laboratoire de physique nucléaire et des hautes énergies (LPNHE), Paris, France)

**Session Classification:** WG3 BSM Higgs Parallel

Contribution ID: 84

Type: **not specified**

## **Interference Effects in BSM Processes with a Generalized Narrow-Width Approximation (14'+6')**

*Monday 28 November 2022 11:00 (20 minutes)*

**Presenter:** WEIGLEIN, Georg Ralf (Deutsches Elektronen-Synchrotron (DE))

**Session Classification:** WG3 BSM Higgs Parallel

Contribution ID: 85

Type: **not specified**

## **Update on from the Forum on the Interpretation of the LHC Results for BSM studies for extended scalar sectors (14'+6')**

*Monday 28 November 2022 09:20 (20 minutes)*

**Presenter:** HEINRICH, Lukas Alexander (Technische Universitat Munchen (DE))

**Session Classification:** WG3 BSM Higgs Parallel

Contribution ID: **86**

Type: **not specified**

## **Semi-dark Higgs decays: sweeping the Higgs neutrino floor (14'+6')**

*Monday 28 November 2022 09:40 (20 minutes)*

**Presenter:** CANO, Jose Manuel (IFT UAM/CSIC)

**Session Classification:** WG3 BSM Higgs Parallel

Contribution ID: 87

Type: **not specified**

## **Searches for Higgs decays to photon + meson at ATLAS (14'+6')**

*Monday 28 November 2022 10:00 (20 minutes)*

**Presenter:** WARD, Robert James (University of Birmingham (GB))

**Session Classification:** WG3 BSM Higgs Parallel



Contribution ID: **88**

Type: **not specified**

## **SUSY-QCD Corrections to A Production in the MSSM (14'+6')**

*Monday 28 November 2022 11:20 (20 minutes)*

**Presenter:** FRITZ, Lukas (Paul Scherrer Institut)

**Session Classification:** WG3 BSM Higgs Parallel

Contribution ID: 89

Type: **not specified**

## **Higgs Mass Calculation in FeynHiggs (14'+6')**

*Monday 28 November 2022 12:10 (20 minutes)*

**Presenter:** BAHL, Henning

**Session Classification:** WG3 BSM Higgs Parallel

Contribution ID: **90**

Type: **not specified**

## **Higgs-boson production in top-quark fragmentation**

*Monday 28 November 2022 09:00 (15 minutes)*

**Presenters:** BRANCACCIO, Colomba (CERN); BRANCACCIO, Colomba

**Session Classification:** WG1 Higgs XS&BR parallel

Contribution ID: **91**

Type: **not specified**

## **ttH production in NNLO QCD**

*Monday 28 November 2022 09:22 (15 minutes)*

**Presenters:** SAVOINI, Chiara (University of Zurich); SAVOINI, Chiara

**Session Classification:** WG1 Higgs XS&BR parallel

Contribution ID: 92

Type: **not specified**

## Top Mass Effects in the Higgs $p_T$ distribution

*Monday 28 November 2022 09:45 (20 minutes)*

**Presenter:** DEL DUCA, Vittorio (Universita e INFN Torino (IT))

**Session Classification:** WG1 Higgs XS&BR parallel

Contribution ID: 93

Type: **not specified**

# Exact top-quark mass dependence in hadronic Higgs production

*Monday 28 November 2022 11:00 (20 minutes)*

**Presenter:** Mr NIGGETIEDT, Marco

**Session Classification:** WG1 Higgs XS&BR parallel

Contribution ID: 94

Type: **not specified**

## **Issues in single and double Higgs production in BSM models (15'+8')**

*Tuesday 29 November 2022 09:50 (15 minutes)*

**Presenter:** SPIRA, Michael (Paul Scherrer Institute (CH))

**Session Classification:** Cross Topic Plenary

Contribution ID: 95

Type: **not specified**

## **Double Higgs production in extended Higgs sectors (15'+8')**

*Tuesday 29 November 2022 10:13 (15 minutes)*

**Presenter:** MÜHLEITNER, Milada Margarete

**Session Classification:** Cross Topic Plenary



Contribution ID: 96

Type: **not specified**

## **Top mass renormalization scheme uncertainties in Higgs cross sections (15'+8')**

*Tuesday 29 November 2022 10:36 (15 minutes)*

**Presenters:** MAZZITELLI, Javier; MAZZITELLI, Javier (Paul Scherrer Institut (CH)); MAZZITELLI, Javier (Universidad de Buenos Aires (AR))

**Session Classification:** Cross Topic Plenary

Contribution ID: 97

Type: **not specified**

## **LHC EFT WG report (15'+8')**

*Wednesday 30 November 2022 14:00 (15 minutes)*

**Presenter:** GILBERT, Andrew (Northwestern University (US))

**Session Classification:** Cross Topic Plenary

Contribution ID: **98**

Type: **not specified**

## **Interpreting SMEFT results in extended scalar sectors (15'+8')**

*Wednesday 30 November 2022 14:23 (15 minutes)*

**Co-authors:** DAWSON, Sally (BNL); DAWSON, Sally; DAWSON, Sally (BNL)

**Presenter:** HOMILLER, Samuel (Harvard University)

**Session Classification:** Cross Topic Plenary

Contribution ID: 99

Type: **not specified**

## **SM and BSM Higgs - conclusions from the Snowmass process (15'+8')**

*Wednesday 30 November 2022 14:46 (15 minutes)*

**Presenter:** VERNIERI, Caterina (SLAC National Accelerator Laboratory (US))

**Session Classification:** Cross Topic Plenary

Contribution ID: **100**

Type: **not specified**

## **ECFA Higgs/Top/Electroweak - an overview (10'+4')**

*Wednesday 30 November 2022 15:09 (10 minutes)*

**Primary author:** KOENEKE, Karsten (Albert Ludwigs Universitaet Freiburg (DE))

**Co-authors:** HAYS, Chris (University of Oxford (GB)); Prof. MALTONI, Fabio (Universite Catholique de Louvain (UCL) (BE) and Università di Bologna)

**Presenter:** KOENEKE, Karsten (Albert Ludwigs Universitaet Freiburg (DE))

**Session Classification:** Cross Topic Plenary

Contribution ID: **101**

Type: **not specified**

## **Results from $h \rightarrow aa \rightarrow 2\mu 2b$ final state**

*Monday 28 November 2022 11:40 (15 minutes)*

**Presenter:** KHAZAIE, Elham (Isfahan University of Technology (IR))

**Session Classification:** WG3 BSM Higgs Parallel

Contribution ID: **102**

Type: **not specified**

## Results from $h \rightarrow aa \rightarrow 4\gamma$ analyses

*Monday 28 November 2022 11:55 (15 minutes)*

**Presenter:** MARZOCCHI, Badder (Northeastern University (US))

**Session Classification:** WG3 BSM Higgs Parallel

Contribution ID: **103**

Type: **not specified**

## Welcome

*Monday 28 November 2022 13:45 (10 minutes)*

**Presenter:** MILENOVIC, Predrag (University of Belgrade (RS))

**Session Classification:** Workshop Introduction



Contribution ID: **104**

Type: **not specified**

## Closeout

*Wednesday 30 November 2022 17:30 (10 minutes)*

**Presenter:** KOENEKE, Karsten (Albert Ludwigs Universitaet Freiburg (DE))

**Session Classification:** Summary, Plans, Outlook, and Closeout Plenary

Contribution ID: **105**

Type: **not specified**

## **Discussion**

*Monday 28 November 2022 18:00 (30 minutes)*

**Session Classification:** Cross Topic Plenary